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PERFORMANCE AND PROSPECTS OF INDO- BIMSTEC RELATIONS: A STUDY THROUGH REVEALED COMPARATIVE ADVANTAGE MODEL

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Abstract

After Second World War countries across the world have formed many regional economic blocks as instrumentsfor consolidating relations to preserve and promote their common political, strategic and economic interests. The successful experience of regional groupings like European Economic Union, ASEAN and othersmotivated countries to explore new landscapeofsuccess through regrouping into economic blocks. SAARC and BIMSTEC are also created to achieve better standards of living for the masses of South Asia through economic integration. BIMSTEC was formed on 6th June 1997 to integrate the "West Look Policy" of ASEAN and "Look East Policy" of India. It is in this context that the present study attempts to examine theperformance and prospects of India's trade relations with BIMSTEC countries by applying the Revealed Comparative Advantage model.The results report that India's CAGR of exports and imports is better with BIMSTEC countries as compared to the CAGRof her global exports and imports. India has astrong (RCA>1) in 19 commodities out of top 25 commodities considered for analysis during the year 2019. The trend analysis of exports, imports and trade and its projection for next ten years indicates that India has a sustainable trade potential and prospects with BIMSTEC countries, butitrequires structural revival and preferential treatment.

Key Words: Exports, Imports, Trade Balance, BIMSTEC, Revealed Comparative Advantage.

1. Introduction: Regional economic groupings are the associationsof countries situated in a particular region which arrives at a common understanding and platform through agreement with specific rules and regulations for propelling economic prosperity among member nations. For this purpose, they aim at reducing or eliminating the tariff and non-tariff trade barriersto trade among the participating nations to facilitate the free movement of goods, services, labor and capital. Thesuccessful experience of European Economic Union and ASEAN is testimony to the contribution of regional cooperation in the economic growth of the countries and world economy as well. In the context of South Asia, the steps initiated by the political elites are reflected in the form of SAAARC and BIMSTEC. SAARC as a regional economic association was established in December 1985 with seven members i.e. India, Nepal, Bhutan, Bangladesh, Pakistan, Sri-Lanka and Maldives for promoting peace, stability, and progress in the region. **(Bhattacharjee, 2018).**Consequently, to integrate the "West Look Policy" of Thailand and ASEAN and "East Look Policy" of India and South Asia, BIMSTEC as a regional economic association was formed on 6 June 1997 through the Bangkok Declaration and this was initially formed with four Member States Bangladesh, India, Sri Lanka and Thailand and named as 'BIST-EC'. Following the inclusion of Myanmar on 22 December 1997 the bloc was renamed as 'BIMST-EC', while with the induction of Nepal and Bhutan in February 2004, the name of the trading bloc was changed to 'Bay of Bengal Initiative for Multi-Sectoral, Technical and Economic Cooperation' (BIMSTEC), with its permanent secretariat established in Dhaka. **(Kabir & Salim, 2010)** BIMSTEC attains the fresh look due to two reasons: one, the stagnation in the functioning of SAARC due to chronic Indo-Pak conflict and second, when in 2019 Prime Minister Narender Modi invited BIMSTEC heads of the states to his 2nd term swearing-inceremony, which highlights the prominence that his governmentis giving to BIMSTEC countries.**(The Hindu, 2019).**

BIMSTEC can also be termed as 5 SAARC + 2 ASEAN nation's economic grouping which is important for its strategic location and potent market. The BIMSTEC region is home to around 1.6 billion people which constitute around 22 percent of the global population with a combined gross domestic product of US$ 2.8 trillion **(Rahman & Kim, 2016).** BIMSTEC Chairmanship rotates among member countries alphabetically. BIMSTEC is one of the least integrated regions in the world although the member countries are contiguous to one another, except for Sri Lanka, which is an island state. BIMSTEC's primary focus is on economic and technical cooperation among the membercountries to

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Gravity Model Analysis of India's Trade Linkages with ASEAN Countries during Pre and Post AIFTA Regime

Raj Kumar Singh, Jyoti Kumari & Ajay Kumar

Abstract

India has long and intimate history of socio-cultural and economic association with Southeast Asian nations. The present study revisits India's economic engagement with ASEAN nations during pre and post ASEAN-India Free Trade Agreement using Gravity Model Theory. (Tinbergen 1962) The study is distinct in the sense that it specifically examines the application of Eli Filip HeckscherBertil Ohlin (1933) and Staffan Linder (1961) theories by employing GDP per capita differential. The study reports that India and ASEAN are emerging economies with impressive share in global DGP, reflecting vast potential for economic co-operation. India's growth of trade, exports, and import is higher in Pre-AIFTA period; however, the overall growth rate of trade, exports, and imports with ASEAN countries is also impressive vis a vis India's global growth rate of trade. The empirical estimates appear consistent with the fundamentals of gravity model as the study reports positive coefficients for economy size and negative coefficient for distance. Trade liberalisation policies and foreign direct investment are unsupportive for boosting India's external sector growth, thus, suggesting rethinking of trade policy and FDI policy. The positive coefficient of per capita GDP differential indicates that trade between India and ASEAN countries happens due to difference in level of economic development based on comparative advantages, proving that trade relations between India and ASEAN are determined by Heckscher-Ohlin hypothesis.

Key Words: Trade, AIFTA Regime, Gravity Model Theory, H-O Theory, Linder's theory.

JEL Codes: F10, F 13, F14, F15, F17.

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9. **HEADINGS: All the headings must be bold-faced, aligned left and fully capitalised. Leave a blank line before each heading.

10. **SUB-HEADINGS: All the sub-headings must be bold-faced, aligned left and fully capitalised.

11. **MAIN TEXT**:

THE MAIN TEXT SHOULD FOLLOW THE FOLLOWING SEQUENCE:

INTRODUCTION

REVIEW OF LITERATURE

NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESIS (ES)

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

LIMITATIONS

SCOPE FOR FURTHER RESEARCH

REFERENCES

APPENDIX/ANNEXURE

The manuscript should preferably be in ***2000 to 5000 WORDS***, But the limits can vary depending on the nature of the manuscript.

12. **FIGURES & TABLES:** These should be simple, crystal **CLEAR**, **centered**, **separately numbered** & self-explained, and the **titles must be above the table/figure**. **Sources of data should be mentioned below the table/figure**. *It should be ensured that the tables/figures are referred to from the main text*.

13. **EQUATIONS/FORMULAE:** These should be consecutively numbered in parenthesis, left aligned with equation/formulae number placed at the right. The equation editor provided with standard versions of Microsoft Word may be utilised. If any other equation editor is utilised, author must confirm that these equations may be viewed and edited in versions of Microsoft Office that does not have the editor.

14. **ACRONYMS:** These should not be used in the abstract. The use of acronyms is elsewhere is acceptable. Acronyms should be defined on its first use in each section e.g. Reserve Bank of India (RBI). Acronyms should be redefined on first use in subsequent sections.

15. **REFERENCES:** The list of all references should be alphabetically arranged. ***The author (s) should mention only the actually utilised references in the preparation of manuscript*** and they may follow Harvard Style of Referencing. **Also check to ensure that everything that you are including in the reference section is duly cited in the paper**. The author (s) are supposed to follow the references as per the following:

- All works cited in the text (including sources for tables and figures) should be listed alphabetically.
- Use (**ed.**) for one editor, and (**ed.s)** for multiple editors.
- When listing two or more works by one author, use --- (20xx), such as after Kohl (1997), use --- (2001), etc., in chronologically ascending order.
- Indicate (opening and closing) page numbers for articles in journals and for chapters in books.
- The title of books and journals should be in italic printing. Double quotation marks are used for titles of journal articles, book chapters, dissertations, reports, working papers, unpublished material, etc.
- For titles in a language other than English, provide an English translation in parenthesis.
- ***Headers, footers, endnotes*** *and* ***footnotes*** *should* ***not be used*** *in the document.* However, **you can mention short notes to elucidate some specific point**, which may be placed in number orders before the references.

PLEASE USE THE FOLLOWING FOR STYLE AND PUNCTUATION IN REFERENCES:

BOOKS

- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio" Ohio State University, Nigeria.

CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–23

UNPUBLISHED DISSERTATIONS

- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

ONLINE RESOURCES

- Always indicate the date that the source was accessed, as online resources are frequently updated or removed.

WEBSITES

- Garg, Bhavet (2011): Towards a New Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

ENTREPRENEURSHIP DEVELOPMENT PROGRAMMES IN HIMACHAL PRADESH

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ABSTRACT

Entrepreneur is the key feature of entrepreneurship and economic growth. Entrepreneurship is a recent incident and in the entrepreneurial process entrepreneurs have to face various problems. In this paper attempts have been made to study the demographic profile of entrepreneurs and analyze the major problems faced by entrepreneurs. For this purpose, primary as well as secondary data has been used. The secondary data have been collected from journals, internet, magazines, newspaper annual reports etc. For primary data a sample of 400 entrepreneurs was taken from high hills zone of Himachal Pradesh. Simple random sampling technique was used to conduct this research paper. Finally, the study reveals that relating to land, availability of raw materials, availability of labour skilled and unskilled, relating to building and machinery equipment, availability of transport facility, marketing and advertisement, registration, industrial licensing and long term finance, high cost of doing business were the major problems faced by entrepreneurs in the high hills zone. Government need to provide financial as well as others facilities like transport, communication and organize awareness programmes regarding different promotional activities and credit facilities for further expansion.

KEYWORDS

enterprises, entrepreneurial process, problems.

JEL CODES

L53, A29, I25.

1.1 INTRODUCTION

Entrepreneurship in India starts in the era of Indus Valley Civilization. Its economy depended majorly on trade, which was facilitated by advanced transportation technology. During the copper age, the Indus Valley Civilization area showed ceramic similarities with southern Turkmenistan and northern Iran which suggested considerable mobility and trade. During the Early Harappa period (about 3200–2600 BCE), similarities in pottery, seals, figurines, ornaments, etc. document intensive caravan trade with Central Asia and the Iranian country. There was an extensive navigation trade network operating between the Harappa and Mesopotamian civilizations as early as the middle Harappa Phase, with much commerce being handled by modern Bahrain and Failaka located in the Gulf. Such long-distance sea trade became possible with the innovative development of plank-built watercraft, equipped with a single central mast supporting a sail of woven rushes or cloth. History elucidates that Aside from the subsistence of agriculture and hunting, the Indus people supported themselves by trading goods. Through trade, the Indus Civilization expanded its culture, coming into regular contacts with faraway lands.

The story of the Indian entrepreneurship is fills with paradoxes. Entrepreneurship as the present era understands was definitely not forthcoming from this social segment. Political & economic factors had an extensive effect on the entrepreneurial spirit. There were many issues that impact negatively on Indian entrepreneurship like Lack of political unity and stability, absence of effective communication systems, existence of custom barriers and oppressive tax policies, prevalence of innumerable currency system until around the third decade of the 19th century. Indian Entrepreneurship ruled by the community system in the Historical past. Brahmans were learned men who had assisted the kshatriyas in the administration, vaishyas have performed trading and industrial productive activities and shudras engaged in an agricultural occupation. Also, the people were organized in a very simple type of economic and social system. In the way to implement this concept to modern entrepreneurship, it can compare with the villages are the organization and an entrepreneur is called as a craftsman. The independent India could claim to have created a conductive climate for spread of entrepreneurship. It is in this broad backdrop that the later evolution and growth of Indian entrepreneurship has to be located.

1.2 PROMOTION OF ENTREPRENEURSHIP

Government will continue to support first generation entrepreneur through training and will support their efforts. Large number of EDP trainers and motivators will be trained to significantly expand the Entrepreneurship Development Programmes (EDP). Industry Associations would also be encouraged to participate in this venture effectively. Women entrepreneurs will receive support through special training programmes.

The concept of entrepreneurial development involves equipping a person with the essential information and information used for enterprise building and polishing his entrepreneurial skills. In these days, entrepreneurship development programmes are treated as an important tool of industrialization, and provides employment to the people of state. Entrepreneurs shape economic future of nations by creating wealth and employment, offering products and services and generating taxes for government because of which entrepreneurship has closely been linked to economic growth of a country. Entrepreneurs convert ideas into economic opportunities through innovations which are considered to be major basis of competitiveness in an increasingly globalizing world economy. Therefore, most governments in the world struggle to expand supply of competent and globally cutthroat entrepreneurs in their respective countries.

2.1 REVIEW OF LITERATURE

Jagallnath Panda, (2005) focuses on small scale entrepreneurs who started their new ventures in Gujarat State in his study entitled Entrepreneurship and Economic Development'. An integral part of his development which have grown up to the stature of potential Indian Multinational like Cedilla, Torrent, Core, Ashima, Adani, Bakeri and the Reliance. Smaller entrepreneurs like Ajanta, Rasna and Syntex have their own success stories. The purpose of this study is to analyze the different facets of entrepreneur's development and its economic consequences in the State of Gujarat.

Venkatapathy, R. (2006) using purposive sampling technique studied 75 first generation and 58 second generation entrepreneurs. The results of the investigations suggested that first generation entrepreneurs perceive the father as a loving person and parents as encouraging and overprotective. They are influential by the father attribute greater importance to friendship, initiative venture to promote self employment, desire to be a model to others. They consider social awareness

and involvement as essentials for a business venture which are the second generation entrepreneurs perceive the father as being dominant, are not influenced by any one, attribute least importance to friendship adopt a venture to avoid unemployment consider social awareness and involvement as not essential for a business venture.

Ansari & Ahmed (2007) analyzed the relationship between risk taking behaviour and age among entrepreneurs. The late entry of entrepreneurs into business having a higher level of education could be on account of two reasons. First on account of the time they were required to spend on education and secondly on account of their failure to get another job which maintained parity with their higher educational qualifications.

Bholanath Dutta, (2009) in his book, Entrepreneurship Management: Texts & Cases, deals in detail on the factors influencing entrepreneurship, viz., education, legality, infrastructure, finance, procedures, IT and communication, rapid changes, size of the firm, R & D and technology, stakeholders and globalization. The author has elucidated the characteristics of a successful entrepreneur at length. According to him, there are many critical factors contributing success such as skills, innovative mind, providing completeness to the factors of production, decision making, creative personality, plan making, dynamic leadership, creator of wealth, self-confidence and ambitiousness, risk bearing, and adventurous mind.

Desai, (2009) in his published book "Environment and Entrepreneur" undertake a review of entrepreneur, entrepreneurship and environmental effects. As per his opinion the concept of entrepreneurship has assumed prime importance both in research and in action for accelerating economic growth in developing countries. He examined entrepreneur and entrepreneurship the person and the process are the critical factors for the growth of organizations. The study brings with the person and the process, conceptual frame work and geographical origins. Concept of entrepreneurial functions and gap in economic theory together with explanations of entrepreneurial talents as a model for environments.

Mohamed, Z., et al. in (2011) examines the effectiveness of informal entrepreneurship extension education among Malaysian farmers especially the members of Farmers' Organization Authority. They found that informal entrepreneurship education is not able to provide the entrepreneurship skills acquisition as expected. The study shows that the level of understanding on "what is entrepreneurship" is still low among the Farmers' Organization Authority (FOA) members. In this regard, efforts should be intensified to improve informal agri-entrepreneurial courses and training, and extension on developing entrepreneurial skill among the farmers.

Briggs Kristina, Henricson, (2013) conducted a study on entrepreneurship as a tool for economic development in Uganda. The main aim of the study is to contributing the knowledge around social entrepreneurship. The study highlighted that entrepreneurship is a key for economic growth is today an important part of national development strategies in both developed and developing countries. The study focuses on how entrepreneurs are supported through business incubators and discuss some implications of business incubators initiatives in developing countries. Further the study suggests that mobilization of entrepreneurship may be more fruitful than attempts to create it, and points that project initiation need awareness of the risk failing into ethnocentric perspective.

Legas Habtamu, (2015) conducted a study on "Challenges to Entrepreneurial Success in Sub-Saharan Africa: A Comparative Perspective". The objective of study was to explore and put in perspective the critical challenges entrepreneurs in Sub-Saharan Africa frequently face gaining ground to start a firm. The results show that cumbersome laws and regulations, corruption, poor infrastructure, lack of finance, lack of strong entrepreneurial training and small market came out as basic obstacles to entrepreneurial success.

3.1 OBJECTIVES OF THE PAPER

1. To study the demographic profile of entrepreneurs.
2. To analyze the major problems faced by entrepreneurs.

3.2 RESEARCH METHODOLOGY

The study was conducted in high hills zones of Himachal Pradesh. Random sampling technique was used for the selection of study area. A sample of 400 respondents was taken on the basis of standard that they should be running their enterprise separately and not in partnership. Enterprises taken up for the study were beauty parlors, handloom units, general stores and bag making units. Well-structured and pretested interview schedule was used for collecting primary data by survey method and secondary data was collected from magazines, newspapers, journals, periodicals, reports, text books and websites.

4.1 DATA ANALYSIS AND INTERPRETATION

This section presents data from the sampled respondents, comprising their Gender, Age, Educational qualification, Occupation, religion, caste and annual Income of the respondents in before business and the range of annul income after business. The Tables 4.1.1 to 4.1.11 contain the profile of the respondents.

Table 4.1.1. Gender wise Distribution of the Respondents

TABLE 4.1: GENDER WISE DISTRIBUTION OF THE RESPONDENTS

Sr. No.	Variables	Frequency	Percent
1.	Male	270	67.5
2.	Female	130	32.5
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

Table 4.1 Shows that the gender wise distribution of the sample respondents. From the total sample a majority group 67.5 per cent are male respondents and 32.5 per cent are female. This refers that majority of the respondents are belonging to male group.

Table 4.1.2. Marital Status of the Respondents

The table 4.2 explains about the marital status of the respondents.

TABLE 4.2: MARITAL STATUS OF THE RESPONDENTS

Sr. No.	Variables	Frequency	Percent
1.	Married	300	75.0
2.	Unmarried	100	25.0
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

Out of the total sample highest group 75.0 per cent were married and the remaining 25.0 per cent are unmarried. This shows that majority of the entrepreneurs were married, 75.0 per cent of the entrepreneurs started their enterprises after their marriage to decrease their family burden with their Family members.

Table 4.1.3. Age of the Respondents

TABLE 4.3 AGE OF THE RESPONDENTS

Sr. No.	Variables	Frequency	Percent
1.	Below 30	109	27.25
2.	30 to 40	190	47.5
3.	40 to 50	90	22.5
4.	50& above	11	2.75
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

The table 4.3 shows that the age wise distribution of sample respondents. Out of the total sample 47.5 per cent were between 30-40 years age group, 27.25 per cent are below 30 years age group, 22.5 per cent are between 40-50 years and 2.75 per cent are 50& above years age group. It may be concluded that majority of the entrepreneurs are between 30-40 years age group.

Table 4.1.4. Education wise distribution of the Respondents

TABLE 4.4: EDUCATION WISE DISTRIBUTION OF THE RESPONDENTS

Sr. No.	Variables	Frequency	Percent
1.	Illiterate	96	24.0
2.	Middle School	161	40.25
3.	High School	66	16.5
4.	HSC Completed	25	6.25
5.	Graduation & above	29	7.25
6.	Any Other	23	5.75
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

The table 4.4 depicts that the educational qualification of the sample respondents. From the total sample a major group 40.25 per cent of middle school followed by 24.0 per cent with illiterate, 16.5 per cent with high school, 7.25 per cent with graduation & above, 6.25 per cent with HSC Completed and the remaining 5.75 per cent with any other. Finally, the table shows that majority of the entrepreneurs are middle School passed.

Table 4.1.5. Religion wise distribution of the Respondents

The distribution of sample respondents by their religion-wise response presented in the above table.

TABLE 4.5: RELIGION WISE DISTRIBUTION OF THE RESPONDENTS

Sr. No.	Variables	Frequency	Percent
1.	Hindu	286	71.5
2.	Muslim	56	14.0
3.	Sikh	41	10.25
4.	Christian	17	4.25
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

Table 4.5 explains the religion wise distribution of respondents. It is observed from the table that the major group 71.5 per cent from the Hindu religion, 14.0 per cent is Muslim religion 10.25 per cent are Sikh religion and 4.25 per cent are Christian religion. It may be concluding that majority of the respondents are from the Hindu religion.

Table 4.1.6. Caste wise distribution of the Respondents

TABLE 4.6: CASTE WISE DISTRIBUTION OF THE RESPONDENTS

Sr. No.	Variables	Frequency	Percent
1.	SC	166	41.5
2.	ST	115	28.75
3.	OBC	62	15.5
4.	General	57	14.25
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

The distribution of sample respondents by their caste-wise response presented in the table number 4.6. The major groups 41.5 per cent from Schedule Caste, 28.75 per cent are Schedule tribes 15.5 per cent are OBC and 14.25 per cent are general categories. Finally, the table shows that majority of the respondents are from the Schedule Caste.

Table 4.1.7. Residential Status of the Respondents

TABLE 4.7: RESIDENTIAL STATUS OF THE RESPONDENTS

Sr. No.	Variables	Frequency	Percent
1.	Rural	227	56.75
2.	Urban	173	43.25
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

Table 4.7reveals that out of the total sample 56.8 per cent respondents are said that they belong to the rural area and 43.25 per cent are belong to the urban area. This shows that majority of the respondents, 56.75 per cent are belonging to the rural area of Himachal Pradesh.

Table 4.1.8. Type of the Family

TABLE 4.8: TYPE OF THE RESPONDENTS FAMILY

Sr. No.	Variables	Frequency	Percent
1.	Nuclear Family	253	63.25
2.	Joint Family	147	36.75
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

It is observed from the table 4.8 that out of the total sample 63.25 per cent respondents are said that they belong to the nuclear family and 36.75 per cent are belong to the joint family. Further the table shows that majority of the respondents, 63.25 per cent are belonging to the nuclear family.

Table 4.1.9. Employment Status of respondents

TABLE 4.9 EMPLOYMENT STATUS OF THE RESPONDENTS

Sr. No.	Variables	Frequency	Percent
1.	Self Employed	82	20.5
2.	Full time employee	28	7.0
3.	Unemployed	114	28.5
4.	Part time employee	121	30.25
5.	Any other	55	13.75
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

The employment status of the respondents is presented in the table 4.9. From the total respondents' majority of them 30.25 per cent are in Part time employee followed by 28.5 per cent unemployed and 20.5 per cent were self employed, and from the remaining 13.75 per cent involved from any other business and 7.0 per cent are full time employees. The results show that the majority of the entrepreneurs are 30.25were part time employees.

Table 4.1.10. Annual Income of the respondents before business

TABLE 4.10: INCOME WISE DISTRIBUTION OF THE RESPONDENTS BEFORE BUSINESS

Sr. No.	Variables	Frequency	Percent
1.	below 1 lakh	219	54.75
2.	100000 to 200000	140	35.0
3.	200,000-300,000	27	6.75
4.	300000 & above	14	3.5
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

Table 4.10 examined that the income wise distribution of respondents before business and the range of annul income at their entry time. From the total sample major groups 54.75 per cent were between less than 1 lakh, followed by 35.0 per cent 1 lakh-2 lakh, 6.75 per cent were 2 - 3 lakhs, and the remaining 3.5 per cent were 3 lakhs and above. It can be observed that majority of the respondents have less than 1 lakh, per annum at the time of their entry.

Table 4.1.11. Annual Income of the respondents after business

TABLE 4.11: INCOME WISE DISTRIBUTION OF THE RESPONDENTS AFTER BUSINESS

Sr. No.	Variables	Frequency	Percent
1.	below 1 lakh	142	35.75
2.	100000 to 200000	158	39.5
3.	200,000-300,000	71	17.75
4.	300000 & above	29	7.0
Total		**400**	**100.0**

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

Table 4.11 depicts that the income wise distribution of respondents after business and the range of annul income after entry into business. From the table it is observed that the majority of respondents were 39.5 per cent fit in between 1 lakh -2 lakh, followed by 35.75 per cent less than 1 lakh, 17.75 per cent were 2 - 3 lakhs, and the remaining 7.0 per cent were 3 lakhs and above. It can be observed that majority of the respondents have 1 lakh-2 lakh, per annum after entry into business.

TABLE 4.12: PROBLEMS FACED BY RESPONDENTS IN CONSTRUCT THE ENTERPRISES

Sr. No.	S.A.	A.	N.	D.	S.D	Total	Mean	S. D.	Skw	Kurto-sis	Chi-square	P-value	D.F
1	43(10.75%)	57 (14.25%)	122(30.5%)	131 (32.75%)	47 (11.75%)	400 (100.0)	2.80	1.15	.368	-.615	91.90	.000	4
2	103 (25.75%)	32 (8.0%)	58 (14.5%)	102 (25.5%)	105 (26.25%)	400 (100.0)	2.81	1.54	.304	-1.417	55.32	.000	4
3	89 (22.25%)	29(7.25%)	58 (14.5%)	105 (26.25%)	119 (29.75%)	400 (100.0)	2.66	1.51	.459	-1.258	55.33	.000	4
4	121 (30.25%)	75 (18.75%)	48 (12.0%)	102 (25.5%)	54 (13.5%)	400 (100.0)	3.26	1.45	-.146	-1.445	48.62	.000	4
5	71 (17.75%)	160 (40.0%)	63 (15.75%)	65 (16.25%)	41 (10.25%)	400 (100.0)	3.38	1.23	-.530	-.783	106.45	.000	4
6	62 (15.5%)	145 (36.25%)	121 (30.25%)	64 (16.0%)	8 (2.0%)	400 (100.0)	3.47	1.00	-.241	-.602	145.88	.000	4
7	61 (15.25%)	140 (35.0%)	118 (29.5%)	68 (17.0%)	13 (3.25%)	400 (100.0)	3.42	1.04	-.266	-.604	125.47	.000	4
8	57 (14.25%)	182 (45.5%)	120 (30.0%)	20 (5.0%)	21 (5.25%)	400 (100.0)	3.58	.972	-.800	.714	245.17	.000	4
9	53 (13.25%)	191 (47.75%)	74 (18.5%)	65 (16.25%)	17 (4.25%)	400 (100.0)	3.50	1.04	-.624	-.336	216.0	.000	4
10	21 (5.25%)	67 (16.75%)	183 (45.75%)	104 (26.0%)	25 (6.25%)	400 (100.0)	2.89	.936	.152	-.037	223.25	.000	4
11	112 (28.0%)	141 (35.25%)	81 (20.25%)	33 (8.25%)	33 (8.25%)	400 (100.0)	3.66	1.20	-.766	-.236	114.55	.000	4

Source: Field Survey

Note: Figures in the parentheses are percentages to the row totals.

Notes:

1. Relating to land
2. Availability of raw materials
3. Availability of labour skilled and unskilled
4. Relating to building and machinery equipment
5. Availability of Transport facility
6. Availability of Technical facility
7. Marketing and advertisement
8. Registration, industrial licensing and long term finance
9. New opportunities in respect of Marketing and production
10. Lack of knowledge of science and technology
11. High cost of doing business

4.12 ANALYSIS OF PROBLEMS FACED BY RESPONDENTS IN CONSTRUCT THE ENTERPRISES

RELATING TO LAND

It is obvious from the table that the respondents are disagreed with relating to land. The mean value is 2.80. This is lower than the average mean score. The standard deviation is 1.15. The positive value of skewness.368 shows the responses are towards lower side of mean value. The value of kurtosis -.615 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the respondents faced problems in construct the enterprises.

AVAILABILITY OF RAW MATERIALS

It is evident from the table that the majority of the respondents are disagreed with availability of raw materials. The mean value is 2.81. This is lower than the average mean score. The calculated value of standard deviation is 1.54. The positive value of skewness.364 shows the responses are towards lower side of mean value. The value of kurtosis -1.417 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the availability of raw material is not adequate.

AVAILABILITY OF LABOUR SKILLED AND UNSKILLED

It is observed from the table that majority of the respondents are strongly disagreed with availability of labour skilled and unskilled. The mean value is 2.66. This is lower than the average mean score. The calculated value of standard deviation is 1.51. The positive value of skewness.459 shows the responses are towards lower side of mean value. The value of kurtosis -1.258 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the availability of labour skilled and unskilled are not sufficient for construct enterprises.

RELATING TO BUILDING AND MACHINERY EQUIPMENT

It is observed from the table that mean value is noted more than the average score i.e. 3 at five point scale. The standard deviation is 1.45. The negative value of skewness -.146 depicts that the responses are towards higher side of mean value. The value of kurtosis -1.145 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the respondents are strongly agree with relating to building and machinery equipment.

AVAILABILITY OF TRANSPORT FACILITY

It is apparent from the table that respondents are agreed with availability of transport facility. The mean value is noted more than the average score i.e. 3 at five point scale. The standard deviation is 1.23. The negative value of skewness -.530 depicts that the responses are towards higher side of mean value. The value of kurtosis -.783 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the availability of transport facility is suitable for respondents.

AVAILABILITY OF TECHNICAL FACILITY

It is clear from the table that availability of technical facility is quite better. The mean value is noted more than the average score i.e. 3 at five point scale. The standard deviation is 1.00. The negative value of skewness -.241 depicts that the responses are towards higher side of mean value. The value of kurtosis -.602 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the respondents are agree with availability of technical facility.

MARKETING AND ADVERTISEMENT

From the table it is estimated that majority of the respondents are agree with marketing and advertisement. The mean value is noted more than the average score i.e. 3 at five point scale. The calculated value of standard deviation is 1.04. The negative value of skewness -.266 shows the responses are towards higher side of mean value. The value of kurtosis -.604 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the marketing and advertisement are suitable for construct enterprises.

REGISTRATION, INDUSTRIAL LICENSING AND LONG TERM FINANCE

It is revealed from the table that majority of the respondents are agree with registration, industrial licensing and long term finance. The mean value is noted more than the average score i.e. 3 at five point scale. The calculated value of standard deviation is.972. The negative value of skewness -.800 shows the responses are towards higher side of mean value. The value of kurtosis.714 shows that the distribution of opinion is lepto kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that respondents are agree with registration, industrial licensing and long term finance for enterprises.

NEW OPPORTUNITIES IN RESPECT OF MARKETING AND PRODUCTION

From the table it is estimated that majority of the respondents are agree with new opportunities in respect of marketing and production. The mean value is noted more than the average score i.e. 3 at five point scale. The calculated value of standard deviation is 1.04. The negative value of skewness.624 shows the responses are towards higher side of mean value. The value of kurtosis -.336 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the majority of the respondents are agree with new opportunities in respect of marketing and production for enterprises.

LACK OF KNOWLEDGE OF SCIENCE AND TECHNOLOGY

It is revealed from the table that the respondents are lack of knowledge of science and technology. The mean value is 2.89. This is lower than the average mean score. The calculated value of standard deviation is.936. The positive value of skewness.152 shows the responses are towards lower side of mean value. The value of kurtosis -.037 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the respondents are not fully aware about science and technology.

HIGH COST OF DOING BUSINESS

It is clear from the table that the respondents are agree with high cost of doing business for enterprises. The mean value is noted more than the average score i.e. 3 at five point scale. The calculated value of standard deviation is.120. The negative value of skewness -.766 shows the responses are towards higher side of mean value. The value of kurtosis -.236 shows that the distribution of opinion is platy kurtic. On the application of Chi square test, calculated value has been found significant at 5 per cent level of significance, therefore a null hypothesis rejects and alternative hypotheses accepts. It can be concluded that the respondents are agree with high cost of doing business for construct enterprises.

Table 4.13 Reliability Statistics

TABLE NO. 4.13

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
0.685	0.691	11

The results of reliability statistics have been presented in table 4.2. The reliability of the construct is determined by computing the Cronbach's alpha. Cronbach's coefficient alpha value of 0.6 is considered acceptable for the exploratory purposes, 0.7 is considered adequate and 0.8 good for confirmatory purposes. The reliability of the construct is determined by computing the Cronbach's alpha.

Further, table reveals that the Cronbach's alpha value based on standardized items obtained is 0.691 which shows considered acceptable reliability of the scale. The overall reliability and validity of the scale as depicted by Cronbach's alpha is nearest 0.7, therefore it is valid to use this scale.

MAJOR FINDINGS

- The majority of the respondents are belonging to male group.
- The majority of the respondents are belonging to male group.
- It may be concluded that majority of the entrepreneurs are between 30-40 years age group.
- It may be concluding that majority of the respondents are from the Hindu religion.
- The majority of the respondents are from the Schedule Caste.
- The majority of the entrepreneurs were part time employees.
- It can be observed that majority of the respondents have less than 1 lakh, per annum at the time of their entry.
- It can be observed that majority of the respondents have 1 lakh-2 lakh, per annum after entry into business.

CONCLUSION

Entrepreneurship development programmes may be defined as a programme designed to help an individual in strengthening his entrepreneurial motive and in acquiring skills and capabilities necessary for playing his entrepreneurial role effectively. Entrepreneurs faced following problems i.e. financial and marketing production, work place facility, health problems, availability of long-term finance, regular and frequent need of working capital, poor location of shop, lack of transport facility, non-availability of raw material. The government needs to take necessary action and organize awareness programmes on Entrepreneurship development and training programmes. Guidelines framed as a solution to these problems can help entrepreneurs to deal with these problems effectively.

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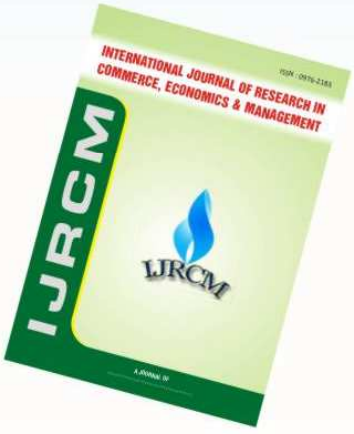



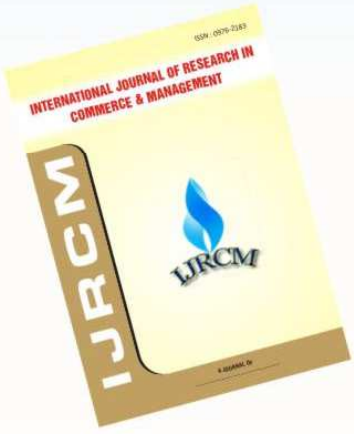

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The purpose of this paper is to study public sector investment contribution of tribal areas of Himachal Pradesh in the gross domestic product of the State. The data has been taken from the secondary sources and analyzed for contribution and growth in the state GDP. The analysis shows a moderate contribution of tribal districts in the gross domestic product of the State.

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Nobody is assured about when the normal economic condition would resume in the countries affected by Covid-19 pandemic. It is quite natural that the financial condition of these countries will improve gradually after the pandemic is over. But it should be kept in mind that Indian economy has been gasping not only due to pandemic but also due to other reasons that happened much more before the Covid-19 pandemic began. It is right that India's jeopardy in both two phenomena viz. per capita income and the rate of growth of national income is quite prominent. In this context comparison of Indian economy with that of Chinese economy can substantiate the matter in a better way. Making comparison between the two economies is not unfair because in many cases our experts draw the context of China. Some discussion regarding the overall investment rate of the two countries over the last two decades but up to the

time when the world got affected by Covid19 pandemic is very much necessary for only one reason that the rate of investment determines the rate of growth of national income. And where there is no significant change in the rate of growth of population year after year, rate of growth of national income confirms the rate of per capita income. Over the last two decades, rate of investment of India is less by 8 to 10 percent-point than the investment in China. Unless the rate of investment of India goes up to the proximity of investment of China, the per-capita income, and standard of living of general people of this country would never be improved. India's progress in service sector is remarkable and India is now one of the world leaders in this sector. But the share of industry in GDP has been falling since 2010. …

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PUBLIC SECTOR INVESTMENT OF HIMACHAL PRADESH AND CONTRIBUTION OF TRIBAL AREAS IN STATE GROSS DOMESTIC PRODUCT

[1]Dr. Devinder Sharma[2]Manoj Kumar

Abstract

The purpose of this paper is to study public sector investment contribution of tribal areas of Himachal Pradesh in the gross domestic product of the State. The data has been taken from the secondary sources and analyzed for contribution and growth in the state GDP. The analysis shows a moderate contribution of tribal districts in the gross domestic product of the State.

Introduction

Himachal now is one of the fast growing hill states of India in terms of its development in all sectors affecting the socio- economic structure of the State. The economy of the State is in the phase of huge changes. It has already shed off the elements of backwardness. It has also acquired characteristics of developed economies. The natural and human resources of the State are the foundations of its economic development. The State is located in the Himalayan range due to which, life is tough. Despite of this fact, tremendous growth of the State raises basic question whether development is indicative of all the regions including tribal areas with reference to the role and strength of Public Sector institutions meant for overall development of the State. The rationale behind the study is to know about Public Sector Investment and Per Capita investment in Public Sector followed by contribution of Tribal regions in State Gross Domestic Product and trend of Per Capita Income of people in the State including tribal areas.

Objectives of the Study:

1. To study total and Per Capita per annum Public Sector Investment in Himachal Pradesh.
2. To examine contribution of Kinnaur and Lahaul&Spiti in terms of State Gross Domestic Product.
3. To analyze the trend of Per Capita Income of tribal areas in Himachal Pradesh

Scope of The Study

The secondary data with effect from 2008-09 have been taken for analysis. The Public Sector Investment trends have been examined since 1st Five Year Plan i.e sinse 1951 and the two tribal districts (Kinnaur and Lahaul&Spiti) have been taken for research analysis.

Analysis and Interpretation

As per the objectives, data have been analyzed as under:

Investment in Public Sector:

The high level of literacy resulting to awareness and prosperity has been assumed to be the factor attracting for more investment. The public sector investment is considered as the safest mode of

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investment. It leads to strengthen Public Sector organizations. The following table 1 shows investment behaviour in Public Sector in Himachal Pradesh since 1951. The Public Sector Investment which was just Rs. 5.27 crore during 1951-56, is Rs. 5700 crores in 2017-18. It is surprising that since 1992, there has been unexpected growth in Public Sector Investment from Rs. 393.81 crore in 1990- 91 & 1991-92 to Rs. 3480.72 crores during 1992-97 and then after, it

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Comparative Study on Cropping Pattern in Kinnaur and Lahaul & Spiti

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Agriculture is a highly dynamic process and the growth and development of agriculture in Himachal Pradesh has crossed several mile stones in different historical periods. The cropping pattern of Himachal Pradesh was based on the traditional system of the subsistence farming without any surplus. With the passage of time, the relationship between commercialisation and cropping pattern emerged complimentary. The State has different variations in the agro-climatic conditions. The agro-climatic variation supports different types of cropping patterns in the State. However, it was the availability or unavailability of marketing facilities which played a key role in determining the cropping structure in the State. The aim of the present paper is to compare the cropping pattern in Kinnaur and Lahaul & Spiti districts of Himachal Pradesh. The percentage method has been used to analyse th…

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Comparative Study on Cropping Pattern in Kinnaur and Lahaul & Spiti

Dr. Heera Bhagti* Devinder Sharma**

*Govt College Sainj, Kullu **Himachal Pradesh University- Hill, Shimla-05.

Abstract: Agriculture is a highly dynamic process and the growth and development of agriculture in Himachal Pradesh has crossed several mile stones in different historical periods. The cropping pattern of Himachal Pradesh was based on the traditional system of the subsistence farming without any surplus. With the passage of time, the relationship between commercialisation and cropping pattern emerged complimentary. The State has different variations in the agro-climatic conditions. The agro-climatic variation supports different types of cropping patterns in the State. However, it was the availability or unavailability of marketing facilities which played a key role in determining the cropping structure in the State. The aim of the present paper is to compare the cropping pattern in Kinnaur and Lahaul & Spiti districts of Himachal Pradesh. The percentage method has been used to analyse the data. The study reveals that the commercial crops of both the study regions are main sources of income of the tribal areas. While analyzing the diversification, the Kinnaur district is witnessing a fruits belt as compared to district Lahaul & Spiti. The farmers are gradually diversifying to commercial crops for the sake of higher earnings.

Key words:- Cropping pattern, Land use, Agriculture.

I. Introduction

India is a country where great majority of population belongs to the rural areas having sufficiency of land holdings for agricultural and horticultural production. The production of the different regions varies widely and the mountainous regions like Kinnaur and Lahaul & Spiti of Himachal Pradesh are known for high level of fertility and good quality of production. In tribal areas, the return of crops is not contributing enough which raises a question to analyze the status of crop intensity and outturn of crops in such area. There is a huge disparity in terms of landscape, climate, irrigation, environmental hazards and preferences of people regarding option of occupation for economic development. All such factors varying production and fertility affect choices of people regarding selection of crops providing optimum outturn and convenient for the producer. The study has been necessitated to be conducted to know about the factors which are affecting choice of crop being produced in the areas under study. Moreover the study is also an endeavour to examine the dependency of tribal's as per their cropping pattern.

II. Literature review

Sharma (1987) in his research, **"The Economy of Himachal Pradesh"** has analyzed the changes in the cropping pattern during the period 1950-51 to 1982-83. The author reveals that there is hardly any change in the cropping pattern of Himachal Pradesh during the entire period.

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The present study was conducted in the cold desert region of the Lahaul valley in Himachal Pradesh. Saussurea costus (Falc.) Lipsch. an endangered medicinal herb, was studied in terms of its distribution pattern, cultivation practices and problems in cultivation. Seed germination showed better results in hot chamber in the month of May, June and July. Seeds sown in hot chamber at 30oC showed better germination (99±1.33%) in the month of June in comparison with cold chamber at 20oC. Energy and monetary efficiencies revealed output/ input ratio of 7.5 and 0.8, respectively. Introducing of seasonal cash crops like Pea, Potato and Hop, need for a mandatory permit for cultivation and export, longer cultivation cycle (3 years), lower and continuously fluctuating market rates were found to be the…

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Willow (Salix fragilis Linn.): A Multipurpose Tree Species under Pest Attack in the Cold Desert of Lahaul Valley, Northwestern Himalaya, India

Yashwant S Rawat

Salix fragilis is the most common willow species grown extensively under the indigenous agroforestry system in the cold desert of Lahaul valley located in the northwestern Himalayas, India. Presently, this tree is under severe pest attack, and other infections have made its survival in the area questionable. This deciduous multipurpose tree species provides vegetation cover to the barren landscape of Lahaul and is a significant contributor of fuel and fodder to the region. This study is a detailed profile of the plant in three villages within this region: Khoksar, Jahlma, and Hinsa. The willow provided 69.5%, 29%, and 42% of the total fuelwood requirements of Jahlma, Khoksar, and Hinsa respectively. A striking observation was that only 30.0 6 20.1% trees were healthy: 55.2 6 16.1% of the willows…

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Najibullah HASSANZOY, Virender Kumar

Land is the most critical factor of production. The problem of scarcity of land is more acute in mountainous regions due to uneven population pressure. Various socio-economic and political factors interact over time and space to determine the pattern of land utilization and cropping in any region. The present investigation attempts to scrutinize these changes during the past three and a half decades in Himachal Pradesh. The findings revealed that the growth rate of net sown area turned out to be negative during the overall study period with the decline being quite strong in the post 1990s period. The area put to non-agricultural uses registered very high growth rates, more so after the 1990s. The growing marginalization of the holdings gets reflected in the fact that about 87 per cent of the farmers…

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Banking in India, has a long historical past to govern all ethnic and religious communities and to meet out the monetary demand of all. In the neo- liberal era, there is a wide disparity in the credit and deposit ratio of commercial banks in all the states and also in Himachal Pradesh, in all the twelve districts. In the period of past two decades, in Himachal Pradesh, the CD Ratio of the commercial banks has shown a gap between 16.23 in Lahaul- Spiti to 65.84 in Sirmaur. It is not a good indicator of the objective to have equitable overall economic development of the State despite of the fact that the commercial banks have focused to govern credits for accomplishment of their goals.

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Comparative Study on Cropping Pattern in Kinnaur and Lahaul & Spiti

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According to the author, the share of land allocated to the cereals and non cereals crops remains by the large unchanged and the share of area under wheat has increased from one third to nearly two fifth of total area sown during the period 1950-51 to 1982-83 as a result of the adoption of new form technology. Further, the author finds a noticeable change in the cropping pattern of Himachal Pradesh, with in the non cereal category, i.e. the rise in share of area under fruits of all kinds. The study concluded that Himachal Pradesh has a large potential for the production of fruits of different categories, but the fruits crops still enjoy a low weight age in the total area sown.

Sharma et.al (1992), studied "**impact of irrigation on socio-economic structure of farm families in Himachal Pradesh.**" They focused on the impact of irrigation on the vegetables based and cereal based crops. The authors have found that in vegetable based farming, a net return on per hectare of cultivated land was high as compared to cereals based farming of the State. They have concluded that irrigated land gives more output in terms of vegetables as compared to cereals, and the positive impact of irrigation is found in socio-economic structure of the farm families in the State.

Swamy, (2011), observed in **"Tribal Land Question and Land Reforms in Kerala"**, that the exclusion of 'adivasis' in India in terms of land rights remains a reality in contemporary India, and their rights to productive resources have generally been left unattained by the State Government. The author highlighted that Government has not taken any significant effort to grant land rights to landless tribal households and they shift from food to cash crops and from indigenous to hybrid seeds have also undermined the livelihood of these people which must be taken care of by the Government.

Uma et. al (2013) in their study **"Changing Cropping Pattern: A Boon or a Bane to Food Security**" revealed that most of the agricultural labourers are showing less interest in producing food crops and are changing their cropping pattern to commercial crops. The authors also find that all marginal farmers are slowly depending on other sector for higher wages without fully neglecting the agriculture. The authors' reveal that instead of changing the cropping pattern and

that the crop sector of Jammu and Kashmir agriculture at an aggregate level is gradually diversifying in favour of high-value crops. The authors found while analyzing the diversification, the Jammu division are witnessing a specialization in food-grain crops, while as Kashmir division depicting a trend towards diversification. The farmers are gradually diversifying to commercial crops for the sake of higher earnings.

Yadav and visvesvaraya (2019) have stated in the article "**Crop Pattern Change and Crop Water Requirement Judgment using Remote Sensing and GIS Techniques: a research onTungabhadra Dam Right**" due to growing population and increase demand for food products crop violation is found in every command leading to more irrigation. According to authors remote Sensing (RS) and Geographical Information System (GIS) techniques have emerged as powerful tools for crop water management. Remotely sensed land use-land cover data was used for analysing the cropping pattern in the area and also to estimate the change in the cropping pattern. The canal selected for cropping pattern analysis is located at vallabhpur, Bellary district on Tungabhadra river. Further, authors revealed that crop water requirement was calculated using Modified Penman Equation for present cropping pattern. The authors find that, approximately 50% of water could be saved using modified Penmen method compared to crop water requirement.

III. Data Base and Methodology

The data for the study gathered from a purposeful and well structured field survey. The survey was conducted during June 2019. The sample was based on stratified random sampling and two stage sample design adopted for the purpose.

IV. Objectives

- To compare the crops grown and cash crops grown in kinnaur and Lahaul & Spiti.

V. Need of the Study

Production of crops is one of the major traditional occupations of the tribal people. The need of the research has been felt to examine the cropping pattern of the tribal communities and its contribution in the living standard of the farmers.

VI. Analysis and Interpretation

1. Crops Grown

There are two seasons of crops in Kinnaur region, spread as Kahriff crops which is being sown in the month of April-May and the Rabi crops which is sown in the month of November and December in the region and during the kharif season, vegetables are also grown. Table 1 shows the different crops being growing. In Lahaul and Spiti, the climate during spring and summer seasons (April-October) is rather mild during which both *Rabi* and *Kharif* crops are grown simultaneously. The rains are scanty and humidity remains low during this period. However, during winters (November-March), the climate is extremely cold and harsh and mercury drops even up to minus 35oC. During this period, heavy snowfall occurs and this area remains cut-off from rest of the world. Therefore, the area has a single cropping season.

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variety of such rewards by the organization. So, according to the results of the study, this can be concluded that most of the employees think that the non-financial rewards in their organization do motivate them and make them retain in that particular organization for the long term. Also, the findings suggest that they value non-financial incentives as much as financial incentives. Therefore, as per the survey study, thiscan be concluded that non-financial rewards have the positive potential to increase the motivation of employee'sand help them in retaining in the private organization.

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a conceptual model of employee satisfaction was developed and 14 factors were identified which affect employees satisfaction. The data analysis revealed that employees" was highly satisfied on the factor likerelationship with peers, training and development, job location and working hour and dissatisfied with the compensation management, recognition and rewards, decision making, physical job security, leadership and performance appraisal policy.

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EMPIRICAL EXAMINATION OF PERCEPTION OF USERS ABOUT PUBLIC TRANSPORT MANAGEMENT IN SHIMLA

3 Author(s): ANUPAM SHARMA ,DINESH K. SHARMA,DEVINDER SHARMA

Vol - 7, Issue- 3 , Page(s) : 11 - 18 (2020) **DOI :** https://doi.org/10.32804/IRJMSI

Abstract

Efficient means of transportation play an important role in the development of a nation in the modern world because movement of people in the present times has increased to higher levels than ever before. Higher levels of economic activity and economic growth increase the movement of people and goods across regions and cities. This movement of people is facilitated by various means of transportation like roadways, railways and airways. Movement within the urban centres is highly dependent on the public transport. Along with this, private vehicles are also used by commuters for daily travel. Public transport is comparatively cheaper and helps in reducing congestion on the roads but the management of public transport most of the times is a challenge for the government. In highly urbanized and highly populated areas public transport is desperately needed to ease off congestion and long traffic jams. In highly urbanized areas the level of economic activity is also high meaning thereby that the earning potential of people is also good. Higher income groups of people will prefer a good quality of public transport or otherwise they would travel using their own vehicles.

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Availability of Banking Facilities in India: A Geographical Analysis

November 2020 · Journal of Social Sciences 62(1-3):1-16
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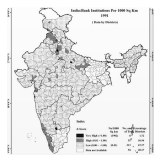
Abstract and Figures

This study aims to analyse the availability of banking facilities in India from 1971 to 2011. The study is based on secondary data and the Z-score technique has been employed to find out the extent and magnitude of disparities. The study reveals that the availability of banks has increased from 5 banks per 1000 sq. km of area in 1971 to 27 per 1000 sq. km in 2011 and indicates a five times increase during last 40 years. The study finds that the increase in banking facilities in relation to population was slow and insufficient and only one bank served a population of 10,000 during the study periods. The study also reveals the prevalence of interregional or inter-districts disparities in availability of banking facilities. The areas in and around the national capital territory of New Delhi, coastal parts of Kerala and central Gujarat have witnessed high development of banking facilities, whereas the mountainous area, desert and peninsular parts of the study area have displayed low development of banking facilities in relation to the area.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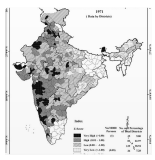
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Availability of Banking Facilities in India: A Geographical Analysis

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KEYWORDS Banks. Coefficient of Variations. District. Geographical Area. Population. Z-score

ABSTRACT This study aims to analyse the availability of banking facilities in India from 1971 to 2011. The study is based on secondary data and the Z-score technique has been employed to find out the extent and magnitude of disparities. The study reveals that the availability of banks has increased from 5 banks per 1000 sq. km of area in 1971 to 27 per 1000 sq. km in 2011 and indicates a five times increase during last 40 years. The study finds that the increase in banking facilities in relation to population was slow and insufficient and only one bank served a population of 10,000 during the study periods. The study also reveals the prevalence of inter-regional or inter-districts disparities in availability of banking facilities. The areas in and around the national capital territory of New Delhi, coastal parts of Kerala and central Gujarat have witnessed high development of banking facilities, whereas the mountainous area, desert and peninsular parts of the study area have displayed low development of banking facilities in relation to the area.

INTRODUCTION

Social infrastructure usually refers to those facilities, which improve the quality of human life. The role of social infrastructure in accelerating the economic growth and enhancing public welfare is more pronounced in developing economies (Rosenstein 1943). It often encompasses education, healthcare, housing and drinking water facilities to name a few. Investment in social infrastructure leads to human capital formation and socio-economic development (Tiwari 2000). While thinking about infrastructure, usually attention is paid to the economic and social infrastructure comprising roads, bridges, railways, power, communication, irrigation, education and health facilities and services to name a few. Quite often, it is not realised that a well-developed, well integrated and efficiently functioning financial infrastructure comprising financial institutions, financial markets and financial services is equally essential for an accelerated rate of development of the economy. The financial infrastructure contributes to the economic growth by increasing the rate of capital formation or investment by encouraging technology development and also by helping the development of economic and social infrastructure. Many scholars believe that economic growth and poverty reduction depend on the effectiveness of the national financial system (Bhole 2006). An effective financial system is said to have a causal link with growth, macroeconomic stability, reduction in volatility, improvement in total factor, productivity and living standards, and poverty reduction. A strong and deep financial system insulates the economy from macro fluctuations. Therefore, it is the job of policymakers to ensure that banks, other financial institutions and stock markets reach their full functional potential (World Bank 2001).

The banking sector plays a vital role in the development of the Indian economy. The growth of the banking sector depends upon the services provided by them to the customers in various aspects. The banking system in India is significantly different from other Asian nations because of the country's unique geographic, social and economic characteristics. India has a large population and land size, a diverse culture and extreme disparities in income. Keeping in view the importance of banks in the financial infrastructure, the accessibility and availability of banking facilities in relation to area and population have been examined in this study.

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B.R. Thakur · Sandeep Kumar

Roads are the key to the development of an economy. A good road network constitute the basic infrastructure that propels the development process through connectivity and opening up of the backward regions to trade and investment. In this paper, an attempt has been made to analyze the road infrastructure in India at the district level for three reference periods i.e. 1971, 1991 and 2011. The base ... [Show full abstract]

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The developing countries of the world are characterized not only by low literacy rate but also by a great disparity in the literacy rates between urban and rural population, between males and females, and between the young and the aged. The purpose of the present study is to examine the regional pattern of the urban-rural differential in literacy in India during 2011. The base of present study is ... [Show full abstract]

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Sandeep Kumar · B.R. Thakur · Manoj Kumar

The present paper purports to investigate the quality of living among the Indian households at state and district level from 2001 to 2011. The study is based on secondary data collected from Registrar General Census Operations, New Delhi. The quality of living has been examined in terms of 5 main dimensions i.e. (i) housing quality, (ii) basic amenities like health, sanitation and cleanliness, ... [Show full abstract]

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The Kinnaur and Lahaul-Spiti districts, in their entirety, and Pangi and Bharmaur Sub-Divisions of Chamba district are notified tribal areas in the state and inhabited by different scheduled tribal communities. The present study is based on secondary data. The secondary data relating to indicators of socio-economic infrastructural development at the village level have been gathered from District ... [Show full abstract]

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B.R. Thakur · Nem Raj · Anita Kumari

Literacy is one of the key indicators of socio-economic development of any society. Generally, literacy rates vary by region, religion, residence, caste and gender. Same holds true in case of Himachal Pradesh where one can witness these variations. The present study seeks to analyze the progress and pattern of literacy and level of educational attainments among the literates of the state between ... [Show full abstract]

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SPATIAL AND TEMPORAL VARIATIONS IN EDUCATIONAL ATTAINMENT IN INDIA

Diksha Kumari
B. R. Thakur
Rajan Bhandari

Abstract

The present study aims at examining the progress in levels of educational attainment in India during 1991-2011. The study is entirely based on secondary data collected from Census of India and educational reports of Ministry of Human Resource Development. In order to examine the progress in educational attainment percentage method has been used. The study shows remarkable increase in the growth rate of highly educated people as compared to elementary and secondary educated persons. The study reveals that the share of secondary educated persons increased from 18.60 per cent in 1991 to 24.10 per cent in 2011. Although the share of higher educated persons has increased from 5.67 per cent in 1991 to 8.90 per cent in 2011, yet India is passing through the teething stage of educational attainments where merely 8.90 per cent out of the total literates are highly educated. The study also reveals that educational attainment in India happens to be uneven at the state level which is attributed mainly to the varying educational and developmental infrastructures. The states and union territories equipped with better availability of educational institutes, gross enrolment ratio, urbanization and less poverty fared well in regard to educational attainment.

Keywords: Education, Attainment, Determinants, Spatial Variations, India.

Introduction

The level of education is one of the major indicators of welfare, prosperity and security of people in any society. The quality of education influences the quality of human resource for the societal benefits (Yadav, 2018). The countries with higher educational enrolments achieve higher growth rates than the countries with lesser educational enrolments (Aftab, 1977). Thus, literacy and education play a decisive role in the development process of a nation. India has experienced epochal shifts in her teaching and learning environment since ancient period. The heritage of Indian philosophy, knowledge and academic climate has been subject to indigenous thoughts, fine tunings, restructuring and rejuvenation introduced through time to time. At the time of attainment of independence in 1947, India had only 20 universities and less than 500 colleges.

After independence, education sector

received a concerted attention both by the central and state governments. With the advent of new economic reforms in 1991, entire educational scenario underwent changes. Under liberalization, privatization and globalization (LPG), many private schools, colleges, universities and other institutes surfaced up in the country. Indeed, the onset of post-reforms period saw the demand for skilled and educated people which led to visible improvement in educational attainments at almost all the stages throughout the country. Many scholars, including geographers, conducted researches on different facets of education in India. Various researchers like Ram (1990), Chaudhary (2009), Panda (2011), Gakhar and Kour (2012), Ahmed (2013), Sharma and Sharma (2017) have studied educational expansion and schooling inequality, determinants of primary schooling, education of girls, scenario of present higher education in India.

Besides, a few studies have been conducted on the levels of educational attainment. Ahuja and Filmer (1995) have assessed the educational attainment in developing countries and projected that currently south Asia, is the least educated part of the world. Filmer and Pritchett (1999) have analysed the effect of household wealth on educational attainment for 35 countries. Mukherjee (2004) has examined the trends and patterns of educational attainment in India excluding the union territories, by focusing on the indices of literacy, enrolment in schools, dropout before completion of study and completion of school stages. Alam and Raju (2007) have assessed the gendered literacy and educational disparities in rural Bihar among various religions. Desai and Kulkarni (2008) have studied the changing inequalities in educational levels among various social groups of India. Husain and Sarkar (2011) have examined the gender disparities at each of the main educational levels in the Indian education system. Khan and Butool (2013) have analyzed the state-wise educational status of Muslims in India.

Although these studies address a spectrum of issues relating to literacy and education in India, yet the issues and progress of educational attainment at different educational standards among states and regions remain unattended. This necessitates to undertake a geographical study on level-wise educational attainment in India. This also raises an academic curiosity to examine how the educational attainment at different levels varies over space and time during the post-liberalization period of 1990-2011.

Objectives of the Study

The major objectives of the study are:

- to examine the spatio-temporal variations in educational attainment at elementary, secondary and higher levels of education and
- to study the reasons of varying pattern of educational attainment.

Study Area

Covering an area of 32,87,263 km², India supported 1210 million population as per 2011 census. It covers 2.4 per cent of the total geographical area and 17.64 per cent of the total world's population. Geographically, it extends from 8° 4' to 37° 6' north latitudes and 68° 7' to 97° 25' east longitudes. India has had a long history of organized education. The Gurukul system of education has been one of the oldest on earth. Gurukuls are considered the traditional Hindu residential schools of learning, typically in the teacher's house or a monastery (Pajankar and Pajankar, 2010).

With the passage of time, the education system in India started expanding during the reign of various dynasties in India. The modern school system has been introduced by the Britishers in India. The Macaulay's Minute of 1830s is the prominent one. The Wood's Despatch of July 19, 1854 has been the landmark in the history of education in British India as it has laid down the broad principles and programmes for educational development. In the post-independence period, the government of India became more concerned for education. The national policy of education (1968 & 1986) and its revised formulation (1992) envisaged a uniform pattern of school education (10+2+3 pattern i.e. 12 years of schooling and 3 years of graduation) across the country. The post reforms of 1990s enhanced the demand of quality human resource and competition in the quickly changing employment landscape and global ecosystem.

Database and Methodology

The study completely relies on secondary sources of data downloaded from the website of Census of India. Apart from Census, planning commission reports and educational reports published by National Institute of Educational Planning and Administration (NIEPA) and Ministry of Human Resource Development (MHRD), Government of India have also been consulted. The study has been conducted with reference to two census years of 1991 taken as base year and 2011 as latest year. The present study is based on analysis of 25 states and 7 union territories as per 1991 census year, although, there are 28 states and 7 union-territories as per 2011 census.

For conducting study effectively and making comparisons easy, the data for newly formed states of Uttarakhand, Jharkhand and Chhattisgarh in 2011 have been clubbed in the parent states of Uttar Pradesh, Bihar and Madhya Pradesh, respectively. Hence, Census map of 1991 has been taken as the base map for comparisons. For the purpose of analysis, the data are compiled to arrive at three broad stages of elementary, secondary and higher level of education. The primary and upper primary educated persons are integrated and taken as elementary educated. Similarly, the educated persons at high/matric and senior secondary level are integrated as secondary educated. While, highly educated include those who have completed the post-secondary education i.e. graduates, post-graduates, M.Phil. and Ph.D. degree holders.

In order to examine the distributional pattern of educational attainment in India, the following 10 determinants of educational attainment have also been analyzed. These include number of elementary schools/800 persons, secondary schools/1000 persons, and higher educational institutes/1,00,000 persons (Y_1); gross enrolment ratio (per cent) at elementary, secondary and higher education levels respectively (Y_2); level of urbanization (per cent) (Y_3); density of population (persons/km^2) (Y_4); level of poverty (per cent) (Y_5); work participation rate (per cent) (Y_6); road density (km/100 km^2) (Y_7); railway density (km/100 km^2) (Y_8); gross state domestic product (GSDP, per cent) (Y_9) and budgeted expenditure on education (per cent) (Y_{10}). Co-efficient of correlation has also been calculated to understand the relationship between educated persons at each level with the determinants of educational development for both the reference years. The number of primary and upper primary schools in each state has been summed up to arrive at single unit, i.e. elementary schools. Acco-

rding to Right to Elementary Education (RTE) Act (2009), a habitation having 300 persons is ideal for building a primary school and a habitation having 500 persons is considered ideal for upper-primary school. So, technically, there should be 1 elementary school per 800 persons. Thus, in the present study, to compute the density of elementary schools per size of population, the population norm of 800 persons has been taken into consideration. The spatio-temporal variations in educational attainment have been discussed with the help of comparative choropleth maps.

Choice of variables

It is imperative to justify the selection of determinants of educational attainment. It needs to be seen in analytical framework rather than abstract logic and should have sound conceptual underpinning. The first indicator in the series is availability of educational institutes. A good educational infrastructure is prerequisite for the development of literacy and education in any nation. Higher the number of educational institutions, more is likely to be the literacy rate and educational attainment. The next indicator is gross enrolment ratio. It determines the number of students enrolled at an educational level. Higher enrolment normally leads to higher literacy and thus higher level of educational attainment. The next indicator is urbanization. Urbanization is the cause and effect of literacy and education. Urban schools are generally larger, more likely to have higher proportion of qualified teachers and have optimum student-teacher ratios as compared to schools in the rural areas of developing countries like India. Access to better schooling facilities in urban areas leads to higher level of literacy and educational attainment as compared to rural areas.

Other indicator is density of population. The states with higher densities of population may record larger stock of population in each level of education, resulting into higher educational attainments and vice-versa. The next variable is poverty. Children from well-off households are more likely to remain in school, college and university as compared to poorer ones who are prone to be withdrawn from educational institutions due to their financial constraints. It is generally assumed that the poor states have lower educational attainments as compared to the economically sound states. Road density and railway density are other potent drivers of educational attainments. The recent development of means of transportation has added a new dimension to the process of propagation of literacy and education. The rural isolation has been broken. Educational institutions in the urban areas have now become accessible to the countryside. The states with better road-railway connectivity are expected to have greater educational attainments and vice-versa.

The next variable in the series is work participation rate (WPR). Higher the level of work participation in a state, more will be the level of educational attainment and better will be the economy of the state. The next indicator is gross state domestic product (GSDP). States with higher GSDP have most successful learning systems, offering education to a good extent to its inhabitants. The last variable is budgeted expenditure on education. The total educational expenditure expressed as a percentage of GSDP gives a good indication of priority given to education sector in the society. More money spent on education is likely to increase all kind of facilities in schools and colleges which are necessary to make a healthy academic environment. Notably, these may not be

adequate indicators in capturing the complex picture of educational attainment in India but surely are the best for which limited secondary data for state level analysis have been available at the time of the study.

Results and Discussion

Inter-state Variations in Levels of Educational Attainment

The spatio-temporal variations in educational attainment have been discussed at three different educational levels i.e. elementary level, secondary level and higher education level as under:

Educated Persons up to Elementary Level (1991-2011)

The share of elementary educated persons has been 49.6 per cent to total literates in 1991. It declined to 41.13 per cent during next two decades (Table 1). But there has been an increase in the absolute number of elementary educated persons. Their number has increased by 78.29 per cent during the study period (Table 2). The highest growth among elementary educated persons has been observed in Dadra & Nagar Haveli (about 280 per cent), followed by Rajasthan (174.86 per cent) and Madhya Pradesh (174.22 per cent). The highest negative growth has been recorded by Kerala (-26.33 per cent) followed by Goa (-13.97 per cent). The decline in share of elementary educated persons is an obvious pointer of pursuance of higher education by more people in these states. It is a visible sign of growing educated population in the country. The rising awareness among people towards higher education for better jobs, quality of life and high standard of living also motivates people to go for higher education. The correlation matrix (Table 3) exhibits a positive correlation between educated persons and work participation rate (0.56 in 1991 and 0.27 in 2011), poverty (0.26 in 2011) and budgeted expenditure on education (0.34 in 2011). However, negative relationship has been found between educated persons at elementary level and level of urbanization (-0.54 in 2011) and density of population (-0.51 in 2011) at national level. The negative association between educated persons and urbanization at elementary stage is largely due to slum population and more scope of unskilled jobs in the country. The study reveals that the poverty is no longer a major constraint in seeking elementary education after universalization of elementary education under Sarva Shiksha Abhiyan (SSA-2001) and Right of Children to Free and Compulsory Education Act-2009. Higher availability of educational institutes, high work participation rate and high budgeted expenditure on education all fostered the elementary educational attainment during the post liberalization period in India.

Areas with High Proportion of Elementary Educated Persons

Three states namely, Kerala, Assam, Nagaland and two union-territories (UTs) Daman & Diu and Lakshadweep have registered high proportion (more than 55 per cent) of literates with elementary education in 1991 (Table 1 and Fig. 1). The study reveals that the states and UTs with high literacy rates like Kerala (89.81 per cent), Lakshadweep (81.78 per cent) and Daman & Diu (71.20 per cent) and states with higher availability of elementary schools like Assam (1.23 unit per 800 persons) and Nagaland (1.09 unit) have registered higher proportion of elementary educated persons (Table 4). The states with high work participation rate like Nagaland (42.70 per cent) and Assam (36.10 per cent) also observed higher share of elementary

Table 1
India: Educated Persons at Different Levels of Education

States and UTs	Per cent of Literates at Different Levels of Education							
	Elementary Level		Secondary Level		Higher Level		Others*	
	1991	2011	1991	2011	1991	2011	1991	2011
Andhra Pradesh	44.62	37.62	19.56	28.14	5.98	11.03	29.84	23.21
Arunachal Pradesh	47.44	43.76	14.77	23.95	5.28	6.99	32.51	25.30
Assam	56.67	45.19	17.50	20.61	3.76	5.27	22.07	28.93
Bihar	49.44	40.97	21.87	21.23	6.26	6.19	22.43	31.61
Goa	51.88	29.86	23.46	31.30	6.00	12.59	18.66	26.25
Gujarat	54.85	41.39	18.51	22.59	4.82	7.72	21.82	28.30
Haryana	45.14	39.02	22.01	30.83	5.06	11.30	27.79	18.85
Himachal Pradesh	50.59	39.47	18.11	35.52	3.67	8.86	27.63	16.15
Jammu & Kashmir	DNA	41.77	DNA	30.96	DNA	9.25	DNA	18.02
Karnataka	46.46	36.05	19.50	28.00	5.30	9.94	28.74	26.01
Kerala	60.58	35.98	17.45	31.05	3.50	8.99	18.47	23.98
Madhya Pradesh	43.05	47.57	14.72	17.92	5.88	7.28	36.35	27.23
Maharashtra	52.31	35.83	19.38	28.01	5.80	10.59	22.51	25.57
Manipur	50.85	41.07	18.11	29.06	7.94	11.82	23.10	18.05
Meghalaya	45.55	39.82	9.74	16.05	4.32	5.07	40.39	39.06
Mizoram	51.93	48.21	8.38	18.53	2.43	5.85	37.26	27.41
Nagaland	56.03	47.29	13.87	20.55	3.36	6.68	26.74	25.48
Orissa	47.58	48.61	11.44	18.53	4.30	6.67	36.68	26.19
Punjab	46.01	39.31	25.36	34.72	5.93	9.41	22.7	16.56
Rajasthan	47.91	46.61	16.30	18.61	6.15	8.00	29.64	26.78
Sikkim	44.17	41.61	16.12	20.08	3.43	7.34	36.28	30.97
Tamil Nadu	49.97	42.31	19.39	28.20	4.82	10.52	25.82	18.97
Tripura	44.84	46.03	8.98	16.90	4.52	4.91	41.66	32.16
Uttar Pradesh	46.60	44.42	20.99	22.85	6.47	8.92	25.94	23.81
West Bengal	53.42	44.57	13.54	17.92	6.25	7.84	26.79	29.67
Andaman & Nicobar Islands	48.86	46.56	18.99	26.72	4.17	8.20	27.98	18.52
Chandigarh	31.77	30.06	28.49	31.01	21.92	24.14	17.82	14.79
Dadra & Nagar Haveli	50.38	38.44	17.60	24.98	4.04	8.58	27.98	28.00
Daman and Diu	72.33	40.90	16.12	32.81	3.17	6.79	8.38	19.5
Delhi	40.44	32.67	27.7	29.71	17.50	21.65	14.36	15.97
Lakshadweep	60.58	45.89	17.45	24.64	3.50	4.38	18.47	25.09
Pondicherry	49.47	37.50	21.54	30.79	5.99	14.83	23.00	16.88
National Average	**49.60**	**41.13**	**18.60**	**24.10**	**5.67**	**8.90**	**26.13**	**25.87**

Source: Compiled by Authors, DNA : Data not Available.
Others* Technical plus non-technical diploma or certificate holders not equal to degree

Table 2
India: Growth Rate (per cent) among Educated Persons (1991-2011)

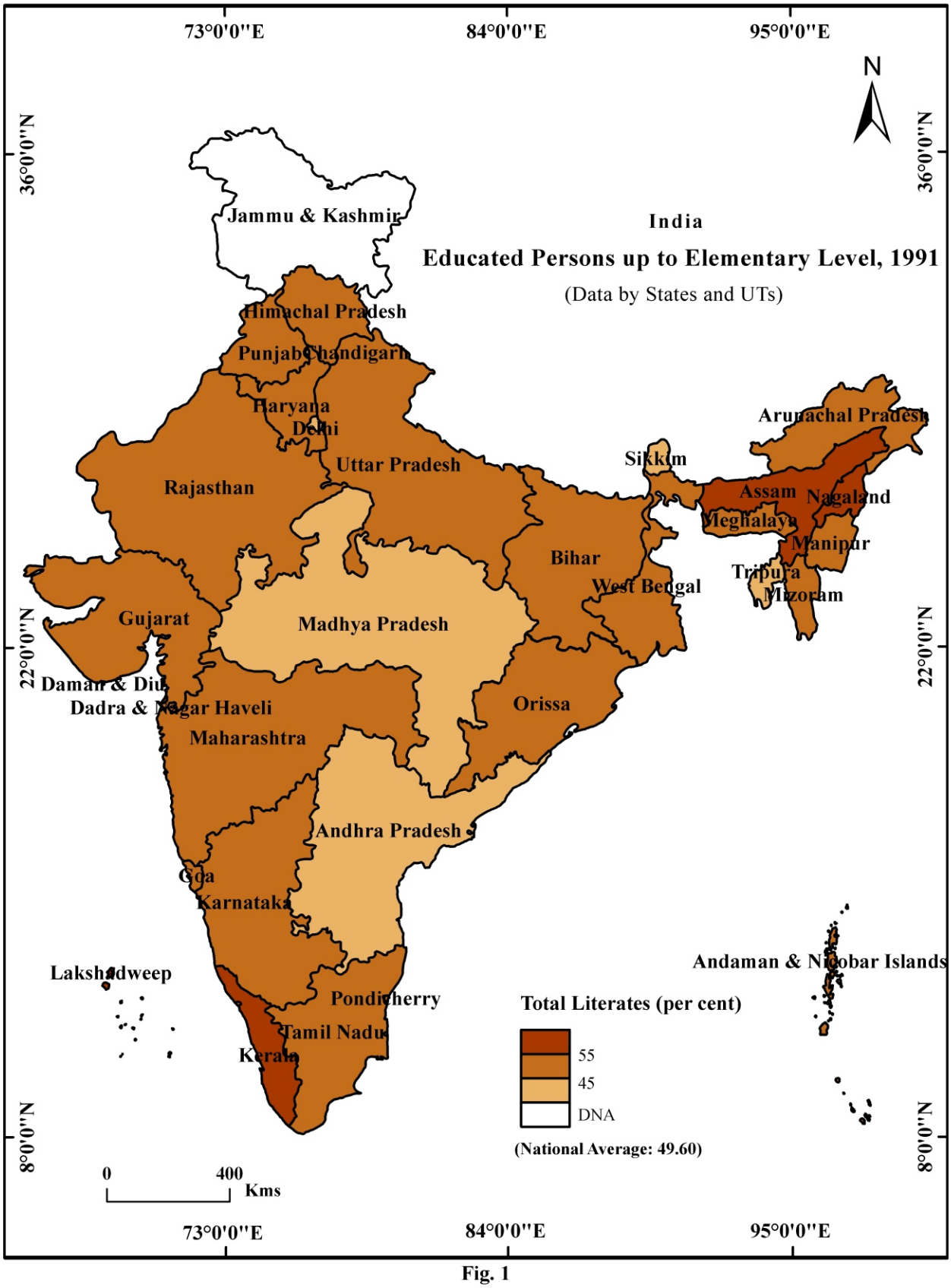
States and UTs	Educational Levels		
	Elementary	Secondary	Higher
Andhra Pradesh	74.08	196.95	280.39
Arunachal Pradesh	149.11	338.03	257.68
Assam	60.72	137.34	182.50
Bihar	122.34	160.36	165.54
Goa	-13.97	99.43	213.75
Gujarat	46.76	137.28	211.55
Haryana	92.61	212.03	397.15
Himachal Pradesh	42.19	257.36	339.33
Jammu & Kashmir	DNA	DNA	DNA
Karnataka	50.09	177.59	263.61
Kerala	-26.33	120.61	218.20
Madhya Pradesh	174.22	202.09	207.02
Maharashtra	31.47	177.49	250.47
Manipur	68.19	234.11	209.67
Meghalaya	130.09	333.69	208.89
Mizoram	70.47	306.11	341.04
Nagaland	83.68	222.33	331.98
Orissa	111.51	235.31	220.57
Punjab	60.92	157.91	198.50
Rajasthan	174.86	222.61	267.18
Sikkim	121.83	193.34	403.30
Tamil Nadu	44.68	148.52	273.06
Tripura	110.77	286.36	122.88
Uttar Pradesh	150.55	186.19	262.33
West Bengal	57.44	149.75	136.79
Andaman & Nicobar Islands	63.90	142.01	238.17
Chandigarh	79.27	106.25	108.64
Dadra & Nagar Haveli	279.91	606.93	957.00
Daman & Diu	74.39	527.51	559.56
Delhi	74.94	132.23	167.86
Lakshadweep	27.02	260.81	278.00
Pondicherry	39.24	162.46	354.61
National Average	**78.29**	**174.94**	**231.00**

Source: Compiled by Authors, DNA : Data not Available.

Table 3
India: Correlation of Educated Persons (X) With Determinants of Educational Attainment (Y)

Levels of Educational Attainment (X)		Determinants of Educational Attainment (Y)																			
		Y_1		Y_2		Y_3		Y_4		Y_5		Y_6		Y_7		Y_8		Y_9		Y_{10}	
		1991	**2011**	**1991**	**2011**	**1991**	**2011**	**1991**	**2011**	**1991**	**2011**	**1991**	**2011**	**1991**	**2011**	**1991**	**2011**	**1991**	**2011**	**1991**	**2011**
X_1		0.23	**0.36**	**0.73**	-0.15	-0.05	**-0.54**	-0.17	**-0.51**	0.07	**0.26**	**0.56**	**0.27**	**-0.26**	**-0.52**	-0.17	**-0.38**	0.05	-0.09	-0.05	**0.34**
X_2		0.02	-0.01	**0.71**	**0.50**	**0.48**	**0.43**	**0.55**	**0.27**	**-0.33**	**-0.41**	0.20	**-0.30**	**0.53**	**0.28**	**0.67**	0.17	0.17	-0.03	**-0.52**	-0.25
X_3		**0.43**	**0.29**	**0.84**	**0.78**	**0.70**	**0.66**	**0.88**	**0.81**	**-0.37**	-0.16	0.04	-0.22	**0.91**	**0.80**	**0.84**	**0.63**	-0.02	0.06	**-0.35**	-0.19

Source: Compiled by Authors; X_1 = Educated Persons up to Elementary Level (%), X_2= Educated Persons up to Secondary Level (%), X_3= Educated Persons up to Higher Education Level (%)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India
Educated Persons up to Elementary Level, 1991
(Data by States and UTs)
Jammu & Kashmir
Himachal Pradesh
Punjab
Chandigarh
Haryana
Delhi
Uttar Pradesh
Rajasthan
Sikkim
Arunachal Pradesh
Assam
Nagaland
Meghalaya
Manipur
Tripura
Mizoram
Bihar
West Bengal
Gujarat
Madhya Pradesh
Daman & Diu
Dadra & Nagar Haveli
Maharashtra
Orissa
Andhra Pradesh
Goa
Karnataka
Lakshadweep
Pondicherry
Tamil Nadu
Kerala
Andaman & Nicobar Islands
Total Literates (per cent)
55
45
DNA
(National Average: 49.60)
0
400
Kms

Fig. 1

Table 4
India: Literacy Rate and Educational Institutions by Size of Population

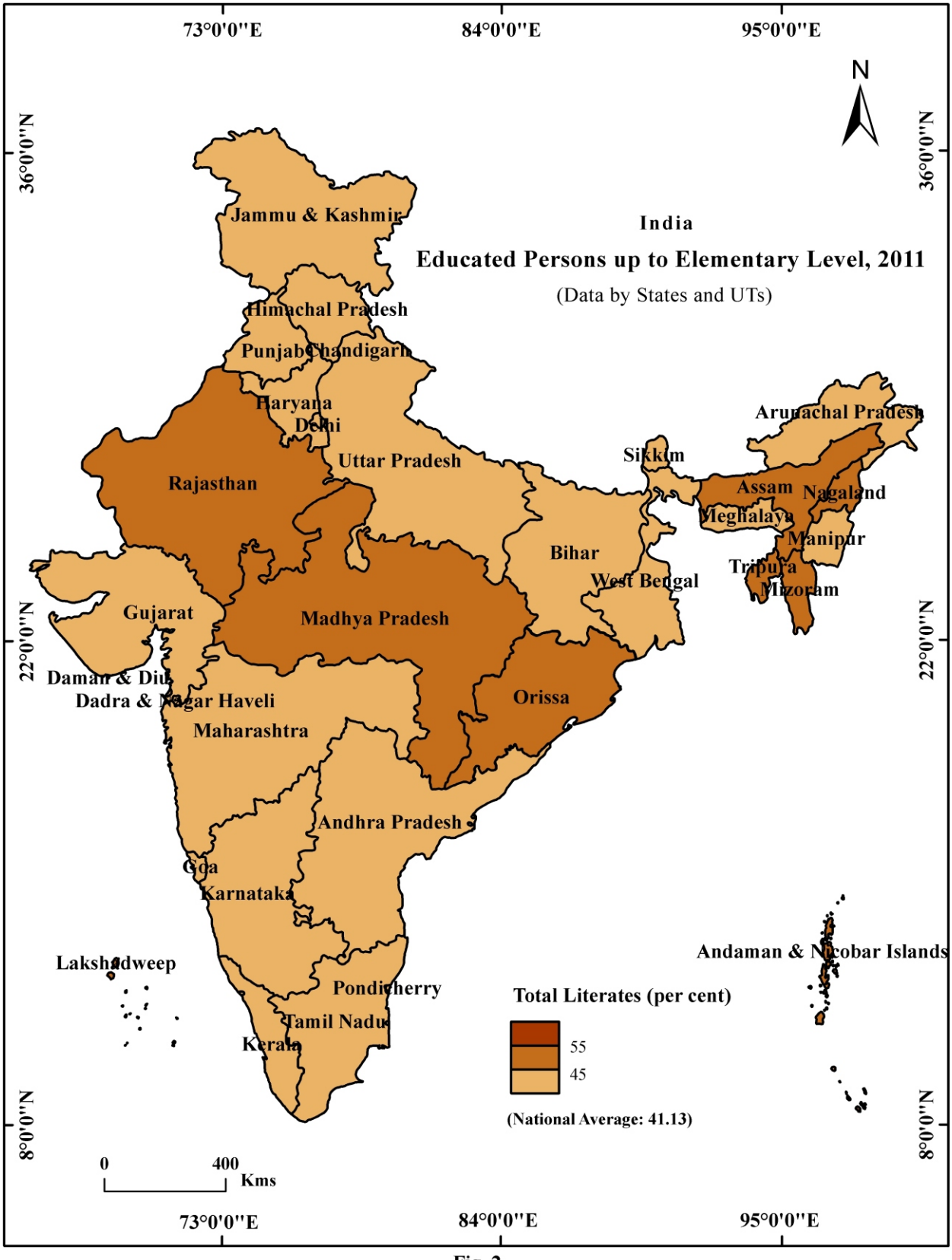
States and UTs	Literacy Rate (per cent)		Elementary Schools/800 Persons (No.)		Secondary Schools/1000 Persons (No.)		Higher Education Institutes/100000 Persons (No.)	
	1991	2011	1991	2011	1991	2011	1991	2011
Andhra Pradesh	44.08	67.02	0.66	0.78	0.11	0.29	0.76	5.74
Arunachal Pradesh	41.59	65.39	1.30	1.75	0.15	0.24	0.58	2.09
Assam	52.89	72.19	1.23	1.16	0.15	0.17	1.05	1.58
Bihar	37.49	62.92	0.60	0.64	0.05	0.08	0.70	0.66
Goa	75.51	88.70	0.78	0.92	0.32	0.32	1.88	3.49
Gujarat	61.29	78.03	0.59	0.55	0.13	0.15	0.82	3.04
Haryana	55.85	75.55	0.31	0.55	0.15	0.28	0.88	4.24
Himachal Pradesh	63.86	82.80	1.35	1.65	0.22	0.48	0.89	4.57
Jammu & Kashmir	DNA	68.74	DNA	1.55	DNA	0.25	DNA	2.53
Karnataka	56.04	75.6	0.71	0.77	0.11	0.29	1.22	5.44
Kerala	89.81	93.91	0.26	0.23	0.09	0.13	0.49	2.93
Madhya Pradesh	44.67	69.57	1.01	1.56	0.07	0.19	0.75	2.69
Maharashtra	64.87	82.34	0.59	0.56	0.14	0.20	1.22	4.13
Manipur	59.89	79.85	1.70	0.88	0.24	0.31	1.96	2.91
Meghalaya	49.1	74.43	2.19	3.32	0.18	0.34	1.41	2.39
Mizoram	82.26	91.58	1.92	2.36	0.33	0.60	1.88	2.91
Nagaland	61.65	80.11	1.09	0.86	0.15	0.30	1.32	3.08
Orissa	49.09	73.45	1.32	1.46	0.15	0.22	1.08	2.63
Punjab	58.51	76.68	0.54	0.62	0.14	0.31	1.00	3.57
Rajasthan	38.55	67.06	0.73	1.04	0.09	0.35	0.48	3.93
Sikkim	56.94	82.2	1.24	1.33	0.18	0.32	0.25	2.78
Tamil Nadu	62.66	80.33	0.50	0.41	0.09	0.09	0.55	3.28
Tripura	60.44	87.75	0.72	0.77	0.17	0.24	0.62	1.14
Uttar Pradesh	41.71	68.22	0.53	0.96	0.04	0.11	0.35	2.53
West Bengal	57.70	77.08	0.64	0.46	0.10	0.10	0.56	1.01
Andaman & Nicobar Islands	73.02	86.63	0.66	0.61	0.24	0.27	1.07	1.57
Chandigarh	77.81	86.05	0.10	0.03	0.12	0.14	2.34	2.84
Dadra & Nagar Haveli	40.71	76.24	0.94	0.70	0.09	0.10	DNA	1.16
Daman & Diu	71.20	87.1	0.51	0.36	0.19	0.15	0.98	2.05
Delhi	75.29	86.21	0.20	0.15	0.12	0.11	0.84	1.24
Lakshadweep	81.78	91.85	0.35	0.38	0.21	0.19	DNA	DNA
Pondicherry	74.74	86.55	0.44	0.25	0.13	0.25	1.49	6.97
National Average	**52.21**	**74.04**	**0.80**	**0.92**	**0.14**	**0.23**	**0.91**	**2.85**

Source: Compiled by Authors, DNA : Data not Available.

Table 5
India: Determinants of Educational Attainment

States and UTs	Urban Population (per cent)		Persons/km^2		BPL Population (per cent)		Work Participation Rate (per cent)		Road Length (km)/100 km^2		Railway Length (km)/100 km^2		GSDP (per cent)		Budgeted Expenditure on Education (per cent)	
	1991	2011	1991	2011	1991	2011	1991	2011	1991	2011	1991	2011	1991	2011	1991	2011
Andhra Pradesh	26.90	33.36	242	308	22.19	9.20	45.10	46.61	15.79	76.22	1.82	1.91	6.87	4.91	3.34	3.24
Arunachal Pradesh	12.80	22.93	10	17	39.35	34.70	46.20	42.47	6.59	13.04	0.001	DNA	0.14	0.14	5.46	4.45
Assam	11.10	14.09	286	397	40.86	32.00	36.10	38.36	38.93	51.43	3.14	4.98	1.99	1.85	3.91	5.36
Bihar	13.10	14.36	959	1516	54.96	35.30	32.20	36.50	10.83	28.72	3.05	6.33	5.71	5.15	4.65	4.15
Goa	41.00	62.17	316	394	14.92	5.10	35.30	39.58	191.62	276.19	2.13	1.86	0.34	0.55	4.59	3.74
Gujarat	34.50	42.59	211	308	24.21	16.6	40.20	40.98	20.44	39.53	2.69	2.69	5.90	7.97	3.42	2.13
Haryana	24.60	34.87	372	573	25.05	11.20	31.00	35.17	52.06	61.33	3.39	3.48	3.27	3.85	2.27	2.69
Himachal Pradesh	8.70	10.03	93	123	28.44	8.10	42.80	51.85	42.77	60.57	0.48	0.53	0.65	0.94	6.45	5.35
Jammu & Kashmir	23.80	27.37	77	124	25.17	10.30	DNA	34.47	5.49	9.81	0.03	0.12	DNA	1.01	4.11	6.44
Karnataka	34.90	38.67	235	319	33.16	20.90	42.00	45.62	68.26	39.21	1.59	1.69	5.82	7.82	3.14	3.04
Kerala	26.40	47.70	749	859	25.43	7.10	31.40	34.78	52.19	72.57	2.53	2.70	3.16	4.71	4.18	3.51
Madhya Pradesh	23.20	26.49	288	425	42.52	35.70	42.80	45.57	29.45	36.31	1.90	3.26	6.11	6.13	3.27	4.06
Maharashtra	38.70	45.22	257	365	36.86	17.40	43.00	43.99	57.34	78.55	1.76	1.82	15.17	16.48	2.40	2.78
Manipur	27.50	29.20	82	122	33.78	36.90	42.20	45.09	23.93	61.93	0.004	DNA	0.19	0.17	7.88	7.16
Meghalaya	18.60	20.06	79	132	37.92	11.90	42.70	39.96	25.35	38.20	DNA	DNA	0.19	0.26	6.23	4.76
Mizoram	46.10	52.11	33	52	25.66	20.40	48.90	44.36	15.97	2.75	0.005	0.01	DNA	0.09	9.63	9.37
Nagaland	17.20	28.85	73	119	37.92	18.90	42.70	49.24	10.58	72.58	0.07	0.08	0.14	0.15	6.35	5.61
Orissa	13.40	16.68	203	269	48.56	32.60	37.50	41.79	DNA	11.66	1.28	1.55	2.76	2.95	4.08	3.41
Punjab	29.60	37.48	403	550	11.77	8.30	30.90	35.67	76.44	207.07	4.28	8.15	4.45	3.45	2.39	2.14
Rajasthan	22.80	24.87	129	201	27.41	14.70	38.90	43.60	17.04	55.34	1.70	1.69	4.50	5.65	3.63	2.85
Sikkim	9.10	25.15	57	86	41.43	8.20	41.50	50.47	31.89	27.26	DNA	DNA	0.08	0.14	9.94	5.79
Tamil Nadu	34.20	48.39	429	555	35.03	11.30	43.30	45.58	131.32	209.33	3.08	2.98	7.27	9.73	3.03	2.67
Tripura	15.30	26.16	263	350	39.01	14.00	31.10	40.00	54.81	161.46	0.42	1.46	0.26	0.25	10.3	5.66
Uttar Pradesh	19.80	22.65	680	1017	40.85	20.30	32.20	35.66	24.37	125.09	3.03	4.28	13.01	10.87	2.80	4.10
West Bengal	27.50	31.87	767	1029	35.66	19.90	32.20	38.08	20.02	23.17	4.30	4.44	8.63	DNA	4.22	3.07
Andaman & Nicobar Islands	26.70	37.70	34	46	34.47	1.00	35.24	40.08	10.47	16.23	DNA	DNA	0.04	0.05	DNA	6.81
Chandigarh	89.70	97.25	5632	9252	11.35	DNA	34.9	38.29	1245.61	2530.41	9.64	14.04	DNA	0.24	DNA	2.36
Dadra & Nagar Haveli	8.50	46.72	282	698	50.84	39.30	53.20	45.73	72.70	164.96	DNA	DNA	DNA	DNA	DNA	DNA
Daman & Diu	46.80	75.17	907	2169	15.8	9.90	37.60	49.86	DNA	242.34	DNA	DNA	DNA	DNA	DNA	DNA
Delhi	89.90	97.50	6352	11297	14.69	9.90	31.60	33.28	1461.9	2202.49	11.32	80.65	3.20	4.45	DNA	1.68
Lakshadweep	56.30	78.06	1616	2013	25.04	2.80	26.40	29.09	DNA	673.33	DNA	DNA	DNA	DNA	DNA	DNA
Pondicherry	64.00	68.33	1683	2598	37.4	9.70	33.10	35.66	97.34	139.82	5.51	4.49	0.14	DNA	DNA	5.63
National	**26.10**	**31.16**	**267**	**382**	**35.97**	**21.90**	**37.50**	**39.80**	**70.79**	**142.68**	**1.89**	**1.96**	**3.45**	**3.57**	**3.80**	**4.17**

Source: Compiled by Authors, DNA : Data not Available.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India
Educated Persons up to Elementary Level, 2011
(Data by States and UTs)
Jammu & Kashmir
Himachal Pradesh
Punjab
Chandigarh
Haryana
Delhi
Rajasthan
Uttar Pradesh
Sikkim
Arunachal Pradesh
Assam
Nagaland
Meghalaya
Manipur
Tripura
Mizoram
Bihar
West Bengal
Gujarat
Madhya Pradesh
Daman & Diu
Dadra & Nagar Haveli
Maharashtra
Orissa
Andhra Pradesh
Goa
Karnataka
Lakshadweep
Pondicherry
Tamil Nadu
Kerala
Andaman & Nicobar Islands
Total Literates (per cent)
55
45
(National Average: 41.13)
0
400
Kms

Fig. 2

educated persons (Table 5) in 1991. In 2011, no state as well as UT fell in this category (Fig. 2). It does not mean that overall educational attainment at elementary level has declined among these states during the study period, rather it is a promising sign of higher educational attainments as people have shifted from lower academic standards to higher ones in the country.

Areas with Moderate Proportion of Elementary Educated Persons

The study reveals that more than half of India registered moderate proportion (45-55 per cent) of elementary educated persons in 1991. The states running from north-western part to eastern and north-eastern parts and coastal states like Gujarat, Maharashtra, Karnataka, Orissa and Tamil Nadu have witnessed moderate proportion of elementary educated people in 1991 (Fig. 1). The moderate to high literacy rates (60 to 75 per cent), moderate to higher availability of elementary schools (1 to 1.5) per size of population and high work participation rates (more than 40 per cent) have been some of the factors responsible for moderate share of elementary educated persons in these states. By 2011, central and north-eastern Indian states of Rajasthan, Madhya Pradesh, Orissa, Mizoram, Assam, Nagaland and Tripura and UTs like Andaman & Nicobar Islands and Lakshadweep have witnessed moderate proportion of elementary educated persons (Fig. 2).

Areas with Low Proportion of Elementary Educated Persons

The states namely Tripura, Sikkim, Andhra Pradesh, Madhya Pradesh and union-territories Delhi and Chandigarh have registered low share (less than 45 per cent) of elementary educated persons in 1991 (Fig. 1). Very high population density resulting into low availability of elementary schools per size of population in Chandigarh (0.10 unit) and Delhi (0.20 unit) could be one of the factors responsible for low proportion of elementary educated persons (Table 4).

In 2011, almost whole of India except Rajasthan, Madhya Pradesh and Orissa (now Odisha) in central India and Assam, Nagaland, Tripura and Mizoram in northeast India registered low proportion of elementary educated persons (Fig. 2). Low proportion of elementary educated persons in large populous states of northern plains namely Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal and peninsular India like Maharashtra, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh is a remarkable sign of educational development. These states witnessed an improvement in educational attainment during next two decades because of the shift of educated people from elementary to secondary stages and beyond (Table 1).

Educated Persons up to Secondary Level (1991-2011)

The national average of secondary educated persons has been about 19 per cent of the total literate population of India in 1991. It increased to 24.10 per cent in 2011 (Table 1). Number of secondary educated persons increased by about 175 per cent between 1991 and 2011 (Table 2). The growth of secondary educated people has been more than the double from the elementary educated persons during the same period. The highest growth among secondary educated persons has been observed in UTs of Dadra & Nagar Haveli (606.93 per cent) and Daman & Diu (527.51 per cent) followed by states of Arunachal Pradesh (338 per cent) and Meghalaya (334 per cent). The least growth in

number of secondary educated persons has been observed in Goa (99.43 per cent) during the study period (Table 2).

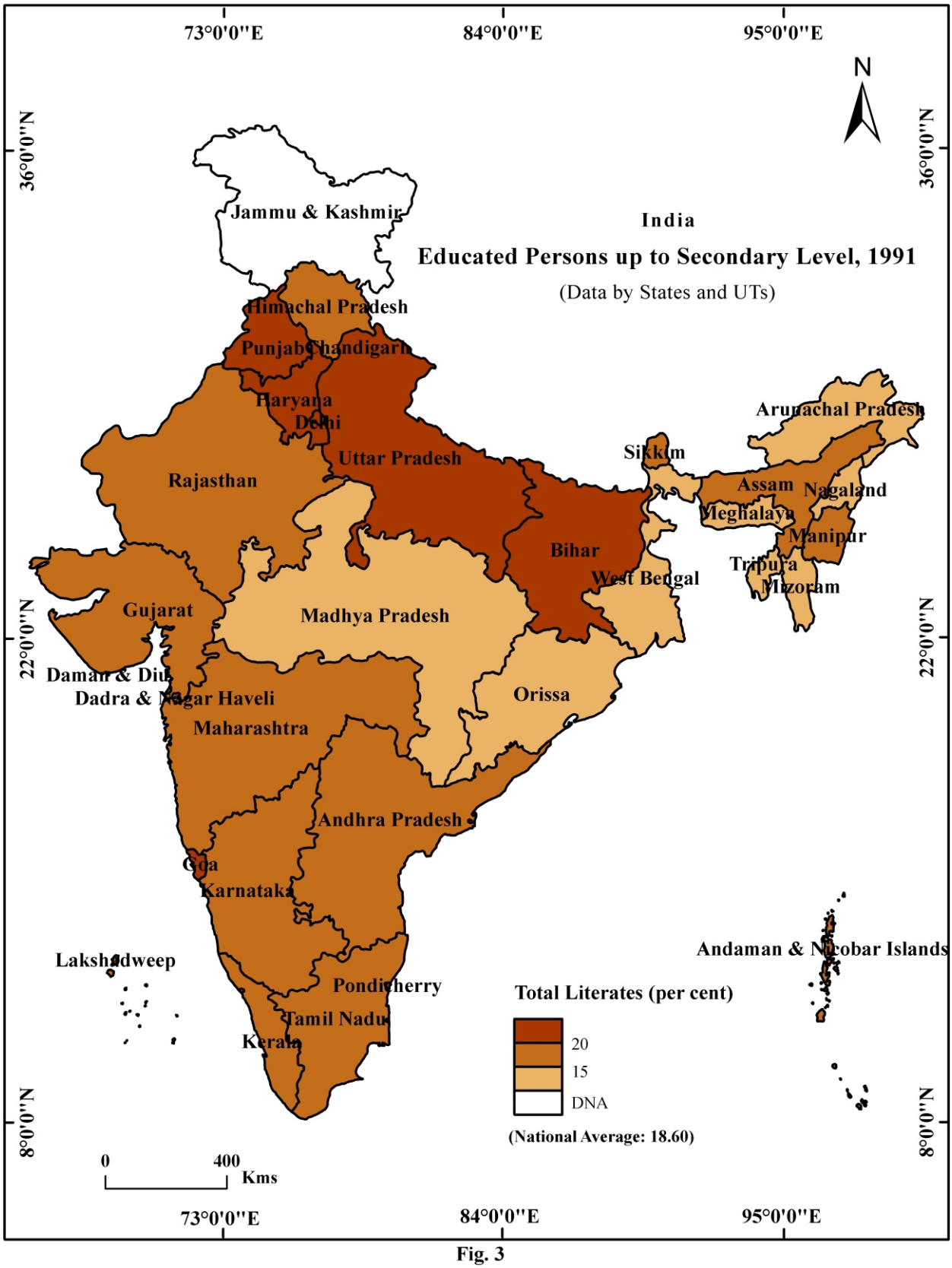
Growing demand of skilled, semi-skilled and educated human resource in different sectors of Indian economy, attracted the people towards attaining higher levels of education. Many literacy and education improvement programmes introduced and implemented by both central and state governments have been equally responsible for the shift of people to secondary and higher education levels. The correlation matrix (Table 3) exhibits a positive correlation between secondary educated persons and gross enrolment ratio at secondary level (0.71 in 1991 and 0.50 in 2011), level of urbanization (0.48 in 1991 and 0.43 in 2011), density of population (0.55 in 1991 and 0.27 in 2011), road density (0.53 in 1991 and 0.28 in 2011) and railway density (0.67 in 1991 and 0.17 in 2011). However, negative relationship is found between secondary educated persons and poverty (-0.33 in 1991 and -0.41 in 2011). The study thus reveals that growing urbanization, development of roads and population density functioned as seedbed for the secondary educational attainment at the national level. Poverty continued to curtail the progress of secondary education at the national level during 1990s and beyond in India. The spatio-temporal variations in secondary educated persons in India have been discussed as under:

Areas with High Proportion of Secondary Educated Persons

The broad pattern of secondary educated persons reveals that Punjab, Haryana, Uttar Pradesh, Bihar, Goa and three UTs namely Delhi, Chandigarh and Pondicherry recorded high percentage (20 per cent and above) of secondary educated persons in 1991 (Fig. 3). In 2011, the states with more density of population, highly urbanised, equipped with better transportation facilities and incurring more expenditure on education namely Punjab, Haryana, Goa, Uttar Pradesh and Bihar recorded higher proportion of secondary educated persons (Fig. 4; Table 5). Similarly, due to high literacy rate and better availability of secondary schools per 1000 persons, the states of Himachal Pradesh (0.48 unit), Goa (0.32 unit), Sikkim (0.32 unit) and Manipur (0.31 unit), have recorded high proportion of secondary level educated persons (Table 4; Fig. 4). Likewise, Delhi and Chandigarh UTs and southern states of India have been better in terms of secondary educational attainment. However, the poverty stricken states like Bihar and Uttar Pradesh and states with poor road-railway connectivity like Jammu & Kashmir and north-eastern India like Sikkim, Arunachal Pradesh, Assam, Nagaland and Manipur have also fared well in attaining higher proportion of secondary education (Fig. 4; Table 5).

Areas with Moderate Proportion of Secondary Educated Persons

The hilly states like Himachal Pradesh, Sikkim, Assam, Manipur and northwest states of Rajasthan, Gujarat and whole of south India have witnessed moderate proportion (15-20 per cent) of secondary educated persons in 1991 (Fig. 3). The moderate urbanization, moderate population density and low poverty in Gujarat, Andhra Pradesh, Himachal Pradesh and Manipur are responsible for their moderate level of attainment of secondary education (Table 5). In 2011, only seven states of country namely Rajasthan, Madhya Pradesh, Orissa, West Bengal and northeastern states of Meghalaya,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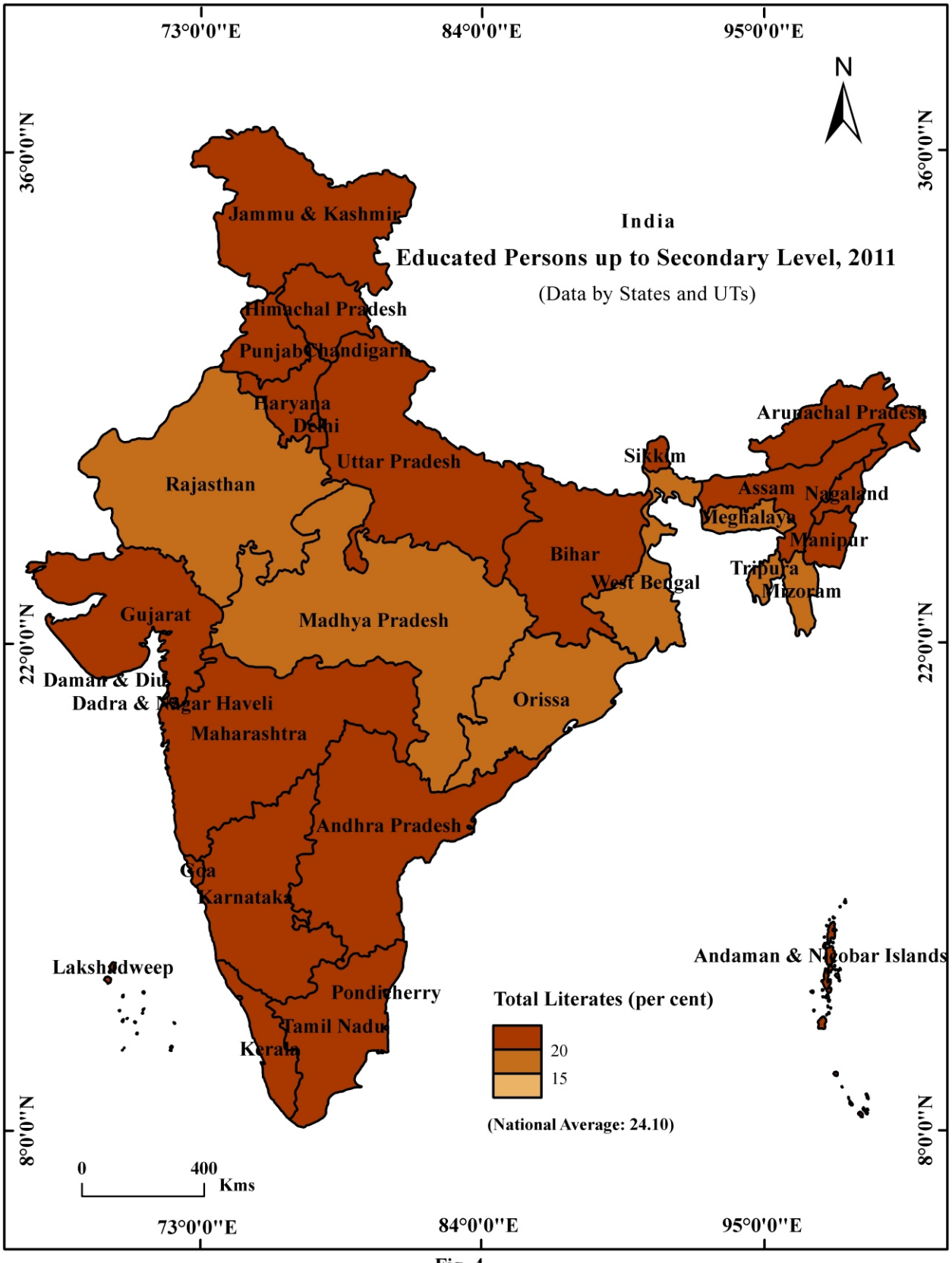
India
Educated Persons up to Secondary Level, 1991
(Data by States and UTs)
Jammu & Kashmir
Himachal Pradesh
Punjab
Chandigarh
Haryana
Delhi
Uttar Pradesh
Rajasthan
Sikkim
Arunachal Pradesh
Assam
Nagaland
Meghalaya
Manipur
Tripura
Mizoram
Bihar
West Bengal
Gujarat
Madhya Pradesh
Orissa
Daman & Diu
Dadra & Nagar Haveli
Maharashtra
Andhra Pradesh
Goa
Karnataka
Lakshadweep
Pondicherry
Tamil Nadu
Kerala
Andaman & Nicobar Islands
Total Literates (per cent)
20
15
DNA
(National Average: 18.60)
0
400
Kms

Fig. 3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India
Educated Persons up to Secondary Level, 2011
(Data by States and UTs)
Jammu & Kashmir
Himachal Pradesh
Punjab
Chandigarh
Haryana
Delhi
Rajasthan
Uttar Pradesh
Sikkim
Arunachal Pradesh
Assam
Nagaland
Meghalaya
Manipur
Tripura
Mizoram
Bihar
West Bengal
Gujarat
Madhya Pradesh
Daman & Diu
Dadra & Nagar Haveli
Maharashtra
Orissa
Andhra Pradesh
Goa
Karnataka
Lakshadweep
Pondicherry
Tamil Nadu
Kerala
Andaman & Nicobar Islands
Total Literates (per cent)
20
15
(National Average: 24.10)
0
400
Kms

Fig. 4

Tripura and Mizoram have been found in this category (Fig. 4).

Areas with Low Proportion of Secondary Educated Persons

The poverty stricken states namely Orissa, Madhya Pradesh, Arunachal Pradesh and Tripura; states with low total work participation rate like West Bengal and poor road-railway connectivity like, Arunachal Pradesh, Tripura, Meghalaya, Nagaland and Mizoram have registered low proportion (less than 15 per cent) of secondary educated persons in 1991 (Fig. 3; Table 5). In 2011, no state has been found in this category as all the states have moved up to upper levels of education. Because of the growing demand of skilled, semi skilled and educated workforce in globalising Indian market, the people have started attaining higher levels of education. A series of flagship programmes such as Programme of Action (POA-1992), National Knowledge Commission (NKC-2005), National Scheme of Incentives to Girls for Secondary education (2008) and Rashtriya Madhyamik Shiksha Abhiyan (RMSA-2009) introduced and implemented by both central and state governments are also equally responsible for the epochal shift of people to higher education levels.

Educated Persons up to Higher Level (1991-2011)

The study unfolds that there has been a slight increase in proportion of highly educated persons from merely 5.67 per cent in 1991 to 8.90 per cent in 2011. It clearly indicates that Indian higher education system is passing through teething stage where even one-tenth of its total literate population is still not highly educated. However, the study has revealed the highest growth of educated people at higher education level as compared with elementary and secondary stages. Their number has increased phenomenally at 231 per cent during the study period. Their growth has been about 3 and 1.32 times higher than elementary and secondary educated people respectively. It signfies the propensity and inclination of people towards higher education after 1990s. The highest growth rate among highly educated people has been observed in two UTs namely Dadra & Nagar Haveli (957 per cent), Daman & Diu (559 per cent) followed by Sikkim (403 per cent) and Haryana (397 per cent) states. On the other hand, the least decadal growth has been observed in Chandigarh (108 per cent). The correlation matrix exhibits a positive association between educated persons at higher level and number of educational institutes per size of population (0.43 in 1991 and 0.29 in 2011), gross enrolment ratio (0.84 in 1991 and 0.78 in 2011), level of urbanization (0.70 in 1991 and 0.66 in 2011), density of population (0.88 in 1991 and 0.81 in 2011) and rail-road density at national level (Table 3). The study shows negative relationship between educated persons at higher level and level of poverty (-0.37 in 1991) at national level. The study therefore reveals that increasing number of educational institutes, higher enrolments, growing urbanization and improved network of roads and railways resulting into greater place to place connectivity furthered higher educational attainments at the national level. The poverty continued to hinder the progress of higher education at the national level during the post-liberalization period in India. The spatio-temporal variations among educated persons at higher level during the study period are discussed below:

Areas with High Proportion of Higher Educated Persons

Two union-territories of Delhi and

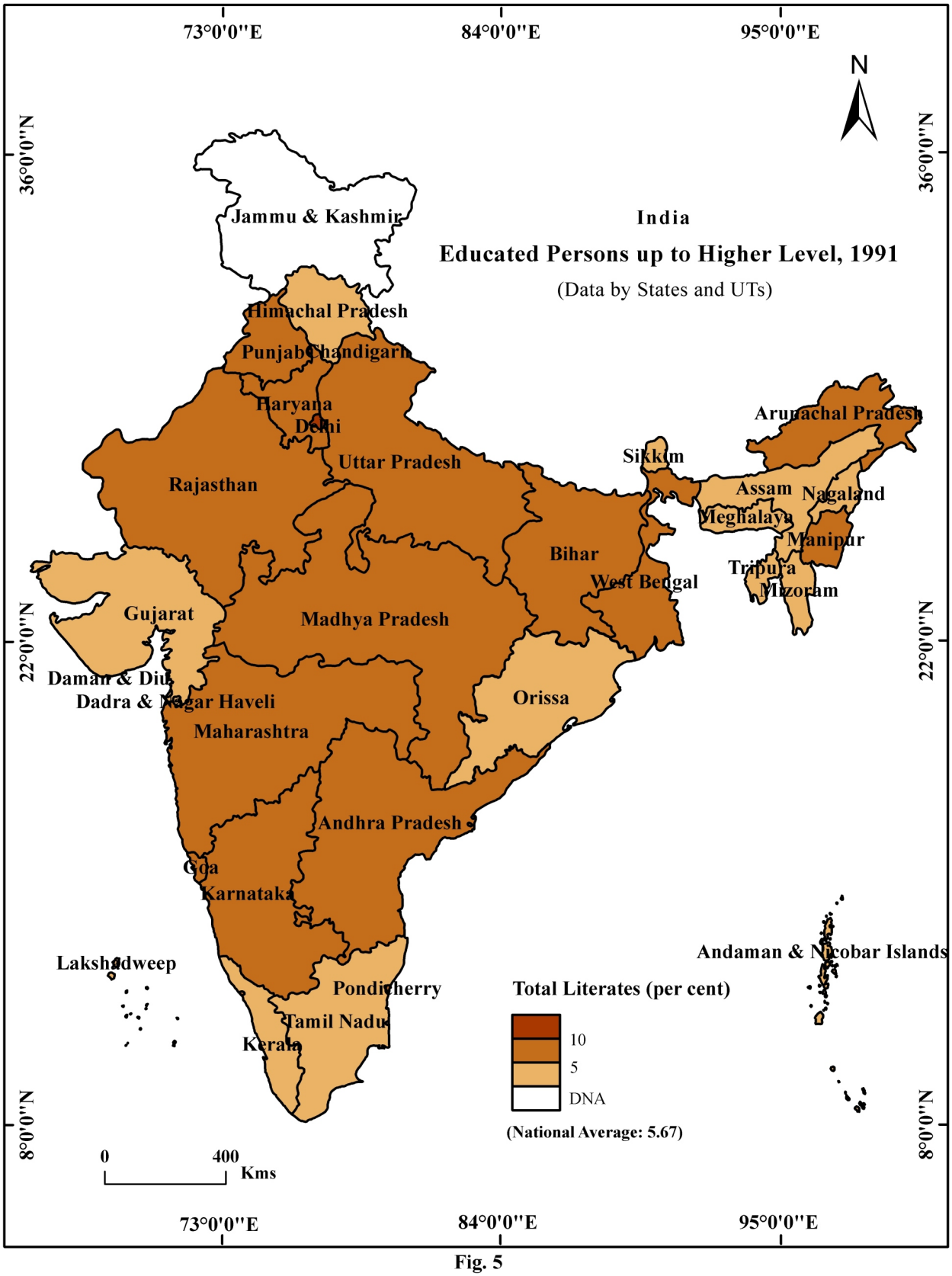
Chandigarh have highest share (10 per cent and above) of graduates, post-graduates, M. Phil. and Ph.D. degree holders (Fig. 5; Table 1). Better road-railway connectivity along with the availability of institutions of higher education and affordability of people to seek higher education are the reasons for high proportion of highly educated persons in these UTs (Table 5). The higher concentration of highly educated people in the national capital territory of India and Chandigarh the capital city of Punjab and Haryana states in 1991 may be attributed to high literacy rate (75.29 per cent and 77.81 per cent), high urbanization (89.90 per cent and 89.70 per cent), high population density (6352 and 5632 persons/km²) and better road-railway connectivity along with the availability of institutions of higher education and affordability of people to seek higher education (Table 4 and 5). In 2011, the states like Haryana, Manipur, Maharashtra, Goa, Tamil Nadu and Andhra Pradesh and UTs such as Chandigarh, Delhi and Pondicherry have recorded high proportion of highly educated persons (Fig. 6). The spatial pattern of highly educated persons (2011) has been the corollary of a host of factors like high urbanization in Delhi (97.50 per cent), Chandigarh (97.25 per cent), Pondicherry (68.33 per cent), Goa (62.17 per cent) and Tamil Nadu (48.39 per cent) and high population density in Delhi (11297 persons/km²), Chandigarh (9252 persons/km²), Pondicherry (2598 persons/km²), and very low poverty in Goa (5.1 per cent), and Andhra Pradesh (9.20 per cent) (Table 5).

Areas with Moderate Proportion of Higher Educated Persons

Major states of India lying in Indo-Gangetic plains extending from Punjab to West Bengal and the tribal population dominated states of Arunachal Pradesh and Manipur along with Madhya Pradesh, Maharashtra, Andhra Pradesh and Karnataka in south India accounted for moderate level of (5-10 per cent) proportion of highly educated persons in 1991 (Fig. 5). In 2011, majority of the states in northern half of India along with Karnataka and Kerala have recorded moderate share of highly educated persons (Fig. 6). A cursory look at the pattern reveals that high population density resulting into more literates to seek higher education in Bihar (1516 persons/km²), West Bengal (1029 persons/km²), Uttar Pradesh (1017 persons/km²) and Kerala (859 persons/km²) has resulted into moderate share of highly educated people. In addtion to this, low poverty indicating more affordability for higher education in Kerala (7.10 per cent), Himachal Pradesh (8.10 per cent), Sikkim (8.20 per cent) and Punjab (8.30 per cent), high work participation rate in Madhya Pradesh (45.57 per cent), Bihar (36.50 per cent), Uttar Pradesh (35.66 per cent) and Himachal Pradesh (51.85 per cent) have been some of the reasons behind such a distri-butional pattern of higher educated persons in these states (Fig. 6).

Areas with Low Proportion of Higher Educated Persons

The hilly state of Himachal Pradesh and some north eastern states along with Gujarat, Orissa, Kerala and Tamil Nadu and Andaman & Nicobar Islands, Dadra & Nagar Haveli, Lakshadweep and Daman & Diu UTs have recorded very low proportion (less than 5 per cent) of highly educated persons in 1991 (Fig. 5). The most intriguing feature is the low proportion of higher educated persons in the high literate states of Kerala (89.81 per cent), Himachal Pradesh (63.86 per cent), Assam (52.89 per cent) and Nagaland (61.65 per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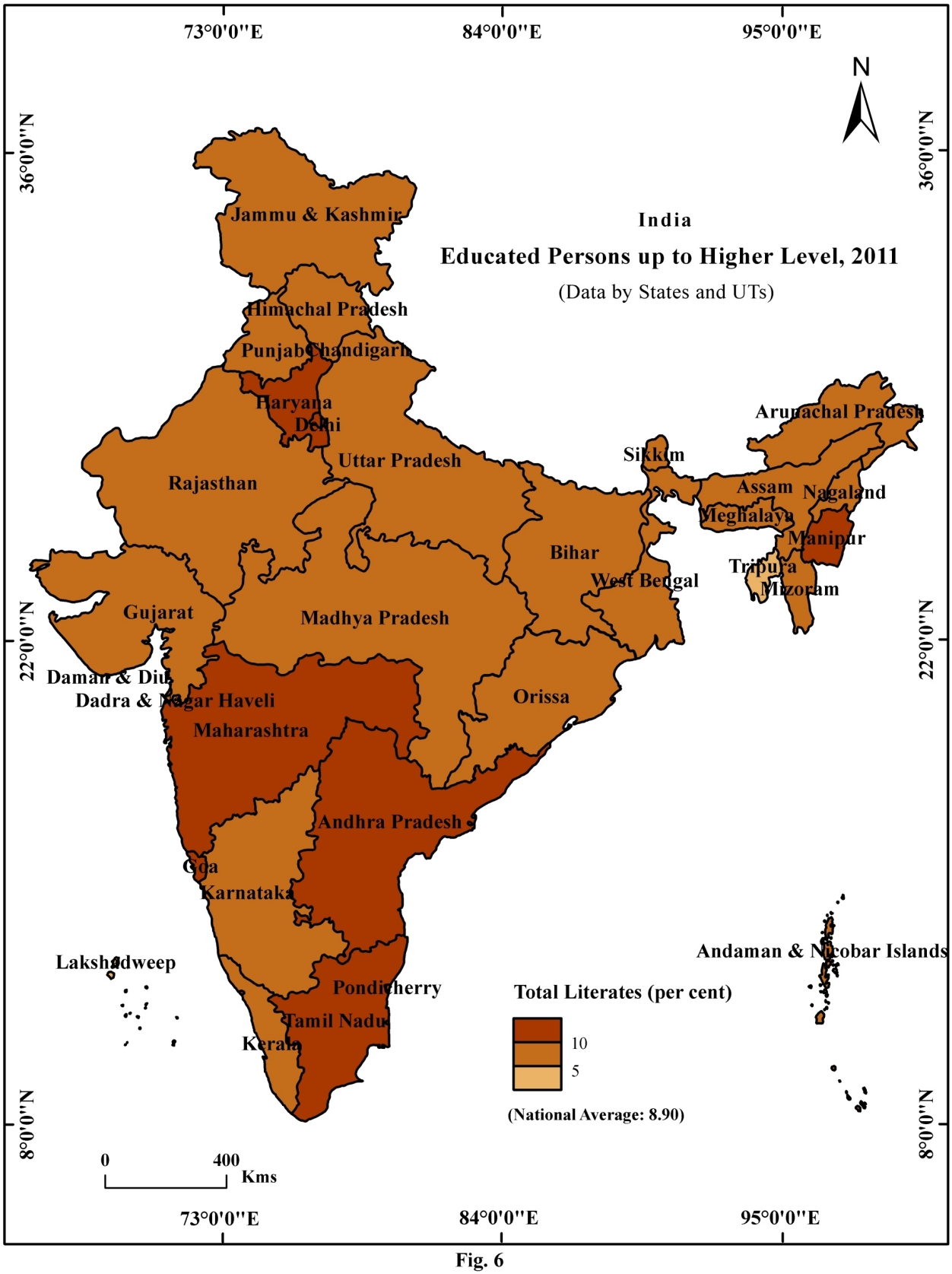
Rajasthan
Uttar Pradesh
Sikkim
Arunachal Pradesh
Assam
Nagaland
Meghalaya
Manipur
Tripura
Mizoram
Bihar
West Bengal
Gujarat
Madhya Pradesh
Daman & Diu
Dadra & Nagar Haveli
Maharashtra
Orissa
Andhra Pradesh
Goa
Karnataka
Lakshadweep
Pondicherry
Tamil Nadu
Kerala
Andaman & Nicobar Islands
Total Literates (per cent)
10
5
DNA
(National Average: 5.67)
0
400
Kms

Fig. 5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Haryana
Delhi
Rajasthan
Uttar Pradesh
Bihar
Sikkim
Arunachal Pradesh
Assam
Nagaland
Meghalaya
Manipur
Tripura
Mizoram
West Bengal
Gujarat
Madhya Pradesh
Daman & Diu
Dadra & Nagar Haveli
Maharashtra
Orissa
Andhra Pradesh
Goa
Karnataka
Lakshadweep
Pondicherry
Tamil Nadu
Kerala
Andaman & Nicobar Islands
Total Literates (per cent)
10
5
(National Average: 8.90)
0
400
Kms

Fig. 6

cent) (Table 4). In 2011, only Tripura state and Lakshadweep UT continued to be at bottom in the higher educational attainments (Fig. 6). Out of the 28 states and 7 UTs, the Tripura state stood at 4th rank in terms of literacy rate in 2011 (Table 4). But, it is at the bottom in terms of higher educational attainment in India (Table 1). However, it is at the top in attainment of professional degrees and diplomas in the country, indicating that people are drifiting away from higher education with little scope for employment. Similar is the case of other highly literate states like Kerala, Himachal Pradesh, Mizoram.

Conclusions

The study finds remarkable changes in the educational attainment at all the three levels of elementary, secondary and higher education in India between 1991 and 2011. The proportion of elementary educated persons has declined due to epochal shift of elementary educated persons towards secondary and higher education levels. But, there has been increase in the absolute number of elementary educated persons during the study period. A rise in elementary schools per size of population, higher work participation rate and high budgeted expenditure on education supported and fostered the elementary education. The government's initiative to achieve the target of universalization of elementary education is a big factor in expanding the elementary education even in poverty ridden, rural and geographically inaccessible areas of the country. The study reveals phenomenal rise in the number of secondary educated persons between 1991 and 2011. The growth of secondary educated people has been more than double as compared to the elementary educated persons during the same period. The national capital Delhi and Chandigarh UT and southern states of India have higher proportion of secondary educated persons. However, the poor states and states with preponderance of tribal population like Madhya Pradesh, Orissa and north-eastern states have shown relatively lower proportion of secondary educated persons during the study period.

The highest growth (about 231 per cent) has been observed in higher educational attainment in India during 1991-2011. The growth among highly educated people has been about 3 and 1.32 times higher than the elementary and secondary educated people respectively. It shows the growing propensity and inclination of people towards higher education after 1990s. Although the number of higher educated people has increased from about 6 per cent in 1991 to 9 per cent of total literates in 2011, even then the country is passing through an infancy stage of higher educational attainments where about 91 per cent of total literates have yet to be graduated and post-graduated. The advanced nations generally have the highest share of population in tertiary education followed by secondary and elementary education, but in case of India it is just opposite. Delhi and Chandigarh UTs emerged as academic leaders in terms of higher educational attainment during the study period. The pace of increase in proportion of highly educated people has been quite low in densely populated states of country like Bihar, West Bengal and in hilly tribal tracts of north-east India.

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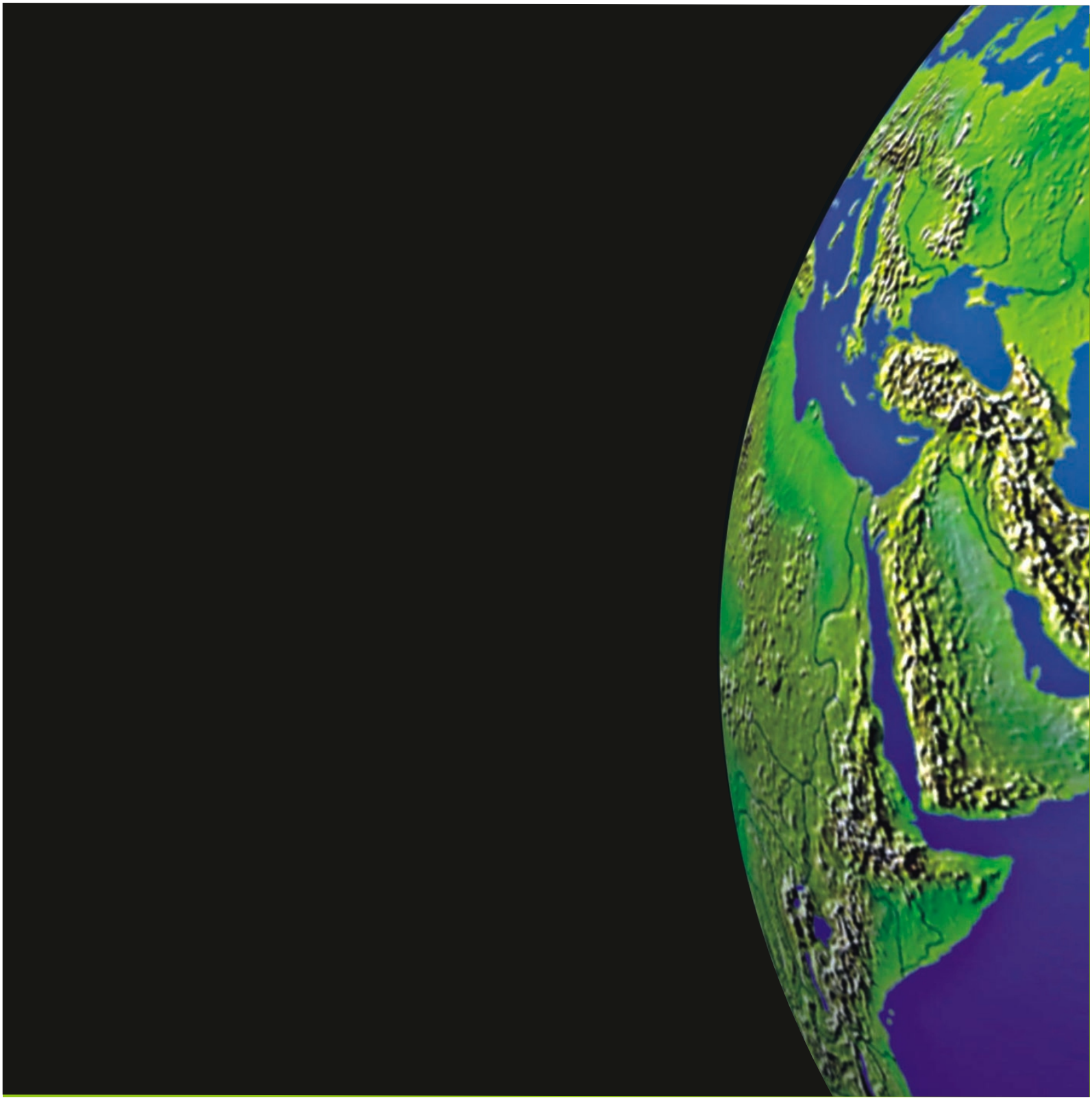

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Spatial Inequalities in Social Development among Northwest Indian States

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KEYWORDS Regional Disparities. Standard Score. North-Western Region of India. Social Backwardness

ABSTRACT The issue of regional imbalances has received attention from various researchers, policy planners and academicians. It is a global phenomenon and can be found all across the world including India. The present study intends to examine the trends and pattern of regional disparities in social development in Northwestern states of India. Based on 8 indicators, the study has been conducted with reference to three reference years, that is, 1971, 1991 and 2011. In order to examine the social development composite standard score has been computed and interpreted. Co-efficient of variation has been computed to gauge into spatial variations at individual level of social variables. Majority of the districts of Jammu and Kashmir and Rajasthan registered low level of social development. The study reveals high development in few enclaves and pockets of the region. Although, regional disparities are declining but some districts are still socially backward.

INTRODUCTION

Spatial inequalities in development is a universal phenomenon at any level. These remain prevalent in all countries of the world. Spatial disparities represent the co-existence of relatively developed and depressed or backward regions in any area. Some particular areas enjoy benefits of concentrated developmental activities due to the factors such as development of markets, favourable geographical conditions, structured government policies along with other social, economic and political reasons. The concept of development evolved mainly during the II World War based on newly originated theoretical foundations guided by international institutions such as International Monetary Fund (IMF), United Nations (UN) and World Bank (WB). The theories of Kuznets (1955) and Williamson (1965) claim that spatial inequalities increase initially in the process of development and follow decline subsequently.

Kuznets discussed that very few people benefit from the early stage of development and the inequalities increase. But during later stages, the shift from agrarian activities to other activities takes place and these spatial inequalities get reduced. Williamson stated that the industrialization was driven by discovery and utilization of natural resources. Therefore, the economic prosperity in the industrialization process is also unequally distributed on space, so the spatial inequalities rise in the process. But, at later stage of development attractive employment opportunities in developed regions attract workers from other regions which result in depressing the wages in destination regions and increasing the wages in home/depressed regions. Thus, a natural convergence process starts, possibly encouraged by government policies, the regional inequalities experience falls. Barrios and Strobel (2009) analysed that growth is accelerated in the leading regions and in result, the regional inequalities increase. The other lagged regions follow the leading regions with the available technological capabilities and natural resources. The study reveals that the spatial inequalities follow the trend of increase, peak and decrease.

Different regions of a country grow with different rates resulting in disparities which result into various socio-economic problems. India has been progressing from underdeveloped to developing country with gaining high capabilities in terms of social, economic and overall development. However, the benefits of socio-economic development remain confined to small areas

of certain social, economic, political or strategic significance. This trend results into regional disparities. Various studies by Rao (1968); Mydral (1974); Dholakia (2003); Rai and Bhatia (2004); Mustaquim et al. (2006); Sahol and Kaur (2006); Kurian (2007); Mohanty (2009); Mishra and Mujoo (2013); Rajalakshmi (2013); Ganaie et al. (2014); Ghosh and Chakma (2014); Nayak (2014); Singh (2014); Asif (2015); Sadaf and Munir (2015); Mustaquim and Asif (2016); Radhika et al. (2016); Savita and Rajeshwari (2016); and Sharma (2017), analysed the issue of regional disparities in India. These studies have mainly investigated the disparities in infrastructure, health and education sectors at the district or sub-district level. Initially, the concept of development was confined to economic variables but later on it has expanded in various other dimensions and social development received an epochal attention. The concept of social development is people-centric. Emphasizing on social development, Copenhagen declaration laid stress on full participation of people in society to promote social progress, justice and betterment of human conditions and integration of economic, cultural and social policies. Various social issues like poverty, unemployment, illiteracy, health and issues related to safe and just societies were discussed. It was observed that social development is about improving the well-being of every individual in society; so, everyone can reach his/her full potential. International Consortium for Social Development (ICSD) defined the social development as an approach to "expand capacity to individuals and communities, promote world peace and social justice, improve access to healthcare and education, overcome discrimination against women and minorities to create sustainable income and economic structures" (ICSD 2012: 13). Health and development are the two important sectors of societal well-being and are the key source of human capital formation (NCERT- Indian Economic Development 2006: 83-84). These are the two key sectors of creating human capital, which lead to social development in particular and overall, in general.

The social dimensions of development primarily received attention in 1980s, which reflected in World Development Report (WDR) of 1991 compiled by the World Bank. It asserted that the challenge of development is to improve the quality of life especially in the world's poor countries. It encompasses ends in themselves, better education, high standard of health and nutrition, less poverty, a clearer environment, more equality of opportunity and a richer cultural life (WDR 1991:4). The concept of social development is inclusive of economic development but differs from it in the sense. It emphasized the development in totality of society in its economic, political, social and cultural aspects (Gore 1973 quoted by Nahar 2014:6). Historically, the development pattern in India has been uneven and irregular due to interplay of physical, economic, cultural and political factors and processes. However, it was during the British regime which served to accentuate the regional disparities in socio-economic development. The basic purpose of British government was to foster the colonial interests, hence developed only those areas which were potentially suitable to them as per their economic, political, cultural and global needs. However, the regional development has always been the part of Indian Planning process. But some factors such as uneven distribution of natural resources, mobility of capital, migration, governance, nature of political will and government policies led to spatial inequalities in social sphere in India. The regional disparities in the north-western part of India are the fulcrum of peculiar physical landscape, historical processes and variations in the socio- political and economic aspects. The present study is an attempt to trace the variations in the level of social development among north-western states of India at district level based on eight variables between 1971 and 2011. The study may be helpful in assessing the inter-district development disparities in social development in the study area.

Objectives

The present study aims to fulfil the following two objectives:

i) To study the level of social development and classify the districts as per levels of development.
ii) To examine the trend of disparities in social development in Northwestern states of India.

Study Area

The Northwest region of India is selected for the present study. According to Census of India (2011), it covers an area of about 6, 67,327 km^2 and population of 17,0047,793 persons. It covers about one-fifth (20.30%) of the total geographical area of country and about 14 percent of the total population of India. Geographically, the study area is located between 23^0 30' N to $37^0$06' N latitude and $69^0$30' E to 81^0 10' E longitude. In the northern part, the study area shares the boundary with Afghanistan and Pakistan. In the north-east, it demarcates the boundary with China and Nepal. In the south-east, it shares the boundary with Madhya Pradesh and Gujarat state lies in the south-west of the study area.

METHODOLOGY

The present study is entirely based on secondary data collected from Directorate of Census Operations, Directorate of Economics and Statistics and Department of Health and Family Welfare of different states (Jammu and Kashmir, Himachal Pradesh, Uttrakhand, Haryana, Punjab, Rajasthan) and union territories (New Delhi and Chandigarh), for the years 1971, 1991 and 2011. The spatial disparities in the levels of social development have been examined at district level in the study area.

The level and pattern of disparities in social development in the study area have been examined with respect to 8 indicators namely (X1) total literacy rate, (X2) female literacy rate, (X3) male literacy rate, (X4) urbanization, (X5) sex ratio, (X6) total health institutes/10000 persons, (X7) total institutional beds/10000 persons, (X8) student-teacher ratio (number of students per teacher).

In order to examine the disparity in social development at district level, z-scores have been computed using the following formula

$$\mathbf{Z} = \left(\frac{xi - \bar{x}}{\sigma}\right)$$

Where; **Z** represents the Z-score.

xi represents the original value of the ith observation.

x denotes the Mean value of variables

σ represents the standard deviation from the mean value

Further, composite z-scores are calculated by summing up the Z scores of all the indicators and divided by the number of indicators using the following formula:

$$CSS = \frac{\Sigma zij}{n}$$

Where**; CSS** means the composite standard score

zij denotes the z-score of all indicators **j** of district **i**

n means total number of indicators

To examine the trend of spatial disparities in social development, the composite standard score has been classified into following three categories:

Category	*Composite Score*
High development	More Than 1.00
Moderate Development	0.00 to 1.00
Low Development	Less Than 0.00

Besides, to find out temporal variation at the level of individual indicator, the co-efficient of variation (C.V.) has been calculated by applying following formula:

$$C.V. = \frac{\sigma}{\bar{x}} \times 100$$

Where; C.V. means co-efficient of variation

σ represents the standard deviation from the mean value

x denotes the mean value of variables

Karl Pearson's co-efficient of correlation method has also been used to show the relationship between social variables in the study area, using the following formula:

$$r = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{N}}{\sqrt{(\Sigma X)^2 - \frac{(\Sigma X)^2}{N}}\ \sqrt{(\Sigma Y)^2 - \frac{(\Sigma Y)^2}{N}}}$$

Choropleth technique has been used in preparing the maps and to show the spatio-temporal variations in the level of development during the study period. Line and bar graphs have also been prepared to show the behaviour of social development in the study area.

OBSERVATIONS AND DISCUSSION

In order to maintain homogeneity in the administrative units and bring out the comparative picture of regional disparities in social development the districts of 1971 have been taken as base districts and

the newly carved out districts of census year 1991 and 2011 have been merged in the districts of base year by using following methodology:

i) If the newly created districts in 1991 and 2011 were fully carved out from a single district, these were merged with the parent district of 1971.
ii) If the newly created district has been carved out from multiple parent districts, the district accounting for more than 50 percent administrative area of the new district is considered as parent district for merging purpose.

On the basis of composite index, the districts of northwestern states of India have been divided into three categories of level of development. Higher value of composite index shows higher level of development and vice-versa.

Areas of High Development (>1.00)

The districts having composite index value more than 1.00 have been taken as the areas of high social development. Lahul and Spiti (Himachal Pradesh), Chandigarh and Delhi were the only three districts with 2.03 percent of total area and 6.62 percent of total population witnessing high level of development in 1971. In 1991, Ladakh district of study area was the only district registering high level of development. Figure 3 exhibits that Chandigarh and Delhi registered the high level of development in 2011 covering about one-tenth of total population. Better socio-economic conditions, earlier availability of healthcare services, small size of population and other government initiatives have resulted into high level of development in the district of Lahul & Spiti in 1971. Lahul & Spiti has performed visibly well in health sector which is evident from 5.93 and 5.64 Z-score values in availability of healthcare institutes and health institutional beds per size of population. Chandigarh and Delhi witnessed high level of development mainly due to better conditions in education and urbanisation sectors. Availability of basic learning institutions, high level of education, and employability contributed to high level of development in Chandigarh and Delhi in 1971. Due to statistical fallacy, Ladakh district in Jammu & Kashmir registered the high level of development in 1991. Because, the data for the reference year (1991) were available for a single variable among all 8 variables of social development. On the basis of available data of total health institutes per 10000 population, the composite index of Ladakh has been taken into consideration and that resulted into the high level of social development. In 2011, Delhi and Chandigarh witnessed high level of development. Relatively better conditions in literacy (both male and female), adequate availability of health institutional beds, appropriate student-teacher ratio and more importantly higher urban population have contributed to high level of development in these areas in 2011.

Areas of Moderate Development (0.00 to 1.00)

Figure 1 exhibits that mainly central and northern parts of study area witnessed moderate level of development in 1971. Entire state of Uttrakhand, Himachal Pradesh (excluding Chamba, Kullu and Lahul & Spiti) and Punjab (excluding Bathinda and Sangrur) observed moderate level of development in the study area. Kaithal, Jind, Mahendergarh and Gurgaon districts of Haryana along with Ajmer, Jaipur, Jodhpur and Bikaner districts of Rajasthan also witnessed moderate level of development in 1971. In 1991, the spatial pattern experiencing moderate level of development remained almost unchanged. The entire states of Jammu & Kashmir, Himachal Pradesh, Uttrakhand and Haryana registered moderate level of development barring some districts in each state (Fig.2). The northern part of Punjab stretching from Patiala district in south-east up to Amritsar district in north-west part along with Chandigarh, Delhi, Ajmer and Jaipur also registered moderate level of development.

Figure 3 portrays that the distribution pattern in the category of moderate level of development remained same but the number and share of the districts changed during next two decades. The study reveals that in 1971, about 44 percent of the total districts registered moderate level of development. It has significantly increased to 47.36 percent in 2011. But locationally, the districts have not remained the same during the study period. The districts have changed with the passage of time. The districts have not progressed with uniform pace of development. The available technological capabilities and natural resources effected the level of development. The

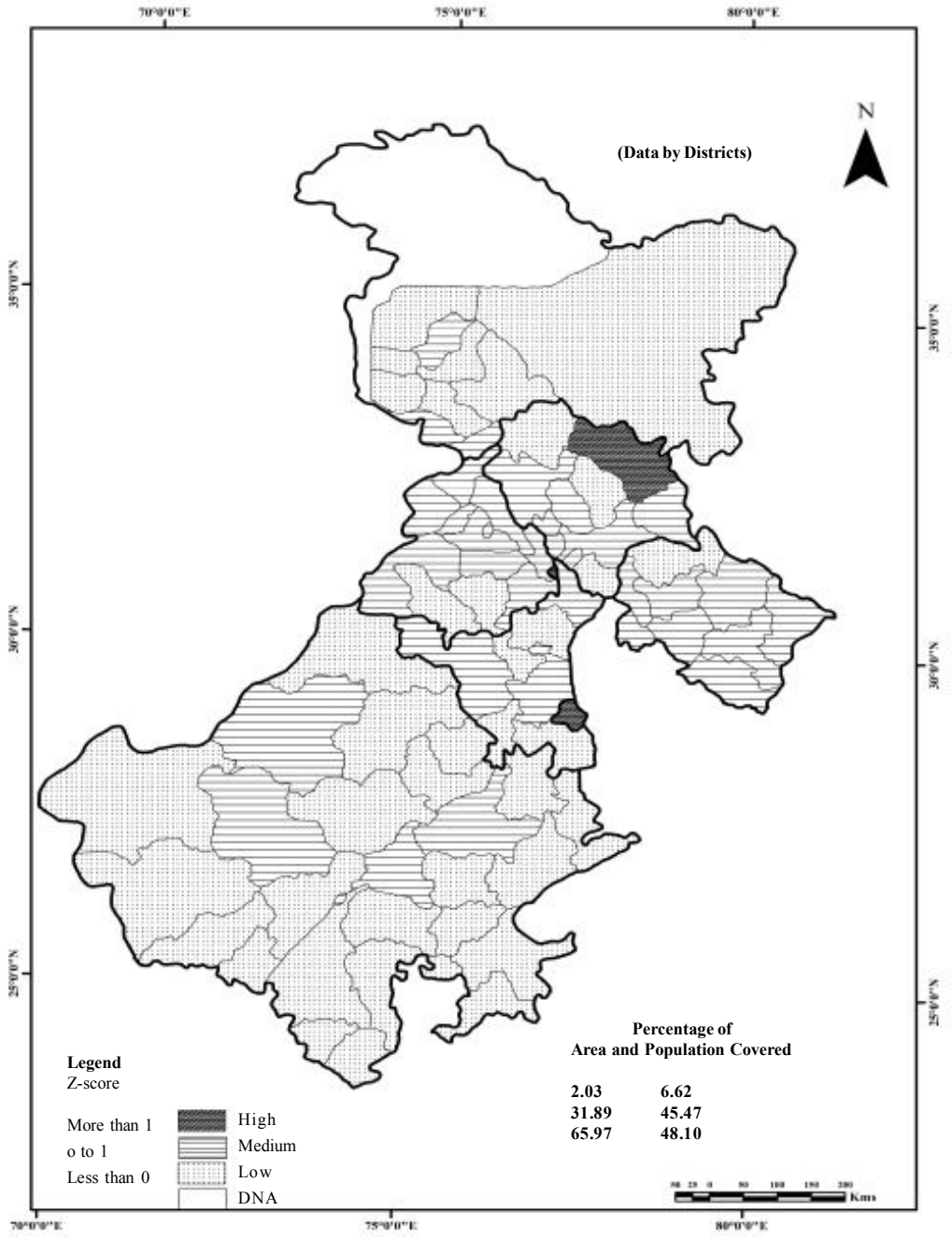

Fig. 1. Northwest India: Levels of Social Development 1971
Source: Prepared by Authors Based on Census of India Data

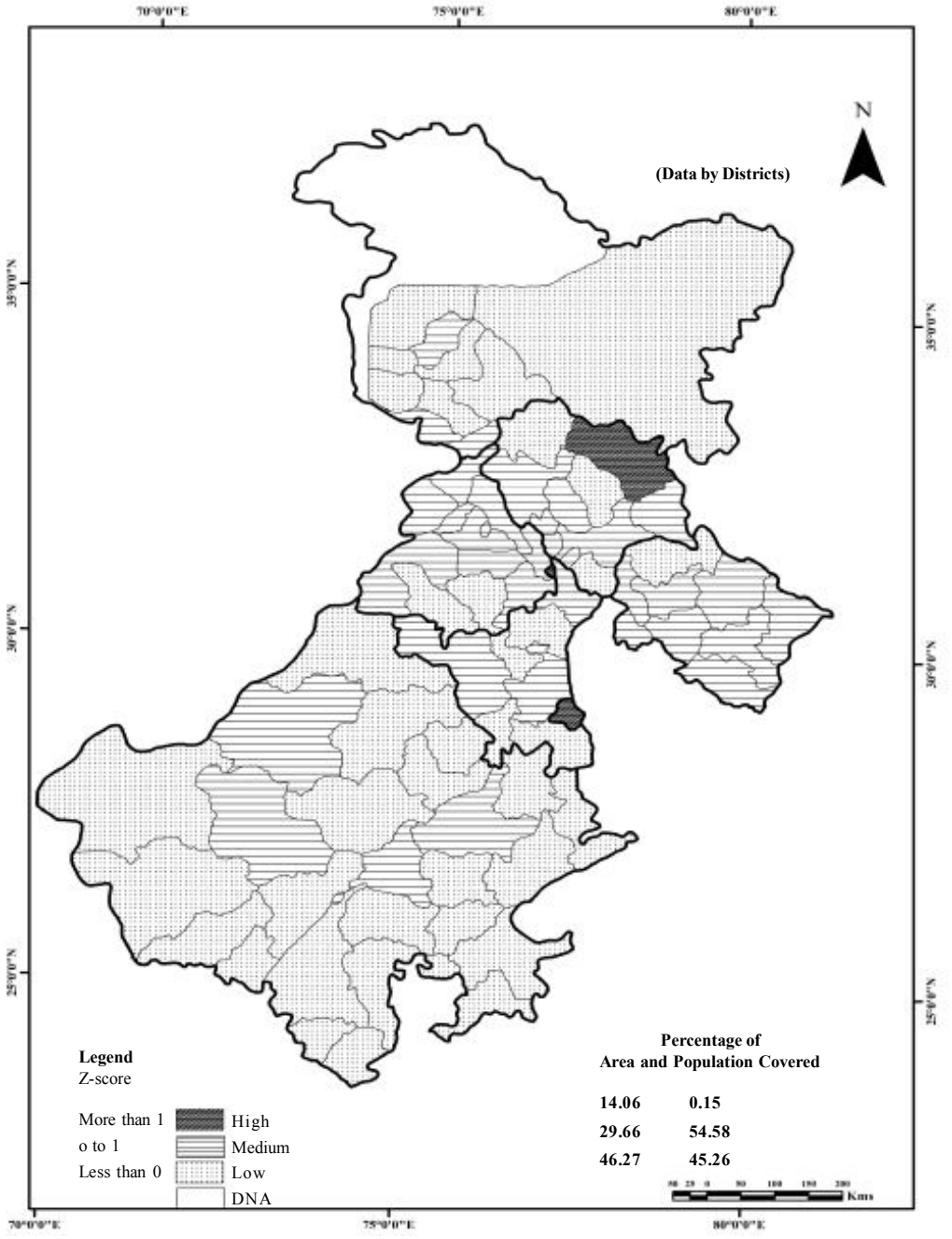

Fig. 2. Northwest India: Levels of Social Development 1991
Source: Prepared by Authors Based on Census of India Data

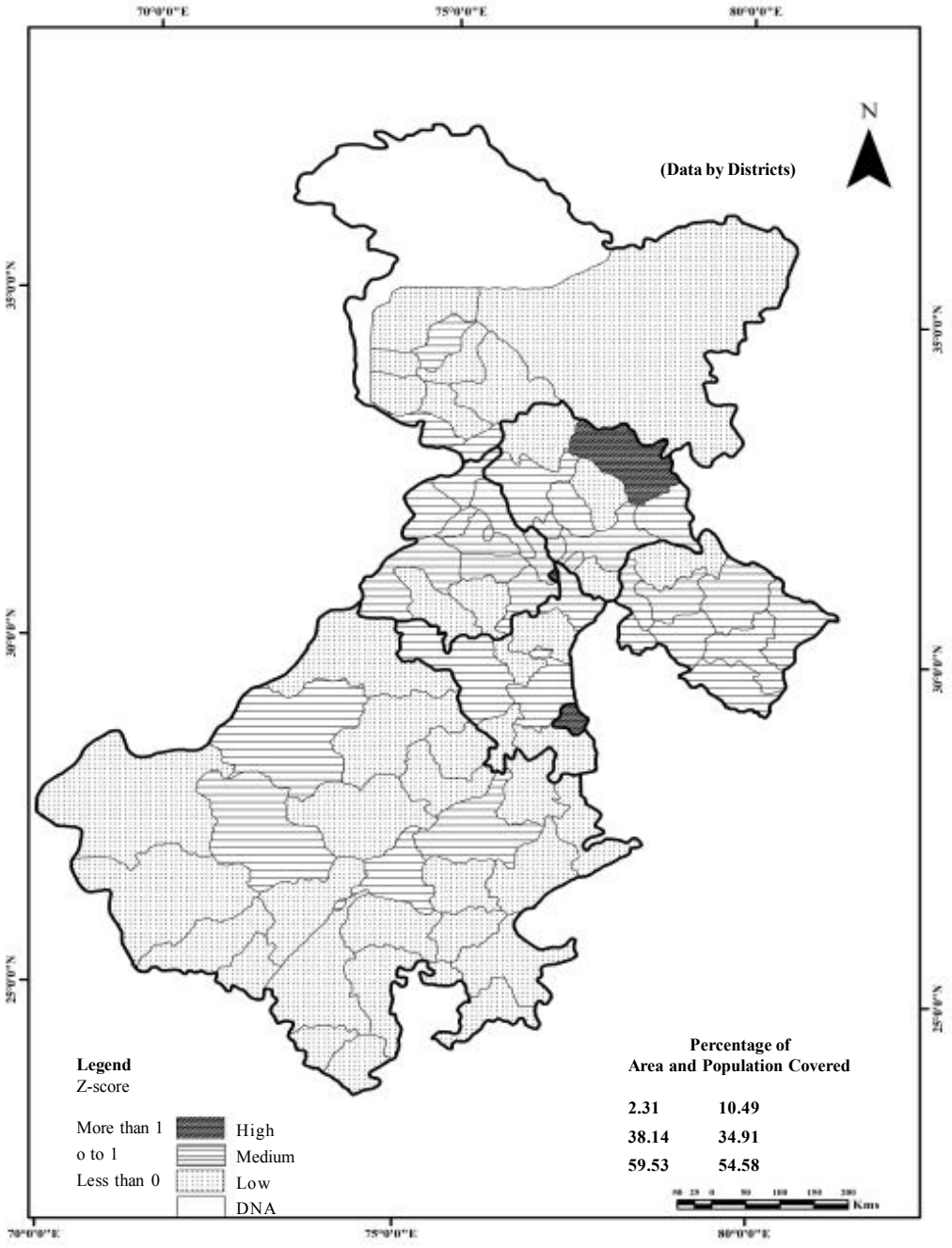

Fig. 3. Northwest India: Levels of Social Development 2011
Source: Prepared by Authors Based on Census of India Data

study reveals that the areas of moderate level of development were mainly concentrated in the central and northern parts of the study area.

Areas of low Development (<0.00)

The study reveals that almost entire state of Rajasthan (excluding Ajmer) and Jammu & Kashmir (excluding Ladakh and Jammu districts) registered low level of development. Some southern and central-eastern parts of Haryana along with Bathinda district of Punjab and Chamba district of Himachal Pradesh observed low level of development in 1971. The study reveals that the whole state of Rajasthan (excluding Jaipur and Ajmer) along with south-western stretch of Punjab in a contiguously observed low level of development. Some individual isolated districts distributed in Himachal Pradesh, Haryana and Uttrakhand registered low level of development in 1991. The share of the districts with low level of development was 51.31 percent in 1991 and reduced to about 48.68 percent in 2011. Figure 3 portrays that almost same geographical locations witnessed low level of development in 2011. Almost entire state of Rajasthan (excluding Ajmer, Sikar and Jhunjhunun), south-western part of Haryana and majority of the districts of Jammu & Kashmir (excluding Ladakh, Punch, Jammu and Kathua) witnessed low level of development. Karnal and Jind districts of Haryana, Chamba and Sirmour districts of Himachal Pradesh along with Hardwar district of Uttrakhand observed low level of development. Low performance in education sector (literacy rates) due to inadequate availability of schooling facility, lack of transportation and communication, economic backwardness and pre-dominance of primary activities and wide gender gap due to patriarchal society, favouritism against females, desire to have a male child, sex selective abortion could be some of the reasons leading to low level of social development in the study area. Apart from the above reasons less urbanisation, engagement of more males in agricultural activities, scattered distribution of population resulting into less population density and negligible industrial development also resulted into low development in the study area during the study period. During 1990, majority of the districts of Jammu & Kashmir witnessing low level of development have moved up to moderate category due to statistical fallacy, as mentioned earlier. In 2011, the districts of Jammu & Kashmir again observed low level of development. Both populations share and the share of districts in low category of developed districts has increased during 1991 and 2011. However, the number of districts witnessing low level of development has changed with time but the spatial location of the districts remained in same areas.

The present study corroborates the theory of Kuznets which finds that regional inequality increases during the early stage of development and decreases as the economy matures. Myrdal (1957), Williamson (1965), Friedman (1966) and Alonso (1980) further supported similar behaviour of regional disparities conceived by Kuznets. Minocha (1983) found that the process of growth in India was confined to a few enclaves which assisted in the process of exploitation of the hinterland. With the independence, the organization has undergone some changes but the organization continues to be based in the favour of metropolitan cities and large urban centres. Similarly, the metropolitan cities and urban centres and politically potent administrative headquarters such as New Delhi, Chandigarh, Shimla and Dehradun witnessed comparatively high level of social development in the study area. Other hinterland areas (including the majority of the districts of Jammu & Kashmir along with Rajasthan) witnessed comparatively low level of social development. These areas continue to be weak in every relationship between urban environs characterised as core and rural hinterland as peripheral milieux.

Regional Disparities in Social Development Variables (1971-2011)

Different regions of a country grow with different rates resulting in disparities in socio-economic life. Given the difference and diversity in physical and human environs among the states of Northwest India, the regional disparities in social development are bound to happen. The study reveals discernible spatial disparities in social development in the study area.

Table 1 represents that the co-efficient of variation in literacy rate was 39.48 percent in 1971. It has phenomenally decreased to 15.55

Table 1: Northwest India: Co-efficient of variation among social development variables

Census year	*Coefficient of variation (%)*							
	X1	*X2*	*X3*	*X4*	*X5*	*X6*	*X7*	*X8*
1971	39.48	30.59	75.54	88.21	9.26	95.95	86.02	83.45
1991	15.55	10.22	24.90	30.30	6.80	75.06	76.10	72.65
2011	14.03	9.74	21.12	47.79	7.40	71.85	66.30	83.19

Source: Computed by Authors based on census of India data
(X1: Literacy Rate, **X2**: Male Literacy Rate, **X3**: Female Literacy Rate, **X4:** Student-Teacher Ratio, **X5**: Sex Ratio, **X6**: Urban Population (percent), **X7**: Health Institutes/10000 persons, **X8:** Institutional Beds/10000 persons)

percent in 1991 and about 14 percent in 2011. The study reveals that the pace of decrease in disparities in literacy rate was higher between 1971 and 1991 than during the next two decades. The study reveals that in 1971, the co-efficient of variation in male literacy was 30.59 percent. It witnessed about three-fold decline between 1970s and 1990s. It declined further marginally to 9.74 percent in 2011. The study reveals that regional disparity in male literacy has witnessed more than three-fold decrease during the study period. The study brings out that the regional disparity in female literacy rate has also registered more than 3.5 times decrease in the study area. In 1971, the co-efficient of variation in female literacy rate was 75.54 percent. It has decreased to about 25 percent in 1991 and about 21 percent in 2011. The study reveals that pace of decline in disparities in the female literacy rate was much higher between 1971 and 1991 than 1991 and next 20 years. It happened due to focus of government towards gender parity and just issues during 1970s and 1980s and increasing awareness in the study area. The study reveals that in 1971, the co-efficient of variation in pupil-teacher ratio was 88.2 percent. It has decreased to about 30 percent in 1991. It further increased to about 48 percent in 2011. Initially, the regional disparities in pupil-teacher ratio registered decline but after 1990s experienced increase due to increasing enrolments and resulting overcrowding class rooms and paucity of primary teachers. The universalization of primary education without adequate provision of primary level teachers also increased the regional disparities in this context.

The sex ratio among northwest states of India has witnessed fluctuating trend during the study period. It is evident from the study that in 1971, the co-efficient of variation in sex ratio was 9.26 percent. It has decreased to 6.80 percent in 1991 and increased slightly to 7.40 percent in 2011. The study reveals that among all the social variables the magnitude of spatial disparities is the least and continues to be minimum in sex ratio. Table 1 reveals that the co-efficient of variation in urbanisation was about 96percent in 1971 and declined to about 75 percent in 1991 and about 72 percent in 2011. Thus, the study shows that during 1970s and 1980s there were notable disparities in urbanisation but declined with the passage of time. The pace of decline was more intense between 1971 and 1991 than 1991 and 2011. Table 1 reveals that regional disparities in availability of health institutions have decreased during the study period. The co-efficient of variation in availability of health institutes per size of population was about 86 percent in 1971 which declined to 66 percent in 2011. In 1971, the co-efficient of variation in availability of institutional beds per size of population was about 83 percent. It has decreased to about 72 percent in 1991 and further increased to about 83 percent during next two decades mainly due to excessive population growth and less availability of institutes in rural areas.

Trend of Disparities in Social Development (1971-2011)

The level of social development varies from area to area and society to society. Disparity in social development mainly follows the two trends either the increase or decrease over period of time. The change in disparities in the levels of social development depends upon many factors. The available social science literature indicates that India has witnessed regional disparities in social development. The study reveals that in

1971, the co-efficient of variation in social development was 63.6 percent among northwest Indian states. It decreased to 38.9 percent in 1991 and 40.2 percent in 2011 (Table 2). The study reveals that the disparities in the levels of social development have decreased between 1971 and 2011. The study shows that the pace of decrease in the disparities in social development was very high between 1971 and 1991. The disparities in social development in the study area remained almost confined to about 40 percent in 2011.

Table 2: Northwest India: Trends in co-efficient of variation in social development

Census year	*1971*	*1991*	*2011*
Co-efficient of variation (%)	63.6	38.9	40.2

Source: Computed by Authors based on census of India data

The decline in the co-efficient of variation showing the levels of development could be largely attributed to the progressive improvements in total, male and female literacy rates. Apart from the above variables, the significant improvement in urbanization and health sectors also helped in reducing the social disparities in the study area between 1971-2011.

Relationship Among Different Sectors (1971-2011)

Table 3 reveals that education sector including total, male and female literacy rates and pupil-teacher ratio is directly correlated with moderate to high degree of correlation with the social development in the study area. The urbanisation is also positively correlated with the social development with high to moderate degree of correlation. Sex ratio and social development registered negatively low degree of correlation in 1971. But, due to improved conditions, it has witnessed the positive signs and registered the positively low degree of correlation in 1991 and

Table 3: Northwest India: Co-efficient of correlation among social sectors (1971)

Variables	*X1*	*X2*	*X3*	*X4*	*X5*
X1	1				
X2	0.67	1			
X3	-0.24	-0.41	1		
X4	0.07	-0.04	-0.07	1	
X5	0.89	0.63	-0.08	0.44	1

Northwest India: Co-efficient of correlation among Social Sectors (1991)

Variables	*X1*	*X2*	*X3*	*X4*	*X5*
X1	1				
X2	0.35	1			
X3	0.009	-0.46	1		
X4	0.26	-0.15	-0.05	1	
X5	0.61	0.21	0.07	0.59	1

Northwest India: Co-efficient of correlation among Social Sectors (2011)

Variables	*X1*	*X2*	*X3*	*X4*	*X5*
X1	1				
X2	0.39	1			
X3	0.05	-0.29	1		
X4	-0.05	-0.26	-0.14	1	
X5	0.90	0.39	0.17	0.26	1

Source: Computed by Authors based on census data
(**X1:** Education, **X2:** Urbanisation, **X3:** Sex-Ratio, **X4**: Health, **X5**: Social Development)

2011. The health sector has observed positive relationship with low to moderate degree of correlation with social development varying during the study period.

CONCLUSION

The study reveals that the level of development in the northwestern region of the country differs from district to district and state to state. In 1971, the high level of development in Northwestern states of India was concentrated in few pockets. Delhi, Chandigarh and Ladakh (Jammu & Kashmir state) witnessed the high level of development. The extreme northern and southern parts of the study area were lagging behind. In 2011 also, almost the same pattern of development has been observed in Northwestern states of India. The centrally located and administratively prime centres, that is, Delhi and Chandigarh registered the high social development and bordering areas of Jammu & Kashmir and Rajasthan especially majority of the districts of Rajasthan are still lagging behind. These areas have registered the multi-sectoral social backwardness.

RECOMMENDATIONS

The Northwestern states of India have certainly undergone visible positive social transformations during the study period. But, rural and multi-sectorally backward districts of the study area have witnessed distinct spatial disparities in the levels of social development. Thus, the Governmental plans and programmes need to focus upon minimising the regional disparities in social development in the area. There is need of balanced regional planning and social development policy. Backward areas need to be strengthened and developed on priority basis.

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Infrastructural development in Churah Tehsil of Himachal Pradesh -a village level analysis

January 2020

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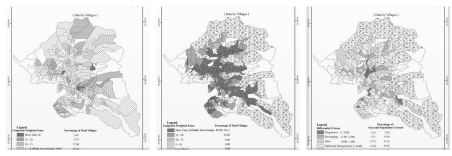

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Infrastructural development in Churah Tehsil of Himachal Pradesh - a village level analysis

Sanjeev Kumar and B. R. Thakur*, Shimla

Abstract

Churah is one of the economically and socially backward tehsils of Chamba district in Himachal Pradesh. The present study, based on secondary data pertaining to the 1991 and 2011 census, evaluates the progress in the levels of development in social and economic infrastructure in this tehsil using village-level data. Six sectoral indicators such as education, health, transport, communication, drinking water and electrification have been considered at the village level for the analysis. A composite index of these six sectors of infrastructure has been computed by assigning differential weightages to different facilities according to their relative importance and relevance in rural socio-economic development. The differential Z-score has also been used to show the pace of infrastructural development. The study reveals that there has been a considerable expansion in infrastructural facilities in different villages during the study period though intra-tehsil disparities have accentuated.

Keywords: *Infrastructure, Development, Spatial Variations, Churah Tehsil.*

Introduction

Chamba being one of the 115 backward districts as identified by the NITI Aayog, occupies a unique place in the history of Himachal Pradesh. Churah is one of the backward *tehsils* (sub-district) of this 'aspirational district' chosen for development. The aspirational district programme was launched by NITI Aayog in January 2018. It is an outcome-focused, data-driven framework aimed at bringing expeditious improvements in the socio-economic indicators of the most underdeveloped regions in the country. At present, there are 112 such pockets in the country. Continued inadequacy of basic infrastructure largely an outcome of the constraint posed by difficult terrain of this *tehsil* located in the Himalayan region, has kept this *tehsil* deprived both socially and economically.

The basic infrastructure required in rural areas is education, health, housing and drinking water to list a few which unfortunately are still poor in most villages (Srikanth and Kavuri, 2019:92-96) of India. Rural infrastructure plays a key role in reaching the benefits of development to the large masses of the rural poor. Poor rural infrastructure limits the ability of the traders to travel and communicate with remote farming areas, limiting market access from these areas and eliminating competition for their produce. Construction of rural roads inevitably leads to an increase in agricultural production and productivity by intensifying existing land use to take advantage of expanded market opportunities (Samanta, 2015:86-93). The access to public infrastructure could have a

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A. Coskun Samli

In Chap. 2, we made a distinction between infrastructure for industrialization of a country versus export-oriented infrastructure, and we discussed that many countries including India, China, and Japan emphasize export orientation. In Chap. 3, we indicated that regardless of what key orientation is taken, infrastructure development must be emphasized; it must be developed rapidly and effectively. ... [Show full abstract]

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Shintia Prissillia Nainggolan · Edy Yusuf Agung Gunanto · Nenik Woyanti · Banatul Hayati

This study aims to analyze the level of participation and willingness to pay the community in rural infrastructure development. This study uses descriptive quantitative analysis in analyzing the participation rate and the Contingent Valuation Method in analyzing the willingness to pay the community. The Data used are primary and secondary data. Primary Data sourced from questionnaire result 92 ... [Show full abstract]

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It is a well-known fact that there is an urgent need to re-energise India's rural economy, including both agricultural and the non-farm sector. A number of recent initiatives undertaken intend to augment the rural infrastructure level, which could contribute positively in this regard. Infrastructure development is also likely to contribute in improving the poverty scenario. Looking at the ... [Show full abstract]

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The Forgotten Power Behind the Scenes: Deteriorating Global Infrastructures

October 2011

A. Coskun Samli

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Sana Fatima · Md Abdus Salam

Rural areas in India constitute around 60 percent of the country. The backwardness of the rural areas has hindered the progress of the nation. The basic occupation of rural area is agriculture which is the highest sector to contribute to the overall GDP of the country.Since Independence, the Government has been focusing on the development of rural areas by introducing different programs and ... [Show full abstract]

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Progress of Higher Education in India, 1991-2011 (A State-Level Analysis)

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Abstract and Figures

The spatio-temporal analysis of the higher educational attainment in India during 1991-2011 has been made at the state level by picking up data/information from the Census of India and Government of India educational reports and documents. Simple percentages, gender differential and coefficient of correlation technique has been used to study the spatial pattern and changes therein. The study unfolds that though there has been an increase in the share of persons having higher educated attainments from 5.7 per cent in 1991 to 8.9 per cent in 2011, still India is at the infancy stage of higher educational attainments where only about one of each ten literates has attained the higher educational level. Moreover, there are wide variations in educational attainment at the regional level, attributed mainly to the varying determinants like availability of educational institutes, gross enrolment ratio, literacy rate, urbanisation and poverty. Rapid expansion in higher education and narrowing down gender inequalities in higher education attainment are some of the distinctive achievements of the post-reforms period.

Gender differentials in…

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Progress of Higher Education in India, 1991-2011
(A State-Level Analysis)

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Abstract: The spatio-temporal analysis of the higher educational attainment in India during 1991-2011 has been made at the state level by picking up data/information from the Census of India and Government of India educational reports and documents. Simple percentages, gender differential and co-efficient of correlation technique has been used to study the spatial pattern and changes therein. The study unfolds that though there has been an increase in the share of persons having higher educated attainments from 5.7 per cent in 1991 to 8.9 per cent in 2011, still India is at the infancy stage of higher educational attainments where only about one of each ten literates has attained the higher educational level. Moreover, there are wide variations in educational attainment at the regional level, attributed mainly to the varying determinants like availability of educational institutes, gross enrolment ratio, literacy rate, urbanisation and poverty. Rapid expansion in higher education and narrowing down gender inequalities in higher education attainment are some of the distinctive achievements of the post-reforms period.

Keywords: Higher education, attainments, determinants of education, India

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Introduction

Higher education, which has long been considered a key factor in economic, institutional, social development and technological progress (Lutz and Goujon, 2001:323), provides not just educated workers, but also knowledge workers to the growth of the economy (Tilak, 2003:152). While computing the human development index of any country, the UNDP has also accorded equal weightage to the education factor, speaking of the vital importance of literacy and education to the development of a nation. The higher education system is thus considered as a key pillar for the development of the national economy and achieving the frontiers of knowledge and innovation for human resource development (see Tilak, 2007; Altbach, 2009; Chattopadhyay, 2009; Jacob, 2018). For centuries, India has been home to higher education institutions and Nalanda university is believed to be one of the World's oldest universities created well before in Europe, America and other developed nations (Stolarick, 2014).

Several studies conducted earlier reveal that the inequality in access to higher education has increased substantially based on household's economic status, gender and residence (see Tilak 2007; 2018). Altbach et al. (2005) while analyzing the patterns of higher education development throughout the world concluded that universities in much of the third world simply cannot cope with the increased enrollments, budgetary constraints, and in some cases, fiscal

[1] Corresponding Author

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The present study aims at examining the progress in levels of educational attainment in India during 1991-2011. The study is entirely based on secondary data collected from Census of India and educational reports of Ministry of Human Resource Development. In order to examine the progress in educational attainment percentage method has been used. The study shows remarkable increase in the growth ... [Show full abstract]

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TRENDS AND PATTERN OF DEVELOPMENT OF EDUCATIONAL INSTITUTIONS IN ROHRU BLOCK OF SHIMLA DISTRICT, HIMACHAL PRADESH

Ajay Chanjta
D.D. Sharma

Abstract

Education plays an important role in the overall development of any region. It strengthens the other sectors by forming human capital and provides human resource to the society. It further shapes the cultural aspects and means and end of economic growth of any region. Development of educational facility is the threshold that can transform all the sectors of social and economic development. In the present study, an attempt has been made to identify the changing pattern and current status of development of educational institutions in Rohru block of Shimla district, Himachal Pradesh. The study reveals that the share of villages having primary school availability increased from 43.37 per cent to 69.82 per cent during the 1991-2019 period. Villages having the availability of middle and high school have also witnessed an increase from 13.25 and 6.63 per cent to 36.09 and 22.48 per cent, respectively. There has not been any senior secondary school at any village during 1991, but 24 new senior secondary schools have been opened during the study period. The study area has a noticeable regional disparity in the levels of development of educational institutions. However, decreasing trends of disparity in the levels of development of educational institutions have been witnessed during the study period.

Keywords: Education, Educational institutions, Development, Disparity, Composite index, Rohru.

Introduction

Education is the basic requirement for human beings. Education provides humans an ability to read and write, participate in economic growth, developing skills, creating an efficient workforce and provides basic skills to human capital for higher earning and better living (Mukherjee, 2004; Sharma and Sharma, 2017). Education is an indicator of the status of living, a path for the advancement of any nation, a gateway towards knowledge and a major contributor to the overall development of any nation (Ahmed, 2013; Wedam et al., 2015; Kumari et al., 2020). Out of eight Millennium Development Goals (MDGs) launched by United Nations in 2000, two have been directly focusing on educational development (Ngwaru and Oluga, 2015). Education is called to be an instrument for social change and it can bring equality and improve social mobility as well as interactions among different social groups of society (Sarkar and Kasemi, 2020). It acts as a tool for social transformation, poverty reduction and a base for social transformation (Rani and Jaglan, 2020). Education is an important avenue that

provides a wide range of opportunities for all-round development (Singh and Singh, 2005). Education is one of the greatest needs of our time as it brings improvement in the quality of life and plays a pivotal role in social reconstructions (Singh and Patidar, 2011). Some of the important indicators of educational development such as literacy rate, schools per 1000 population, single teacher school, drop-out rate, enrolment ratio and pupil teacher ratio have been studied and explained by Vijender and Kaushik (2015) at district level for Himachal Pradesh.

At the time of Independence, there have been only 20 universities and less than 500 colleges all over the country. After independence, in 1950, constitutional committee made provision of free and compulsory education up to the age of 14 which further converted to the right to education for 6-14 years of age by the constitutional amendment of 2002 (CREATE, 2009). This constitutional amendment has strengthened the education sector in India. Economic reforms of 1991 have boosted the private sectors to institutionalized education and improved the status of education sector in India (Kumari et al., 2020).

Many scholars have conducted studies on different areas of education over the world and in India. Ahuja and Filmer (1995) have analyzed the educational attainment in developing countries and projected the level of educational attainment by the year 2020. The study projected rising trends in the gender gap in education. Wedam et al. (2015) have critically examined the community participation in educational infrastructure development and management in Ghana. They have further observed that the local community has a considerable knowledge and understanding at the local level for the betterment and development of educational infrastructure. Mukherjee (2004) has examined the educational attainments in India with respect to trends, patterns and policy issues. She has observed that providing elementary education to all in India still remains an un-assailed frontier and there are still regional variations and disparity in the post-reform period in education with a moderate rate of success. Khan and Butool (2013) have analyzed the state-wise educational status of Muslims in India and concluded that the educational status of Muslims in India is not satisfactory and requires special attention. Sharma and Sharma (2017) have examined the trends and patterns of education in India and suggested a complete structural reform to improve the quality. Kumari et al. (2020) have analysed the spatial and temporal variations in educational attainments in India and observed increasing trends and patterns of educated persons at secondary and higher level of education. Bhunia et al. (2012) have tried to map the existing school infrastructure at primary and upper primary level in Paschim Medinipur district in West Bengal and observed that Sarva Shiksha Abhiyan has contributed significantly in improving the infrastructure up to the upper primary level. Before independence, Himachal Pradesh was also far behind in terms of educational infrastructure. But after independence from the first to sixth five-year plan, special emphasis has been given to develop educational infrastructure in the state (Lal, 2013). In terms of literacy, Himachal Pradesh has made a remarkable progress. Rana and Jyoti (2018) have found that in 1950, total literacy rate of Himachal Pradesh has been only 4.8 per cent which has increased to 83.78 percent in 2011. Similarly, Vijender and Kaushik (2015) have observed an increase in

the enrolment of the students between the age group of 6-14 and school dropout rate has also fallen considerably especially among the girls of SC/ST families in Himachal Pradesh.

Although, all these studies addressed different aspects of the educational infrastructure and educational policies, yet the issue of availability of educational institutions at village level remain untouched. This gap has necessitated to carry out a village-level study on the status of development of educational institutions in Himachal Pradesh. It is the institution that provides the base on which the structure of educational development can be erected. In this context, this study has been conducted to evaluate spatio-temporal variations in the availability of educational institutions and disparity in the level of development of educational institutions in the Community Development block Rohru of Himachal Pradesh.

Objectives

Major objectives of the study are:

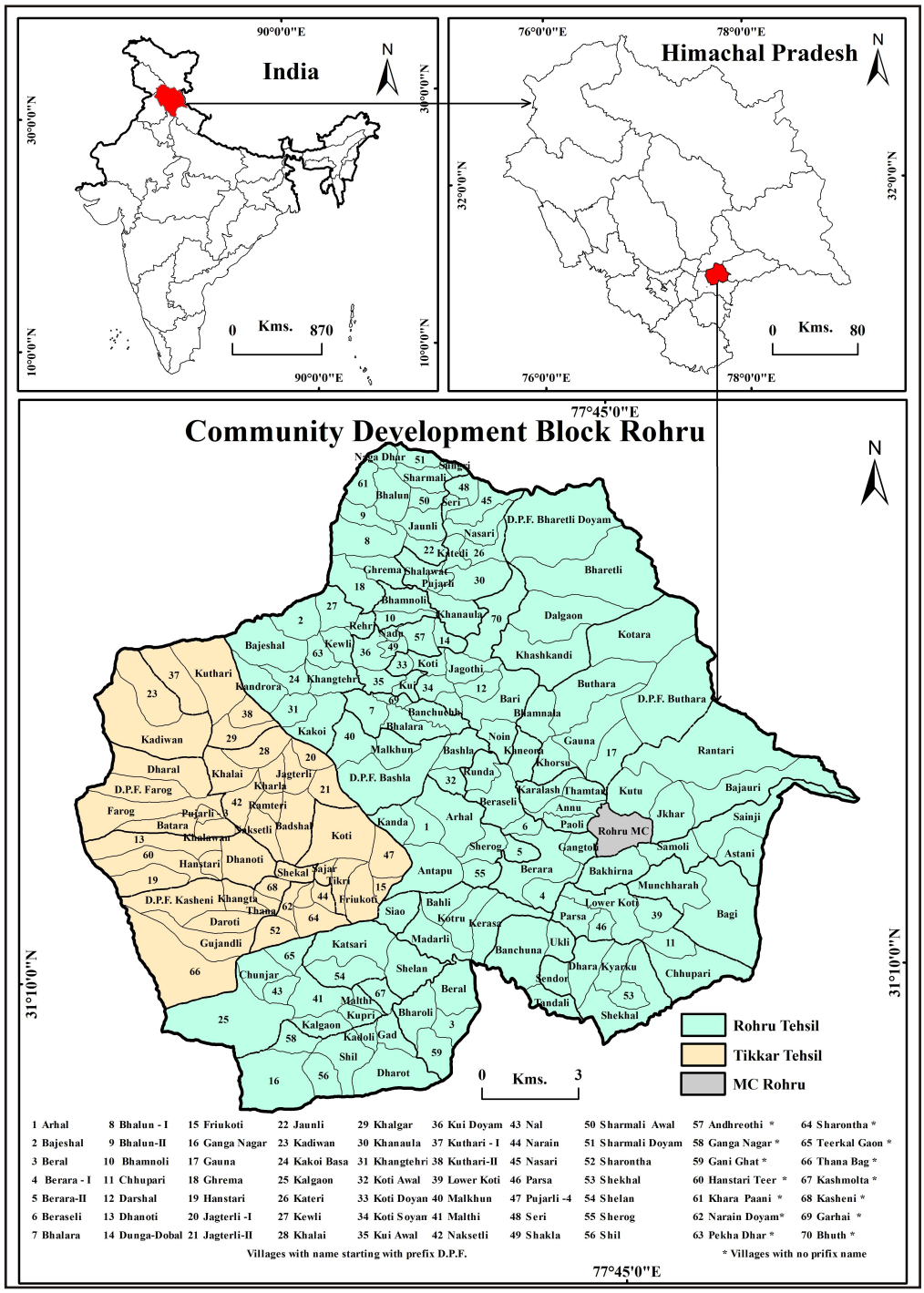
- to examine the current status and changing pattern of availability of educational institutions, and
- to evaluate the trends and pattern of disparity in the levels of development of educational institutions in Community Development Block Rohru of Himachal Pradesh.

Study Area

The study area constitutes Community Development (CD) Block Rohru of Shimla district. The block is situated in eastern part of the Shimla district of Himachal Pradesh. The block is located between latitudes of 31º 6' 39" to 31º 17' 32" north and longitudes of 77º 40' 15" to 77º 55' 35" east. The block spreads over an area of approximately 324 km^2 and falls in the lesser Himalayan region (Fig. 1). CD block Rohru covers the south-eastern part of Shimla district which is a water divide of two major river systems of India i.e., Ganga river system and the Indus river system. This area has a complex physiographic mosaic of hills, valleys and snow-clad peaks. The relief of this area ranges from a minimum of 1378 meters to a maximum of 3409 meters. This area is drained by Sai khad and Dogra khad which are tributaries of Pabbar river. Pabbar river rises from Chandra Nahan north of Rohru and joins Tons river near Tuini in Uttarakhand. The study area comprises of 188 villages out of which 170 have been inhabited with 12,480 households in 2011. The total population of the study area has been 56,421 persons in 2011, constituting 29,050 males and 27,371 females. The density and sex ratio of population in the study area have been 186 persons per km^2 and 942 females per thousand males, respectively in 2011. The literacy rate of the study area has been 76.75 per cent and there has been only 0.11 per cent of gender disparity in literacy. The economy of the study area is agro-based. The study area is dominated by apple cultivation and is one of the major apple producers in the state. More than 45 per cent of the study area is under cultivation in which 43 per cent area is under the cultivation of horticultural crops. In 2011, about 31 per cent of the total population has been of cultivators and agricultural labourers.

Database and Methodology

The study is based on secondary data collected from the Census of India for the decades of 1991, 2001 and 2011. Data have also been collected from the Directorate of Elementary and Higher Education, Shimla,


India
Himachal Pradesh
Community Development Block Rohru
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1 Arhal
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11 Chhupari
12 Darshal
13 Dhanoti
14 Dunga-Dobal
15 Friukoti
16 Ganga Nagar
17 Gauna
18 Ghrema
19 Hanstari
20 Jagterli -I
21 Jagterli-II
22 Jaunli
23 Kadiwan
24 Kakoi Basa
25 Kalgaon
26 Kateri
27 Kewli
28 Khalai
29 Khalgar
30 Khanaula
31 Khangtehri
32 Koti Awal
33 Koti Doyan
34 Koti Soyan
35 Kui Awal
36 Kui Doyam
37 Kuthari - I
38 Kuthari-II
39 Lower Koti
40 Malkhun
41 Malthi
42 Naksetli
43 Nal
44 Narain
45 Nasari
46 Parsa
47 Pujarli -4
48 Seri
49 Shakla
50 Sharmali Awal
51 Sharmali Doyam
52 Sharontha
53 Shekhal
54 Shelan
55 Sherog
56 Shil
57 Andhreothi *
58 Ganga Nagar *
59 Gani Ghat *
60 Hanstari Teer *
61 Khara Paani *
62 Narain Doyam*
63 Pekha Dhar *
64 Sharontha *
65 Teerkal Gaon *
66 Thana Bag *
67 Kashmolta *
68 Kasheni *
69 Garhai *
70 Bhuth *
Villages with name starting with prefix D.P.F.
* Villages with no prifix name

Fig. 1

Himachal Pradesh for the year of 2019. The census year 1991 has been taken as base year because the study intended to compare two decades prior to Right to Education (RTE; 1991, 2001) and almost two decades after RTE (2011 and 2019) since census 2021 is yet to be conducted. It provides almost 30 year long period to study the development of educational institutions in the study area. The village is the primary unit of study. To study the levels of development of educational institutions, the availability of primary school, middle school, high school, senior secondary school and college in a village has been given scores according to their hierarchy as 1 for primary school; 2 for middle school, 3 for high school, 4 for senior secondary school and 5 for college. The scores have been added together for the particular village to know the composite score. To evaluate the overall development of educational institutions in the study area statistical technique of z-score has been used. Village-wise raw data of each indicator have been computed into a standard score which may be expressed as:

$$Z_{ij} = \frac{X_{ij} - \bar{x}}{\sigma}$$

where, Z_{ij} is standard value of the indicator i in village j, x_{ij} is actual value of indicator i in village j, $\bar{x}$ is the mean value of indicator i in all villages and σ is standard deviation of indicator i in all villages. Population estimation for the year 2019 has been done by following the equation developed by Al-Eideh and Al-Omar, (2019), which is mathematically expressed as: $Nt = P \times e^{r \times t}$ where, Nt represents the number of people at a future time, P is the population at the beginning time, e is the base of the natural logarithms (2.71828), r is the rate of increase (natural increase divided by 100) and t represents the period involved.

Results and Discussions

Availability of Primary Schools

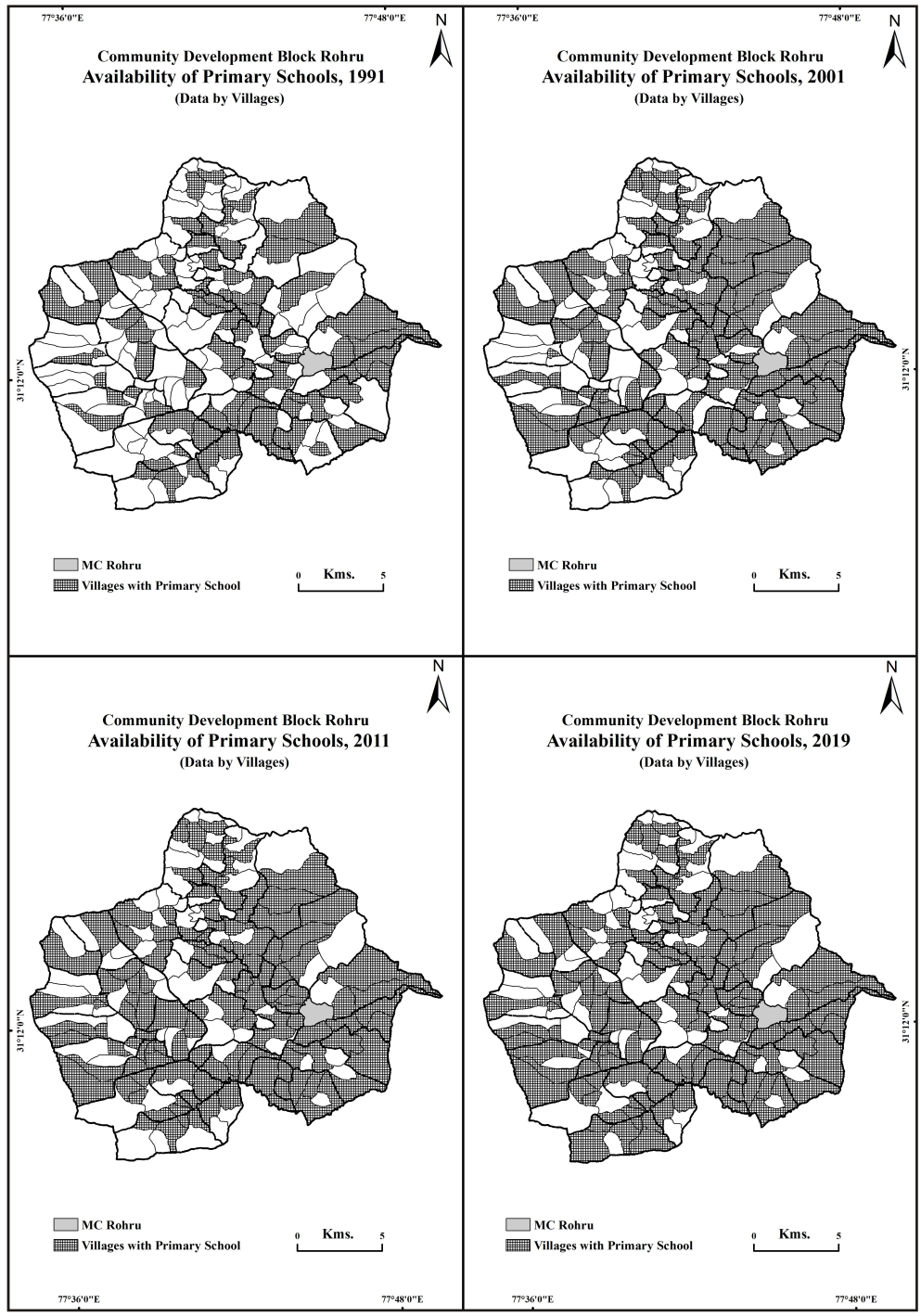
In Himachal Pradesh, a primary school can be opened if there is a walking distance of 1.5 km from the neighbourhood school and a minimum of 25 children in the age group of 6-11 years are available and willing to get enrolment in that school. Table 1 shows that except a minor decline in 2019, there has been a constant increase in the number of primary schools during the study period. In 1991, there have been 72 villages (43.37 per cent, of the total inhabited villages) having primary schools. The spatial distribution of villages having primary school reveals that in 1991, villages on the central, eastern and southern parts of the study area have a noticeable availability, while northern, western, north-western, south-western and south-eastern parts are having fewer villages with the availability of primary school facility (Fig. 2). In 1991, 96 inhabited villages have been lacking primary school facilities. Table 1 further shows that in 1991 the number of schools per 300 persons has been only 0.48. In 2001 the number of villages with primary school facility increased to 104 villages (62.65 per cent) with having a total of 118 primary schools. In 2001, 46 new primary schools have been added in 32 villages. These villages are distributed in the northern, north-eastern, eastern, central, southern, western and north-western parts. The study shows that the number of primary schools per 300 persons increased to 0.69 in 2001 from 0.48 in 1991.

In 2011, there have been 136 primary schools located in 115 villages. With respect to 2001, 11 new villages with 18 primary schools have been added in 2011. Out of these 11 villages, 5 villages (D.P.F. Kui Awal, Anu, Kerasa, Kalgaon and D.P.F. Nal) have been

Table 1
C.D. Block Rohru: Availability of Educational Institutions

Institutions	Villages having Facility Available											
	1991			2001			2011			2019		
	Villages	Number of Institutions	Primary Schools (per 300 Persons) Other Institutions (per 1000 Persons)	Villages	Number of Institutions	Primary Schools (per 300 Persons) Other Institutions (per 1000 Persons)	Villages	Number of Institutions	Primary Schools (per 300 Persons) Other Institutions (per 1000 Persons)	Villages	Number of Institutions	Primary Schools (per 300 Persons) Other Institutions (per 1000 Persons)
Primary Schools	72 (43.37)	72	0.48	104 (62.65)	118	0.69	115 (68.05)	136	0.72	118 (69.82)	133	0.61
Middle Schools	22 (13.25)	22	0.49	46 (27.72)	46	0.90	63 (37.27)	64	1.13	61 (36.09)	62	0.94
High Schools	11 (6.63)	11	0.24	26 (15.66)	26	0.51	34 (20.12)	34	0.60	38 (22.48)	38	0.58
Senior Secondary	0 (0.00)	0	0.00	15 (9.04)	15	0.29	27 (15.98)	27	0.48	24 (14.20)	24	0.37
Schools Colleges	1 (0.60)	1	0.02	1 (0.60)	1	0.02	1 (0.59)	1	0.02	2 (1.18)	2	0.03
Total Population	45,004			50,870			56,421			65,159 (Estimated Population)		

Source: Compiled by authors. The figure in parentheses shows the percentage of villages having the facility.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Availability of Primary Schools, 1991
(Data by Villages)
MC Rohru
Villages with Primary School
0 Kms. 5
Community Development Block Rohru
Availability of Primary Schools, 2001
(Data by Villages)
MC Rohru
Villages with Primary School
0 Kms. 5
Community Development Block Rohru
Availability of Primary Schools, 2011
(Data by Villages)
MC Rohru
Villages with Primary School
0 Kms. 5
Community Development Block Rohru
Availability of Primary Schools, 2019
(Data by Villages)
MC Rohru
Villages with Primary School
0 Kms. 5

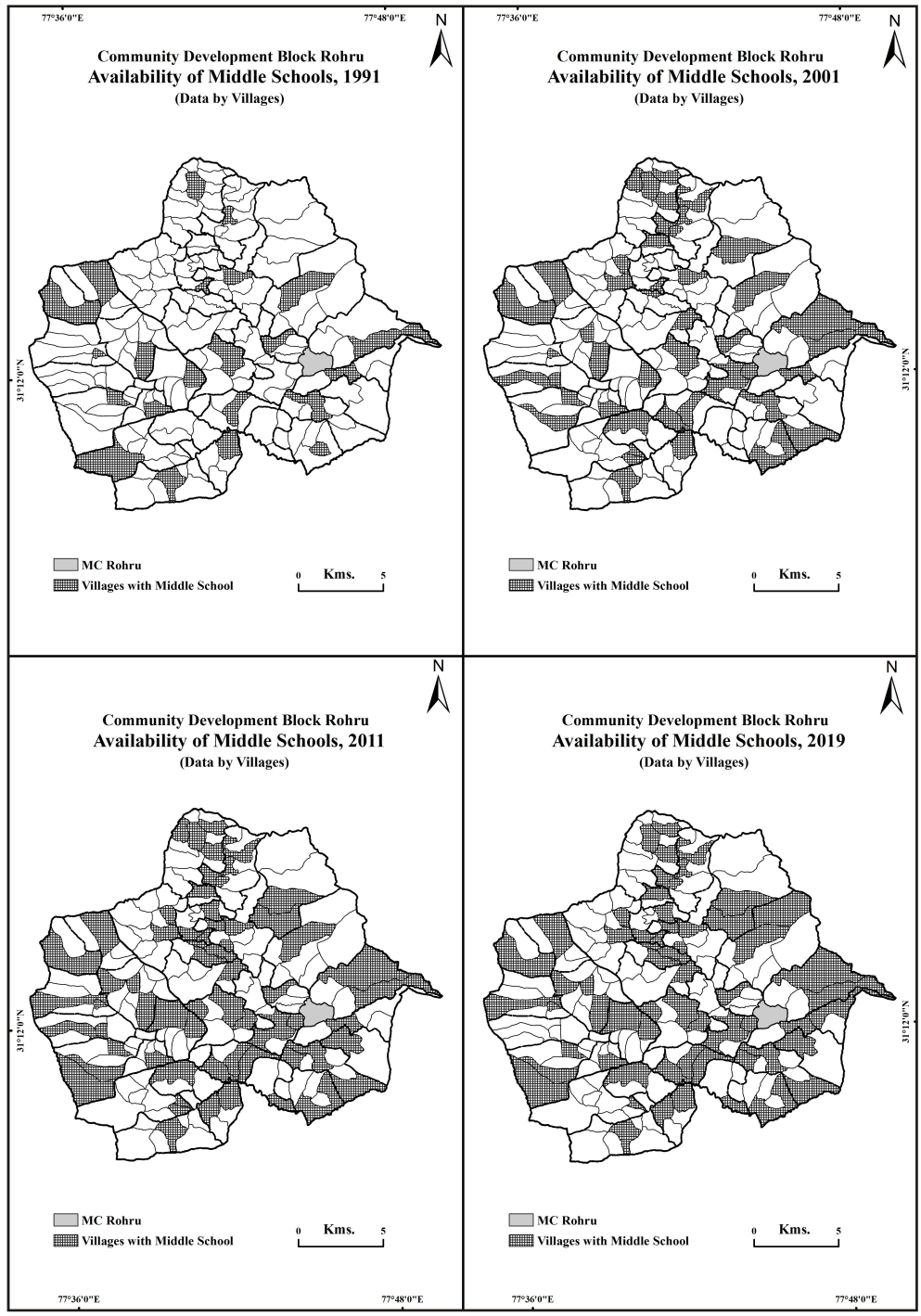
Fig. 2

from Rohru tehsil, while 6 villages (Farog, D.P.F. Hinstari, Naksetli, Koti, Shekal and D.P.F. Narain) have been from Tikkar tehsil (Fig. 2). Table 1 further shows that there have been 0.72 schools per 300 persons in 2011, suggesting a slight improvement for the year with respect to 2001. In 2019, there have been 133 primary schools in 118 villages (69.82 per cent of total inhabited villages), suggesting degradation of 3 schools with respect to 2011. These three schools are GPS Shardu, GPS Barla and GPS Galon located at Sainji and Banchuchh villages of Rohru tehsil and Naksatli village of Tikkar tehsil, respectively. These schools have been discontinued by the Directorate of Elementary Education due to decreasing strength of the students. The number of primary schools available per 300 persons also declined from 0.72 in 2011 to 0.61 in 2019. However, the study reveals that with the state government's initiatives regarding the expansion of primary school facilities in the block, the Right to Education Act, awareness of the public and improvement of education among the people have led to the expansion of primary schools, as the facility recorded about two times improvement during the study period. Although, there has been an increase in the number of primary schools, yet the facility is still far behind the state government norm i.e., a primary school per 300 persons and one school per 1.5 km of travel distance.

Availability of Middle Schools

According to the government norms of Himachal Pradesh, a middle school also known as upper-primary school can be opened if there is a walkable distance of 3 km from a neighbourhood school having not less than 25 children in class 5th and are willing for enrolment in that school. In 1991, there have been only 22 villages (13.25 per cent to total inhabited villages) having middle schools (Table 1). There has been a random distribution pattern of the villages having middle school facility in 1991 (Fig. 3). Out of these, there have been only 7 middle schools for 46 villages with 11, 450 population in Tikkar tehsil. While, in Rohru tehsil there have been only 15 middle schools for 141 villages having 33,554 population. Thus, middle school facility has been better in Tikkar tehsil with respect to Rohru tehsil. Table 1 further shows that in 1991, the number of middle schools per 1,000 persons has been only 0.49 in the study area. The number of villages having middle school increased to 46 (27.72 per cent) in 2001. Thus, an addition of 24 new middle schools has been witnessed in 2001. Out of these 24 villages, 21 villages (Bashla, Berara, Bhamnoli, Chhupari, Dalgaon, Gangtoli, Garhai, Jaunli, Katsari, Kewli, Khangtehri, Khara Paani, Kupri, Madarli, Malthi, Nasari, Pujarli, Rantari, Seri, Shalawat and Sharmali) have been from Rohru tehsil, while 3 villages (Hanstari, Hanstari Teer and Kharla) have been from Tikkar tehsil. These villages have been distributed randomly all over the study area (Fig. 3). The study shows that in 2001 the number of middle schools per 1000 persons increased to 0.90 with respect to 0.49 schools per 1000 persons in 1991.

In 2011, the number of villages with middle school facilities further increased to 63 (37.27 per cent) having 64 middle schools. In 2011, 18 new middle schools have been opened. Out of these 18 villages, 13 villages (Andhreothi, Banchuchh, Bhalara, Bharoli, D.P.F. Kui Awal, Kanda, Kerasa, Khashkandi, Koti, Munchharah, Parsa, Sherog and Tandali) fall in Rohru tehsil, while 5 villages (Farog, Khalai, Koti, Thana Bag and Kuthari) have been from Tikkar tehsil. These villages have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Community Development Block Rohru
Availability of Middle Schools, 1991
(Data by Villages)
MC Rohru
Villages with Middle School
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Community Development Block Rohru
Availability of Middle Schools, 2001
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Community Development Block Rohru
Availability of Middle Schools, 2011
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Villages with Middle School
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Community Development Block Rohru
Availability of Middle Schools, 2019
(Data by Villages)
MC Rohru
Villages with Middle School
0 Kms. 5

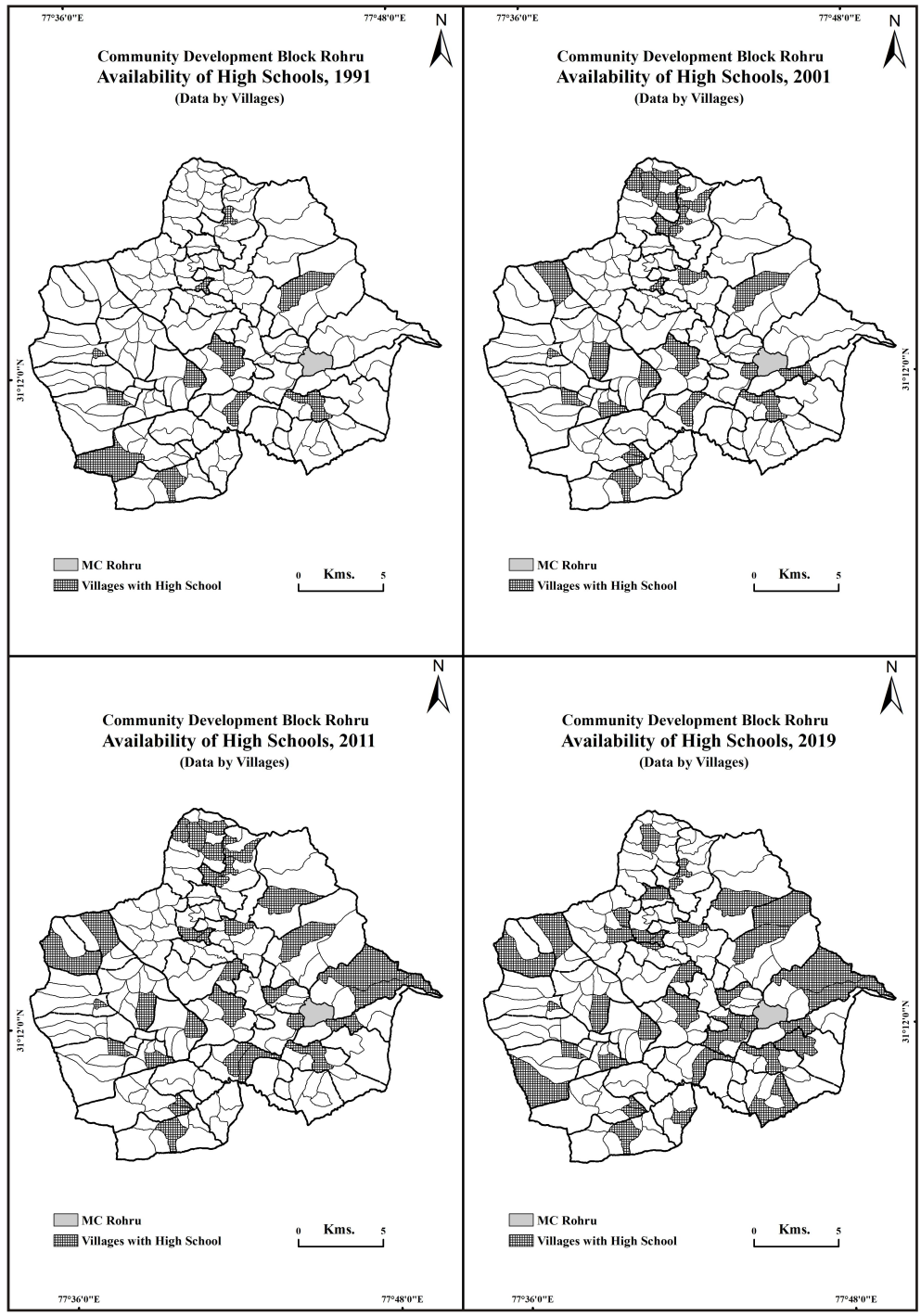
Fig. 3

been distributed in the central, western, southern and south-eastern parts. Table 1 further shows that middle school per 1000 persons increased to 1.13 in 2011 from 0.90 in 2001. However, in 2019, the number of villages with middle schools decreased to 61 (39.09 per cent) with a total of 62 middle schools, because two schools (Shekhal village of Rohru tehsil and Katlah village of Tikkar tehsil) have been degraded due to a drop in student enrolment. There have been 0.94 middle schools available per 1000 persons in 2019, suggesting a decline in school population ratio with respect to 2011 (Table 1). Thus, the middle schools in the study area increased from 22 to 62 in number during the study period of 1991-2019. However, the number is still not sufficient as per the government norms. Students from 93 villages still have to walk up to 5 km to reach a middle school. Students from 12 villages like Bari, Bhamnala, Chunjar, D.P.F. Beraseli, D.P.F. Hanstari, D.P.F. Malkhun, D.P.F. Sharmali Doyam, Kaneora, Kasheni, Kutu, Runda and Thana have to walk 6 to 10 km to reach a middle school and students from D.P.F. Bhalara village have to walk more than 10 km to avail the facility of middle school.

Availability of High Schools

A middle school can be upgraded to a high/secondary school if the enrolment of students in 8th class is at least 40 and it should be at a 3 km distance from the neighbourhood secondary school. The availability of high schools also has shown increasing trends with an increase in the population. Table 1 shows that there have been only 11 villages (6.63 per cent) in 1991 having high schools' facility. There have been only 4 high schools in Tikkar tehsil at D.P.F Kalgaon, Khangta, Pujarli-3 and D.P.F. Pujarli-4 villages. These schools have been serving 46 villages having 11,450 population. While, in Rohru tehsil there have been only 7 high schools at Arhal, Bhutara, Katedi, Kotru, Kui, Lower Koti and Shil villages serving 141 villages having 33,554 population. Table 1 further reveals that the number of high schools per 1,000 persons has been 0.24 in 1991. The number of villages with high school facility increased to 26 (15.66 per cent) in 2001. Thus, an addition of 15 new high schools has been witnessed in 2001. Out of these 15 villages, 12 villages like Bhalun, Jagothi, Jaunli, Khara Paani, Kupri, Malthi, Nasari, Pujarli, Samoli, Seri, Shalawat and Sharmali fall in Rohru tehsil, while 3 villages (Kuthari, Sharontha and Badshal) have been from Tikkar tehsil. These villages have been distributed in northern, central, south-western and western parts (Fig. 4). In 2001, there have been 0.51 high schools per 1,000 persons, which is an improvement of more than two times with respect to 1991.

With the addition of 8 new high schools in 2011, the number of villages with high school facility increased to 34 (20.12 per cent). Out of these 8, 7 villages like Bajauri, Bashla, D.P.F. Kui Awal, Dalgaon, Karalash, Kerasa and Rantari) are from Rohru tehsil, while only one village (Kadiwan) falls in Tikkar tehsil. These villages have been distributed in the central, western, and eastern parts of the study area. Table 1 further shows that the number of high schools per 1,000 persons increased to 0.60 in 2011 from 0.51 in 2001. In 2019 with the addition of 4 new schools the number of villages with high school facility increased to 38 (22.48 per cent). The new high schools have been opened in Kotara, Munchhara, Khangtheri and Shekhal villages. There have been 0.58 high schools available per 1000 persons in 2019, recording a slight decline with


77°36'0"E
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N
Community Development Block Rohru
Availability of High Schools, 1991
(Data by Villages)
MC Rohru
Villages with High School
0 Kms. 5
Community Development Block Rohru
Availability of High Schools, 2001
(Data by Villages)
MC Rohru
Villages with High School
0 Kms. 5
Community Development Block Rohru
Availability of High Schools, 2011
(Data by Villages)
MC Rohru
Villages with High School
0 Kms. 5
Community Development Block Rohru
Availability of High Schools, 2019
(Data by Villages)
MC Rohru
Villages with High School
0 Kms. 5

Fig. 4

respect to 2011. Although, the number of high schools increased from 11 in 1991 to 38 in number in 2019, recording more than 3 times improvement, yet the number is still not as per the government norms. Students from 40 per cent of villages have to walk up to 5 km to reach the school. Students from 28 per cent of villages have to walk 6 to 10 km to reach a high school and students from 9 per cent of the villages have to walk more than 10 km to avail the facility of high school, while as per government norms the facility should be available within the distance of 3 km from the neighbourhood.

Availability of Senior Secondary Schools

A senior secondary school can be opened if there is a walkable distance of 5 km from the neighbourhood and a minimum of 60 children in the 10th class. It is evident from the study that there has been no senior secondary school in any village till 1991. During the 1991-2001 period, 15 senior secondary schools have been opened in 15 villages (9.04 per cent of total inhabited villages). Out of these, 2 senior secondary schools have been at Khangta and D.P.F. Pujarli 4 villages of Tikkar tehsil serving 46 villages having 12,501 population. While, in Rohru tehsil there have been only 13 senior secondary schools at Arhal, Bashla, Bhalun, Gangtoli, Jaunli, Khara Paani, Kui, Malthi, Nasari, Pujarli, Seri, Shalawat and Sharmali serving 141 villages having 38,369 population. These schools have been distributed in the northern, central and western parts (Fig 5). Table 1 further shows that in 2001 the number of senior secondary schools per 1,000 persons has been 0.29.

With addition of 12 new schools, the number of villages having senior secondary school increased to 27 (15.98 per cent) in 2011. Out of these 12 villages, 9 villages of D.P.F. Kui Awal, Dalgaon, Karalash, Katedi, Kerasa, Kotru, Lower Koti, Rantari and Samoli have been from Rohru tehsil, while 3 villages of Kuthari, Pujarli-3 and Badshal have been from Tikkar tehsil. These villages have been distributed in the northern, central, eastern western and north-western parts (Fig. 5). In total there have been 4 senior secondary schools for 46 villages having 13,970 population in Tikkar tehsil and 23 senior secondary schools for 141 villages having 42,451 population in Rohru tehsil. The institutional population ratio has increased from 0.29 in 2001 to 0.48 in 2011. However, it must be mentioned that Census of India has shown the availability of senior secondary schools in nine villages of Bashla, Jaunli, Khara Paani, Kotru, Nasari, Pujarli, Seri, Shalawat and Sharmali in 2001 as well as in 2011 but the data received from Directorate of Elementary and Higher Education and field check revealed that there have been no such schools in these villages. Thus, actually there have been 6 and 18 senior secondary schools in the block in 2001 and 2011.

With the addition of 6 new schools, there have been 24 (14.20 per cent) senior secondary school in 2019. There have been 0.37 senior secondary schools available per 1000 persons in 2019 as compared to 0.48 schools available per 1000 persons in 2011, suggesting a decline in school population ratio (Table 1). These schools are distributed in northern, central, eastern, southern, western and north-western parts (Fig. 5). Thus, the senior secondary schools in the study area increased from 0 in 1991 to 24 in 2019. However, the number is still not sufficient as per the government norms. Students from 73 villages still have to walk up to 5 km to reach a senior secondary school. Similarly, the

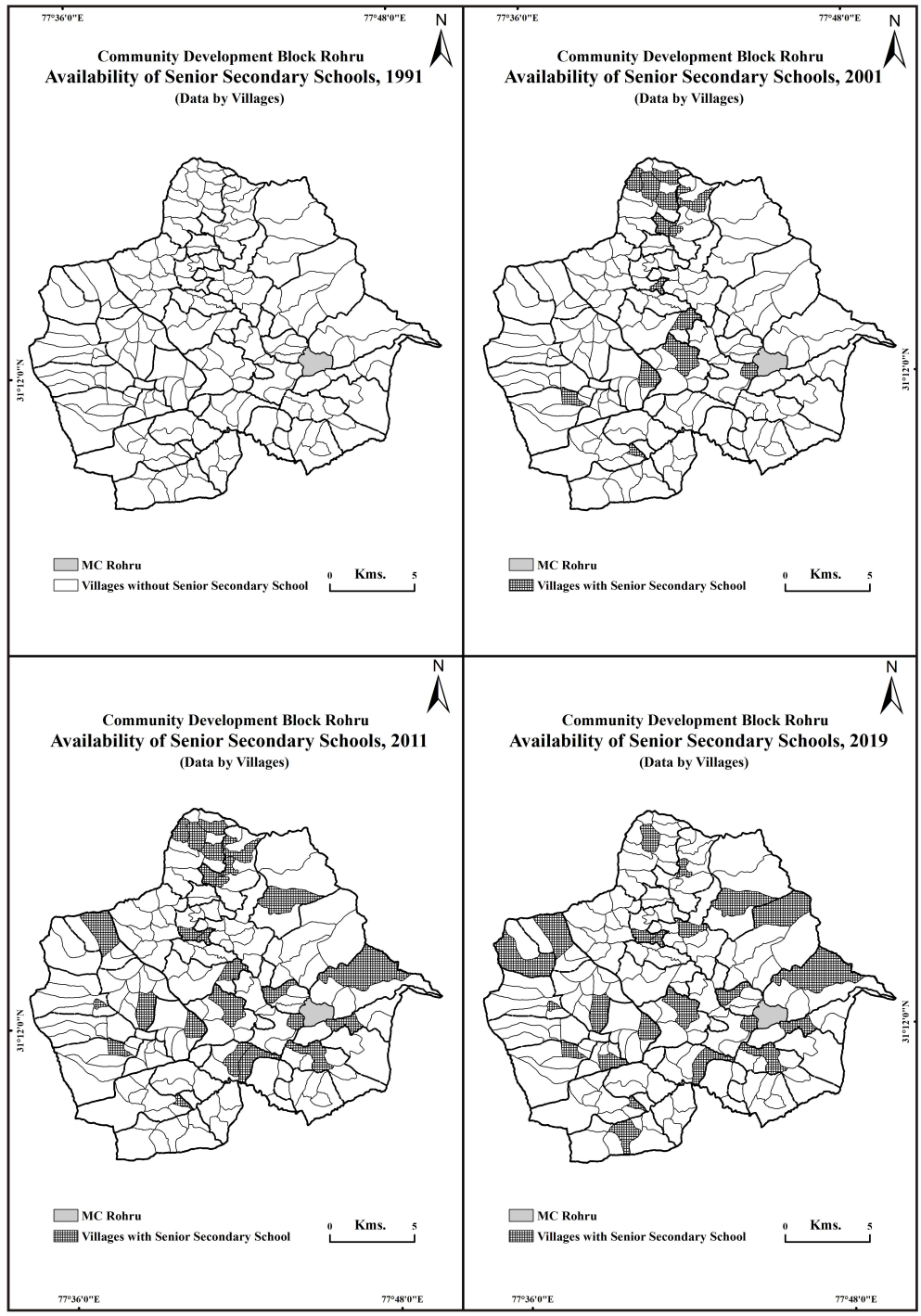
77°36'0"E
77°48'0"E
N
Community Development Block Rohru
Availability of Senior Secondary Schools, 1991
(Data by Villages)
29°12'0"N
MC Rohru
Villages without Senior Secondary School
0 Kms. 5
Community Development Block Rohru
Availability of Senior Secondary Schools, 2001
(Data by Villages)
Villages with Senior Secondary School
Community Development Block Rohru
Availability of Senior Secondary Schools, 2011
(Data by Villages)
Community Development Block Rohru
Availability of Senior Secondary Schools, 2019
(Data by Villages)

Fig. 5

students from 52 villages have to walk 6 to 10 km to reach a senior secondary school and students from 17 villages have to walk more than 10 km to avail the facility of a senior secondary school.

Availability of Colleges

A degree college can be opened if there is a walkable distance of 25 km from the neighbourhood college. The study shows that there has been only one college in the study area during 1991-2011, located at Seema village. However, a new college at village Khangta (Tikkar) has been opened in 2016 improving the accessibility for higher education.

Disparities in Levels of Development of Educational Institutions (1991-2019)

To highlight the regional variations in disparities in the levels of development of educational institutions, z scores have been calculated and the results have been discussed as under.

Areas with High Level of Development

The villages recording composite z score values of more than 1.50 fall in this category. In 1991, 12 villages comprising 7.23 per cent of total inhabited villages witnessed high level of educational institutional facility (Table 2; Fig. 6). In 2001, the number of villages falling in this category increased to sixteen. Only 5 villages (Arhal, Bajauri and Kui from Rohru tehsil and D.P.F. Pujarli-4 and Khangta from Tikkar tehsil) could maintain their position from 1991 to 2001 period. 11 new villages entered to this category in 2001. The addition of new primary, middle, high and senior secondary schools in Gangtoli, Junli, Pujarli, Seri and Khara Paani villages and addition of the middle school, high school and senior secondary schools in Malthi, Nasari, Shalwat and Sharmail villages has shifted these villages to the high level of educational facility in 2001. Similarly, the addition of middle and high schools in Bhalun village and addition of middle and senior secondary schools in Bashla village has led to the improvement in their development of educational institutions. Seven villages (D.P.F. Kalgaon and Pujarli-3 from Tikkar tehsil and Buthara, Katedi, Kotru, Lower Koti, and Shil from Rohru tehsil) recorded no expansion of educational facilities in 2001 as compared to other villages in 1991, therefore due to this factor these villages could not retain their position and shifted to the lower levels of educational facility.

In 2011, the number of such villages increased to 28 (Table 2). All the sixteen villages from 2001 maintained their position in this category in 2011. Twelve new villages (Pujarli-3, Kuthari and Badshal from Tikkar tehsil and Katedi, D.P.F. Kui Awal, Dalgaon, Karalash, Kerasa, Rantari, Lower Koti, Kotur and Samoli from Rohru tehsil) entered to category in 2011. The addition of new primary, middle, high and senior secondary schools in D.P.F. Kui Awal and Kerasa villages and the addition of either middle, high school and senior secondary schools at Bashla, Rantari, Badshal, Katedi, Kotru, Karalash, Pujarli-3, Dalgaon, Lower Koti and Samoli villages has led to the improvement in their composite z scores for joining this category in 2011. However, in 2019, only twenty-four villages witnessed a high level of development of educational institutions. Nineteen villages could maintain their position of 2011 in 2019 (Table 2). While, Jagothi, Kotara, Shil, Kadiwan and Sharontha villages joined this category with improvement in the composite score with the addition of middle, high and

Table 2
Rohru CD Block:Decade-wise Villages Falling under Various Levels of Development in Educational Institutions

Levels	Rohru Tehsil	Tikkar Tehsil	No.
	1991		
High	Arhal, Bajauri, Buthara, D.P.F.Pujarli-4, Katedi, Kotru, Kui, Lower Koti, Shil	D.P.F. Kalgaon, D.P.F. Pujarli-4, Khangta	12
Moderate	Beral, Bhalun, D.P.F.Shekhal, Jagothi, Karalash, Samoli	Badshal, Kadiwan, Kuthari, Sharontha	10
Low	Andhreothi, Astani, Bashla, Bajeshal, Banchuchh, Banchuna, Bari, Berara, Bhalara, Bhamnoli, Bharetli, Bharoli, Chhupari, Dalgaon, Dhara, Gad, Ganga nagar, Garhai, Ghrema, Jkhar, Kalgaon, Kaneora, Katsari, Kewli, Khanaula, Khangtehri, Kerasa, Madarli, Noin, Munchharah, Paoli, Parsa, Runda, Sainji (Majhgaon), Sendor, Shelan, Sherog, Nasari, Malthi, Tandali, Rantari, Shalawat, Sharmali	Batara, D.P.F.Khalai, Gujandli, Hanstari, Jagterli, Kashiani, Kharla	50
No Institution	Annu, Antapu, Bagi, Bahli, Bakhirna, D.P.F.Arhal, Beraseli, D.P.F.Kuiawal, Bhamnala, Bhuth, Chunjar, D.P.F.Bajeshal, D.P.F.Bashla, D.P.F.Beral, D.P.F.Berara – I, D.P.F.Berara-II, D.P.F.Beraseli, D.P.F.Bhalara, D.P.F.Bhalun – I, D.P.F.Bhalun-II, D.P.F.Bhamnoli, D.P.F.Bharetli Doyam, D.P.F.Darshal, D.P.F.Ganganagar, D.P.F.Gauna, D.P.F.Kadiwan, D.P.F.Khangtehri, D.P.F.Koti , Awal, D.P.F.Koti Soyam, D.P.F.Malkhun, D.P.F.Sharonta, D.P.F.Nagselti, D.P.F.Seri, D.P.F.Sharmali Awal, D.P.F.Sharmali Doyam, D.P.F.Shelan, D.P.F.Sherog, D.P.F.Shil, Dharot, Gani Ghat, Kutu, Nadu, Naga Dhar, Pekha Dhar, Gangtoli, Sungri, Jaunli, Gauna, Kadoli, Kakoi, Kanda, Kandrora, Kashmolta, Kupri, Khashkandi, Khorsu, Koti, Kotara, Kyarku, KharaPaani, Malkhun, Shekhal, Siao, Pujarli, Teerkal Gaon, Thamtari, Ukli, Seri	D.P.F.Jaunli, D.P.F.Kewli, D.P.F.Kui Doyam, D.P.F.Malthi, D.P.F.Shakla, Daroti, D.P.F.Jagterli-II, D.P.F.Hanstari, D.P.F.Nal, Dhanoti, Farog, Friukaroti, Dharal, Khalawan, Hanstari Teer, Sajar, Khalai, Koti, Nagsetli, Thana, Narain Awal, Narein Doyam, Ramteri, Tikri ,Shekal, Thana Bag	94
	2001		
High	Arhal, Bajauri, Bashla, Bhalun, Gangtoli, Jaunli, Khara Paani, Kui, Malthi, Nasari, Pujarli, Seri, Shalawat, Sharmali	D.P.F. Pujarli-4, Khangta	16
Moderate	Buthara, Jagothi, Katedi, Kotru, Kupri, Lower Koti, Samoli, Shil	Badshal, Kuthari, Pujarli- 3, Sharontha	12
Low	Andhreothi, Astani, Bagi, Bajeshal, Bakhirna, Banchuchh, Banchuna, Bari, Beral, Berara, Beraseli, Bhalara, Bhamnala, Bhamnoli, Bharetli, Bharoli, Bhuth, Chhupari, Chunjar, D.P.F.Sharonta, Dalgaon, Dhara, Gad, Ganga nagar, Garhai, Gauna, Ghrema, Jkhar, Kadoli, Kakoi, Kanda, Kandrora, Kaneora, Karalash, Kashmolta, Katsari, Kewli, Khanaula, Khangtehri, Khashkandi, Khorsu, Kotara, Koti, Kyarku, Madarli, Malkhun, Munchharah, Noin, Paoli, Parsa, Rantari, Runda, Sainji (Majhgaon), Sendor, Shekhal, Shelan, Sherog, Siao, Tandali, Teerkal Gaon, Thamtari, Ukli	D.P.F.Khalai, Friukaroti, Gujandli, Hanstari, Hanstari Teer, Jagterli, Kadiwan, Kashiani, Khalai, Kharla, Narain Awal, Narein Doyam, Ramteri, Thana Bag	76
No Institution	Annu, Antapu, Bahli, D.P.F.Arhal, D.P.F.Bajeshal, D.P.F.Bashla, D.P.F.Beral, D.P.F.Bhalara, D.P.F.Bhalun-II, D.P.F.Bhamnoli, D.P.F.Darshal, D.P.F.Dunga Dobal, D.P.F.Ganganagar, D.P.F.Ghrema, D.P.F.Kakoi Basa, D.P.F.Kashiani, D.P.F.Khanaula, D.P.F.Khangtehri, D.P.F. Koti Awal, D.P.F.Koti Dom, D.P.F.Koti Soyam, D.P.F.Kuiawal, D.P.F.Malkhun, D.P.F.Nagselti, D.P.F.Narain, D.P.F.Sharmali Awal, D.P.F.Shelan, D.P.F.Shil, Dharot, Gani Ghat, Kalgaon, Kerasa, Kutu, Nadu, Naga Dhar, Pekha Dhar, Rehri, Sungri	Batara, D.P.F.Dhenoti, D.P.F.Friukoti, D.P.F.Hanstari, D.P.F.Jagterli–I, D.P.F.Jagterli-II, D.P.F.Jaunli, D.P.F.Kalgaon, D.P.F.Kewli, D.P.F.Kuidoyam, D.P.F.Malthi, D.P.F.Nal, D.P.F.Shakla, Daroti, Dhanoti, Dharal, Farog, Khalawan, Koti, Nagsetli, Sajar, Shekal, Thana, Tikri	62
	2011		
High	Arhal, Bajauri, Bashla, Bhalun, D.P.F.Kuiawal, Dalgaon, Gangtoli, Jaunli, Karalash, Katedi, Kerasa, KharaPaani, Kotru, Kui, Lower Koti, Malthi, Nasari, Pujarli, Rantari, Samoli, Seri, Shalawat, Sharmali	Badshal. Khangta. Kuthari. Pujarli-3. D.P.F. Pujarli-4	28
Moderate	Buthara, Jagothi, Kupri, Shil	Kadiwan, Sharontha	06
Low	Andhreothi, Annu, Astani, Bagi, Bajeshal, Bakhirna, Banchuchh, Banchuna, Bari, Beral, Berara, Beraseli, Bhalara, Bhamnala, Bhamnoli, Bharetli, Bharoli, Bhuth, Chhupari, Chunjar, D.P.F.Narain, D.P.F.Sharonta, Dhara, Gad, Ganganagar, Garhai, Gauna, Ghrema, Jkhar, Kadoli, Kakoi, Kalgaon, Kanda, Kandrora, Kaneora, Kashmolta, Katsari, Kewli, Khanaula, Khangtehri, Khashkandi, Khorsu, Kotara, Koti, Kyarku, Madarli, Malkhun, Munchharah, Noin, Paoli, Parsa, Runda, Sainji (Majhgaon), Sendor, Shekhal, Shelan, Sherog, Siao, Tandali, Teerkal Gaon, Thamtari, Ukli	D.P.F.Hanstari, D.P.F.Khalai, D.P.F.Nal, Farog, Friukaroti, Gujandli, Hanstari, Hanstari Teer, Jagterli, Kashiani, Khalai, Kharla, Koti, Nagsetli, Narain Awal, Narein Doyam, Ramteri, Shekal, Thana Bag	81
No Institution	Antapu, Bahli, D.P.F.Arhal, D.P.F.Bajeshal, D.P.F.Bashla, D.P.F.Beral, D.P.F.Berara–I, D.P.F.Beraseli, D.P.F.Bhalara, D.P.F.Bhalun–I, D.P.F.Bhalun-II, D.P.F.Bhamnoli, D.P.F.Darshal, D.P.F.Dunga Dobal, D.P.F.Ganganagar, D.P.F.Ghrema, D.P.F.Kakoi Basa, D.P.F.Kashiani, D.P.F.Kateri, D.P.F.Khanaula, D.P.F.Khangtehri, D.P.F.Koti Awal, D.P.F.Koti Soyam, D.P.F.Malkhun, D.P.F.Nagselti, D.P.F.Sharmali Awal, D.P.F.Sharmali Doyam, D.P.F.Shelan, D.P.F.Shil, Dharot, Gani Ghat, Kutu ,Nadu, Naga Dhar, Pekha Dhar, Rehri, Sungri	Batara, D.P.F.Dhenoti, D.P.F.Friukoti, D.P.F.Jagterli–I, D.P.F.Jagterli-II, D.P.F.Jaunli, D.P.F.Kalgaon, D.P.F.Kuidoyam, D.P.F.Malthi, D.P.F.Shakla, Daroti, Dhanoti, Dharal, Khalawan, Sajar, Thana, Tikri	54
	2019		
High	Arhal, Bajauri, Bhalun, D.P.F.Kuiawal, Dalgaon, Gangtoli, Karalash, Jagothi, Katedi, Kotara, Kerasa, Kui, Lower Koti, Malthi, Shil, Rantari, Samoli	Badshal, Khangta, Kuthari, Pujarli-3, Kadiwan, Sharontha, D.P.F.Pujarli-4	24
Moderate	Bashla, Berara, Bhamnoli, Buthara, Garhai, Kewli, Khangtehri, Munchharah, Shekhal, Pujarli	Thana Bag	11
Low	Andhreothi, Annu, Astani, Bagi, Bajeshal, Bakhirna, Banchuchh, Banchuna, Bari, Beral, Beraseli, Bhalara, Bhamnala, Bharetli, Bharoli, Bhuth, Chhupari, Chunjar, D.P.F.Beral, D.P.F.Ganganagar, D.P.F.Kashiani, D.P.F.Narain, D.P.F.Sharonta, Dharot, Dhara, Gad, Ganga nagar ,Jaunli, Gauna, Ghrema, Jkhar, Kadoli, Kakoi, Kalgaon, Kanda, Kandrora, Kaneora, Kashmolta, Katsari, Kupri, Khanaula, Khashkandi, Khorsu, Koti, Kyarku, Madarli, Khara Paani, Malkhun, Kotru, Noin, Paoli, Parsa, Runda, Sainji (Majhgaon), Sendor, Shelan, Sherog, Nasari, Siao, Tandali, Teerkal Gaon, Thamtari, Ukli, Seri, Shalawat, Sharmali	D.P.F.Jagterli-II, D.P.F.Hanstari, D.P.F.Khalai, D.P.F.Nal, Farog, Friukaroti, Gujandli, Hanstari, Hanstari Teer, Jagterli, Kashiani, Khalai, Kharla, Koti, Narain Awal, Narein Doyam, Ramteri, Shekal	84
No Institution	Antapu, Bahli, D.P.F.Arhal, D.P.F.Bajeshal, D.P.F.Bashla, D.P.F.Berara–I, P.F.Bhalun–I, D.P.F.Bhalun-II, D.P.F.Bhamnoli, Doyam, D.P.F.Buthara, D.P.F.Darshal, D.P.F.Dunga Dobal, D.P.F.Ghrema, D.P.F.Kakoi Basa, D.P.F.Kateri, D.P.F.Khanaula, D.P.F.Khangtehri, D.P.F.Koti Awal, D.P.F.Koti Soyam, D.P.F.Malkhun, D.P.F.Nagselti, D.P.F.Sharmali Awal, D.P.F.Sharmali Doyam, D.P.F.Shelanv, D.P.F.Shil, Gani Ghat, Kutu, Nadu, Naga Dhar, Pekha Dhar, Rehri, Sungri	Batara, D.P.F.Dhenoti, D.P.F.Friukoti, D.P.F.Jagterli–I, D.P.F.Jaunli, D.P.F.Kalgaon, D.P.F.Kuidoyam, D.P.F.Malthi, D.P.F.Shakla, Daroti, Dhanoti, Dharal, Khalawan, Sajar, Nagsetli, Thana, Tikri	50

Source: Compiled by Authors.

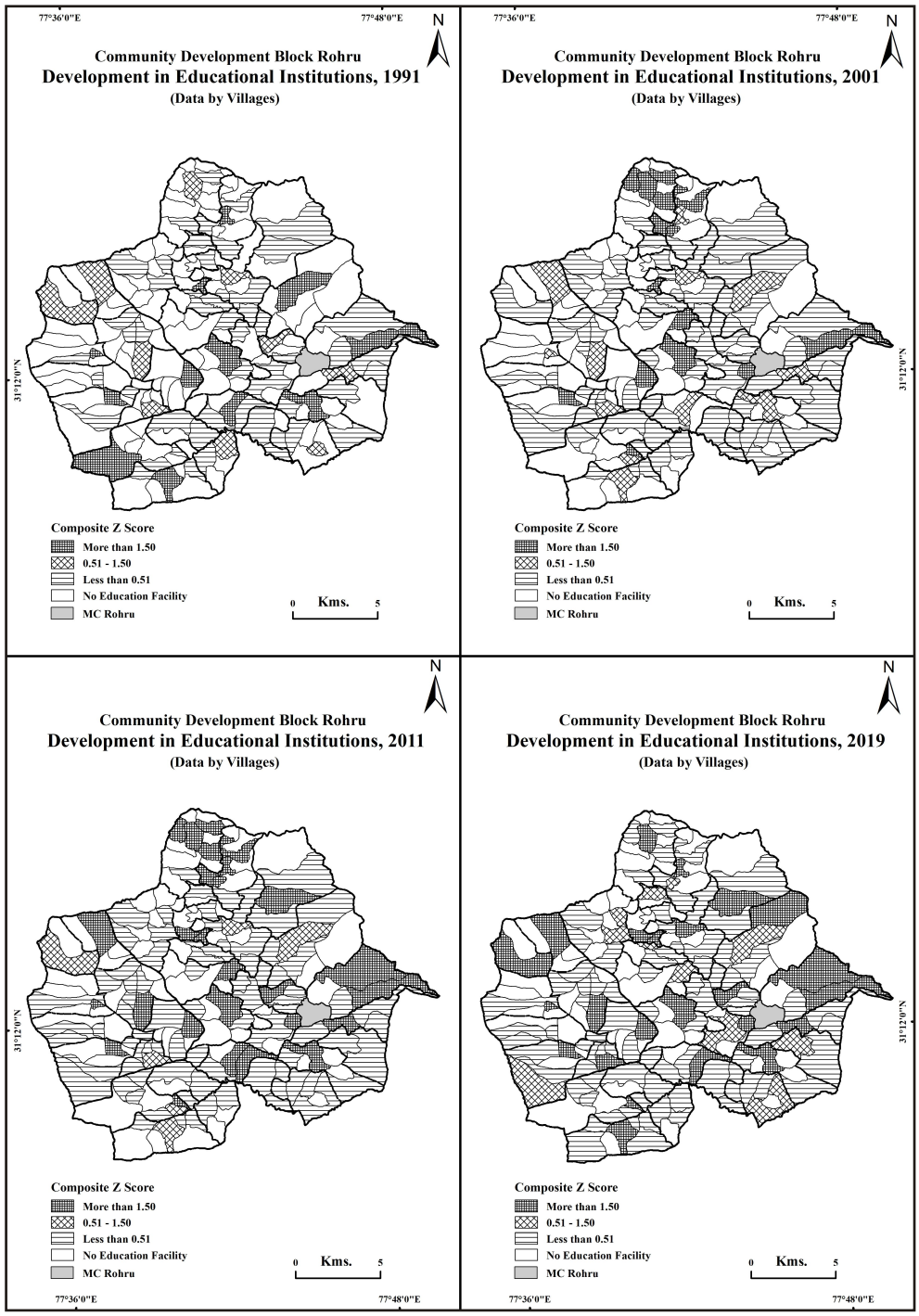
77°36'0"E
77°48'0"E
N
Community Development Block Rohru
Development in Educational Institutions, 1991
(Data by Villages)
31°12'0"N
Composite Z Score
More than 1.50
0.51 - 1.50
Less than 0.51
No Education Facility
MC Rohru
0 Kms. 5
Community Development Block Rohru
Development in Educational Institutions, 2001
(Data by Villages)
Community Development Block Rohru
Development in Educational Institutions, 2011
(Data by Villages)
Community Development Block Rohru
Development in Educational Institutions, 2019
(Data by Villages)

Fig. 6

senior secondary schools. It can be observed from the above discussion that there has been a continuous change in the number as well as the spatial pattern of the villages witnessing a high level of the educational institutional facility.

Areas with Moderate Level of Development

The villages recording composite z scores ranging from 0.51 to 1.50 fall in this category. The study shows that only 10 villages have recorded moderate level of development of educational institutions in 1991 (Table 2; Fig. 6). In 2001, the villages witnessing moderate level of educational facility increased to 12. Only 5 villages (Badshal, Kuthari and Sharontha villages from Tikkar tehsil and Jagothi and Samoli villages from Rohru Tehsil) could maintain their position in areas of moderate category from 1991 to 2001 period. Seven new villages such as Buthara, Katedi, Kotru, Lower Koti, Pujarli-3, Shil and Kupri have entered this category in 2001. The opening of new primary, middle and high schools in Kupri village has led to its entry in this category, while the other six villages recorded no expansion of educational facilities as compared to other villages, due to this factor these six villages have been shifted from high level of development in 1991 to moderate level educational facility in 2001.

Five villages (Bhalun, Kadiwan, Beral, D.P.F. Shekhal and Karalash) falling in this category in 1991 could not maintain their position in levels of moderate development of educational institutions in 2001. Bhalun village recorded the addition of high and senior secondary schools, therefore shifted to a high level of educational infrastructure facility in 2001. Beral, Kadiwan and Karalash recorded no expansion of educational facilities as compared to other villages, therefore recorded a decrease in the composite score as compared to other villages and shifted to a low level of educational infrastructure facility in 2001. D.P.F. Shekhal witnessed closing of primary and middle schools, therefore, recorded no educational facility in 2001 (Fig. 6).

In the year 2011, only 6 villages recorded a moderate level of educational infrastructure facility (Fig. 6; Table 2). Five villages (Buthara, Shil, Jagothi, Sharontha and Kurpi) could maintain their position of 2001 in 2011. While, Kadiwan village entered this category with the addition of a high school in the village. Seven villages (Katedi, Badshal, Lower Koti, Kuthari, Samoli, Pujarli-3 and Kotru) which have been in this category in 2001, have joined the category of a high level of development of educational institutions due to the addition of senior secondary schools in these villages in 2011. In the year 2019, 11 villages witnessed a moderate level of educational infrastructure. Only Buthara village could maintain its position in this category in 2019 with respect to 2011. Ten new villages such as Bashla, Berara, Bhamnoli, Garhai, Kewli, Khangtehri, Munchharah, Pujarli, Shekhal and Thana Bag entered moderate level of development of educational institutions in 2019. Thana Bag village from Tikkar tehsil and Berara, Bhamnoli, Garhai, Kewli, Khangtehri, Munchharah and Shekhal villages from Rohru tehsil recorded addition of the primary, middle and high school, therefore joined the areas of a moderate level of development of educational institutions in 2019. Five villages (Jagothi, Kupri, Shil, Kadiwan and Sharontha) that have been in this category in 2011 could not maintain their position in 2019. Out of these Jagothi, Shil, Kadiwan and Sharontha villages recorded the addition of the senior secondary school, therefore, shifted to

high level of educational infrastructure category in 2019. Kupri village could not be able to retain its position in moderate level of development of educational institutions in 2019 as compared to 2011.

Areas with Low Level of Development

The villages recording composite z score 0.50 or less fall in this category. In the year 1991, 50 villages, comprising 30.12 per cent of the total villages witnessed a low level of development of educational institutions (Fig. 6; Table 2). In 2001, the number of such villages has increased to 76, comprising 45.78 per cent of the total villages. Only 42 villages could maintain their position in the low category from 1991 to 2001 period (Fig. 6). Thirty-four new villages have joined this category due to the addition of new primary and middle schools (Table 2). Eight villages (Bashla, Batara, Kerasa, Kalgaon, Malthi, Nasari, Shalawat and Sharmali) which have been in this category in 1991 could not retain their position in this category in 2001. The addition of middle and high schools in Bashla, Malthi, Nasari, Shalwat and Sharmali villages has shifted these villages to the moderate level of educational facility in 2001. While Batara, Karasa and Kalgaon villages witnessed closing down of primary schools and therefore recorded no educational facility in 2001 as compared to 1991.

Further in 2011, 81 villages consisting of 47.93 per cent of total villages witnessed low levels of development of educational institutions. Out of these, 72 villages are from the list of 2001 (Table 2). Nine new villages of Annu, Kalgaon and D.P.F. Narain from Rohru tehsil and Farog, Koti, D.P.F. Hanstari, D.P.F. Nal, Nagsetli and Shekal from Tikkar tehsil have joined this category by recording an increase in the composite score due to the opening of primary and middle schools in 2011. Four villages (Karalash, Dalgaon, Rantari and Kadiwan) from the list of 2001 have been shifted to the upper category of educational development in 2011 by having the addition of high and senior secondary schools (Fig. 6). However, in 2019, 84 villages witnessed low level of educational infrastructure facilities. Out of these, 71 villages are from the list of 2011 that could maintain their position in the low category in 2019 (Table 2). Thirteen new villages entered the category of low level of educational infrastructure in 2019. Among these, D.P.F. Beral, D.P.F. Ganga Nagar, D.P.F. Jagterli-II, D.P.F. Kashiani and Dharot villages witnessed an addition of the primary school, therefore joined this category in the year 2019. Jaunli, Khara Paani, Kotru, Kupri, Nasari, Seri, Shalawat and Sharmali have been shifted from category of high level of educational facilities in 2011 due to data fallacy as there have been no senior secondary school in 2019 in these villages but the census data have shown the availability of senior secondary schools in these villages in 2001 and 2011. Ten villages (Berara, Bhamnoli, Garhai, Kewli, Kotara, Khangtehri, Munchharah, Shekhal, Nagsetli and Thana Bag) from the list of 2011 have been shifted to moderate level of educational facilities in 2019 due to the addition of middle school and high school facilities. It can be observed from the above discussion that a high proportion of villages that have witnessed low level of development of educational institutions are having only primary and middle school facility.

Areas having No Educational Institution

In 1991, a total of 94 villages comprising 56.63 per cent of the total villages of the

block have been without any school (Table 2). Among these, 68 have been from Rohru tehsil and 26 have been from Tikkar tehsil. In 2001, the number of such villages decreased to 62 villages comprising of 37.35 per cent to total villages, out of which 38 and 24 villages have been from Rohru and Tikkar tehsils, respectively. Thirty-seven villages that have been in this category in 1991 witnessed improvement in educational infrastructure with the opening of either new primary middle or high schools in all of them, therefore these villages have been shifted to the upper category in 2001 (Fig. 6). Five villages (Batara, D.P.F. Kalgaon, D.P.F. Shekhal, Kalgaon and Kerasa) which have been in high, moderate and low categories in 1991 have joined this category due to closing down of primary, middle and high school from D.P.F. Kalgaon and D.P.F. Shekhal villages and closing down of primary school from Batara, Kalgaon and Kerasa villages in 2001.

Further in 2011, the number of villages falling in this category decreased to 54 comprising 31.95 per cent of total villages, out of which 37 villages have been from Rohru tehsil and 17 have been from Tikkar tehsil. Eleven villages (Annu, D.P.F. Kui Awal, D.P.F. Hanstari, D.P.F. Nal, D.P.F. Narain, Farog, Kerasa, Kalgaon, Koti, Nagsetli and Shekal) which have been in this category in 2001 witnessed improvement in their educational infrastructure due to addition of new schools, therefore joined the categories of a higher level of educational infrastructural facilities in 2011. In 2019, the number of such villages further decreased to 50 out of which 33 villages have been from Rohru tehsil and 17 have been from Tikkar tehsil. Five villages (D.P.F. Ganga Nagar, D.P.F. Kashiani, Dharot, D.P.F. Baral and D.P.F. Jagterli-II) shifted from no educational facility in 2011 to a low level of educational facilities in 2019 due to the addition of primary schools. Naksetli village witnessed a decrease in composite score due to the close-down of only primary school in the village, therefore entered in this category. It can be observed from the above discussion that there have been decreasing trends in the number of villages with no educational facilities which shows the improvement in availability of educational institutions, but still over one-third of the total villages are away from the basic educational facilities.

Conclusions

Educational institutional facility plays an important role in the overall development of any region. The study shows remarkable improvement in the village-wise availability of educational institutions at all the three levels (elementary, secondary and higher) in the study area during 1991-2019. In 1991, there has been a total of 105 schools at elementary, secondary and higher secondary level accounting for 2.33 schools per thousand persons, in 2019 the number of institutions increased to 257 and availability increased to 3.94 schools per thousand persons. This shows improvements in the availability of educational institutions in the study area during the study period.

Villages with primary school facilities within the village have increased from 38.50 per cent in 1991 to 63.10 per cent in 2019. The ratio of primary schools per 300 population has improved from 0.48 schools in 1991 to 0.61 schools in 2019. The percentage of villages having middle schools has also increased from one-tenth in 1991 to near about one-third of the total villages in 2019. The number of high schools has witnessed an increase from 11 to 38 during the study period, while the number of senior secondary schools has increased from

nil in 1991 to 24 in 2019.

The study also shows that the inter-village disparity in terms of availability of educational institutions has gone down. The number of villages having high and moderate composite scores has increased while a decreasing trend has been witnessed in the number of villages with low composite scores. According to the government norms there should be a primary school within the distance of 1.5 kilometers from the neighboring school but near about thirty per cent of the total villages of the study area are deprived of this facility, where the students have to walk more distance to reach the school. There are seven villages namely Daroti, Batara, Tikri, Bahli, Khalwan, Antapu and Nagsetli with more than 300 population but without a primary school. As per population criteria these villages qualify to have a primary school. This anomaly should be addressed.

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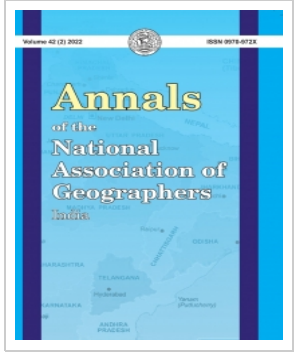

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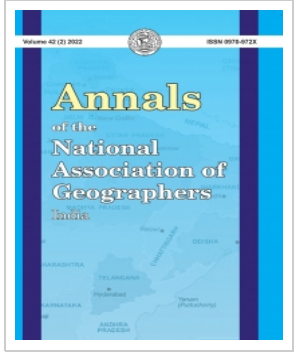

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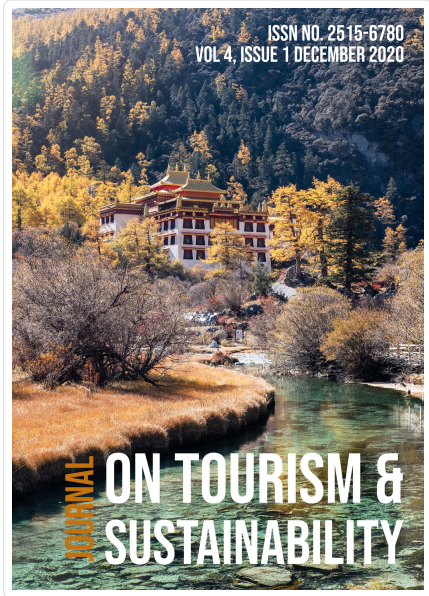

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Chaos, Curries and Curiosities: Some Experiential Dimensions of Indian Culture for Foreign Tourists

Sonia Khan, Professor[+]

Full Article

Abstract

The culture of India has held a special attraction for international tourists. The vast landmass of the subcontinent offers a kaleidoscope of diversity. Though the country has a vast and varied resource base of tourism product, the top of mind awareness of India remains concentrated in the images of the 'Taj Mahal' huge population, colours, food, culture, customs and particularly the all-pervasive 'chaos' that forms the heartbeat of the country. This paper aims at gaining insight into the distinct aspects of India and Indian culture that tourists find curious, captivating, fascinating, shocking, and incomprehensible. The study concludes that India provides both an 'intimidating' and 'exhilarating' travel experience. The challenging country full of unpredictable surprises (both pleasant and unpleasant) is discovered as a 'universe' in itself, which delivers everything conceivable for tourists and much more. For the experiential tourists, with all its positives and negatives, a visit to India culminates into a profound 'life changing' experience that no other country can offer.

Keywords: India, Culture, Chaos, Experiential Tourism

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Domestic Tourism: A Panacea for Global Disasters

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Abstract: - **Disasters and pandemics have from time immemorial wreaked havoc on tourism industry worldwide. Recently tourism has been badly affected by the impact of Corona virus and the worst hit would be international tourism industry. In the wake of the threat of corona virus looming large, international tourism is bound to fall back into oblivion due to uncertainties involved. Although this pandemic has spelt disaster for tourism industry globally, domestic tourism worldwide could emerge as a ray of hope in such grim scenario. This paper is an attempt to project domestic tourism as the way forward during crises or global pandemics.**

Key words: **Disasters, pandemics, domestic tourism, international tourism.**

I. INTRODUCTION

World due to its dynamic nature is very diverse and complex and is witness to many disastrous events (Richardson, 1994). These disasters may be natural or manmade. Disaster events resulting from natural and human-made hazards are frequent occurrences throughout the world (International Federation of Red Cross and Red Crescent Societies, 2006). Latest one such disaster to hit the world is COVID-19. This deadly pandemic has in many ways devastated the lives of people globally and wrecked havoc on humanity. As per Maslow's hierarchy of needs Maslow, 1954), physiological needs are the most basic needs followed by the needs of safety and security. Tourism activities fall under higher order needs. Tourists would not want to climb up the ladder of hierarchy of needs if their lower and the most basic needs are compromised. Therefore the growing numbers of disasters and such unforeseen events/crises (Paraskevas et al., 2013) have an adverse impact on the tourism demand.

The disease had its origin from Wuhan, Hubei Province of central China. It first emerged in December, 2019. Chinese are the world's top outbound travelers. Since tourism involves movement of people, tourism activities were considered as stimulating factors that had contributed to the spread of virus. The nature of the tourism products are such that these services cannot be brought to one's door steps. A person willing to consume tourism services has to visit a particular location to avail these services (Lovelock & Wirtz, 2007). Many travelers, who travelled to and from China, became the carriers of this deadly virus, resulting in the spread of this disease all across the globe. Unfortunately even the most developed countries of the world are unable to deal with this virus or to find a cure. In these trying times when most of the countries have opted for 'lock down' or 'social distancing', economy worldwide is heading for the biggest recession of all times which is likely to last for many years to come. Tourism industry is the hardest hit industry during these tough times. When the survival of humanity is at stake, tourism would be the last thing to consider. Almost all the countries have put a ban on tourism related activities since January, 2020. International tourism would be considered a highly risky venture in modern world's uncertainties for some time to come. However, Some scholars have opined that disasters do not have lasting impact on the economy of a destination (Cavallo et. al., 2013). Tourism is a very resilient industry and has the capacity to bounce back. Many researchers suggested ways for revival of tourism industry through varied innovative measures.

Keeping in view the uncertainties and dangerous nature of the deadly virus, an attempt has been made in this paper to focus on the growing need of strengthening, promoting and projecting domestic tourism as a panacea for ailing tourism industry of the world.

II. METHODOLOGY

The study relies on the secondary data. Many researchers have studied impacts of pandemics on tourism and have suggested a way forward. Many web sites have also been consulted in this study.

Disasters, Crises and Domestic tourism

There is not much literature available on the impact of crises on tourism. Very few researchers have studied the impacts of disasters on tourism industry (Faulkner, 2001).

Travel, in general is governed by Push and pull factors. Whereas 'push' factors are intrinsic in nature and indicate personal needs, such as relaxation or breaking the monotony by taking to travel and tourism activities, 'pull' factors present the attributes of a destination (Dann, 1977, p.187). Modern world is full of complexities. Disasters or crises could happen anywhere across the globe.

Natural disasters (like earthquake, typhoons, floods, droughts), climate change and global epidemics by a new types of influenza or other unknown diseases have been identified by Prideaux (2003) as events requiring more attention and in depth studies from tourism perspective for such events may cause the most frequent and serious losses at tourism destinations. Disaster occurrences not only affect the safety of local residents and tourists, they also give rise to negative tourism images and have serious impacts on tourism development (Stylidis, Biran, Sit, & Szivas, 2014).

Tourists may have a firsthand experience or learn through media about a destination's approach /unpreparedness to deal with such crises or disasters. It would result in creating

negative image of a destination leading to avoidance of visiting that particular destination. In the wake of such eventuality, unforeseen circumstances and uncertainties tourism industry is always the first one to suffer and invariably the last on to revive. People would also have concern about travelling to the countries where health care system is compromised or not up to the mark. It has emerged from the previous studies that when image of a tourist destination is low owing to its safety or health measures, chances of revival of economy are also very low as tourists would not wish to visit such a destination (Walters et. al., 2015, p.111). Therefore, riskier destinations may be omitted from the destination choice set (Crompton, 1992; Sönmez & Graefe 1998a, 1998b). When traveling internationally, tourists often experience a great degree of anxiety (Korstanje,2011). Risk perceptions, whether real or perceived, can potentially become the dominant factors in travel related decisions, particularly in the international context (Sönmez & Graefe, 1998a; Sönmez, 1998). Air transportation is the basic element of international tourism. This may prove to be a risky preposition as infections may be spread on the aircraft through close contact and large droplets (Mangili & Gendreau, 2005); airborne spread through small-particle aerosols, as in the case of severe acute respiratory syndrome (SARS) (Olsen et al., 2003); or even through contaminated food, (Eberhart-Phillips et al., 1996; Widdowson et al.,2005). Risk perceptions associated with international travel may vary depending on the geographic region (Sönmez & Graefe, 1996). Furthermore, risk perceptions seem to have a great effect on avoidance of geographic regions and destinations (Sönmez & Graefe, 1998b). The same has been suggested by Gunter and Smeral (2016). They opined that such unforeseen situations and disasters create uncertainties with consumers, to which they react by reducing international travels and substituting it with domestic tourism, necessities to fulfill basic needs and increased savings for emergencies. Domestic tourism and regional tourism may be marketed and promoted as an antidote for survival and revival to sail through such turbulent times. Domestic tourism is the travel of residents within their own country for tourism purposes (Middleton, et al., 2009). Similarly, Hall & Lew (2009) defined domestic tourism as the tourism of resident tourists within the economic territory of the country of reference. Furthermore, Horner & Swarbrooke (2005) defined domestic tourism as a tourism activity when residents conduct holiday tours wholly within their own country of reference. Over the past 25 years a number of tourism researchers have emphasized upon the need for more scholarly attention to be devoted to domestic tourism (Jafari, 1986; Pearce, 1996; Ghimire, 2001; Gladstone, 2005).

Taine (2014: 46) opined that domestic tourism particularly in developing countries had been awarded relatively little attention compared to international tourism. Scheyvens (2007: 308) pointed about an insidious perception that domestic tourism had invariably been the 'poor cousin' of the more glamorous international tourism market, and that domestic tourism could not bring the same range of development benefits to a country. In the recent years much emphasis has been given to international tourism over domestic tourism in most developing countries. (Jerenashvili, 2014; Scheyvens, 2007; Mazimhaka, 2007).

However, importance of domestic tourism cannot be undermined, more so in the prevalent uncertain situation. Domestic tourism is the largest and the most significant form of tourism when compared to its international counterpart (UNWTO, 2012). It has been observed that countries such as Brazil, India, Indonesia and South Korea promote domestic tourism as a vehicle for national integration and nation building seeking to channel local tourists to destinations of collective symbolic significance (Ghimire, 2001; UNWTO, 2012; Kang et al., 2014).

International Tourism a treacherous endeavor in the times of pandemics?

Tourism worldwide has suffered a lot from covid-19 pandemic and is not likely to recover in the coming years. In the current scenario, when thought of crowded airports is a cause of grave concern, travel for the purpose of exploring and enjoying foreign destinations will cease to be a source of joy and pleasure. During such treacherous times domestic tourism may emerge as a less risky alternative.

Experts have predicted a grim future for tourism industry across the globe. It may take from a few months to years for tourism industry to recover from the impact of Corona virus. People may not be willing to undertake international travel and tourism activities for the risk and uncertainties involved. There has been a growing concern among the natives with regard to foreigners or even their own nationals who had travelled abroad. Non natives are scrutinized with suspicion. The whole outlook towards travel and tourism activities took a U-turn. All across the globe, people who were travelling or had travelled recently have been treated like untouchables for the obvious reasons. Majority of the countries globally have opted for 'lockdown' for months altogether. The worst hit in this exercise were tourists who were stranded in foreign lands with limited means. There were travelers who were stuck in cruise ships with the fear of corona virus looming large. Many of them became infected with the deadly virus. Thus tourism related activities have instilled fear and anxiety in the minds of future travelers as well. However, due to these trying times tourism should not be labeled as a dangerous activity. Tourism is a highly resilient industry. These times should be seen as an opportunity to develop and promote domestic and regional tourism. This can prove to be as an antidote to cure ailing tourism industry globally. Studies have revealed that domestic tourists are not much affected by the global upheavals. Domestic tourism has the capacity to spring back on track quickly compared to international tourism as the fear or anxiety factor of venturing within one's own country is significantly less.

Socio-economic implications of domestic tourism

Dynamism is inherent in mankind urging to find ways to explore and discover. Road ahead for tourism should be to discover their own countries or undertake regional travel as this may be considered less risky. Efforts should be made to connect people to their roots by encouraging them to travel to undiscovered or lesser discovered destinations in their own countries. This may emerge as a safeguard against spatial disparities in tourism. Moreover this would also ensure somewhat equal distribution of tourism earnings to far flung areas by reducing congestion of tourism in some well defined pockets.

Domestic tourism can also prove to be instrumental in stopping rural exodus. This type of tourism may encourage rural population to develop means to engage in ethnic handicraft/souvenir production, and also explore the possibilities of experimenting with local cuisines for the use of tourists. Fairs and festivals of ethnic communities should be promoted as rich and knowledgeable cultural products. This could be promoted among the tourists as an added touristic appeal.

There are many distant and lesser explored destinations that remained virus free even during the peak of pandemic. These unexplored remote areas having a great potential for nature, cultural, adventure, spiritual and wellness tourism should be identified by the developers and marketed among the domestic tourists with the help of local communities.

Domestic tourism is as important for a country as international tourism. During the uncertain times, domestic tourism can give a thrust to economic growth in the holiday regions and may give a fillip to ethnic art and craft. This may even help in filling up the void created by the lack of international tourist visitation. In one of the earliest studies conducted on domestic tourism. Archer (1978: 127) stresses its positive impacts for bringing about "a spatial re-distribution of spending power" as well as "an inter-mingling of people from diverse social and cultural backgrounds". Domestic tourism ensures a steady flow of currency and keeping it within the country. It keeps a check on inflation and also proves to be a steady source of income and employment for locals. The same fact is also emphasized by Kang et al. (2014), according to them, continuing recognition among government agencies of international travel as more significant from an economic perspective since at the national level inbound international tourism represents a form of income whereas domestic tourism represents the recycling of monies within the nation. (Kang et al., 2014: 3). During the times of crises and disasters domestic tourism assumes tremendous importance as foreign tourists shy away from crossing international boundaries. Studies revealed that domestic tourism contributions, when compared with international tourism, are as high as 60% of the overall tourism income and up to 80% of tourism arrivals (Boniface and Cooper, 1994 cited in Ghimire, 2001). The robust domestic tourism could also be used to alleviate financial outflows (Ranjanthran & Mohammed, 2010), to iron out seasonality (Kruger & Douglas, 2015) and the uncertainty of the tourism industry (Okello, Kenana, & Kieti, 2012). Domestic tourism expands and diversifies the tourism industry (Mazimhaka, 2007), generates employment, enhances economic growth, and overall tourism industry development (WTO, 2006). Domestic tourism is widely recognized as a wonderful 'crisis shock-absorber' (Mazimhaka, 2007) counterbalancing the uncertainties of international tourism owing to varied reasons such as pandemic threats, threat to safety and security, less promotional effort or lack of requisite infrastructure for international tourists. Furthermore, domestic tourism inculcates a sense of pride among natives for their culture, creates employment and entrepreneurship avenues for them, aids in economic development and promotes travel culture among the residents (Mendiratta, 2011).

This has also been observed that if a destination has negligible number of domestic tourists' visitation, it is not even popular among international tourists. Therefore generally domestic tourists are instrumental in discovering a destination and making it popular among tourists. Domestic and international destinations exceedingly depend on each other (Malska, Hudo, & Cubuh, 2005). If domestic tourism in the country has low number of tourists, this destination has also low attractiveness for international travelers. And vice versa, if country has high number of international arrivals it means that this destination is also attractive for local citizens (Djachenko, 2007). Therefore importance of domestic tourism cannot be undermined.

The global domestic tourism is lead by the United States and followed by China, India, Brazil, and the United Kingdom (Bigano, et al., 2007). Following an increase of middle income earning people and the spread of globalization, travel for the pursuit of pleasure by nationals within their own country has shown significant growth in the third world countries (Scheyvens, 2007).

Marketing as an effective tool for promoting Domestic tourism

International tourism has generally been assigned much importance than domestic tourism by most of the developing countries. Despite the fact that domestic tourism represents approximately 80 percent of world tourism flows, within tourism scholarship domestic tourists are given far less attention than their inter-national counterparts (Scheyvens, 2002; Canavan,2013). Post COVID this trend needs to be changed. It has been observed there is an esteem and prestige value attached to foreign visits by developing countries' nationals. Many of the high spender tourists who undertake international visits have yet to explore their own countries. Since international travel would not be considered safe for quite some time post COVID, therefore such potential tourists could be motivated to discover their own countries by engaging in travel to farthest unexplored corners. One effective way to attract potential tourists to these virgin native destinations

could be by posting beautiful pictures of scenic locations and tranquility on social media/websites while the world erstwhile was ravaged by the deadly virus. Various tour packages like adventure, nature, rural, health and wellness, cultural, ecological etc. can be prepared for the varied categories of tourists.

Way forward

Post COVID efforts should be made to attract tourists to those destinations that have not been affected or very less affected by this corona virus, so that tourists feel safe to visit these destinations. It is also important to safeguard these destinations against any future virus threat. Tourists should not act as carriers of this deadly virus. Therefore entry of tourists should be subject to their production of covid-19 free certificate.

Fairs and festivals of a destination should be promoted as year round attractions for tourists. Remote and unexplored destinations should be marketed as destinations abundant in natural beauty along with added touristic appeal of wellness, spiritual and cultural destinations. This has to be done with the active support of native community. Community approach can prove to be the most effective and positive during the times of crises. Community through its cumulative efforts can deal with the disasters by way of providing medical services, provisions for food and safety or housing the people in need. The same has been emphasized by Yamamura, 2016, in the study conducted on the impact of the Great Hanshin-Awaji earthquake in Japan in 1995.

It could be inferred from the after effects of pandemics that social distancing could emerge as the new norm. This aspect should be accorded due attention by the tourism developers as well. Many service providers such as restaurants have started experimenting with social distancing while serving their guests. A restaurant in New Zealand has been offering beverages to its guests using lumber (https://www.republicworld.com).

Some of the countries have used the lockdown period to promote tourism virtually with the help of social media. Tourism ministry of India has launched ‘dekho apna desh’ (discover your own country) webinar series to motivate people to travel across India. This webinar series has been providing an in-depth knowledge of Indian destinations and also urging them to explore their own countries after the lockdown period (https://www.incredibleindia.org). The same could be adopted by other nations too where their natives could be encouraged to explore own country by ‘venture within’ or ‘discover your own country’.

III. CONCLUSION

Scholars suggested governments, researchers, and tourism business sectors to prioritize domestic tourism for diversifying the country’s tourism industry (Mazimhaka, 2007), for a more socially and economically sustainable development of less developed regions (Seckelmann, 2002), in addressing the spatial uneven tourism development (Rogerson, 2015), for the recovery of the tourism industry (Bulin, 2015), for the development of non-industrialized areas to reduce economic disparities (Xu, 1999).

It has been observed that Domestic tourists are frequent travelers than international tourists (Eijgelaar, et al., 2008), and the growth of domestic tourism is steady and rarely affected by situations of the international market. Moreover, it minimizes seasonality of tourism; spread tourism activity; creates awareness (UNWTO, 2012); brings better tourist security (Mendiratta, 2011); solidarity among people (Mendiratta, 2011); sustainable development (UNWTO, 2012); retain the tourism spending within the nation; it can be developed without huge investment and so on (Som & Al-Kassem, 2013). Furthermore, providing job opportunities, rectifying the rural exodus, and revitalizing the economy, the impact of domestic tourism is dynamic for the overall economic, social, cultural and political goals of the nations (Mazimhaka, 2007; UNWTO, 2012). Hence, tourism trends are definitely slated to hit for a change for times to come. In order to revive tourism industry, it is desired to promote domestic tourism as a less risky, safe and gratifying alternative over international tourism.

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Studies on Diversity, Distribution and Relative Abundance of Insect Pollinators on Mango in Kyarda Doon Valley of District Sirmaur, Himachal Pradesh

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Abstract: ***The present studies were conducted on diversity, distribution and relative abundance of insect pollinators of mango in KyardaDoon valley of district Sirmaur, Himachal Pradesh. During the flowering period i.e. April - May 2019, collections were made regularly from 7 different localities viz. Kolar, Dhaulakuan, Majra, Paonta Sahib, Puruwala, Rajban and Sataun. Insect diversity studies showed a total of 23 species of insect pollinators belonging to 4 orders and 13 families of class Insecta. Of these, 11 species belonged to Diptera, 6 to Coleoptera, 4 to Hymenoptera and 2 toHemiptera. Morphological features, genitalia and wing venation of the insect species were studied. Analysis of data on relative abundance of different insect pollinators revealed that dipterans were the most prominent insect visitors of mango flowers in all the localities i. e. Kolar (56.10%), Dhaulakuan (52.03%), Paonta Sahib (57.71%), Majra (47.62%), Puruwala (61.58%), Rajban (59.96%) and Sataun (64.85%). Episyrphusbalteatus was the most abundant insect visitor to mango flowers in all the localities i. e. Kolar (16.06%), Dhaulakuan (18.09%), Paonta Sahib (13.12%), Majra (9.43%), Puruwala (27.44%), Rajban (20.11%) and Sataun (27.31%). Besides dipterans, coleopterans also constituted an important group of insect pollinators followed by hymenopterans and hemipterans.***

Keywords: Insect pollinators, Diversity, Distribution, Relative Abundance, Mango, KyardaDoon Valley

1. Introduction

Pollination is the transfer of pollen grains from male anther to the female stigma of flowering plants. Plants depend on animal pollination through insects, birds, bats and others, while insects playing the major role (Abrol, 2012). Insects and other animal pollinators are play very important role in the production of healthy crops for food, fibers, edible oils, medicines, and other products. Cross pollination by insects is of great importance in increasing crop yield, improving fruit and seed quality. Insect pollinators mainly belong to orders Coleoptera, Lepidoptera, Diptera, Thysanoptera and Hymenoptera. Pollination is an ecosystem service that is a key to food security. Pollinators are essential for many fruit and vegetable crops. Most of the Crops like cashew, mango, high blush blueberry, cramberry, squash, cacao and cardamom are pollinated by wild insects having having a combined average value of $1.2 billion (Gupta and Gupta, 1997).

The mango (*Mangifera indica* L.*)* has been acknowledged as an excellent fruit from the ancient times and has been liked by adults and infants alike. In India, the mango is produced in almost all the states. Production of this fruit has been found in the Uttar Pradesh, Andhra Pradesh, Bihar and Maharashtra, Gujarat, West Bengal, Karnataka and Kerala in the beginning. But now a days, most of the states like Punjab, Haryana and Himachal Pradesh have entered in its cultivation. Mango plants are pollinated by various pollinators and flies and stingless bees are thought to be the dominant pollinators of mangoes as they visit the flowers in large numbers and disperse between different trees.

2. Literature

Review of literature has indicated that various researchers has worked on the insect pollinators from different region of country e.g. Popenoe (1917) reported that honey bees were the important Hymenopteran insect visitors of the mango flowers. More than 550 species of flowering plants are visited by Dipterans that are potential pollinators. Mukherjee (1953) listed a number of important insects visiting mango which belonged to Lepidoptera, Hymenoptera, Coleoptera and Diptera including important genera like *Musca, Syrphus* and *Psychonosma*. Singh and Sturrock (1969) observed that flowers of mango had none of the characteristics of wind pollinated flower and considered mango to be an insect pollinated plant. Dag and Gazit (1996) observed insect pollinators visiting on mango bloom in 10 orchards located in all major mango growing areas at Israel. The species were found to play a significant role in mango pollination are; Dipterans: *Lucilia sericata, Chrysomyia albiceps (*blow flies), *Musca domestica (*housefly) and several species of syrphidae family (hoverflies). Rajan and Reddy (2019) studied the pollination efficiency of two species viz. *Apis florae (*Hymenoptera) and *Chrysomya megacephala (*Diptera) and concluded that the Calliphorid fly (*C. megacephala*) was as good as wild bee (*A. florae*) in effecting mango pollination and enhancing fruit set.

The annual economic value of insect pollinators to agricultural productivity for the major crops cultivated in the state of Himachal Pradesh is US Dollar 365 million and it is US Dollar 6.93 million for mangoes in Himachal Pradesh (Klein *et al*., 2007). This indicates that a total loss in local insect pollinators would result in a two - thirds reduction in fruit crop production (Partap and Tang, 2012). Keeping in

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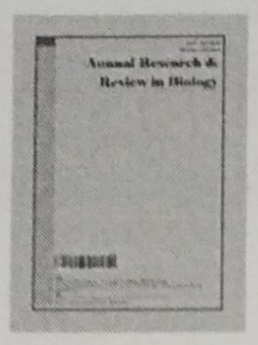

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Biology of Anar Butterfly: *Deudorix (Virachola) isocrates* Fabricius (Lepidoptera: Lycaenidae) in Mid Hill of Himachal Pradesh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The study on biology of fruit borer, *Virachola isocrates* Fabricius was carried out under laboratory conditions.
Place and Duration of study: Study on the biology of *V. isocrates* was carried out under laboratory conditions in the Horticultural Research Station, Dr Y S Parmar University of Horticulture and Forestry, Seobagh Kullu in 2019.
Methodology: In order to study life cycle, *V. isocrates* reared in the laboratory and measurements of different stages were regularly recorded with the help of ocular micrometer and stage micrometer.
Results: The average incubation period was recorded to be of 8.66 ± 2.05 days. The developmental period of first, second, third, fourth and fifth instar was 2.66 ± 0.46, 3.33 ± 0.46, 3.66 ± 0.46, 3.33 ± 0.46 and 3.33 ± 0.46 days, respectively. The total larval period was found to be of 15.33 ± 6.94 days. Pupal duration was found to be 15.33 ± 6.94 days. Total developmental period was completed within 40 ± 4.08 days through five larval instars on pomegranate.

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EFFICACY OF *MENTHA PIPERITA* L. AND *VERBASCUM THAPSUS* L. EXTRACTS AGAINST *CALLOSOBRUCHUS CHINENSIS* L. IN HORSE GRAM

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ABSTRACT

In view of the insecticidal properties of *Mentha piperita* (peppermint) and *Verbascum thapsus* (jungle tambakoo) these were evaluated for their efficacy against pulse beetle *Callosobruchus chinensis* (L.) infesting horse gram. Extracts of leaves, roots and inflorescence were prepared with acetone and methanol and these evaluated by considering adult mortality, oviposition and emergence of F1 progeny. The results revealed significant effects on oviposition and emergence of adults, with extracts from leaves providing the best protection. It was observed that 20% extract of *M. piperita* resulted in 100% inhibition of adult emergence.

Key words: *Mentha piperita*, *Verbascum thapsus*, leaves, roots, inflorescence, acetone, methanol extracts, *Callosobruchus chinensis*, oviposition, emergence, progeny, mortality

Pulse food grains are most susceptible to insect pest damage having 5% susceptibility index as compared to wheat (2.5%), paddy (2.0%) and maize (3.5%) (Sharon et al., 2014). Horse gram *Dolichos biflorus* L. is a commercially and medicinally important pulse crop in India. Bruchids are well known pests of stored legumes worldwide and *Callosobruchus chinensis* L. is the most notorious among these and infesting horse gram. Infestation begins in the field when pods are near maturation and continues during storage where it causes maximum damage. Chemical pesticides are used for controlling its infestation but it has its own undesirable effects. Methyl bromide and phosphine are still being used as the most effective fumigants but some stored-product insects have developed resistance (Kim et al., 2003). Hence, there is a need to find ecofriendly alternatives, and plant pesticides or botanicals can satisfy this need. The plant derivatives/ metabolites play major role in defense and produce behavioural and physiological effects on insects. Use of native plants is a promising approach and this study evaluates the efficacy of acetone and methanol extracts of leaves and roots of *M. piperita* and leaves and inflorescence of *V. thapsus* on adult mortality, emergence and oviposition deterrence of *C. chinensis*.

MATERIALS AND METHODS

Experiments were carried out in the Department of Biosciences, Himachal Pradesh University, Shimla during 2016-2018. Seed samples infested with *C. chinensis* were collected from grain market, Sundar Nagar, Mandi, Himachal Pradesh and cultured on horse gram at 25°C and 70% RH. Maximum seven days were allowed for mating and oviposition and progenies emerging from subculture were used. Acetone and methanol extracts of both plants were prepared following Talukder and Howse (1993) with slight modifications. Freshly collected leaves and roots of *M. piperita* and leaves and inflorescence of *V. thapsus* were air dried and ground to fine powder. Powder was passed through a mesh sieve to obtain a fine dust. The extracts were prepared by mixing 20 g of plant powder in 100 ml of solvent in a covered glass beaker to make stock solution. This was filtered through Whatman filter paper No. 41 and left undisturbed for 24 hr. and then kept in hot water bath for complete evaporation at 56°C for acetone and 64.7°C for methanol. These crude extracts were weighed and preserved in sealed bottles in refrigerator until used for insect bioassays. Concentrations viz., 5, 10 and 20% were prepared by mixing the 2 g extracts with 40, 20, 10 ml of distilled water and whole volume of each solution was applied separately on filter paper disc and placed in 90 x 15 mm petri dish for drying. Five pairs of *C. chinensis* adults were placed on these with 50 healthy prewashed and dried horse gram seeds in each. Acetone and methanol treated filter papers in petri dishes formed the control, making the total treatments to four, each replicated thrice. Daily observations on mortality were made up to fifteen days along with observations on oviposition

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Distribution of Himalayan Grey Langur, *Semnopithecus ajax*, Pocock 1928 in Himachal Pradesh, India

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ABSTRACT

Study on diversity, distribution and abundance of critically endangered species *Semnopithecus ajax* Pocock 1928commonly known as Himalayan Gray Langur was carried out in Himachal Pradesh, India and it has been observed that out of total twelve districts of the state this species is confined to Chamba districts only. This species was studied from 18 different localities of Chamba district during 2015-18. The largest troop consisting of 89 individuals was recorded from Prangal panchayat of Bharmaour block and an isolated single young individual was noticed on Koti Bridge near Sundla. There is seasonal but local migration of grey langur in the study area and species has conflict with human being due to shrinking of habitat and other natural resources.

Key words: Himalayan Gray Langur, Critically endangered, Distribution, Human langur conflict.

INTRODUCTION

India has a rich diversity of fauna and flora due to its diverse geographical and climatic conditions. These rich natural conditions equip Indian land mass to support diverse number of species of non human primates. Fourteen species comprising six species of macaques, five of langurs, two of loose, and one species of gibbon and 39 subspecies of nonhuman primates occur in India (Southwick & Lindburg, 1986; Mir *et al.*, 2015). In population abundance, Rhesus and Semnopthecus (Hanuman langur) are considered as largest population of non human primates sharing this distinction with baboon of Africa (Roonwal & Mohnot, 1977). Langurs are important species as they occupy a key position in food chains of many forest ecosystems. In India most of the population of langur comes under genus *Semnopithecus*.

Prior to 2001 *Semnopithecus entellus* was considered only one species with several subspecies like *S. entellus achates* (Plains langur), *S. e. ajax* (Dark-eyed Himalayan langur), *S. e. anchises* (Deccan hanuman langur), *S. e. entellus* (Bengal hanuman langur), *S. e. hector* (Grey langur), *S. e. hypoleucos* (Dark-legged Malabar langur), *S. e. schistaceus* (Central Himalayan langur), *S. e. dussumieri* (Dussumier's Malabar langur), *S. e. priam* (Madras grey langur) and *S. e. thersites* (Grey langur) (Molur *et al.*, 2003). It was in 2001 when these subspecies were recommended for separate subspecies under genus *Semnopithecus*. Accordingly seven different species viz. Nepal grey langur (*Semnopithecus schistaceus),* Kashmir grey langur (*Semnopithecus ajax),* Tarai grey langur (*Semnopithecus hector),* northern plains grey langur (*Semnopithecus entellus*), black-footed grey langur (*Semnopithecus hypoleucos*), Southern plains grey langur (*Semnopithecus dussumieri*)and tufted grey langur (*Semnopithecus priam*) have been recognised (Groves, 2005).

Dark-eyed Himalayan grey langur *S. ajax* is one of the least studies species of langur. This species is distributed in a varied habitat including quite dry savannah and tropical rain forests. They inhabit between 2200-4000 m amsl in the subtropical, tropical moist temperate, alpine, coniferous, broad leaved forests and scrublands (Nowak, 1999; Hilton & Taylor, 2000). In Indian subcontinent their distribution is reported from Himachal Pradesh and Jammu and Kashmir and adjacently from Pakistan and Nepal. In Himachal Pradesh they are reported from Kalatop-Khajjiar and in State of Jammu and Kashmir noticed in Dachigam National Park and in Bhaderwal district.

This species is reported from different places of the Pakistan (Roberts, 1997) and from Neelum Valley (Machiara National Park and Salkhala Game Reserve), Jehlum Valley (Moji Game Reserve and surroundings), and Hillan and Phalla game reserves in District Bagh of Pak occupied Kashmir (Ahmed *et al.*, 1999; Baig, 2004; Dar, 2006). They are also reported from Lang Tang National Park of Central Province in Nepal (Walker & Molur, 2004).

Himalayan Gray Langur is normally confused with other species of *Semnopithecus* but can be easily identified by its larger size and outer sides of both the fore and hind limbs covered with silvery-dark coloured hair (Wilson, & Reeder 1992). The long tail of this langur always forms a broad arc over their back curving towards the head when on the ground (Jay, 1965).

Dark-eyed Himalayan gray langur is basically folivorous and mostly feed on a combination of fruits, buds, leaves, stems, barks, roots and flowers and also observed eating insects. They prefer mature leaves as compared to the other parts of the plants. Average group size of *S. ajax* does not show much variation across seasons. The overall population density of *S.ajax* is about 16.32 to 28.3 individuals/ km^2 (Bagchi *et al.*, 2003; Minhas *et al.*, 2012; Edgaonkar, 2008). There is not significant variation in the density of langurs across different seasons.

S. ajax is an endangered species according to IUCN red data list but after reassessment in 2004 this species was re-designated as "Critically

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Pandemics and biodiversity: A review

Authors
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Abstract
Pandemics and biodiversity: A review Sunita Saklani[1], Nitesh Kumar[2] [1] Department of zoology, Govt. College Sujanpur Tihra, Himachal Pradesh, India [2] Department of Botany, Govt. College Sujanpur Tihra, Himachal Pradesh, India Abstract Pandemics have a long history throughout the centuries and most of them not only result in the fatality and also undermine the social and economic set up of a society. Pandemics are always linked with biodiversity since most of the pandemics are of zoonotic origin and the majority of these are caused by viruses like Influenza (H1N1, H2N2, H3N2), MERS, Ebola and most familiar present-day. The main cause of these outbreaks is the imbalance caused by humans in Nature. A rich level of biodiversity can overcome the menace of the outbreak of pandemics. Hence, by taking the lessons from the present and past pandemics, human as a global community need to take steps to mitigate the risk of future pandemics. Keywords: biodiversity; influenza; pandemics; viruses

Introduction In this modern era, where human advances in every field are taking giant leap the emerging and re-emerging of various communicable disease health threats, and its transmission is an ever- evolving subject. If we look at the history of emerging or re-emerging infectious disease pandemics globally, then we can easily conclude that on an average it happened in every decade. However, now, the trend is changing, and it is quite evident that-, the frequency between pandemics seems to be disturbingly shorter. Transmission of pathogens that causes acute respiratory diseases/infections which were better illustrated by Severe Acute Respiratory Syndrome (SARS) in 2003, Influenza A H1N5 (bird flu) in 2007, H1N1 (swine flu) in 2009, Middle East Respiratory Syndrome (MI 2012, Ebola in 2014 and in present- most common example is Coronavirus disease 2019 (COVID-19) (Rewar & Rewar, 2015; Ma 2016; Qiu et al., 2016) [23, 16, 21]. If we look at terms often used for infectious disease, they are mistakenly used interchangeabl by medical experts. This is because the definition of each term is like liquid and it changes with the diseases which become m less prevalent over the times. (Harris, 2000; Morens et al., 2009) [1, 9]. Definitions are as follows So, Pandemic is an epidem AN EPIDEMIC is a disease that affects a large number of people within a community, population, or region.travels with A PANDEMIC is an epidemic that's spread over multiple countries or continents. enormity in term ENDEMIC is something that belongs to a particular people or country. geographical area, number AN OUTBREAK is a greater-than-anticipated increase in the number of endemic cases. of cases and days of suffering resulting in deaths. But what's the difference between endemic and epidemic? Endemic, are the diseases which have a constant presence in a specific location as malaria is endemic to parts of Africa, whereas on the other hand, an epidemic is often localised to a region, but the number of cases infected in that particular region is significantly higher than the normal. For example, when SARS cov2 or COVID-19 was reported, it was limited to Wuhan (China) at that time it was an epidemic. Afterwards, its geographical spread turned it into a pandemic. The human population have suffered from many pandemics throughout history be it the earlier form of smallpox or tuberculosis or various flu or the recent incidence of HIV/AIDS or H1N1 or SARS cov1&2. All these have created catastrophic damage in different forms. Pandemics The literal meaning of pandemic is "pan" meaning all and "demos" meaning population which apply to the rapid spread of transmissibl diseases. So, pandemics are large scale outbreak of new infectious diseases globally, which affect the substantial number of population and destroy economic and social set up of the countries. It is primarily used to indicate the rate of spread of disease and the distance of its spread (Last, 1988) [14]. The first known use of the word pandemic was found in 1666, referred to "a *Pandemick*, or *Endemick*, or rather a *Vernacular* Disease (a disease mainly dominating in a Countrey) (Harvey, 1666) [10]. Afterwards in 1828, epidemiologist and lexicographer Noah Webster in his first edition of *Webster's Dictionary* listed epidemic and pandemic as synonym (Webster, 1828) [32]. In late 19th and early 20th-century influenza pandemics may have temporarily systemise the use of word pandemic, but due occurrences of large-scale non-influenza infections and chronic and lifestyle- associated diseases it gradually loses its exactness and it thereby returned to a status similar to its later one i.e. denoting almost anything that increased in and appeared to spread within or among groups of people. Moreover, with better control on major pandemic diseases as cholera, plague, smallpox and tuberculosis etc. the term "pandemic" became closely associated with ancient time diseases, rather than present time diseases (Moren et al., 2009) [19]. In the past 5-6 decades, the origin of 335 emerging infectious diseases was reported globally. Most recent epidemics are primarily zoonotic originating in wildlife

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Herbal potential of some plants from Shivalik hills of H.P, Northwestern Himalaya for treatment of waterborne diseases: A Review

Nitesh Kumar, Priya Kumari, Rakhi Gagotia, Sunita Saklani, Arvind Kumar

Abstract

Water pollution is the significant pollution of rural areas and even in the cities pollution of water occurs when pollutants or contaminants are inducted into the natural surroundings intentionally or unintentionally. Water pollution is the discharge of impurities into water bodies like chemicals, microorganisms, radioactive energy, and heat. These substances are called water pollutants and obstruct the essential water utilization or the natural working of the ecosystem. The contaminated or polluted water causes many human diseases such as cholera, diarrhea, dysentery, typhoid, jaundice, polio (infantile paralysis), and trachoma (eye infection). Himachal Pradesh is a hilly state which is full of forests with characteristic medicinal wealth and floristic diversity. Mostly the peoples of Himachal Pradesh live in the rural areas and the vicinity of the forest. They are having a great reservoir of traditional knowledge regarding the use of local plants from the forest to treat various health problems. This study emphasizes the conventional use of some plants from the forest of Shivalik hills of Himachal Pradesh, the North-Western Himalayan region, for the cure of diseases that occurs because of water pollution.

Keywords

Contaminated water, ethnomedicinal, Himachal Pradesh, Shivalik Hills, water pollution

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To investigate leaf extracts of *Verbascum thapsus* Linn. For their antioxidant potential

Ved Prakash and Anand Sagar

Abstract
In today's times, the role of antioxidants has been continuously recognised as a critical influence on the biochemistry of living beings. Any substance that causes delay or prevents oxidative damage to a target biomolecule is often known as an antioxidant. Antioxidants prevent the oxidation of certain biomolecules such as nucleic acids, proteins, carbohydrates, fatty acids etc. by various mechanisms. The current study was undertaken to investigate the leaf extracts of *Verbascum thapsus* Linn. for their antioxidant activity. The antioxidant capacity of the different extracts i.e. methanol, acetone and aqueous was evaluated by DPPH (1,1-diphenyl-2-picrylhydrazyl) and reducing power tests. The plant exhibited good DPPH radical scavenging activity (57.00% at 100 µg/mL in methanol extract) but moderate reducing power potential. Thus the study provided scientific evidence to the traditional uses of this plant in the treatment of disorders caused due to oxidative stress. Therefore, the leaf extracts of this plant can be selected for further investigation to predict their exact mechanism by isolating and purifying their active constituents.

Keywords: *Verbascum thapsus*, leaf extracts, DPPH, reducing power

Introduction
Pathological conditions such as ischemia, asthma, arthritis, inflammation, neuro-degeneration, Parkinson's diseases, mongolism, dementia etc. are caused by accumulation of free radicals. Natural products have become the target for a great number of research studies around the globe in finding the sources of potentially safe and more effective antioxidants [1]. Herbal drugs are considered as free radical scavengers for their therapeutic applications. Antioxidants are generally applied to prevent lipid per-oxidation in the food industries [2, 3].
Reactive oxygen species (ROS) are class of highly reactive molecules mostly derived from the oxygen metabolism through various mechanisms. Reactive oxygen species are an inevitable by-product of cellular respiration causing oxidation of lipids, nucleic acids and proteins thereby ROS damage is an underlying cause of many diseases [4, 6]. These free radicals exist in the body during an imbalance between Reactive oxygen species and antioxidants. Many medicinal plants contain valuable antioxidants such as Vitamin C, Vitamin E and polyphenols [7]. Natural antioxidants enhance the antioxidant potential of the plasma and reduce the risk of certain diseases related to heart and skin. There are many synthetic antioxidants but they are associated with many side effects hence there is a need for more potent and less toxic antioxidants [8]. It has been revealed that plants rich in phytochemicals especially polyphenolic compounds such as flavonoids possess antioxidant properties [9, 10]. Cells have refined antioxidant regulatory systems to maintain proper balance between ROS and antioxidants, however, disruption in homeostasis leads to oxidative stress and tissue injury [11, 12].
Verbascum thapsus Linn. (Family: Scrophulariaceae) grows all over Europe and in temperate Asia as far as the Himalayas and in North America. The plant is found wild on stony grounds, wastelands, woodlands, clearings and roadsides. *V. thapsus* is a herbaceous annual or biennial, erect and stout weed that produces a low vegetative rosette up to 60 cm. Leaf margins are entire or obscurely crenate and alternately arranged. Stem is erect and stout having 50-180 cm range of tallness. Flowers are densely arranged usually occurring one per axil. These flowers are yellow in colour bearing five sepals, five petals, two-celled ovary and five stamens [13, 14].
V. thapsus is known to exhibit many valuable medicinal properties such as analgesic, antihistaminic, anti-inflammatory, anticancer, antioxidant, antiviral, antibacterial, cardio-depressant, estrogenic, fungicide, hypnotic, sedative etc. The leaves, roots and flowers are usually anodyne, anti-inflammatory, antiseptic, spasmolytic, astringent, demulcent, diuretic, emollient, expectorant, nervine and vulnerary [15, 16].

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Analysis of Achyranthes aspera L. extracts for their α-Amylase and urease inhibitory activities

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Ved Prakash · Anand Sagar

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Abstract and figures

Plant products have served as a major source of useful drugs for centuries and about half of the pharmaceuticals in use today are derived from these natural products. The efficacy and safety of herbal medicines have attracted the attention of scientists towards medicinal plants research. The present study was designed to investigate the whole plant extracts of Achyranthes aspera L. for their anti-enzyme (α-amylae and urease) activity. All the extracts of A. aspera were reported to show good alpha-amylase and urease inhibitory activity of greater than 50% in all the solvents used at a concentration of 1 mg/mL. α- amylase inhibition ranged from 17.66±0.10-69.90±0.50% whereas urease inhibitory activity ranged from 18.60±0.50 to 79.90±0.50% suggesting a strong α- amylase and urease inhibitory effects of this plant. Thus the study provided scientific evidence to the traditional uses of this plant in the treatment of obesity, diabetes, ulcers, kidney stones intestinal infections etc. Therefore, the whole plant extracts of A. aspera can be selected for further investigation to find their therapeutic potential. Keywords: Achyranthes aspera, plant extracts, α-Amylase, Urease

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STUDIES ON ANTIBACTERIAL AND ANTIOXIDANT ACTIVITIES OF *CALTHA PALUSTRIS* L.

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Abstract

Antibacterial and antioxidant activities of *Caltha palustris* L. were evaluated by using agar-well diffusion method and DPPH free radical scavenging assay respectively. Antibacterial activity of different plant part extracts in acetone and methanol solvents was tested against four human pathogenic bacteria namely *Escherichia coli, Listeria monocytogenes, Shigella dysenteriae* and *Staphylococcus aureus* using different concentration (i.e. 25, 50, 75 and 100%.) Further, antioxidant activity of different extracts in acetone and methanol was also studied at 5%, 10%, 15% and 20% µg/mL concentrations. Extracts of different plant parts exhibited significant antibacterial and antioxidant activities. Methanol root extract showed greater zone of inhibition as compared to others extracts. Similarly, acetone leaf extract of this plant showed greater zone of inhibition as compared to others. Root and leaf acetone extracts of this plant exhibited higher antioxidant potential with lowest IC50 values 33.43 and 43.83 respectively. Potential antibacterial and antioxidant activity of this plant further investigated for knowing the bioactive molecules.

Key words: Zones of inhibition, Plant extracts, antibacterial activity, agar-well diffusion methods, DPPH (2, 2-Diphenyl-1-picrylhydrazyl) free radical scavenging assay.

Introduction

India is one of the 17-mega biodiversity centres possessing 10% of the biodiversity wealth in the world (Shiva, 1996). There are around 20,000 species of medicinal plants recorded in India till today (Dev, 1997). Himachal Pradesh is a hub of medicinal plants and people of the state have a good faith in curative properties of medicinal plants (Sharma *et al*., 2014). In India, different parts of medicinal plants have been used to cure various diseases from time immemorial (Bhattacharjee, 1998). Since, most of the available antimicrobial drugs are being resisted by microorganisms therefore researchers have focused on screening novel bioactive compounds from various medicinal plants having potential to overcome multiple drug resistance and be effectively curative in nature (Bizauyehu and Assefa, 2017). Medicinal plants produce a diverse range of bioactive molecules making them source of many useful drugs (Sukanya *et al*., 2009). Antioxidants protect the bio-molecules and different cell components from harmful free radicals by various mechanisms (Braca *et al*., 2002). The antioxidant compounds are effective free radical scavengers and popularly called secondary metabolites, present in all parts of plants (Methew and Abraham, 2006). These secondary metabolites functions as singlet or triplet oxygen quenchers, enzyme inhibitors, peroxide decomposers and synergists (Larson, 1998). Natural antioxidants are in more use as compared to synthetic antioxidants because these are less toxic, cost effective and having no side effects. Therefore interest in natural antioxidants is growing rapidly. Certain phytochemicals like flavonoids and phenolics are potent for free radical scavenging activity (Channda and Dave, 2009). Investigated medicinal plant *Caltha palustris* L. is a wild species of Ranunculaceae family having ethno-botanical medicinal uses has been collected and analised from district Kullu of Himachal Pradesh.

***Author for correspondence :**

Materials and Methods

Collection of plant material

Kharidhar is the name of collection area of this plant (*C. palustris*) located at altitudinal range of 2500-3500 meters in Panchayat Picchalihar, Tehsil and District Kullu

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BIORECLAMATORY STUDIES ON SALT AFFECTED SOIL BY USING CYANOBACTERIAL BIOFERTILIZERS

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Soniya Devi · Nisha Rani · Anand Sagar

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Abstract and figures

In the present investigation, three strains of cyanobacteria isolated from agricultural fields near to salt mine were used as biofertilizer individually and in consortia. Farm yard manure was also used along with cyanobacterial biofertilizers to see the ameliorative effect on soil physical, chemical and biological properties. The algalization experiment was conducted in pots in the glass house of the department for 240 days. There was an improvement in carbon, nitrogen, phosphate, potassium, magnesium, calcium, zinc, iron, copper and manganese with biofertilizers treatment whereas sodium ion, EC and pH were found to be decreased. Soil microbial activities and plant growth parameters were found to be improved. Thus, the cyanobacterial species show promise in effective exploitation for phytoremediation and improved productivity of saline soils.

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Diversity of Rhizosphere Fungi and VAM Fungal Spores Associated with *Murraya koenigii* (L.) Spreng. From Hamirpur District of Himachal Pradesh

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Abstract **– The study was conducted to isolate and identify the rhizosphere fungi and AM spores from the soil samples of *Murraya koenigii* (Curry patta) growing in three different sites of Hamirpur District of Himachal Pradesh. For the isolation of Rhizosphere fungi Dilute Plate Method was followed. Isolation and identification of AM spores was done by using Schenck and Perez (1990), manual. Investigations on rhizosphere fungi and VAM spores isolated from the root adhering soil samples of curry patta revealed the presence of thirty species of fungi and seven species of VAM fungi belonging to three genera were present. A comparison of seasonal distribution of these fungal associates revealed that twenty species belonging to 16 fungal genera (*Alternaria, Aspergillus, Chaetomium, Coniothyrium, Curvularia, Emericella, Fusarium, Gliocladium, Mortierella, Mucor, Penicillium, Phoma, Pythium, Rhizoctonia, Rhizopus* and *Trichoderma*) were reported in rainy season and eleven species of fungi belonging to seven genera (*Aspergillus, Cunninghmella, Fusarium, Mortierella, Penicillium, Rhizoctonia* and *Trichoderma*) were recorded in spring season. Eight species belonging to six genera (*Alternaria, Aspergillus, Baratalinia, Coniothyrium, Chaetomium*, and *Trichoderma*) were recorded in summer season and seven species of fungi belonging to four genera (*Aspergillus, Gliocladium, Mortierella* and *Penicillium*) were recorded in winter. The VAM fungi include three genera *Acaulospora*, *Gigaspora* and *Glomus. Acaulospora* was the dominant genus represented by four species (i.e. *A. delicata*, *A. foveata*, A. *mellae* and A. *spinosa*). The genus *Glomus* was represented by two species (i.e. *Glomus geosporum* and *Glomus macrocarpum*). The genus Gigaspora was represented by a single species (i.e. *Gigaspora calospora*). The results showed the association of rhizosphere as well as VAM (Vesicular *Arbuscular Mycorrhiza*) fungi in *Murraya koenigii*.**

Keywords **– Rhizosphere fungi, VAM, *Acaulospora*, *Gigaspora*, Curry Patta.**

I. INTRODUCTION

Murraya koenigii (L.) Spreng. is an important member of family Rutaceae. The genus *Murraya* include five species of which, the leaves of *Murraya koenigii* are used as an ingredient in curry. The common name of this plant is Curry Patta. It is distributed in India, China and Philippine islands. In India it grows in Himachal, Punjab, Parts of Assam (Lakhimpur), Bengal, Deccan, Konkan, Western Ghats of Bombay to Travan core and Ceylon.

The 'rhizosphere' generally refers to the zone of soil surrounding the roots with higher microbial activity than in soil remote from roots [1]. The rhizosphere microorganisms increase the ability of plants to acquire nutrients from soil by either increasing the extent of root system (through the fungal hyphae) or solubilising macronutrients such as phosphorous or sulphur [2].

VAM fungi are ubiquitous in distribution. They occur over a wide ecological zone. It has been estimated that VAM can be found in 70% of all plant families [3]. Members of order Glomales form mycorrhizal relationship with most agronomically important angiosperms, some gymnosperms, as well as certain bryophytes and pteridophytes and even a few algae [4].

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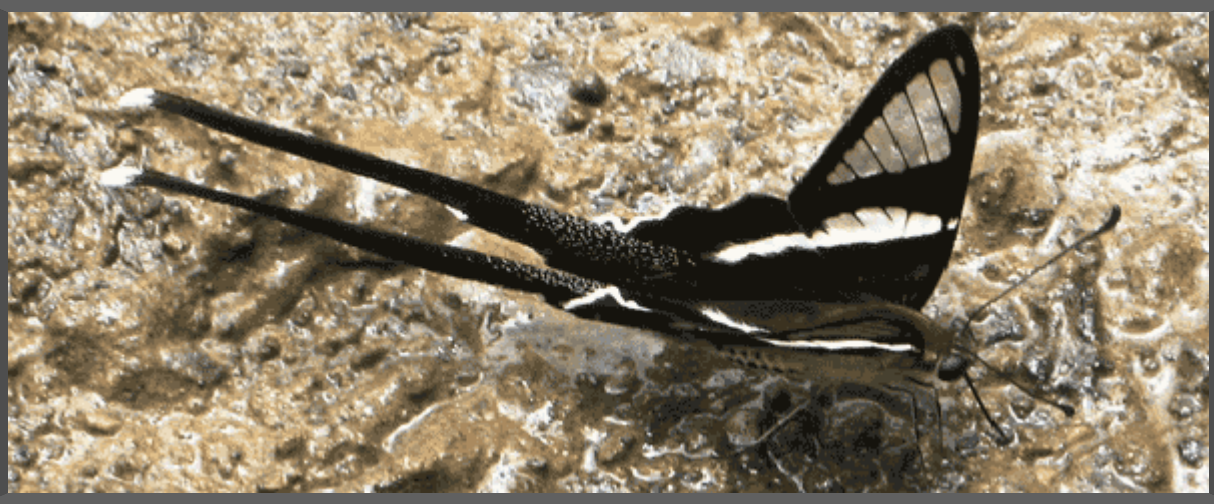

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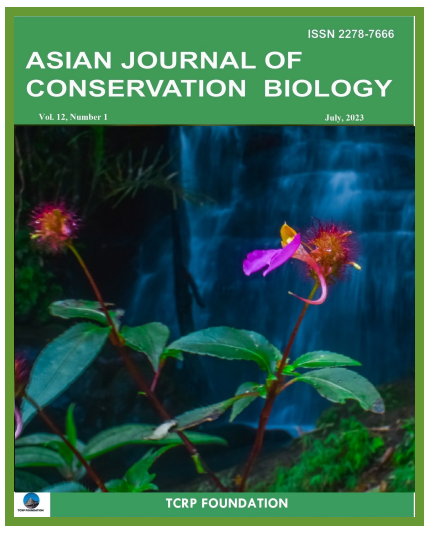

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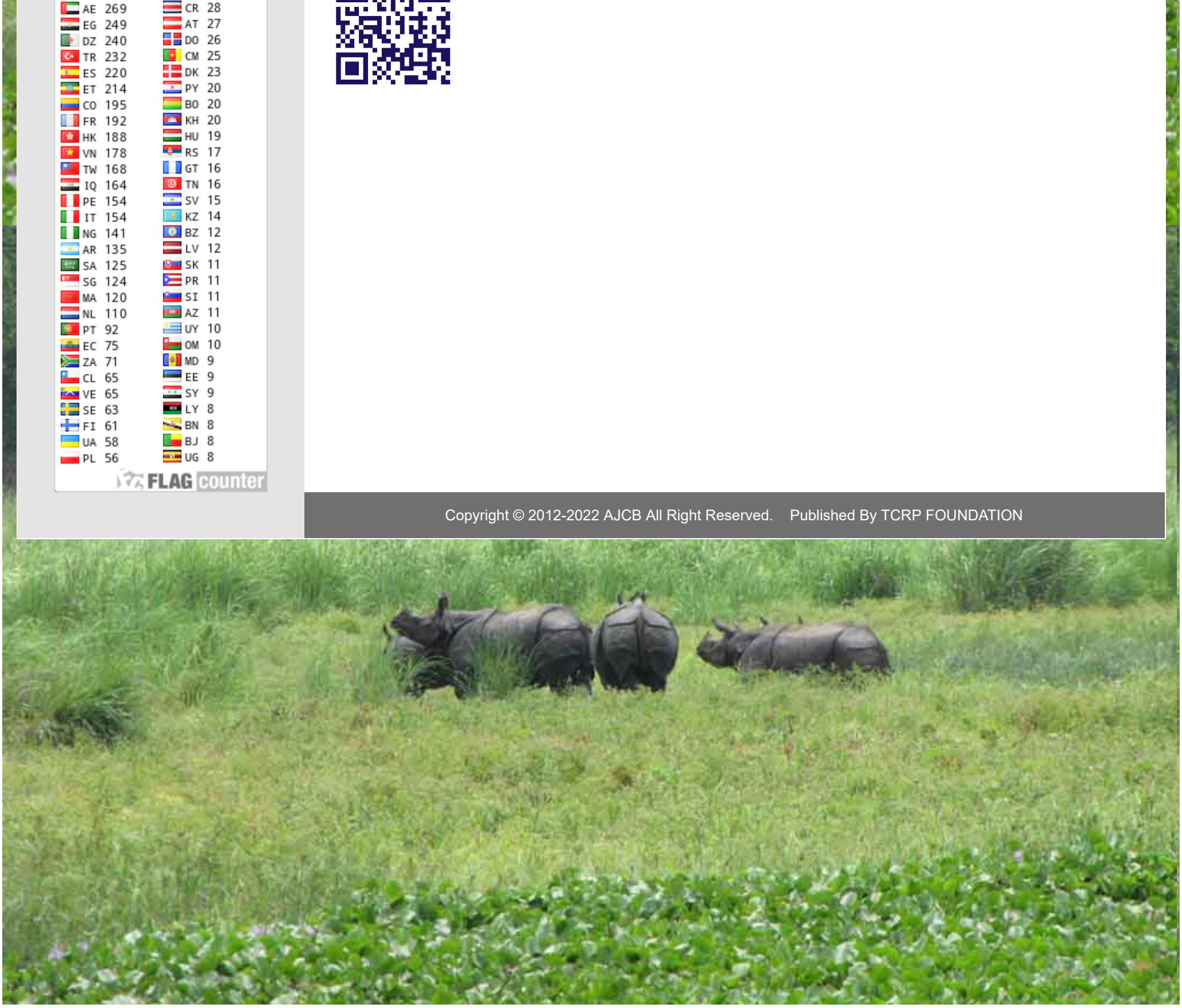

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Teachers' Perception towards National School Lunch Programme (Mid-Day Meal Scheme) In District Kangra of Himachal Pradesh at Elementary Level

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Abstract

The purpose of this study was to study the teacher's perception towards national school lunch programme (mid-day meal scheme) in district kangra of Himachal Pradesh at elementary level. A sample of 100 teachers, which included 74 female and 26 male teachers, were selected using purposive sampling technique. Teachers' perceptions towards national school lunch programme (Mid-Day Meal Scheme) studied by using questionnaire. The information collected through teacher's questionnaire, was put to percentage analysis to give meaning to data. This study will be very helpful to the teachers, policy makers and all others who are concerned with the mission to develop elementary education and reach the goal of universalization of Elementary Education in India.

KEYWORDS: Teachers Perception, National School Lunch Programme, MDM, Elementary level Himachal Pradesh.

Introduction

The Mid day Meal Scheme was launched by Government of India with the objective of giving a boost to universalisation of education by increasing enrollment, attendance and retention and simultaneously improving the nutritional status of students in primary/upper primary classes. Mid Day Meal in schools has had a long history in India. In 1925, a Mid Day Meal Programme was introduced for disadvantaged children in Madras Municipal Corporation. Levinger (1994) the impact of School Feeding Programmes (SFPs); National Council of Educational Research and Training (2000) improve the enrolment and retention of girls in schools; Grewal et al. (2004) Nutritional Status of Rural Punjabi Children; Rana (2005) Utilization of Resources at Primary Stage; De et al. (2005) Mid Day Meal Scheme (MDMS) ; Kumar (2005) Effectiveness of National Programme of Nutritional Support to Primary Education (Mid Day Meal scheme); Gangadharan (2006) Mid Day Meal Scheme (MDMS) (termed as noon-meal scheme in Kerala); Gupta (2006) Effectiveness of National Programme of Nutritional Support to Primary Education (Mid Day Meal scheme); Deodhar (2007) Mid Day Meal Scheme; Hadi (2009) Mid Day Meal Schemes; Sharma et al. (2010) Impact of wholesome mid day meal (MDM) program; Mehta and Kour (2012) The nutritional contribution of MDM to the actual daily dietary intake of children; Paul and Mondal (2012) Impact of Mid-day Meal Programme on Academic Performance of Students; Kales (2014) Mid-day meal scheme; Chhabra and Rao (2014) The Challenges and interventions in meeting delivery of nutrition in mid-day meal scheme; Grover and Kaur (2014) examine the execution of Mid Day Meal Scheme; Lalita (2016) examine the nutritional contribution of MDM norms at Upper primary Classes; Jayalakshmi and Jissa

(2017) The Nutritional status of Mid-Day Meal programme beneficiaries and Samal and Dehury (2017) Family Impact Analysis of Mid-day Meal (MDM) Scheme in India with Special Focus on Child Education and Nutrition.

Need:

Almost all of the above studies were conducted on enrolment and retention, utilization of Resources at Primary Stage, effectiveness of national programme of nutritional support to primary education (Mid Day Meal scheme) and no efforts have so far been to see the teachers perception towards national school lunch programme (mid-day meal scheme). So, to study the teachers perception at elementary level this study was selected.

OBJECTIVES:

1. To study teachers' perceptions towards national programme of nutritional support to elementary education in Kangra district of Himachal Pradesh with regard to achievement of objectives of mid day meal scheme.

2. To study teachers' perceptions towards national programme of nutritional support to elementary education in Kangra district of Himachal Pradesh with regard to quality of meal provided under mid day meal scheme and its preparation.

3. To study teachers' perceptions towards national programme of nutritional support to elementary education in Kangra district of Himachal Pradesh with regard to perceived effect of value inclination and development of hygienic habits among students.

4. To study teachers' perceptions towards national programme of nutritional support to elementary education in Kangra District of Himachal Pradesh with regarding their own role.

5. To study teachers' perceptions towards national programme of nutritional Support to elementary education in Kangra District of Himachal Pradesh with regard to perceived effect of mid day meal scheme with respect to some miscellaneous factors.

Tools:

To conduct the study effectively a questionnaire was developed by the researcher for the purpose of obtaining responses from the teachers. This questionnaire consisted of three parts in which Part-I is introductory, Parts-II consisted of closed type 30 items concerning all the important aspect of Mid-Day Meal Scheme and Parts-III consisted of open ended questions in which teachers were allowed to write down freely the problems related to implementation of Mid-Day Meal Scheme and also the suggestions for its improvements and making the scheme more effective.

Methodology:

To achieve the objectives of the present study effectively survey technique under descriptive method of research was used.

Sampling:

A sample of 100 Government primary school teachers both 26 males and 74 females was selected by using purposive sampling procedures.

Statistical Technique:

The data collected through questionnaire was analyzed. In the study percentage was used for the interpretation of data. The percentage means that the results are calculated and discussed from per 100 in order to understand the results in a better manner.

Results and Discussion:

Major Findings of the Study based on Teachers' Perceptions towards national school lunch programme (mid-day meal scheme) in district Kangra of Himachal Pradesh at elementary level

- 92% government elementary school teachers were of the view that Mid Day Meal Scheme is helping to achieve the goals of Universalization of Elementary' Education and 53% teachers responded that there is no increase in enrolment at all.
- Maximum 59% teachers responded that there is no increase in the attendance of students as a result of Mid Day Meal Scheme and 80% of the teachers are against the reduction in number of dropouts.
- Improvement in learning levels as per the reviews maximum number of 80% teachers responded that there is very little improvement in learning levels and 49% government school teachers were of the view that a very little improvement in nutritional status by the Mid Day Meal Scheme.
- 98% government elementary school teachers were of view that Mid Day Meal scheme is helping to balanced and nutritious diet and 90% school teachers are in favour whereas rest 10% teachers are of the view that Mid Day Meal scheme is helping to some extent only.
- 98% government school teachers are in favour that the quality of food grains (rice) provided by F.C.I. is good in quality and 99% teachers are with the view that all the precautions has been adopted by the staff while preparing Mid Day Meal.
- 98% teachers are in favour of inculcation of values through this Mid Day Meal scheme and as per the statistic 100% teachers are in favour of scheme to eradicate discrimination.
- Sitting arrangement of children from different castes as per the result 100% teachers are in favour of sitting together children of all caste.
- 100% teachers of the government school supported the idea of development of hygiene habits through this Mid Day Meal and 82% teachers are not taking the Mid Day Meal as a problem whereas 14% teachers are taking it as a problem.

- 91% teachers responded that they should be free from the responsibility of Mid Day Meal Scheme and 77% teachers are no problem of motivation for proper implementation of Mid Day Meal Scheme.
- 88% teachers that implementation of various schemes like Mid Day Meal . Sarav Shiksha Abhiyan etc. scheme is primary concern in government elementary schools and 82% teachers were in favour of Mid Day Meal Scheme in Himachal Pradesh they realized its need in the H.P.
- 91% teachers were that Mid Day Meal Scheme is not a wastes the teaching-learning time of teachers and students and 95% teachers were in favour of providing hot cooked mid day meal daily to the students in the school.
- 97% teachers were that after the launching of cooked Mid Day Meal Scheme there is inspection by parents/guardian of children in the context to this scheme and 63% teachers have expressed that students do not feel sleepy after taking mid day meal.
- 100% teachers perceived that the meal, which is provided to the children under Mid Day Meal Scheme is liked by the students and 100% teachers responded that there is no help received on the part of local people for the implementation of Mid Day Meal Scheme.

Major Findings of the Study based on Problems Related to Mid-Day Meal Scheme in district Kangra of Himachal Pradesh at elementary level

- In district Kangra mostly there is no separate kitchen in the elementary schools for preparation of mid day meal and the preparation of meals in the same surrounding near the classes disturb the students and teachers.
- The attention of students is distracted due to this inappropriate distance of kitchen from classrooms.
- Proper storage provisions are not available in most of the elementary schools.
- There are no safety provisions in case of any accident like fire, leakage of gas cylinder etc.
- The grant for National School Lunch Programme (Mid Day Meal) is not made available timely by the concerned department dealing with Mid Day Meal Scheme.
- There is no participation and help received from the local community for the implementation of National school lunch programme (Mid-day meal).

Major Findings of the Study based on Suggestions for Making the Scheme More Effective in district Kangra of Himachal Pradesh at elementary level

1. Elementary School Teachers should be relieved of all National School Lunch Programme (Mid Day Meal) responsibilities, except supervising the preparation and distribution of mid day meal.

2. Separate kitchen-cum- store should be made available to all government elementary schools and it should be at an appropriate distance from the classrooms.

3. The National School Lunch Programme (Mid Day Meal) should be implemented in such a manner that in any circumstances it does not adversely affect teaching-learning activities in schools.

4. The grant for National School Lunch Programme (Mid Day Meal) should be increased by taking into consideration the inflation rate and should be provided monthly well in time.

5. Encourage the participation of the local school management committee in the implementation of National School Lunch Programme (Mid Day Meal).

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EFFECT OF IMPLEMENTATION OF INCLUSIVE EDUCATION OF THE DISABLED AT SECONDARY STAGE (IEDSS) SCHEME IN THE STATE OF HIMACHAL PRADESH

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Abstract

Disability is part of human life, and children with disabilities can be found in every society, every culture and every community throughout the world. They have the right to have respect and support in order to ensure their full participation and equality in society, but often, as a result of social attitudes or environment, they are unable to realize these rights. "Education contributes to an individual's journey toward self-reliance and independence. Schools and instruction must be designed and organized to meet the varying needs of individual learners". The present study is an attempt in this direction and assesses the objectives of Inclusive Education of the Disabled at Secondary Stage (IEDSS) in terms of indicators of access, quality and equity.

***Keywords**: Disability, Disabled students, Inclusive Education, Secondary Stage, IEDSS etc.*

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INTRODUCTION:

The concept of an Inclusive Education is clearly a shift from the traditional welfare and service oriented practice of special/integrated education that is no longer appropriate or effective given the current agenda based on human rights. Inclusive Education is a relatively new concept, and is now recognized throughout the world. Inclusive.

Education in essence stands for equality, and accepts every child with his or her own unique capabilities. This notion is now being accepted by all the international, national and local educational programmes. Inclusion therefore entails the educational system making it open and welcoming to all. As far as the inclusion of disabled children is concerned, there is a shift

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in outlook and the services from `care of the disabled child' to `education and personal development' of the child.

INCLUSIVE EDUCATION OF THE DISABLED AT SECONDARY STAGE (IEDSS) SCHEME IN HIMACHAL PRADESH:

A proposal was finalized and submitted by Himachal Pradesh Government to Government of India (G.O.I.) in 2010-2011. The proposal was approved by the Government of India (G.O.I.) in 2013-2014 and in the same year Himachal Pradesh Government executed that with immediate effect. With the mandate of providing education to every child with special needs (CWSN), irrespective of the kind, category and degree of disability, in an appropriate environment, Inclusive Education for Disabled at Secondary Stage (IEDSS) was commenced in the state in 2013-14.

REVIEW OF RELATED LITERATURE:

Affleck et al (1988) also found no significant differences in academic progress when they compared pupils without disabilities in inclusive settings (N=39) to the progress of pupils in non-inclusive settings (in this case, a comparable group in the same school but whose class did not include pupils with SEN). The pupils with SEN had mild 'handicaps', described by the authors as learning disabilities, mild 'mental retardation' and severe behavioural disorders. The measures taken carried out by California Achievement Test Battery. The results showed no significant differences between the groups. The authors conclude that placing pupils with SEN in inclusion setting does not help or hinder the academic performance of pupils without special educational needs.

Jan et al. (1990) described neurological, developmental and cognitive differences that exist between visually impaired, blind and sighted children. The findings revealed that visual impairment affects the total process of gathering and exchanging information and the effect is noticeable not only in motor skills, but also in cognition, language development and social skills.

Singal (2007) contends that in India inclusive education is understood and practiced differently from the western world. In fact there is ''a tendency to be 'politically correct' by taking on current trends in the west without a real or common understanding of their meaning, resulting in dilution of service quality''. Ideally, "inclusive education means

attending the age appropriate class of the child's local school, with individually tailored support".

Subramanyam and Rao (2008) aimed at assessing the impact of gender on emotional intelligence and academic achievement of secondary school students. The investigators concluded that there was no significant difference with regard to the impact of gender on emotional intelligence and academic achievement.

Reema (2010) conducted a study of relationship between self-concept and adjustment of visually impaired adolescents studying in inclusive and special schools. The findings of the study revealed that the development of self-concept was better in inclusive schools. It was even better in the case of male adolescent than the female ones. The relationship between self-concept and level of adjustment in the case of female adolescents was better in inclusive school settings than their male counterparts. This trend was reversed in the case of relationship between those aspects in special schools.

M. Tariq Ahsan (2011) did his work on "Meeting the Challenges of Inclusive Education in Bangladesh" the impact of the international trends for adopting inclusive educational approaches on the developing country contexts. While critically analysing the issue & mentioned about the uniqueness of the challenges of developing countries that include massive diversity in students, resource challenges, teacher readiness, accessibility related challenges, curricula and pedagogy reform and also the reluctance of the systems to accept reforms related to inclusion.

Sood Siddhi and Agnihotri Kamakshi (2015) studied the topic entitled "status of inclusion of children with special needs and effective teaching in inclusive classrooms". Inclusion, right of Children with Special Needs, is an approach to educate students with special educational needs with non-disabled children, i.e., Inclusive Education.

OBJECTIVE:

To study the perception of parents towards the implementation of INCLUSIVE EDUCATION OF THE DISABLED AT SECONDARY STAGE (IEDSS) Scheme in the state of Himachal Pradesh.

METHODOLOGY AND PROCEDURE:

The population in this study included all government secondary and senior secondary schools students' parents of Himachal Pradesh state.

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EFFECT OF IMPLEMENTATION OF INCLUSIVE EDUCATION OF THE DISABLED AT SECONDARY STAGE (IEDSS) SCHEME IN THE STATE OF HIMACHAL PRADESH

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Abstract: *Inclusive education is a pairing of philosophy and pedagogical practices that allow each student to feel respected, confident and safe so he or she can learn and develop to his or her full potential. It is based on a system of values and beliefs centred on the best interests of the student, which promotes social cohesion, belonging, and active participation in learning, a complete school experience, and positive interactions with peers and others in the school community. These values and beliefs will be shared by schools and communities. Inclusive education is put into practice within school communities that value diversity and nurture the well-being and quality of learning of each of their members. Inclusive education is carried out through a range of public and community programs and services available to all students. The present study was undertaken to investigate the perception of teachers towards implementation of IEDSS (Inclusive Education of the Disabled at Secondary Stage) in the state of Himachal Pradesh.*

Key Words: *Inclusive Education, Disabled students, Secondary Stage, IEDSS etc.*

1. INTRODUCTION:

Education occupies a very important place in the history and life of a nation. It is most important single factor in the achievement of rapid economic development and technological progress and also it assists in creating healthy society which aim to promote social justice through equal opportunities and freedom to masses. It is very much essential to the refinement of the cultural life of the society. So long as the educational system of a civilization is sound and comprehensive, it is alive; otherwise it could fall into small fragments. For a long time those concerned with the field of education have been grappling with the serious question of what kind of education to provide for children especially in the context of varying and different abilities of the students. Traditionally education had come to be separated into two types, namely, general education and special education. Experts and authorities have been increasingly questioning for some time now if this was a correct approach to provide education in a situation where there were children with differing abilities. It had been believed earlier that children with differing needs and especially those with special needs must be given education separately. Owing to lack of knowledge, educational access and technology, disabled or challenged and disabled children were therefore initially segregated from other children. This had led to the rise of general schools on one hand and on the other, the establishment of 'Special Schools' for the disabled or the disabled. Since the last three decades this segregation in the education field has come under severe criticism and now a consensus has begun to emerge that instead of continuing with segregated education, inclusive education must be provided. Hence efforts have been made in this direction, particularly during last two decades.

1.1. INCLUSIVE EDUCATION OF THE DISABLED AT SECONDARY STAGE (IEDSS) SCHEME:

The National Policy on Education (NPE), 1986 and the Programme of Action (1992) gives the basic policy framework for education, emphasizing on correcting the existing inequalities. It stresses on reducing dropout rates, improving learning achievements and expanding access to students who have not had an easy opportunity to be a part of the general system. The NPE, 1986 envisaged some measures for integrating of children with physical and mental handicap with the general community as equal partners, preparing them for their normal growth and development and enabling them to face life with courage and confidence. India has also been a signatory to international declarations like the Salamanca Statement and Framework for Action on Special Needs Education (1994) and the Biwako Millennium Framework for Action (2002) and the UN Convention on the Rights of Persons with Disabilities, 2006 that emphasize the need for fundamental educational policy shifts to enable general schools to include children with disabilities. The Centrally Sponsored Scheme of Integrated Education for the Disabled Children (revised 1992) is presently being implemented in States and UTs in over 90,000 schools benefiting over 2,00,000 children with disabilities. The scheme was introduced with a view to providing educational opportunities for children with disabilities in general schools, to facilitate their retention in the school system. It provides for facilities to students with disabilities including expenses on

books and stationery, expenses on uniforms, transport allowance, reader allowance, escort allowance, hostel accommodation and actual cost of equipment. The scheme also supports the appointment of special teachers, provision for resource rooms and removal of architectural barriers in schools. An important policy development after 1992 has been the enactment of Persons with Disabilities (Equal Opportunities, Protections of Rights and Full Participation) Act, 1995. Article 26 (a) of the Act makes it a statutory responsibility on the part of Central, State and Local Governments to provide free education in an "appropriate environment" for all children with disabilities up to the age of 18 years. Article 26(b) of the Act calls upon appropriate governments and local authorities to promote the integration of students with disabilities in normal schools. In addition, the Act stipulates that the appropriate Governments and the local authorities, inter alia, shall make schemes for varieties of educational initiatives and strategies.

2. REVIEW OF RELATED LITERATURE:

Singal (2007) contends that in India inclusive education is understood and practiced differently from the western world. In fact there is ''a tendency to be 'politically correct' by taking on current trends in the west without a real or common understanding of their meaning, resulting in dilution of service quality''. Ideally, "inclusive education means attending the age appropriate class of the child's local school, with individually tailored support".

Arunmozhi and Rajendran (2008) made an attempt to assess the influence of age, marital status, type of family, community and family status on the emotional intelligence of 305 women self-help group members. The investigator concluded that the self-help group members do not differ in their emotional intelligence based on their age, marital status, type of family community and family status.

Nusrat Zerin (2009) done his work on Braille Champions: Inclusive and Community Development Approach to Support Children with Visual Impairment - Experience of Sight savers Bangladesh. Sight savers Bangladesh is demonstrating the Braille champion approach, which is creating mass awareness in the community and ensuring more involvement and participation of community people in the process of implementing inclusive education of persons with visual impairment and children. Thus, illiterate persons with visual impairment are becoming literate and the children with visual impairment are getting community level support in learning Braille.

Brenda Peters and Chris Forlin (2010) did their work on "Children with ASD as Part of the Learning Community in Three International Schools in Hong Kong: Practical Implications for Class Practice" there has been a global rise in the numbers of children and young people with special educational needs, including those with Autism Spectrum Disorder (ASD), attending regular schools. The inclusion of children with ASD into regular classrooms has been mooted the most challenging for teachers. A wealth of research has investigated inclusive practices in the West. Little is known, however, about inclusive practices in Hong Kong schools for learners with ASD. Therefore, reports the results of a mixed methods study that focuses on enhancing social communication and interaction for learners with ASD. Extant inclusive class practices and opportunities for social interaction and communication for children with ASD in regular schools in Hong Kong are identified and practical implications for class practice are employed.

Astha, Bhargav Smriti and Vats Rajeev (2012) done their work on "inclusive education for disabled at secondary stage in Haryana: inputs and action required" and found that education of children with disabilities has seen a paradigm shift from segregated education in separate schools to inclusive education in regular schools along with normal children. Successful implementation of inclusive education requires consideration of policy matters, legislation reforms, financial resources, human resources, infrastructural resources and intellectual resources. There is an urgent need for providing competencies at various levels for inclusion to be successful.

Ram & Rao (2013) investigated in their study and found that providing quality education for all children in inclusive setting has been identified as the most challenging. The main purpose of this study was to find an approach of elementary school teachers for inclusive education. Attitude towards the Inclusive Education Scale (ATIES) was conducted on 78 teachers, who were working in primary school in Visakhapatnam district of Andhra Pradesh. It was found that the primary school teacher had a positive attitude towards inclusive education, significant differences found in approach towards inclusive education in relation to sex, area, age educational qualification and learning experience etc.

2.1. OBJECTIVE:

To study the perception of Teachers towards the implementation of INCLUSIVE EDUCATION OF THE DISABLED AT SECONDARY STAGE (IEDSS) Scheme in the state of Himachal Pradesh.

3. METHODOLOGY AND PROCEDURE:

The population in this study included all government secondary and senior secondary schools teachers of Himachal Pradesh state.

3.1. SAMPLE OF THE STUDY: 94 schools, 10 % of the government secondary and senior secondary schools of four sample districts, were taken up out of the total number of 940 schools and 2 teachers of each sample schools (i.e. 188 teachers) sample districts were included in the sample.

4. RESULTS:

Table 1. Perception of Teachers for the evaluation of inclusive education for disabled at secondary stage (IEDSS) in Himachal Pradesh (Total Teachers= 188)

A. Attainment of Indicators that provide educational opportunities and facilities to the students with disabilities at secondary level:

Item No.	Description	Response					
		Yes		No		Not Sure	
		N	%	N	%	N	%
i.	**Identification and assessment of children with disabilities**						
1.	Is the assessment team assess and identify the CWSN?	188	100	0	0	0	0
	If Yes, the assessment team include which of the following:						
	a. Special Educator	188	100	0	0	0	0
	b. Clinic Psychologists	188	100	0	0	0	0
	c. Therapists	188	100	0	0	0	0
	d. Doctors	188	100	0	0	0	0
	e. Any other, please specify	0	0	0	0	0	0
2.	Did CWSN attend the medical camp organized for the assessment of CWSN?	188	100	0	0	0	0
	If yes, were they diagnosed to be in need of some assistive devices?	188	100	0	0	0	0
3	Was any disability certificate issued to them?	188	100	0	0	0	0
	If yes, by whom?						
	a)Doctors and department of social justice and empowerment.	188	100	0	0	0	0
ii.	**Provision of aids and appliances to all the students with disabilities needing them.**						
4.	Is there any provision of aids and appliances to all CWSN Students?	188	100	0	0	0	0
	If yes, the Devices are:						
	a. Braille Textbooks	166	88.30	22	11.70	0	0
	b. Audiotapes	114	64.77	57	32.39	5	2.84
	c. Talking Books	188	100	0	0	0	0
	d. Textbooks in Large prints	124	65.96	61	32.44	3	1.60
	e. Locomotive devices	188	100	0	0	0	0
	f. Spectacled	188	100	0	0	0	0
	Please Tick and name it in the following by which schemes these are provided to CWSN like:						
	g. State or Centre IEDSS Scheme	188	100	0	0	0	0
	h. Voluntary organisations	86	45.74	102	54.26	0	0
	i. Rotary Clubs	34	18.09	66	81.91	0	0
	j. Any other, like Donations by volunteers	188	100	0	0	0	0
iii.	**Access to Learning Material ensuring that each disabled student will have access to learning material.**						
5	Whether appropriate TLM is available for CWSN?	188	100	0	0	0	0

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Rethinking Status of Goddesses in Greek and Indian Mythology: A Prefatory Comment

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Abstract

Myth is a folklore genre in which characters are usually gods, demigods, or supernatural humans. Myths are endorsed by rulers and priests and are closely linked to the way a religion is practiced. In referring to their remote past many societies invoke their myths, legends or history to make an evaluation of their present. Indian and Greek mythologies are very ancient and share some startling similarities. However, mythological history across civilizations has been largely recorded by male sages, poets or philosophers like Aeschylus, Homer, Sophocles, Valmiki, Kalidas. A closer scrutiny of goddesses in various mythological traditions clearly shows that every culture was dominated by male gods although goddesses were elevated to the status of mothers or deities. In both Greek and Indian mythologies gods, who we worship, have ill-treated goddesses. The present paper highlights sufferings faced by goddesses or their subjugation in Greek and Indian mythologies.

Keywords: **mythology, goddesses, folklore, subjugation, gods, culture, discrimination**

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Indian and Greek mythologies are two very popular ancient mythologies known to the world. Both mythologies have no settled connections with one another yet these share some startling similarities. Devdutt Pattanaik, an Indian mythologist, draws links between Indian and ancient Greek mythological practices. He draws parallels between Greek and Indian mythologies—'Dionysus and Shiva', '*Illiad* and *Ramayana*', 'Hercules and Krishna', 'Indra and Zeus', 'Sita and Persephone', 'Mount Olympus and Kailasha'[1] and many others. Mythologies have given variety of sacred and spiritual ideas and thereby manipulated social and cultural life of societies. Worshipping goddesses as mothers is one such idea which has trickled down in the present societies wherein women are revered as mothers. In all societies Ahmed Rasool argues "The responsibility of women for the preparation of food, reproduction and maintenance of children creates this meaning for the human community at a time that the female is guarantee of the survival of the human community. Based on this conception the image of women, they gained more power in society, the persistence of life by women, turned into a sacred matter… they were sanctified to the extent that they were praised as Goddesses and mother-gods" (24). Perhaps the most important reason of treating them as Goddesses was the fertility and reproduction (25).

History is written by men—Indian, Greek or Persian sages, poets or philosophers like Aeschylus, Homer, Sophocles, Valmiki, Kalidas recorded or created myths. All the goddesses that we revere or worship have been invented or discovered by men. In "Unearthing the Goddess Within" Christine C Keating suggests "a discourse that has been established by a patriarchal myth. We were given such characters with their beauty and flaws, by men" (486).

Martha Beck in 'Using the Greek Goddesses to Create a Well-lived Life for Women' says:

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> People's behavior, that how should one act and behave is mere a personification of Gods and Goddesses of Greek, Hindu and other mythologies. This pattern or behavior is followed by every person. Gods are embodiment of each thing they do. Our myths clearly show how every culture is male dominating 'patriarchal'. And men eventually use their power to abuse women. They are exposed and condemned in myths and suddenly we realize, gods who we think to be sacred, actually treated their women in similar abusive manner, they made their women to suffer for what they did or not, knowingly or unknowingly. (1)

In any mythology one finds plethora of stories in which goddesses are humiliated or punished by their male counterparts. Irrespective of any religion or culture a society imitates their gods and goddesses to legitimize their social or personal conduct. One takes examples from their life and tries to follow them. On a closer view one can easily find that the goddesses were generally subjugated in various mythologies. They rarely had an independent voice. In real life there is no practical equality between man and women in any society. Women might appear to be happy and rejoicing their honorable status but in real life they are subject to all sorts of maltreatment and misconduct. "Make her Lakshmi" and set boundaries for her—is one of the commonly spoken lines in India**.**

Sue Blundell and Susan Blundell in *Women in Ancient Greece* describe:

> …Evolution of patriarchal dive power and of an orderly cosmos are seen to be inextricably linked. Thus male domination is represented as an essential ingredient in the stability of the universe and the justice of divine rule… Uranus tried to block the birth of his children, and it was from his genitals that the Aphrodite was born. Cronus swallowed his children and then disgorged them through his mouth… Zeus is the ruler, he produces a daughter, Athena. this means he

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> completely usurps the woman's reproductive role; and birth now takes place from the head, the seat of wisdom. (21)

Aphrodite being born from the genitals of Cronos and Eve from the ribs of Adam--by this they seized the mother's reproduction. The male takes the role of a creator. Every single culture and religion glorify the magnificence of gods alone while goddesses are given a secondary role of child bearing and child rearing. Everyone is aware of the fact that fertility is in women's nature. That is why earth is worshipped as a mother because of its productive nature.

In ancient Greece several restrictions were imposed on women. They married off their daughters as soon as they attained puberty and gained sexual awareness. Many scholars claim Draupadi was married to five Pandavas as she attained her puberty at the age of sixteen; Sita was married to Lord Rama at the age of six. Similarly, Helen of Troy was married when she was seven or ten years old. P. Walcot, in "Greek Attitudes towards Women: The Mythological Evidence" says "Marriage was arranged at this age so that they could not easily tempted by all other suitors. In the course of time, it has become propensity of a man to devalue woman and they viewed her as an object of entertainment "(38). Another important factor of the passiveness of Indian women is they prefer to suffer and be dutiful to their husbands rather than submit themselves to others for the sake of pleasure and love. A popular example is of Washerman's wife in Ramayana**,** who remained truthful and dutiful to her husband after all his atrocities, she remained loyal to him. Persephone, who was the daughter of Demeter, the Goddess of grain, was abducted by Hades, the God of under-world. She pacified her mother that she would live with him and remained faithful to him.

There are many stories in Greek or Indian mythology where one finds issues like rape or abduction and there is no doubt that the female body is frequently made susceptible to sexual assault. In *Mahabharata* one witnesses the plight and agony of Draupadi, who had five

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husbands, walked through fire to restore her virginity before she went to the next husband. Men desire pure, virgin and dutiful yet quiet women. To use a Keatsian phrase in "Ode to Grecian Urn", "unravished bride of quietness." Nobody can measure the trauma of Draupadi when she was called a 'whore' in the gambling hall of Kaurvas. Similarly, Menelaus, King of Sparta used to call his wife, Helen of Troy, a whore, and curse her beauty.

According to Manu a woman's most important duty is taking care of her children, husband and the extended family as protector and supplier. According to *Manusamriti* Verse 9.3 "Pita raksati kaumare bharata raksati yauvane|raksanti sthavire putra na nari svatantryamarhati||3|| "The father guards her during virginity, the husband guards her in youth, the sons guard her in old age; the women is never fit for independence" (258). Manu in *Manusmriti* again added guidelines for men, "even if man's mind is unable to resist and is full of desires, he should avoid to have sex with a woman who is on menstruation; he should not even sleep with her in the same bed. A man who has sex with a woman flooded in menstrual blood loses his wisdom, energy, strength, eyesight and long life" (255). The ideal Indian womanhood has often been transmitted through the highly popular expression 'Sati-Savitri'. The figure of Sati and Savitri constitute imitable standards of Hindu womanhood passed on by Indian mythology. Sati has been seamless in strengthening ideal of Hindu womanhood in which a wife stood by her husband's side in every situation and Savitri brings the husband back from the kingdom of dead. In *Iliad* Homer describes the role of women as a mere toy or object over which men fight with each other. Sharon L. James and Sheila Dillon in *A Companion to Women in Ancient World* say there is a constant "Conflict between Agamemnon and Achilles for the ownership of the captive Briseis" (57) and in *Ramayana* Tara, wife of Bali felt crushed between two brothers Bali and her brother-in-law, Sugriva, for the throne of Kishkindha.

Devdutt Pattanaik in his book *Sita: An Illustrated retelling of Ramayana* retells a story of Renuka.She was so faithful to Jamadagni that she could collect water for him from the river in

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unbaked pots. One day Renuka saw a Gandhrava bathing in the river. She forgot the purpose and got late to return home. Jamdagani accused her of adultery and ordered his sons to cut-off their mother's head. Four out of five refused, but the youngest one swung his axe and did the needful. He used the axe in so dreadful manner, thereafter he is known to the world as Parushrama (n.pag.). Devdutt Pattanaik in *7 Secrets of the Goddesses* explains "Sita proves her fidelity by going through a trial by fire. A Sati's fidelity allegedly offered her protection from widowhood. *The Puranas* tells the story of Shilavati, who carries her leper husband on her shoulders to prostitutes. A sage is so disgusted by her husband that he declares he will die when the sun rises next. Shilavati then uses her power of chastity to prevent the sun from rising" (25).

In biblical mythology Eve is tempted by the serpent and eats the fruit from the tree of knowledge and also compels Adam to do so. For this act of transgression, both Adam and Eve are cast out of Paradise and Eve is made subservient to Adam. Before the creation of Eve, god is said to have created Lilith with hairy legs, but she refused to be subservient to Adam and so was cast out, and eventually she became the mother of Monsters.

Society located its honour in woman's body. Thousand Greek ships sailed to bring back Helen, the wife of Menelaus, King of Sparta, who eloped with Paris, Prince of Troy. Greek epics described her action brought shame to all of Greece. After Troy was torn to the ground, the wives of Trojan Warriors were brought back to Greece as concubines. Agamemnon, the leader of the Greeks, who had sacrificed his daughter Ipigeniah, to ensure good winds as they sailed to battle, returned with the Trojan princess Cassandra by his side. Agamemnon's wife, Clytemnestra was so angry that she murdered her husband and his concubine

In these stories one finds a woman stops being a person; she is dehumanised and turned into a symbol of masculine honour. This transformation from prized possession to venerated object marks the triumph of patriarchy.

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If Gods are true symbols of infallibility, then why did goddesses suffer irreparably and immensely in *Ramayana, Mahabharata, Iliad,* and *Odyssey*? Standards of morality had been set by Gods: as Rama is known for his 'righteousness', Shiva for his 'impartiality', Brahma for his 'justice', Zeus for his 'mercy', and Poseidon for his 'friendly nature. That's why they are worshipped. But even gods failed to sustain 'dharmic' conduct. Following are a few examples of goddesses from Indian and Greek mythology of goddesses who have been subjugated and victimized? Most of the goddesses in great epics like *Ramayana, Illiad, Odyssey,* and *Mahabharta* suffered immensely at the hands of gods or sages.

Goddesses are generally linked with beauty, love, motherhood and fertility whereas gods are linked to valour, strength, masculinity, saviours of women, warriors—a clear binary.

II

Helen and Sita

Both *Iliad* and *Ramayana* are always glorified with the tales of heroism and hyper masculinity. Amidst the glory of men depicted in these epics lies a woman who's sacrifice and fidelity is always neglected and marginalized. In "How *Iliad* and *Mahabharata* have depicted Woman as Catalysts of War" Divya Godbole says women were harbingers of war simply because they were silent or were silenced in the course of the narrative. These muted characters and their positions were presented as catalysts of war… Their beauty was a weapon in their arsenal that they apparently used to bring the down fall of great men". Madhu Kishwar in "Yes to Sita, No to Ram" says "Sita's proof of being a chaste, by coercing her through 'Agnipariksha' was a sudden whim of an unreasonable and dubious husband" (23). When Sita came back to Ayodhya, she was not welcomed there and they called her impure. Rama sent pregnant Sita to the forest against her will and she suffered her entire life**.** Helen, who was daughter of Zeus and wife of Menelaus suffered similar fate. Margaret R. Scherer in "Helen of Troy" says "how Zeus made a plan with

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Themis, Goddess of order, to bring about the Trojan War. And it was him who made Helen to run away with him and this resulted into Trojan War. Helen was mere a puppet of Zeus and Aphrodite's conspiracy. When Helen came back to Sparta, Menelaus in undignified manner used to call her 'whore'. Gods were the reason why these two women wailed all of their life" (369-70).

Diti and Gaia

Stories of killing foetus in a mother's womb or murdering new born babies out of fear either of castration or usurpation of the throne is quite common in different mythologies. In Indian mythology one finds examples of Diti (mother of Asuras, Marutas) and Devaki (biological mother of Krishana) whose brother Kamsa killed her seven sons. And in Greek mythology one finds Gaia (Earth-mother) and Rhea (daughter of Gaia) who also suffered same pain as their husbands Uranus and Cronus swallowed their own children and controlled parturition.

Diti is the mother of both the Marutas and the Asuras and sister of Aditi and Sati. Many sons of Diti were killed by Indra. In her grief Diti, pleaded with sage Kashyapa, her husband, that she should be blessed with a heroic son. Out of fear Indra managed to splinter her foetus into several pieces who became devas known as 'Maruts'. Whenever she asked her husband to have intercourse. He avoided her by saying, women should control their desires. According to *Srimad Bhagavatam* in Canto 3(3.14.23) women (only women) need to control her sex desires. "the difference between a married wife and a public prostitute is that one is restrained in sex life by the rules and regulations of the scriptures, whereas the other is unrestricted in sex life and is conducted solely by the strong sex urge."[3]

One finds a similar situation in Greek mythology. Gaia is personification of Earth in Greek mythology. *7 Secrets of Goddesses* of Devdutt Pattanaik tells a story of Gaia: her mate Uranus, the starry sky, clung to her intimately and gave her no space to deliver her children. After

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castrating Uranus, his father Cronus declared himself king and ate his own children to prevent them from overpowering him as he overpowered his father. Gaia saves one son, Zeus, from the brutality of Cronus, and eventually Zeus attacked and killed Cronus. In triumph Zeus declared himself the father of Gods and takes residence atop Mount Olympus. Gaia remained the earth-mother, respected but distant (3). One can't say whether relations between Earth and other Gods was ever amiable. Donald J. Hughes and Frank Richard in "Gaia: Environmental Problems in Chthonic Perspective" say "The Gods, warrior of sky are mostly males. Sky gods became Olympians, by dominating and exasperating Gaia" (95). Woman has always paid for a man's greed.

Persephone and Saraswati

According to the Bible Eve was born out of Adam's ribs and is technically the daughter of Adam. In certain versions Adam and Eve are viewed as siblings born like two parts of single fruit. Therefore, the relation between them can be called incestuous. *Rig Veda* also tells a story of Dyaus, who had an incestuous relation with his daughter Usha. Devdutt Pattanaik in *7 Secrets of Goddesses* retells a story in which son of Brahma tried to rape his own daughter. There are many similar stories of rape and incest in different mythologies. Zeus, the lord of gods and impersonator was notorious for his libido. He had secretly seduced wives and daughters of many kings. He took the form of Swan and made love with Leda. He took the form of a beam-light and made love to Danae. He made love to Alcmene, disguised as her husband Amphitryon. Michael L. Morgan in "Plato and Greek Religion" explains that "In the shape of a serpent Zeus violently raped his mother Rhea and sired Persephone then he raped Persephone and sired Dionysos (237). In Indian mythology Brahma is considered to be the first amongst Gods. Saraswati came out from his mouth and he created human race. *Shiva Purana* tells us that when Brahma's daughter came into being Brahma desired her. In *7 Secrets of Goddesses* Devdutt Pattanaik is of the view that disgusted by the incestuous craving of father, Shiva beheaded brahma and took upon himself

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the great burden of Brahma-hatya-paap. *Vishnu Purana* tells us that Ravana, a brahmin, abducted Ram's wife, Sita, not remembering that she is actually his daughter whom he had abandoned long ago (91-93).

Surapnakha and Medusa

In various mythologies the pain of goddesses remains unsung and unhonoured**.** There are many female characters in male epics who are misunderstood, ignored and almost forgotten. Those women are always seen and understood through this patriarchal vision. Both Surapnakha and Medusa are examples of those misunderstood characters and have been portrayed as demon, ogress and bad women. A dominating, vocal, sexually aggressive woman is seen as a threat to patriarchal society. Athena originated from Zeus's head, and was devoted to her father and usually did things that pleased him. Patriarchy here works this way. The name Medusa originated from a Greek word meaning 'Guardian'—was one of the three Gorgons sisters and after rejecting her childhood lover, she chose to be a priestess of Athena's temple. One day Poseidon in a fit of rage raped Medusa in the temple of Athena. Athena found Medusa guilty for seducing Poseidon cursed Medusa and turned her into a monster and transformed her hair into serpents. William S. Duffy in "Medusa as Victim and Tool of Male Aggression" says, Ovid was the first author who recognised Medusa as a rape victim. In Greek mythology one finds Gods routinely having non-consensual sex with mortal women without sustaining its consequences and without losing their status and prominence. And women were reprimanded badly for attracting the gods (5-6).

In Indian context there is a story which revolves around the most misunderstood character of *Ramayana*, Ravana's sister, Meenakshi, who was innocent, naïve, and sweet. In her childhood because of her ugliness, she faced the ignorance of her mother and later she fell in love with Vidyujiva and married him, soon after the death of her husband, on the orders of Ravana, she metamorphosed from sweet Meenakshi to ogress Surapanakha, one with sharp nails. In Dhanak

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forest, Rama ordered his brother Laxamana to slice off Surapnakha's ears and nose. In a revenge Ravana abducted Sita. The alternative story of Surapnakha's describes her as a strong independent woman, who is able to fight for her own rights. She is equally strong as any man. She was a victim in the hands of patriarchal dominance and a gender biased society. She got punished merely for showing interest in another man. While Rama is shown as protector of women and he is seen as commanding Laxamana to mutilate Surapnakha's nose. Beautiful face of a woman is an asset to her because it captivates one and all. If her face is disfigured, her strength and existence is broken. Both Medusa and Surapnakha are examples of beautiful maidens. One suffered the lust of a God, the other suffered the humiliation of a God.

Indra's Wife (Sachi) and Zeus' Wife (Hera)

As a symbol of patriarchal society one finds 'pativratas' like Sita, Anasuya, Arundhati, Savitri, Mandodari, Damayanti celebrated as ideal women, who half-heartedly served their husband inspite of their treachery and impertinence. These are women who sacrificed their all and mutely suffered all throughout their life and were considered as the epitome of womanhood. In any mythology sexuality of every goddess was totally controlled by their husbands. According to *Ancient History Encyclopedia*, Hera, daughter of Rhea and Cronus, wife of Zeus and queen of the Olympians is frequently represented as the faithful wife of Zeus, but she is more famous for jealously and revengeful nature. Hera constantly caught her husband's infidelity as he was always in a chase to find a voluptuous maiden. She always remained worried and insecure for her husband. Laura Kennelly in *Is Zeus a Boundary Breaker?* suggests "Zeus in Greek mythology has been always known for his sexual voraciousness; his illicit affairs; and for his chameleonic instincts. Zeus also disregarded the paramountcy of his marriage to Hera through his countless affairs" (17). Hera was so insecure that she punished all lovers of Zeus and made them to suffer as she was suffering the agony of not being loved.[2] As W.J Wilkins in *Hindu Mythology* refers to Indrani also known by another name Sachi: "She is the Goddess of beauty in

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Hinduism. She is the daughter of Asura, Puloman. She is famously known for her wrath and jealousy" (62). But like Hera she was sick of Indra's infidelity. Emily West in "The Transformation of Cyavana: A Case Study in Narrative Evolution" argues how Indra, seduced the wife of sage Gautama, Ahalya, by disguising himself as her husband (95). Both Zeus and Indra had many affairs with mortal women as well as goddesses. Apalla , Tilottama, Menaka are the names of some apsaras who had been seduced by Indra. Renate Sohnen in "Indra and Women" says "Indra being impish, was always ready to make love with a human woman, regardless of she be a virgin, married, or a paramour" (71). One of the mythological novel *Menaka's Choice* written by Kavita Kane discusses that he couldn't resist himself after seeing Menaka and took her to Amaravati. He wanted all the pleasures from her solely. Aishwarya Javalgekar in her "Indra, Zeus, and Thor: A Comparative Study of Indo-European Mythology" describes "Indra is a phallic God and a dancer. In one of the myths, Indra is castrated by angry Shiva, and is given testicles of Rama instead, which are much more potent than those of a human or anthropomorphic god" (10).

To conclude, one finds that internalization of patriarchy is very strong in women and it could be traced back to mythological goddesses who suffered silently at the hands of gods. Mythology has been always a play of men by men. In mythological space women generally did not play any significant role; they were treated as side actors in both Greek and Indian mythology. They have either been treated as an auxiliary or appendage and rarely had a voice of their own. That's why Sita's testament, Surapnakha's mutilation, Eve's elimination, Circe's expulsion and Medusa's disfigurement is showcased as the right thing they deserved. Women are portrayed as troublemakers. Pandora being a curse is blamed to bring all the bad luck and problems to the human kind. Helen is generally blamed to bring Trojan war and Draupadi for Mahabharata. Adrienne Rich has defined "re-visioning" is the act of looking back at things with a fresh perspective and Jacques Derrida has given the concept of "deconstruction" which could be used

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to reinterpret centrality of mythologies, patriarchy, supremacy of men, domination and restore dignity of characters like Sita, Ahalya, Helen, Draupadi, Kunti, Mandodari, Tara, Aphrodite, Helen, Semele Surapnakha and Medusa who have been labeled as unfaithful, preludes to war and bad omens. A reinterpretation of their lives can liberate these goddesses from their afflictions and sensitize societies and cultures about treachery and abomination inflicted upon them by gods.

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[2]https://www.ancient.eu/Hera/

[3]https://vaniquotes.org/wiki/Diti

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Position of Women Down the Ages in India

Dr. Sharda Devi

The status of women in India has been progressing subject to the chan[illegible] years. From ancient time to present the promotion of equality for women by [illegible] in India and is also believed that women enjoyed equal status with men in all [illegible] Patanjali and Katayana is believed that women were educated in the early Vedic [illegible] women got married at matured age and were free to choose their [illegible] Upanishad mention the existence of women sages and seers in those periods [illegible] Tamil Literature Silapathikharam that Kannaki had instigated the king Pandian [illegible] women enjoyed equal status and rights even during the early Vedic period. Throughout the Vedic period women were given a status equal to men to participate in sacrificial rites to undergo the investiture [illegible] and to be man's equal in upholding dharma. Vedic era has witnessed equal rights for women in [illegible] education, religion, politics, property and inheritance. However, later on approximately [illegible] the [illegible] of women began to decline. Around sixth century the practices of child marriage [illegible] in India. The position of women in the society gradually weakened during [illegible] considered the worst period in the history. During this period society has [illegible] difference was evident. Mari Woman role was decided on the basis of [illegible] four walls of home. Later on Sati, child marriage and on widow remarriage [illegible] some part of India, the Devadasi or the temple women were sexually [illegible] especially among Hindu Kashatriya rules. Queen Durgavati ruled for [illegible] battle with Mughal emperor Akbar's gen[illegible]

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Position of Women Down the Ages in India

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The status of women in India has been progressing subject to the changes in the legislature over the past few years. From ancient time to present the promotion of equality for women by many reformers has been eventful in India and is also believed that women enjoyed equal status with men in all walks of life. From the words of patanjali and Katayana is believed that women were educated in the early Vedic period. Rig Veda elucidate that women got married at matured age and were free to choose their husbands. Scriptures of Rig Veda and Upanishad mention the existence of women sages and seers in those periods. It is also known from the great Tamil Literature Silapathikharam that Kannaki had instigated the king Pandian for justice. It is believed that women enjoyed equal status and rights even during the early Vedic period. Throughout the Vedic period women were given a status equal to men to participate in sacrificial rites, to undergo the investiture ceremony and to be man's equal in upholding "dharma". Vedic era has witnessed equal rights for women in the field of education, religion, politics, property and inheritance. However, later on approximately during 500 B. C. the status of women began to decline. Around sixth century, the practices of child marriages is believed to have started in India.

The position of women in the society gradually weakened during the medieval period. It was considered the worst period in the history. During this period society had become patriarchal and men women difference was evident. Man-Woman role was decided on the basis of sex. Women were consigned inside the four walls of home. Later on Sati, child marriage and on widow remarriages became part of social life in India. In some part of India, the Devadasi or the temple women were sexually exploited. Polygamy was widely practised especially among Hindu Kshatriya rules. Queen Durgavati ruled for fifteen years before she lost her life in a battle with Mughal emperor Akbar's general Asaf Khan in 1564. Chand Bibi defended Ahmednagar against the mighty Mughal forces of Akbar. Jahangir's wife Nure Jahan effectively wielded the imperial power and was recognized as the real force behind the Mughal throne Shivaji's mother, Jijabai was deputed queen regent, because of her ability as a warrior and administrator. In south India, many women administered villages, divisions, towns and heralded social and religious institutions. The Bhakti cult tried to restore women and questioned some of the forms of oppression. Mirabai, a female saint poet was one of the most important personalities in Bhakti movement. Some other female saints include Akkanna Devi, Rani Janabai, and Lal Dev Bhakti sects within Hinduism such as the Mahanubhab, Varkari and many other were principle movements within the Hindu fold to openly advocate social justice and equality between men and women. JahanAra Bagum and Princess Zebunnisa were well known poetesses and they also influenced the ruling administration. Gurus of Sikhs also preached the messages of equality between men and women by advocating assemblies.

During the modern period a number of social reformers felt the need to emancipate women and tried to establish a justified place for them in the family and society. The thinkers and social reformers realized that unless the condition of 50% of Indian population is improved Indian society cannot improve. In this era, the demographic factors, industrialization, organization and advancement of knowledge have brought about radical changes in the basic institution like family and are also affecting the economic security and social status of women. In the beginning the Britishers adopted passive "non-interference" policy towards personal status of Women. However, the impact of Western civilization through British rule gave an impetus to claim equal status and rights by the Indian women.

Sincere efforts were made by eminent scholars, judges and social reformers like Raja Ram Mohan Ray, Dwarakanatha Tagore, kesava Chandra Sen, Eshwara Chandra Vidyasagar, etc. to improve the status of Indian women. As a result of the efforts of the social reformers and public up surge some reformative laws like Hindu Widows remarriage Act 1856, the Abolition of sati Act, [1929] The Widow Remarriage [1858],Female infanticide Act, [1870],The civil Marriage Act [1873], the Married Women property Act [1874] The age consent Act [1881] the child Marriage Act [1992] were passed by the British Govt. the family and social status of Women also improved during the British period because of female education and raise in the age of Marriage. In 1946, the Hindu Women's Right of separate Residence and maintenance Act 1946 was passed. To improve the pathetic status of Widow, the Hindu Women Right of property Act was passed in the year 1937. Entrance of Dr. Anne Besant in the Indian political scene in the year 1914, marked the dawn for Women's resurgence. Gandhi ji call for Women's participation in the freedom struggle brought out the Indian Women from the seclusion in their houses. Many Women leaders emerged during the freedom struggle Sarojini Naidu, Durgabai Desh Mukh, Aruna Asaf Ali etc. are some of the prominent personalities to mention. The Government of India Act 1935 provided franchise and civil service under the crown for the women.

After Independence in 1947, Government of India went for socio, economic transformation of the country and the framers of the constitution realized the unequal status of women and assured that women should get equal rights. The fundamental rights enshrined in Article 14, 15 and 16 guarantees the principle of equality before law, equality of sexes and equal opportunities in all walks of like. Effective steps were taken to improve the status and position of Women by envisaging equality before law and equal protection of laws in the constitution of India. There were

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6.1 IMPACT FACTOR

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Socio-Economic Impact of the Covid-19 in India: A Case Study of Himachal Pradesh

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Abstract: Over the past decades there have been numerous outbreaks of serious infectious diseases across the world. Now we are dealing with corona-virus or covid-19 a serious outbreak through the world. The first case of Covid-19 in India was reported on January 30, 2020. (Rohit Kapur, 2020). The spread of the corona-virus has created a multi-dimensional crisis not only in India but in whole world. The pandemic covid-19 is endangering health and life of the people, financial insecurities, stress and uncertainty of employment, education, food insecurities, Public transport, farming sector etc. Earlier there were many outbreaks of serious infectious diseases across the world like Ebola, (H1N1) virus, swine flu, Zika, SARS, MERS, bird flu and noro-virus etc. The more serious outbreaks have cost thousands of lives and have devastated public health infrastructure in affected countries(Walsh, 2017). The main objective of this study is to investigate that how the pandemic Covid-19 has created a multi-dimensional crisis that is affecting Socio-economic & Psychological life of people around District Shimla of Himachal Pradesh. It would be very interesting to know that how do respondent feels during the lockdown period due to Covid-19 and for how long is it possible to maintain a lockdown without causing deadly damage to the society.

Keywords: Pandemic, epidemic, covid-19, corona-virus, lockdown, knowledge, social distancing, perceptions, Himachal Pradesh.

Introduction:

We live in an era when the explosion of trade, travel, and communications is spreading new cultural influences and lifestyles faster than ever before, and the division between domestic and international health problems is becoming increasingly obsolete. Globalization also permits the spread of risks, pathogens, and other threats. The ever-increasing movement of people everywhere increases the potential for epidemics. Travelers, refugees, and displaced people are more vulnerable to infectious diseases, and their movement contributes to spreading pathogens into new areas (Dean T. Jamison,Joel G. Breman,Anthony R. Measham,George Alleyne,Mariam

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वर्तमान परिपेक्ष्य में भरमौर के गद्धी जनजाति के लोकगीतों की महत्ता

डॉ. शारदा देवी

लोकगीत लोक के गीत हैं जिन्हें कोई एक व्यक्ति नहीं बल्कि पूरा लोक समाज अपनाता है। सामान्यतः लोक में प्रचलित, लोक द्वारा रचित एवं लोक के लिए लिखे गए गीतों को लोकगीत कहा जा सकता है। लोकगातों का रचनाकार अपने व्यक्तित्व को लोक समर्पित कर देता है।[1]

लोकनृत्य लोक संस्कृति के अभिन्न अंग होते हैं। इसे यूँ भी कहा जा सकता है कि लोकनृत्यों से उस स्थान विशेष की लोक संस्कृति की झलक मिलती है। विभिन्न राज्यों केलोकनृत्यों की अपनी विशेष पहचान है। हि. प्र. के लोकनृत्यों की बात आते ही पहाड़ों, नदियों, सीढ़ीनुमा छोटे-छोटे खेतों और बर्फ से ढकी पर्वतों की चोटियों एवं देवभूमि की स्मृति किसी के भी मानसपटल पर उभर सकती है। हिमाचल प्रदेश के लोकनृत्य में कांगड़ा का झमाकडा, बिलासपुर का गिद्धा व लुड्डी तथा ऊपरी शिमला की नाटी आदि का अपना ही अलग महत्त्व है। इसी तरह गद्धी लोकनृत्य की झलक पाते ही व्यक्ति चंबा के गद्धी जीवन की लोक संस्कृति में खोता सा चला जाता है। वास्तव में लोकनृत्यों में लोक संस्कृति के गीतों, रस्सों-रिवाजों पहनावे आदि का भी परिचय प्राप्त होता है।[2]

गद्धी भारत के हिमाचल प्रदेश और जम्मू कश्मीर राज्यों में रहने वाले खत्री राजपूत, राठी और ब्राह्मणों की उपजाति है।[3]

वर्तमानगद्धी भारतीय में दोनों के उन जाति-विहीन धूमंतू चरवाहों में से एक की संतान है जो कभी राजस्थान के बाड़मेर क्षेत्र के आसपास रहते थे और विभिन्न वेशभूषा और सामान की समानता से वह प्रभावित होता है।[4]

भारत की 2011 की जनगणा के अनुसार गद्धी की जनसंख्या हिमाचल प्रदेश में 178130 थी। हिमाचल प्रदेश में गद्धियों का लिंगानुपात 1014 और साक्षरता दर 73.3 थी। इन्हें भारत की आरक्षण प्रणाली के तहत अनुसूचित जनजाति के रूप में वर्गीकृत किया गया है। गद्धी जनजातियों की अधिकता मुख्य रूप से हि. प्र. राज्य के धौलाधार श्रेणी के दोनों किनारों पर पाई जाती है। काफी संख्या में गद्धी जनजातियाँ मुख्य रूप से चंबा जिले के भरमौर क्षेत्र में, रावी नदी के ऊँचे क्षेत्रों में बुधिल नदी की घाटियों में भी बसती है। अन्य क्षेत्रों में काँगड़ा जिला शामिल है, जो मुख्य रूप से तोता रानी, खनियारा धर्मशाला के करीब के गाँवों में है।

लोकगीत मानव जीवन की अनुभूत अभिव्यक्ति और उद्‌गारों का साफ दर्पण है जिसमें समाज का प्रतिविंब दिखाई देता है। लोकगीत ही लोकजीवन की वास्तविक भावनाओं को प्रस्तुत करता है। इसमें मनुष्य के पारिवारिक, सामाजिक जीवन का भावनात्मक चित्रण रहता है। जीवन के सभी पहलुओं एवं विभिन्न परिस्थितियों में मनुष्य के मानसिक एवं शारीरिक व्यापार जैसे ही होते हैं, उनका वास्तविक चित्रण लोकगीतों में देखने को मिलता हैं जनसमाज के अपने गीत होते है जिनमें किसी विशेष समाज की जीवनुभूति की अभिव्यंजना होती है। लोकगीतों में सामाजिक प्राणियों के सुख-दुख, आशा-निराशा, रोग अवसाद आदि सभी की अभिव्यक्ति होती है। लोकगीत अपनी सरलता और स्वाभाविकता के कारण ही मोहक होता है। यहाँ हम विशेष रूप से हिमाचल प्रदेश में भरमौर के गद्धी जनजाति के लोकगीतों के महत्व पर चर्चा करेगें। हिमाचली लोकगीतों में गद्धी जनजाति के लोकगीतों का अपना एक विशेष स्थान है। गद्धी युवकों के बारे में एक विद्वान का कहना है कि गद्धी युवक लोकगीतों के इतने शौकीन होते हैं कि हर एक युवक के पास सदा ही एक बाँसुरी पाई जाती है। वह किसी भी अपने काम में सलग्न हो, खेत, खलियान, धार-नगार आदि में उन्हें जब भी अपने काम से समय लगे वह अपना मनोरजंन करने व थकावट जो दूर करने के लिए बाँसुरी की तान तत्काल आरंभ कर देते हैं।[5]

इसी संदर्भ को आगे बढाते हुए डॉ. सूरत ठाकुर लिखते हैं, इनके लोकगीतों में शौर्य, साहस, मिलन व विरह और त्याग की भावना मुखरित होती है। जिस कारण इनके लोकगीतों ने सम्मान व ख्याति अर्जित की है वह किसी अन्य क्षेत्र में नहीं की है। गद्धी समुदाय के लोकगीत व लोकनृत्य सुनने व देखने में बड़ा आनंद आता है। ये लोकगीत प्रायः नृत्य के साथ-साथ गाए जाते हैं व कुछ धार्मिक अनुष्ठानों पर लोकगीत अपने मनोरंजन के लिए भी गाए जाते हैं।[6]

डॉ. गौतम व्यक्ति ने इनके लोकगीतों को वर्गीकृत करते हुए ढोलरू, बसोआ पत्रोड़ू, श्राद्ध, सैर, लोहड़ी, शिवरात्रि, राधाष्अष्टमी, भरमौर, मणिमहेश व छतराड़ी

Gender Equal Society: Myth and Reality



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Sushma Rewal Chugh
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ROLE OF MEDIA IN PUBLIC AWARENESS DURING COVID-19

Tara Hetta
Dr. Sharda Devi

The aim of this study is to examine the effective role of media in public awareness about covid-19 among the public, their perception and attitude, and govt. action plan in district Shimla, Himachal Pradesh. Cross-sectional survey questionnaires were distributed to 130 respondents about accessing the public awareness of modes of corona-virus transmission, perceptions and attitudes towards people getting infected with corona-virus, as well as understanding of public about the government action plan to break the chain of covid-19. People belong to various social background and different professional streams were the sources of information seeking on covid-19.Most of the respondents were aware of the modes of covid-19 transmission. However, they were few respondents who still have misconceptions about the modes of transmission. Most of the respondents were supporting government's action plan in the region. Overall, the respondents had certain knowledge about the transmission modes of covid-19 and highly positive perceptions and attitudes towards the control of infectious covid-19. The further studies could be conducted to examine about how media effectively played its role to elevate people's from covid-19 and take it to the normal track as it was earlier.

Keywords: attitudes, covid-19, corona-virus, knowledge, social distancing, perceptions, Himachal Pradesh

Introduction

The media coverage is the most important factor responsible for the dissemination of awareness of the infectious disease and its transmission, it is a very important issue which has to be taken care of seriously because it can prevent epidemic. In the case of a large number of infected cases, on one hand, the media coverage may cause the panic of the society, while on the other hand, it can certainly reduce the opportunity and probability of contact transmission among the alerted susceptible populations, which in turn helps to control and prevent the disease from further spreading.(Jingan Cui,1,2 Yonghong Sun,3 and Huaiping Zhu4,5,6,

3.4.5 Number of research papers per teacher in the Journals notified on UGC website during the year

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(साहित्य-समाज-संस्कृति और राजनीति के खुले मंच की अर्द्ध वार्षिक-अव्यावसायिक पत्रिका)

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-वीरेंद्र सिंह

इस मनुष्य-जीवन में कुछ प्रश्न ऐसे होते हैं, जिन्हें सुलझाने के लिए हम पूरा जीवन लगा देते हैं लेकिन उनका उत्तर हमें नहीं मिलता। कुछ प्रश्न तो इतने उलझाते हैं कि उनसे पार पाने के लिए हम दार्शनिक भी बन जाएँ, तो भी कुछ नहीं होगा। ये मानुष-जीवन भी ऐसी ही एक पहेली है, जिसे सुलझाने में न जाने कितनी सदियाँ और युग बीत गए और यह आज भी हमें चिढ़ाती मुँहबाये खड़ी है। क्या है ये मनुष्य-जीवन? यदि गहन चिंतन-मनन कर देखा जाये, तो यह नाना प्रकार की विसंगतियों, विडंबनाओं, विरोधाभासों, अंतर्विरोधोंका पुंज है, जिसके अपने ही धूपछाँही रंग हैं। इसे जानने का जितना भी प्रयास करें, परिणाम शून्य ही होता है। बस इसके इंद्रधनुषी रंगों में से जो भी नसीब हो, उसका भरपूर आनंद लेना ही जिंदगी है।

मनुष्य ने विवेक पाया है और इसी के सहारे जब भी उसने मनुष्य-जीवन को समझने का प्रयास किया, हर बार उसे विडंबनाओं और विसंगतियों से भरा पाया। 'विसंगति' समकालीन जीवन की वह स्थिति है, जहाँ प्रत्येक मूल्य या धारणा का ठीक उलटा रूप दिखाई पड़ता है; एब्सर्डिटी।'[1] इसे विसंगति, असंगति, एब्सर्डिटी कुछ भी कह दीजिये लेकिन इस बात से इनकार नहीं किया जा सकता कि यह आज के आपाधापीयुक्त जीवन का एक अनचाहा सच है। आज मनुष्य-जीवन के दो चेहरे हैं- एक दृश्य और दूसरा अदृश्य। दूसरे शब्दों में इन्हें काल्पनिक और वास्तविक कह सकते हैं। 'नकली चेहरा सामने आए, असली सूरत छुपी रहे' गीत के मायने इस मनुष्य-जीवन पर सही बैठते हैं। आजमानव-जीवन मुखौटाधारी हो गया है जहाँ हर चेहरे पर न जाने कब से नकाब चढ़ा है। कोविड-19 महामारी ने तो इस नकाब को उघाड़कर सिर्फ इतना संकेत किया है कियह नकाब मानव-जीवन का अभिन्न हिस्सा हो गया है जिसे अब उसे स्वीकार कर लेना चाहिए। आज मनुष्य की कथनी और करनी, चेहरे और चरित्र में विरोधाभास है। वह जो कुछ कहता या जैसा दिखता है, होता उसके बिल्कुल उलटा है। ऐसे में आप तय नहीं कर पाते कि सच क्या है और झूठ क्या? कभी-कभार तो वास्तविक सच को ही संदेह की दृष्टि से देखने को हम मजबूर हो जाते हैं और परिणामस्वरूप गलत निष्कर्ष निकाल बैठते हैं।

आज का यथार्थ बड़ा जटिल और संगुम्फित है और साहित्य हमें इसे समझने की दृष्टि देता है। कविता इस जटिल यथार्थ की अभिव्यक्ति का सब से सशक्त माध्यम है जिसकी घड़ी का पेंडुलम समय के तीन ध्रुवों पर एक साथ अपने घंटे बजाता है। स्मृति और स्वप्न के बीच कविता वर्तमान होती है'[2] और यह धारणासमकालीन हिंदी कविता को बखूबी स्पष्ट करती है। इस कविता में विसंगति का स्वर तभी से वर्तमान है जब धूमिल ने 'बीस वर्ष बाद' जैसी कविताएँ लिखकर भारतीय जीवन की देशव्यापी विसंगतियों का बेबाकी के साथ पदार्फाश किया था।

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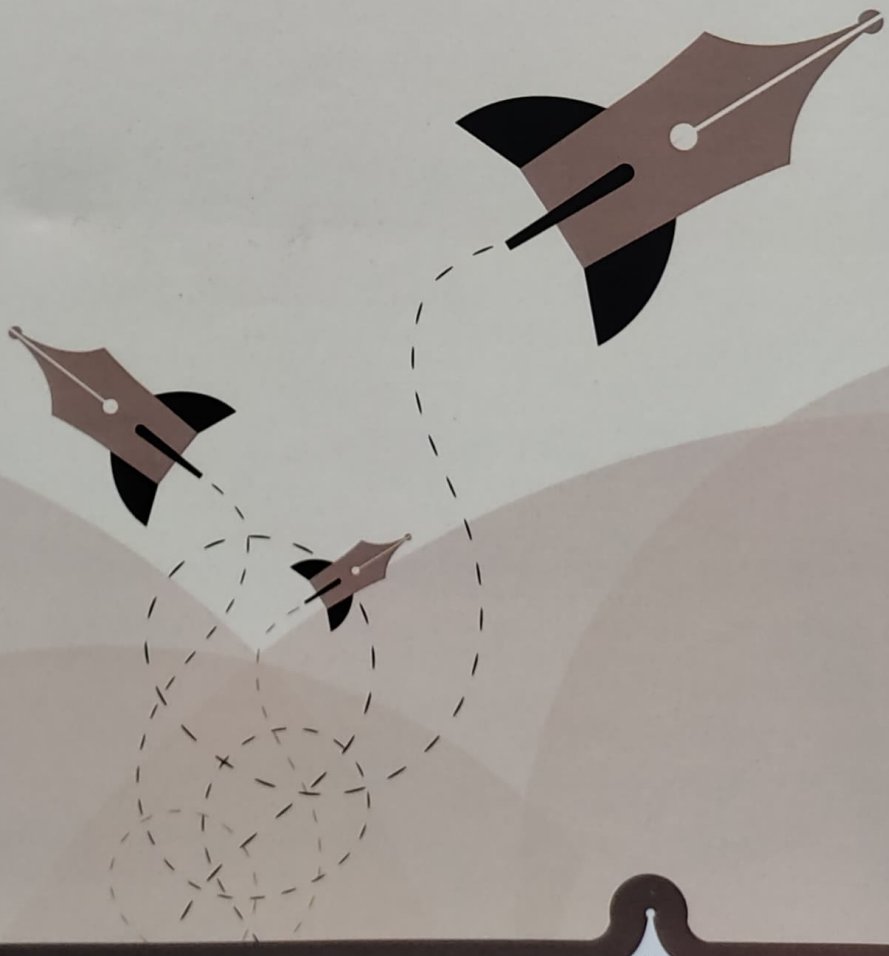

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स्त्री की विरल तस्वीर : कुमार कृष्ण की कविता

वीरेन्द्र सिंह*

शोध सारांश

इस आधुनिक समय में सर्वाधिक प्रताड़ित वर्ग में स्त्री भी आती है और उसकी विविध छवियाँ हिंदी हिंदी कविता में आज तक बनती रही हैं। कवि कुमार कृष्ण ने स्त्री को समग्र रूप में अपनी कविता में शामिल किया है। इतना अवश्य कहा जा सकता है कि उनकी कविता मे स्त्री का प्रधान रूप पत्नी का ही है और फिर अन्य। उन्होंने स्त्री का समाज–सापेक्ष चित्र ही प्रस्तुत किया है, जिसमें न तो उनकी रूढ़िवादी सोच झलकती है और न ही स्त्री का एकांगी चित्र ही है। पत्नी के रूप में उनकी स्त्री प्रसाद की 'श्रद्धा' और दिनकर की 'औशीनरी' के करीब तो है पर बिलकुल वैसी ही नहीं है । उनकी स्त्री अपने पति, परिवार और समाज में सम्मान पाती है इसलिए राग ही राग लुटाती है। वह आधी नर में है और आधी नारायण में। यह सही है कि महानगरीय जीवन में ढली स्त्री यहाँ मुखरित नहीं हुई है और इसका कारण है– एक तो यह कि कवि को स्त्री का ऐसा रूप कभी काम्य नहीं रहा और दूसरे यह कि महानगर की जीवनशैली की झलक भी हिमाचल प्रदेश जैसे पहाड़ी राज्य में अब तक दिखाई नहीं दी है।

Keywords : समकालीन कविता, स्त्री–विमर्श, देहवाद।

जिस धरती पर **'यत्र नार्यस्तु पूज्यन्ते, रमंते तत्र देवता'** और **'जननी जन्मभूमिश्च स्वर्गादपि गरीयसी'** जैसे जीवन–मूल्यों की बात हो, वहाँ आज के दौर में स्त्री की चिंताजनक स्थिति से अंतरात्मा कराह उठती है। भूमंडलीकरण के इस दौर में मनुष्य उपभोक्ता–संस्कृति की गोद में जी रहा है। आज संसार में हर वस्तु की तरह आदमी भी बाजार की एक वस्तु हो गया है– स्त्री भी । मानव–सभ्यता के आदिकाल से लेकर अब तक का इतिहास इस बात का गवाह है कि इस पुरुष–प्रधान भारतीय समाज में स्त्री को भोग–विलास की वस्तु मात्र समझा जाता रहा। एक विहंगावलोकन कीजिये, तो पाएंगे कि भारतीय समाज में स्त्री सदा से ही उपेक्षित वर्ग में रही है। धर्मग्रंथों के विधान से लेकर आज की व्यवस्था तक में यही परिदृश्य सामने आता है जिसका परिचय समय–समय पर मिलता रहता है। वैदिक काल भारतीय इतिहास में स्त्री समाज का उत्कर्ष काल माना जा सकता है जिसके बाद स्त्री के लिए परिस्थितियाँ बद से बदतर होती चली गयी हैं।

हिंदी साहित्य के अब तक के इतिहास में भी स्त्री की इतिहासपुष्ट तस्वीर प्रतिबिंबित होती रही है। इसका आदिकाल स्त्री–समाज के लिए 'जा घर देखी सुंदर नार, ता घर जाय धरी तलवार' कहावत को चरितार्थ करने वाला दिखाई देता है। जैन, सिद्ध व नाथ साहित्य में भी स्त्री के प्रति कोई अच्छी धारणा नहीं दिखाई देती। भक्तिकाल में स्त्री को विद्या–अविद्या दोनों रूपों में देखा गया ; एक तरफ जहाँ उसे महाठगिनी' और 'विष की बेल' तक कहा गया तो दूसरी ओर उसमें राधा और सीता जैसे पात्र भी उभारे गए। इसी कालखंड में पद्मावती का चरित्र भी अनेक संभावनाओं के साथ अस्तित्व में आता है। मीराबाई तो स्वयं ही स्त्री–समाज के लिए एक आदर्श बन गयी थीं हालांकि उन्हें भी इस समाज की पुरुषवादी मानसिकता का शिकार कई बार होना। रीतिकाल में स्त्री का चित्रण उसकी देह से ऊपर उठकर लगभग हुआ ही नहीं, हालांकि रीतिमुक्त काव्य इसका अपवाद है। आधुनिक काल में पद्मावती और मीराबाई के चरित्र को कुछ दिशा मिलती दिखाई देती है। इसी समय हरिऔध के 'प्रियप्रवास' में राधा के रूप में स्त्री का चरित्र एक प्रेयसी से ऊपर उठकर एक समाज–सेविका के रूप में भी सामने आया जिससे स्त्री की समाज–सापेक्ष छवि को उभारा गया। आगे चलकर छायावाद में उसके 'श्रद्धा' और 'इड़ा'' दोनों रूप सामानांतर उभारे गए, चारदीवारी की कारा से उसकी मुक्ति के स्वर उठने लगे। निराला ने 'विधवा' और 'तोड़ती पत्थर' कविताओं में स्त्री की एक अलग ही छवि उभारी और फिर 'कामायनी' में चित्रित स्त्री के दोनों रूपों का विकास दिनकर की 'उर्वशी' में देखा जा सकता है। प्रयोगवाद और नयी कविता के समय स्त्री फिर से देह बनती दिखाई देती है किन्तु समकालीन हिंदी कविता में स्त्री के दोनों रूपों की एक बार

*सहायक आचार्य हिंदी – हि० प्र० विश्वविद्यालय क्षेत्रीय केंद्र धर्मशाला, जिला काँगड़ा, हि०

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एक सिक्के के दो पहलू : मीडिया तथा साहित्य

◆ डॉ. संदीप कुमार

मीडिया और साहित्य समाज का दर्पण है। ये माध्यम सामाजिक परिस्थितियों, घटनाओं और विचारों को जनता के समक्ष यथार्थ रूप में प्रस्तुत करते हैं। ये एक ही सिक्के के दो पहलू हैं। दोनों का उद्देश्य समाज में घटित सम्पूर्ण घटनाओं का विवरण पूर्णतः से उद्घाटित कर उनकी वास्तविक तस्वीर जनता के समक्ष प्रस्तुत करना है। सीप में जैसे मोती का विकास होता है उसी प्रकार प्रत्येक व्यक्ति के व्यक्तित्व का विकास उसके सामाजिक वातावरण में होता है। अतः व्यक्ति के विकास में समाज की महत्वपूर्ण भूमिका रहती है। समाज के अन्तर्गत परिवार एवं उनमें प्रचलित परम्पराएँ, रीति-रिवाज इत्यादि सम्मिलित होते हैं। ये समाज में रहने वाले भिन्न-भिन्न व्यक्तियों और समुदायों को एक धागे में पिरोए रखते हैं। समाज में निरन्तर परिवर्तन होते रहते हैं। समय-समय पर साहित्य और मीडिया इन्हीं परिवर्तनों को अवलोकित कर साक्षात् रूप में जनता के सम्मुख उजागर करते हैं। अतः ये दोनों साधन मनुष्य, समाज, सभ्यता, संस्कृति और राष्ट्र को अपनी भूमिका से प्रभावित करते हैं तथा इसके परिवर्तन और विकास का पर्याय बनकर लोगों को सामाजिक चेतना प्रदान करते हैं। भूगोल, इतिहास, संस्कृति और कला, साहित्य एवं मीडिया से अछूता नहीं है। प्राचीन समय में मीडिया आधुनिक युग की तरह इतना समृद्ध और सशक्त नहीं था लेकिन समयानुसार उचित था। संदेश भेजने के लिए घुड़सवारों, कबूतरों एवं पत्रों का प्रयोग किया जाता था। वैदिक युग में लेखन की अलग शैली थी। पत्राचार के लिए ताड़ के पत्तों या छाल और शिलालेखों का प्रयोग किया जाता था। लोग संदेश भेजने के लिए दूतों के माध्यम से विशेष चिन्हों का प्रयोग करते थे। वे ज्ञानार्जित संपत्ति को संजोने के लिए हस्तलिखित सामग्री का प्रयोग करते थे।

साहित्य में प्रगतिशील मूल्यों का चित्रण तभी हो सकता है जब वे मूल्य समाज में विद्यमान होंगे। अतः साहित्य समाज का दर्पण मात्र ही नहीं अपितु वह उसकी आलोचना भी है। आलोचना और कला शक्ति के कारण साहित्य सामाजिक मूल्यों में परिवर्तन के साथ-साथ नये मूल्यों के निर्माण में भूमिका निभाता है। अतः साहित्य और समाज का घनिष्ठ सम्बन्ध है। साहित्यकार सामाजिक परिस्थितियों से प्रभावित होकर साहित्य रचना करता है और व्यक्ति तक धारा के समान प्रवाहित होता है। साहित्य का सम्बन्ध मानव से है और यह पूर्णतः मानव केन्द्रित होता है। साहित्य की जिस समाज में रचना हुई, उस समाज के सम्बन्ध में निरूपित है कि यह, समाज का समग्र ब्योरा प्रस्तुत करता है। साहित्य व्यक्ति की अभिव्यक्ति है, समष्टि के लिए। वह किसी आदेश पर लाखों हाथों का एक हाथ की तरह उठ जाना नहीं है, अपितु वह अन्तःकरण का हजारों-लाखों अन्तःकरणों में विसर्जित हो जाना। अतः पुराने समाज के भीतर ही नये समाज के बीज अंकुरित होते हैं। ये विकासमान अंकुरण नये वस्तु तत्वों और रूपों के स्तर पर दिखाई देते हैं। पुराने और नये सामाजिक सम्बन्धों के तनाव के बीच साहित्य का जन्म होता है। साहित्यिक रचना

आधुनिक युग में मीडिया समाज के महत्त्वपूर्ण घटक के रूप में अवतरित हुआ है। यह एक ओर तो लोगों के मनोरंजन का साधन है तो दूसरी ओर ज्ञानवर्द्धन में भी सहायक है। वस्तुतः किसी भी देश में मीडिया की भूमिका जनहित के पक्ष में होती है। इसलिए इसे देश का आधारभूत स्तम्भ कहा जाता है। आज मीडिया की व्यापकता धर्म, पर्यावरण, राजनीति, अर्थतंत्र, संस्कृति और साहित्य को प्रभावित कर रही है। वर्तमान समय में यह लोगों की मानसिकता बदल कर सामाजिक सम्बन्धों को नया रूप प्रदान कर रहा है। समसामयिक युग में सामाजिक ढाँचे को परिवर्तित करने में मीडिया ने महत्त्वपूर्ण भूमिका निभाई है और लोगों को जागृत करके समाज को बदलकर नई दिशा प्रदान की है।

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पौराणिक परिप्रेक्ष्य में पुरुषार्थ चतुष्टय : एक अध्ययन

डॉ० विपन कुमार

पौराणिक संस्कृत वाङ्मय में जीवन दर्शन के प्रभूत संकेत विद्यमान हैं। वैदिक युग से लेकर अर्वाचीन काल तक मानव जीवन का उद्देश्य पुरुषार्थ चतुष्टय अर्थात् धर्म-अर्थ-काम तथा मोक्ष की प्राप्ति करना रहा है। भारतीय संस्कृति उपर्युक्त बिन्दुओं की धुरी पर परिक्रमण करती है। यही सनातन धर्म के आधारभूत स्तम्भ के रूप में दृष्टिगोचर होते हैं। मानव इन तत्वों को जीवन पद्धति में सहज रूप से आत्मसात् कर सकता है। पुराण वस्तुत: अतीत को वर्तमान से जोड़ने वाली कनकमयी श्रृंखला है। यह भारतवर्ष की धार्मिक, दार्शनिक, सांस्कृतिक, सामाजिक और राजनैतिक विचार-सम्पदा का अक्षय भण्डार हैं। भारतीय जीवन दर्शन में पुरुषार्थ चतुष्टय, संस्कृति एवं सभ्यता के स्रोत वेदों में सन्निहित हैं। प्रस्तुत शोध-पत्र में उक्त वर्ण्य विषय पर प्रकाश डाला गया है।

धर्म-

धर्म शब्द व्युत्पत्ति की दृष्टि से "धृ" धारणे धातु से मन् प्रत्यय लगाने से निष्पन्न होता है। इसका अभिप्राय है "ध्रियते लोकोऽनेन" 'धरति लोकं वा' अर्थात् जिसके द्वारा यह लोक धारण किया जाता है। इस प्रकार लोक की धारक शक्ति को ही धर्म कहा गया है।[1] वेदों में धर्म शब्द का प्रयोग वेद विहित धार्मिक, विधियों तथा संस्कारों के रूप में हुआ है।[2] पी०वी० काणे के अनुसार व्यक्ति समाज का सदस्य होने के कारण उसकी समस्त क्रियाओं को नियमित करता है। जिसका लक्ष्य व्यक्तित्व को प्राप्त करना है।[3] वाल्मीकिरामायण में कहा गया है कि संसार में धर्म ही सर्वश्रेष्ठ है, वही परम गति है, धर्म में ही सत्य प्रतिष्ठित है।[4] याज्ञवल्क्यस्मृति में श्रुति, स्मृति, सदाचार एवं आत्मा की तुष्टि के साथ संकल्प से उत्पन्न इच्छा को धर्म का मूल कहा गया है।[5] देवीभागवतपुराण में उल्लिखित है कि धर्म का नाश नहीं होना चाहिए, त्याग होने में हानि नहीं है। त्याग की अपेक्षा मरण श्रेयस्कर है, मनुष्य को धर्म हानि नरक के निमित्त ले जाती है।[6] दुर्गा ने स्वयं कहा है कि वह शत्रुता रहित होकर धर्म रक्षा के निमित्त इस संसार में विचरण करती है। साधुओं की रक्षा करना उनका व्रत है तथा सदैव इसका पालन करती हैं।[7] गरुड़पुराण में धर्म को पापों का विनाशक तथा भुक्ति-मुक्ति प्रदाता कहा गया है।[8] भगवान ने स्वयं कहा है कि वह ही धर्म हैं। समस्त वर्णों एवं आश्रमों का सनातन धर्म भी वही है।[9] धर्म के संबंध को मनुष्य से स्थापित करते हुए कहा गया है कि अर्जित किए हुए धन का मनुष्य को दान करना चाहिए। क्योंकि यदि दान को एक ओर तथा भयभीत की प्राण रक्षा का दूसरी ओर तोल किया जाए तो दोनों सम होते हैं।[10]

* सहायक आचार्य, संस्कृत-विभाग, हिमाचल प्रदेश विश्वविद्यालय, क्षेत्रीय अध्ययन केन्द्र, धर्मशाला।

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संरक्षकमण्डलम्

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भारतीयशास्त्र परम्परा में पर्यावरण चिन्तन

*डॉ. विपन कुमार**

आज पर्यावरण शब्द जिस अर्थ में प्रयुक्त हो रहा है, अब से तीन चार दशक पूर्व उसका ऐसा कोई पारिभाषिक अर्थ नहीं था। प्राचीन संस्कृत-हिंदी कोशग्रंथों में अद्यावधि ही यह शब्द उपलब्ध नहीं होता।इसका मूल कारण यह है कि यह शब्द उस समय तक किसी भी अर्थ में पारिभाषिक रूप से प्रचलित नहीं हो पाया था। अतः प्राचीन कोशकारों ने इसका कोई विशेष अर्थ प्रस्तुत नहीं किया। तथापि पर्यावरण शब्द की उत्पत्ति परि "आ" उपसर्ग पूर्वक 'वृञ् आच्छादने" धातु से होती है।

पर्यावरण शब्द एवं उसका अर्थ अत्यंत व्यापक है, जिसमें संपूर्ण ब्रह्मांड समाहित हो जाता है।परि अर्थात् हमारे चारों ओर का आवरण(ढकना) ही पर्यावरण है। समस्त मानव जाति एवं सृष्टि पृथ्वी-जल-तेज- वायु-आकाश, वन, वृक्ष, नदी, पर्वत तथा पशु-पक्षी इत्यादि से आवृत्त है। उपर्युक्त समस्त तत्वों तथा पदार्थों का समग्र रूप अथवा समुदित रूप जो पर्यावरण है, उसी में जीवों की उत्पत्ति होती है। इस प्रकार समस्त कार्यों की पूर्ति पर्यावरण में ही सम्वर्धित है। अतः समाज एवं जीवन-दर्शन हेतु पर्यावरण का संरक्षण एवं पोषण नितान्त आवश्यक है। प्रस्तुत शोध-पत्र में वैदिक कालखण्ड से लेकर अर्वाचीन काव्यों में वर्णित पर्यावरण शिक्षा से सम्बंधित विषयों पर प्रकाश डाला जाएगा।

प्रकृति से हमें उतना ही लेना चाहिए, जिससे हमारी मूलभूत आवश्यकताओं की पूर्ति हो सकती है। हमारे पूर्वजों ने हमारे भविष्य की चिंता की और प्रकृति की धरोहर को संजोकर रखा जबकि आधुनिकतावाद की दौड़ में मानव जाति प्राकृतिक संसाधनों का भरपूर दोहन करने में लगी है।एक बार गांधी जी ने दातुन मंगवाई। किसी ने नीम की पूरी टहनी तोड़ कर दे दी, यह देख कर गांधीजी उस व्यक्ति पर क्रोधित हुए। तब उसे डांटते हुए उन्होंने कहा- "जब छोटे से टुकड़े से मेरा काम चल सकता था तो पूरी टहनी क्यों तोड़ी? यह न जाने कितने व्यक्तियों के उपयोग में आ सकती थी।" गांधीजी की इस फटकार से हम सब को भी सीख लेनी चाहिए। प्रकृति से हमें उतना ही लेना चाहिए, जिससे हमारी आवश्यकताओं की पूर्ति हो सकती है।

'वेद' वह ज्ञान है जिसको सर्वप्रथम ऋषि महर्षियों ने खोजा। वेद सम्पूर्ण वाङ्गमय का बोधक शब्द है। ऋषियों ने जिस परमात्मास्वरूप ज्ञान का साक्षात्कार किया वह प्रकाशपुञ्ज वेद भारतीय ज्ञान गंगा का उत्स हैं जो स्वयं अपनी दिव्य आभा से भासित हैं, अपौरुषेय और अनादि हैं इसलिए वे स्वयंभू, स्वयं प्रकाश और स्वतः प्रमाण हैं। भारतीय संस्कृति के इतिहास में वेदों का स्थान अत्यंत गौरवपूर्ण है।

प्रकृति भारतीयों के लिए सदा से पूजनीय रही है चाहे कांति प्राप्ति के लिए सूर्य का पूजन हो नारी को ,स्वामी की दीर्घायु का वरदान मांगना हो या निर्धन को कुबेर बनने का स्वप्न अथवा विद्यार्थी को विद्या प्राप्ति की कामना अथवा हमें जीवन प्रदान करने वाली नदियों की उपासना हो, इन सबके लिए हमें वेदों की शरण में जाना ही पड़ता है वेदों में वर्णित नदी ,सागर ,सूर्य ,चंद्र ,जल और वायु - ये सभी हमारी आस्था के स्रोत रहे हैं हमने तो वृक्षों से वरदान मांगना भी अपनी संस्कृति में समाहित कर लिया है।

* सहायक आचार्य, संस्कृत-विभाग, हि.प्र. विश्वविद्यालय क्षेत्रीय केन्द्र धर्मशाला।

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जनसंचार माध्यमों में हिन्दी साहित्य के बदलते परिदृश्य



डॉ. भवानी सिंह

साहित्य का स्वरूप : समाज में रहकर ही साहित्यकार सुख-दुःख की परिस्थितियों और घटनाओं से जूझता है तथा युग का घटनाक्रम साहित्य को प्रभावित करता है। उन्हें देखता या सुनता है। वह सामान्यजन से अधिक संवेदनशील होता है। इसलिए प्रत्येक परिस्थिति या घटना को अधिक सूक्ष्मता से ग्रहण कर उसकी तह में घुस जाता है और फिर अपनी सूक्ष्म संवेदना को अपने साहित्य में मूर्त रूप देकर समाज के समक्ष प्रस्तुत करता है। रचनाकार अपनी लेखनी से अपनी प्रतिक्रिया को प्रकट कर आत्माभिव्यक्ति को समाज की अभिव्यक्ति देता है। उसकी सभी रचनाएं कलमबद्ध होकर समाज द्धकी रचनाएं बन जाती हैं। तुलसीदास जी के अनुसार, 'हित अनहित पशु पक्षिहुं जाना' अच्छे-बुरे का ज्ञान, हित एवं अहित का ज्ञान पशु-पक्षियों को भी होता है। फिर मनुष्य तो सर्वश्रेष्ठ जीव है।' अतः उसका समाज भी पशु-पक्षियों से श्रेष्ठ होगा। इसी समाज की सच्ची तस्वीर साहित्य प्रस्तुत करता रहा है। किसी विद्वान् ने कहा है कि 'संगीत, साहित्य कला विहीना, साक्षात् पशु पुच्छ बिना हीना।' अर्थात् संगीत, साहित्य और कला से विहीन मनुष्य उस पशु के समान है, जिसके पास न तो सींग हैं और न ही पूंछ। अतएव साहित्य के विषय में यही कहना उपयुक्त होगा - 'हितेन सहितम्, साहित्स्य भावः साहित्यम्।' साहित्य हमारी कौतूहल और जिज्ञासा वृत्तियों को शान्त करता है। ज्ञान की पिपासा को तृप्त करता है और मस्तिष्क की क्षुधापूर्ति करता है।

हिन्दी साहित्य का आधुनिक काल, जो हमारी नई सोच और नए दृष्टिकोण का प्रतिनिधित्व करता है, उसके लिए तत्कालीन विभिन्न राजनीतिक, सामाजिक, धार्मिक, आर्थिक परिस्थितियों तो उत्तरदायी थीं ही, साथ ही उन परिस्थितियों के ग्रहण के लिए वह अंग्रेजी सत्ता जिसने वास्तव में हमें प्रत्यक्षतः तथा परोक्षतः पुनर्जागरण के लिए उत्तेजित किया। इसमें हमारे साहित्यकारों ने विभिन्न परिस्थितियों से परिचित होकर अपनी महत्त्वपूर्ण भूमिका निभाई और उनसे प्रेरित हो साहित्य के क्षेत्र में आधुनिकता का आह्वान किया। इस काल खण्ड में नवचेतना के उदय से जीवन के प्रायः सभी क्षेत्रों में व्यापक परिवर्तन हुए। शिक्षित जनता की बदली हुई मनोवृत्ति ने साहित्यिक गतिविधियों को बहुत प्रभावित किया। फलतः इस युग में रचे गये साहित्य में पूर्ववर्ती रीतिकालीन काव्य की पुरानी प्रवृत्तियों को अपदस्त कर नये आयामों को प्रशस्त करने की चेष्टाएं परिलक्षित हुईं। नये पुराने के सम्मिश्रण में से अपेक्षित वस्तुओं को ग्रहण और अनपेक्षित वस्तुओं को त्यागकर

जिसको प्रचारित और प्रसारित करने में आधुनिक जनसंचार माध्यमों की अहम भूमिका है। जनसंचार माध्यम में आज के दौर में हिन्दी का व्यापक प्रयोग हो रहा है। भले ही यह हिन्दी शुद्ध न हो, लेकिन हिन्दी की एक नई शैली विकसित हो रही है, जिसमें आज का युवा रचनाकार हिन्दी साहित्य की विभन्न विधाओं में निरन्तर सृजन करता जा रहा है, जो शायद आज के वैश्वीकरण के दौर में हमारी जरू रत बन गई है। लेकिन हमें इस बात से भी सचेत होने की आवश्यकता है कि संचार माध्यमों की अति उदारता के चलते हम हिन्दी भाषा तथा साहित्य के वास्तविक स्वरूप को न खो दें, क्योंकि विभिन्न संचार माध्यमों में हिन्दी के अलग-अलग रूप प्रयुक्त होते हैं। रेडियो श्रव्य माध्यम है। अतः इसकी भाषा केवल सुनी जा सकती है। इसलिए यह अन्य माध्यम, विशेषकर दृश्य माध्यम से भिन्न है। समाचार-पत्र और पत्रिकाओं की भाषा काफी हद तक परिष्कृत होती है।

परिणामस्वरू प वैश्वीकरण के प्रभाव ने संसार की सीमा को तोड़ दिया है। इसको तोड़ने में संचार के प्रमुख माध्यम तथा जनसंचार क्रान्ति के औजार कंप्यूटर, इंटरनेट, रेडियो, टेलीविजन, वेबसाइट, टेलीफोन, मोबाइल फोन, ई-मेल तथा सामाजिक माध्यमों में मोबाइल, फेसबुक, वंट्सऐप, ट्वीटर, यूट्यूब और इन्स्टाग्राम आदि ने प्रमुख भूमिका निभाई है। हालांकि आरम्भ में इन पर अंग्रेजी भाषा का ही अधिकार था। लेकिन धीरे-धीरे हिन्दी ने इसका अधिकार समाप्त कर दिया है। आज भारत में ही नहीं अपितु विदेशों में भी हिन्दी साहित्य में रुचि पैदा हो रही है, विशेषकर हिन्दी फिल्मों ने पूरे विश्व में अपना परचम लहरा दिया है। यह हिन्दी साहित्य ही है जिसने अपनी भाषा शैली कथावस्तु से समाज को जागरु क करने का काम किया है और इसको विश्व के कोने-कोने तक पहुँचाने की भूमिका जनसंचार माध्यमों ने बखूबी निभाई है। आज हमारे पास आधुनिक जनसंचार के विभिन्न माध्यम उपलब्ध हैं। यदि हम गुणवत्तापूर्ण तथा सामाजिक सरोकार से युक्त और समाज में पनप रही कुरीतियों से सम्बन्धित साहित्य का सृजन करेंगे तो वह तुरन्त करोड़ों लोगों तक पहुँच जाएगा। लेकिन कुछ रचनाकार साहित्य सृजन में उपभोक्तावादी संस्कृति की ओर मोड़ रहे हैं, जो पाठकों को ग्लैमरस तथा तथा वासना की ओर ले जा रहा है और जिसमें इन जनसंचार माध्यमों की भूमिका भी लगातार बढ़ती जा रही है। अतः इस ओर आज के साहित्यकारों, रचनाकारों और जनसंचार के माध्यमों का संचालन करने वाले विद्वानों को गौर करना भी अत्यावश्क है ताकि समाज को उपभोक्तावादी संस्कृति से काफी हद तक बचाया जा सके।

सहायक पुस्तकें :

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10. सुदेश, साहित्य के विविध आयाम।

सहायक व्याख्यान

1. डॉ. अमर नाथ अमर, साहित्य और समाज के ऊत्थान में मीडिया की भूमिका (विशेष संदर्भ : दूरदर्शन द्वारा प्रसारित कार्यक्रम)।
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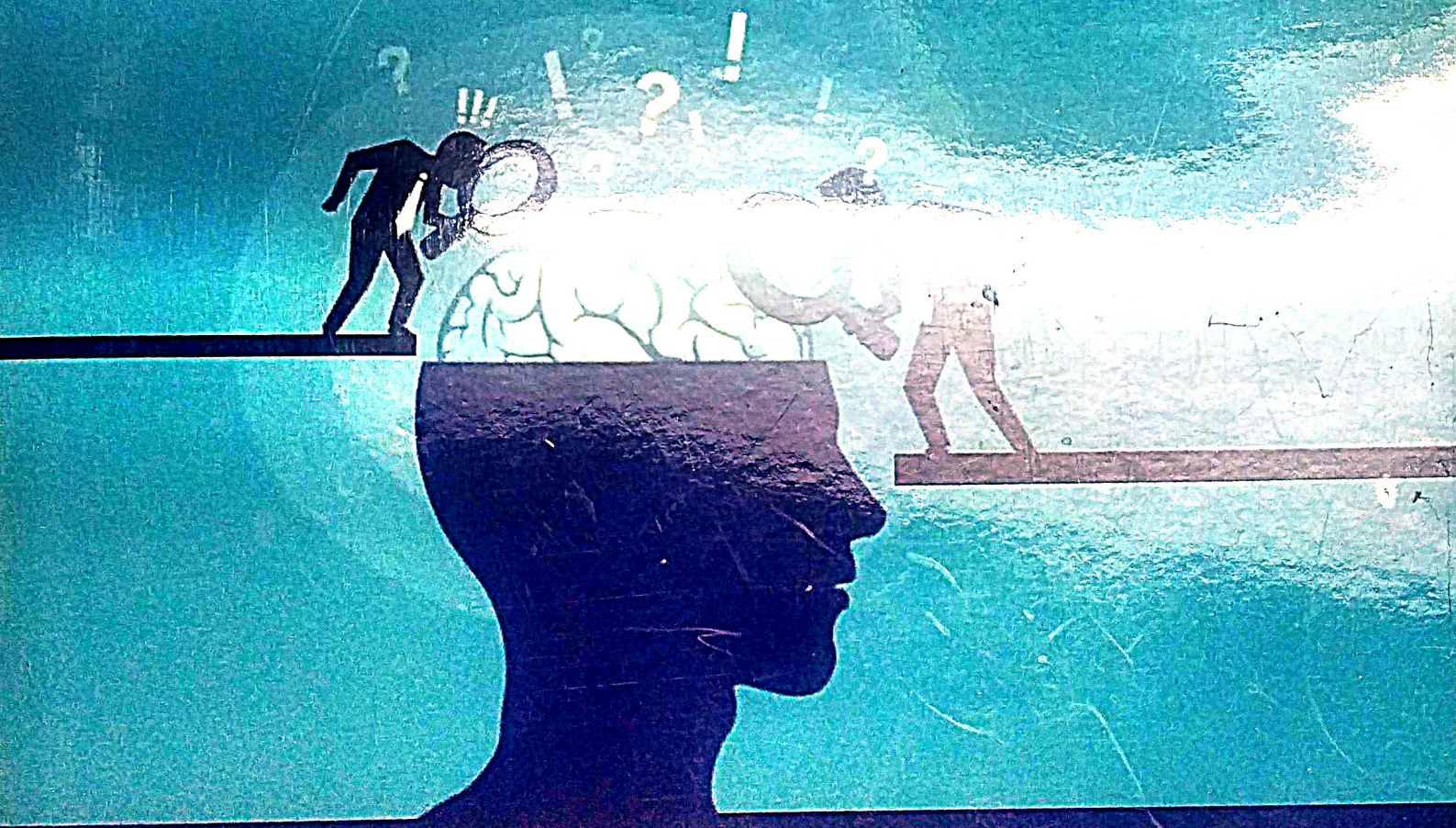

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मधु काँकरिया के 'सलाम आखिरी' उपन्यास में अभिव्यक्त वेश्या जीवन

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वेश्यावृति भारतीय समाज में नारी जीवन की अभिशप्त अंग है। यह प्राचीन काल से समय-समय पर अपने स्वरूप और उद्भव स्रोतों में
साथ चली आ रही हैं इतिहासकारों के अनुसार वैदिक काल में गणिकावृति अस्तित्व में थी। वेदों में प्रयुक्त पुनश्चली, महानग्नी और राष्ट्रा
कोटि की गणिकावृति के ही सूचक है। जैन और बौद्ध धर्म की जातक कथाएँ गणिकाओं के उल्लेख से भरी पड़ी हैं। भारत में दरअसल
द्वारा गणिकावृति को स्वीकृति इसी युग में मिली। राज्य की देखरेख में ही वे पनपीं। उस युग की सुसंस्कृत एवम् कला की आराधक
गणिकाओं की जोड़ी की थी। दरअसल भावना प्रधान हमारे देश में काम जीवन सदैव ही अमर्यादित रहा, विश्रृखंलित रहा। इसीलिए यहां
रहीं बस नाम बदलते रहे। कभी उन्हें देवदासी, सर्वभोग्य, रूपजीवा-तो कहीं उन्हें नृत्यांगना, गणिका, नगरवधू तो कभी तवायफ, वारांगना,
कसबिन एवम् पतुरिया कहा जाता रहा, अन्तर केवल यह है पहले काम के अलावा रिझाने की दुकान लगती थी, वहाँ अब सिर्फ काम की
है अर्थात् पहले वेश्या अपनी चाटुरता बुद्धि से अपने ग्राहक को लुभाती थी, नृत्य करती थी परन्तु वर्तमान समय में इनका रूप कामवासना
वह केवल भोग की वस्तु मात्र बनकर रह गई। वेश्या बनना या होना नारी के लिए एक बहुत बड़ा कलंक है। समाज और धर्म के सामने
घृणा और अपमानजनक ही है। वेश्या का समाज में कोई स्थान नहीं होता। वह तो केवल विलासी पुरुषों का मनोरंजन का साधन मात्र बन

मधु जी का 'सलाम आखिरी' उपन्यास में वेश्वावृति एवम् उससे सम्बन्धित समस्या को उजागर किया है। मधु जी स्वयं इन लालबत्ती इलाकों
वेश्याओं का साक्षात्कार लिया। लेखिका ने इस उपन्यास की मुख्य पात्र सुकीर्ति के माध्यम से अपने विचार कि अभिव्यक्त किया। जो कलकत्ता
बहुबाजार कालीघाट, बैरकपुर, खिदिरपुर आदि रेड लाइट एरिया में जाती है और वेश्याओं से मिलती हैं। उपन्यास में उन्होंने वेश्यावृति और
संघर्ष की गाथा को यथार्थता के साथ चित्रण किया है तथा इसके साथ ही उन्होंने उनसे जुड़ी समस्याओं को जानने की कोशिश करती है।
और वेश्यावृति के पूरे परिदृश्य को देखते हुए हमारे भीतर उन असहाय स्त्रियों के प्रति करूणा पैदा करने की कोशिश करता है जो किसी
में जुड़ गई हैं। कलकता के सोनागाच्छी एरिया का सीधा साक्षात्कार कराते हुए लेखिका सभ्य समाज की संवेदनहीनता और कठोरता से
नग्न यथार्थ चित्रण उन्होंने अपने इस उपन्यास में किया है। इस समस्या का मूल कारण प्राय: आर्थिक, आधारहीनता, गरीबी, अशिक्षा है।
उपन्यास में भी दर्शाया गया है कि किस तरह गरीबी, धन की कमी, अशिक्षा के कारण स्त्री वेश्या बनती है। सुकीर्ति जब अपने घर में काम
आया की बेटी को ढूंढने के लिए सोनागाच्छी जाती है तब वह वहाँ एक वेश्या से प्रश्न करती है "तुम्हें डर नहीं लगता अपनी इज्जत को इस
मर्द के हवाले करते..." तो वह वेश्या उतर देती है "क्यों नहीं लगता है, बहुत लगता है एकदम शुरू- शुरू में तो बोटी-बोटी अकड़ गई थी।"

"तो फिर क्यों करती हो तुम ऐसा?"

"क्योंकि इससे भी ज्यादा डर एक और चीज है, उससे लगता है।"

"क्या है वह?"

"भूख!"

इससे स्पष्ट होता है निर्धनता के कारण ये वेश्याएँ वेश्यावृति को अपनाती है। आज भी भारत में असंख्य लड़कियां ऐसी है जो अपने परिवार
उठाती है और इस पेशे की राह पर चलती है। उपन्यास में रमा भी अपने परिवार का पालन पोषण स्वयं करने के लिए हर महीने, घर भेजती है
पिता को लगता है कि वह कारखाने में काम करती है। इसी सन्दर्भ में रमा कहती है "मैं हर महीने अपने गाँव, अपने माँ बाप को छोटे भाई-बहनों
हजार रूपये के आसपास भेजती हूँ। यह कहकर कि मैं किसी कारखाने में काम काम करती हूँ और अठारह सौ रूपये महीने कमाती हूँ। यदि
जाएं उन्हें कि मैं कैसे कारखानें में हूँ तो मेरा मुंह तक न देखें वे... पैसा लेना तो दूर।"[2] वेश्याओं को समाज सहज रूप से स्वीकार नहीं करता
कि उनका परिवार भी स्वीकार नहीं करता जिनका वह पालन पोषण करती है। नूरी भी अपने परिवार की जिम्मेदारियों के कारण इस व्यवसाय
है।

इन चकले में रहने वाली लड़िकयों के जीवन की ही यह समस्याएँ नहीं ये तो चकले के मालकिन की भी वही स्थिति है। अपने छोटे भाई
बाप के खातिर बर्तन चौका करने वाली मीना को धोखे से इन गलियों में बेच दिया जाता है। 15 वर्ष की उम्र में ही वेश्या बनी मीना पूरी तरह
अधंकार में डूब जाती है। "अब कोई भी लड़का तुमसे शादी नहीं करेगा, क्योंकि पन्द्रह वर्ष की उम्र में ही तुम वेश्या हो गई हो। अच्छा है, ई
कमाने के लिए करो और छः महीने तक मुझे पुरी तरह से भोग - भागकर, अघाकर एक रात वह भी मुझे इन्हीं अंधेरी गलियों में बेच गया।"

कुछ वेश्याएं ऐसी भी होती है जो उनके पति द्वारा जबरदस्ती वेश्याएँ बना दी जाती है। उपन्यास में नलिनी, गायत्री भी उपने पति द्वारा इस व्यवसाय में धकेल दी जाती है। 30 वर्षीय गायत्री तीन बच्चे की माँ है और पति द्वारा छोड़ने पर वह इस पेशे में आई। गायत्री किसी चकले में काम नहीं करती। वह बरेल स्टेट की लाइनवाली है। उसे चकले की भाषा में फ्लाइंग वेश्या कहते है। वह पास के ही गाँव मागराघाट से सुबह ग्यारह बारह बजे तक आती है और जो ग्राहक मिलते है उन्हें किराया के मकान में ले जाती और धंधा करती है। गायत्री पति के द्वारा छोड़ देने के बावजूद भी वह पति के नाम का सिन्दूर लगाती है। वह सिन्दूर के माध्यम से अपने आपको सुरक्षित मानती है क्योंकि समाज उसी स्त्री की इज्जत करता है जिसके पीछे पुरुष हो। गायत्री कहती "मैं प्रतिदिन गाँव से आती हूँ वहाँ सब जानते है कि पति ने मुझे छोड़ दिया है, फिर भी यदि मैं सिन्दूर नहीं लगाऊँगी तो लोग मुझे बदचलन समझेंगे, फब्तियाँ कसकर जीना हराम कर देंगे। मेरी सास मुझसे सम्बन्ध तोड़ लेगी।" गायत्री के इन शब्दों को सुनकर लेखिका को बेहद दुःख हुआ और वे कहती है "भारतीय समाज का यह एक और विरोधाभास! जो स्त्री अपने परिवार को भूखमरी से बचाने के लिए अन्तिम विकल्प के रूप में अपनी अस्मिता तक को दाव पर लगाने का साहस कर पाती है वह भी बिन सुहाग चिह्नों के अपनी बिरादरी वालों मे आँख मिलाने की हिम्मत नहीं बटोर पाती। भारत की आत्मा, ये ग्रामीण स्त्रियाँ और भारत के ये गाँव जहाँ आज भी स्त्री का आँकलन उसकी जुझारू प्रवृति, उसकी कर्मठता, श्रम और परिवार के लिए किए गए उसके त्याग के आध पर नहीं होकर उसके सतीत्व के आधार पर ही होता है।"[5] नलिनी की कहानी भी कुछ ऐसी ही है। उसे भी उसके पति के द्वारा इन गलियों में बेच दिया था। नलिनी एक बड़ी उम्र के मर्द के प्यार में पड़ जाती है और वह उसके साथ घर से भागकर कलकता आ जाती है। उसके पति ने नलिनी के साथ कुछ दिन तक शादी का नाटक किया और अंत में उसने उसे एक दिन बहुबाजार के चकले में बेच दिया। नलिनी की तड़प "आज भी जब-जब दिन के पहले ग्राहक के पास जाती हूँ तो उसके नाम पर अपने उस पहले मर्द पर एक बार थूक अवश्य देती हूँ।"[6] नलिनी का दुःख तथा क्रोध देखा जा सकता है। कोई भी स्त्री उस व्यक्ति को कभी भी क्षमा नहीं कर पाती है, जो उसे वेश्या बनाता है। कुए वेश्याएँ ऐसी होती है जो न तो किसी मजबूरी में वेश्या बनती है और न ही उन्हें धोखे से चकले मे बेचा जाता है वे स्वयं सहर्ष वेश्यावृति को स्वीकार करती है। इस उपन्यास की पात्र पिंकी भी सहज रूप से वेश्यावृति स्वीकार करती है। पिंकी की माँ भी वेश्या थी उसने भी पहली बार अपनी आँखे तो इसी माहौल में खोली। वेश्या जीवन के संस्कार उसे अपनी मां से विरासत में मिले थे। गायत्री, नूरी या चम्पा की तरह न तो उसे अपने पेशे से घृणा थी और न ही आक्रोश और न ही जमाने से किसी प्रकार का गिला शिकवा और न ही बातचीत में कोई दैन्य भाव। अशिक्षा वेश्यावृति का मूल कारण रहा है परन्तु अब अशिक्षित वेश्याओं के अतिरिक्त शिक्षित लड़कियाँ भी इस पेशे को अपनाने के लिए बाध्य है। "कालेज पढ़ने वाली शिक्षित लड़कियाँ तक पार्ट टाइम के हिसाब से इस पेशे को अपनाने को बाध्य हैं। आपने पढ़ा होगा 23 अगस्त 2000 का टेलीग्राफ। कालेज में पढ़ रही लड़की अपनी ट्यूशन फीस किताबें और कपड़ों के खर्च के लिए इस पेशे को अपनाने को बाध्य थी।"[7]

वर्तमान समय में नाबालिक लड़कियों को वेश्याएं बनाया जा रहा है तथा इनकी मांग भी अधिक है। नेपाल, बांग्लादेश आदि कई देशों से इन गरीब लड़कियों को लाया जाता है तथा इन बच्चियों को अप्राकृतिक ढ़ंग से बच्ची से औरत बनाया जाता है। उपन्यास में भी दर्शाया गया हे कि किस तरह छोटी बच्चियों को अप्राकृतिक ढंग से औरत बनाया जाता है तथा उन्हें वेश्यवृति के लिए तैयार किया जाता है। सुकीर्ति जब कालीघाट में वेश्या माया से मिलती है तो उसे ज्ञात होता है कि किस प्रकार बच्चियों को वेश्याएँ बनाया जाता है। माया कहती है "किसी भी छुकरी के उस अंग में (आँख के इशारे से समझा देती है वह वह कौन सा अंग) शोला (कागज का बना पदार्थ जो पानी पड़ने से ही गल जाता है, जिसे बंगाली भाषा में शोला कहा जाता है) घुसा दिया जाता है फिर उन्हें पानी के टब में बैठा दिया जाता है। जैसे-जैसे पानी में शोला फूलता है वैसे-वैसे गुप्तांगों में भी फैलाव आता जाता है। इसी प्रकार पुराने जमाने की औरतें अपने कानों के छेदों को बड़ा बनाती थी। मोटे जेवर घुसेड़ने के लिए। करीब पाँचवे-छठे महीने में लड़की पूरी तरह तैयार हो जाती है।"[8] सुकीर्ति यह सुनकर स्तब्ध हो गई उसे वहां की वायु प्रदूषित लगने लगी तथा साँस लेने में कठिनाई होने लगी। उसे अपनी नजरों के सामने टबों में बैठी दस ग्यारह बर्षीया लड़कियाँ ही लड़कियाँ दिखाई देने लगी और वह मन में सोचती है कि "हे भगवान् गुड़ियाँ! खेलने की उम्र और इतनी दरिन्दगी! कैसे जीती होंगी वे।"[9]

आजीविका के पर्याप्त साधन न होना वेश्यावृति की मूल समस्या है। कोई भी नारी वेश्यावृति को अपनाने के लिए तैयार नहीं होती उसे मजबूरी में इस व्यवसाय को अपनाना पड़ता है। ये न तो अधिक शिक्षित होती है और न ही इनके लिए समाज तथा सरकार द्वारा आजीविका कमाने के साधन उपलब्ध करायें जाते हैं। सुकीर्ति विजय से कहती हैं "देखो, यह समस्या आज इतनी व्यापक और इस कदर समाज के अन्दर तक जड़ जमा चुकी है कि मान लो आज एक रात में ही किसी चमत्कारिक ढंग से वेश्यावृति को रोक दिया जाएं, तो ये वेश्याएँ भूखी मर जाएँगी, न कोई शिक्षा इसके पास, न कोई विकल्प न ही किसी का संरक्षण इनके पास।"[10] जीविका के पर्याप्त साधन न होने के कारण इन्हें जीवित रहने के लिए वेश्यावृति अपनानी पड़ती है।

स्वास्थ्य सम्बन्धी ज्ञान का अभाव के कारण वेश्याएँ एड्स जैसी बीमारियों से रोगग्रस्त हो जाती है जिसके कारण अल्पायु में इनकी मृत्यु हो जाती है। उपन्यास में बताया गया है पिंकी नामक वेश्या एक साधारण से क्लीनिक में अपना गर्भपात करवाती है, उसके रक्त का रिसाव नहीं रूकता तथा उसकी मृत्यु हो जाती है। पिंकी की मित्र रेश्मी सुकीर्ति से कहती है "यह कोई विशेष घटना नहीं यहाँ के जीवन की। आधी से ज्यादा गरीब वेश्याओं का भाग्य ऐसा ही होता है। चालीस पैंतालीस तक कई मर मुरा जाती हैं या अपंग या सड़-गल जाती है। यदि यह नहीं हुआ तो पागल या भिखारिन ही बन जाती है। पिंकी थोड़ा जल्दी मर गई। अरे, यदि सेप्टिक और रक्तस्राव से नहीं मरती तो कुछ सालों बाद एड्स या सिफलिस से संक्रमित होकर मर जाती। जानती है चालीस तक आते-आते बहुत सारी वेश्याएं सड़-गल कर तीन चौथाई मर चुकी रहती है, शरीर और मन दोनों से।"[11]

किसी भी स्त्री का वेश्या जैसा व्यवसाय अपनाने के बाद उसका इस दलदल से बाहर निकलना असम्भव हो जाता है क्योंकि समाज और परिवार अपनी विकृत सोच के कारण उसे स्वीकार नहीं करता और वह इसी व्यवसाय को वापिस अपनाने पर मजबूर हो जाती है। इसी सन्दर्भ में इन्द्राणी सुकीर्ति से कहती है:- "हाँ, कई जगह, छोटी जगहों पर बात के बहुत फैल जाने पर सामाजिक डर के चलते भी माँ-बाप वेश्या बन चुकी अपनी लड़की को वापस नहीं ले पाते हैं कि यदि ऐसा किया तो उनके बाकी बच्चों का भविष्य, शादी-ब्याह दाँव पर लग जाएगा। लोगों के कटाक्ष ताने उनका जीना हराम कर देंगे।"[12]

वेश्याओं के जीवन की यह भी त्रास्दी है कि उनके इस पेशे का प्रभाव उनके बच्चों पर भी पड़ता है क्योंकि उन्हें न तो पिता अपने नाम का पता है और न ही उन्हें समाज में प्रतिष्ठा मिलती है। लेखिका ने भी उपन्यास में वेश्या के बच्चों की मनोदशा को दर्शाया हैं पिंकी नामक वेश्या कहती है "मेरा पता नहीं किसकी औलाद हूँ। औलाद का पता नहीं किस बाप से है, साला बाप नहीं कोई खुदा हुआ, बस सुना ही सुना, देखा तो आज तक तो नहीं।"[13] रेडलाइट एरिया में स्वयं जाकर लेखिका ने यह भी पाया वेश्या का जीवन चाहे कितना भी जिल्लत भरा हो परन्तु वह अपने बच्चों को अपने जीवन की

छाया मात्र से भी दूर रखती है। अधिकांश वेश्याएं अपने बच्चों के लिए आपसी सहयोग से एक अलग उनके रहने की व्यवस्था करती है। [illegible] देवनार भी अपनी बच्ची को अपने पास नहीं रखती। माया 10-11 वर्षीया कम उम्र की बच्चियों को अप्राकृतिक ढंग से औरत बनाकर [illegible] है परन्तु उसने अपनी पुत्री को अपने गाँव में अपनी बहन के पास छोड़ रखा था। हर महीने वह उन्हें खर्च भेजती तथा अपने धंधे के [illegible] उनसे मिल जाती थी परन्तु एक दिन माया बीमार पड़ गई वह एक दो महीनों से अपनी बच्ची से सम्पर्क नहीं कर पाई। उसकी बच्ची [illegible] माहौल में आ गई और माया की अनुपस्थिति में किसी ने उसी की चौदह वर्षीय पुत्री को वेश्या बना डाला। माया का दर्द फूट पड़ता है और [illegible] "जैसी करनी वैसी भरनी। इतनों को वेश्या बना डाला तो खुद की पुत्री को कैसे बचाती।"[14]

वेश्याओं को समाज में उचित स्थान नहीं मिलता। समाज में ऐसा कोई स्थान या व्यक्ति नहीं होता जहाँ वे सुरक्षित महसूस कर सकें। [illegible] गया है बैरकपुर की एक महिला राहगीरों को परेशान करने के आरोप में पुलिस उसे पकड़ लेती है तथा उसके उपरान्त पुलिसवालों ने [illegible] बलात्कार किया। जब उसने हिम्मत करके कहा कि वह इसकी शिकायत सीनियर पुलिस से करूँगी, तो पुलिस वाले हँस पड़े। [illegible] सुकीर्ति जब उससे मिलने जाती है तो उसने पहले तो बात करने से मना कर दिया परन्तु बाद में उसने दुःख बयान किया उसने कहा, "[illegible] एक मालिक होता है, एक ठौर ठिकाना होता है, हर कोई उसे हडका नहीं सकता। पर हमारा क्या है, रास्ते में पड़ी कुतिया से भी बदतर [illegible] कोई भी मार दे ठोकर। जो भी डाल दे दो पैसे, बस उसी के आगे बिछ जाना पड़ता है क्योंकि हम किसी की भी नहीं है। न माँ की, न बाप [illegible] की, न बहन की, न हिन्द की और न ही हिन्दुस्तान की। किसी भी की नहीं।"[15] इससे हमें वेश्या की पीड़ा का ज्ञान हो जाता है कि वेश्याओं [illegible] भी सामाजिक सुरक्षा नहीं होती।

समय के साथ-साथ वेश्यावृति में भी बदलाव हो रहें हैं। प्राचीन समय में वेश्याएं नृत्य करती थी, चाटुकारिकता के माध्यम से व्यय, विद्वत [illegible] समाज में भी इनका स्थान इतना निकृष्ट नहीं था जितना आधुनिक समय में है। इन वेश्याओं का जीवन तो भूख और कामवासना है। [illegible] रहा है कि कामवासना की प्रवृति बढ़ गई है। अब केवल काम को ही महत्त्व दिया जाता है। लेखिका ने उपन्यास में भी बताया है किस [illegible] में भी बदलाव आया है। सुकीर्ति विजय से कहती है "पहले की वेश्याएं तो फिर भी रिझानें, जलाने और तड़पाने के गुर जानती थी पर आज की [illegible] तो खुद ही इतनी जली-भुनी चिड़ि चड़ी एवम् तपी रहती है कि यह भी नहीं समझ पाती है कि ग्राहक इसमें, सिर्फ देह ही नहीं इनके [illegible] को भी भोगने आता है।"[16]

निष्कर्षत

यह कहा जा सकता है उपन्यास के माध्यम से लेखिका ने वेश्या जीवन के उस यथार्थ को दिखाने का प्रयास किया है। जो कहीं अंधेरी [illegible] हुए है। मधु जी ने लालबती इलाकों में जाकर वेश्या जीवन के यथार्थ को गहराई से जाना तथा उपन्यास के माध्यम से पाठकों के समक्ष प्रस्तुत किया [illegible] के जीवन की यह दर्दनाक दास्तान शायद ही पहले किसी ने इस तरह बेबाक पदति से पाठकों के सामने रखी है। वेश्याओं से जुड़े इन बहुआयामी [illegible] ों लेकर लेखिका की चिंता को कोई भी कैसे अनदेखा कर सकता है। समाज में वेश्याओं की मौजूदगी एक चिरन्तन सवाल है जिससे हर समाज [illegible] अपने-अपने ढंग से जूझता रहा हैं वेश्या को कभी लोगों ने सभ्यता की जरूरत बताया है। कभी कलंक बताया। समाज में सभी रूढ़ियों के उन्मूलन [illegible] की जाती है चाहे वो सती प्रथा, बहुविवाह, बाल विवाह आदि हो परन्तु वेश्याओं के उन्मूलन की कोई बात नहीं करता और न ही समाज तथा [illegible] ओर से कोई ठोस कदम उठाए गए हैं।

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Work Life Balance (WLB)in Relation to Family Variables: A Study of Himachal Pradesh Police Personnel

Authors

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DR. JAI SINGH PARMAR[2]

Abstract

Policing has long been recognized as a stressful, emotionally wearisome, and sometimes dangerous occupation. An imbalance in work life and other aspects of life is related to several harmful outcomes for officers, and ultimately to police organizations and nation at large. Various workplace factors have been studied to see what relationship they have with WLB (work life balance) of police officers. There has been far less research on how family related variables might be linked to WLB of police officers. Thus, keeping this fact in mind, this research work sought to discover the nexus of various family related variables with wok life balance of police personnel. Data was gathered from781police personnel of Grade-II employed in Himachal Pradesh, India. Various statistical tools viz. Pearson correlation coefficient, one way- ANOVA and Post Hoc were employed with the help of SPSS 21. The outcome of research reveals that spouse support and WLB is significantly positively correlated, whereas family role overload and WLB is significantly negatively correlated. The research further shows that WLB of police personnel vary significantly at different extents of spousal support and family role overload.

Keywords: *Work- life balance, work- family conflict, spouse support, family variables*

Introduction

In the past, people often attend one major role in their life, i.e. career or housework, etc., rather than to several (e.g., to a career, being a mother, being happy as an individual. etc) (Mescher et al., 2009). In the last few years, a remarkable revolution has occurred in the workforce and this leads to changes in the demographic profile of workers. People have modified their traditional manly 'breadwinner' viewpoint to dual-earner couples and single parental families (Walia, 2011). This makes a single person to play multiple roles of an employee, boss, subordinate, spouse, parent, friend, sibling, member of the club and others. Relative to the working environment, organizations are demanding an increase in employees' work timing, flexibility and productivity. Arulkumar (2015) expressed that conventional phenomenon of one job for whole life has changed and now there is an environment of volatility, instability and job uncertainty. Employees' viewpoint and prospects towards work have also changed. Contemporary orientations towards lifetime learning, individual and professional advancement, and an increased understanding and the need for a balance between work and life have influenced the working environment in which organizations now operate which

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is totally different from any time in history (Shoemaker, Brown, & Barboer,2011).All these factors leads to creation of a world called VUCA world for modern organization where V stands for volatile, U stand for uncertainty, C for complex and A stands for ambiguous.

Naithani (2010) and Naithani and Jha (2009) specified that from 1950's up to the early years of the 21st century an extensive changes have occurred in socioeconomic factors which are influencing the work and personal life of employees. They categorized these factors into three groups viz. family domain, work domain and other factors. *Family domain factors* include the influx of women in the labour force, employment of working mothers, dual earner couples and single parents. This trend increased the child and elder care burden on a large number of staff and created new challenges in balancing work and family life. Work domain factors include extended working hours' culture, changing work time, unpaid overtime and work escalation. These *work domain factors* resulted in increased work strain, less time for home and family responsibilities. *Other factors* influencing work and family life include ageing population, shortage of skill, technological complexities of the workplace, and the growth of service sector industry and lack of social support network, globalization and liberalization (Naithani, 2010).

The above mentioned factors influencing work and family life reflect the belief that work and family lives are interdependent. The difficulties of coordinating these two domains of life (work and family domain) have become a challenge for the majority of Indian working families. In the new VUCA economy, with its focus on 365 working days has affected the employees' family relationship. Large number of employees now a days have family responsibilities regardless of gender, and maximum employees who are married have an employed spouse but jobs are not still modified and carrying the same design and structure considering as employees have no family responsibilities. Thus, managing work domain and family domain, and lessening the conflict between these two domains have become a vital issue. It is especially essential to the police personnel that are compelled to deliver their work with the best attainable quality and additionally to the organizations and governments that hire them and are concerned with nation security and expect top quality services from them.

Literature Review

In the last few years time span, an enormous number of studies have been completed to inspect the work life and family life balance of employees employed in various organizations. These investigated studies have investigated the connection between different family related factors and WLB. **Frone, Yardley & Markel (1997)** in a study on employees who were married and/or parents found a circuitous reciprocal relation between work-to-family conflict and family-to-work conflict. The study prescribed that family-related help may diminish family-to-work struggle fundamentally by lessening family misery and parental over-burden. **Kim & Ling (2001)** in their study examined the sources and type of work-family conflict among married Singapore women entrepreneurs and found that the spousal emotional and attitudinal support had a significant negative relation with work-family conflict. **Mesmer-Magnus &Viswesvaran (2006)** in their study examined the value of facets of family friendly work environment, i.e., work/family policies and programs, including flexibility and dependent care and family-friendly culture, including work/family culture, supervisor support and co-worker support in reducing worker reports of work/ family conflict. The study found spousal support to be strongly related to family work conflict. In addition, small relationship was found between dependent care assistance and work/family conflict.

Kinnunen, Feldt, Mauno, &Rantanen (2010) made an attempt to analyze the relationships between work-family conflict and well-being in the domains of work (job satisfaction) and family (parental distress) among dual-earner couples. The study revealed that high family to work conflict was related to high work to family conflict in both partners, and family to work conflict of the wife was linked to her decreased job satisfaction. Furthermore, family to work conflict was also related to job distress and depression. **Razak, Omar & Yunus (2010)** examined the relationship between spouse support, parental demand and family involvement (family issues) with the two dimensions of work-family conflict [work interference with family and family interference with work]. The study found a significant and positive relationship between parental demands and work interference with family and family interference with work. In addition, a significant and negative relationship was found between spouse support and family interference with work. **Michel, Kotrba, Mitchelson, Clark & Baltes (2011)** examined an organizing framework and theoretical model of work-family conflict. The study found family role stressors (family stressors, role conflict, role ambiguity, role overload, time demands, parental demands, number of children / dependents), family social support (family support, spousal support), family characteristics (internal locus of control, negative affect/ neuroticism) as antecedents of family-to-work conflict (FWC). **Abendroth & den Dulk, L. (2011)** in their study on 'relevance of different types of support for satisfaction with WLB' reported a positive

impact of emotional family support on work-life balance satisfaction while found no impact of instrumental family support on WLB satisfaction of workers.

Rana & Adhikari (2013) examined the role of work and family domain variables in explaining the work family conflict. The results showed that work-family conflict is significantly positively associated with work role conflict and significantly negatively associated with family support. The study further concluded that social support variables such as work support and family support are significant negative predictor of work-family conflict. The study also found no significant role of parental demand in explaining work-family conflict. **Russo, Shteigman & Carmeli, (2015)** study contributes to a better understanding of social support role in balancing work and non-work life of employees. They found that support from work and nonwork sources (family support) plays an essential role for the pursuit of employees to achieve balance in the spheres of work and life and suggest that the WLB helps in the development of psychological availability and augmenting employee positive energy.WLB, psychological availability and positive energy, which is requisite for ensuring people's productivity and development. **Sharma & Parmar (2017)** explored the relationship between family related variables and WLB. The study discovered a significant and positive correlation between spouse support and WLB. The study further reported a significant and negative correlation between family role overload and WLB. The study found no significant correlation between family related variables viz. parental demands, household responsibility and WLB.

Need For Study

The police force in India is over burdened, especially at lower levels where constabulary is forced to work continuously 14-16 hrs and also for 7 days a week (Yadav, Times of India, 2016). It adversely impacts their performance and personal life. The pressure of work has been escalating over the years and it is affecting the work as well as life beyond work of the police personnel. Timely intervention can prevent much of the damage caused by work stress. Many research studies reported social support as one of influencing factors that might minimize the impact of stress (Cobb, 1976; Kaufmann &Beehr, 1989). The employees who availed more social support were found to have a better life than those who availed less social support (Cohen & Wills, 1985; Gansteret. al., 1986). Many research studies conducted in the past have indicated that family support is related negatively to work-family conflict (Parasuraman, Greenhaus, &Granrose, 1992; Frone, Yardley & Markel, 1997). Spouse support was found as the most significant source of family support. Spouse support doesn't only minimize the negative effects of work-family conflict, but also acts as a moderator when work stress is high. Lord (1996) found that work and non-work support from spouse had a positive impact on the police officer's attitude and performance. Keeping these facts in mind, the present study is an attempt to examine the relationship between spouse support and WLB; and WLB of police personnel at varied levels of spousal support.

Further, the demographic and structural changes in the family need to be taken into account; while understanding the need for having a balanced life. In Western industrial culture, there is an increase in the number of childless singles, single-parent families, and single-earner families, along with increased demands of child care, elder care and increasing participation of women population in the labour market (Ferber, O'Farrell & Allen, 1991; Guest, 2002). In the Indian context too, changes in the family structure are evident. The traditional joint and extended families are vanishing and their place is taken by the nuclear families (Rajadhyaksha, 2004). Another change is the influx of women in the workforce in a big way, while still continuing with their earlier role of a homemaker. So, now more employees are now engaged in a dual- earner lifestyle where both partners work and share responsibility for family care-giving (Greenhaus et al., 2000). A research conducted by Bond et al. (1998) found that 85% of employees report having some day-to-day family responsibilities. These changing demographic trends, coupled with greater family involvement by men (Pleck, 1985) have significant impacts on how work and family life relate to each other. Keeping these facts in view, the existing studies on WLB with reference to increased family obligations (viz. household responsibilities, parental demands, family role overload etc.) are available in very limited numbers in India and specifically in Himachal Pradesh. Hence, through the present study, an attempt has been made to examine the relationship of WLB (WLB) with family related variables.

Objectives

The present study was undertaken keeping in view the following objectives:

- To study the relationship between family related variables and WLB of police personnel of Himachal Pradesh.
- To study the difference in WLB of police personnel at varied levels of family related variables.

Hypotheses

In order to meet the objectives of the study, the hypotheses were formulated as under:

H_1: Spouse support will be significantly and positively related toWLB of police personnel.

H_2: Household responsibility will be significantly and negatively related to WLB of police personnel.

H_3: Parental demands will be significantly and negatively related to WLB of police personnel.

H_4: Family roles overloads will be significantly and negatively related to WLB of police personnel.

H_5: There will be a significant difference in WLB (and its dimensions) among police personnel at varied levels of spouse support (i.e., low, average and high spouse support)

H_6: There will be a significant difference in WLB (and its dimensions) among police personnel at varied levels of parental demands (i.e., low, average and high parental demands)

H_7: There will be significant difference in WLB (and its dimensions) among police personnel at varied levels of household responsibility (i.e., low, average and high household responsibility)

H_8: There will be significant difference in WLB (and its dimensions) among police personnel at varied levels of family role overload (i.e., low, average and high family role overload)

Methodology

In this research, exploratory approach and hypotheses testing were employed. The primary data was collected from non-gazetted police personnel of Grade-I employed in Himachal Pradesh state of India. In order to get the required information, a well designed questionnaire was prepared and distributed among the respondents. Questionnaires were distributed among 1040 police personnel on the basis of convenience and judgment sampling. Total no. of questionnaires considered for analysis purpose was 781 after removal of incomplete and irrelevant questionnaire. thus yielding a response rate of 75%. Various statistical tools viz. Pearson correlation coefficient, one way-ANOVA and Post hoc test were used with the help of SPSS 21 to analyze the data. Different standardized reflective scales were used (see Table 1) to collect required information. Negative items were reverse coded.

Table 1: Scales used and their reliability (Cronbach's alpha coefficients)

S.No.	Factor	Scale used	No. of items	Cronbach's alpha coefficients
1.	Work Life Balance (WLB)	Hyman(2005)	15	.86
2.	Family Related Factors			
i.	Spouse support	Caplan et al. (1975)	4	.82
ii.	Family role overload	Beehret al.(1976)	3	.70
iii.	Household responsibility index	Hyman et al., 2003	6	.70
iv.	Parental demands	Walia (2010)	6	.85

Results and Discussion

The useful questionnaires in present study were 781. The demographic characteristics of respondents are as: 78.9% (616) of respondents were male; 21.14% (1654) of respondents were female. The average age of the respondents was 32.58 years (S.D. =7.50). In terms of marital status, 57.6% (450) of respondents were married and 42.4% (331) were single or widowed, or divorced.

Relationship between Family Variables and WLB

In order to find out the relationship between family related variables and WLB of police personnel, Pearson correlation coefficient was employed and the results are shown in Table 2. From the results, Spouse support (SS, r =.172**, p<0.01) was found to be significantly and positively correlated with WLB. Family role overload (FRO, r =-.090*, p<0.05) was also found related to WLB of police personnel, although the relationship was not strong. Further, WLB showed no relationship with family related variables viz. parental demands and household responsibility. Hence, the hypothesis H_1i.e. *'Spouse support will be significantly and positively related to WLB of police personnel' is accepted. The hypotheses H_2i.e. 'Household responsibility will be significantly and negatively related to WLB of police personnel' and H3i.e., 'Parental demands will be significantly and negatively related toWLB of police personnel' are rejected.*

Table 2: Correlation among Variables

Family Related Variables	WLB
SS***	.172**
PD***	-.086
HHR***	.004
FRO***	-.090*

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
*** SS- Spouse Support, PD-Parental Demands, HHR-Household Responsibility, FRO-Family Role Overload

WLB of Police Personnel at Varied Levels of Family Variables

One-way ANOVA was applied to find whether there is any significant difference in WLB among police personnel at varied levels of family related variables. For this, police personnel were categorized into three categories on the basis their family related variable scores (see Table 3):

(a) Low spouse support, parental demands, household responsibility and family role overload: Score< (Mean – 0.5 S.D.)

(b) Average spouse support, parental demands, household responsibility and family role overload: Scores between (Mean and 0.5 S.D.)

(c) High spouse support, parental demands, household responsibility and family role overload: Score > (Mean + 0.5S.D.)

Table 3: Categorization of police personnel based on their family related variable scores

Family Related Variables	Low			Average			High		
	N	%	Mean	N	%	Mean	N	%	Mean
SS	104	23.1	10.64	226	50.2	14.52	120	26.7	18.11
PD	112	28.1	11.28	180	45.2	17.48	106	26.7	24.0
HHR	240	30.7	10.85	327	41.9	15.98	214	27.4	21.24
FRO	203	26.0	4.74	447	57.2	8.19	131	16.8	11.04

Note: SS- Spouse Support, PD-Parental Demands, HHR-Household Responsibility, FRO- Family Role Overload

One of the assumptions of ANOVA is that variances of the groups should be similar. As indicated in the results of Levene's Test of Homogeneity of Variances (see Table 4), the sig. value was found to be less than 0.05 for spouse support, thereby violating the assumption of homogeneity of variance. Therefore, adjusted F statistic can be used for spousal support which is provided by Welch and Brown-Forsythe test (see Table 5). The sig. value was found to be greater than .05 for parental demands, household responsibility and for family role overload; hence, the assumption of homogeneity of variance is supported.

Table 4: Test of homogeneity of variances – Family related variables (NGOs Grade-II)

Family related variables	Levene Statistic	df1	df2	Sig.
SS	8.362	2	447	.001
PD	2.419	2	395	.090
HHR	2.041	2	778	.134
FRO	1.175	2	778	.309

Table 5: Robust test of equality of means – Spousal support (NGOs Grade-II)

Family related variable	Robust Test	Statistic	Df1	Df2	Sig
SS	Welch	3.282	2	226.346	.039
	Brown-Forsythe	3.933	2	315.532	.021

As per the results of robust test of equality of means (see Table-5), F value was found to be significant for spouse support ($F= 3.28$, $p< 0.05$). The result shows that there is a significant difference in WLB among NGOs Grade-II at low, average and high levels of spouse support.

Table 6: ANOVA Table for WLB of police personnel at varied levels of family related variables

Family Related Variables	Sources of Variance	Sumof Squares	Df	Mean Square	F	Sig.
PD	Between Groups	463.659	2	231.829	1.061	.347
	Within Groups	86322.895	395	218.538		
	Total	86786.555	397			
HHR	Between Groups	372.570	2	186.285	.990	.372
	Within Groups	146326.676	778	188.080		
	Total	146699.247	780			
FRO	Between Groups	1876.429	2	938.214	5.040	.007
	Within Groups	144822.818	778	186.147		
	Total	146699.247	780			

The results of ANOVA analysis (see Table 6) shows that F value wasnot found significant for parental demands (F=1.061, p> 0.05) and household responsibility(F=.990, p>0.05) which further imply that there is no significant difference in WLB among police personnel (NGOs Grade-II) at varied levels of parental demands and household responsibility. Hence the hypotheses H_6 i.e.,*there will be a significant difference in WLB (and its dimensions) among police personnel at varied levels of parental demands (i.e., low, average and high parental demands) and* H_7 *i.e.,there will be a significant difference in WLB (and its dimensions) among police personnel at varied levels of household responsibility (i.e., low, average and high household responsibility*) were rejected.

Further, F value was found significant for family role overload (F=5.04, p<0.05) which indicates significant differences in WLB among police personnel (NGOs Grade-II) with low, average and high levels of family role overload.

Post Hoc Test

Since WLB of police personnel was found to significantly different at varied levels of spousal support(in robust tests) and family role overload (in ANOVA), thus, post hoc tests were employed to identify the pair of groups that contributed to significant differences. The results of the comparison are summarized in Table 7.

Table 7: Post hoc examinefor assessment of WLB of NGOs Grade-II at varied levels of spousal support and family role overload

Games Howell							
	Groups		Mean Difference (a-b)	Std. Error	Sig.	95% Confidence Interval	
	(a)	(b)				Lower Limit	Upper Limit
SS	Low (57.78)	Average	-0.924694	1.551385	.822	-4.587183	2.737796
		High	-5.004487*	2.042098	.040	-9.823668	-0.185306
	Average (58.70)	Low	0.924694	1.551385	.822	-2.737796	4.587183
		High	-4.079794	1.828957	.069	-8.399461	0.239874
	High (62.78)	Low	5.004487*	2.042098	.040	0.185306	9.823668
		Average	4.079794	1.828957	.069	-0.239874	8.399461
Tukey HSD							
FRO	Low (61.90)	Average	2.851809*	1.15473	.037	0.140249	5.563369
		High	4.568307*	1.52903	.008	0.977816	8.158799
	Average (59.04)	Low	-2.851809*	1.15473	.037	-5.563369	-0.140249
		High	1.716498	1.35551	.415	-1.466517	4.899514
	High (57.33)	Low	-4.568307*	1.52903	.008	-8.158799	-0.977816
		Average	-1.716498	1.35551	.415	-4.899514	1.466517

Note: Values in parenthesis indicate means

* The mean difference is significant at the 0.05 level

The results of Games-Howell post hoc analysis (see Table-7) shows that in case of spousal support, the p-value of low-high group was found to be less than 0.05, indicating that the mean scores between low-high groups differed significantly at the 5% level of significance. However, the p-value for low-average and average-high groups was found to be greater than 0.05, showing that there is no significant difference among these groups. The result infers that the WLB differed significantly among police personnel with low-high spouse support, at the same time, does not vary significantly among police personnel with low-average and high-average spouse support. WLB was found to be highest among groups with high spousal support (M_H=62.78), followed by average (M_A= 58.70) and low spousal support (M_L= 57.78).

The results of Tukey HSD post hoc analysis (see Table 7) revealed that in case of family role overload, the p-value of low-average and low-high groups were less than 0.05, showing that the mean scores between low-average and low-high groups differed significantly at the 5% level of significance. However, the p-value for average-high group was found to be greater than 0.05, showing that there is no significant difference in this group. The result infers that WLB differed significantly among police personnel with low-average and low-high family role overload, however, does not differ significantly among police personnel with average-high family role overload. The WLB was found to be highest among groups with low family role overload (M_L= 61.90), followed by average (M_A= 59.04) and high family role overload (M_H= 57.33). Hence, the hypothesis H_5 i.e., there will be a significant difference in WLB (and its dimensions) among police personnel at varied levels of spouse support (i.e., low, average and high spouse support) and H_8 i.e., there will be a significant difference in WLB (and its dimensions) among police personnel at varied levels of family role overload (i.e., low, average and high family role overload) were accepted.

Conclusions and Implications

The present study was carried out to inspect the WLB of police personnel in relation to various family related variables. The study found a significant and positive correlation between spouse support and WLB which further indicate that higher the spousal support higher will be the WLB of employees. The finding of the present study corroborates the studies made by Lord (1996) who found that work and non-work support from spouse had a positive impact on the police officer's attitude and performance. Jackson (1992) found that support from spouses reduces the negative impacts of work stress. Aycan & Eskin (2005) reported a negative association between spouse support and family to work conflict. Further, in the present study, a negative relationship was found between family role overload and WLB. This result is in consistent with the studies made by Frone et al., (1997) and Kopelman et al. (1983) who observed that the increasing dual career responsibilities make it difficult for an individual to maintain a balance between family and work responsibilities. Responsibilities towards family/ house interfere with workplace responsibilities.

The difference in WLB of police personnel at varied levels of family related variables viz. spouse support, parental demands, household responsibility and family role overload was also examined. The study found a significant difference in WLB of police personnel at low, average and high levels of spousal support and family role overload indicating these two family related variables as significant predictors of WLB of police personnel. These predictors cannot be directly managed by the organizations, though; organizations can make an effort to manage the impact of these predictors on WLB. For example, family room, sick leave to take care of children, provisions for child care referral services, parenting or family support programs and crèches may help in managing the affect of family demands on WLB. In family, the demands have increased as a consequence of changes in demographic profile of the workforce and changes in family structure such as a dual-earner couples, single-parent families and nuclear families. This trend has created new challenges in balancing work and other domains of life. Riley (2012) reported that even with reliable work-family arrangements, conflict can arise from sporadic events such as deadlines at workplace and sudden illness of children. Therefore, support from non-work based sources (such as spouse, children, and friends) help to reduce the conflict between work and life domains. Spouse support was found as the most significant source of family support. Spouse has a better understanding of the family environment and provides appropriate support in family domain. Spouse support doesn't only minimize the negative effects of work-family conflict, but also acts as a moderator when work stress is high. This fact would be especially important for police officers as there is a significant spillover between work and family in police work (Roberts & Levenson, 2001). If police personnel receive the needed support from spouse, it may become easier to maintain a balance in their life. Education for family members of police personnel is recommended regarding the work of police and vigorous demands of the job that may enable loved ones to provide support that is most appropriate to the officer's need.

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Exploring Consumer Psychograph and Positioning Opportunities in Urban Markets

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ABSTRACT

Formulation of a thoughtful marketing strategy is of utmost importance for the success of any industrial venture. No matter which sector of our economy we talk about, a lot depends on the marketing strategies adopted. With the ever expanding movement of man, money and machinery the concept of markets has also changed. Today, markets are not geographically-bound; rather globalization has outstretched the horizons of markets both in vertical and horizontal domains. Though there has been an exponential increase in terms of the opportunities available, the fierce competition pooling from all around the globe has also increased. Focus and adoption of innovative techniques for production is necessary but in no ways sufficient. The undertaken research focuses on the analysis of consumer's psychographic profile in Shimla district of Himachal Pradesh in resonance to the marketing strategies that are currently employed and can be adopted to yield better results to the rural producers. A sample of 100 respondents was selected randomly to map their psychographic profile and correlate various factors that influence their buying decision.

Key Words: Analysis, Consumer, Cognitive Profile, Product Positioning, Psychograph, Strategic Marketing.

INTRODUCTION

The steady growth of the Indian economy is supported by the abundant manpower available within the country, constituted of both skilled and unskilled labour. Taking into account the projected trend, it is expected that, in 2020, the average age of an Indian will be 29 yr; thus making India one of the youngest and most dynamic nation in the world.

Even the contribution of the Agriculture sector in the Indian economy is much higher than world's average (6.4 %) standing at 15.4 per cent of the country's GDP. Further, the population distribution of India indicate that there are twice as many people living in the rural parts of the country compared to the ones residing in the urban parts. According to the findings of the 2011 Census, the rural to urban population of India was roughly 68.84**:**31.16 per cent.

Most of the people living in the rural parts of the country earn their livelihood from agriculture, livestock, forestry, hunting, beekeeping, fishing and pisciculture. Agriculture itself plays a vital role in the Indian economy with over 70per cent of the rural households directly dependent on it. Presently, India is among the top two farm producers in the world and provides approximately 52 per cent of the total number of jobs available in the country both directly and indirectly. Agriculture is the only means of living for almost two-thirds of the employed class in India and the agriculture sector occupies almost 43 per cent of India's geographical area. Clearly a major chunk of rural India engages itself in the primary sector and contributes a lot to the country's GDP.

Today we live in the age of open markets where instead of having monopoly or oligopoly

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Table1. 2011 Census-Population distribution data (in crore).

Net Population	2001	2011	Net Change
India	102.9	121	18.1
Rural	74.3	83.3	9
Urban	28.6	37.7	9.1

we have existence of perfect competition, not only coming from within the country, but from multiple competing nations. Whether we talk about the production of rice, tea, coffee beans, almonds or any other primary sector based product, our local producers face stiff competition from multinational firms and companies. In most of the cases the foreign agriculture and farm based products that are sold in the Indian markets, are supported by extravagant financial lobbies that employ multiple strategists and marketing teams to handle the success of their products. In contrast, the domestic producer no matter how big or small whether with the availability of funds or not, fails to capture the mass market due to lack of proper marketing and positioning strategy. Grahovac (2005), Acharya and Agarwal (2006) reported that rural marketing in India is characterized by two main activities as selling of agricultural and rural items in the urban areas & selling of manufactured products in the rural regions. The selling of manufactured products in the rural areas is further categorized as the selling of urban manufactured products in rural markets & the selling of rural manufactured products in the rural markets.

The marketing and the sales of the urban products in the rural markets saw an exponential rise in the early 2000s estimated by Singh and Sharma (2012), in response to the extensive research and marketing strategies adopted by multinational giants like, Proctor & Gamble, HUL, TATA, Dabur etc. in the FMCG sector, along with companies like John Deere, Ford and Mahindra in tractor manufacturing sector; but when it comes to the marketing of rural products (whether consumables or durables) in the urban markets there is still a long uphill battle that needs to be fought.

MATERIALS AND METHODS

Exploratory research was conducted to analyze the consumer's psyche and product perception. This research is characterized by the use of questionnaire and successive responses generated by the targeted population to draw meaningful conclusion. This research is based on the primary data collected by the means of questionnaire and first hand interview. A standardized questionnaire was prepared to conduct this research focusing on the key parameters that dictates the purchase decision of buyers. Common Indian consumers and retailers were interviewed to gather reliable data. Non Probabilistic sampling strategy was followed where techniques like convenience sampling, snowball sampling and quota sampling were applied to fulfill the research objective. A sample size of 100 individuals was considered for this research.

Table 2: Population distribution and income status of respondents.

Income status respondents	Number of respondents
Below Rs 20,000	19
Rs 20,000 – Rs 35,000	22
Rs 35,000 – Rs 50,000	46
Rs 50,000 & Above	13

Demography

In order to correlate the psychographic profile of the urban consumers to the sale of rural commodities in the market, it was important to look into the demographic profile of the respondents. The set of believes, values, attitude and perception of a person depends on multiple factors like the level of education, age of a person, his/her corresponding exposure to the outside world along with the

location where he/she lives. Since the targeted population for this research pertained to the Shimla urban area (H.P), most of the correspondents were either graduate or above belonging to different age groups and varying professions.

Table 3: Population distribution according to the age group of respondents.

Age groups of respondents	Number of respondents
Below 20	17
20 -35	32
35 – 50	23
50 & Above	28

The varying income status of the respondents provided a deep understanding of the key factors that consumers consider before buying any commodity viz. packaging, quality and price etc.

RESULTS AND DISCUSSION

Product packaging and presentation

Based on the survey 81per cent of the respondents considered seal-packed agro products like dairy products, soya bean nuggets etc. to be of superior quality when compared to the unpacked sales of the same products at various kiryana stores. Simply put, air tight packaging of agro products inspires more confidence in urban population. Also correlating to previously conducted research by Pawan Kumar & Neha Dangi in 2011, focusing on Rural Marketing in India, Challenges and opportunities

Product quality assurance and certification significance

Product quality and authenticity plays a very vital role in the sale of any commodity hence 93 per cent of the surveyed population considered buying only those agro products that carry certification by agencies like FSSAI and AGMARK.

Online market and its significance

Technological development and growth of online shopping sites has made life easier for lots of people. Shimla, not being a big metro city doesn't enjoy facilities of online mega grocery retailers like Grofers, Godrej Nature's Basket, Big Basket etc.

but E Commerce giants like Amazon and Flipkart do carter the needs of the urban population. Thirty eight per cent of respondents agreed buying agro-products like honey, chia seeds, fruit jams and juices etc. directly from E Commerce websites.

Significance of branding

Seventy three per cent of the surveyed population considered brand name as an important factor that influences their purchase decision. A brand promoted by a famous public figure or one which has been there in the market for a considerable duration of time promotes trust in buyers and helps in the acceleration of sales for that product.

Price and quality perception

The asking price for a commodity can create a make or break situation for that particular product, especially when there are multiple competing brands in the market. In rural regions where earning per person is on the lower side people prefer to buy products that require minimum expenditure but interestingly when the urban surveyed population was asked to rank the quality of three competing almond brands based only on their perception the results were eye opening. Apart from the brand name the only information provided to the respondents was the MRP of the three competing brands. In absence of any other parameter for judgment, 92 per cent respondents considered the most expensive almond brand to be of superior quality when compared to the other two brands; but shockingly even with that perception only 12 per cent of the respondents considered buying it in future. Whereas the most affordable brand that was considered inferior to the other two brands by 79 per cent of the people, still had higher consideration for buying, voted by 21 per cent respondents. On the other hand the brand that existed in the middle of the price spectrum was ranked 2nd by 82 per cent respondents and more importantly was considered by maximum 67%

Table 4. Quality perception with respect to price.

Brand Name (500g)	MRP	No. of Respondents Ranked 1	No. of Respondents Ranked 2	No. of Respondents Ranked 3	Consideration for Buying
Solimo Almonds	705	3	82	15	67
Wonderland Premium Almonds	1399	92	3	5	12
Saptrishi Almonds	530	5	16	79	21

Table 5. Monthly earnings and buying choices of urban population.

Monthly Earnings (in Rupees)	Branded Agro-Product Buyers	Unbranded Agro-Product Buyers	Row Total
Below Rs 20,000	7	12	19
Rs 20,000 –Rs 35,000	13	9	22
Rs 35,00 –Rs 50,000	29	17	46
Above 50,000	8	5	13

Calculating the expected value

people for future purchase. It simply suggested that knowingly or unknowingly people do associate the quality of a product with its price but that does not necessarily mean that they would definitely buy it. What people look for, is the balance between good quality and reasonable price for that commodity.

In order to understand the current status and performance of rural-agro products in the urban market, specific questions were added to the questionnaire targeting urban retailers and whole sellers. Based on the feedback from the whole sellers and retailers, locally produced commodities like soya-badi, pine nut, dried lentil badi, spices etc. face stiff competition from seal packed branded commodities. 68 per cent respondents agreed to the fact that urban households prefer to buy branded packaging instead of going for the locally produced commodities, vegetables being the exception.

Coming to the marketing part, almost all the retailers confirmed constant efforts on part of big FMCG companies like ITC, MDH, Dabur etc. for the promotion of their agro products by the means of free gift schemes, installation of advertisement hoarding in shops, festivity offers etc. On contrary local rural producers do not involve themselves with any kind of product promotional activity as stated by 84% retailers.

Market coverage and dispersed presence of the rural products is another important factor that determines the success of product sales as stated by marketer Semenik J Richard, in his research work based on product promotion and integrated marketing . Out of 25 surveyed shops and shopping complexes local soya nuggets brand "A-1 Soya Chunks", had market presence of just 8% in contrast to brands like Fortune and Saffola with over 80% cent market presence. Clearly with all the data and seller's response, it would not be wrong to say that the current marketing strategies adopted by the local rural producers were not up to the mark with 86 per cent of the sellers confirming the fact themselves.

Effect of income level of urban respondents on the purchase decision of unbranded rural products:

Table 6. Calculation of expected values.

Monthly Earning (in Rupees)	Branded Agro-Product Buyers	Unbranded Agro- Product Buyers	Row Total
Below Rs 20,000	57x19/100 = 10.83	43x19/100 = 8.17	19
Rs 20,000 – Rs 35,000	57x22/100 = 12.54	43x22/100 = 9.46	22
Rs 35,000 –Rs 50,000	57x46/100 = 26.22	43x46/100 = 19.78	46
Above Rs 50,000	57x13/100 = 7.41	43x13/100 = 5.59	13

Computation

Monthly Earnings (in Rupees)	Branded Agro-Product Buyers (O-E)	Unbranded Agro-Product Buyers (O-E)	Branded Agro-Product Buyers $(O-E)^2/E$	Unbranded Agro-Product Buyers $(O-E)^2/E$
Below Rs 20,000	-3.83	3.83	1.35	1.79
Rs 20,000 – Rs 35,000	0.46	-0.46	0.01	0.02
Rs 35,000 –Rs 50,000	2.78	-2.78	0.29	0.39
Above Rs 50,000	0.59	-0.59	0.05	0.06

Calculation of Probability value (P value)

Therefore Chi square = (Observed frequency-Expected Frequency)^2 Expected Frequency 1.35 +0.01 +0.29 +0.05 +1.79 +0.02 +0.39 +0.06 **= 3.96**

From the Chi^2 table for the value **3.96,** with **the** degree of freedom, **df** = 3 & level of significance **(α) = .05,** the **P Value** comes out to be **.2632**

Interpretation:

Since the Chi^2 value is > P value therefore the result is not significant at p <.05

This implies: Buying of unbranded rural commodities by the urban buyers is independent of their income status. Hence we accept the Null hypothesis.

Based on cumulative responses for the asked questions, it can be easily understood that the urban buyers not only buy agro products rather they focus on buying brands, which simply means buying products from a reputed company that has been around for a considerable duration of time and has positive buyer's opinion so as to ensures proper quality and safety of the consumers. Urban buyers do acknowledge and support the use of indigenously produced agro products but when it comes to making the purchase decision, the origin of the products doesn't carry much weightage as long as the products meet the quality standards and are marketed at a reasonable price.

More or less, all human beings are judgmental by nature. Urban buyers being no different, make the buying decision even before trying out the other products just on the basis of how the product and its packaging looks. As a result in case of agro products, packaging and presentation does play a crucial role.

CONCLUSION

The Indian urban market with its vast size and heterogeneous demand base offers great lucrative opportunities to marketers. In India there are twice as many people living in the rural parts of the country compared to the ones residing in the urban

parts, most of which directly or indirectly depend on agriculture for their livelihood. Agriculture is the only means of living for almost two-thirds of the employed class in India and provides approximately 52% of the total number of jobs available in the country. With all the necessary potential and available opportunities, there also exists stiff competition, pooling into the Indian markets from all around the globe. As a result to tackle this competition, it becomes absolutely necessary for the rural Indian producers to adopt various positioning strategies in order to make a mark for themselves in the urban markets. The Urban consumers of present day India are very informed and expect nothing less than perfection. They have access to a wide variety of products, produced both nationally and internationally. Hence to satisfy their needs, and to help the small rural producers of India earn well, it is very crucial to share the importance of incorporating marketing strategies along with focusing on the production process.

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Quality of Work Life in Transport Sector - A Comparative Study of Himachal Road Transport Corporation and Punjab Roadways

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ABSTRACT

Organizations cannot run without the precious sources called workforce. A high quality of work life (QWL) is essential for organizations to continue to attract and retain employees. QWL is an all-inclusive program designated to improve employee satisfaction. The aim of this research paper is to understand and compare the quality of work life of employees in Himachal Road Transport Corporation (HRTC) and Punjab Roadway (PR) and to assess the attitudes of the employees towards the welfare and safety measures, the physical facilities/working conditions, and social security and welfare measures in HRTC and Punjab Roadways. It was found from the results that the employees of both the organizations were not satisfied with the quality of work life in their respective organizations.

Keywords: Quality of work life, Working conditions, Human Resource Management Practices.

INTRODUCTION

Quality of work life (QWL) refers to the favorableness or unfavorableness of a job environment for the employees working in an organisation. It basically deals with the methods in which an organisation can ensure the holistic well-being of an employee instead of just focusing on work-related aspects. It includes the physical, social, economic, psychological and cultural well-being of employees. Quality of work life efforts are systematic efforts made by an organisation to give its employees a better opportunity to contribute towards the overall effectiveness of their organisation. A happy and healthy employee will give better turnover, make good decisions and contribute positively towards the organizational goals. An assured good quality of work life will not only attract young and new talent but

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also retain the existing experienced talent. So the organizations should always provide better quality of life and working conditions to its employees so that they can utilize other resources efficiently and effectively. Efforts towards QWL measurement help in efficient and effective allocation of resources to enhance productivity and stability of the workforce.

REVIEW OF RELATED LITERATURE

Singh & Maggu (1980), Kaushal (1997), Singh, S. (2014) found out that managerial experiences, hierarchy and remuneration do not significantly influence the perceived quality of work life. The high QWL was the result of the fact that organization took care of its workers in respect of pay, working conditions etc. Job enrichment, job enlargement and quality circles can contribute a lot. There is need to have customized work life balance policy considering the age groups of present work force. Tan & Akhtar (1992), Gani(1993) in their study revealed that the selected HRM practices like job security and satisfying work relationships are generally valued by employees and do contributes towards employee retention. The wage discontent, deplorable working and living conditions, job security and poor industrial relations climate continue to be the major considerations in employees working lives. Parmar (2002), Singh (2000), Gupta, S.(2007) found that the new vistas in QWL areas would be explored with the advancement in the technology, more autonomy at the work place and more participative decisions making. The work culture in private sector is characterized by challenging work, opportunity for growth and learning, freedom to act and congenial work conditions. Whereas public sector work culture were found to be related to high job security, moderate chance for promotion and better policies and administration. The participation in problem solving strengthens organizational commitment in both private and public sectors.

Panda(2004), Ghosh (2008), Krishnan(2010),Sarkar (2010) in their study emphasized on the industrial relation environment in terms of structural mechanisms for industrial relation management, trade unions and collective bargaining, workers participation in management and union management

relationship. Sharma, R.R.(2006), Kanwar, Y.S.P. et.al.(2009) found out that poor quality of work life resulting in stress and strain coupled with burnout has far reaching consequences on both the individual employees and the organization in terms of low motivation and productivity, increase in health cost, low engagement and employees' turnover. K., Sreenath and Annalakshmi (2010) in their study revealed that employees with high level resilience show high quality of work life.

OBJECTIVES OF THE STUDY

Following are the objectives of the study:

To find out and compare the satisfaction level of employees with quality of work life in HRTC and Punjab Roadways.

To assess the attitudes of the employees towards the welfare and safety measures, the physical facilities/working conditions, and social security and welfare measures in HRTC and Punjab Roadways.

HYPOTHESIS

$\mathbf{Ha}_{QWL1}$: There is a significant relationship between the age and satisfaction of employees with the quality of work life in HRTC.

$\mathbf{Hb}_{QWL1}$: There is a significant relationship between the age and satisfaction of employees with the quality of work life in PR.

$\mathbf{Ha}_{QWL2}$: There is a significant relationship between the salary and satisfaction of employees with the quality of work life in HRTC.

$\mathbf{Hb}_{QWL2}$: There is significant relationship between the salary and satisfaction of employees with the quality of work life in PR.

$\mathbf{Ha}_{QWL3}$: There is a significant relationship between the different categories of staff and satisfaction of employees with the quality of work life in HRTC.

$\mathbf{Hb}_{QWL3}$: There is significant relationship between the different categories of staff and satisfaction of employees with the quality of work life in PR.

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RESEARCH METHODOLOGY

This research is conducted in selected depots of HRTC and Punjab Roadways. Sampling is defined as a practice of taking a small part of a large bulk to represent the whole. In a statistical inquiry when only a part of the population or only a group of units is taken into consideration, it is called sample method of inquiry (Ghosh, 1987).

HRTC has a three tier structure. The corporate office at Shimla control 4 Divisional Offices located at Shimla, Mandi, Hamirpur and Dharamshala. In all there are 27 depots, which are operating in HRTC. Out of 27 depots, 6 depots were selected on random basis including head office. Similarly Punjab Roadways has two tier set up. First tier is headed by Director State Transport. The second tier in the set up is depot management. There are 18 depots of Punjab Roadways. Out of 18 depots, 5 depots were selected including head office as shown in on random basis for the purpose of the study.

A total sample of 550 employees was taken with the help of convenience-cum–judgment sampling technique which was comprised of 300 from HRTC and 250 from Punjab Roadways. The relevant data for the study has been collected from both primary and secondary sources. For the purpose of this study, a well structured interview schedule was used for the data collection which increased the quality of the result and helps to justify the use of this research. This structured interview schedule was pretested and partially modified before its final administration to the respondents.

The secondary sources of data collection comprised of the corporate offices of HRTC and Punjab Roadways, books, magazines, newspapers, journals, websites and other published reports and gazettes by different department.

In this study data was analyzed using Statistical Program for the Social Science (SPSS 20) software. Various statistical tests were applied to analysis the data collected from the respondents such as percentages, frequency, mean, standard deviation, chi-square, Spearman correlation, skewness and kurtosis etc. for better understanding and interpretation.

RESULTS AND DISCUSSION

Keeping in view the existing level of quality of work life in the HRTC and PR in this section an attempt has been made to analyze the demographic characteristics viz. age, salary and categories of staff vis-a-vis satisfaction with quality of work life in HRTC and PR.

Table 1: Age vis-a-vis quality of wok life in HRTC & PR

Age	HRTC			Punjab Roadways		
	Satisfaction with the Quality of Work Life		Total	Satisfaction with the quality of work life		Total
	Yes	No		Yes	No	
18-25 Years	14 (70.0)	6 (30.0)	20 (100.0)	2 (7.7)	24 (92.3)	26 (100.0)
26-35 Years	17 (34.0)	33 (66.0)	50 (100.0)	46 (55.4)	37 (44.6)	83 (100.0)
36-45 Years	14 (25.9)	40 (74.1)	54 (100.0)	24 (53.3)	21 (46.7)	45 (100.0)
46-55 Years	27 (19.9)	109 (80.1)	136 (100.0)	16 (32.7)	33 (67.3)	49 (100.0)
55 and above	7 (17.5)	33 (82.5)	40 (100.0)	27 (57.4)	20 (42.6)	47 (100.0)
Total	79 (26.3)	221 (73.7)	300 (100.0)	115 (46.0)	135 (54.0)	250 (100.0)
	χ^2=25.731	P=0.000		χ^2=25.294	P=0.000	

Note: Figures in parenthesis shows percentages

In order to find out the relationship between the age and satisfaction of employees with the quality of work life, the following hypotheses were formulated:

Ha_{QWLI}: There is a significant relationship between the age and satisfaction of employees with the quality of work life in HRTC.

Hb_{QWLI}: There is a significant relationship between the age and satisfaction of employees with the quality of work life in PR.

It is clear from the table 1, that the value of χ^2 test is 25.731 for HRTC and 25.294 for PR and its corresponding p value is 0.000<0.05 and 0.000<0.05 for

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HRTC and Punjab Roadways respectively. ***Since the p value is less than 0.05, the*** Ha_{QWL1} ***and*** Hb_{QWL1} ***hypotheses are accepted*** meaning thereby there is significant relationship between the age and satisfaction of employees with the quality of work life in both the organizations understudy. Hence, it can be stated that the concept of QWL is very significant to all the age groups of employees. It is clear from the analysis that employees from the lower age group in HRTC were satisfied than the old age group of employees. Whereas in PR, it was reverse of it. Therefore, employees always expect good QWL before joining any organization. In case of HRTC the large majority of respondents (82.5 percent) in the age group of 55 & above have expressed their viewpoints that they are not satisfied with the quality of work life in the organization. Whereas 70 percent respondents in the age group of 18-25 years pointed out that they are satisfied with the quality of work life in HRTC. Whereas in case of PR the majority of respondents (92.3 percent) in the age group of 18-25 years have said that they are not satisfied with the quality of work life in the organization. Whereas 57.4 percent of respondents in the age group of 55 & above have replied that they are satisfied with the quality of work life in PR. The overall perception of employees was unfavorable (73.7 percent) in HRTC and (54 percent) in PR regarding the satisfaction with quality of work life.

Table 2: Salary vis-a-vis Quality of Work Life in HRTC & PR

Salary(Rs.)	HRTC			Punjab Roadways		
	Satisfaction with the Quality of Work Life		Total	Satisfaction with the quality of work life		Total
	Yes	No		Yes	No	
Below 10000	26 (38.2)	42 (61.8)	68 (100.0)	11 (18.6)	48 (81.4)	59 (100.0)
10001-20000	5 (38.5)	8 (61.5)	13 (100.0)	3 (50.00	3 (50.0)	6 (100.0)
20001-30000	1 (3.3)	29 (96.7)	30 (100.0)	7 (41.2)	10 (58.8)	17 (100.0)
30001-40000	19 (17.9)	87 (82.1)	106 (100.0)	50 (54.9)	41 (45.1)	91 (100.0)
40001-50000	13 (25.0)	39 (75.0)	52 (100.0)	21 (70.0)	9 (30.0)	30 (100.0)
50001 & above	15 (48.4)	16 (51.6)	31 (100.0)	23 (48.9)	24 (51.1)	47 (100.0)
Total	79 (26.3)	221 (73.7)	300 (100.0)	115 (46.0)	135 (54.0)	250 (100.0)
	χ^2=25.816	P=0.000		χ^2=30.684	P=0.000	

Note: Figures in parenthesis shows percentages

In order to find out the relationship between the salary and satisfaction of employees with the quality of work life, the following hypotheses were formulated:

Ha_{QWL2}: There is a significant relationship between the salary and satisfaction of employees with the quality of work life in HRTC.

Hb_{QWL2}: There is significant relationship between the salary and satisfaction of employees with the quality of work life in PR.

From the table 2, the value of χ^2 test is 25.816 for HRTC and 30.684 for Punjab Roadways and its corresponding p value is 0.000<0.05 and 0.000<0.05 for HRTC and PR respectively. ***Since the p value is less than 0.05, the*** Ha_{QWL2} ***and*** Hb_{QWL2} ***hypothesis are accepted*** meaning thereby that there is significant relationship between the salary and satisfaction of employees with the quality of work life in both the organizations. On the basis of this information, it can be inferred that the quality of work life depends on the salary of the employees as adequate and fair compensation is one of the dimension of quality of work life. The dissatisfaction level of the employees with QWL in higher salary group is less as compare to the employees of lower salary groups. In case of HRTC the large majority of respondents (96.7 percent) in the salary group of 20001-30000 have expressed their view that they are not satisfied with the quality of work life in the organization. Whereas 48.4 percent respondents in the salary group of 50001 & above pointed out that they are satisfied with the quality of work life in HRTC. Whereas in case of PR the large majority of respondents (81.4 percent) in the salary group of below 10000 have said that they are not satisfied with the quality of work life in the organization. Whereas 70 percent of respondents in the salary group of 40001-50000 have replied that they are satisfied with the quality of work life in PR. Considering the majority (73.7 percent in HRTC and 54 percent in PR) it can be concluded that employees working in both the organizations understudy are not satisfied with the existing measures of QWL provided by these organizations.

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Table 3: Categories of staff vis-a-vis quality of work Life in HRTC &PR

Categories of Staff	HRTC			Punjab Roadways		
	Satisfaction with the Quality of Work Life		Total	Satisfaction with the quality of work life		Total
	Yes	No		Yes	No	
Workers	32 (21.3)	118 (78.7)	150 (100.0)	48 (38.1)	78 (61.9)	126 (100.0)
Trade Union Leaders	15 (20.0)	60 (80.0)	75 (100.0)	25 (40.3)	37 (59.7)	62 (100.0)
Management Personnel	32 (42.7)	43 (57.3)	75 (100.0)	42 (67.7)	20 (32.3)	62 (100.0)
Total	79 (26.3)	221 (73.7)	300 (100.0)	115 (46.0)	135 (54.0)	250 (100.0)
	χ^2=13.798	P=0.001		χ^2=15.773	P=0.000	

Note: Figures in parenthesis shows percentages

In order to find out the relationship between different categories of staff and satisfaction of employees with the quality of work life, the following hypotheses were formulated:

Ha_{QWL3}: There is a significant relationship between the different categories of staff and satisfaction of employees with the quality of work life in HRTC.

Hb_{QWL3}: There is significant relationship between the different categories of staff and satisfaction of employees with the quality of work life in PR.

From the table 3, the value of χ^2 test is 13.798 for HRTC and 15.773 for PR and its corresponding p value is 0.001<0.05 and 0.000<0.05 for HRTC and PR respectively. ***Since the p value is less than 0.05, the Ha_{QWL3} and Hb_{QWL3} hypothesis are accepted***. On the basis of this information, it can be inferred that there is significant relationship between the different categories of staff and satisfaction of employees with the quality of work life in both the organizations. The management personnel are dissatisfied less with quality of work life at workplace as compared to workers and trade union leaders in HRTC whereas in PR management personnel are satisfied with QWL. The reason may be the difference in their working environment and the facilities being provided to them. In case of HRTC, the majority of trade union leaders (80 percent) have stated that

they are not satisfied with quality of life at workplace in the organization. Similarly 78.7 percent of workers and 57.3 of the management personnel have shown the same view that they are not satisfied with quality of life at workplace in HRTC. Whereas in case of PR, the majority of workers (61.9 percent) followed by the trade union leaders (59.7 percent) have stated that they are not satisfied with quality of life at workplace. While 67.7 percent of management personnel have pointed out that they are satisfied with quality of life at workplace in PR. The overall perception of employees was unfavorable (73.7 percent) in HRTC and (54 percent) in PR regarding the satisfaction with quality of work life.

ATTITUDES OF RESPONDENTS TOWARDS THE WELFARE AND SAFETY MEASURES IN HRTC AND PR

The attitude of employees of HRTC and PR towards welfare & safety measures followed by their respective organization has been analyzed through 11 statements using five point Likert scale. The information regarding this has been presented in table 4. The opinions of the majority of the respondents regarding the statement that *'The organization provides proper facilities and amenities to its employees and their families'* is falling towards lower side. The value of mean score is 2.89 and 2.73 for HRTC and PR respectively which is less than the mean standard score 3.00. Further the positive value of skewness (0.030 in HRTC & 0.308 in PR) also reveals that the opinions of respondents are scattered more towards a lower side of the standard mean score. The calculated value of the kurtosis (-1.407 in HRTC & -1.396 in PR) shows that the distribution of the responses is platykurtic in both the organizations. The calculated value of the χ^2 test is significant as the as the p value is less than 0.01. It reveals that the opinions of the respondents are not equally distributed in the organizations. In HRTC 39.7 percent and 11.7 percent of the respondents disagree and strongly disagreed respectively to this statement. Whereas in PR 52.8 percent and 8.0 percent of respondents disagree and strongly disagree to this statement. Thus it can be concluded from this analysis that proper facilities and amenities are not being provided by HRTC and PR to the employees and their families.

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It is evident that the mean score of the employees' viewpoint regarding the statement *'The appropriate steps are taken to ensure that employees enjoy their work at workplace'* is 2.46 and 2.59 in HRTC & PR respectively, which is less than the average standard score 3.00 on the five-point scale. The standard deviation is (1.14 in HRTC & 1.12 in PR), the positive value of skewness (0.827 in HRTC & 0.474 in PR) and the kurtosis is (-0.371 in HRTC & -1.160 in PR). This indicates that their opinions have scattered towards the lower side of the mean score in both the organizations. The χ^2 test of goodness of fit also shows a significant difference in the opinions of the employees in the organizations and it further supports the above findings. Thus it can be concluded that employees of both the organizations are dissatisfied with the statement that the appropriate steps are taken to ensure that employees enjoy their work at workplace.

While analyzing the views of the respondents regarding the statement *'Union-management relations are cordial in the organization'* it is noted that the mean value is the 3.57 and 3.46 in HRTC & PR respectively, which is higher than the average standard score 3.00. The standard deviation is 1.03 in HRTC and 1.06 in PR and the negative value of the skewness (-1.131 in HRTC & -0.660 in PR) shows that the opinion of the respondents is scattered towards the higher side of the mean standard score. The value of the kurtosis (0.580 in HRTC & -0.718 in PR) shows that the distribution of the responses is leptokurtic in HRTC and platykurtic in PR which also supports the above viewpoint. The calculated value of the χ^2 test is significant as the as the p value is less than 0.01. Thus it can be concluded from this analysis that relations between union-management are cordial in both the organizations.

The mean score of the responses relating to the statement, *'Welfare facilities provided are better in comparison to other similar organizations'*, is 2.52 in HRTC and 2.65 in PR, which is less than the average mean value 3.00. It depicts that the opinion of the employees is largely divided between disagree to strongly disagree. The standard deviation is 1.06 in HRTC and 1.13 in PR. The positive value of the skewness (0.634 in HRTC & 0.350 in PR) supports that the majority of the responses of the employees are skewed more towards the lower side. The calculated value of the kurtosis is (-.513 in HRTC & -1.305 in PR) which

depicts that the distribution of the responses is platykurtic. The calculated value of the χ^2 test is highly significant at 1 per cent level of significance. It can be concluded that the opinion of the employees is not equally distributed over this statement and the majority of the employees either disagree or strongly disagree with the opinion that the welfare facilities provided by the organizations are better in comparison to other organizations.

The result clearly indicates that 48 percent respondents disagree and 25 percent respondents strongly disagree with the statement *'Safe and sound working conditions are prevailing in the organization'* in the HRTC. The mean score value is 2.30 which less than the standard average score i.e. 3.00 at five point Likert scale which supports the above analysis. The positive value of the skewness 0.775 supports that the majority of the responses of the employees are skewed more towards the lower side of standard mean score. The calculated value of kurtosis -0.531 shows that the distribution of the responses is platykurtic. Whereas in case of PR, the opinion of majority of respondents (66.8 percent agree) is falling towards higher side in case of PR. The mean score value 3.28 and negative value of skewness -0.866 supports that the majority of the responses of the employees are skewed more towards the higher side of standard mean score. The calculated value of kurtosis is -0.784 which shows that the distribution of the responses is platykurtic. The calculated value of the χ^2 test is significant as the p value is less than 0.01 in both the organizations. It reveals that the opinions of the respondents are not equally distributed in the organizations. Thus it can be concluded that the majority of the employees agree with the statement that safe and sound working conditions are prevailing in PR whereas in case of HRTC the majority of the employees either disagree or strongly disagree with the opinion that the safe and sound working conditions are prevailing in the organizations.

Majority of the respondents in HRTC have given the mixed opinion regarding the statement *'Management of the organization is deeply concerned with the job security of its employees'*. The mean score is 2.88 which is less than the average standard score 3.00 in five point scale. The variation in the opinion of the respondents is recorded at 1.24. The negative value of the skewness -0.64

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shows that the opinion of the respondents is scattered more towards a higher side of the standard mean score. This shows that the opinion of the respondents is mixed towards this statement. The calculated value of the kurtosis is -1.488, which shows that the distribution of the responses is platykurtic. Whereas in case of PR majority of respondents agree to this statement. The higher value of the mean (3.22) and the negative value of the skewness -0.637 depicts that the majority of the respondents are on the higher side of mean which supports the above analysis. The negative value of the kurtosis shows that the distribution of the responses is platykurtic. The calculated value of the χ^2 is significant at 1 per cent level of significance in the organizations. Thus it can be concluded from this analysis that majority of employees agree to the statement that the management of the organization is deeply concerned with the job security of its employees in PR as compared to the HRTC.

It is evident that in case of HRTC, the mean score of the respondents' views regarding the *'Organization provides attractive retirement benefits'* is 2.97 which is nearest to the standard average score. The standard deviation and the skewness are 1.12 and 0.081 respectively. It exhibits that the majority of the respondents have expressed feeling of disagreement with this statement. The calculated value of the kurtosis -1.346 reveals that the distribution of the opinion is scattered towards the lower side of the mean score which supports the above opinion. Whereas in case of PR, the mean score value 3.19 and negative value of skewness -0.262 supports that the majority of the responses of the employees are skewed more towards the higher side of standard mean score. The calculated value of kurtosis is -1.433 which shows that the distribution of the responses is platykurtic. The calculated value of the χ^2 test is significant as the p value is less than 0.01 in both the organizations. It reveals that the opinions of the respondents are not equally distributed in the organizations. Thus it can be concluded that the majority of the employees in PR agree with the statement thatorganization provides attractive retirement benefits whereas in case of HRTC the majority of the employees either disagree or strongly disagree with the opinion that the organization provides attractive retirement benefits.

Further, the results for the statement *'Management stands out to safeguard the interests of employees in risky situations'* shows the mixed opinions of the respondents (41.7 percent agree, 6.3 percent strongly agree, 4.3 percent neutral, 35.3 percent disagree, 12.3 percent strongly disagree) in case of HRTC whereas in PR 56.8 percent of respondents agree to the statement that management stands out to safeguard the interests of employees in risky situations. The value of mean score, standard deviation, skewness and kurtosis supports the above analysis in both the organizations. The highly significant value of χ^2 test reveals the responses of respondents are not equally distributed. Hence, it can be concluded that majority of employees in PR agree to the statement that management stands out to safeguard the interests of employees in risky situationsas compared to the employees of HRTC.

It reveals from the table that *'There exists proper coordination between management and employees in both of the organizations.'* 60 percent of respondents were agreed to the statement in HRTC while in PR 80 percent of respondents agree to this statement. The mean value is the 3.30 and 3.59 in HRTC & PR respectively, which is higher than the average standard score 3.00. The standard deviation is 1.09 in HRTC and 0.96 in PR and the negative value of the skewness (-0.517 in HRTC & -1.588 in PR) shows that the opinion of the respondents is scattered towards the higher side of the mean standard score. The value of the kurtosis (-0.989 in HRTC & 1.372 in PR) shows that the distribution of the responses is platykurtic in HRTC and leptokurtic in PR which also supports the above viewpoint. The calculated value of the χ^2 test is significant as the as the p value is less than 0.01.Thus it can be concluded that there is a proper coordination between management and employees is HRTC as well as in PR as stated by the respondents.

It is noted that the majority of respondents of both of the organizations disagree with the statement *'congenial and hygienic work environment is provided to them by the organizations'*. The 81.6 percent respondents of the HRTC and 69.2 percent respondents of PR either disagree or strongly disagree to this statement. The mean score value is 2.14 and 2.46 in HRTC & PR respectively,

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which is less than the average standard score 3.00 on the five-point scale. The standard deviation is (0.93 in HRTC & 1.14 in PR), the skewness (1.183 in HRTC & 0.553 in PR) and the kurtosis is (1.182 in HRTC & -0.999 in PR). This indicates that their opinions have scattered towards the lower side of the mean score in both the organizations. The χ^2 test of goodness of fit also shows a significant difference in the opinions of the employees in the organizations and it further supports the above findings. Thus, it can be concluded that the majority of the employees of HRTC & PR do not agree with the statement that congenial and hygienic work environment is provided to the employees by the organization.

Further the satisfaction level of employees is noted regarding the statement *'Employees are satisfied with the welfare activities and measures adopted by the organization'*. shows the majority of the employees of HRTC and PR are dissatisfied with statement. The mean score value is 2.30 in HRTC and 2.62 in PR, which is less than the average mean value 3.00. It depicts that the opinion of the employees is largely divided between disagree to strongly disagree. The positive value of the skewness (0.951 in HRTC & 0.326 in PR) supports that the majority of the responses of the employees are skewed more towards the lower side of standard mean score. The calculated value of the kurtosis also supports the above findings. The calculated value of the χ^2 test is highly significant at 1 per cent level of significance. It can be concluded that the opinion of the employees is not equally distributed over this statement and the majority of the employees either disagree or strongly disagree with this statement that employees are satisfied with the welfare activities and measures adopted by the HRTC and PR.

Table 4: Attitude of Employees towards Welfare and Safety measures in HRTC & PR

(HRTC, N= 300, Punjab Roadways, N =250)

S. No	Statements	Organization	Frequencies					Mean	S.D.	Skewness	Kurtosis	Chi-Square	P-Value
			Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree						
1	Organization provides proper facilities and amenities to its employees and their families	HRTC	18 (6.0)	119 (39.7)	9 (3.0)	119 (39.7)	35 (11.7)	2.89	1.22	.030	-1.407	199.200	0.000
		Punjab Roadways	6 (2.4)	92 (36.8)	-	132 (52.8)	20 (8.0)	2.73	1.11	.308	-1.396	171.184	0.000
2	Appropriate steps are taken to ensure that employees enjoy their work at workplace	HRTC	22 (7.3)	55 (18.3)	14 (4.7)	166 (55.3)	43 (14.3)	2.46	1.14	.827	-.371	258.337	0.000
		Punjab Roadways	6 (2.4)	79 (31.6)	-	137 (54.8)	28 (11.2)	2.59	1.12	.474	-1.160	163.280	0.000
3	Union-management relations are cordial in the organization	HRTC	30 (10.0)	184 (61.3)	33 (11.0)	33 (11.0)	20 (6.7)	3.57	1.03	-1.131	.580	322.233	0.000
		Punjab Roadways	25 (10.0)	142 (56.8)	14 (5.6)	61 (24.4)	8 (3.2)	3.46	1.06	-.660	-.718	245.400	0.000
4	Welfare facilities provided are better in comparison to other similar organizations	HRTC	12 (4.0)	59 (19.7)	39 (13.0)	153 (51.0)	37 (12.3)	2.52	1.06	.634	-.513	198.733	0.000
		Punjab Roadways	6 (2.4)	86 (34.4)	1 (0.4)	129 (51.6)	28 (11.2)	2.65	1.13	.350	-1.305	247.160	0.000
5	Safe and sound working conditions are prevailing in the organization	HRTC	12 (4.0)	61 (20.3)	8 (2.7)	144 (48.0)	75 (25.0)	2.30	1.17	.775	-.531	204.833	0.000
		Punjab Roadways	6 (2.4)	162 (64.8)	2 (0.8)	58 (23.2)	22 (8.8)	3.28	1.12	-.866	-.784	352.640	0.000

6	Management of the organization is deeply concerned with the job security of its employees	HRTC	15 (5.0)	127 (42.3)	8 (2.7)	108 (36.0)	42 (14.0)	2.88	1.24	-.064	-1.448	197.433	0.000
		Punjab Roadways	12 (4.8)	146 (58.4)	3 (1.2)	64 (25.6)	25 (10.0)	3.22	1.18	-.637	-1.054	273.800	0.000
7	Organization provides attractive retirement benefits	HRTC	18 (6.0)	115 (38.3)	24 (8.0)	127 (42.3)	16 (5.3)	2.97	1.12	.081	-1.346	208.500	0.000
		Punjab Roadways	15 (6.0)	129 (51.6)	3 (1.2)	95 (38.0)	8 (3.2)	3.19	1.11	-.262	-1.433	269.280	0.000
8	Management stands out to safeguard the interests of employees in risky situations	HRTC	19 (6.3)	125 (41.7)	13 (4.3)	106 (35.3)	37 (12.3)	2.94	1.23	-.086	-1.392	179.333	0.000
		Punjab Roadways	6 (2.4)	136 (54.4)	7 (2.8)	82 (32.8)	19 (7.6)	3.11	1.12	-.445	-1.328	263.320	0.000
9	There is proper coordination between management and employees in the organization	HRTC	20 (6.7)	160 (53.3)	23 (7.7)	83 (27.7)	14 (4.7)	3.30	1.09	-.517	-.989	260.233	0.000
		Punjab Roadways	9 (3.6)	191 (76.4)	4 (1.6)	31 (12.4)	15 (6.0)	3.59	.96	-1.588	1.372	505.280	0.000
10	Congenial and hygienic work environment is provided to the employees by the organization	HRTC	6 (2.0)	34 (11.3)	15 (5.0)	187 (62.3)	58 (19.3)	2.14	.93	1.183	1.182	362.500	0.000
		Punjab Roadways	6 (2.4)	70 (28.0)	1 (0.4)	129 (51.6)	44 (17.6)	2.46	1.14	.553	-.999	220.280	0.000
11	Employees are satisfied with the welfare activities and measures adopted by the organization	HRTC	8 (2.7)	45 (15.0)	23 (7.3)	176 (58.7)	48 (16.0)	2.30	.99	.951	.260	298.300	0.000
		Punjab Roadways	6 (2.4)	79 (31.6)	13 (5.2)	119 (47.6)	33 (13.2)	2.62	1.13	.326	-1.222	183.920	0.000

Note: Figures in parenthesis shows percentages,
S.D - Standard Deviation

ATTITUDES OF RESPONDENTS TOWARDS THE PHYSICAL FACILITIES/WORKING CONDITIONS IN HRTC AND PR

The opinion of the respondents regarding the physical facilities/working conditions prevailing in the HRTC and PR has been analyzed by the 6 statements. The information regarding this has been presented in table 5. In case of HRTC, majority (56.6percent) of the respondents have expressed their disagreement (46.3 percent disagree and 10.3 percent strongly disagree) with the statement '*There is sufficient office space at the workplace*'. The mean value is 2.83 which is lower than the average mean value 3.00. It depicts that the opinion is largely divided between disagree to strongly disagree. The standard deviation is 1.22. The positive value of the skewness 0.206 supports that the majority of the responses of the employees are skewed more towards the lower side. The calculated value of the kurtosis is -1.387 which depicts that the distribution of the responses is platykurtic. Whereas in case of PR, 57.2 percent (52 percent agree and 5.2 percent strongly agree) of the respondents of PR have expressed their agreement towards this statement. Also the mean value is 3.11 which is more than the mean standard score i.e. 3 at five point likert scale. The variation in the opinion is noted at 1.19. Further the negative value of skewness -0.375 states that opinion is scattered more towards higher side of mean standard score. It is also supported by the calculated value of kurtosis which shows distribution the responses is platykurtic. While applying χ^2 test of goodness of fit, it is significant implying that the opinion of the respondents is not equally distributed in both the organizations. Thus it can be concluded that there is sufficient space at workplace in PR, while in case of HRTC majority of the respondents stated that there is no sufficient space at the workplace.

Further, majority of the respondents of both of the organizations have shown their disagreement with the statement that *'Adequate restroom facilities are provided to employees'* at workplace. The mean score of the responses is 2.44 in HRTC and 2.62 in PR which is less than the average standard score 3 in five-point scale. The positive value of the skewness (0.530 in HRTC & 0.322 in PR) also supports the above viewpoint. The calculated value of the kurtosis shows that

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distribution of responses is platykurtic in both the organizations. While applying $\chi 2$ test of goodness of fit, it is significant implying that the opinion of the respondents is not equally distributed. In HRTC, majority (66.7 percent) of the employees disagree (45.7 percent disagree and 21 percent strongly disagree) to this statement while in PR, 62.4 percent of respondents disagree (45.2 percent disagree and 17.2 percent strongly disagree) with this statement. Thus it can be concluded from the results that both the organizations are not providing adequate restroom facilities to its employees at workplace. There should be proper provision of the restrooms so that the employees can take rest during the working hours.

It is revealed from the table that in case of HRTC, majority of respondents (95 percent) have shown their disagreement (56 percent disagree and 39 percent strongly disagree) regarding the statement that *'Crèche facility is provided by the organization'* while in PR, 94.8 percent were disagree (70.8 percent disagree and 24 percent strongly disagree) with this statement. The low value of mean (1.71 in HRTC & 1.84 in PR) and standard deviation (0.71 in HRTC & 0.60 in PR) shows that the distribution of the responses is towards the lower side of the standard mean score. Further, the positive value of skewness, the value of kurtosis and χ^2 test of goodness of fit also supports the results. Thus it can be concluded that none of the organizations provide crèche facility to their employees.

It is evident from the table that the majority of respondents have shown their disagreement regarding the statement *'Residential facilities are adequately provided by the organization'*. The calculated value of mean, skewness and kurtosis also shows that that the responses of the respondents are skewed towards the lower side of the standard mean score in both the organizations. The χ^2 test of goodness of fit also shows a significant difference in the opinions of the employees in the organizations and it further supports the above findings. In case of HRTC 35 percent and 18.3 percent of respondents disagree and strongly disagree respectively with this statement. Whereas in PR 49.2 percent and 13.6 percent of respondents disagree and strongly disagree respectively with this statement. Thus it can be concluded that residential facilities are not provided

adequately by the organizations to their employees.

Furthermore, the results regarding the statement *'Canteen facilities are existing in the organization'* clearly indicates that the mean value is 3.37 for this in HRTC which show responses of majority of the respondents is falling towards higher side of the standard mean score 3.00. The negative value of skewness -0.916 also reveals that the opinions of respondents are scattered more towards the higher side of the standard mean score. The calculated value of the kurtosis is -0.484 which shows that distribution of responses is platykurtic. Majority of respondents of HRTC agree (63 percent agree & 5.3 percent strongly agree) with this statement that the canteen facilities are existing in the organization which supports the above findings. Whereas in PR, 59.6 percent respondents have shown their disagreement (22.4 percent disagree and 37.2 percent strongly disagree) to this statement that canteen facilities are existing in the organization. The mean score of the responses related to this is 2.44 in PR which is less than the average standard score 3.00 in five-point scale. The standard deviation is 1.36, this shows that the variation is towards the lower side of the mean standard score. The positive value of the skewness 0.234 also supports the above viewpoint.The χ^2 test of goodness of fit states that it is significant implying that the opinion of the respondents is not equally distributed in the organizations. Thus it can be concluded that the respondents of the HRTC agree with the statement that the canteen facility are existing in the organization whereas in case of PR, majority of the respondents disagree to this statement.

Majority of the respondents in both of the organizations have shown agreement to the statement that *'Computers and online connectivity is available in the organization'*. In HRTC, 74 percent of respondents agree (24.7percent strongly agree and 49.3percent agree) to the statement while in PR 94.8 percent of respondents agree (17.2percent strongly agree and 77.6percent agree) to this statement. It is noted that the mean value is the 3.68 and 4.06 in HRTC & PR respectively, which is higher than the average standard score 3.00. The standard deviation is 1.20 in HRTC and 0.68 in PR and the negative value of the skewness (-0.798 in HRTC & -2.230 in PR) shows that the opinion of the respondents is

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scattered towards the higher side of the mean standard score. The value of the kurtosis (-0.557 in HRTC & 9.120 in PR) shows that the distribution of the responses is platykurtic in HRTC and leptokurtic in PR which also supports the above viewpoint. The result of χ^2 test has shown that there is statistically significant difference of opinions of the respondents as the p value is less than 0.01. Hence, it can be concluded that computers and online connectivity is available in both the organizations.

Table 5: Attitude of Employees towards Physical Facilities / Working Conditions in HRTC & PR

(HRTC, N= 300, Punjab Roadways, N =250)

S. No.	Statements	Organization	Frequencies					Mean	S.D.	Skewness	Kurtosis	Chi-Square	P-Value
			Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree						
1	There is sufficient office space at the workplace.	HRTC	20 (6.7)	110 (36.7)	-	139 (46.3)	31 (10.3)	2.83	1.22	.206	-1.387	137.093	0.000
		Punjab Roadways	13 (5.2)	130 (52.0)	3 (1.2)	80 (32.0)	24 (9.6)	3.11	1.19	-.375	-1.323	231.080	0.000
2	Adequate restroom facilities are provided to the employees.	HRTC	10 (3.3)	76 (25.3)	14 (4.7)	137 (45.7)	63 (21.0)	2.44	1.17	.530	-.958	180.167	0.000
		Punjab Roadways	10 (4.4)	84 (33.6)	-	113 (45.2)	43 (17.2)	2.62	1.22	.322	-1.315	98.384	0.000
3	Crèche facility is provided by the organization.	HRTC	2 (0.7)	10 (3.3)	3 (1.0)	168 (56.0)	117 (39.0)	1.71	.71	1.497	4.223	400.433	0.000
		Punjab Roadways	-	8 (3.2)	5 (2.0)	177 (70.8)	60 (24.0)	1.84	.60	.963	3.516	310.288	0.000
4	Residential facilities are adequately provided by the organization.	HRTC	9 (3.0)	110 (36.7)	21 (7.0)	105 (35.0)	55 (18.3)	2.71	1.22	.059	-1.420	144.533	0.000
		Punjab Roadways	-	90 (36.0)	3 (1.2)	123 (49.2)	34 (13.6)	2.60	1.11	.250	-1.463	140.304	0.000
5	Canteen facilities are existing in the organization.	HRTC	16 (5.3)	189 (63.0)	11 (3.7)	57 (19.0)	27 (9.0)	3.37	1.12	-.916	-.484	367.933	0.000
		Punjab Roadways	4 (1.6)	93 (37.2)	4 (1.6)	56 (22.4)	93 (37.2)	2.44	1.36	.234	-1.663	159.320	0.000
6	Computers and online connectivity is available in the organization.	HRTC	74 (24.7)	148 (49.3)	-	63 (21.0)	15 (5.0)	3.68	1.20	-.798	-.557	120.987	0.000
		Punjab Roadways	43 (17.2)	194 (77.6)	3 (1.2)	4 (1.6)	6 (2.4)	4.06	.68	-2.230	9.120	540.920	0.000

Note: Figures in parenthesis shows percentages,
S.D - Standard Deviation

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SATISFACTION LEVEL OF EMPLOYEES TOWARDS SOCIAL SECURITY AND WELFARE MEASURES IN HRTC & PR

The satisfaction level employees towards social security and welfare measures in the HRTC and PR has been analyzed by the different factors and presented in table 6. The table clearly indicates that majority of the respondents were not satisfied at all (88 percent in HRTC and 98.8 percent in PR) with '*The sports and recreational activities*' in both of the organizations. The mean score (1.15 in HRTC & 1.01 in PR) is also lower than the mean standard score i.e. 3.00 at five point Likert scale. The variation in the opinion is noted at 0.48 and 0.11 in HRTC & PR respectively. Further the positive value of skewness states that opinion is scattered more towards lower side in both the organizations. It is also supported by the calculated value of kurtosis which shows that distribution of responses is leptokurtic. While applying χ^2 test of goodness of fit, it is significant implying that the opinion of the respondents is not equally distributed in the organizations. Thus, it can be concluded that the employees are not satisfied with the sports and recreational activities in both the organizations.

It is observed that mean value of the opinions regarding the '*The education facilities provided for children*' is 1.23 in HRTC and 1.01 in PR which is less than the average standard score 3 in five-point scale. The positive value of the skewness (2.312 in HRTC & 9.018 in PR) also supports the above viewpoint. The calculated value of the kurtosis shows that distribution of responses is leptokurtic in both the organizations. While applying χ^2 test of goodness of fit, it is significant implying that the opinion of the respondents is not equally distributed. The 80.7 percent respondents in HRTC and 98.8 percent in PR are not at all satisfied with the education facilities for children. Thus it can be concluded that the employees of both the organization are not satisfied with the education facilities for their children.

It is noted that the mean score of the responses related to the *'Canteen facility'* is 2.93 and 2.72 in HRTC & PR respectively. This indicates that the opinion of the respondents is scattered towards the lower side of the standard mean score 3.00. The positive value of the skewness shows that the responses are skewed more towards the lower side. Further, the negative value of kurtosis in HRTC shows that the responses of the respondents are platykurtic which shows that the opinion of the respondents is shifted from 'to moderate extent' to 'not at all'. Whereas in case of PR, the positive value of the kurtosis shows that the responses of the respondents are leptokurtic which shows that the opinion of the

respondents is shifted from 'to some extent' to 'not at all'. The calculated values of the χ^2 test are significant at 1 percent level of significance. It reveals that the opinions of the respondents are not equally distributed. Thus it can be concluded that the satisfaction level of the employees regarding the canteen facility is towards the lower side in both the organizations.

The employees in both of the organizations are not satisfied with the *'Library and reading room'* facilities provided by the organizations. Majority of respondents (86.7 percent in HRTC and 90 percent in PR) are not satisfied at all with the library and reading room facility at all. The calculated value of mean, standard deviation, skewness and kurtosis also supports the above results.

Also the extent to which the employees are satisfied with the '*Medical facilities*' is falling towards higher side with a mean score of 3.53 in HRTC and 3.76 in PR which is more than the mean standard score i.e. 3.00. The negative value of skewness (-0.739 in HRTC and -1.634 in PR) states that opinion is scattered more towards the higher side. It is also supported by the calculated value of kurtosis. While applying χ^2 test of goodness of fit, it is significant implying that the opinion of the respondents is not equally distributed. Thus it can be inferred that employees of both the organizations are satisfied from high to moderate extent with the medical facilities provided by the respective organizations.

Further, the result clearly indicates that amenities like '*Proper drinking water*' are prevailing in the organizations under study. It is noted that the mean score of the responses related to the facility of drinking water is 3.63 in HRTC and 3.18 in PR which is more than the mean standard score 3.00. The negative value of skewness in both the organizations show that the opinion of the respondents is scattered more towards the higher side of the standard mean score. The positive value of the kurtosis shows that the distribution of the responses regarding the drinking water facility is leptokurtic. While applying the χ^2 test, it has been found significant as the p value is less than 0.01. Thus, it can be concluded on the basis of the above analysis that the satisfaction level of the employees is shifting lies between high to some extent regarding the drinking water facility provided to the employees by the organization. It shows that the drinking water is provided by the organization.

Majority of the respondents in the HRTC and PR have shown dissatisfaction with the facilities like '*entertainment, cooperative society, vehicle loan, home loan and personal loan*'. The mean values of the responses regarding

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different welfare practices like entertainment, cooperative society, vehicle loan, home loan and personal loan are less than the mean standard score 3.00 on the five point scale. The variations in the opinion of the respondents are noted to be less for all the facilities. This indicates that the opinion of the respondents is scattered towards the lower side of the mean score. The positive values of the skewness show that the opinion of the respondents is between 'low extent' to 'not at all'. Further, the positive values of the kurtosis show that the responses of the respondents are leptokurtic. The calculated values of the χ^2 test are significant implying that the opinions of the respondents are not equally distributed. It can be concluded that the employees are not satisfied with the facilities like entertainment, cooperative society, vehicle loan, home loan and personal loan in both the organizations.

However the respondents of both the organizations have shown their satisfaction with the different benefits like '*TA/DA, compensatory leaves and retirement benefits*'. The table infers that the mean value of the opinion regarding the benefits like TA/DA (3.77 in HRTC and 3.69 in PR), compensatory leaves (3.76 in HRTC and 3.73 in PR) and retirement benefits (3.36 in HRTC and 3.10 in PR), are more than the standard mean score 3.00 in five point scale. The negative values of skewness in both the organizations regarding these benefits show that the opinion of the respondents is scattered more towards the higher side of the standard mean score. It exhibits that the distribution of the responses is scattered towards the higher side of the mean. The positive value of the kurtosis shows that the distribution of the responses regarding the benefits is leptokurtic. The results of χ^2 test shows that there is statistically significant difference of opinions of the respondents as the p value is less than 0.01. It exhibits that employees of HRTC and PR are satisfied with the benefits like TA/DA, compensatory leaves and retirement benefits.

Table 6: Satisfaction level of Employees towards Social Security and Welfare measures in HRTC & PR

S. No	Statements	Organization	Frequencies					Mean	S.D.	Skewness	Kurtosis	Chi-Square	P-Value
			High Extent	Moderate Extent	Some Extent	Low Extent	Not at all						
1	Sports and recreational activities	HRTC	1 (0.3)	3 (1.0)	-	32 (10.7)	264 (88.0)	1.15	.48	4.485	25.423	643.067	0.000
		Punjab Roadways	-	-	-	3 (1.2)	247 (98.8)	1.01	.11	9.018	79.960	238.144	0.000
2	Education facilities for children	HRTC	1 (0.3)	-	10 (3.3)	47 (15.7)	242 (80.7)	1.23	.52	2.312	5.283	511.653	0.000
		Punjab Roadways	-	-	-	3 (1.2)	247 (98.8)	1.01	.11	9.018	79.960	238.144	0.000
3	Canteen facility	HRTC	38 (12.7)	70 (23.3)	74 (24.7)	70 (23.3)	48 (16.0)	2.93	1.27	.027	-1.056	17.067	0.000
		Punjab Roadways	12 (4.8)	92 (36.8)	17 (6.8)	30 (12.0)	99 (39.6)	2.72	2.99	10.624	14.64	218.960	0.000
4	Library and reading room	HRTC	-	1 (0.3)	7 (2.3)	32 (10.7)	260 (86.7)	1.16	.45	3.062	10.111	615.653	0.000
		Punjab Roadways	3 (1.2)	2 (0.8)	19 (7.6)	1 (0.4)	225 (90.0)	1.23	.72	3.296	10.753	770.000	0.000
5	Medical facilities	HRTC	93 (31.0)	110 (36.7)	17 (5.7)	24 (8.0)	56 (18.7)	3.53	1.47	-.739	-.919	112.500	0.000
		Punjab Roadways	40 (16.0)	173 (69.2)	3 (1.2)	5 (2.0)	29 (11.6)	3.76	1.12	-1.634	1.825	398.000	0.000
6	Drinking water	HRTC	63 (21.0)	104 (34.7)	32 (10.7)	54 (18.0)	47 (15.7)	3.63	2.00	-3.150	74.522	111.480	0.000
		Punjab Roadways	29 (11.6)	125 (50.0)	4 (1.6)	46 (18.4)	46 (18.4)	3.18	1.36	-.493	1.348	164.280	0.000

7	Entertainment	HRTC	-	1 (0.3)	7 (2.5)	38 (13.7)	234 (84.7)	1.18	.85	2.777	8.2886	589.115	0.000
		Punjab Roadways	-	14 (5.6)	-	1 (0.4)	233 (94.00)	1.17	.69	3.845	13.942	475.964	0.000
8	Cooperative society	HRTC HRTC	-	-	-	23 (7.7)	277 (92.3)	1.34	1.39	7.128	51.127	645.389	0.000
		Punjab Roadways	-	4 (1.6)	3 (1.2)	-	243 (97.2)	1.07	.43	4.971	36.191	458.864	0.000
9	Vehicle loan facility	HRTC	-	-	5 (1.7)	19 (6.3)	276 (92.0)	1.09	.34	3.949	15.958	468.889	0.000
		Punjab Roadways	-	8 (3.2)	-	15 (6.0)	224 (89.6)	1.28	.71	3.942	15.327	597.584	0.000
10	Home loan facility	HRTC	-	-	-	18 (6.0)	277 (92.3)	1.13	.56	5.844	36.476	470.760	0.000
		Punjab Roadways	-	13 (5.2)	-	19 (7.6)	215 (86.0)	1.28	.81	3.158	9.162	408.224	0.000
11	Personal loan facility	HRTC	-	-	-	18 (6.0)	277 (92.3)	1.13	.56	5.844	36.476	470.760	0.000
		Punjab Roadways	-	2 (0.8)	-	18 (17.2)	227 (90.8)	1.14	.56	5.211	30.062	379.856	0.000
12	TA/DA	HRTC	-	110 (36.7)	32 (10.7)	22 (7.3)	34 (11.3)	3.77	1.32	-.985	-.229	119.467	0.000
		Punjab Roadways	-	146 (58.4)	4 (1.6)	10 (4.0)	36 (14.4)	3.69	1.26	-1.248	.388	262.880	0.000
13	Compensatory leaves.	HRTC	-	100 (33.3)	43 (14.3)	17 (5.7)	32 (10.7)	3.76	1.27	-.969	-.969	113.707	0.000
		Punjab Roadways	-	56 (22.4)	3 (1.2)	2 (0.8)	39 (15.6)	3.73	1.27	-1.385	.881	293.400	0.000
14	Retirement benefits	HRTC	-	91 (30.3)	33 (11.0)	29 (9.7)	64 (21.3)	3.36	1.52	-.470	-1.279	93.267	0.000
		Punjab Roadways	-	36 (14.4)	3 (1.2)	4 (1.6)	83 (33.2)	3.10	1.55	-.479	-1.500	221.729	0.000

Note: Figures in parenthesis shows percentages.
S.D. - Standard Deviation

CONCLUSIONS AND SUGGESTIONS

Quality of work life is very essential for the smooth running for an organization and as well as for the success of its employees. The work life balance must be ensured in the organizations so that the employees can work up to their full potential and are free from any type of stress. QWL can effects the productivity, commitment, absenteeism and satisfaction of the employees. The overall perception of employees was unfavorable in HRTC and PR regarding the satisfaction with quality of work life. There is significant relationship between the age, salary and categories of staff vis-a-vis satisfaction of employees with the quality of work life in both the organizations understudy.

On the basis of the information regarding the welfare & safety measures followed by HRTC & PR, it was found that employees were not satisfied with the welfare and safety measures adopted by the organizations. However, the cordial union management relationship and proper coordination between employees & management exists in both the organizations as stated by the respondents. Both the organizations should maintain the *congenial and hygienic work environment* so that the employees can work in healthy work environment and *appropriate steps should be taken to ensure that employees enjoy their work at their workplace*. Whereas in case of HRTC there is a need of improvement in the area like *working conditions, job security of the employees, retirement benefits and to safeguard the interests of employees in the risky situations*. On the basis of information regarding the different physical facilities/working conditions prevailing in the HRTC and PR, it can be inferred that in the majority of statements it was found that both the organizations are not providing proper physical facilities/working conditions to the employees as stated by the respondents. So in both the organization attention should be given to provide the *adequate restroom facilities, residential facilities and crèche facility* to the employees. However, *the computers and online connectivity* is available in both the organizations as stated by the respondents. In case of HRTC the focus should be on providing *the sufficient space at workplace* while in case of PR, there is need to improve the *canteen facility* in the organization as stated by the

respondents. On the basis of the information analyzed regarding satisfaction level of employees towards social security and welfare measures adopted by the HRTC & PR, it can be inferred that the organizations are not following the proper welfare and social security measures. The employees were satisfied with some of the welfare and social security measures like *medical facilities, drinking water, TA/DA and compensatory leaves*. Whereas, it was found that employees have shown their dissatisfaction towards the social and welfare facilities like *sports & recreational, library & reading room, canteen, cooperative society, entertainment* and *availability of different types of organizational loans (personal, home & vehicle loan)* in both the organizations. So the management of both the organizations should try to improve these facilities for the well being of their employees.

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PERSONALITY TRAITS AND WORK ENGAGEMENT: A CASE STUDY ON FEMALE BANK EMPLOYEES IN BANKING SECTOR

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ABSTRACT

The purpose of the present study is to explore whether there is any qualifying relationship between personality traits and work engagement, also, the level of work engagement and big five personality traits among female employees in Himachal Pradesh. Relevant data through questionnaire was collected from 150 female employees working in 3 different Public sector banks namely State Bank of India, Punjab National Bank and UCO Bank in the state of Himachal Pradesh. The results of the study specified that there were a significant positive relationship between work engagement and big five personality traits. Extraversion, Agreeableness, conscientiousness, and openness were significantly related to work engagement and its dimensions namely vigor, dedication and absorption whereas neuroticism was found to be negatively related to the work engagement and the three dimensions of it. The level of work engagement was high in public sector whereas extraversion, conscientiousness, neuroticism and openness were average except the agreeableness trait of personality was high.

Keywords: Big five personality traits, work engagement, vigor, dedication and absorption

I. INTRODUCTION

The contemporary world of work has witnessed dramatic ups and downs over the preceding decades whether the reason behind that is innovation in technologies, meeting the demands of increasingly diverse personnel or any superfluous economic factor like globalization of business (Burke and Cooper 2005; Cooper and Burke 2002). Organizational agility is continuously looking out for the employees who bubble, sparkle or effervesce with dynamism, enthusiasm, energy, employees who believe in themselves and their abilities (Bakker and Schaufeli, 2008). This implies that in order to achieve competitive edge organization need to have engaged employees who are willing to put in that little bit extra for business. Bleeker & Roodt, 2002; Schaufeli & Bakker, 2004 stated the importance for managers of fostering the growth of work engagement as disengagement or alienation is the central problem of workers' lack of commitment. Literature highlighted that research on work engagement has been done in various professions like nursing (Montgomery et al., 2015) police officers (Rothmann S., & Storm K. 2003) & Louw G.J. 2014), school principals, teachers (Hakanen et al., (2006); Zaidi et al., 2013, Sarath P & Manikandan K. (2014), including banking personnel (Koyuncu et al., 2006).

The issues in work engagement among banking personnel specially the female employees has received important responses these days because of the economic pressure of inflation, the acts upon of other women's movement and the psychological need to spring up one's self identity.. This brings us to a very important question as to why certain female employees show signs of work engagement while others exhibit no signs of work engagement. For Instance two employees working in the same environment may have different levels of engagement and this individual difference can exist because of their different personality traits" (Ozgur Ongore, 2014). It thus, implies that Personality plays a significant role in the engagement process and it can be considered as an important variable to affect the engagement level because individuals enter the workplace with their own sets of personality characteristics. Therefore it becomes important to study the relationship between personality traits and work engagement.

a) Work Engagement

Engagement is an important concept to study and analyze because it is associated with the positive individual and work related outcome as focused by Maslach et al., (2001). Engaged employees confirm themselves quickly to changes in their surroundings, and pass easily from one activity to the other as compared to their counterparts Laangelaan et al., (2006). It is defined as a "positive, fulfilling work related state of mind that is characterised by vigor, dedication and absorption" (Schaufeli, Salanova, Gonzalez-Roma & Bakker, 2002, p. 74).Vigor pertains to high levels of vim, dynamism, zip and mental exuberance while actively engaged in work. Vigor perhaps is

delineated as a pool of energy possessed by the employees and that could be used when dealing with demanding and stimulating situations (Shirom 2007 p. 86). Dedication refers to an intense work involvement and comprehends feeling of self-respect and personal worth, pride, enthusiasm, significance and challenge. Absorption which is the last variable of work engagement is characterised as being totally focused on one's work as the time appears to pass quickly and one finds it increasingly hard to detach oneself from work. In short, engaged employees work hard; they are passionate about their work; and are fully plunged in their work activities (Bakker and Demerouti, 2008).

b) Personality Traits

Traits or attributes are the fundamental building blocks of personality and refer to as the static perceptual structure, the manner in which the individuals think, feel and behave (Pervin et al., 2005). Individual differences cover a broad array of factors that gives the description of the way in which behaviour and performance of human beings differ from each other (Hogan, Harkness and Lubinski 2000). Personality refers to cognition and perceptual structure of behaviour that depicts constancy or stability throughout time and across situations (e.g. Cattell 1965) .

Extraversion is a personality trait that is characterized by warmth, assertiveness, gregariousness, talkative, enthusiastic, active, energetic, expressive etc. (Costa & McCrae, 1992). This variable consists of two components, Ambition (initiative, surgency, ambition and impetuous) and Sociability (social, exhibitionist and expressive) (Hogan 1986).

Neuroticism represents individual differences indicating general tendency to be anxious, tense, hostile, impulsive, vulnerable, self-consciousness etc. (Costa & McCrae, 1992). Any individual who scores high on Neuroticism indicates that a person is prone to have irrational ideas, being less able to control impulses, and is grappling badly with stress Rothmann et al., (2003).

Agreeableness is the propensity to be sympathetic, kind, generous, modest, compliant, altruism, considerate etc. (Costa & McCrae, 1992). Agreeableness is required to work in peace and to conclusively settle the conflicts. (Ozgur Ongore, 2014).

Conscientiousness individuals are efficient, responsible, self-disciplined, compliant, organized, and reliable (Costa & McCrae, 1992). Hence, individuals who scores high on conscientiousness should report more engagement in their work due to their sense of duty towards every role they take on. Openness to Experience is qualified by being artistic, introspective, and curious and values and intellectual matters. (Costa & McCrae, 1992).It includes traits such as imagination, curiosity, and creativity (Goldberg, 1993).

c) Literature

Work Engagement: Several research studies have been conducted by various research groups who provided thorough insight for understanding work engagement in conceptual terms.

Enumerate research has been done to examined the potential antecedents and consequences of work engagement Koyuncu et al., (2006), Oliver (2007) and Burke et al., (2010 & 2013. Only one variable of work engagement i.e. vigor has been focussed by Shirom (2004, 2007), Sonnentag et al., (2008). Someone who's suffering from burnout have less mitigating resources like social support than those who execute their duties vigorously Louw G.J. (2014). The creativity and charisma among female leaders and the role of resources and work engagement among 84 female school principals and 190 teachers were examined by Bakker et al., (2013).Job resources facilitate employees' sense of self-efficacy and resiliency, and consequently foster work engagement Bakker et al., (2013).

Big Five Personality Traits*:*

Managers who are emotionally stable, open to experience and agreeable tend to perform better than those who measured lower on these dimensions Rothmann et al., (2003). Bakker et al., (2006), examined the relationship between burnout and big five personality traits: extraversion, agreeableness, conscientiousness, emotional stability, and intellect/autonomy whereas openness to experience was not included in the study. A large number of studies have been done on personality traits and burnout Kim et al., (2007); Kaja et al., (2015); Alarcon et al., (2009); Zellar (2000); Joseph et al., (2011). The relationship among conscientiousness, neuroticism and burnout

in healthcare staff of private hospitals was examined, leaving out the remaining three personality traits (extraversion, agreeableness, openness to experience) which was not included in the study S. M. Azeem (2013).

Work Engagement and Personality traits:

Research has shown strong relationship between individual differences e.g. personality characteristics and burnout (Allen and Mellor, 2002). If personality traits can facilitate in predicting level of burnout among employees, it is fair enough to assume that attributes of personality can equally anticipates the level of work engagement by employees. Ongore (2014) investigated the relationship between personality traits and job engagement. Rantanen et al., (2013) explored the relations between personality, role engagement and four dimensional typology of work life balance. Woods et al., (2013) examined the association of personality traits with work engagement. Relevance of the variables of big five taxonomy when studied in relation with engagement is yet to be determined. For Instance, Langelaan et al., (2006) considered only two of those, whereas, Kim et al., (2009) considered conscientiousness to be significant and also, Kim et al., (2008) focused on the relationship between job burnout, job engagement and the big five personality dimensions which included extraversion, agreeableness, conscientiousness, neuroticism and openness to experience. Bozionelos (2004) explored the relationship between the big five personality and work involvement.

Akhtar et al., (2015) & Neha &Venkatesh (2015) investigated the relationship between personality and work engagement. The interactive effect of personality and employee engagement on organizational citizenship behavior has been investigated. Organizations should recognize the relationship between employee engagement and organisation citizenship behavior and should take efforts to enhance the employee engagement drivers, which will contribute to better performance Savitri J.J (2015).

d) Objectives

To measure the level of work engagement and personality trait among women employees in banking sector.

To find out the relationship between personality traits and work engagement.

e) Hypothesis

Ho1: There is no relationship between work engagement and extraversion.

Ho2: There is no relationship between work engagement and neuroticism.

Ho3: There is no relationship between work engagement and agreeableness.

Ho4: There is no relationship between work engagement and conscientiousness.

Ho5: There is no relationship between work engagement and openness to experience.

II. METHODOLOGY

a) Respondents

A survey was conducted to collect the data from 150 female employees working in three different public sector banks in the state of Himachal Pradesh namely State Bank of India, Punjab National Bank and UCO bank. The respondents were given standard based questionnaires comprising questions related to personality traits and work engagement.

Measures:

Respondents filled out the standard questionnaires containing statements related to work engagement and big five personality traits respectively. Work Engagement was assessed with the validated 17-item Utrecht Work Engagement Scale (UWES', whereas the big five personality traits was evaluated with the Big five Inventory (BFI). It included total of 44 statements. Demographic attributes such as name, age, marital status, job experience, designation, salary and total work experience were measured in the first section of the questionnaire.

a) **Cronbach's alpha:** To measure the validity and reliability of the variables of work engagement cronbach's alpha were used. The cronbach's alpha for all the variables of work engagement and the five big personality traits was between α.84 to .61

b) Statistical analysis:

Firstly, mean and standard deviation was calculated for work engagement and personality. These measurement tools helped in finding the level of the work engagement and its three dimensions namely vigor, dedication and

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absorption and also of the big five personality traits namely extraversion, agreeableness, conscientiousness, neuroticism and openness. Skewness and Kurtosis showed the normal distribution of the data. Further, Pearson correlation method was used to explore the relationship between the work engagement and its three variables namely vigor, dedication and absorption with the big five personality traits.

III. RESULTS AND DISCUSSION

Results of the present study suggest that five factor model can be used as an important tool to find out the levels of work engagement. The hypotheses were tested with the help of bivariate correlation method.

a) Descriptive statistics:

Table 1: Mean and Standard Deviation

	N	Mean	Std. Deviation	Skewness	Kurtosis	Minimum	Maximum
Vigor	150	3.791	.6526	-0.16	-0.45	2.0	5.0
Dedication	150	4.128	.7358	-0.93	0.31	2.0	5.0
Absorption	150	3.939	.6303	-0.40	-0.24	2.2	5.0
Work Engagement	150	3.791	.6526	-0.56	-0.25	2.0	4.9
Extraversion	150	3.508	.5754	-0.14	-0.04	3.0	5.0
Agreeableness	150	4.106	.4462	-0.09	-0.69	1.6	5.0
Conscientiousness	150	3.981	.5918	-0.64	1.26	1.0	4.3
Neuroticism	150	2.530	.7036	0.01	-0.60	2.9	4.8
Openness	150	3.855	.3950	0.11	-0.22	2.0	5.0
Personality Traits	150	3.508	.5754	-0.08	-0.50	2.0	5.0

Table 1 reveals the descriptive statistics of vigor, dedication, absorption, work engagement, extraversion, agreeableness, conscientiousness, neuroticism, openness and personality traits of women employees of public banks. The above table explicit that for public banks, the average value of vigor was 3.791 with standard deviation of .6525, average value of dedication was 4.128 with standard deviation .7358 and the average value of absorption was 3.939 with standard deviation .6303. Whereas, mean of work engagement for public banks is 3.791 with standard deviation .6526. While for public banks, average value of extraversion is 3.508 with standard deviation .5754, average value of agreeableness is 4.106 with standard deviation .4462, average value of conscientiousness is 3.981 with standard deviation .5918, average value of neuroticism is 2.530 with standard deviation .7036 and average value of openness is 3.855 with standard deviation .3950.

However, mean and standard deviation of personality traits for public banks are 3.508 and .5754, respectively. Since coefficient of skewness of vigor (-0.16), dedication (-0.93), absorption (-0.40), work engagement (-0.56), extraversion (-0.14), agreeableness (-0.09), conscientiousness (-0.64) and personality traits (-0.08) are less than 0, therefore distributions of vigor, dedication, absorption, work engagement, extraversion, agreeableness, conscientiousness and personality traits for public banks are negatively skewed. But distributions of neuroticism and openness for public banks are positively skewed with coefficient of skewness 0.01 and 0.11, respectively. Curves of vigor, absorption, work engagement, extraversion, agreeableness, neuroticism, openness and personality traits for public banks are plattykurtic as values of kurtosis for these variables are (-0.45 -0.24, -0.25, -0.04, -0.69, -0.60, -0.22 and -0.50) are less than zero. However curves of dedication and conscientiousness for public banks are leptokurtic with coefficient of kurtosis 0.31 and 1.26, respectively.

b) Level of Work Engagement and Personality Traits

Table 2 Level of Work Engagement and Personality Traits

Variables		Frequency	Percentage	Normal Range
Vigor	Low	45	30.0%	Below 3
	Average	52	34.7%	3-4

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	High	53	35.3%	Above 4
Dedication	Low	47	31.3%	Below 4
	Average	41	27.3%	4-5
	High	62	41.3%	Above 5
Absorption	Low	43	28.7%	Below 3
	Average	56	37.3%	3-4
	High	51	34.0%	Above 5
Work Engagement	Low	34	22.7%	Below 3
	Average	52	34.7%	3-4
	High	64	42.7%	Above 4
Extraversion	Low	54	36.0%	Below 3
	Average	51	34.0%	3-4
	High	45	30.0%	Above 4
Agreeableness	Low	42	28.0%	Below 3
	Average	41	27.3%	3-4
	High	67	44.7%	Above 4
Conscientiousness	Low	34	22.7%	Below 3
	Average	48	32.0%	3-4
	High	68	45.3%	Above 4
Neuroticism	Low	52	34.7%	Below 3
	Average	37	24.7%	3-4
	High	61	40.7%	Above 4
Openness	Low	32	21.3%	Below 3
	Average	57	38.0%	3-4
	High	61	40.7%	Above 4
Personality Traits	Low	36	24.0%	Below 2
	Average	61	40.7%	2-3
	High	53	35.3%	Above 3
Total		150	100%	100

Table 2 depicts the descriptive statistics giving information about the level of work engagement, personality traits and its variables' among women employees of public banks. From table 2, we can conclude that majority of women employees of public banks i.e. 35.3%, are highly vigorous. Similarly, majority of 41.3% women employees of public banks are highly dedicated. Whereas 37.3% women employees of public banks were averagely absorbed in their work and 42.7% women employees had high level of work engagement in banking sector. However level of extraversion in banking sector was low i.e. 36% women employees of public banks were extrovert. According to 44.7% women employees their level of agreeableness in banking sector was high. Although according to 45.3% women employees of public banks their level of conscientiousness in banking sector was high. Similarly, level of neuroticism in banking sector was high, as 40.7% women employees were highly neurotic. Likewise, according to 40.7% women employees of public banks their level of openness in banking sector was high. Level of personality traits in banking sector was average; according to majority of 40.7% women employees of public banks. Thus, it implies that overall level of work engagement is high and personality traits in public sector bank are average.

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1 Correlation between Personality Traits and Work Engagement: The Pearson correlation method was used to find out the correlation between the work engagement and the various personality traits using SPSS statistics 23.

c) Hypothesis Testing:

Table 3 Correlations

	Vigor	Dedication	Absorption	Work engagement	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Personality
Vigor	1	.746**	.680**	.909**	.395**	.371**	.369**	-.342**	.360**	.420**
Dedication		1	.621**	.900**	.425**	.274**	.363**	-.303**	.304**	.401**
Absorption			1	.854**	.373**	.366**	.335**	-.215**	.289**	.442**
Work engagement				1	.449**	.376**	.401**	-.324**	.357**	.473**
Extraversion					1	.258**	.461**	-.475**	.274**	.604**
Agreeableness						1	.488**	-.257**	.354**	.690**
Conscientiousness							1	-.593**	.343**	.650**
Neuroticism								1	-.212**	-.097
Openness									1	.626”
Personality										1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Work engagement and Extraversion:

The above table signifies the correlation values between the variables of work engagement (vigor, dedication, and absorption) with one of the variable of big five personality traits namely extraversion of public sector banks. Vigor was significantly positively correlated with dedication, absorption, work engagement and extraversion with coefficient of correlation 0.746, 0.680, 0.909 and 0.395, respectively i.e. ($p<0.001$). Similarly, dedication has positive relationship with absorption (0.621, $p<0.001$), work engagement (0.900, $p<0.001$) and extraversion (0.425, $p<0.001$).

There was a significant positive relationship between extraversion and work engagement with correlation coefficient 0.449, p<0.001). Absorption was positively correlated with extraversion and work engagement as the correlation of coefficient was found to be 0.854 and 0.373, respectively i.e. (p<0.001).

Work engagement and agreeableness:

Table 3 reveals the correlation values between the variables of vigor, dedication, absorption, workout engagement and agreeableness of public banks. Agreeableness was positively correlated with vigor (0.371, p<0.001), dedication (0.274, p<0.001), absorption (0.366, p<0.001) and work engagement (0.376, p<0.001). Absorption had a significant positive relation with both dedication and vigor as their coefficient of correlations was found to be 0.621 and 0.680 respectively i.e. (p<0.001). There was a significant positive relationship between dedication and vigor with correlation coefficient 0.746, p<0.001). However work engagement was positively correlated with vigor, dedication and absorption with coefficient of correlation 0.909, 0.900 and 0.854, respectively i.e. (p<0.001).

Work engagement and conscientiousness:

Table 3, depicts the correlation values between the variables of vigor, dedication, absorption, workout engagement and conscientiousness of public banks. Vigor was significantly positively correlated with dedication, absorption, work engagement and conscientiousness with coefficient of correlation 0.746, 0.680, 0.909 and 0.369, respectively i.e. (p<0.001). Similarly, dedication has positive relationship with absorption (0.621, p<0.001), work engagement (0.900, p<0.001) and conscientiousness (0.363, p<0.001). There was a significant positive relationship between conscientiousness and work engagement with correlation coefficient 0.401, p<0.001). Absorption was positively correlated with conscientiousness and work engagement as the correlation coefficient was 0.335 and 0.854, respectively i.e. (p<0.001).

Work Engagement and Neuroticism:

Table 3 explicit the correlation values between the variables of vigor, dedication, absorption, work engagement and neuroticism of public banks. Neuroticism has negative relationship with vigor (-0.342, p<0.001), dedication (-0.303, p<0.001), absorption (-0.215, p<0.001) and work engagement (-0.324). On the contrary, work engagement has a significant positive correlation with vigor, dedication and absorption with coefficient of correlation 0.909, 0.900 and 0.854, respectively. There was a significant positive relationship between dedication and vigor with correlation coefficient 0.746. Absorption has significantly positive relationship with dedication and vigor with coefficient of correlation 0.621 and 0.680, respectively i.e. (p<0.001).

Work Engagement and Openness to experience:

Table 3 concludes the correlation values between the variables of vigor, dedication, absorption, workout engagement and openness of public banks. Vigor was significantly positively correlated with dedication, absorption, work engagement and openness with coefficient of correlation 0.746, 0.680, 0.909 and 0.395, respectively i.e. (p<0.001). Similarly, dedication has positive relationship with absorption (0.621, p<0.001), work engagement (0.900, p<0.001) and openness (0.3401, p<0.001). There was a significant positive relationship between openness and work engagement with correlation coefficient 0.357, p<0.001). Absorption was positively correlated with openness and work engagement as correlation coefficient was 0.289 and 0.854, respectively i.e. (p<0.001).

Work Engagement and Personality Traits:

The correlation values between the variables of vigor, dedication, absorption, workout engagement and personality traits of public banks are presented by table 7. Personality traits had a positive relationship with vigor (0.420, p<0.001), dedication (0.401, p<0.001), absorption (0.442, p<0.001) and work engagement (0.473, p<0.001). Likewise Absorption was significantly positively correlated with dedication and vigor with coefficient of correlation 0.621 and 0.680, respectively i.e. (p<0.001). Work engagement has positive relationship with vigor, dedication and absorption with coefficient of correlation 0.909, 0.900 and 0.854, respectively i.e. (p<0.001). There was a significant positive relationship between dedication and vigor with correlation coefficient 0.746, p<0.001).

IV. CONCLUSION

The present study was conducted in banking sector which is one of the emerging and an impressive sector for the youth of country especially the females but the tremendous change in the sector has developed a need to study work engagement and the role played by the big five personality traits. The result of the present study suggests that there was a significant positive relation between work engagement and big five personality traits. The level of work engagement was found to be high in the banking sector which implies that the female employees working in this sector are satisfied with their job and are fully vigorous, dedicated and are absorbed. Though the level of personality traits were average but agreeableness was found to be high which implies that the respondents are more motivated and positive towards resolving the conflicts. Thus, the present study may help in future reviews and this study in other institutes need to be done.

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ASSESSING THE ROLE OF SERVICE QUALITY IN ENHANCING CONSUMER SATISFACTION IN FOOD AND GROCERY RETAILING

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Abstract
This paper explores service quality in food and grocery retail outlets its influence on customer satisfaction. RSQSscale (Dhabolkar et al., 1996)been used for measuring service quality.Involving the five dimensions of service quality i.e.Policy, Reliability, Personal Interaction,PhysicalAspects and Problem Solving. Customer satisfaction was measured by a four-item scale adapted from Oliver, 1980. The data was then analyzed using Karl-pearson coefficient of correlation and Multiple regression analysis to understand the effect of service quality on customer satisfaction. The outcomes as derived from regression analysis suggest that all five dimensions of service quality influence customer satisfaction. The information provided by this research can be used while designing marketing strategies to improve customer satisfaction in food and grocery retailing.

Key Words: Food and Grocery, Service Quality, Policy, Reliability, Personal Interaction,PhysicalAspects and Problem Solving Customer satisfaction.

1. Introduction

Indian Retail industry occupies a substantial position and is undeniably one of the fastest thriving industries across the globe. This sector is indeed placed at the cusp of unlocking novel frontiers in form of supermarkets, departmental stores and hypermarkets. These emerging modern shopping formats are proving to be the best one shop destination for shopping, entertainment and food. It has been estimated that by 2022,the Indian organized retail sector is anticipated to expand its retail space by 39 million sq ft**(Economic times, 2019).**The Retail industry being one of the India's largest employers has been providing approximately 8% of the total employment in addition to excellent business opportunities to millions of people across the length and breadth of the country. According to a report by (**IBEF,2019),** Indian retail industry's contribution to Gross Domestic Product (GDP) of the country stands close to 10% where India enjoys a sturdy fifth rank in terms of an emerging global destination in the retail space**(Delloite Report, 2018).** It was also anticipated to become the world's fifth largest economy by 2019, touching a total of GDP exceeding $3 trillion(The Livemint 2019). During the past decade India has observed an astonishing shopping revolution with substantial transitions in consumer buying behaviour patterns (Sharad Venkta,2017). Indian Retail Industry has experienced a booster through a collaborative impact of digitization, fast paced urbanization, rising disposable incomes and drastic lifestyle changes amongst the middle-class segment in the recent past. With this, the projected rise in the Indian consumer expenditure is expected to reach –approx. USD 3,600 billion by the end of 2020 (ShephaliKapoor)

2. Food grocery retailing in India

India's food and grocery retail sector accounts for approx. U.S. $380 billion(Shubhi and Anthony, 2018). Nearly 91% of the total retailing pie is predominated by unorganized neighbourhood shops(Care Rating 2017). It has been projected that the market share of modern retail formats will double to approx. four percent by 2020 (Shubhiand Anthony , 2018). As per the report, 44.63 percent of the household expenditure is spent on food and beverages. Emerging Investments in latest technology, robust expansion strategies, introduction of private labels with home delivery options, have largely aided the growth of this segment (Crisil Report, 2018). Apart from the Kirana stores, food and grocery is being readily sold in India through modern formats like supermarket, hypermarket, discount stores and convenience stores(Mukherjee and Zameer (2011].India's big blue-chip companies like Reliance, Bharti and RPG have diversified and indeed value added to their portfolios by venturing into retail domains. Big Bazaar, the flagship brand owned and controlled by Future Group is the leading brand in grocery retailing. Its share, though small, is growing year on year. It has now become a synonym with modern grocery retailers as being considered a pioneer in organized retail segment to make inroads in Indian territory (Euromonitor Report, 2017).It is anticipated that the grocery retailers in India will witness an enlarged footfall during the forecast period in 2021 due to the rise in health awareness (FICCI and PWC Report 2012). As lifestyles continue to change, Indian consumers are transforming to healthy eating habits with preferred home cooked food which in turn would push the consumers to purchase groceries and other household supplies on a more regular basis from these food and grocery retail outlets. Marketers need to strive hard to ensure the customers' delight level in theeir purchase journey. Retailers call such milestones as

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"trustpoints" instead of "touchpoints (Accenture Report). Diverse planned initiatives by the Governments clubbed with developmental incentives has led to a multiplier effect in increasing movements of goods, services especially in food and grocery segment.

3. Review of literature

Systematic review of literature reveals that various studies have been conducted across the global concerning the behavioural aspect of consumers while taking retail purchase decisions. The consumer behaviour changes based on the place of shopping and level of involvement while buying merchandises (Berman and Evans, 2005). Kiranas have proved to be better performers in terms of location but poorly on cleanliness, offers, quality and helpful trustworthy salespersons (Panda 2013). However, Service quality helps in better understanding of the association between service delivery and the customer expectations (Parasuraman et al , 1988). Mom & pop stores are crafted in order to provide a well tailored product service to their local communities. Consumers often prefer to visit a store which is in the close vicinity of their house (Sinhaetal., 2002). Further, as highlighted by (Deka,2019) the shoppers give high weightage to store interiors and ambience while making purchase decisions. (Goswami and Mishra,2008) opined that consumers are loyal towards grocery outlets which are centrally located with supportive staff and clean hygienic interiors. (Banerjee and Dasgupta,2010) observed that consumers prefer to shop at the new format shopping malls as they are air-conditioned, well designed and provide better quality goods, value added services, risk free transactions, self-service, ample parking facilities, technology based operations along with convenience of shopping. (Kushwaha et al.,2017) explored that the tangible and intangibles elements clubbed with relevant promotional offers are the key factors in attracting larger customer footfall into the malls. However on the flip side many consumers perceive in-store shopping as time consuming,chaotic, tiring, frustrating and stressful, especially amid huge traffic inside the store (Buttle and Coates, 1984; Aylott and Mitchell, 1998; Roberts et al., 2003). Many researchers have also analysed that consumers consider food and grocery shopping as an unavoidable monotonous task (Corral, 1999; Geuens et al., 2003) that leads to sheer wastage of time (Picot-Coupey et al., 2009). (Buttle and Coates,1984) opined that consumers don't consider grocery buying as a form of 'shopping'. Instead, grocery shopping is often considered by many as a core household chore that is compulsive, mundane and a necessary evil (Buttle and Coates,1984).
So our study will furnish valuable insights regarding modern food and grocery retail format which are working hard to satisfy young consumer's hedonic and utilitarian needs especially in emerging economies like India. Customers expect an enhanced product quality along with excellent service as a hallmark of value for money (Singh, 2013). Expectations of the customers varies across diverse retail stores for different types of customers needs (Paul, 2016)

3. Service Quality Dimensions:

3.1 Physical Aspects

A physical aspect of a store is considered to be a multi facet concept. In addition to attractive physical amenities, it also includes convenient store layout and comfortable zone for public resting, latest equipment and fixtures (Martinelli, 2012),. Substantial evidence from the extant literature (Tanwar et al., 2013; Sam, 2011; Dabholkaretal., 1996) proves that attractive and pleasant services capes is the most favourable determinant for rich shopping experience(Kim and Jin, 2002;Malhotra et al., 1994), customer satisfaction and repurchase intentions(siu 2004) particularly in the countries where organized retail is at its nascent stage. Apart from enhancing the store image, these physical aspects render primary cues for customers to pursue the retailers' service offerings.

3.2 Reliability

The proficiency of various service organisations in achieving an assured service level in an utmost adequate fashion elaborates the concept of Reliability. In its broadest sense, reliability measures the speed of service, accuracy of transactions and speed of outcome. It also includes that food and grocery retailer would deliver the merchandise at the promised time with an appropriate problem resolution mechanism in case of any discrepancy. The employees should provide error free billing; honest and appropriate feedback about the product and sales-staff should have adequate product knowledge. The retail stores should be made accident proof by installing requisite surveillance devices and fire-fighting equipments. Its a combination of not only keeping promises but a commitment of "doing the right things". The retailer should refrain from over charging and deliver core service attributes at the right time at the right circumstances to the right customers.

3.3 Personal interaction

The interaction among store staff and store customers plays a significant role for attaining customers' loyalty if the store personnel are warm, friendly, and impulsive. (Bellenger et al, 1976) Simmers and Keith (2015) had defined the personal interaction dimension for retail stores that have empathetic employees, well equipped with product / service knowledge, ready to extend a helping hand when required with a proactive approach to resolve customer's queries. It also incorporates providing customer's individualised attention thereby showing

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courteous behaviour as desired. Store managers should leverage their store assistants for enhancing their customer interactions though pro active approach.

3.5 Problem solving

The problem-solving dimension includes the willingness of retailers to process returns and exchanges in a hassle free manner and an earnest keenness in solving customer grievances along with establishing a decent dialogue with the customer. Sheth (1976), defined interaction quality as combination of rules, regulations and mannerism clubbed with appropriate content for communication. Firstly a healthy dialogue shapes up a positive outcome through buyer-seller interaction. Secondly employee competence could be gauged from the knowledge and skills that employees possess to effectively assess the needs of its client, their appropriate knowledge about products and services offered and delivered efficiently and if they could communicate effectively with customers. A competent employee is expected to provide prompt service and handle customer complaints efficiently.(Herling, 2000)

3.5 Policy

Store policy dimension captures the retailers' code of conduct and corporate narratives that reflects the organizations ethos and values. It includes quality merchandise, convenient operating timings, and acceptance of major credit cards/ digital payments. Requisite policy and procedures should be drafted to define the distinct levels of authority and accountability at the retail outlets.(Bailey, D. 1994) that should be dealt fairly, carefully and confidentially, managed in a way not against the legal conditions and the company policy, necessary reforms and checks should be carried out constantly to avoid the occurrence of the repetitive dissatisfaction. Transparency is predicated upon customer relations and resolving all customer dissatisfactions, perceived as the main principle.

4. Customer satisfaction

Customer satisfaction is the primary factor that aids in realizing organizational objectives, meeting standard of efficiency that mirrors hallmark of excellence for any organization (Gerson, 1993; Munusamy and Chelliah, 2011). Customers unanimously rank service quality as a nexus between customer satisfaction, and, consequently gaining competitive advantage.(Martinelli201). Customer satisfaction fosters an evaluative judgement for any service/ product performance which results in meeting or exceeding the customer's expectations (Kumar, 2012; Lombard, 2009; Santouridis&Trivellas, 2010(Kumar, 2012; Lombard, 2009; Santouridis&Trivellas, 2010). The Review of literature highlights different perspectives about customer satisfaction (HennigThurau& Klee, 1997; Groonroos, 2007). Few authors states that customer satisfaction stems from a positive affirmation about offers by the consumers (Oliver, 1997). Others argue that customer satisfaction/dissatisfaction is a perfect blend of experiences by perceived quality of the offer (Bitner, 1990; Bolton & Drew, 1991; Hennig-Thurau& Klee, 1997). The third group considers both constructs as one and the same (Gummesson, 1987; Spreng& Singh, 1993)..(martinelli201)Satisfied customers tend to be more loyal, less price sensitive, show stable demand patterns and engage in positive recommendation to other(Anderson et al., 2004;Matzler et al., 2008). Customer Satisfaction acts as a holy grail for modern retailers (Fornell, 2007), checking and improving the current as well as potential performance of businesses (Zairi, 2000).

5. Scope of the study

Since organised retailing is still in its nascent stage in Indian context,it is believed that food and grocery sector is the one of the most promising segment to set up retail venture for both indigenous and MNCs in Indian subcontinent. This fact is validated by the inroads made by domestic players like Reliance and foreign giants like Walmart and METRO. This is huge gulf in the research area concerning Indian context as limited empirical research have been done that contributes to the existing literature. Hence, this study aims at deciphering the key factors concerning service quality issues in food and grocery retailing in India. Reviewing service quality dimensions can help the managers to focus on weaknesses and chalk out a corrective action plan as desired. The geographical scope of the study is confined to the tri cities of north India i.e. Chandigarh, Mohali and Panchkula.

6. Objective of the study

- To understand the relationship between constructs of service quality and customer satisfaction
- To explore the important determinants of Service Qualityfor measuring customer satisfaction in Indian organized food and grocery retailing.
- To suggest the measures that can lead to increase of customer satisfaction in Indian organized food and grocery sector.

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7. Hypothesis

H1: Physical Aspects as service quality dimension has a significant influence on customer satisfaction in Indian organized food and grocery retailing.
H2: Reliability as service quality dimension has a significant influence on customer satisfaction in Indian organized food and grocery retailing.
H3: Personal Interaction as service quality dimension has a significant influence on customer satisfaction in Indian organized food and grocery retailing.
H4: Problem solving as service quality dimension hasa significant influence on customer satisfaction in Indian organized food and grocery retailing.
H5: Policy as service quality dimension has significant influence on customer satisfaction in Indian organized food and grocery retailing.

8. Methodology

8.1 Measurement Instrument

In this study, a structured questionnaire was developed to collect the data for understanding the cues of service quality dimensions for enhancing customer satisfaction in food and grocery retail outlets. The questionnaire is divided into two sections.The first section was used to determine the respondents' perceived importance of service quality cues. 28 items were used to measure the holistic response of respondents' on a 5-point Likert scale where "Strongly disagree" is represented as 1 and "Strongly agree" is represented by 5,(Dhabolkaret al. 1996)Retail Service Quality Scale (RSQS)was used in the present study. This scale was further adapted and modified to suit the Indian food and grocery retail scenario for measuring in-store customer satisfaction parameters. 4 items of customer satisfaction was adopted fromOliver, 1980 .the second section of the questionnaire inquired about the respondents' basic demographic characteristics such as age, gender, education, annual household income,The instrument was pre-tested on 154 consumers. Based on the Pre-testing feedback, the instrument was revised to improve the clarity of the questions and to increase the content validity of the measurement instrument

8.2 Sampling and data collection

A quantitative based research approach was used for the study to test the stated hypothesis.Self-administered structured questionnaire wasframed to collect the data. Survey participants were randomlyselected from outside the supermarkets of Chandigarh, Panchkula and MohaliIndia.The participants wereinitially briefed about the aim of the study, anonymity, and the voluntary nature of participation before requesting them to fill the questionnaire The study's dataset includes 473 valid participant responses out of 550 resulting a yield rate of 86%.Khare (2012) assessed that the demographic and cultural factors deeply influence customer's preference to shop from small retail outlets in developing countries like India.Hence it becomes indispensable for retailers to value the true drivers of food and grocery shopping behaviour in the Indian retailing perspective (Sinha and Banerjee, 2004).The basic demographic profile is summarized in Table 1.which illustrates that 58.1% of the respondents are males, maximum respondents (39.32%) fall in the age bracket of 31-40 yrs.whereas71.04 % respondents are married and are58.56 % of respondents possess postgraduate degree. 40.08 % of the respondents earn a monthly income between 50000 -75000 per month and 46.09 % of respondents earn their living through a private job. eThe responses obtained were later analyzed using Karl Pearson coefficient of correlation along with regression analysis was . Data coding, recording and analysis were conducted with the help of SPSS 26 software

Table 1: Demographic profile

Demographic Characteristics		Frequency	Percentage
Gender	Male	275	58.1%
	Female	198	41.9%
Age(yrs)	Less than 20	23	4.86
	21-30	114	24.10
	31-40	186	39.32
	41-50	73	15.43
	51-60	65	13.74
	> 60	12	2.54
Marital Status	Married	336	71.04
	Unmarried	137	28.96
Educational	Under Graduate	71	15.01

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Level	Graduate	38	8.03
	Post Graduate	277	58.56
	Doctorate	87	18.39
Monthly Family Income (in INR)	25001-50000	54	11.42
	50001-75000	193	40.80
	75001-100000	106	22.41
	>100000	81	17.12
Occupation	Housewife	15	3.17
	Private Job	218	46.09
	Self employed/ Business	98	20.72
	Government Job	48	10.15

8.3 .Research instrument

Eysteinsson and Bjornsdottir (2012) concluded in their research, that the dimensions of service quality particularly in retailing differ as per the culture and type of retail outlet. So,principal component of factor analysis with varimax rotation was conducted to identify the dimensions of service quality and customer satisfaction in food and grocery retail outlets. In factor analysis, factors with eigenvalues greater than 1.0 and items with rotated factor loadings of 0.50 or greater were retained for further analysisas they are considered statistically and practically significant (Hair et al., 1998).Exploratory factor analysis shows that Bartlett's test of Sphericity was 0.00 (significant) The Chi-square value is 11389.875, df is 378 and Kaiser Meyer Olkin (KMO) value is .847indicating a good sampling adequacy. EFA extracted 5factors with cumulative variance extracted 69.713%.The first factor is identified with 9 variables and factor loadings ranged from .852 to .701. All the 9 variables in this factor relate to the Personal Interaction aspect of food and grocery retail outlets and explains the variance of 20.543with an Eigen value of 5.752 The second factor is identified with 6 variables and factor loadings ranged from .930 to .788.All the 6variables in this factor relate to the Physical aspect of food and grocery retail outletsand explained variance of 15.605% with an Eigen value of 4.369. The third factor is identified with three variables and factor loadings ranged from .935 to .784.All the five variables in this factor relate to Reliabilityof food and grocery store explained variance of 13.583with an Eigen value of 3.803.The forth factor is identified with five variables and factor loadings ranged from .806 to .670. All the five variables in this factor relate to policy aspect of food and grocery store and explained a variance of 11.219 with an Eigen value of 3.141. The fifth factor is identified with three variables and factor loadings ranged from .920to .804. All the 3 variables in this factor relate to problem solving aspect in food and grocery store and explained variance of 8.763 with an Eigen value of 2.454.

Where asExploratory factor analysis of customer satisfactionconstruct shows that Bartlett's test of Sphericity was 0.00 (significant) The Chi-square value is 2543.374, df is 10 and Kaiser Meyer Olkin (KMO) value is ..785. andcommunalities ranged from. .551 to .899 indicating good sampling adequacy. EFA extracted 1 factors with cumulative variance extracted 71.174% and eigenvalue 3.559.the factor loading ranged from .948 to .694.

The measurement instrument was tested for reliability usingCronbach alpha. This was done to estimate the degree to which the observed variables measure the true and error free value preferably in likertscale. Factor Analysis and Reliability results are summarised in Table 2. All the variables shows that the Cronbach alpha values were well above the customary cut-off limitoff 0.6 (Griethuijsen et al., 2014) indicating a satisfactory level on internal consistency.

Table 2: Factor analysis and Reliability analysis of the variable in the study

Statements	Factor Loadings	Eigenvalue	%variance explained	Cronbachalpha
Personal Interaction				
PI_Employees have answer to customers queries	.852	.5752	20.543	.927
PI_Behaviour of employeesinstilconfidence in customers	.832			
PI_Employees give prompt services to the customers	.820			

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PI2_customer feel safe in their transitions with this store	.817			
PI_Employees tell customers exactly when the services will be performed	.812			
PI_Employees are ready to help customers	.774			
PI_Customers get individual attention	.757			
PI_Employees are courteous with customers	.743			
PI_Employees are courteous with customers over the phone	.701			
Physical Aspects				
PA3_shapoing bags, catalogues etc associated with store are visually appealing	.930	4.369	15.605	.914
PA_Store has clean, attractive and convenient public areas.	.845			
PA_Layout makes it easy for the customer to find what they want.	.816			
PA_Layout makes it easy for the customer to move around	.808			
PA_Physical Facilities are well appealing In this store	.801			
PA1_ Food and Grocery store has modern equipments and furniture	.788			
Reliability				
R_When store promises to do something by a certain time, it will do so	.935	3.803	13.583	.915
R_Store provides timely services	.928			
R_Stores performs the service right the first time	.816			
R_Store stocks all the necessary merchandise required by the customer	.798			
R_store provides error free transitions	.784			
Policy				
PO_Store has its own loyalty card	.806	3.141	11.219	.842
PO_Store accepts all debit/ credit cards	.797			
PO_Store has convenient operating hours	.796			
PO_Store offers convenient parking place	.746			

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PO_Store offers high quality of merchandise	.670			
Problem solving				
PS_Store handles returns and exchange willingly	.920	2.454	8.763	.876
PS2_Customers problems are handled with sincere interest	.894			
PSEmployees handle customer complaints immediately	.804			
Customer satisfaction (Dependent variable)				
CS_ I am satisfied with my decision to by food and grocery from this store	.948	3.559	71.174%	.893
CS_ I think that I did the right thing by deciding to by food and grocery from this store	.938			
CS_ My decision to join this store was a wise one	..864			
CS_ My expectations of service at this store had been fully met	.743			
CS_ overall I'm satisfied with this store	.694			

9. Correlation analysis

The outcomes as derived, clearly exhibited support for all the specified hypothesis i.e. from H1 to H5.Hence it could be deduced that all thementioned proposed constructs i.ePhysical Aspect(r=584 p≤0.05), Personal Interaction (r=.456 p≤0.05), Reliability(r=..441 p≤0.05), Policy(r=..422 p≤0.05) Problem Solving (r=..350 p≤0.05) were found to have positive effect on customer satisfaction in food and grocery retail in India . Preliminary analysis revealed that there was no violation of the assumption of linearity and homoscedasticity and all associations were found to be significant at 95% level

10. Regression Analysis

In the consecutive step, to explorethe aspects of specified service quality parametersi.ePhysical Aspect, personal interaction, policy, reliability and problem solving whichshow a stronger influence on the customer satisfaction in food and grocery retail outlets multiple regression analysis was implemented. In the model, five dimensions of service quality were measured by 28 itemswhichwere considered as independent variables and customer satisfaction dimension was measured by 5 items whichwere considered as the dependent variables. The model was found significant at p≤.05 level and the adjusted R^2 =0623 .Table 6 shows theunstandardized beta coefficients illustrating the independentvariables" explanatory power. Five constructs were found to be impactful($p \leq 0.05$ level) in elaborating customer satisfaction in food and grocery retailing . The specified constructs based on their significance as exhibited through their unstandaizedbeta coefficients, are Physical aspect quality (β=0.392),Personal Interaction (β=.508), Reliability(β=.246) and Problem solving (β=.192) and policy (β=.221). All of the coefficients were found to be in expected direction. The results show support for hypotheses, H1, H2, H3, H4.H5

The final Regression Equation can be summed up as:

Customer satisfaction =2.575 + 508 (Personal Interaction) + .392 (Physical Aspects) +.246(Reliability) .221 (Policy) +.192 (problem Solving)

The independent variables were also checked for multicollinearity. A multicollinearity problem is likely to occur when explanatory variables correlate with each other. If a high degree of correlation exists, it is then difficult to determine the contribution of each independent variable, because their

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effects are confounded (Hair et al., 1995). A common measure for assessing pairwise and multiple variable collinearity is the variance inflation factor (VIF), which tells us the degree to which each independent variable is explained by the others. Normally a set of explanatory variables is highly correlated if tolerance is low and VIF exceeds ten, thus presenting a multicollinearity problem (Hair et al., 1995). The tolerance of an independent variable (TV) is an additional method to measure the effects of multicollinearity in a data set. The closer the tolerance of variable value to one indicates independence, and if the tolerance value is close to zero, the variables are multicollinear. HenceTolerance Value (TV) and Variance Inflation Factor (VIF) for each explanatory variables were used to measure multicollinearity. The multicollinearitydiagnostis statistics were listed in Table 6. It can be seen that tolerance value is towards the higher side and VIF does not exceed the recommending limit.

Stepwise Regression Results Relationship between service quality dimensions (independent Variable) and Customer satisfaction (Dependent Variable)						
	Unstandardized Coefficients				Collinearity Statistics	
Independent Variables	B	Std. Error	t	Sig.	Tolerance	VIF
(Constant)	2.575	.273	9.421	.000		
Personal interaction	.508	.045	11.268	.000	.924	1.083
Physical aspects	.392	.031	12.770	.000	.855	1.170
Reliability	.246	.026	9.400	.000	.895	1.117
Policy	.221	.053	4.197	.000	.818	1.222
Problem solving	.192	.029	6.647	.000	.899	1.112
$R^{2=}$.627; Adjusted R^2=.623; F statistics=157.327 (p-value = 0.000)						
Dependent variable (customer satisfaction)						
Sample size (473)						

11. Results and Discussion

Our research findings are in line with the existing literature that service quality is crucial predictor of customer's satisfaction which not only help retailers to gain competitive advantage but also for enhancing performance outcomes in food and grocery retailing. Service quality has been shaped as an indispensable construct that retailers must religiously adhere to if they really wish to satisfy the needs/ wants of their clients, to retain their share of wallet, expect positive word of mouth and finally increased footfall and sales in the grocery outlet.

Service quality index works as an important diagnostic tool for grocery retail managers for monitoring, improving customer satisfaction. Results are in line with previous studies highlighting the direct implication of service quality on customer behaviour (Cronin et al., 2000; Sirohi et al., 1998). Food and grocery retailers should make a consistent endeavour to understand the impact of each construct of service quality, so as tolay the foundation of a persistent and profitable relationship with their clients. (Lovelock and Wright, 2002).Markets these days are characterized by cut throat competition and high-demanding customers. So by providing idyllic retail setting, not only customer satisfaction and loyalty be enhanced but also consistent store traffic and a high share of customer shopping spending is ensured.

The result from the hypothesis testing of research model reveals that the most important constituent of service quality which has the effect on customer satisfaction is personal interaction that plays a crucial role in gaining customer satisfaction As, grocery shopping behaviour is unplanned buying (Park et al., 1989) and different customers have different motivations aspects linked to shopping. This may range from diversion from monotonous tasks, gathering knowledge about new products, to enjoy the bargaining process etc. (Tauber, 1972). So, in this case interaction with Sales personnel plays a key role in delivering right experience in form of customer service to its client and magnifying post purchase satisfaction. The store personnel attitude and treatment towards its customers (Gagliano and Hathcote, 1994) can make or lose the customer for lifetime. The employees should be trained to be more responsive towards customer's queries, pay them individual attention, being empathetic and courteous towards the customers.It was also noteworthy that Physical Aspects has a positive effect on customer satisfaction. The store should adorn itself with latest equipment, fixtures and furniture. The physical facilities inside the store should be visually appealing so as to convert a walker by into a stopper and stopper into a shopper. The restrooms and fitting rooms should be easily located within the outlets, the store personnel ought to be well-dressed as they serve as primary cues for shoppers to appraise the retailers' servicescape to mould the customers repurchase intentions in favour of the retail outlet, the Service provider should work wholeheartedly tomatchthetasteandpreferenceoftheircustomersto win their loyalty.Results show

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that Reliability too plays a pivotal role in enhancing customer satisfaction.Grocers should make a note of the personal preferences of their customers that they do not walk out of the store because of stock out. Retailer should keep its promisesofproviding right assortment of goods and services along with consistent supply of fresh and dry grocery,appropriate sales record and safety in transitions. The findingswere found to be in sync as those found by (Huddleston et al.,2004).Another important dimension of retail service quality is Policy. Retailers should work on framing a comprehensive return and exchange policy to facilitate any issues concerning the products sold in the outlet. They should also adhere to convenient opening and closing hours and rules for accepting major debit/ credit cards which will help in predicting future purchase behaviour (Kasper, 1988). Last but not the least the results also indicate that problem solving too has an effect on gauging the service quality. In this today's competitive world customer always want everything under one roof along with convenience of location). Knowledgeable and helpful sales personnel are viewed as the strongest pillar of customer satisfaction (King and Ring, 1980).It was also found that store personnel should take sincere interest in solving service failures and should go an extra mile to satisfy the problem of the client.

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Customer Satisfaction Indices: A Study of Organized Retail Stores in the Tri-city

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Abstract:

The world of retailing is currently undergoing a rapid transition, with both customers and retail stores responding to changing market scenarios and customer preferences (Goyal & Aggarwal: 2009). In today's IT enabled world, traditional retailing formats are facing strong competition from the fast emerging retail experiences offered by online and digital retailers (Bhattacharya, 2001). More than ever before, customer satisfaction has become the defining feature that helps traditional retailers sustain and still grow.

Customer satisfaction continues to remain a primary and powerful tool by which the retailer can ensure that clients return to their stores even in a climate of extreme transition and change as IT enabled retail makes massive inroads into the traditional retail segment and categories. Novel strategies, more responsible, responsive and enhanced service and greater returns on every rupee spent are some of the strategies that are being utilized by retail outlets to retain customers.

This study, conducted across a large sample in the Tri-city comprising Chandigarh, Mohali and Panchkula aims to determine the success of the strategies being employed by the big organized retail outlets and the degree of customer satisfaction that these retail organizations are able to achieve. The study also identifies areas and indices that the organized retail outlets need to develop and improve to enhance their customer satisfaction scores in the future.

Keywords: Retail, Organised Retail, Customer satisfaction, Tricity, competition

Introduction

Retailing can be explained as business activity that primarily involves selling products and services to consumers directly for their personal, family or household usage (Berman and Evans, 2001). Traditionally, businesses have tended to focus on one financial metric as the determinant of all strategy and plans. This variable is also considered the indicator of success. The bottom-line or the profit margin has long been the financial indicator that has guided all business decisions and policies (Wong, Sohal, A & Amrik: 2003).

In a changing world, the profit margin can no longer be considered the be-all and end all of business strategy. As competition increases to unprecedented levels in the retail space, with more responsive and customer friendly business models such as hypermarkets and superstores making deep inroads into not only towns, but also small cities and rural markets, the rules of the game have changed drastically (Rigby, 2011). With the retail business becoming more competitive as hypermarkets and supermarkets invade the traditional retail space, retailers are now offering more freebies, value additions and enhanced services to the consumers.

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Recent research has shown that retail companies are losing majority of customers on average in five years (Rigby, 2011). The causes for these are not far to seek as new strategies, attractive discounts, better services and enhanced customer focus becomes the cornerstones of retail amid cutthroat competition. (Fernandes et al.,2000). Customer satisfaction is the one tool that retailers have in measuring the degree of the customers' satisfaction in real time, analyzing their expectations for the mid and long term and devising novel effective retention strategies for the future.

Customer satisfaction is not just another variable now. It is an inalienable and critical part of not just the branding, sales and marketing strategy, but the crux of the business that guides all decisions. This has now become essential for survival as differentiation from the competition, brand value more than mere advertising or marketing and on the ground visible and effective improvements that help businesses retain clients and also boost sales. (Ramaswamy and Namakumari, (2002).

Price Water Coopers, in a study in 2018 concluded that bad customer service experiences are driving people away faster and conclusively than ever before. Retail businesses need to realize that clients can walk away from a beloved brand after just one bad experience in an era where they have unlimited choices to opt from. In the United States, 59% of the customers walk away from a well established brand they have been loyal to after multiple bad experiences. In Latin America, this percentage is even higher as 49% of the customers were found willing to walk away from a brand after just *one* bad experience.

In India, this scenario is fast getting replicated as customers venture beyond the traditional neighborhood stores and experience organized retail. The task of retaining customer in traditional retail formats is made even more challenging by the presence of online retail which is mushrooming at a fast pace. As more and more customers become tech savvy and online global giants such as Amazon, Ikea, Walmart etc make rapid inroads into the Indian Retail space, clients are taking full ademerging online platforms.

The current study aims to delve into the components of retail customer experience and explore the impact of such indices on customer satisfaction as a core for any retail business survival. This study can potentially help the retailer identify factors that induce customer satisfaction and loyalty in the long run.

Review of Literature

A review of Literature is necessary to understand the various dimensions of the research that has already been done by various scholars on the subject in recent times.

Reddy, Suresh Jakka. (2013) in his path breaking book "Customer Satisfaction in Organized Retailing: A practical book to know Customer Satisfaction factors in the retail sector" has outlined the gap between the perceptions and expectations of the customers and the actual products that are delivered to them. The book has been written from the perspective of the Indian customer and offers insights on how to bridge the gap between customer expectations and actual experience. For the purpose the author surveyed 1200 customers from three retail shopping malls in Hyderabad and analyzed the data through various tools. He found that the Indian consumer has become much more aware and exacting now with high expectations which retailers must exceed or at least meet in order to retain customer loyalty.

Dr. S. Rosita et al, (2014) carried out research in India to understand the customer perceptions and satisfaction in organized retail. In their study carried about 6 years ago, they found that the expansion of organized retail formats to be rapid and impactful. As foreign companies and global corporate hone in on India as one of the biggest global markets, insightful market research and data analysis is the need of the hour. As demographics, lifestyles and purchasing power undergoes fast changes, customer satisfaction and retention hinges on detailed analysis. This study found that Indian consumers and customers gave a lot of importance to factors such as quality of the merchandise, physical surroundings, promotional schemes and personnel interaction. In addition to the service, the Indian consumer also is concerned about after sale service, entertainment and security arrangement.

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Rao, Ajit and Chandra, Subhash (2013) in their 180 page book titled The Little Book of Big Customer Satisfaction Measurement, use their expertise as being senior management and strategic thinkers working in top positions in an Anaytics firm, The Neilson Company, to pinpoint the various methods and tools that can help retailers gauge and improve their customer satisfaction results. The authors have explained how the various tools of qualitative research can be utilized to understand customer needs and evolve methodologies to meet and exceed client expectations.

Statement of the Problem

The retail landscape is undergoing constant change and correction. Customer retention is increasingly getting more dependent on forming a deeper understanding of what customers are seeking from in-store experiences. With immense competition emerging from new spaces such as online retail, in-store retailers have to constantly keep engaging with their current customers, so as to keep closely attuned to their needs and wants.

Further, it is essential to take feedback and pointers of the pain points which the customers feel, so to remove these at the earliest. The strategies for the future can also be devised after taking adequate feedback about the current situation and perceived challenges (Coughlan, Anderson, Stern and El-Ansary, 2001). The various elements and attributes that add up to create a satisfying shopping and retail experience for the clients are essential to generate more sales, and retain customer engagement &loyalty (Kline, R.B 2005). Region, climate and cultural practices also have a role to play in dictating customer behavior in a certain geography (Mulky and Nargundkar 2003), as they have different demographic features. In order to determine the affiliations, wants, needs, expectations of the residents of the Tri-city, a detailed study was essential.

Objective of the Study

The major objectives of the study:

1. To ascertain if the customers in the Tri-city are satisfied with the organized retail outlets.
2. To determine the major factors which play a role in customer satisfaction.
3. To ascertain the specific indices that affect customer satisfaction the most.

Research Methodology and Design

The Tri-city refers to the Union Territory and combined capital of Punjab and Haryana, Chandigarh and the adjoining cities of Mohali in Punjab and Panchkula in Haryana. Collectively, these three cities form a homogenous and compact urban metropolis that is referred to as the Tri-city.

This study is based on Primary data that has been painstakingly collected across the Tri-City. The respondents were randomly selected and approached inside the hypermarket and supermarket retail stores. Primary data was collected by interviewing select respondents to provide detailed responses to a questionnaire with both closed and open ended questions, and demographic details.

Secondary data was collected from various sources that include books, journals, newspaper articles and trade reports etc. Simple random sampling was carried out on a sample of 200 customers in retail stores.The data was analyzed and statistically tested to ascertain the viability of the statements.

Hypothesis of the study

H1: The goods available in the stores are not adequate.
H2: The Store is not easily assessable and approachable.

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H3: The store doesn't provides prompt customer services
H4: The store doesn't provides enough coupons and membership cards

Limitations of the Study

1. The Study was conducted only at organized retail outlets in the Tri-city
2. The Survey was confined to the limits of the Tri-city that includes area of Chandigarh, Mohali and Panchkula.

Analysis

Bain and Company, the top global market research firm, has already predicted that rapid innovation, absolute scale and customer data analytics are the new norms for retail success.

Market share of the organized Retail Stores surveyed in Tri-city

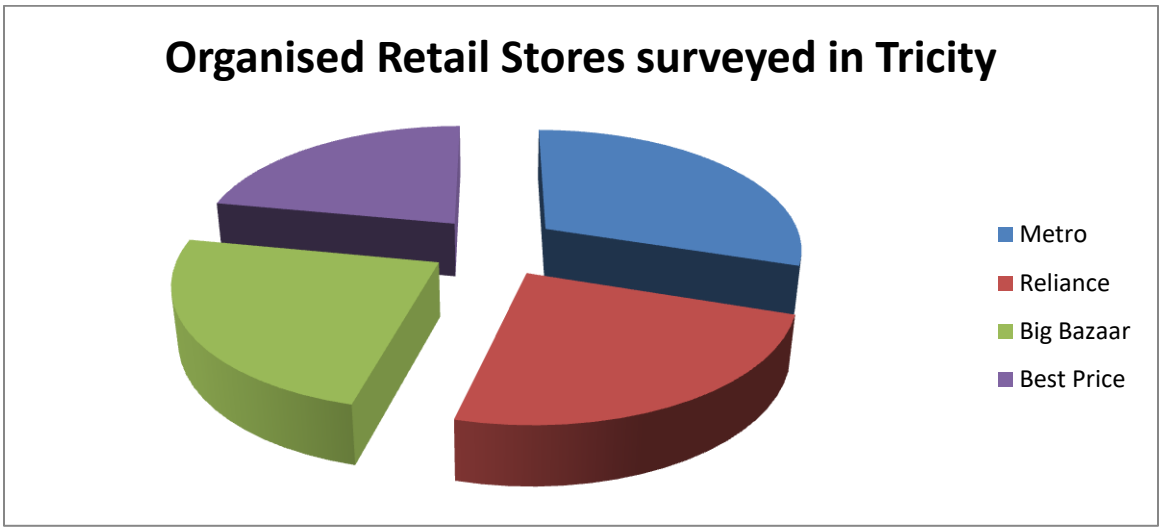

Table 1

Market share of the Organized Retail Stores surveyed in Tri-city

S no	Retail Store	Customers	Valid %age	Cumulative %age
1	**Metro**	60	30%	30%
2	**Reliance Supermart**	48	24%	54%
3	**Big Bazaar**	48	24%	78%
4	**Best Price**	44	22%	100%
		200	100%	

Source: Original primary data gathered by the researcher

Inference of Table 1

In recent years, organized retail in India has seen an unprecedented boom. There has been a rapid inroad made, not only in the metropolises such as Delhi NCR, Kolkata, Mumbai and Chennai, but also in Tier 2 cities such as the Chandigarh. From the above table, it becomes clear that organized retail chains with a pan India presence such as the

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four surveyed in the present study have been well established in the Tri-city. Many have been present here for almost a decade now, and have had ample time and opportunity to attract and retain customer loyalty. As clear from the table, the retail chains which were surveyed for this study included Metro, which had the largest number of 60 customers. Reliance Supermart and Big Bazaar, both multi utility stores had 48 customers each out of the 200 surveyed and Best Price as the fourth with 44 customers.

Customer Satisfaction Indices

The four indices on which the customer satisfaction was surveyed in a study of 200 customers across the Tri-city who frequently visited the organized retail outlets were adequate goods availability, store's accessibility, customer service and provision of membership and coupons.

The customers ranked their satisfaction with these aspects on a 5 point likert scale ranging from Strongly Agree (5) to Strongly Disagree (1).

1) Assessing the goods availability at the stores.

	Frequency	Valid % age	Cumulative %age
Strongly agree	55	27.5%	27.5%
Agree	47	23.5%	51%
Neither agree nor disagree	25	12.5%	63.5%
Disagree	69	34.5%	98%
Strongly disagree	4	2%	100%
Grand Total	200	100%	

Source: Primary data collected by Researcher

The availability of goods and the choices available as desired is a crucial criteria in customer satisfaction. Customers must feel that they have adequate choices and the product will be available without delay and be delivered on time as promised (Coughlan, et al, 2001). The immediacy and vast scale of organized retail stores such as Reliance Megamart, Big Bazaar, Best price and Metro is one of the biggest attractions of these stores. The results showed that customers were overall satisfied with the goods availability wherein 27.5% of the customers strongly agreed that there were adequate goods available in the store and 23.5% percent agreed to this statement. 34,5% customers felt that the store did have adequate goods and choices available and only 2% strongly disagreed that there were adequate goods available. 12.5% were non-committal in their response. The response to this statement indicates that majority of customers are satisfied with this parameter.

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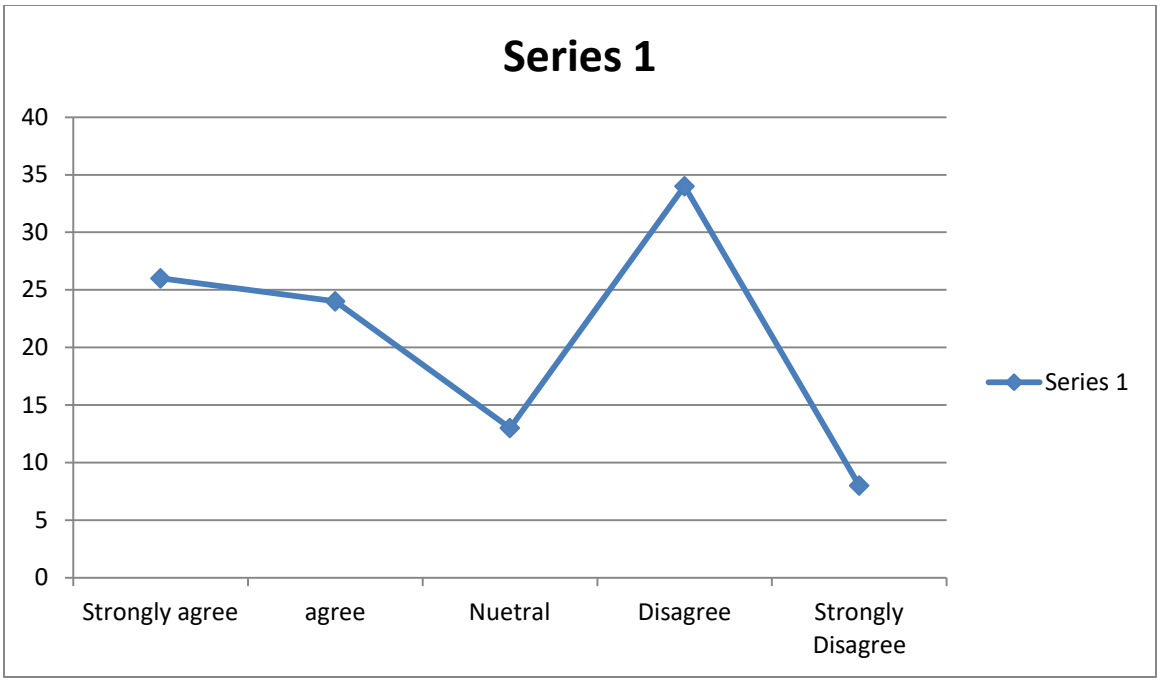

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Goods Availability	200	3.400	1.2681	.0897

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Goods Availability	4.461	199	.000	.4000	.223	.577

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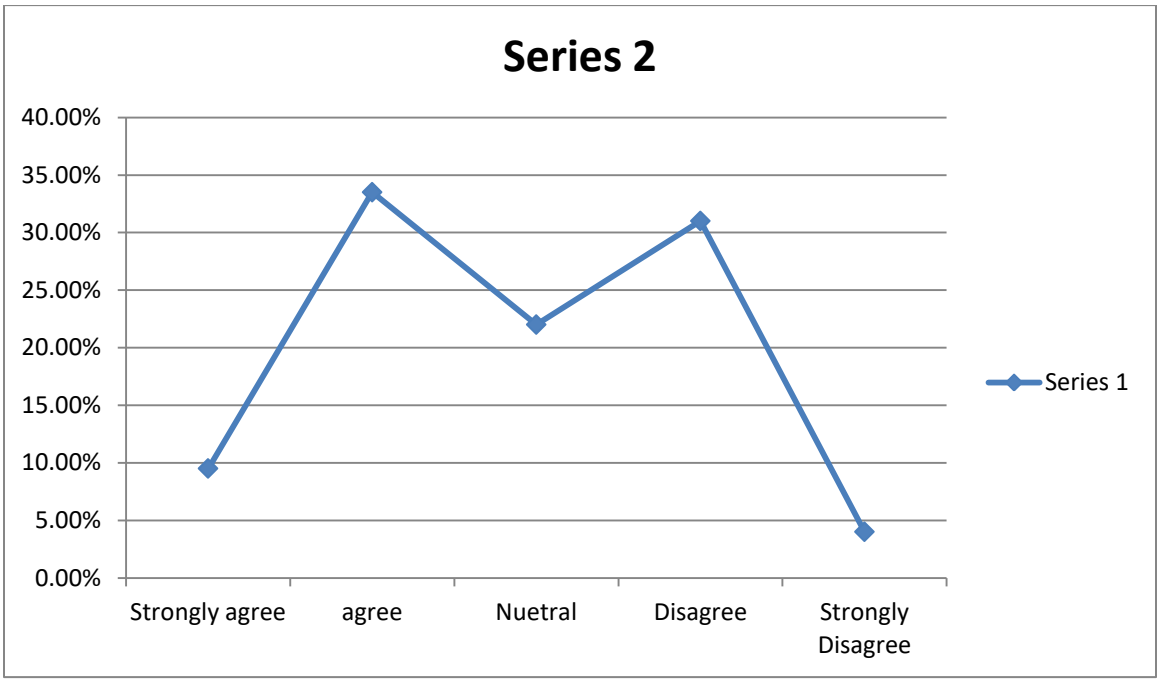
The t value came out to be 4.461which is statistically significant at .05 level of significance. Thus the null hypothesis stands rejected and we can conclude that consumers are satisfied about the adequate availability of the goods at the retail stores. The mean score is 3.4 shows a higher level of satisfaction.

2) Assessing the store's approachability and accessibility

	Frequency	Valid % age	Cumulative %age
Strongly agree	19	9.5%	9.5%
Agree	67	33.5%	43%
Neither agree nor disagree	44	22%	65%
Disagree	62	31%	96%
Strongly disagree	8	4%	100
Grand Total	200	100	

Source: Primary data collected by Researcher

At a time when the increasing traffic snarls make even grocery shopping and parking a hassle, the approach road and ease of access of a retail destination can make or break the customer satisfaction response (Dabas, Sternquist & Mahi, 2012). In response to the statement that the store is easily available and accessible, only 9.5% customers agreed strongly. 33.5% agreed and 22% were non-committal in their response, 35% customers were of the view that the approach was difficult and store was not accessible (with 31% of customers disagreed and 4% strongly disagreed). This means that these customers would have switched to another retail store in the proximity that might be more easily accessible and approachable (Radhakrishnan 2003). However, on the whole, the customers seem to be satisfied with the approach and accessibility of the stores.



One-Sample Statistics

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	N	Mean	Std. Deviation	Std. Error Mean
Store Accessibility	200	3.135	1.0829	.0766

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Store Accessibility	1.763	199	.079	.1350	-.016	.286

The t value came out to be 1.763 which is statistically insignificant at .05 level of significance. Thus the null hypothesis stands rejected and we can conclude that the consumers are satisfied with respect to accessibility of retail stores. However, there is scope for improvement on this parameter..

3) Assessing the prompt customer services of the store

	Frequency	Valid % age	Cumulative %age
Strongly agree	16	8%	8%
Agree	69	34.5%	42.5%
Neither agree nor disagree	47	23.5%	66%
Disagree	61	30.5%	96.5%
Strongly disagree	7	3.5%	100%
Grand Total	200	100	

Source: Primary data collected by Researcher

Many customer satisfaction studies attest that the emphasis on Prompt customer services is a key denominator in the success of any retail enterprise (Gupta, Chaturvedi, 2008). Service is a very critical component, especially in the Indian retail market (Sharma, 2000). In the context of the present study, it was analyzed by the responses of the respondents that on this statement that the store provides prompt services, the customers were largely satisfied. 4% of the customer strongly agreed with the statement and another 34.5% agreed, which means that a cumulative of 42.5% was satisfied with the service provided. 23.5% neither agreed nor disagreed. 30.5% disagreed that the services were prompt and 3.5% of the customers strongly disagreed with the statement. The graphical depiction of the results is as follows

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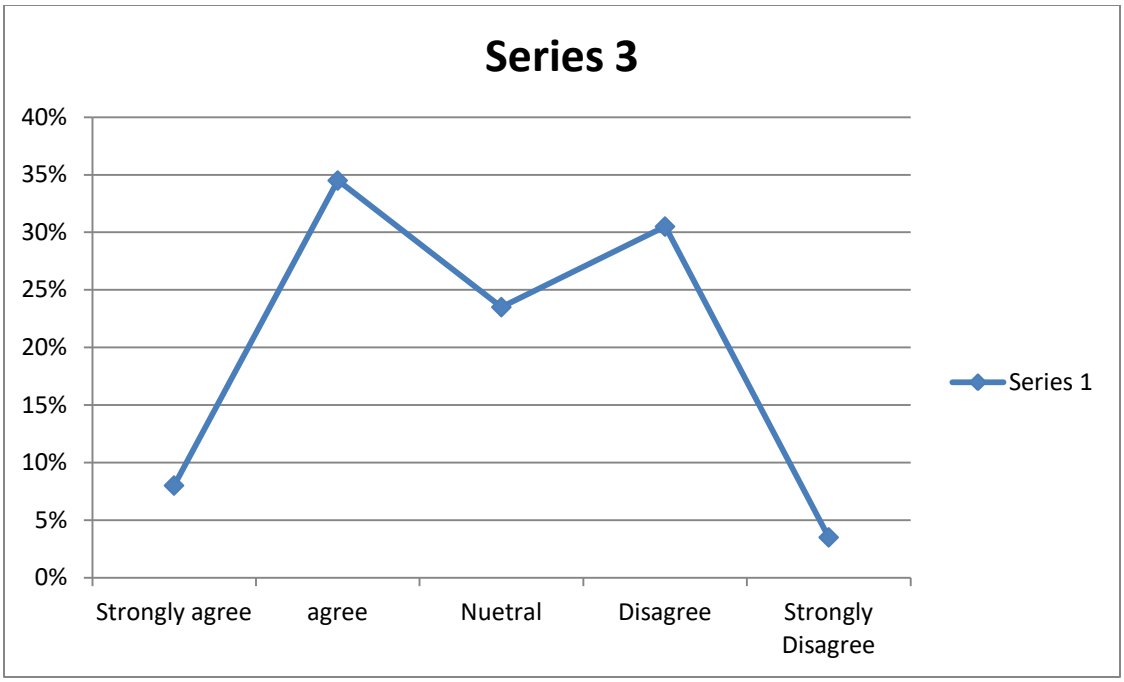

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Consumer Service	200	3.130	1.0481	.0741

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Consumer Service	1.754	199	.081	.1300	-.016	.276

The t value came out to be 1.754 which is statistically insignificant at .05 level of significance. Thus the null hypothesis stands rejected and we can conclude that consumers are satisfied about the level of consumer services offered by the stores.

4) Assessing provision of coupons and membership cards by the store.

	Frequency	Valid %age	Cumulative %age
Strongly agree	81	40.5%	40.5%

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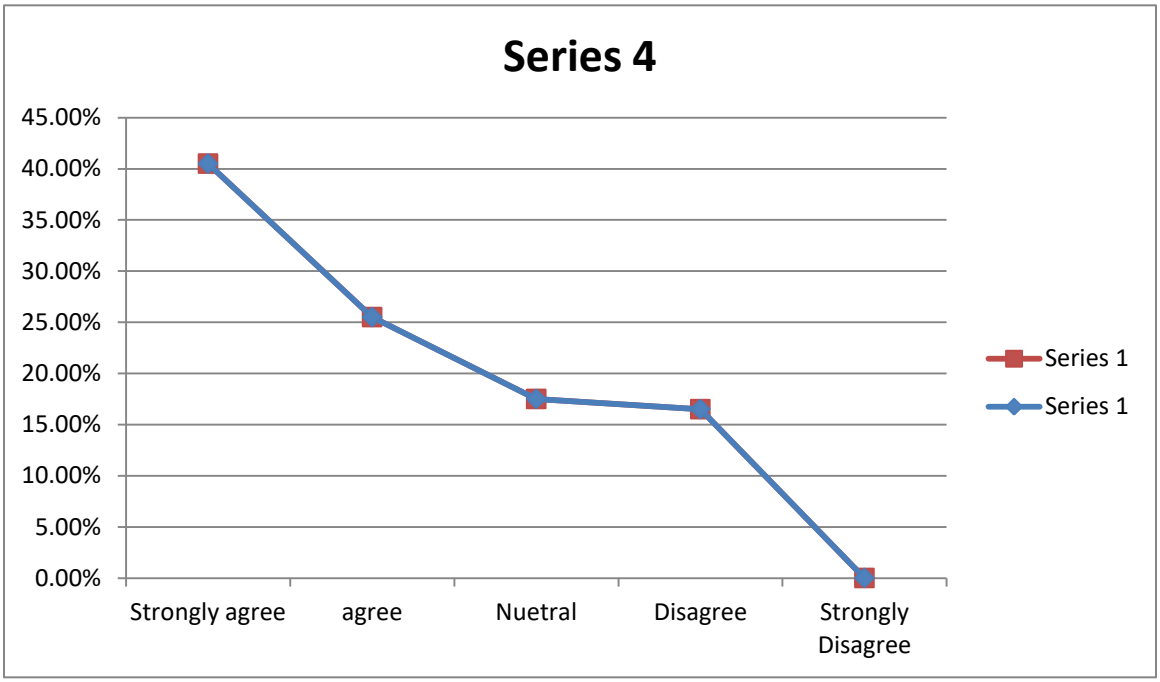
Agree	51	25.5%	66%
Neither agree nor disagree	35	17.5%	83.5%
Disagree	33	16.5%	100%
Strongly disagree	0	0%	100%
Grand Total	200	100	

Source: Primary data collected by Researcher

A definite advantage that organized retail has is that the bigger retail stores offer many advantages that also work to retain customers and attract new ones (Ganguli and Kumar, 2008). One of these is the coupons or member shop systems wherein the customer is rewarded every time he buys from the store and builds up a bank of rewards in terms of points which can be redeemed at a future date. In this way, the organized retail is able to retain more and more clients and ensure that they keep coming back multiple times for more goods (Aggarwal, 2000). In this respect, when asked to respond to the statement that the Store provides various coupons and membership cards, 40.5% of the respondents strongly agreed. Another 25.5% agreed while 17.5% remained neutral. Here 33% were in disagreement with the statement, while none strongly disagreed. Hence overall, the satisfaction levels seem to be high for this parametre amongst the residents of the Tricity.



One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Cards and Coupons	200	3.900	1.1118	.0786

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One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Cards and Coupons	11.448	199	.000	.9000	.745	1.055

The t value came out to be 11.448 which is statistically significant. The null hypothesis stands rejected. The observed value of mean came out to be 3.9 which show that the overall the consumers of Tri-city are very satisfied with the kind of coupons and other cards etc provided to the consumers.

Understanding the overall level of Customer satisfaction

Causal Relationship to be tested with four independent variables namely Availability of Goods, Store's accessibility, Consumer Service and Store incentives like coupon and cards.

H0: Customers are not satisfied with the organized retail stores in the tri-city.
HA: Customers are satisfied with the organized retail stores in the tri-city.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Customer Satisfaction	200	3.260	1.0235	.0724

One-Sample Test

	Test Value = 3					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Customer Satisfaction	3.592	199	.000	.2600	.117	.403

The mean value for overall customer satisfaction came out to be **3.260.** The t value for it was 3.592 which is statistically significant at .05 level of significance. We can conclude that the satisfaction is slightly above the satisfactory stance towards the positive side with a scope for improvement.

Modern organized retail has certainly induced a dynamic new approach to the retail scenario. This has been achieved by opening much more convenient, well stocked, attractively showcased and merchandised and superior

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shopping experiences that have lured the consumer from the traditional retail formats which have held sway till now. By opening new format stores that offer convenient, bigger, better and superior shopping experience which is gradually changing the consumer preferences for grocery shopping in local *kirana* stores to organized convenience stores. It is also identified that the factors that influence consumers' preference for supermarkets are add-on benefits, general services and variety in merchandise.

Conclusion

Traditionally, customer satisfaction has been the long cherished and primary goal of all retail businesses. This especially holds true even today where there are numerous retail avenues and novel strategies and schemes competing vigorously not only for the attention, but also for the loyalty and long term engagement of every client.

The interpretation of the data collected shows that the majority of the customers in the Tri-city are quite satisfied with the level of service and kind of products and goods that are offered by the retail organizations operative here. The organized retail brands are some of the biggest in the business, and the level of customer satisfaction was found to be high. When the data was statistically tested, the analysis and interpretation of the data was found to be satisfactory.

The overall level of the customer satisfaction on the basis of the statements in the Tri-city were quite positive which indicates that people as a whole are quite satisfied and happy with the level of goods and services that are offered by the organized retail stores. On the statement that the goods were adequate, the retail store was easily approachable, there was good customer service provided and that the stores provided enough cards and coupons, the majority expressed their satisfaction.

On the premise that there was adequate goods available in the stores, the response was largely satisfactory, while the question of if the approach and accessibility of the store was fine, was found to elicit satisfactory response, with scope for improvement. The prompt and good service was also statistically proved, which means that there is a lot of scope for the organized retail stores to improve on this premise. To the last indice of whether the customers were satisfied with the coupons and cards which were provided by the stores, the response was largely satisfactory again. All four factors were found to play a major role in the overall customer satisfaction.

The two variables which proved to be the most significant in the statistical co-relation of the four indices to the calculation of the overall satisfaction scores were the adequate availability of the goods and the store accessibility.

Based on the results, it can be suggested that the retail organizations will do well to focus more on these two vital parameters. Overall, the statistical average of 3.260 above the mean of 3 indicates above non committal stance which means that the consumers are moderately satisfied overall. Since the response is non committal on two indices, which are approach and accessibility and prompt service. This means that with an improvement in these indices, the overall satisfaction score of the Tri-city consumers can be significantly increased.

The study clearly proves that retail stores of Tri-city have been able to generate a very positive response amongst its customers. However, there is always a lot of scope for improvement to satisfy the customers fully. There is also a word of caution for the traditional retails formats. In the face of increasing competition from other shopping formats such as online shopping platforms, it is very vital for the traditional retail setups to realize the critical position they are in. The brands need to work tirelessly to maintain and improve their rankings on the customer service indices in order to be able to not only attract new customers but also keep the old customers loyal and coming back. (Sinha, Bannerjee, Uniyal, 2002).

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The appropriateness of the sales and marketing decisions, identification of the real needs of the clients, timely corrective actions and responsive and flexible sales strategies depends on reliable collection and analysis of customer data (Venugopal,2001). As the customer becomes increasingly the central focus than ever before, customer satisfaction can make or break any retail business that will thrive has already realized this fact. The Organized Retail outlets in the Tri-city can derive important learning and insight from such studies and develop more effective and profitable strategies to ensure improvement in consumer satisfaction indices for the future.

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Occupational Stress in Himachal Pradesh Police Constabulary

Shyam L. Kaushal* **and Stuti Jalan****

ABSTRACT

Constabulary forms the foundation of the police organization in India. They are also known as field personnel who act as the facilitators of all the directions issued by the decision-makers at the ground level. Various researches have acknowledged that policing is a stressful occupation. Owing to differing work patterns of each rank, the stressors can be different for the constabulary. The study aims to investigate the level of stress and stressors in Himachal Pradesh police constabulary in general and demographic analysis in particular. The results revealed that the constabulary is facing a high level of stress. It was also found that males, married, postgraduates, younger age groups and those with less experience were more stressed. To manage stress, it has been suggested to ensure effective workforce planning, implementation of the shift system, recruiting personnel as per the sanctioned strength, outsourcing non-core activities and organizing need-based training.

KEYWORDS: Constabulary, Police Constables, Stress, Occupational Stress, Stressors, India

Introduction

Indian police organization has a structure analogous to a pyramid, wherein the constabulary forms the base of it. The constabulary, also known as the lower subordinates includes the officers in the position of Constables and Head Constables. The total strength of police in our country is approximately 20, 67, 270. Out of this, the constabulary accounts for a total population of 17, 45,136. This means that the constabulary (Head constables and constables) comprises of about 84% of the state police force (BPR&D, 2019). Constables are also known as field personnel; working on the ground level and assisting their supervisors. Constabulary is usually the first point of contact between the department and the general public. Head Constables have three primary roles -police station duty, maintaining records at the police station and in charge of outposts. Constables are involved in assistance, surveillance, escorting and performing tasks assigned to them. The constables are recruited directly subject to the eligibility criteria laid down by their respective states. In the case of Himachal Pradesh, the eligibility is between 18-23 years, with a height of 5'6" and chest between 31-32 inches. The

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Focus

Women Empowerment through Self Help Groups in HP: An Analysis

SHYAM L. KAUSHAL AND NIVEDITA SHARMA

Women empowerment is a buzzword around the globe including India. Here, many initiatives are taken for this purpose and among those, Self Help Groups (SHGs) have emerged as one of the important options. Basically, empowerment refers to social and political succession that is dependent on economic empowerment. It consists of income and livelihood on one side, and freedom to spend income and control over resources on the other. Review of literature witnessed that education, access to resources, nutritional food, health care facilities, decision-making power and self-employment are the basic tenets and the Self Help Group movement paved the way to empower women in India. Further, the studies show direct relationship between growth of SHGs and women empowerment. But women empowerment in a patriarchal society remains a critical challenge in reality, and time to time attracts academicians and policy makers to debate the issue. The present paper is an endeavour to study the women empowerment through SHGs by examining its growth pattern in HP. The data and information were collected from primary and secondary sources like books, magazines, journals, newspapers, websites and MIS/offices circulars etc. The collected data was analysed with suitable statistical tools.

From the data analysis, it is concluded that SHGs are spreading throughout the country including HP but their formation and growth prototype is uneven. However, upward trend clearly hint that SHGs are helping significantly in financial inclusion of poor women. In consequence to their association with SHG movement, women have started saving small amounts of money for their future needs, linked themselves with formal banking system and availed micro credit on easy terms. Thus, it demonstrates that SHGs are not only solving their routine problems but also improving their decision-making and risk-taking habits. However, its growth pattern was not same in all areas in the country. In the same vein, in Himachal Pradesh where 33 per cent SHGs were formed in two districts of the state could be a pointer to prevalent irritants and bottlenecks in other regions. However, the fact is that need-based training capsules and access to economic resources at affordable rates motivate women to start new economic units collectively under the ownership of SHGs, which improved their confidence levels, moral strengths, leadership qualities, managerial and entrepreneurial skills and decision-making skills. Yet, a need has been felt to educate women about government policies, training programmes, banking system and interest rates for attaining real objectives of SHGs and consequently achieving the cherished goal of women empowerment in reality. But from the analysis, it can be concluded that women have diversified their sources of income by looking beyond agricultural activities and became financially independent on one side, and paved way to their social and political advancement.

Introduction

Women comprise almost half of the Indian population. After independence, socio-economic role of women have changed a lot but still needs to achieve equality. With the changing scenario, the Government of India has changed its focus from welfare to development and now to empowerment of women. Similarly, the government had declared 2001 as year of Women Empowerment[1]. According to Oxford dictionary, empower means to give authority to someone or to give power to someone. The World Bank defines empowerment as "the process of increasing the capacity of individuals or groups, to make choices and to transform those choices into desired actions and outcomes. Central to this process are actions which both build individual and collective assets and improve the

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WORK LIFE BALANCE IN PRIVATE EDUCATION SECTOR UNDER COVID-19: A STUDY ON WORKING FROM HOME WOMEN IN HIMACHAL PRADESH

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ABSTRACT

Working women significantly contributes to the growth of the economy of the Nation. Women as teachers not only impart knowledge but are also epitome of empathy and morals to the youths who are the future Nation builders. Their health and well being is of utmost importance, especially during the time of 'new normal' of work. Work from home or remote working has questioned various parameters of work life balance and well being of working women who are facing the brunt of both paid work and household and family responsibilities. This study analyses the Stress and its impact on Work Life Balance of 200 women teachers in the private education sector while working from home. It was found that Work Life Balance of women teachers is significantly predicted by paid work related stress and household & family responsibilities related stress.

KEYWORDS: *Work Life Balance, Stress, Work from Home, Covid-19, Women Teachers, Private Education Sector.*

1. INTRODUCTION

Work-life balance is a significant dimension of a healthy work environment at work. Attaining work-life balance helps overcome stress and hence prevents the situation of burnout at the workplace. The chronic stress impacts mental health negatively as it is linked to a higher risk of depression, anxiety and insomnia irrespective of any gender and geographical considerations. The term WLB (work-life balance) describes the state of equilibrium where a person equally prioritizes the demands of one's career and the demands of one's personal life (Schwartz et al., 2018).The previous studies witness some of the common reasons that lead to a poor work-life balance which are increased responsibilities and long working hours. Moreover the circumstances like COVID-19 pandemic have added to many miseries of employees especially working women.

Work Life Balance has always been a problem for women ever since they have moved out of their homes for paid work. But unpaid work, which they perform at home, apparently has not

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A STUDY ON FINANCIAL PLANNING AMONG WORKING WOMEN IN THE EDUCATION SECTOR

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Abstract

Personal financial planning is essential for the financial well-being of both men and women. Personal financial planning is attributed to differences in skills, knowledge, attitude, approaches, as well as opportunities presented. Various studies have established beyond any measure of doubt that women's participation in financial planning is very low. In comparison to men, women have to take breaks from their work due to marriage, childbirth, childcare, and elderly care at home. This interruption in their career leads to less earning and less saving opportunities for women as compared to men. Sometimes, women have to permanently leave their jobs due to family responsibilities. The life expectancy of women is more as compared to men and they thus need mandatory financial planning for their financial well-being and retirement. Also, women earn less and get fewer opportunities to get financial awareness which is a very important aspect of financial planning. Many initiatives are taken by the government to improve financial awareness among women in our country but the level of financial awareness is still alarmingly low. There is a need to make women financially independent and at the same time making them financially literate. This study is an attempt to ascertain the preferences of women working in the education sector of Punjab and Himachal Pradesh states towards financial planning. The financial planning aspects are analysed based on the understanding of financial terms, financial planning, tax

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management, liability management, insurance, retirement planning, and estate planning. The results of the study indicate that women are not participating actively in personal financial planning and a majority of them have little to no knowledge about financial aspects. There is a need to encourage working women towards participation in financial planning for their secure future.

Keywords: *Financial Planning Perception, Investment Preferences, Working Women Financial Planning,*

1. Introduction

Financial planning is a process of assessing the short- term and long-term financial goals of the client arising at different stages of life based on the client's income, savings and investments to achieve the financial goals (Sinha, 2008). It can also be understood as deciding what investments and activities would be most suitable under both personal and broader economic circumstances to achieve financial goals. Financial planning can be short-term and long-term. Short-term financial planning is less uncertain than long-term financial planning because of an increased uncertainty because of changing socio-economic scenario. Women are good at household budgets and money management, while men are good at making long-term investment decisions (Hung, et al., 2012). In a study conducted by a large fund house, around 77 percent of working or earning women in India were found to be dependent on their father, spouse, or other male members in the family to make investment decisions for them. Out of the remaining 23 percent working women, 18 percent were single working women. Financial or investment-related decisions in our country are generally informed to women without considering their opinions. The primary reason behind women not taking investment or financial decisions is that women are risk-averse and are thereby reluctant to take any risk. Systematic saving comes naturally to women and is very much helpful in planned investments. Many studies show that majority of the women don't

start savings early on in their careers or life and don't have proper retirement plans (Andrade, 2016). Women generally have low financial awareness and possess a low confidence when it comes to making financial decisions themselves. This scenario is also prevalent among working women who are earning and still reluctant to take financial decisions independently. In this study, working or earning women are considered for understanding their financial behaviour and factors affecting their financial planning.

2. Literature Review

Women generally have low confidence and are less inclined to learn about personal financial planning (Chen & Volpe, 2002). Women are less financially literate and less involved in retirement planning. Thus, there is a need to improve financial literacy level among women (Lusardi & Mitchell, 2005). Financial knowledge and financial planning are closely related. Women who possess higher financial literacy are more likely to successfully plan their retirement (Lusardi & Mitchell, 2008). Women are to a great extent lacking when it comes to retirement planning and are less active in financial matters as compared to males. Workshops and seminars are required to improve money-related knowledge among women (Klatt, 2009). Women need to be more confident and educated to achieve financial independence (Malhotra & Witt, 2010). Individuals who are more financially literate focus more on personal financial planning to avoid the adverse impact that poor personal financial planning might have on their life (Boon, et al., 2011). Women are good at household money management but lacking in critical areas of financial planning and investments. Effective education programs and the development of high-level policies are the need of the hour (Hung, et al., 2012). Women are conservative while taking financial decisions. There is a need to develop investment instruments that suit the risk-taking characteristics of women (Bhushan & Medury, 2013). There is a need to improve the financial literacy level among people and the focus should be on developing a positive financial behaviour and attitude

towards investments (Bhushan & Medury, 2014). Basic financial knowledge is essential for every woman. Apart from this, its application needs to be understood as well as practiced by them. The government should empower women and women need to continuously try to improve their financial well-being for a better future (Mishra, 2015). Women are conservative and prefer traditional investment modes such as bank deposits, insurance, gold, real estate and don't invest in derivatives, stocks, or mutual funds. There is a need to educate women about financial instruments so that they are able to trade-off between risk and returns (T.S & S, 2015). Women are dependent on their male family members for finance-related matters, which causes and further propagates less awareness among them. The active involvement of government, private sectors as well as employers, in the case of working women, in conducting financial literacy workshops can help spread awareness (Arora, 2016). With the government initiatives towards financial inclusion and financial literacy, there is a need to acknowledge the importance of women's financial literacy separately (Baluja, 2016). There is a need for financial education and customized financial products for women (Saviano, et al., 2017).

3. Research Objectives

- To study the preference towards financial planning among working women in the education sector.
- To analyze the effect of financial literacy level on financial planning among working women in the education sector.

4. Hypothesis:

- **H_{01}:** There is not a significant difference between levels of financial literacy and financial planning among working women in the education sector.

- **H_{02}:** There is not a significant difference between levels of financial literacy and management of taxes among working women in the education sector.
- **H_{03}:** There is not a significant difference between levels of financial literacy and managing liabilities among working women in the education sector.
- **H_{04}:** There is not a significant difference between levels of financial literacy and managing insurance among working women in the education sector.
- **H_{05}:** There is not a significant difference between levels of financial literacy and managing investment among working women in the education sector.
- **H_{06}:** There is not a significant difference between levels of financial literacy and managing retirement among working women in the education sector.
- **H_{07}:** There is not a significant difference between levels of financial literacy and estate planning among working women in the education sector.

5. Research Methodology

Working women in the education sector from Punjab and Himachal Pradesh are considered for this research study. The data has been collected through primary and secondary sources. For primary data, a close-ended structured questionnaire is used for the survey comprising closed-ended questions, attitude rating questions, and financial knowledge testing questions. To measure the women's financial literacy level, the financial literacy scale developed by Lusardi and Mitchell (2007) has been used. Based on the financial literacy scores, the women respondents were grouped into three categories namely High financial literacy, Medium financial literacy, and Low financial literacy. The maximum possible score for financial literacy was 10 (5 for basic financial literacy and 5 for advanced financial literacy). Preference towards financial planning is measured using

5 points Likert scale divided into 7 components of financial planning. The study employed the non-random convenience sampling method for data collection of 135 working women of the education sector from Punjab and Himachal Pradesh. The primary data has been analyzed using statistical tools like percentages, bar charts, quartile, and mean scores. The hypothesis has been formulated and tested at a 5% significance level and conclusions are then drawn.

6. Data Analysis and Results:

6.1 Demographic Detail: The demographic profile of working women respondents is shown below in Table 1.

Table 1: Demographic Detail of Women Respondents

Variable	Category	Frequency	%	Variable	Category	Frequency	%
Organizational Type	Public	41	30%	Educational Qualification	Graduate	46	34%
	Private	94	70%		Post Graduate	82	61%
Place	Punjab	77	57%				
	Himachal Pradesh	58	43%		Doctorate	3	2%
					Others	4	3%
Marital Status	Married	65	48%	Monthly Personal Income	Less than Rs.25,000	72	53%
	Single	68	50%		Rs.25,000 to less than Rs.50,000	35	26%
	Others	2	1%				
Employment Status	Contractual	58	43%		Rs.50,000 to less than Rs.75,000	14	10%
	Permanent	77	57%		Rs.75,000 or more	14	10%
Age	21 -30 Years	85	63%				
	30-40 Years	41	30%				
	More than 50 years	9	7%				

The demographic profile shows that a majority of women in the education sector are working in private institutes (70%) and a few have government

jobs (30%). A majority of the respondents are young (63%) and a few are above 50 years of age (30%). Also, most of the women respondents are post-graduate (61%) and a few (2%) have done a doctorate (Ph.D.). Earning status is not good as around half o the respondents, about 53% of them earn less than 25000 per month, followed by 26% respondents earning between 25000 to 50000, while 10% respondents earning between 50000 to 75000 and more than 75000 per month each. The marital status shows that 50% respondents were single, 48% were married and the remaining 2% respondents were either divorced, separated, or widow. Overall, a majority of the working women employed in the education sector who participated in the study work are young, working in private institutes, and earning less than 25000 monthly.

6.2 Perception of Personal Financial Planning: The perception of personal financial planning among working women of the sampling area for the study is shown in Table 2.

Table 2: Perception of Personal Financial Planning Among Working Women in the Education Sector

Component	Subject	Mean score
Financial Planning	Understanding of financial planning.	3.37
	Set financial goals and objectives for life	3.42
	Gather data and analyze current financial position before making a financial decision	3.51
	Execute the financial plan with the help of experts	3.05
	Review the financial plan periodically after the implementation.	3.3
Managing Taxes	Utilize the various tax relieves and rebate entitled to while filing the tax return.	3.31
	Happy to pay tax as the amount is very minimal as compared to others.	3.29
	Manage their taxes.	3.19

Managing Liabilities	Pay off the full credit card outstanding amount every month.	3.39
	Interest charged by financial institutions on credit card outstanding amount is reasonable.	2.85
	Pay mortgage and hire purchase instalments on time every month.	3.44
	Personal loans offered by financial institutions are a convenient tool to use and to borrow.	2.9
Managing Insurance	Have sufficient insurance coverage in the event of death, disability, or sickness	3.02
	Have only life insurance, no other type of insurance	2.73
	Can distinguish the different types of insurance policies offer in the market.	3.28
	Do not have any insurance.	2.34
Managing Investment	Invest money based on the opinions of others.	2.7
	Understand my risk profile- high-risk taker, medium risk-taker, or the low-risk taker.	3.34
	Invest in different investment instruments	2.68
	Appreciate the interest compounding effect	3.16
	If given a lump sum of money, know how to use it properly	3.29
Managing Retirement	Know the amount needed to fund a comfortable retirement.	3
	Have started planning for retirement.	2.9
	Have a formal retirement plan that was developed in consultation with a financial professional	2.6
	Employee Provident Fund contributions are sufficient for retirement.	2.67

Estate Planning	Have a will.	2.46
	Understand what trust is.	2.99
	Estate planning is important	3.1
	Estate planning leave the peace of mind	3.12

Note: "1" = Strongly agree; "2" = Agree; "3" = Neutral; "4" = Disagree; "5" = Strongly disagree

The perception towards financial planning among working women in education sector is measured using 5 points Likert scale divided into 7 components of financial planning. Respondents with mean score less than 3 are considered as having low preference towards financial planning and those with more than median score are considered as having high preference towards financial planning. Respondents with a mean score of 3.37 are considered aware of financial planning and the ones with a mean score of 3.42 have set financial goals for life. The ones with a mean score of 3.19 are considered to be able to manage taxes. With a mean score of 3.39, respondents are paying credit cards outstanding on time and with a mean score of 3.44, they pay other instalments on time. Respondents with a mean score of 3.02 are carrying insurance for the coverage of events like sickness, disability, and death and with a mean score of 3.16, they appreciate interest compounding effect. Responders, with a mean score of 3, are aware of the amount needed for retirement but a fewer number of respondents have started retirement planning with a mean score of 2.9 and few have retirement planning after consultation with financial professionals with a mean score of 2.6. Respondents are also aware that estate planning is important (mean score of 3.1) and few have a will (mean score of 2.46). The mean score of working women respondents shows that they have an understanding of financial planning and have financial goals. They are able to manage liabilities and investments but only a few of women respondents have formal retirement plans.

6.3 Relationship between Women's Financial Literacy and Personal Financial Planning:

The relationship between financial literacy and personal financial planning among working women in the sampling area of the study is shown below in Table 3.

Table 3: Financial Literacy Effect on Personal Financial Planning

Components of Personal Financial Planning		High Financial Literacy	Medium Financial Literacy	Low Financial Literacy	F Value	Significance
Financial Planning	Mean	3.84	3.1094	3.027	11.14	0.000
	N	45	53	37		
	Std. Dev.	0.56825	1.08809	0.89711		
Managing Taxes	Mean	3.7704	3.0126	3	10.117	0.000
	N	45	53	37		
	Std. Dev.	0.67353	1.09185	0.94281		
Managing Liabilities	Mean	3.6444	2.9057	2.8851	11.099	0.000
	N	45	53	37		
	Std. Dev.	0.81445	0.98086	0.75368		
Managing Insurance	Mean	3.4222	2.9057	2.7514	7.468	0.001
	N	45	53	37		
	Std. Dev.	0.56604	0.98262	0.90481		
Managing Investment	Mean	3.1833	2.7075	2.6216	6.539	0.002
	N	45	53	37		
	Std. Dev.	0.63827	0.86705	0.81142		
Managing Retirement	Mean	2.8611	2.8208	2.6689	0.515	0.599
	N	45	53	37		
	Std. Dev.	0.73962	0.93333	0.99487		
Estate Planning	Mean	3.1833	2.8208	2.7365	3.092	0.049
	N	45	53	37		
	Std. Dev.	0.69167	1.03934	0.86792		

Firstly the women respondents were categorized into low, medium, and high literacy levels based on their financial literacy scores and quartiles. Women who scored more than 7 out of 10 are categorized under high financial literacy. The ones scoring between 4-6 are categorized under medium and those who scored 3 or less than 3 are categorized into low financial literacy. To test the hypothesis of whether the survey results are

significant or not, the ANOVA test was applied with a 5% significance level ($p<0.005$). The results are as follows:

H_{01}: There is a significant difference between levels of financial literacy and financial planning among working women in the education sector.

H_{02}: There is a significant difference between levels of financial literacy and management of taxes among working women in the education sector.

H_{03}: There is a significant difference between levels of financial literacy and managing liabilities among working women in the education sector.

H_{04}: There is a significant difference between levels of financial literacy and managing insurance among working women in the education sector.

H_{05}: There is a significant difference between levels of financial literacy and managing investment among working women in the education sector.

H_{06}: There is not a significant difference between levels of financial literacy and managing retirement among working women in the education sector.

H_{07}: There is a significant difference between levels of financial literacy and estate planning among working women in the education sector.

7. Findings and Suggestions

The study has found that financial planning is perceived as important among working women in the education sector of Punjab and Himachal Pradesh. It was found that while women are educated, the financial literacy level is not high among the majority of the women working in the education sector of these states. It was also found that working women with high literacy levels actively participate in financial planning and have a formal financial plan for long-term goals like marriage, child education, and

retirement. Women with low financial literacy are on the other hand found to be less active in financial planning activities and do not have any formal financial plan. The results of hypothesis testing and ANOVA test bring forth a positive relationship between financial literacy and financial planning. Based on these results, it is concluded that financial literacy has a significant effect on financial planning among women. Thus, by improving the financial literacy levels among women, their financial participation can be improved. Considering the importance of financial literacy and financial planning, it is suggested that the government should step forward to improve the financial literacy level among women. There is an evident need for formal training and refresher programs to enhance financial literacy and personal financial planning among working women in the education sector.

8. Discussion

In the current study, close-ended structured questionnaire was used to collect the primary data from the working women of Punjab and Himachal Pradesh. By arguing that financial literacy level doesn't affect women's participation in financial planning, a structured questionnaire was designed to know the financial literacy level, the effect of financial literacy, and financial participation among working women. The results of the study indicate that women have basic financial knowledge but do not possess sound advance financial literacy. Nonetheless, the results agree with the argument from the existing literature that women possessing high financial literacy tend to participate in financial planning (Lusardi & Mitchell, 2008); (Sinha, 2008); (Sykes, et al., 2005); (Hung, et al., 2012) ; (Roy & Jain, 2018). While distinguishing the working women's financial planning based on their financial literacy level, the results of the study suggest that financial literacy level directly affects the preference towards financial planning. Our results contradict the existing research (JULIA, 1998); (Sykes, et al., 2005) which suggests that there are other factors such as social, cultural, and emotional factors that affect financial planning among women. Our observations signify the need for financial education programs and training

for women for their secure future from a financial standpoint. Government and organizations should also initiate for creating awareness (Malhotra & Witt, 2010); (Bhushan & Medury, 2013); (Mishra, 2015); (Baluja, 2016) ; (Saviano, et al., 2017). The study has used a close-ended structured questionnaire and the possibility of misinterpretations of the survey questions. Also, there are chances of biased responses from the respondents.

9. Conclusion

The level of education plays an important role in financial planning and decision making. The study shows that women with high financial literacy are more focused on personal financial planning in comparison to those who have less financial knowledge. Income also plays an important role in financial planning. The study shows that women with higher income levels are also actively focused on personal financial planning than women who earn less. Literature reviews on women's financial literacy and financial planning also indicate that there is a need to enhance the financial literacy among women for the improvement of their financial planning participation. There is a need for active, rigorous and continuous initiations from the government and other institutions towards the conduction of workshops and seminars on women financial literacy and financial planning participation. This goes on to confirm that financial literacy is a useful indicator of an individual’s financial planning decision. When effective financial planning becomes widespread among women, women will be more independent and empowered, thereby stimulating economic growth.

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ABSTRACT

The financial well-being of women is dependent on their financial planning. Many studies have confirmed that the participation of women in financial planning is very low. Women have been known to take more breaks as compared to men to marry, childbearing, and care as well as elderly care in the family. As a result of this sabbatical or interruption in their career, women earn comparatively less to men and hence have fewer opportunities to save. Oftentimes, owing to obligations in the family or responsibilities in the family, women leave their jobs permanently. Women have a higher life expectancy in comparison to men and hence the need for financial planning among women is more urgent to ensure financial well-being and stress-free retired life. With fewer opportunities for financial awareness and lesser earnings, women currently lag concerning financial planning. Despite numerous initiatives undertaken by the government both at the state and national level to better the financial awareness among women, it continues to stay alarmingly low. There is an increasing urgency in making women financially literate and economically independent today. This research paper is an endeavor to determine the level of financial literacy in women from various professions and walks of life encompassing privately employed working professionals, entrepreneurs, teaching community, and self-employed women in the Tricity area of Chandigarh, Mohali, and Panchkula. The study attempts to understand the need to improve the financial literacy levels among women, reasons for lack of financial literacy, and also determine the ways to improve the financial literacy levels, both basic and advanced among women. The study highlights that while some women have a basic understanding of financial instruments, they lack knowledge and understanding of advanced investment avenues and products such as mutual funds, shares, and debentures.

KEYWORDS

Financial Literacy, Personal Financial Planning, Women Financial Literacy, Women Financial Planning Participation, Working Women Financial Literacy Level.

INTRODUCTION

The financial well-being of both genders is heavily dependent on personal financial planning.

Knowledge of financial products, attitude towards financial instruments/ approaches, individual skills, and available opportunities/ investment opportunities constitutes personal financial planning. Financial planning is a systematic process of assessing long-term financial goals that arise during life intervals. Financial planning ensures that the investor has a sufficient amount of money at the right time to fulfill his/her long-term goals (Sinha, 2008). Personal financial planning helps in managing major financial planning issues of individuals and families (Billingsley, et al., 2016). Financial planning is important for everyone to have a comfortable life after retirement. Many studies show that women do not actively participate in the financial planning process. The results of a study conducted by a fund house show that around 77 percent of working women in India are dependent on their male family members for making financial investments. The other 23 percent of working women, 18 percent are single. In India majority of the financial decisions are made without considering their opinions. This is because of our social-cultural environment, which is male dominating. Women also do not actively participate in investment decisions as they are risk-averse and are more comfortable in making short-run or household budgets. As per Andrade (2016), the majority of women do not start planning their retirement at an early age and face problems later. The current study is an effort to understand the women's financial literacy level, which is an important factor for financial planning as well as women's participation in the financial planning process.

LITERATURE REVIEW

Women are good at making short-run or household budgets. While men are good at making long-term financial decisions and investments (Hung, et al., 2012). Women live longer as compared to men and have low earnings than men. The majority of women do not plan their retirement successfully. Financial literacy and financial planning are closely related.

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A structured review and theme analysis of financial frauds in the banking industry

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A structured review and theme analysis of financial frauds in the banking industry

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Abstract

Organizations of all types are vulnerable to frauds. Banks contribute to a significant extent in a country's economic development by generating a large part of revenue in the service sector. Deterrence of fraud is impossible without understanding it. The present study attempts to extract themes by highlighting the major areas of the bank fraud literature within a specific time frame of 2000–2019 and finding the research gaps citing the future scope for research. Post the review of existing literature, using thematic analysis, two major themes were observed by the author, namely, "regulatory and compliance"–based studies and studies related to the "socio psychological" aspect of the literature. An examination of themes indicated that the popularity of the research areas shifted from accounting frauds or balance sheet frauds in early 2000s to areas such as cyber frauds and identity theft at the later decade. The present study paves way forward for future research on the bank customer's vigilance, experiences and perspectives on frauds. Other significant areas of research include coping mechanisms with the various challenges faced by banks in marketing themselves after any major fraud occurrence.

Keywords Frauds · Thematic analysis · Banking institutions · Research gaps · Regulatory and compliance · Sociopsychological

Introduction

Financial frauds are at their peak in present times and have come centre-stage on the economic agenda. This is due to outburst of many large value frauds which derailed the

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financial health and reputation of banks and the economy (Gupta and Gupta, 2015). Fraud is defined by Cambridge Dictionary as anything or any act with the intent of deceiving others, by unjustifiably claiming or being credited with accomplishments (Alleyne et al., 2010). Frauds in the banking sector have always been one of the key concerns for the governments all across the globe (Kaveri, 2014). While the banks always try to improve their fraud risk management framework in response to regulatory directives and/or rising incidents of fraud, it is quite evident that there is a dire need to integrate a larger financial crime compliance agenda working across a wider arena (Ghosh & Bagheri, 2006). The thought-provoking questions still remain intact such as are regulators doing enough? Is the internal control framework effective? What are the major challenges faced by the banks to detect and prevent frauds? Are banks aware of the possible new fraud arenas? Do the banks have necessary capability to identify "red flags" proactively? (Khanna & Arora, 2009).

The last decade involved a significant coverage of banking frauds by the global media. While the governments enact several laws aimed at restraining fraud, their meager enforcement has attenuated the intended impact. With the rise of digital transactions backed by technology, frauds have spread to new areas. The banking institutions act as financial intermediaries and providers of capital for major economic activities (Costa and Wood, 2014). Finding modes of preventing and detecting bank frauds is thus vital. The most critical challenge for banks still remain in developing exhaustive fraud risk management controls to prevent and detect frauds (Boateng et al., 2010).

The banking frauds landscape

While some of the risks in the financial sector have existed since inception, they keep changing with the constantly evolving technology standards. The evolution of frauds from Hawala transactions, ponzi schemes, and inadequate due diligence to money laundering, identity theft, and cyber crime have put a serious issue in front of the regulators to tackle financial crimes more diligently than ever. The common types of financial frauds committed are listed below:

1. Money laundering: Addressing the threat of money laundering is a matter of priority for financial institutions on multiple fronts. Money laundering can be defined as a process where the proceeds of crime are transformed into apparently legitimate money or other assets (Swamy, 2011). The complexity of money laundering is the highest in bigger institutions with multiple business lines, areas, and geographies, as they need to comply with multiple legal and regulatory requirements. Though the regulators have tightened controls, still, the banks are facing increased entanglement on customer identification and monitoring programs (Bhasin, 2015).
2. Fraudulent loans and advances: Loans and advances constitute a major proportion of the total bank frauds. Advance-related frauds might occur due to a breach of trust of collusion with internal sources, leading to misuse of financial tools such as Letters of Credit, Bills Discounting, submission of fake documents, mortgaging fake assets. (Reurink, 2018). In such cases of frauds, the internal control systems operating in the banks are of utmost importance.

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3. Bribery and corruption: Several reports over the years are indicative of the growing risks of fraud and corruption in the banking and financial services industry. The primary and biggest challenge is that the bank employees conspire with third parties providing them undue or illegal benefits in exchange of monetary or non monetary bribes (Milan, 2018). It significantly leads to an increase in the risk exposure of the organization's credibility and puts its compliance with rules and regulations at stake.
4. Identity theft: Fraudsters use identity theft to impersonate the identity of a person and commit frauds. The major frauds can be listed as stealing passwords and making payments via the internet, opening a bank account on a person's name, operating someone's account for withdrawing money or buying stuff (Song et al., 2018). This is an extremely dangerous form of fraud which might lead to a person's loss of all her had earned money.
5. Accounting frauds: The type of accounting based frauds may range from overstating sales and income, inflating the worth of the company's assets, to showing false profits. The false data might be used to seek an investment or to make fraudulent loan applications in order to obtain more money to delay the collapse of an unprofitable or mismanaged firm.
6. Phishing and online banking frauds: Phishing can be defined as an attempt to obtain secretive information of individuals with fraudulent motive. The information obtained might be their usernames, passwords, and credit/debit card details by camouflaging as a trustworthy entity on internet. It is largely done by email spoofing directed at the users tricking them to enter their personal information at a fake website impersonating the legitimate site.

According to the PwC, 2014, cybercrime was one of the top economic crimes reported by organizations across the world. In 2019, KPMG conducted a comprehensive survey and published their report on global banking frauds, across 43 retail banks out of which 13 belonged to Asia Pacific region, 5 were American banks, and 25 banks were from European and Middle East and Africa region. Out of the total banks, 18 had revenues of more than US$10 billion, and 31 of the banks gave employment to more than 10,000 people across the globe. The report highlighted that banks globally were experiencing a boost in the number of frauds, and in most of the regions, cyber frauds was found to be most challenging. It was further suggested that since customers were found to be the key in prevention and detection of frauds in their accounts, they must be made more aware and vigilant by giving them necessary education.

Figure 1 shows that cyber-related fraud risks pose the most significant challenge to banks in all the three regions. The digital connection of the top 5 frauds listed in all the regions is quite evident. With a rapid digital transformation in banking operations and service sector all across the globe, designing a comprehensive and sustainable risk management framework is becoming essential more than ever.

This paper explores the phenomenon of fraud in the context of banking operations. Financial fraud has clearly become a widespread obstruction in the growth of the global banking industry. The aftermath of many significant reports published on the banking fraud landscape revealed a great number of scandals. Incidentally, with the clear observance of this trend, the mainstream academic research on financial frauds has largely covered a few major segments of bank frauds. The study describes the empirical

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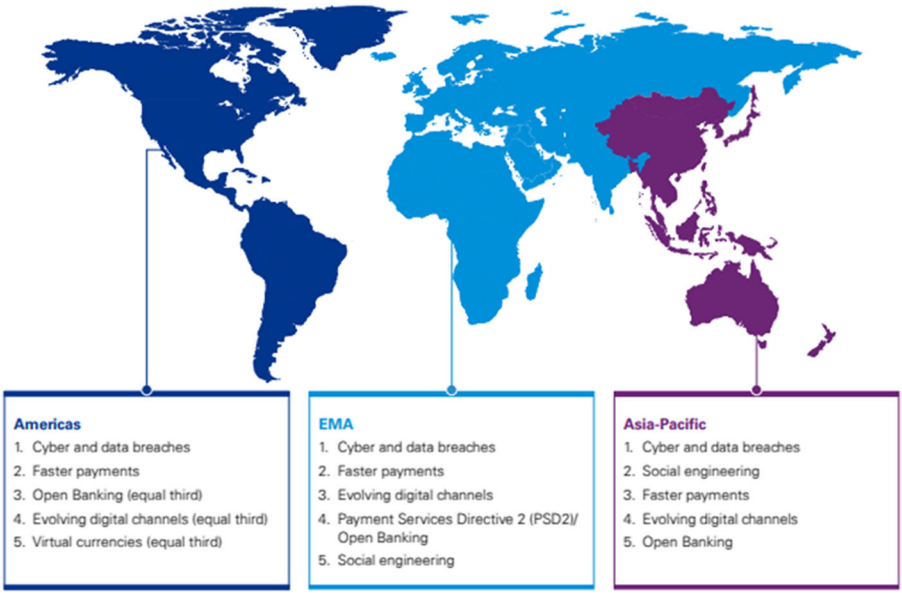

Fig. 1 Region-wise fraud typology trends. Source: Global Banking Fraud Survey, KPMG International, 2019

universe of banking fraud as it has been documented in the literature in a wide variety of disciplines. It attempts to provide a descriptive account of the different forms of fraudulent behavior as identified by previous research.

The literature on bank frauds and fraud detection methods has grown immensely in the past decade. As the volume and scale of frauds became extensive, several researchers began to explore the phenomenon. As stated by Rossouw (2000, p. 885), fraud is a worldwide phenomenon that ruins the profitability, reputability, and legitimacy of organizations wherever it occurs. As the researchers explore different arenas of financial frauds, the fraud theories became more sophisticated which describe fraud and its motivations thoroughly.

Objectives of research

1. To carry a structured review of various researches on the financial frauds in the banking industry
2. To collate and create theme-based parameters to ascertain the types of research undertaken

Research methodology

Thematic synthesis has been explained through three stages by Thomas and Harden (2008). The initial stage involves coding of text from each line. This leads to descriptive themes which are grouping of same types of narratives of ideas. Finally, stage will be the analysis and creation of analytical themes. The study in itself may involve primary or secondary literature. This study has carried out a sequential and thematic study of various issues related to the scope of paper and collated these into themes.

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A systematic literature review–based approach was followed as per the guidelines proposed by Kitchenham (2004). The method includes developing a review protocol to guide in the search and selection of relevant studies. The scope of the review was limited to the time frame of 2000–2019 to provide a fair representation of existing research on banking frauds. Data sources were largely electronic libraries considering the fact that academic literature on bank fraud taken is fairly current and would be expected to have been published digitally. Digital libraries containing scientific, engineering, and technology publications were chosen. Results yielded four electronic databases (1) Proquest, Scopus, and EBSCO.

In each electronic database, publications were searched using the search strings "fraud," "financial fraud," and "banking fraud." Articles published between 2000 and 2019 were defined in a search query. The search query was only applied to article abstracts, titles, and keywords so as to minimize the chance of retrieving irrelevant publications. This means that an article was selected for review if the abstract or title or keyword(s) contains the defined search string.

The selected articles were then uploaded to Endnote bibliographic software. With the assistance of this software, duplicate records were located and removed. An inclusion and exclusion criteria were developed to aid in filtering out the relevant publications. Those included for the review had to be written in English, formed part of original work, published between January 1, 2000 and December 31, 2019. The excluded publications were masters' theses, doctoral dissertations, news reports, textbooks, duplicates, and those without authors or abstracts.

In order to facilitate the discussion, the research focused on identifying themes within the literature using thematic analysis. Thematic analysis refers to identification of different patterns or themes within a qualitative dataset. Suggest that "it provides core skills that are essential for developing a baseline for other kinds of analysis" (p.78).

The objective of a thematic analysis is to identify themes, which can be defined as the patterns in data that are distinguished, important, and interesting. The themes are then used to address the research or say something about an issue. At the conclusion of the analysis, the major findings along with the research gaps are identified and listed to discover least-explored or new areas of research in the discipline.

The financial fraud literature

For this study, extensive review has been undertaken in order to gain insights into various perspectives in relation to financial frauds. Seventy research papers pertaining to the topic were selected for review. The papers were selected by the use of keywords like "Frauds," "Financial Frauds," "Bank Frauds," in K-Hub, Proquest, Ebsco, Google Scholar, Shodhganga and also in the library containing finance and banking journals. In order to keep the research latest, the papers were selected between the years 2000–2019. The detail of all papers reviewed is attached in Appendix 1.

Many researchers examined the impact of regulatory framework in curbing financial frauds. Ribstein (2002) and Yallapragada et al. (2012) discussed the reforms that emerged post financial misconducts focused on mitigating frauds. The author specifically focused on the infamous Enron and Worldcom cases with a special reference to the provisions of the Sarbanes Oxley Act 2002. Desai (2015) and

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Malhotra (2013) stressed upon the regulatory and legislative landscape of financial frauds and assessed the impact of regulatory framework in curbing financial frauds with special reference to the amendments made in the Indian Companies Act, 2013.

Gupta and Gupta (2015), Bhasin et al.,(2016) stated that while factors like poor job practices, ineffective employee training, and weak internal control systems were found to be most significantly enhancing the chances of occurrence of frauds, Khanna and Arora (2009); Ganesh and Raghurama (2008); Livshits et al. (2015) in their respective studies indicated that lack of training, overburdened staff, competition, and low compliance level were the main reasons for bank frauds.

A lot of researchers focused on the regulatory role of central bank in the detection and prevention of frauds. Ghosh and Bagheri (2006) revealed with reference to a case study that regulatory loopholes and lack of proper supervision by the central bank led to the fraud. Subbarao (2009), and Ciobu and Timuş-Iordachi (2019) deliberated on the minimal standards of fiduciary responsibility in detecting frauds and stressed upon the vital role of central banks in monitoring the banking system efficiently to reduce the likelihood of frauds.

Kaveri (2014) revealed that majority of the fraud cases reported by the banks were related to technological loopholes in online banking. Baz et al. (2016) developed a thorough framework using 2 mechanisms, namely, administrative controls and technical controls in order to navigate frauds timely. Yamamura et al. (2019), Rahman and Saha (2019), and Arhin (2019) assessed the fraud detection network system and fraud detection methods including ATM frauds, mobile payments, and cyber crime.

Several researchers studied the drivers, consequences, and provisions for prevention of frauds. McCusker (2005); Zoubi and Al-Khazali (2007); Jackson et al. (2010); Aris et al. (2013); Soltani (2013); and Lokare (2014) analyzed the provisions to reduce risks to financial system and conflicts of interest that exist in banking. The studies disclosed that frauds predominantly occurred due to inadequacy of supervision of senior management and technological loopholes in online banking systems, and the banks neglected the due diligence processes.

Many researchers also focused on the auditor's role in coping with financial frauds. Schiehll et al. (2007); Goel and Gangolly (2011); Swamy (2011); and Dantas et al. (2014) studied accounting frauds and financial statement fraud and the role of auditors in detection and prevention and finding regulatory loopholes. Prawitt et al. (2008) precisely pointed out to the significance of quality audit practices to reduce fraudulent activities. Zhou and Kapoor (2011); Costa and Wood (2014); Kranacher and Riley (2019); Gee and Button (2019); and Kazemian et al. (2019) focused on forensic accounting and assessment of financial cost of frauds and asset misappropriation and the role of auditors and management in pointing out the same.

The findings showed that enhancement in employee capabilities and advancement in technology could decrease banking frauds up to a significant level, hence decreasing the overall negative impact.

Bossard and Blum (2004); Moyes (2007); Yang et al. (2009); Sandhu (2016); Magro and Cunha (2016); and Moyes et al. (2019) discussed the importance of effectiveness of management and employee red flags in detecting and preventing frauds. Yusof and

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Lai (2014) created an integrated model to predict frauds which included identification of red flags and unusual behaviors among employees.

Gender diversity and demographics of fraudsters were discussed by Uzun et al. (2004); King et al. (2005); Steffensmeier et al. (2013); and Hilliard and Neidermeyer (2018) assessed the role of gender gap and involvement in organizational fraud.

Treviño et al. (2006); Cohen et al. (2012); Umphress et al. (2010); Ramamoorti et al. (2014); Omar et al. (2015); Strawhacker (2016); Spicer (2016); and Matthews (2018) stressed up on the significance of establishing a sense of behavioral ethics in organizations and enforcing positive reciprocity beliefs on unethical pro-organizational behavior.

Adequate importance was given to the dilemmas among employees in relation to whistle blowing and making tough choices in exposing fraud, waste, and abuse on the job (Miethe, 2019). OGW et al. (2019) laid emphasis on employee unethical behavior and corruption in Kenya. Several studies assessed the applicability of Cressy's theory of fraud triangle (Mackevičius, Giriunas 2013; Roden et al. 2016) and perception of bankers with reference to their responsibility in preventing frauds and its impact on their customer relationships and corporate social responsibility of the organizations (Nabhan & Hindi 2009; Hoffmann & Bimbrich 2012; Harjoto 2017).

Anand et al. (2015) talked about different areas in fraud research. The paper attempts to highlight the diversity within fraud literature studied. The findings of the literature review state a number of recent developments that researchers have studied which facilitated the occurrence of financial fraud, including the fundamental conflicts of interest, an influx of unknown, gullible participants, the increasing complexity involved in financial transactions, and rapid technological, legal, and financial innovations in novel banking arenas.

After a thorough review of the studies mentioned above, it was observed that most of the studies showed some common ground around which the research was conducted. Hence, to structure the discussion, a conceptual distinction is made between two broader areas identified by the author: the regulatory aspect of financial frauds and sociopsychological aspect of financial frauds. The papers classified under the recognized themes are given in Appendix 2.

Data analysis

As shown in the Table 1, the data analysis involved the similar approach as used by Gary et al. (2011) involving the following steps: (1) defining a tentative phenomena using topics identified from literature review, (2) analyzing text to identify fraud topics, (3) developing fraud themes, and (4) continually refining themes until all articles were accounted for.

The final classified fraud topics and themes are shown in Fig.2.

Studies focused on regulations and compliance mainly included the regulatory and legislative landscape of financial frauds and stressed up on the impact of and loopholes in regulatory framework in curbing financial frauds. The papers mainly presented the causes of detection of financial frauds and suggested improvements in regulatory body's preventive measures.

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Table 1 Approach used for Data Analysis

Step	Additional description	Illustration
Defining a tentative phenomena	Formulating provisional statements about the phenomenon	The review of the fraud literature provided with a working list of over 20 fraud topics, like determinants of fraud, methods of fraud prevention, and motivational factors in bank frauds.
Analyzing text to identify fraud topics	Creating descriptive codes that require little or no inference beyond the text itself	Line-by-line coding was conducted to focus on the content of the text in the line and to identify fraud areas in the selected articles.
Developing fraud themes	Creating inferential codes that pull together text into smaller and more meaningful units	Analysis of the fraud areas and their comparison across various articles was conducted. The analysis finally led to derive two major research themes.
Continually refining fraud themes until all were accounted for	Refining and substantiating the emerging themes	The iterative process continued until it was possible to comprehensively explain the two fraud research themes.

Source: Summary of data analysis procedures adopted in thematic analysis, Gary et.al (2011)

The research focused on the sociopsychological aspect contains broad areas related to an ethical organizational culture, red flags, and behavioral characteristics of fraudsters. These studies basically highlighted the organizational frauds where employees and/or management were involved and stressed up on the significance of establishing a sense of behavioral ethics in organizations in order to prevent financial frauds.

Discussion

The themes identified in the study are central to the articulations and findings. The findings demonstrate the diversity in fraud research areas and scope for further

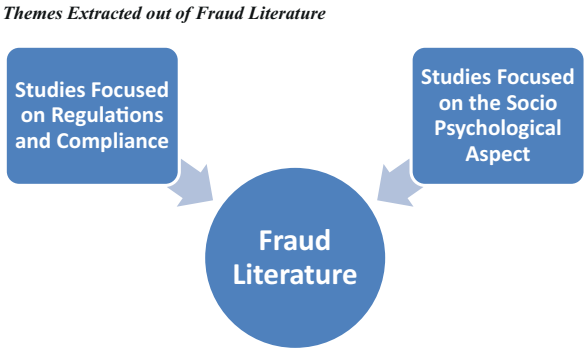

Fig. 2 Themes extracted out of fraud literature. Source: Author's compilation

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research. The present study addresses this limitation of previous studies and establishes the different parameters of research under the identified themes. Somewhat similar themes in fraud literature were identified by Corritore et al. (2003) and Gary et al. (2011) stating the various types of frauds being categorized as per some common ground.

The regulatory studies mainly focused on the causes and preventive measures to be opted to reduce financial frauds (Khanna and Arora, 2009; Ganesh and Raghurama, 2008; Livshits et al., 2015). The authors mostly focused on what happened (case-based approach) (Ghosh and Bagheri, 2006; Swamy 2011), what should have been done (Compliance based approach) (Ribstein, 2002; Yallapragada et al., 2012; Khanna and Arora, 2009; Ganesh and Raghurama, 2008; Livshits et al., 2015), and what should be done in the future (suggesting preventive measures) (Baz et al., 2016; Baz et al., 2016).

It was quite interesting to note that in case of studies related to bank frauds, with the change in technology, the cases became more sophisticated and complex. The popularity of the research areas thus shifted from accounting frauds or balance sheet frauds in early 2000s (Ribstein, 2002; Uzun et al., 2004; King et al., 2005), to areas such as cyber frauds and identity theft in the later decade post 2010 (Jackson et al., 2010; Aris et al., 2013; Soltani 2013; Lokare 2014; Yamamura et al., 2019; Rahman & Saha 2019; Arhin 2019). While the regulatory studies mostly focused on rules and regulations, internal controls, and their implementation or non-implementation, the sociopsychological researchers mostly focused on the complex behavioral patterns of people indulged in fraudulent activities.

Majority of the studies focused on the sociopsychological aspects were causal and descriptive and in nature. The behavioral studies in the fraud literature covered the "human side" of frauds (Bossard & Blum 2004; Moyes 2007; Yang et al., 2009; Sandhu 2016; Magro and Cunha, 2016; Moyes et al., 2019). The researchers cited the person-specific areas such as describing characteristics of the fraudsters as identified by their peers, behavioral red flags alarming the fraudulent acts of individuals, studies citing the demographics of the fraudsters such as gender, and age-based comparisons (Uzun et al., 2004; King et al., 2005; Steffensmeier et al., 2013; Hilliard and Neidermeyer, 2018). The sociopsychological studies widely covered the impact of organizational culture and ethical practices on the mindset of their employees and the likelihood of frauds.

Scope for further research

It was observed that research on comparing the counter fraud strategies used in the public and private sectors was relatively rare. Very few studies included the bank customers' perspective on frauds considering they can also be subject to third party frauds. The negligence of bank employees being highlighted in various studies, the researchers did not focus much on the challenges or difficulties faced by the bank employees in preventing and detecting frauds. The social research areas could not identify much on the behavioral patterns of the fraudsters, apart from the previously proven theories. Not much was found on

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the awareness levels of bank employees as well as customers on the issues related to vulnerability to corporate fraud.

The researchers can explore these areas further, and considering the huge uprising of cyber frauds over the last decade, research on the sophisticated techniques used by the fraudsters exposing banks and their customers to a huge risk of financial frauds can be pursued.

Practical implications

The study is useful to academic researchers to understand the various constructs of fraud literature and to explore the research area further in order to gain new insights based on the research gaps found. It is equally useful for the regulatory authorities in order to provide them with a reality check to analyze the current withstanding of banking institutions with regard to their current compliance level and additional measures required along with determining the further steps to be taken in order to prevent frauds from occurring in future.

Although the existing literature in bank frauds has covered many significant areas, there is much left to do. For instance, future research can include bank customer's awareness, experiences, and perspectives on frauds. Another area of research could be the identification and coping mechanisms with the various difficulties faced by bank employees.

Limitations of the study

The study suffers from some limitations. The study identifies the themes but does not comment on the various variables identified within the themes. Although the transition and shift in research areas was highlighted, it needs to be further explored to understand the trend and changing scenario for future researchers. The study also leaves scope to study the intensity of the themes identified.

Conclusion

Though the risks in financial sector have always existed, the scenario keeps changing with the change in technology (Singh et al., 2016). The chronological advancement of bank fraud cases from Hawalas and ponzi schemes to identity theft and cyber frauds has pushed the regulators to tackle bank frauds more cautiously than ever. The study has many notable findings such as shifting of the fraud literature areas from conventional frauds to cyber frauds and identification of two major themes around which most of the literature revolves gaining new insights onto the scope for further research on many areas keeping in mind the impact on various banking stakeholders.

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Appendix 1

Table 1 Detail of research papers taken for review

S.N.	Author	Year	Title	Journal/Publisher
1	Ribstein	2002	Market vs. regulatory responses to corporate fraud	Journal of Corporation Law
2	Uzun. Szewczyk and Varma	2004	Board composition and corporate fraud	Financial Analysts Journal
3	Bossard and Blum	2004	Reading the red flags of fraud	Pennsylvania CPA Journal
4	McCusker	2005	Underground banking: legitimate remittance network or money laundering system	Trends and Issues in Crime and Criminal Justice
5	King, Nuxoll, and Yeager	2005	Are the causes of bank distress changing? Can researchers keep up?	FRB of St. Louis Supervisory Policy Analysis
6	Ghosh and Bagheri	2006	The Ketan Parekh fraud and supervisory lapses of the Reserve Bank of India (RBI)	Journal of Financial Crime
7	Treviño, Weaver, and Reynolds	2006	Behavioral ethics in organizations	Journal of Management
8	Moyes	2007	The differences in perceived level of fraud-detecting effectiveness of SAS No. 99 red flags between external and internal auditors	Journal of Business & Economics Research
9	Schiehll, Borba and Murcia	2007	Financial accounting: an epistemological research note	RevistaContabilidade&Finanças
10	Zoubi and Al-Khazali	2007	Empirical testing of the loss provisions of banks in the GCC region	Journal of Managerial Finance
11	Ganesh and Raghurama	2008	Status of training evaluation in commercial bank	Journal of social sciences and management sciences
12	Prawitt, Smith and Wood	2008	Internal audit quality and earnings management	The Accounting Review
13	Anderson	2009	The economics of online crime	Journal of Economic Perspectives
14	Khanna and Arora	2009	A study to investigate the reasons for bank frauds and the implementation of preventive security controls in Indian banking industry	International Journal of Business Science & Applied Management
15	Subbarao	2009	Banking structure in India looking ahead by looking back	Rbidocs.RBI.ORG.IN
16	Nabhan and Hindi	2009	Bank Fraud: Perception of Bankers in The State of Qatar	Academy of Banking Studies Journal
17	Yang, Moyes, Hamedian and Rahdarian	2009	Professional Demographic Factors That Influence Iranian Auditors Perceptions Of The Fraud-Detecting Effectiveness Of Red Flags	International Business & Economics Research Journal
18	Boateng, Longe, Mbarika, Avevor, and Isabalija	2010	Cyber Crime and Criminality in Ghana: Its forms and implications	AMCIS
19	Cohen, Ding, Lesage and Stolowy	2010	Corporate fraud and managers' behavior: Evidence from the press	Entrepreneurship, governance and ethics, Springer
20	Jackson, Holland, Albrecht and Woolstenhulme	2010	Fraud is not just for big business: Understanding the drivers, consequences, and prevention of fraud in small business	Journal of International Management Studies
21	Umphress, Bingham, and Mitchell	2010	Unethical behavior in the name of the company: The moderating effect of organizational identification and positive reciprocity beliefs on unethical pro-organizational behavior	Journal of Applied Psychology
22	Goel, S., Gangolly	2011	Beyond the Numbers: Mining the Annual Reports for Hidden Cues Indicative of Financial Statement Fraud	Wiley Online Library
23	Swamy	2011		

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Table 1 (continued)

S.N.	Author	Year	Title	Journal/Publisher
			Financial Management Analysis Of Money Laundering, Corruption And Unethical Business Practices: Case Studies Of India: Nigeria And Russia	Journal of Financial Management & Analysis
24	Zhou and Kapoor	2011	Detecting evolutionary financial statement fraud	Journal of Decision Support Systems
25	Yallapragada, Roe and Toma	2012	Accounting fraud, and white-collar crimes in the United States	Journal of Business Case Studies
26	Dantas, Costa, Niyama and Medeiros	2012	Audit regulation in banking systems: analysis of the international context and determining factors	RevistaContabilidade&Finanças
27	Hoffmann and Bimbrich	2012	The impact of fraud prevention on bank customer relationship: An empirical investigation in retail banking	International Journal of Bank Marketing
28	Malhotra	2013	Earnings Management Practices in Indian Companies: A Cross-Sectional Analysis.	Journal of Modern Accounting and Auditing
29	Mackevičius, Giriunas	2013	Transformational Research of the Fraud Triangle	Ekonomika
30	Aris, Othman, Ali and Rahman,	2013	Islamic banking products: Regulations, issues and challenges	Journal of Applied Business Research
31	Steffensmeier, Schwartz and Roche	2013	Gender and twenty-first-century corporate crime: Female involvement and the gender gap in Enron-era corporate frauds	American Sociological Review
32	Soltani	2013	The anatomy of corporate fraud: A comparative analysis of high profile American and European corporate scandals	Journal of Business Ethics
33	Anand, Dancin and Murphy	2014	The continued need for diversity in fraud research	Journal of Business Ethics
34	Kaveri	2014	Bank frauds in India: Emerging challenges. Journal of Commerce and Management	Journal of Commerce and Management Thought
35	Rajan	2014	Minimal standards of fiduciary responsibility in detecting frauds	U.S. Patent No. 7,818,231. Washington, DC: U.S. Patent and Trademark Office
36	Raju	2014	Healthy banks under healthy Regulation	Competition Commission of India on May 20, 2014 at New Delhi
37	Lokare	2014	Re-emerging stress in the Asset Quality of Emerging Markets: Macro-Financial Linkages	RBI Working Papers
38	Ramamoorti, Morrison, Koletar and Pope	2014	ABC's of behavioral forensics: applying psychology to financial fraud prevention and detection	John Wiley & Sons
39	Yusof and Lai	2014	An integrative model in predicting corporate tax fraud	Journal of Financial Crime
40	Desai	2015	Scanning the HIM Environment: AHIMA's 2015 Report Offers Insight on Emerging Industry Trends and Challenges	Journal of AHIMA
41	Gupta and Gupta	2015	Corporate frauds in India perceptions and emerging issues	Journal of Financial Crime
42	More and Nalawade	2015	Online banking and cyber attacks: the current scenario	International Journal of Advanced Research in Computer Science and Software Engineering
43	Livshits, MacGee, Tertilt	2015	The Democratization of Credit and the Rise in Consumer Bankruptcies	University of Mannheim and CEPR, tertilt.vwl.uni-mannheim.de
44	Omar, Johari and Hassan,	2015	Corporate culture and the occurrence of financial statement fraud: A review of literature	Elsevier
45	Bhasin	2016	Frauds in the Banking Sector: Experience of a Developing Country	Asian Journal of Social Sciences and Management Studies
46	Enfoe at al.	2016	Forensic Audit and Corporate Fraud	International Journal of Economics and Business Management
47	Swain and Pani	2016	Frauds in Indian Banking: Aspects, Reasons, Trend-Analysis and Suggestive Measures	International Journal of Business and Management Invention

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Table 1 (continued)

S.N.	Author	Year	Title	Journal/Publisher
48	Singh et al.	2016	Frauds in the Indian Banking Industry	Journal of Banking
49	Costa and Wood	2016	Corporate Fraud	Journal of Management
50	Baz, Samsudin, Che-ahmad and Johnson	2016	Capability component of fraud and fraud prevention in the Saudi Arabian banking sector	International Journal of Economics and Financial Issues
51	Roden et al.	2016	The Fraud triangle as a predictor of corporate fraud	Academy of Accounting and Financial Studies Journal
52	Sandhu	2016	Behavioural red flags of fraud—A qualitative assessment	Journal of Human Values
53	Strawhacker	2016	Analysis of factors influencing corporate ethics and anti-fraud programs	Doctoral dissertation, Utica College.
54	Spicer	2016	Explanatory Case Study on Factors that Contribute to the Commission of Financial Fraud	Northcentral University
55	Magro and Kunha	2016	Red flags in detecting credit cooperative fraud: the perceptions of internal auditors	RevistaBrasileira de Gestão de Negócios
56	Ramana, S.V., and Krishna	2017	A study on impact of fraud in Indian banking sector with special reference on retail banking products	International Journal of Academic Research and Development
57	Harjoto	2017	Corporate social responsibility and corporate fraud	Social Responsibility Journal
58	Matthews	2018	A Theory of Consumer Fraud in Market Economies	Doctoral dissertation, University of Missouri--Kansas City
59	Singh and Gupta	2018	Gem of a scam: Nirav Modi	Delhi Business Review
60	Hillard and Neidermeyer	2018	The gendering of fraud: an international investigation	Journal of Financial Crime
61	Moyes, Anandarajan, and Arnold	2019	Fraud-Detecting Effectiveness of Management And Employee Red Flags as Perceived by three Different Groups of Professionals	Journal of Business and Accounting
62	Miethe	2019	Whistleblowing at work: Tough choices in exposing fraud, waste, and abuse on the job	Routledge
63	Kranacher and Riley	2019	Forensic accounting and fraud examination	John Wiley & Sons
64	Gee, J. and Button	2019	The Financial Cost of Fraud 2019: The Latest Data from Around the World	Researchportal.port.ac.uk
65	Yamamura, Nishida, and Kawamorita	2019	Fraud detection network system and fraud detection method	U.S. Patent No. 10,469,531. Washington, DC: U.S. Patent and Trademark Office
66	Kazemian, Said, Nia and Vakilifard	2019	Examining fraud risk factors on asset misappropriation: evidence from the Iranian banking industry	Journal of Financial Crime.
67	Rahman and Saha	2019	Comparative Study and Performance Analysis of ATM Card Fraud Detection Techniques	Journal of Information Security
68	Arhin	2019	Impact of fraud on the financial performance of mobile payment in Ghana	International Journal of Research Publications
69	Ciobu and Timuş-Iordachi	2019	Role of the central banks in prevention and management of bank frauds	Journal of Social Science
70	OGW, Kiragu, and Riro	2019	Financial Misstatement and Corruption on Fraud Risk Among State Corporations in Mombasa County in Kenya	Repository.dkut.ac.ke

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Appendix 2

Table 2 Studies classified under recognized themes

Regulatory and compliance	Year	Socio psychological aspect	Year
Ribstein	2002	Uzun. Szewczyk and Varma	2004
McCusker	2005	Bossard and Blum	2004
Ghosh and Bagheri	2006	King, Nuxoll, and Yeager	2005
Schiehll, Borba, and Murcia	2007	Treviño, Weaver, and Reynolds	2006
Zoubi and Al-Khazali	2007	Moyes	2007
Ganesh and Raghurama	2008	Nabhan and Hindi	2009
Prawitt, Smith, and Wood	2008	Yang, Moyes, Hamedian, and Rahdarian	2009
Anderson	2009	Cohen, Ding, Lesage, and Stolowy	2010
Khanna and Arora	2009	Umphress, Bingham, and Mitchell	2010
Subbarao	2009	Hoffmann and Bimbrich	2012
Boateng, Longe, Mbarika, Avevor, and Isabalija	2010	Mackevičius, Giriunas	2013
Jackson, Holland, Albrecht, and Woolstenhulme	2010	Steffensmeier, Schwartz, and Roche	2013
Goel, S., Gangolly	2011	Anand, Dancin, and Murphy	2014
Swamy	2011	Ramamoorti, Morrison, Koletar, and Pope	2014
Zhou and Kapoor	2011	Yusof and Lai	2014
Yallapragada, Roe, and Toma	2012	Omar, Johari, and Hassan	2015
Dantas, Costa, Niyama, and Medeiros	2012	Roden et al.	2016
Malhotra	2013	Sandhu	2016
Aris, Othman, Ali, and Rahman	2013	Strawhacker	2016
Soltani	2013	Spicer	2016
Kaveri	2014	Magro and Kunha	2016
Rajan	2014	Harjoto	2017
Raju	2014	Matthews	2018
Lokare	2014	Hillard and Neidermeyer	2018
Desai	2015	Moyes, Anandarajan, and Arnold	2019
Gupta and Gupta	2015	Miethe	2019
More and Nalawade	2015	OGW, Kiragu, and Riro	2019
Livshits, MacGee, Tertilt	2015		
Bhasin	2016		
Enfoe et al.	2016		
Swain and Pani	2016		
Singh et al.	2016		
Costa and Wood	2016		
Baz, Samsudin, Che-ahmad, and Johnson	2016		
Ramana, S. V., and Krishna	2017		
Singh and Gupta	2018		
Kranacher and Riley	2019		

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Table 2 (continued)

Regulatory and compliance	Year	Socio psychological aspect	Year
Gee, J. and Button	2019		
Yamamura, Nishida, and Kawamorita	2019		
Kazemian, Said, Nia, and Vakilifard	2019		
Rahman and Saha	2019		
Arhin	2019		
Ciobu and Timuş-Iordachi	2019		

Source: Author's compilation

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NATIONAL FOOD SECURITY ACT 2013: A REVIEW

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Abstract
The National Food Security Act (NFSA), 2013, which is, also known as Right to Food Act is a significant Act of Parliament of India that targets to provide subsidized food grains to around 1.2 billion people or two thirds of Indian population. This review paper presented and analyzed The National Food Security Act, 2013 in a detailed manner. The impact of NFSA, 2013 on the economy is relatively high and significant as it drastically changes the entire public distribution system in India. The role of both the Central and State Government is important to maintain a proper balance between the distribution and allocation of food grains. It has been realized that the individuals entitled with this Bill can attain food grains at a reasonable price along with effective provisions for pregnant and lactating women. The economic implications of the Act are also significant in both the agricultural sector as well as it increases the subsidies which creates pressure on both the Central and State Governments of India. The pros of the Act are that it offers food grains to the poor people those cannot afford high value items. Further benefits relating to the National Food Security Act, 2013 are women empowerment, reasonable pricing of food grains and improving the economic structure of India. The cons of this Act is the imperfect implementation by the government machinery. In addition, the Public Distribution System has several issues where recycling of food grains from public agency storehouse is abandoned. Hence, it can be stated that appropriate strategies and techniques must be integrated for the successful execution of the Act in India.

Keywords: National Food Security Act, Distribution, Economic implications, Inefficient, Strategies.

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Introduction

The Government of India enacted National Food Security Act, 2013 which provides subsidized food grains to around 67 percent of India's population. It was signed on 12th September 2013 by the Government of India. Based on the provisions of the bill, the beneficiaries can purchase 5 kilograms bowls of cereal per month as per eligibility (Banerjee *et al,*2014). On the other hand, certain categories of children, pregnant women as well as lactating mothers are eligible for obtaining daily free meals. In addition, better health is one of the primary aspects that act as a necessary precondition for the development of the economy. This bill is potentially a radical one that has a significant impact on the economy of India (Upadhyay&Palanivel, 2011). Hence, the requirement of effective and successful execution in every region of India can transform and enhance the lives of people. The objective and salient features of the Act highlighted by the Lok Sabha Committee report is food security represents the availability of adequate food grains to meet the demand of domestic people and access the entity level to deliver sufficient quantities of food at reasonable prices (Brahmanand *et al,*2013). In addition, the salient features of the Act also highlights that 50% urban and 75% of the rural population are entitled to 3 years from enactment offering 5 kg food grains every month (Chandrasekhar *et al,*2017). However, the eligibility of individuals is determined by the State government. On the other hand, 600 calories or Rs 6,000 for six months of the ration is allowed for pregnant and lactating mothers. Other than that, the food security allowance is also available for the beneficiaries for whom the food grains cannot be supplied.

The bill has been greatly controversial as it has a significant impact on the economy as well as the environment of our country India, due to poor management of resources and materials by the distribution agencies (Guérin& Srivastava,2012). (Kareemulla*et al,*2013) highlighted that this bill have been passed in order to deal with deficiencies in India where it has been analyzed that around 40.4% of children are underage under the age of three. In addition, the condition of women and children of other age groups have been also found critical due to lack of basic amenities which is food (Sen,2011). Furthermore, (Rai *et al,*2015) also suggested that the relationship between health and economic growth is unidirectional. Hence, improving economic conditions can certainly lead to better health. In other words, it can be also stated that through better health, economic conditions can be improved. The National Security Food Act is a potentially controversial bill as it can have a significant impact on the economy (Reddy *et al,*2011). However, if such a bill is well crafted as well as successfully implemented, then the condition of the lives of people can be enhanced towards betterment leading to improved economy of India. Likewise, (Narayanan, 2015) also highlighted that the potential of this bill is unlimited if it is executed appropriately in order to manage the issues related to health in India. The rationale for addressing this topic is to provide in-depth understanding and analysis about the appropriateness of The National Food Security Act, 2013 within the economy and environment of India. In relation to such context, this review paper highlights the role of central and state government based on The National Food Security Act, 2013. In addition, the implications of the bill towards the economy of India have been significantly

highlighted in this review paper. After reviewing the existing studies on NFSA, four categories has been identified and these are: role of central government for food security, role of state government for food security, economic implications of this Act and lastly pros and cons of the Act.

Objectives of the Study

Keeping in view the significance of National Food Security Act, it is essential to know the role of Government towards this Act and its implications. In relation to the literature related to NFSA, 2013, the followings are the objectives of this study:

1. To identify the role of the Central and State Governments towards execution of The National Food Security Act in India;
2. To analyze the economic implications of The National Food Security Act in India;
3. To analyze the positive and negative impacts of The National Food Security Act.

Role of Central Government for food security

The role of the central government to promote The National Food Security Act, 2013 is significant. The role and responsibility of the central government is to protect the current food grain and maintain the appropriate allocation to each state. Other than that, the Bill does not have any particular criterion for the identification of households that are suitable for public distribution system entitlements (Chavan *et al,*2015). In relation to such context, the role of the central government is to mitigate the state wise coverage of the public distribution system based on the appropriate proportion of the rural and urban population. This, in turn, would assist to analyses the number of eligible individuals which are extracted from the Census population figures (Sharma,2011). Other than that, the central government needs to monitor that the individuals those are entitled with the supply of food grains are either attaining the materials at subsidized rate or non-supply of the quantities of food grains of meals should compensate with food security allowance (Ramsundar& Jaydeb,2011). The role of the central government in managing the public distribution system for enhancing the economy and environment structure of the country is significant (Patel *et al,*2014). In addition, it has also been analyzed that the full transparency of records along with appropriate management of fair price shops have tobee followed based on the policies and framework put forward by the central government. Hence, it can be stated that the role of the central government for effective management and execution of entire processes of food security and its distribution is significant for exploiting the opportunities associated with the Bill, (Gustafson,2013). On the other hand, the major role and obligation of the central government is to provide food grains or appropriate funds to the state governments at the prices indicated in the Schedule I of the Bill in order to implement the primary entitlements. In addition, the rules and policies that are framed under this Bill have to be consulted with the State government in order to successfully execute the plan.

On the other hand, the role of central government under the food security act includes preparation of adequate amount of cereals which will be available for every individual based on the bill for

safeguarding survival (Masiero,2015). In addition, (Pal,2011) also highlighted that the Central Government is responsible to manage sufficient availability of cereals and pulses. The food security bill also entails availability of milk and milk products, pulses and cereals in order to enhance the condition of the people in our country India. Other than that, the Central Government of India has enacted this bill for laying a basic foundation to augment production of pulses and cereals. It thus becomes the role of Central Government to support production increase across the regions of India in an adequate manner (Kumar &Mohanty,2012). The major role of central government in managing the act is to accumulate the investment of both public and private investment for delivering appropriate service delivery. Furthermore, effective planning and strategic management by Central Governmentis highly required within India for facilitating the services offered by this to every region of India. The Central Government should consult the State Governments and other advisory bodies while implementing NFSA for taking complete advantage of the bill and contributing in development of the economy (Varadharajan *et al,*2014).

Role of state government for food security

NFSA, 2013 highlights the role of state Government for ensuring food security. The food security allowance needs to be provided by the state Government to the respective beneficiaries when the supply of food grains is limited(Kareemulla *et al,*2013). This role of state government is imperative to fulfill in order to accomplish the overall objective of the Act. Other than that, the identification of eligible households specifically for the entitlement of lactating and pregnant women are left to the state government. It has to be done within 365 days and the lists of suitable households have to be displayed prominently with an adequate supply of food grains and essentials (Kumar *et al,*2012). Furthermore, as the Bill is defined based on two-tier grievance redressal system, the integration of State Food Commission and District Grievance Redressal officer of the state is highly significant. The State Government must also put in place appropriate internal grievance redressal machinery to assist the people in need and utilise the benefits offered by such Act through help lines and call centers (Lawford*et al,*2013).

In addition, it has been also evident that limited resources and exponentially increasing population, poor performance of Public Distribution System, lack of infrastructure and operational inefficiencies within the state government highly impact the execution of this bill (Kishore *et al,*2014). Other than this, previous studies have also highlighted the need of major reforms in distribution, procurement and movement food grain strategies for sustainability of the act in every state. Hence, the need for appropriate execution of the Bill in the entire regions of each State is highly significant. It is also imperative that the role and responsibilities of the State Government are maintained appropriately (Tanksale& Jha,2015). The complaints must be heard accordingly and appropriate obligatory actions have to be taken by the State Government based on the norms and rules along with the integration of State Food Commission. Hence, the role of the State government is imperative in executing the Bill successfully; however, consultation with the Central Government is also required for formulating any rules and norms (Yu *et al,*2015).

It has been well identified by (Kumar & Ayyappan,2014); that the role of State Government is significant for its substantial influence on the foods delivered for human consumption. In addition, it is the significant responsibility of the State Government to be concerned with the supply of foods by assisting the farmers in maintaining a fair standard of return. This can certainly assist to achieve the mission of food security bill in India (Atteridge *et al,*2012). Other than that, the involvement of State Government towards analyzing the quality of food as well as protect consumers from unfair trading practice is also significant duty and responsibility of state government (Drèze& Khera,2017). Likewise, the responsibility of the government to deliver explicit information on nutrition and food to the consumers of respective state is highly significant in order to safeguard their livelihoods. In other words, it can be stated that rational Government involvement by respective state can certainly assist to provide better nutrition for the population which in turn can stimulate the agricultural industry efficiently (Dobe ,2015). As agricultural industry is highly related towards delivering adequate resources to the individuals, the state government must ensure to provide adequate assistance to the farmers accordingly.

Economic Implications of National Food Security Act, 2013

India has newly been experiencing high food inflation with record creation of food grains, buffer stocks. An unique trait of recent food inflation has been the continued value pressure in protein rich things (pulses, milk, fish, meat and eggs). As per RBI, the inflationary effect of NFSB will rely upon how much it will raise interest for foodgrains comparative with the ordinary increment in supply. This will create demand pressures, which will typically spread out to market costs of food grains (Badgaiyan& Singh,2015). Further, the subsidies are increased through this Bill. As a result, the need for huge funds from the Central Government is highly required for the Food and Security Bill, 2013. In addition, the pressure on food prices due to inflation is relatively high as a significant impact of the Bill. In relation to the RBI, the inflationary effect of the Bill would certainly depend on the degree by which the rise in demand for food grains would be relative to the increase in supply (Kishore *et al,*2014). This, in turn, it critically generates huge pressure on the demand side affecting the market prices of food grains. The burden of food subsidy would be also relatively high on the funding as it lifts up the fiscal deficit leading to inflationary pressures at the macro level.

The public investment in agriculture is only approximately one-fourth of total agri-GDP (Khera ,2013). This is the philosophical nature of the imbalances between the investment and the use of subsidies as the policy instruments for agricultural growth. Other than that, during the last five year plans, the agricultural sector has gained moderate growth of 4% in which, between the years 2010-2011, the GDP ratio of agriculture accounted for 12.4 percent (Rai *et al,*2015). On the other hand, it has been also comprehended that the Bill is expected to decrease the natural process of agriculture and at places can even annul this particular trend in India. The major economic implication of this Bill is it has created a forcible low-equilibrium trap for the agricultural sector in India (McMichael & Schneider,2011). Other than that, the government is trying to reverse the movement of Indian agriculture form high value items towards food grains. This will certainly

impact the agricultural sector as the returns of valuable items are relatively high in revenue compared to food grains. Other than that, the food economy is expected to cripple the level of competition (Hertel,2015). As the wheat crop is abundant, the increasing demand side is critical to fulfill. In the last three months, the wheat price also increased by 20% due to such criticality in the wheat market. This in turn critically impacts the availability of food grains appropriately which affects the domestic grain market.

Pros and Cons of the National Food Security Act, 2013

The implication of The National Food Security Act, 2013 towards the economy and environment of India is significant as the law grants food grain at greatly discounted prices which is affordable to the lesser income people (Haddad,2011). The benefits associated with The National Food Security Act, 2013 are women empowerment, reasonable pricing of food grains and enhancing the economic structure of India (Misselhorn *et al,*2012). The major advantages of the bill is it is a very crucial law initiated by the Government of India in order to ensure security of food of the 75% population of the country (Gahukar,2011). In addition, it can certainly assist in analyzing the number of malnutrition children and assist to enhance the health of child accordingly below five years as well as pregnant and lactating mothers in the entire country (Dreze& Khera,2015). The empirical study conducted on the benefits of the bill highlights that the around 47% of children in India is experiencing malnutrition had also is the home of the underweight children at an elevated level compared to other countries in the global world (Sandhu,2014). Through the use of both quantitative and qualitative analysis in the study based on pre-published journals and statistical tools, the results attained highlights the need of effective execution policy of the bill for enhancing the livelihood of people specifically the poor and informal sector.

The cons of The National Food Security Act, 2013 is the flawed implementation by the Government machinery. In addition, the Public Distribution system has several issues where recycling of food gains from state agency storehouse is unrestrained (Desai & Vanneman,2015). Hence, it needs to be successfully executed in the entire regions of India for enhancing the economy and lives of people in India. Furthermore, the food grains are reaches to the private traders and do not reach to the shops of fair price due to such distribution issues leading to economic vulnerability (Saxena,2018). The other issue is food grain production. Through in population is exceeding the supply of food grain as the number of administrative machinery in relation to manpower, logistics and warehouses in highly limited (Dev &Sharma ,2010). Other than that, (Brauw & Suryanarayana,2015); highlighted that as the food grains will be distributed through PDS, there is a huge possibility that the resources may not reach to the respective individuals due to corruption or leakages of food grains. The each number of poor individual is not estimated accurately as different departments have different numbers which requires significant concentration. In addition (Banik,2011); stated that the implementation cost is relatively high which can burden the government leading to fiscal deficit. Further, the economy is also under big threat as the food grains will be produced by the government reducing the exports. Hence, it can be stated that The National Food Security Act, 2013 has both pros and cons.

Conclusion

This paper has a huge contribution for transforming the lives of people as it promotes the right to food for each individual residing in India. It also brought forward significant knowledge about the bill that has drastically transformed the economic structure of the country. In this review paper, the relevant past studies of The National Food Security Act, 2013 have been investigated through analyzing their results and effectiveness. The success of executing the bill in the entire regions of India is highly needed for exploiting the opportunities associated with it. On the basis of entire review of studied literature, it has been observed that a lot of work has been done in this area. Further Analyzing its implications and execution strategy can provide a wide area for future researcher to conduct a study in this particular field of investigation. Hence, the need of appropriate strategies and policies have to be framed for the successful implementation of this Act and followed by the central and state legislative agencies appropriately.

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UNDERSTANDING PERCEPTIONS OF KEY BANKING STAKEHOLDERS USING TEXT ANALYSIS

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Abstract

Fraud literature suggests that the perceptions of banking stakeholders play a significant role in identifying the major areas of concern. Given this consideration, the present study qualitatively explores the perceptions and views of the key banking stakeholders namely, management, auditors and customers who have personally investigated or closely observed a fraud using Text Analysis conducted through QSRNvivo12 software. The analysis of thirty interviews helps condense some of the interesting and in depth viewpoints on banking frauds. The broad areas concerning fraud vulnerability, accountability, impact and prevention of fraud are central to the articulations of the respondents' views. The results are likely to help capture significant areas of direct concern and improve proactive preparations related to frauds, both from an organizational and regulatory perspective.

Keywords: *Text Analysis, QSRNvivo12, Fraud, Stakeholders, Perceptions*

Introduction

Fraud is defined by Cambridge Dictionary as a phenomenon intended to deceive others, typically by unjustifiably claiming or being credited with accomplishments or qualities (Alleyne, Persaud, Alleyne, Greenidge, & Sealy, 2010). The ACFE further explains that the financial frauds can be regarded as an inevitable and undesired concomitant of economic development (Mathews, 2018). Financial frauds have emerged in various forms and valuations, throughout global financial history. Robert Shiller, a

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top housing expert in the United States wrote in Global Research that the mortgage fraud was a lot like the fraud which occurred during the Great Depression in 1930s (McCarty, Poole & Rosenthal,2013).

Some of the most notable and expensive corporate fraud scandals throughout the world including the cases of fraudsters like Charles Ponzi, Madoff, Jordan Belfort, Enron & WorldCom have been due gross mismanagement as well as lack of financial awareness (Straney, 2010). The last decade involved a significant coverage of banking frauds by the global media.

While the governments enact several laws aimed at restraining fraud, their meager enforcement has attenuated the intended impact. With the rise of digital transactions backed by technology, frauds have spread to new areas. The banking institutions act as financial intermediaries and providers of capital for major economic activities (Costa & Wood, 2016). Finding modes of preventing and detecting bank frauds is thus vital.

In India, the financial framework is as old as early Vedic period. The book of Manu contains reference with respect to stores progresses, promise strategy of advance, and pace of intrigue. From the earliest starting point of twentieth century banking has been created to such an extent that truth be told, has come to be designated "LIFE BLOOD" of exchange and business (Sharma, 2007).

In India, banking has created from the crude stage to the advanced arrangement of banking in a manner that has no equal on the planet history. With the beginning of autonomy, changes of huge size have occurred in India. After freedom India propelled a procedure of arranged financial action so as to conquer the large number of issues it looked as an immature country (Goyal & Joshi, 2012). The expanding rhythms of financial movement lead to enormous increment in the volume and unpredictability of banking action. Along these lines, the job of banks grew at a quick pace.

Figure 1: Number of banking frauds and amount involved

Reeling Under the Pressure

Bank Group/ Institution	2017-18		2018-19	
	Number of Frauds (₹ cr)	Amount Involved (₹ cr)	Number of Frauds (₹ cr)	Amount Involved (₹ cr)
Public Sector Banks	2,885	38,260.87	3,766	64,509.90
	-48.8	-92.9	-55.4	-90.2
Private Sector Banks	1,975	2,478.52	2,090	5,515.10
	-33.4	-6	-30.7	-7.7
Foreign Banks	974	256.00	762	955.30
	-16.5	-0.6	-11.2	-1.3
Financial Institutions	12	164.70	28	553.40
	-0.2	-0.4	-0.4	-0.8
Total	5,916	41,167.00	6,801	71,542.90

Source: The Economics Times, October 9, 2019

The above figure clearly indicates towards an increase in both the number of frauds and amount involved from 2017-18 to 2018-19, the public sector banks being the worst affected of all comparatively.

Fraud and its redressal is a major concern area for the banking sector and across all portfolios - retail, corporate, and priority sector. Some of the recent fraud incidents in India reported by the media relate to fixed deposits, loans disbursement or extending credit facilities for bribes, phishing and other internet/ ATM based frauds.

Figure 2: *Current fraud risks that are of high concern to banks*



Source: Jeyanthi, Mansurali, Harish, & Krishnaveni (2020)

Risks are inherent in the banking business, but with frauds on the rise, organizations need to put their business in order by having effective control mechanisms in place. There are a number of different "stakeholders" or interested parties in the banking sector. These stakeholders include customers and depositors, regulators, investors, taxpayers, politicians and the directors and staff of banks. All stakeholders, though, have an interest in the proper functioning of the banking system, none operates in isolation. Although each of the stakeholders differ in terms of control and expectations, each of the stakeholders seek returns that maximizes and safeguards their interest.

The risks taken by the banking sector are still worrisome, although there has been a bit of moderation. The same has been indicated by the bank stability. Banks were also worried due to poor quality of assets. The proportion of stressed assets has increased significantly in the past years. Given the amount of transactions in banking, it is imperative that banks implement a dynamic monitoring mechanism so as to remain vigilant to early signs of distress in the borrower accounts.

Keeping all this in mind, to find and implement an effective coping mechanism is therefore, not an option but the need of the hour. A significant aspect to enhance accountability and transparency within the banks may prove to be an effective mechanism to enable and empower the employees to raise and voice their concerns internally in an effective manner when and if they discover any malpractice. The study emphasizes on the perceptions of various banking stakeholders giving it a 360 degree overview of the current situation and issues. Their perspectives are extremely essential in accentuating their contribution in mitigating banking frauds.

Defining the key stakeholders

As of late, India has enacted laws explicitly supporting endeavors towards forestalling corporate extortion, negligence, and wrongdoing. This is an indication that controllers know about the difficulties looked by associations in checking misrepresentation and are resolved to guarantee business is led morally. The Prevention of Corruption (Amendment) Act, 2018 is currently increasingly extensive and targets pay off suppliers as well, with the goal of

guaranteeing that associations progress in the direction of setting up satisfactory techniques intended to forestall pay off. The Fugitive Economic Offenders Bill, 2018 is relied upon to stop people engaged with misrepresentation and other financial offenses.

Similarly, the changing consumer preferences and advanced technology have further elaborated the risks. With the huge surge in the cases of bank frauds, existing approaches seem to have become less effective at detecting and mitigating the risks. Now is the time to re-examine the overall approach, to review what risks are emerging and what responses are necessary.

It is also significant to explore how various stakeholders perceive their own responsibility towards preventing frauds. The senior management officials in banks have huge responsibility of monitoring the operations at various branches and taking necessary action in order to curb the growing cases of bank frauds. Auditors play a major role in intensive examination of large-value accounts, the nature of security provided by borrowers as well as financial statements of borrowers. With cyber frauds and identity theft on the rise, it has become more and more imperative for the bank customers to understand and be proactive against any kind of frauds they might encounter.

Research Objective

To analyze the perceptions of key stakeholders' on financial frauds in banks.

Literature Review

The literature on bank frauds and fraud detection methods has grown immensely in the past decade. As the volume and scale of frauds became extensive, several researchers began to explore the phenomenon. As stated by Rossouw (2000, p. 885) fraud is a worldwide phenomenon that ruins the profitability, reputability, and legitimacy of organizations wherever it occurs. As the researchers explore different arenas of financial frauds, the fraud theories became more sophisticated which describe fraud and its motivations thoroughly.

Subbarao, (2009) enumerated the moral hazard problem in the banking system as privatization of profit and socialization of costs. Sandhu, (2016) conducted in depth interviews of the close coworkers of the offenders who identified certain behavioral red flags among their colleagues. The findings of the study highlighted certain common and significant factors identified among the offenders such as strong ambition, financial problems at home and dissatisfaction with the work. Yusof & Lai, (2014) presented an integrated model to predict financial fraud in their paper. The study incorporated three major theories of fraud namely, 'Theory of reasoned action, Theory of planned behavior and The fraud triangle (Zoubi & Khazali 2007). It was found that both individual and organizational factors impacted the indulgence of employees in financial frauds. Strawhacker, (2016) suggested that the organizations must embed ethical elements in the organizational culture to influence employee behavior in an optimistic manner.

Harjoto, (2017) revealed that the businesses scoring high in CSR activities had lower rate of financial frauds. Spicer, (2016) discussed the elements of the fraud triangle theory and their presence in the extracted cases. It was revealed that the theory was applicable where the fraudster had personal financial crisis at home.

Anderson, (2009) stated the factors such as over reliance on senior officers and outside experts as well as weakness in the regulatory system inducing the chances of occurrence of financial frauds. Yang, Moyes, Hamedian & Rahdarian, (2009) investigated the relationship between the professional demographics of auditors and their effectiveness in identifying red flags to detect financial frauds. Bossard & Blum, (2004) stressed upon the role of auditors to maintain professional skepticism and identify the fraud risks. Magro & Kunha, (2016) found that the internal auditors attributed greater importance to red flags associated with operational activities and internal control procedures.

Singh et.al, (2016) focused on the various kinds of phishing techniques used by the fraudsters in order to cheat the bank customers. Various cases reported by many private and public sector banks reported the existence of fake websites and emails which led to huge losses to their customers. On

similar lines, Thangamuniyandi & Ragavan (2016) stated that in order to have maximum access to security from phishing, the banks must focus on educating their customers to distinguish between original and fake websites and URLs. Also, the bank employees handling and controlling the systems must be adequately trained and aptly selected.

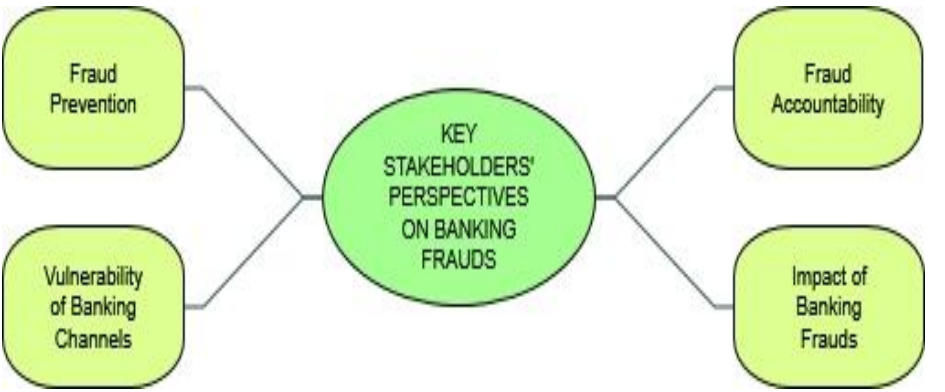
It was quite interesting to note that in case of studies related to bank frauds, with the change in technology, the cases became more sophisticated and complex. The popularity of the research areas thus shifted from accounting frauds or balance sheet frauds in early 2000s Ribstein, (2002); Uzun, Szewczyk & Varma, (2004); King, Nuxoll & Yeager, (2005) to areas such as cyber frauds and identity theft in the later decade post 2010 Jackson, Holland, Albrecht & Woolstenhulme, (2010); Aris, Othman, Ali & Rahman, (2013); Soltani, (2013); Lokare, (2014); Yamamura, Nishida & Kawamorita, (2019).

Research Methodology

The present research qualitatively explores the perspectives of the banking stakeholders. The data for the study was collected with the help of both Face to Face and telephonic interviews conducted by the author between January 2020 and July 2020. Post Covid 19, mixed interviews approach was considered particularly suitable for the present research since it permitted the respondents to completely articulate their own experiences from their homes via telephones and effectively convey their perceptions on the same (Ross & Squires, 2011).

The respondents of the study were selected by using purposive sampling techniques. The confidentiality of their responses was assured to the interviewees. Out of 41 people approached, 9 refused to participate in the study and 2 were unable to communicate due to connectivity issues. The good response rate is indicative of the willingness of the participants to share their perspectives on the subject matter. The interviewees were requested to provide the contact information of potential participants, in case the interviewee knew any. A total of 30 semi-structured interviews were conducted. The duration of the interviews ranged between 18 to 30 minutes. The interview schedule covered four broad areas given in the figure below.

Figure 3: Mind Map generated for broad areas covered under interview of key banking stakeholders



Source: QSRNvivo12 Output

S. No.	Gender	Age	Stakeholder Profile	Mode of Interview
1	Male	31	Bank Customer	Face to Face
2	Male	47	Bank Customer	Face to Face
3	Female	51	Senior Manager	Telephonic
4	Male	36	Bank Customer	Face to Face
5	Male	45	Senior Manager	Telephonic
6	Male	54	Senior Manager	Face to Face
7	Female	56	Senior Manager	Face to Face
8	Female	34	External Auditor	Telephonic
9	Male	53	Senior Manager	Telephonic
10	Male	54	Senior Manager	Telephonic
11	Female	43	External Auditor	Face to Face
12	Female	41	External Auditor	Telephonic

13	Male	52	Senior Manager	Telephonic
14	Male	38	External Auditor	Telephonic
15	Male	30	Bank Customer	Face to Face
16	Female	30	Bank Customer	Face to Face
17	Male	31	Bank Customer	Face to Face
18	Male	29	Bank Customer	Face to Face
19	Male	30	Bank Customer	Face to Face
20	Female	32	External Auditor	Telephonic
21	Female	38	External Auditor	Face to Face
22	Female	51	Senior Manager	Telephonic
23	Male	31	Bank Customer	Face to Face
24	Male	54	Senior Manager	Telephonic
25	Female	33	External Auditor	Telephonic
26	Female	36	External Auditor	Telephonic
27	Female	37	External Auditor	Telephonic
28	Male	47	External Auditor	Telephonic
29	Male	35	Bank Customer	Face to Face
30	Male	51	Senior Manager	Telephonic

The above table describes the demographic characteristics of the individuals interviewed by the author. Out of all the stakeholders, there were 18 and 12 male and female respondents respectively belonging to varied age groups and designations. The sample respondents belonging to varied categories were deliberately chosen equally by the author for interview (10 each).

Data Analysis

In the data analysis stage, two qualitative softwares were used to transcribe and analyze the data. The first software used was NVivo Transcription, which was used to transcribe the recorded interviews. The software assisted in converting the audio files into MS-Word files. The other software was

NVivo 12 which was utilized in the analysis of the transcribed data. NVivo is an information management tool especially useful for the qualitative research. The transcribed files were imported to NVivo and various analysis techniques namely, Word Frequency, Text Query, Word tree and cloud tags were applied to the collected data.

Word Cloud: A word cloud is a collection, or cluster, of words depicted in different sizes. The bigger and bolder the word appears, the more often it's mentioned within a given dataset.

Figure 4: Word Cloud as per most frequently used words by the respondents



Source: QSRNvivo12 Output

The word cloud in the above figure helps in capturing the whole view of responses in a single sight. The above figure shows the most common words uttered by respondents during interviews. It can be seen that the respondents focused upon data related frauds, use of analytics in fraud prevention, cybercrime, sophisticated technologies, business risks, etc.

Text Search Query: Text search queries aim at search for words or phrases in the data. It includes exploration of the usage of words while the researcher derives the context and meaning out of it.

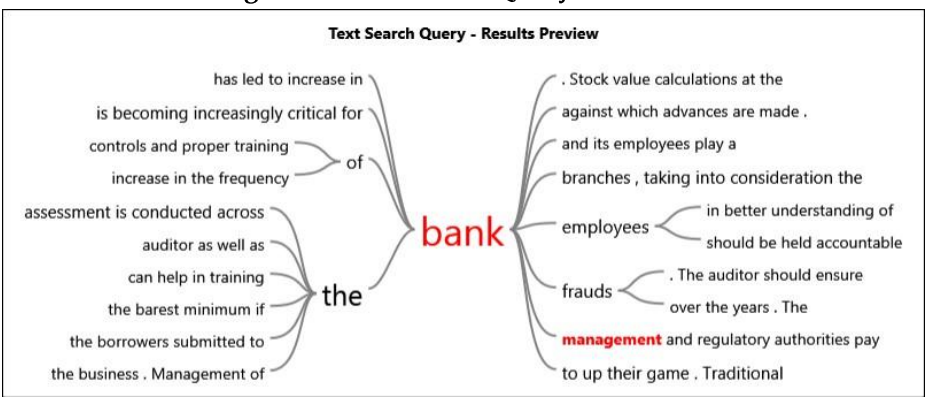
Figure 5: Text Search Query for 'Fraud'



Source: QSR NVivo12 output

The above figure shows the word tree which was generated by text search query for the word 'Fraud'. There are several associations which can be easily drawn out of this query such as 'advances being more prone to bank frauds', 'cyber frauds can be prevented through data analytics', 'identification of various red flags to reduce fraud incidences, schemes and sophistication of fraud techniques, etc.

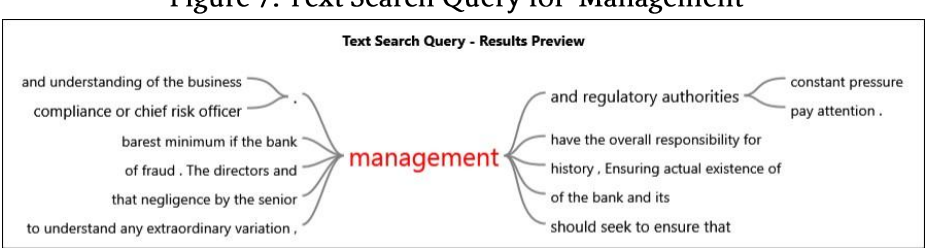
Figure 6: Text Search Query for 'bank'



Source: QSR NVivo12 output

Many inferences can be drawn from the above figure by adjoining sentences like 'Auditors as well as the bank employees should be held accountable in case of oversight of discrepancy', 'A better understanding of bank frauds is becoming increasingly critical for bank management', Bank frauds can be at barest minimum if the management and regulatory authorities pay attention', etc. Text queries for individual stakeholders are given below.

Figure 7: Text Search Query for 'Management'

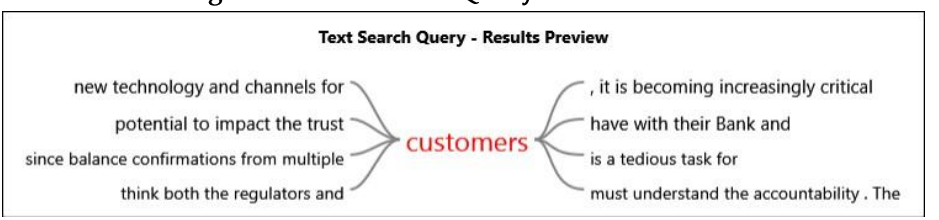


Source: QSRNvivo12 Output

A lot of perceptions are highlighted in the above figure like, 'Negligence by the senior management at times', 'The directors and management are under constant pressure', 'To understand any extraordinary variation, management and regulatory authorities should pay attention', 'compliance or chief risk officer have the overall responsibility to prevent frauds', etc. A few notable mentions which were repetitively frequent in the interviews were "Most of the frauds that got reported were credit related so I think both the regulators and customers must understand the accountability", "I think setting up of a

Special Surveillance Cell with forensic trained staff with a proactive approach is the main requirement". "There are inadequate tools and technologies in place to detect early warning signals and red flags pertaining to different frauds".

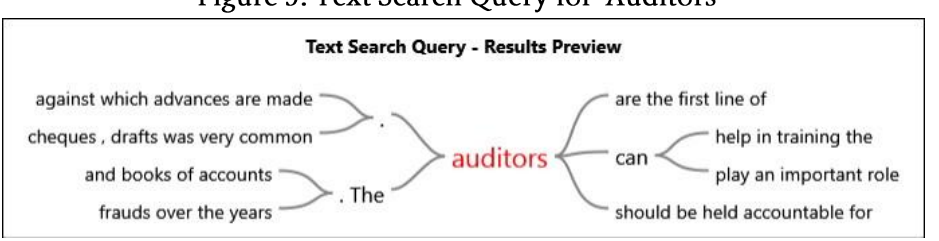
Figure 8: Text Search Query for 'Customers'



Source: QSRNvivo12 Output

The above figure containing text query depicts the most frequent perceptions of bank customers. Various issues have been highlighted such as 'increasing usage of new technology and channels', 'fraud has the potential to impact the trust customers have with their bank', 'both regulators and customers must understand their accountability' etc. A notable reference in one of the interviews was the "Due to sophisticated technologies and usage of various electronic channels, the consumers are not given due attention in terms of enhancing the knowledge on security measures especially in rural areas. This is something the banks definitely need to improve."

Figure 9: Text Search Query for 'Auditors'



Source: Nvivo12 Output

Text query search for the word 'Auditors' described various perceptions such as 'Cheques and draft based frauds were found to be very common by the auditors', 'Auditors are the first line of defense', 'The Auditors can help in training the bank employees to remain vigilant', 'The auditors should be held accountable for identification of fraudulent transactions in books of

accounts', etc. Banks would only be able to reduce the occurrence of frauds by ensuring competent working of staff, whereas, if we talk about the detection of frauds, the importance of the auditors' role can never be denied. Armed with specialized combination of skills, these financial detectives are significant assets.

Findings

1. The stakeholders' perceptions on fraud prevention majorly stressed upon the usage of data analytics to prevent cyber frauds.
2. It was highlighted that in case of internal bank frauds, identification of various red flags to monitor the employees may drastically reduce fraud incidences.
3. Auditors as well as the senior management considered themselves accountable in case of oversight of internal discrepancy
4. Repetitively, the respondents from banks' senior management, focused upon setting up of a 'Special Surveillance Cell' with forensic trained staff having a proactive approach and inadequacy of tools and technologies to detect early warning signals and red flags pertaining to different frauds.
5. With fraud techniques being complex and sophisticated, a better understanding of bank frauds is becoming increasingly critical for bank management.
6. Bank customers' perception mainly highlighted the fact that fraud has the potential to impact the trust they have with their bank.
7. Bank customers' sentiment also reflected upon complexity of sophisticated technologies and stressed that the consumers must be given due attention in terms of enhancing the knowledge on security measures especially in rural areas.
8. Cheques and draft based frauds were found to be very common by the auditors
9. Auditors considered themselves as the first line of defense and a few expressed interest in volunteering for training the bank employees to be careful.
10. Overall, the fraud incidences encountered by the stakeholders were most frequently found to be of cyber frauds and frauds pertaining to loans and advances were found more frequent than others.

Suggestions

1. Since frauds related to loans and advances were found quiet frequent, due diligence for sanctioning of loans as well as end use of funds must be done periodically and observations of bank's system and procedures should be thoroughly checked.
2. Implementing an employee whistle blowing hotline can prove to be an effective measure to curb internal bank frauds so that the employees anonymously report malpractices without fear.
3. Auditors must conduct a thorough fraud risk assessment using data analytics to identify and address high-risk areas to cater to cyber frauds.
4. Retired and credible bank officers can be hired to facilitate the internal audit of the bank. Since they possess the required operational and regulatory knowledge, they must be empanelled.

Practical Implications

The Indian banks are marching through an increasingly difficult scenario with increased financial frauds and low recoveries. The stakeholders' perceptions highlighted by the author in this study facilitates an in depth understanding of various facets of banking frauds and clearly raise concern to work on the increased regulatory scrutiny with respect to modus operandi and extent of accountability of the respective stakeholders. Recent banking frauds and willingness to gain a deep understanding of various facets related to bank frauds served as the prime motivation to carry out this detailed study. The research is useful to the banks and regulatory authorities as it as a reality check to analyze the current withstanding of these institutions with regard to their current compliance level as perceived by their key personnel of interest and to determine the further steps to be taken in order to prevent frauds from occurring in future.

Conclusion & Scope for future research

The potentially greater impact from frauds is reputational damage and diminished customer and investor confidence. These issues have the potential to impact the trust customers have with their bank and in worst cases, it may lead to an overall systemic crisis. The accountability is not of a

single individual. Risks are definitely inherent in the banking business, with frauds on the rise, effective control mechanisms are definitely required to be put in place. Banks need to take a comprehensive view of their and relook at their anti-fraud measures. Having an adequate prevention method in place makes it harder for fraud to be committed. With fraud schemes and the sophistication of fraud perpetrators constantly evolving, analytical tools provide the ability to discern anomalies, across available data that might otherwise go unnoticed. Also, with cyber crimes on the rise, the customers have to ascertain to remain vigilant and secure at all times while using any of the E-banking channels. Though the overall sentiment of all the key stakeholders were found to be optimistic about prevention of banking frauds, certain areas still need specific attention like new technologies, new entrants into the industry, new regulations and changing consumer preferences which may combine to disrupt the existing approaches towards banking frauds.

The study leaves the scope for further research. One interesting area of research can be the identification and coping mechanisms of various difficulties faced by bank employees. The present study highlights the growing sentiment and concern of stakeholders regarding cyber frauds, therefore the researchers can further explore the upcoming areas of data analytics, artificial intelligence and other sophisticated techniques to decrease the frequency of frauds and their detection time.

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Personality Traits and Work Engagement: A Case Study on Female Bank Employees in Banking Sector

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Abstract

The purpose of the present study is to explore whether there is any qualifying relationship between personality traits and work engagement, also, the level of work engagement and big five personality traits among female employees in Himachal Pradesh. Relevant data through questionnaire was collected from 150 female employees working in 3 different Public sector banks namely State Bank of India, Punjab National Bank and UCO Bank in the state of Himachal Pradesh. The results of the study specified that there was a significant positive relationship between work engagement and big five personality traits. Extraversion, Agreeableness, conscientiousness, and openness were significantly related to work engagement and its dimensions namely vigor, dedication and absorption whereas neuroticism was found to be negatively related to the work engagement and the three dimensions of it. The level of work engagement was high in public sector whereas extraversion, conscientiousness, neuroticism and openness were average except the agreeableness trait of personality was high

Keywords: Personality traits, work engagement, vigor, dedication and absorption

1. *Introduction*

Organizational agility is continuously looking out for the employees who bubble, sparkle or effervesce with dynamism, enthusiasm, energy, employees who believe in themselves and their abilities Bakker and Schaufeli, (2008). This implies that in order to achieve competitive edge organization need to have engaged employees who are willing to put in that little bit extra

for business. Bleeker & Roodt, (2002); Schaufeli & Bakker, (2004) stated the importance for managers of fostering the growth of work engagement as disengagement or alienation is the central problem of workers' lack of commitment. Literature highlighted that research on work engagement has been done in various professions like nursing (Montgomery et al., 2015) police officers (Storm K. & Rothmann S. (2003) & Louw G.J 2014), school principals, teachers (Hakanen et al., (2006); Zaidi et al., 2013 and Manikandan K. & Sarath P (2014), including banking personnel (Koyuncu et al., 2006).

The issues in work engagement among banking personnel specially the female employees has received important responses these days because of the economic pressure of inflation, the acts upon of other women's movement and the psychological need to spring up one's self identity.. This brings us to a very important question as to why certain female employees show signs of work engagement while others exhibit no signs of work engagement. Personality plays a significant role in the engagement process and it can be considered as an important variable to affect the engagement level because individuals enter the workplace with their own sets of personality characteristics. Therefore, it becomes important to study the relationship between personality traits and work engagement.

1.1 *Work Engagement*

Engagement is an important concept to study and analyze because it is associated with the positive individual and work related outcome as focussed by Maslach et al., (2001). Engaged employees confirm themselves quickly to changes in their surroundings, and pass easily from one activity to the other as compared to their counterparts Laangelaan et al., (2006). It is defined as a "positive, fulfilling work related state of mind that is characterised by vigor, dedication and absorption" (Schaufeli, Salanova, Gonzalez-Roma & Bakker, 2002, p. 74).Vigor pertains to high levels of vim, dynamism, zip and mental exuberance while actively engaged in work. Vigor perhaps, is delineated as a pool of energy possessed by the employees and that could be used when dealing with demanding and stimulating situations (Shirom 2007 p. 86). Dedication refers to an intense work involvement and comprehends feeling of self-respect and personal worth, pride, enthusiasm, significance and challenge. Absorption, which is the last variable of work engagement is characterised as being totally focused on one's work as the time appears to pass quickly and one finds it increasingly hard to detach oneself from work. In short, engaged employees work hard; they are passionate about their work; and are fully plunged in their work activities (Bakker and Demerouti, 2008).

1.1.2 Personality Traits

Personality refers to cognition and perceptual structure of behaviour that depicts constancy or stability throughout time and across situations (e.g. Cattell 1965)

Extraversion is a personality trait, which is characterized by warmth, assertiveness, gregariousness, talkative, enthusiastic, active,

energetic, expressive etc. (Costa & McCrae, 1992). This variable consists of two components, Ambition (initiative, surgency, ambition and impetuous) and Sociability (social, exhibitionist and expressive) (Hogan 1986).

Neuroticism represents individual differences indicating general tendency to be anxious, tense, hostile, impulsive, vulnerable, self-consciousness etc. (Costa & McCrae, 1992). Any individual who scores high on Neuroticism indicates that a person is prone to have irrational ideas, being less able to control impulses, and is grappling badly with stress Rothmann et al., (2003).

Agreeableness is the propensity to be sympathetic, kind, generous, modest, compliant, altruism, considerate etc. (Costa & McCrae, 1992). Agreeableness is required to work in peace and to conclusively settle the conflicts. (Ozgur Ongore, 2014).

Conscientiousness individuals are efficient, responsible, self-disciplined, compliant, organized, and reliable (Costa & McCrae, 1992). Hence, individuals who scores high on conscientiousness should report more engagement in their work due to their sense of duty towards every role they take on. Openness to Experience is qualified by being artistic, introspective, and curious and values and intellectual matters. (Costa & McCrae, 1992).It includes traits such as imagination, curiosity, and creativity (Goldberg, 1993).

2. *Literature*

2.1 Work Engagement: Several research studies have been conducted by various research groups who provided thorough insight for understanding work engagement in conceptual terms.

Enumerate research has been done to examined the potential antecedents and consequences of work engagement Koyuncu et al., (2006), Oliver (2007) and Burke et al., (2010 & 2013. Only one variable of work engagement i.e. vigor has been focussed by Shirom (2004, 2010), Sonnentag et al., (2008). Someone who's suffering from burnout have less mitigating resources like social support than those who execute their duties vigorously Geritt J. Louw G.J. (2014). The creativity and charisma among female leaders and the role of resources and work engagement among 84 female school principals and 190 teachers were examined by Bakker et al., (2013).Job resources facilitate employees' sense of self-efficacy and resiliency, and consequently foster work engagement Bakker et al., (2013).

2.2 Big Five Personality Traits:

Managers who are emotionally stable, open to experience and agreeable tend to perform better than those who measured lower on these dimensions Rothmann et al., (2003). Bakker et al., (2006), examined the relationship between burnout and big five personality traits: extraversion, agreeableness, conscientiousness, emotional stability, and intellect/autonomy whereas openness to experience was not included in the study. A large number of studies have been done on personality traits and burnout Kim et al., (2007); Kaja et al., (2015); Alarcon et al., (2009); Zellar (2000); Joseph et al., (2011). The relationship among conscientiousness, neuroticism and burnout in healthcare staff of private

hospitals was examined, leaving out the remaining three personality traits (extraversion, agreeableness, openness to experience) which was not included in the study Azeem S. M. (2013).

2.3 Work Engagement and Personality traits:

Ongore (2014) investigated the relationship between personality traits and job engagement. Rantanen (2008) explored the relations between personality, role engagement and four dimensional typology of work life balance. Woods et al., (2013) examined the association of personality traits with work engagement. Relevance of the variables of big five taxonomy when studied in relation with engagement is yet to be determined.

For Instance Langelaan et al., (2006) considered only two of those whereas for Kim et al., (2009) considered conscientiousness to be significant.

Inceoglu & Warr (2011). Langelaan et al., (2006) studied whether burnout and work engagement could have been differentiated based on Eysenck's two- dimensional model of personality which included extraversion and neuroticism whereas agreeableness, conscientiousness and openness to experience have not been included. Kim et al., (2009) focused on the relationship between job burnout, job engagement and the big five personality dimensions, which included Extraversion, Agreeableness, Conscientiousness, Neuroticism and openness to experience. Bozionelos (2004) explored the relationship between the big five personality and work involvement. Individuals suffering from burnout have less mitigating resources like social support that those who execute their duties vigorously (Louw G J. 2014).

Neha &Venkatesh (2015) investigated the relationship between personality and work engagement. The interactive effect of personality and employee engagement on organizational citizenship behavior has been investigated.

3. *Objectives*

1. To measure the level of work engagement and personality trait among women employees in banking sector.
2. To find out the relationship between personality traits and work engagemen

3.1 Hypothesis

H01: There is no relationship between work engagement and extraversion.

H02: There is no relationship between work engagement and neuroticism.

H03: There is no relationship between work engagement and agreeableness.

H04: There is no relationship between work engagement and conscientiousness.

H05: There is no relationship between work engagement and openness to experience.

4. Method

4.1 Respondents

A survey was conducted to collect the data from 150 female employees working in three different public sector banks in the state of Himachal Pradesh namely State Bank of India, Punjab National Bank and UCO bank. The

respondents were given standard based questionnaires comprising questions related to personality traits and work engagement.

4.3 Measures:

Respondents filled out the questionnaires containing statements related to work engagement and big five personality traits respectively. Work Engagement was assessed with the validated 17-item Utrecht Work Engagement Scale (UWES), whereas the big five personality traits was evaluated with the Big five Inventory (BFI). The scale characterizes big five personality traits i.e. Extraversion, Agreeableness, conscientiousness, neuroticism and openness to experience, it included total of 44 statements. Demographic attributes such as name, age, marital status, job experience, designation, salary and total work experience were measured in the first section of the questionnaire.

4.3 Cronbach's alpha: To measure the validity and reliability of the variables of work engagement cronbach's alpha were used. The cronbach's alpha for work engagement and big five personality traits lies between $\alpha = .84$ to .61

4.4 Statistical analysis:

Firstly, mean and standard deviation were calculated for work engagement and personality. These measurement tools helped in finding the level of the work engagement and its three dimensions namely vigor, dedication and absorption, and also of the big five personality traits namely extraversion, agreeableness, conscientiousness, neuroticism and openness. Further, Pearson correlation method was used to explore the relationship between the work engagement and its three variables namely vigor, dedication and absorption with the big five personality traits.

5. Results:

Results of the present study suggest that five factor model can be used as an important tool to find out the levels of work engagement. The hypotheses were tested with the help of bivariate correlation method.

5.1 Descriptive statistics

Table 1 depicts the descriptive statistics of vigor, dedication, absorption, work engagement, extraversion, agreeableness, conscientiousness, neuroticism, openness and personality traits of women employees of public banks. The above table explicit that for public banks, average value of vigor is 22.75 with standard deviation 3.92, average value of dedication is 20.64 with standard deviation 3.68 and average value of absorption is 23.63 with standard deviation 3.78. Whereas mean of work engagement for public banks is 67.02 with standard deviation 10.10. While for public banks, average value of extraversion is 28.07 with standard deviation 4.60, average value of agreeableness is 36.58 with standard deviation 4.21, average value of conscientiousness is 35.83 with standard deviation 5.33, average value of neuroticism is 20.24 with standard deviation 5.63 and average value of openness is 38.97 with standard deviation 4.36.

However, mean and standard deviation of personality traits for public banks are 159.69 and 11.57, respectively.

Table 2 depicts the descriptive statistics giving information about level of work engagement, personality traits and its variables among women employees of public banks. From table 2, we can conclude that majority of women employees of private banks i.e. 35.3%, are highly vigorous. Similarly, majority of 41.3% women employees of public banks are highly dedicated. Whereas 37.3% women employees of public banks, averagely absorbed in their work in banking sector and 36.7% women employees had high level of work engagement in banking sector. However level of extraversion in banking sector is average, according to 42.7% women employees of public banks. According to 35.3% women employees their level of agreeableness in banking sector is high. Although according to 37.3% women employees of public banks their level of conscientiousness in banking sector is average. Similarly, level of neuroticism in banking sector is average; according to majority of 36.7% women employees. Likewise, according to majority of 42.7% women employees of public banks, level of openness in banking sector is average. Level of personality traits in banking sector is average; according to majority of 36% women employees of public banks. Thus, it implies that overall level of work engagement is high and personality traits in public sector bank are average.

5.2 Hypothesis Testing: Correlation between Personality Traits and Work Engagement: The Pearson correlation method is used to find out the correlation between the work engagement and the various personality traits using SPSS statistics 23.

5.2.1 Work engagement and Extraversion.

The above table signifies the correlation values between the variables of work engagement (vigor, dedication, and absorption) with one of the variable of big five personality traits namely extraversion of public sector banks. Vigor is significantly positively correlated with dedication, absorption, work engagement and extraversion with coefficient of correlation 0.746, 0.680, 0.914 and 0.395, respectively i.e. ($p<0.001$). Similarly, dedication has positive relationship with absorption (0.621, $p<0.001$), work engagement (0.886, $p<0.001$) and extraversion (0.425, $p<0.001$).

There is a significant positive relationship between extraversion and work engagement with correlation coefficient 0.447, $p<0.001$). Absorption is positively correlated with extraversion and work engagement as the correlation of coefficient is found to be 0.864 and 0.373, respectively i.e. ($p<0.001$).

5.2.2 Work engagement and agreeableness.

The correlation values between the variables of vigor, dedication, absorption, work engagement and agreeableness of public banks. Agreeableness is positively correlated with vigor (0.368, $p<0.001$), dedication (0.260, $p<0.001$), absorption (0.398, $p<0.001$) and work engagement (0.386, $p<0.001$). Absorption had a significant positive relation with both dedication and vigor as their coefficient of correlations was found to be 0.621 and 0.680 respectively i.e. ($p<0.001$). There is a significant positive relationship between dedication and vigor with correlation coefficient 0.746, $p<0.001$).

However work engagement is positively correlated with vigor, dedication and absorption with coefficient of correlation 0.914, 0.886 and 0.864, respectively i.e. ($p<0.001$).

5.2.3 Work engagement and conscientiousness.

The correlation values between the variables of vigor, dedication, absorption, workout engagement and conscientiousness of public banks. Vigor is significantly positively correlated with dedication, absorption, work engagement and conscientiousness with coefficient of correlation 0.746, 0.680, 0.914 and 0.369, respectively i.e. ($p<0.001$). Similarly, dedication has positive relationship with absorption (0.621, $p<0.001$), work engagement (0.886, $p<0.001$) and conscientiousness (0.363, $p<0.001$). There is a significant positive relationship between conscientiousness and work engagement with correlation coefficient 0.400, $p<0.001$). Absorption is positively correlated with conscientiousness and work engagement as the correlation coefficient is 0.335 and 0.864, respectively i.e. ($p<0.001$).

Work engagement and Neuroticism.

The correlation values between the variables of vigor, dedication, absorption, work engagement and neuroticism of public banks. Neuroticism has negative relationship with vigor (-0.342), dedication (-0.303), absorption (-0.215) and work engagement (-0.323). On the contrary work engagement has a significant positive correlation with vigor, dedication and absorption with coefficient of correlation 0.914, 0.886 and 0.864, respectively. There is a significant positive relationship between dedication and vigor with correlation coefficient 0.746. Absorption has significantly positive relationship with dedication and vigor with coefficient of correlation 0.621 and 0.680, respectively.

5.2.4 Work Engagement and Openness to experience.

The correlation values between the variables of vigor, dedication, absorption, workout engagement and openness of public banks. Vigor is significantly positively correlated with dedication, absorption, work engagement and openness with coefficient of correlation 0.746, 0.680, 0.914 and 0.385, respectively i.e. ($p<0.001$). Similarly, dedication has positive relationship with absorption (0.621, $p<0.001$), work engagement (0.886) and openness (0.389). There is a significant positive relationship between openness and work engagement with correlation coefficient 0.424, $p<0.001$) . Absorption is positively correlated with openness and work engagement as correlation coefficient is 0.355 and 0.864, respectively i.e. ($p<0.001$).

5.2.5 Work Engagement and Personality Traits.

The correlation values between the variables of vigor, dedication, absorption, workout engagement and personality traits of public banks are presented by table 3. Personality traits had a positive relationship with vigor (0.439, $p<0.001$), dedication (0.430, $p<0.001$), absorption (0.476, $p<0.001$) and work engagement (0.505, $p<0.001$). Likewise Absorption is significantly positively correlated with dedication and vigor with coefficient of correlation 0.621 and

0.680, respectively i.e. (p<0.001). Work engagement has positive relationship with vigor, dedication and absorption with coefficient of correlation 0.914, 0.886 and 0.864, respectively i.e. (p<0.001). There is a significant positive relationship between dedication and vigor with correlation coefficient 0.746, p<0.001).

Conclusion:

The present study was conducted in banking sector which is one of the emerging and an impressive sector for the youth of country especially the females but the tremendous change in the sector has developed a need to study work engagement and the role played by the big five personality traits. The result of the present study suggests that there is a significant positive relation between work engagement and big five personality traits. The level of work engagement was found to be high in the banking sector which implies that the female employees working in this sector are satisfied with their job and are fully vigorous, dedicated and are absorbed. Though the level of personality traits were average but agreeableness was found to be high which implies that the respondents are more motivated and positive towards resolving the conflicts. Thus, the present study may help in future reviews and this study in other institutes need to be done.

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Table 1: Mean and Standard Deviation

	N	Mean	Std. Deviation	Minimum	Maximum
Vigor	150	22.75	3.92	12.00	30.00
Dedication	150	20.64	3.68	10.00	25.00
Absorption	150	23.63	3.78	13.00	30.00
Work Engagement	150	67.02	10.10	38.00	85.00
Extraversion	150	28.07	4.60	16.00	39.00
Agreeableness	150	36.58	4.21	25.00	45.00
Conscientiousness	150	35.83	5.33	14.00	45.00
Neuroticism	150	20.24	5.63	8.00	34.00
Openness	150	38.97	4.36	29.00	50.00
Personality Traits	150	159.69	11.57	129.00	184.00

Table 2: Level of Work Engagement & Personality Traits

Variables		Frequency	Percentage	Normal Range
Vigor	Low	45	30.0%	Below 20
	Average	52	34.7%	21-22
	High	53	35.3%	Above 23
Dedication	Low	41	27.3%	Below 19
	Average	47	31.3%	20-21
	High	62	41.3%	Above 22
Absorption	Low	43	28.7%	Below 22
	Average	56	37.3%	23-25
	High	51	34.0%	Above 26
Work Engagement	Low	46	30.7%	Below 62
	Average	49	32.7%	63-71
	High	55	36.7%	Above 72

Extraversion	Low	41	27.3%	Below 26
	Average	64	42.7%	27-29
	High	45	30.0%	Above 30
Agreeableness	Low	49	32.7%	Below 34
	Average	48	32.0%	35-38
	High	53	35.3%	Above 39
Conscientiousness	Low	46	30.7%	Below 33
	Average	56	37.3%	34-37
	High	48	32.0%	Above 38
Neuroticism	Low	52	34.7%	Below 17
	Average	55	36.7%	18-22
	High	43	28.7%	Above 23
Openness	Low	42	28.0%	Below 37
	Average	64	42.7%	38-41
	High	44	29.3%	Above 41
Personality Traits	Low	47	31.3%	Below 154
	Average	54	36.0%	155-161
	High	49	32.7%	Above 162

Table 3: Correlation between Work Engagement & Personality Traits

	Vigor	Dedication	Absorption	Work engagement	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Personality
Vigor	1	.746**	.680**	.914**	.395**	.368**	.369**	-.342**	.385**	.439**
Dedication		1	.621**	.886**	.425**	.260**	.363**	-.303**	.389**	.430**
Absorption			1	.864**	.373**	.398**	.335**	-.215**	.355**	.476**
Work engagement				1	.447**	.386**	.400**	-.323**	.424**	.505**
Extraversion					1	.266**	.461**	-.475**	.306**	.591**
Agreeableness						1	.560**	-.295**	.346**	.714**
Conscientiousness							1	-.593**	.405**	.711**
Neuroticism								1	-.238**	-.172*
Openness									1	.695”
Personality										1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

DYNAMICS OF HORTICULTURE PRODUCE MARKETING: A STUDY BASED ON HIMACHAL PRADESH

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ABSTRACT

The fact is well known that fruits provides important vitamin and minerals, in some cases fruits are even considered as the healer for various diseases. Among all these benefits horticulture industry provides great benefit to the GSDP of the country. Horticulture products plays and important role in commerce trade and food processing industry. However currently horticulture industry is not delivering according to its potential due to the problem and challenges it has with respect to the distribution and marketing channels in the state. Not only in the state, when it comes to the marketing and distribution of horticulture crop, it has been a major problem in India as well. Marketing is the process of movement of goods from produces to consumer at the desired time, place and form. In view of this, this research paper tries to express the dynamics of horticulture produce marketing in the state of Himachal Pradesh. This research paper also tries to put some emphasis on the marketing aspects of horticulture produce of the state as it is not to mention that livelihood of the state depends on it. The focus on the marketing aspect will enhance the potential of this industry and will generate enormous amount of opportunities.

KEYWORDS

Himachal Pradesh, horticulture produce marketing.

JEL CODE

INTRODUCTION

Himachal Pradesh is a state which possess its economic strength in the activities related to agriculture, horticulture, animal husbandry, limestone mines and allied activities in the primary sector. Among other states of the country Himachal provides one the best horticulture environment. Horticulture industry of Himachal Pradesh provides fruits, vegetables, species, floriculture and coconut etc. the state of Himachal provides diversified climate conditions and wide range of soils to accommodate the horticulture industry. When it comes to Horticulture Himachal provides fruits, vegetables, species, Floriculture and coconut etc. and it also has diversified climate conditions and wide range of soils to accommodate the horticulture industry. It also provides many experienced and skilled workers (ranging from officer class to labour class), so it will generate high employment to the state post COVID-19.

Horticulture contribution towards the state domestic product

1. HP is the only state in the country whose 89.96% of population lives in rural areas (census 2011)
2. It provides 62% of the total workers of the state.
3. Till now about 10.4% of total GSDP comes from the agriculture and its allied sectors.

Total geographical area of the state is 55.67 lakh hectares, out of which operational holding is of 9.55 lakh hectares, which is being operated by 9.61 lakh farmers (land holdings according to 2010-11). 87.95 % of the holdings are of others (agriculture census). 11.71 percent of holding are owned by semi medium and medium farmers and 0.34 percent is by large ones. Economic survey of India (2008) provides data regarding the growth rate of food grain products which is decelerated to 1.2 percent from 1990-2007. The population of India is increasing and is estimated to touch 1370 million by 2030. Demand will rise and to meet this demand production of food grains needs to be 289 mt, which is matter of concern.

On the basis of past studies, it can be stated that very few studies have been conducted in the area of marketing of horticulture produce in Himachal Pradesh which involves problems related to marketing of horticulture produce of the state, awareness about the government policies provided by the state government as well as the centre government, problems in the existing techniques used for the marketing of horticulture products. Keeping these facts in mind, there is a need of improvement in the area of marketing of horticulture produce and thus the study on marketing of horticulture produce in Himachal Pradesh is required in order to develop new strategies for the solution of problems in the future.

Marketing of Horticulture produce is a complex phenomenon. Marketing pattern of horticulture is different from other agriculture commodities. Every horticulture produce has its own different pattern cum channel of distribution. For example, Apples are first brought to the nearby wholesale markets and from there to the terminal markets. The dispersion channel is totally different in case of apples. In similar manner for other horticulture produce dispersion channel is different from one another. Middleman plays a vital role in the trade of horticulture produce i.e. between the producers and the consumers. Horticulture produce marketing in Himachal Pradesh is carried out by private sector which involves pre-harvest contractor, forwarding agent, commission agents, wholesalers and retailers. Due to involvement of middlemen there is exploitation of producers and this effects the profit margin one can get from their crop.

On the basis of past studies, it can be stated that very few studies have been conducted in the area of marketing of horticulture produce in Himachal Pradesh, which involves problems related to marketing of horticulture produce of the state, awareness about the government policies provided by the state government as well as the centre government, problems in the existing techniques used for the marketing of horticulture products. Keeping these facts in mind, there is a need of improvement in the area of marketing of horticulture produce and thus the study on marketing of horticulture produce in Himachal Pradesh is required in order to develop new strategies for the solution of problems in the future. The fact is well known that fruits provides important vitamin and minerals, in some cases fruits are even considered as the healer for various diseases. Among all these benefits horticulture industry provides great benefit to the GSDP of the country. Horticulture products plays and important role in commerce trade and food processing industry. However currently horticulture industry is not delivering according to its potential due to the problem and challenges it has with respect to the distribution and marketing channels in the state. Not only in the state, when it comes to the marketing and distribution of horticulture crop, it has been a major problem in India as well.

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INTRODUCTION

REVIEW OF LITERATURE

NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESIS (ES)

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

LIMITATIONS

SCOPE FOR FURTHER RESEARCH

REFERENCES

APPENDIX/ANNEXURE

The manuscript should preferably be in ***2000 to 5000 WORDS***, But the limits can vary depending on the nature of the manuscript.

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BOOKS

- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio" Ohio State University, Nigeria.

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ONLINE RESOURCES

- Always indicate the date that the source was accessed, as online resources are frequently updated or removed.

WEBSITES

- Garg, Bhavet (2011): Towards a New Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

DYNAMICS OF HORTICULTURE PRODUCE MARKETING: A STUDY BASED ON HIMACHAL PRADESH

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ABSTRACT

The fact is well known that fruits provides important vitamin and minerals, in some cases fruits are even considered as the healer for various diseases. Among all these benefits horticulture industry provides great benefit to the GDP of the country. Horticulture products plays and important role in commerce trade and food processing industry. However currently horticulture industry is not delivering according to its potential due to the problem and challenges it has with respect to the distribution and marketing channels in the state. Not only in the state, when it comes to the marketing and distribution of horticulture crop, it has been a major problem in India as well. Marketing is the process of movement of goods from produces to consumer at the desired time, place and form. In view of this, this research paper tries to express the dynamics of horticulture produce marketing in the state of Himachal Pradesh. This research paper also tries to put some emphasis on the marketing aspects of horticulture produce of the state as it is not to mention that livelihood of the state depends on it. The focus on the marketing aspect will enhance the potential of this industry and will generate enormous amount of opportunities.

KEYWORDS

Himachal Pradesh, horticulture produce marketing.

JEL CODES

Q13, M31.

INTRODUCTION

Himachal Pradesh is a state which possess its economic strength in the activities related to agriculture, horticulture, animal husbandry, limestone mines and allied activities in the primary sector. Among other states of the country Himachal provides one the best horticulture environment. Horticulture industry of Himachal Pradesh provides fruits, vegetables, species, floriculture and coconut etc. the state of Himachal provides diversified climate conditions and wide range of soils to accommodate the horticulture industry. When it comes to Horticulture Himachal provides fruits, vegetables, species, Floriculture and coconut etc. and it also has diversified climate conditions and wide range of soils to accommodate the horticulture Industry. It also provides many experienced and skilled workers (ranging from officer class to labour class), so it will generate high employment to the state post COVID-19.

Horticulture contribution towards the state domestic product

1. HP is the only state in the country whose 89.96% of population lives in rural areas (census 2011).
2. It provides 62% of the total workers of the state.
3. Till now about 10.4% of total GSDP comes from the agriculture and its allied sectors.

Total geographical area of the state is 55.67 lakh hectares, out of which operational holding is of 9.55 lakh hectares, which is being operated by 9.61 lakh farmers (land holdings according to 2010-11). 87.95 % of the holdings are of others (agriculture census). 11.71 percent of holding are owned by semi medium and medium farmers and 0.34 percent is by large ones. Economic survey of India (2008) provides data regarding the growth rate of food grain products which is decelerated to 1.2 percent from 1990-2007. The population of India is increasing and is estimated to touch 1370 million by 2030. Demand will rise and to meet this demand production of food grains needs to be 289 mt, which is matter of concern.

On the basis of past studies, it can be stated that very few studies have been conducted in the area of marketing of horticulture produce in Himachal Pradesh, which involves problems related to marketing of horticulture produce of the state, awareness about the government policies provided by the state government as well as the centre government, problems in the existing techniques used for the marketing of horticulture products. Keeping these facts in mind, there is a need of improvement in the area of marketing of horticulture produce and thus the study on marketing of horticulture produce in Himachal Pradesh is required in order to develop new strategies for the solution of problems in the future.

Marketing of Horticulture produce is a complex phenomenon. Marketing pattern of horticulture is different from other agriculture commodities. Every horticulture produce has its own different pattern cum channel of distribution. For example, Apples are first brought to the nearby wholesale markets and from there to the terminal markets. The dispersion channel is totally different in case of apples. In similar manner for other horticulture produce dispersion channel is different from one another. Middleman plays a vital role in the trade of horticulture produce i.e. between the producers and the consumers. Horticulture produce marketing in Himachal Pradesh is carried out by private sector which involves pre-harvest contractor, forwarding agent, commission agents, wholesalers and retailers. Due to involvement of middlemen there is exploitation of producers and this effects the profit margin one can get from their crop.

On the basis of past studies, it can be stated that very few studies have been conducted in the area of marketing of horticulture produce in Himachal Pradesh, which involves problems related to marketing of horticulture produce of the state, awareness about the government policies provided by the state government as well as the centre government, problems in the existing techniques used for the marketing of horticulture products. Keeping these facts in mind, there is a need of improvement in the area of marketing of horticulture produce and thus the study on marketing of horticulture produce in Himachal Pradesh is required in order to develop new strategies for the solution of problems in the future. The fact is well known that fruits provides important vitamin and minerals, in some cases fruits are even considered as the healer for various diseases. Among all these benefits horticulture industry provides great benefit to the GDP of the country. Horticulture products plays and important role in commerce trade and food processing industry. However currently horticulture industry is not delivering according to its potential due to the problem and challenges it has with respect to the distribution and marketing channels in the state. Not only in the state, when it comes to the marketing and distribution of horticulture crop, it has been a major problem in India as well.

REVIEW OF LITERATURE

Parmar (2005) reported in his study "Marketing Operations of Himachal Apple- An overview" that a good production of apple and the marketing problems of growers are increasing day by day with the increase in the production of apples.

Dastagiri,M.B and Kumar Ganesh. B., (2010) reported in "Innovative Models in Horticulture Marketing in India "India produces around 111.8 MT of vegetables and 57.73 MTs of fruits (2006-07).

Ahmad, and Rifat, **(2012),** stated in "Marketing of Fruit Products: A case of Apple Fruit in Himachal Pradesh" marketing efficiency is important for increasing production and fair returns to apple growers. They talked about three marketing channels and have concluded that marketing channel i.e., Growers to consumer is having less price spread and more returns to growers, but is in rare practice due to lack of marketing information, credit and institutional facilities, small holdings.

Bowman, and Zilberman, **(2013)** research findings "Economic factors affecting diversified farming systems. Ecology and Society", had concluded that the expansion and adoption of DFS is limited by a number of factors, including still-limited demand for products produced via DFS, supply-side constraints such as high costs of tilling or harvest in multiple crop systems, and policies such as subsidies and crop insurance which discourage diversification.

Gaurav Bera, **(2015)** "An assessment of apple cultivation in Kalpa (Kinnaur Distt.) Himachal Pradesh". This research mentioned that horticulture has great future prospect in terms of exports. It also mentioned that horticulture does affect the socioeconomic life of inhabitants of Kalpa.

Tripathya, and Manjunath, **(2014)** investigation of the study "Operational semi-physical spectral-spatial wheat yield model development" had identified the existing farming systems in 12 major states of India at district level using remote sensing and ancillary data, delineated 44 farming systems with the help of GIS it became possible for integrating different enterprises

Chatterjee et al., **(2015)** in "Methodology of identification and characterization of farming systems in irrigated agriculture: Case study in West Bengal State of India" had identified four distinct farm types, namely, farms growing food grain and jute, farms with animal husbandry and fishery based diversification with high off-farm income, farms with crop based diversification with off-farm income, and farms growing vegetables and fruits and also concluded that farm type identification and characterization based on estimates of income from different farm components allows simplifying diversity in farming systems.

Parrey, and Hakim, **(2015**) States in). "Exploring marketing activities of apple growers: Empirical evidence from Kashmir" that apple grower has strong incentive to apple sale information, investigating price and demand changes by using all the available information sources. However, low availability of market information and high cost on analysis and recognition of getting signals cause such problems, including convergence of information sources, limitation in the local market, and low reliability of information.

Goswami et al., **(2014)** in their study "Farm types and their economic characterization in complex agro-ecosystems for informed extension intervention: study from coastal West Bengal, India of research findings" had identified four major types of farms, based on the source from which maximum gross income was earned by the farmers. Those were – rice-based farming system (34 households), vegetable - based farming system (70 households), fishery - based farming system (10 households) and farming system based on off - farm income (20 households).

Lokesh, and Hira.S, **(2014)** in his research paper entitled, "Horticulture development in Himachal Pradesh: An Empirical Analysis", the contribution of the horticulture within primary sector has risen from 18.53 percent in 2000-01, 26.98 per cent in 2009-10. In terms of contribution to GSDP and NSDP, horticulture sector demonstrates a phenomenal place during the span of ten years.

Iles and Marsh, **(2012)** findings of the study "Nurturing Diversified Farming Systems in Industrialized Countries: How Public Policy Can Contribute" had concluded diversified farming systems depends on the willingness and capacity of farmers to diversify their farms, but they need support and incentives to help survive the risks of changing from conventional to alternative production practices and to work together more collaboratively at the landscape level.

Khatun and Roy, **(2012)** in their study "Rural livelihood diversification in West Bengal: Determinants and constraints" conducted in the state of West Bengal had shown that household-head experience(age), educational level, social status, training, asset position, access to credit, rural infrastructure, agro climatic condition and the overall level of economic development of a region are the main driving force towards livelihood diversification in the state.

OBJECTIVES OF THE STUDY

The objectives of the study are to analyse the horticulture produce marketing in the state which will involve the existing marketing practices, and also to analyse the government aids with respect to horticulture produce.

1. To analyse the government aids by the state government with respect to horticulture industry.
2. To analyse the distribution channels of different horticulture produce.
3. To analyse the contemporary marketing issues with respect to horticulture produce.

RESEARCH METHODOLOGY

This research paper is an analytical study which is based on secondary data. Secondary data means which is already available, it refers to data which has been collected and analysed by someone else. Certain types of secondary data such a product details of the company, main aspects of the research, data about the marketing of new products, essentials of advertisements in marketing etc. For meeting the objectives of the study, the secondary data of last 10 years related to production of various horticulture produce of Himachal Pradesh has been analysed. The data for this purpose has been collected from the secondary sources such as official websites, reports, journals and newspapers etc.

ANALYSIS AND DISCUSSION

1. GOVERNMENT AIDS

A. MISSION FOR INTEGRATED DEVELOPMENT OF HORTICULTURE(MIDH)

Mission for integrated development of horticulture sector is a sponsored scheme for the overall growth of this sector which covers fruits, vegetables, root & tuber crops, mushrooms, spices, flowers, aromatic plants, coconut, cashew and cocoa.

Under MIDH there are further five more schemes on horticulture:

i) National Horticulture Mission (NHM)
ii) Horticulture Mission for North East and Himalayan States (HMNEH)
iii) National Horticulture Board (NHB)
iv) Coconut Development Board (CDB)
v) Central Institute of Horticulture (CIH), Nagaland

In MIDH, Govt. of India (GOI) contributes 60% of the total outlay and 40% of the total outlay is provided by the state governments. For the North East States and Himalayan States, GOI contributes 90%. Under the above mentioned 5 schemes GOI contributes 100%. The total Budget allocated for this is Rs. 2160.25 crore has been earmarked for 2020-21. And as on 31st December, 2020 Rs. 857.47 crores have been released under MIDH, i.e. Rs. 495.13 crore for NHM, Rs. 197.75 crore under HMNEH, Rs. 80.00 crore under CDB, 77.42 Crore to NHB and Rs. 7.17 crore to CIH, DCCD & DASD.

i. NATIONAL HORTICULTURE MISSION(NHM):

NHM comes under MIDH which is centrally sponsored scheme and was launched in 2005-06, it aims at the overall development of the horticulture, through cluster approach which ensures forward and backward linkage and also the active participation of all the stake holders. 384 districts in 18 states and 6 union territories were covered under NHM. There are total of 16 national level agencies (NLAs) that were included under this Mission.

A. PHYSICAL PROGRESS

TABLE 1: PHYSICAL PROGRESS UNDER NHM

S. No.	Components	Unit	Progress during 2020-21 (as on 31st December, 2020)
1	Area Expansion	Ha.	80406
2	Rejuvenation	Ha.	6783
3	Protected Cultivation	Ha.	9450
4	Integrated Pest/ Nutrient Management	Ha.	35460
5	Nurseries	No.	14
6	Water Resources	No.	1213
7	Beekeeping	No.	49194
8	Horticulture Mechanization	No.	4081
9	Post Harvest Management		
	(i) Pack House	No.	661
	(ii) Cold Storage	No.	29
	(iii)Primary/mobile processing units	No.	117
10	Rural Market	No.	1

Source: as per the data uploaded by State Govt. on MIDH web portal

B. FINANCIAL PROGRESS

During 2019-20, as on 31st March, 2020, funds to the tune of Rs. 800.13 crore have been released to States/ UTs/NLAs for implementing NHM scheme against BE of Rs.1217.00 crore and RE of Rs 1065.00 crore. During 2020-21, an amount of Rs. 1363.62 crore has been allocated for NHM, against of which an amount of Rs. 495.13 crore has been released as on 31st December, 2020.

ii. HORTICULTURE MISSION FOR NORTH EAST AND HIMALAYAN STATES (HMNEH):

HMNEH is a scheme under MIDH which is also a centrally sponsored scheme for North East and Himalayan states. Earlier this scheme was known as Technology Mission for Integrated Development of Horticulture in North Eastern States only, since 2001-02. During the X plan (2003-04) this scheme was extended to three Himalayan states namely: Himachal Pradesh, Jammu and Kashmir and Uttarakhand. This scheme covers full spectrum of horticulture, from the planting to the consumption with the forward and backward linkage. HMNEH subsumed under MIDH from 2014-15.

A. PHYSICAL PROGRESS

TABLE 2: PHYSICAL PROGRESS UNDER HMNEH

S. No.	Components	Unit	Progress during 2020-21 (as on 31st December, 2020)
1	Area Expansion	Ha.	3843
2	Rejuvenation	Ha.	300
3	Protected Cultivation	Ha.	125
4	Integrated Pest/Nutrient Management	Ha.	6730
5	Nurseries	No.	5
6	Water Resources	No.	15
7	Beekeeping	No.	0
8	Horticulture Mechanization	No.	1067
9	Post Harvest Management		
	(i) Pack House	No.	32
	(ii) Cold Storage	No.	0
	(iii) Primary/Mobile Processing Units	No.	0
10	Rural Market	No.	0

B. FINANCIAL PROGRESS

During 2019-20, as on 31st March, 2020, funds to the tune of Rs. 326.74 crore have been released to States implementing HMNEH scheme against BE of Rs.415.00 crore. During 2020-21, an amount of Rs. 470.00 crore has been allocated for North Eastern States and Himalayan States (including PMDP), against which an amount of Rs. 197.75 crore has been released as on 31st December, 2020.

iii. NATIONAL HORTICULTURE BOARD

Government of India started National Horticulture Board (NHB) in 1984 as an autonomous body under Ministry of Agriculture and Farmers Welfare and registered under societies registration act 1860 and re-registered under the Haryana Registration and Regulation of Societies Act 2012. The NHB aims at the commercial horticulture development by creation of production hubs, post-harvest infrastructure and cold chain facilities, promotion of new crops and promotion of growers' associations.

A. PHYSICAL PROGRESS

1. Under the scheme of Commercial Horticulture Development through Production and Post-Harvest Management, board sanctioned 249 projects as on 31 December, 2020, which involves subsidy of Rs. 3219.50 Lakh.
2. Under the Capital Investment Subsidy for construction/ expansion/ modernization of cold storages for horticulture produce scheme, board sanctioned 06 projects of cold storages/CA storages which involves subsidy of Rs. 32122 MT as on 31.12.2020.
3. Under the scheme of Technology development and Transfer for promotion of Horticulture, board sanctioned 04 projects for New technology introduction, progressive farmers visit, horticulture sangam, various awareness programs which involves financial assistance of Rs. 11.21 Lakh as on 31.12.2020.

B. FINANCIAL PROGRESS

For the period 2020-21, total of Rs. 77.42 crore has been released to NHB against BE of Rs. 170.00 crore.

2. MARKETING AND DISTRIBUTION CHANNEL

A Horticulture produce marketing agency have many activities and operations like procurement, packing, storage, transportation, processing and marketing of produce related to horticulture sector. Marketing strategy for horticulture produce, if it is efficient, rely on the decisions related to where, when and how much to market. The horticulture products pass through different channels on their way to final consumer and the profit share of producers depends on the channel followed.

i. DISTRIBUTION STRATEGIES FOR HORTICULTURE PRODUCES

Distribution, as the name suggest, is the process of making a product available for final consumer. It is very important to have a good distribution channel for every product. Horticulture produce involves perishable products, therefore, distribution is considered to be very important element. Due to perishability, the distribution channel of these products needs to be as fast as possible.

There are so many factors which plays an important role in the distribution of horticulture produce such as nature of produce, Competitors choice of selection of channel, financial resources, transportation saving, storage facilities, market knowledge, High marginal cost, image of the producers, price and convenience. The large chain of commission agents affects the profit of orchardists, so choosing a cost saving channel is always considered to be the best channel. Distribution

channel also involves commission agent, wholesaler, private companies HPMC, and retailers. Majority of horticulture produce growers consider commission agent and wholesaler as the most efficient channel.

ii. DISTRIBUTION CHANNELS OF HORTICULTURE PRODUCE

Marketing of any consumer good comprises of the movement that good from producer to consumer, and in case of Horticulture produce one can say from grower to consumer. Distribution is important because it decides the almost everything in any business. Distribution channels one is using needs to be efficient and cost effective so that growers/producers can get the maximum benefit out of it. In the state of Himachal Pradesh there are so many problems in when it comes to distribution due to its geographical situation. It is very challenging for the producers to manage the supply chain in the state. In this chain of distribution there are various agencies involved like growers, pre-harvest contractors, wholesalers, retailers and consumers. The following are the existing channels used for the purpose,

1. Channel A: Producer-wholesaler-retailer-consumer
2. Channel B: Producer-primary wholesaler-secondary wholesaler-retailer-consumer
3. Channel C: Producer-pre harvest contractor-primary wholesaler-secondary wholesaler- retailer-consumer
4. Channel D: Producer-retailer-consumer

iii. MARKETING FUNCTIONS

Marketing in case of Horticulture produce involves various marketing function. After growing the produce has to be prepared for the market which involves picking, assembling, grading, packing, transportation, loading/unloading, storage etc. These marketing functions are important determinants for setting up the prices of horticulture produce. Being careful in performing these function helps in setting up the good tone for the net returns and vice-versa.

i) **Harvesting**: marketing function starts from the picking function and hence it is important to depicts the correct time for picking to ensure its quality and maximum storage life. The picking stage also depends on the time lag between the expected arrival of the produce in the market and picking. The horticulture produces are considered to be very susceptible to bruising and other mechanical injuries and therefore, should be handled carefully. If any damage cause due to rough handling, it will reduce the value of the horticulture produce.

ii) **Grading**: Grading is considered to be the second important marketing function. Grading is not considered for every horticulture produce as it varies from produce to produce, for example in case of apples, apples are classified into different grades on the bases of quality, sizes.

iii) **Packing**: packaging is considered to be very important marketing function as it is the package which appears in front of consumer. Horticulture produce involves perishable items which are fragile in nature, and needs to be transported to different locations therefore it is very important to have a good packaging material which can protect and preserve its quality during transportation and handling.

iv) **Transportation**: transportation is another function in marketing which adds utility and need to be done carefully. Managing the supply chain is very important as horticulture produces are perishable and fragile in nature.

CONCLUSIONS AND SUGGESTIONS

Himachal Pradesh provides wide variety of soils and diversified climate conditions for the horticulture produces in the state. Geographical area of the which ranges from Lower hills (Shivalik range), Inner Himalayas (mid-mountains) and Greater Himalaya (Alphine zone) makes it suitable to produce variety of horticulture produce within the state itself. Horticulture produce in the state is having very wide range i.e. Apple, Plum, Peach, Apricot, Pear, Cherry, Kiwi, Pomegranate, Olive, Persimmon, Strawberry, Almond, Walnut, Pecannut, Hazulnut, Mango, Litchi, Guava, Papaya, Jackfruit, Aonla, Grapes, Loquat, Ber, Banana, Karonda, Fig, Spota, Deon, Bael, Harad, Jamun, Baherba, Orange/Kinnow, Malta/Musambi, Kagzi Lime, Galgal, Grape fruit, etc. There are approximately 38 varieties of fruits only.

Among other issues related to horticulture sector, marketing and distribution channel in the state needs to be improved. Focusing on Marketing channels will open many opportunities to the growers as well as towards the economy of the state. The existing marketing practices needs to revisited by the government as well as the growers. Innovative strategies and new marketing tools available in the market needs to be utilized by the horticulture sector as well. Centre as well as state governments are providing so many facilities to the growers but many of the growers are not aware of it. Awareness programs should be provided to the growers. Supply chain facility which will manly focus on the transportation related issues needs to be addressed. E-Marketing as well as direct marketing will enhance the states potential in the horticulture sector. Niche marketing and in case of premium quality produce can also be considered. Also, advertising and promotional activities needs to be focused and increased.

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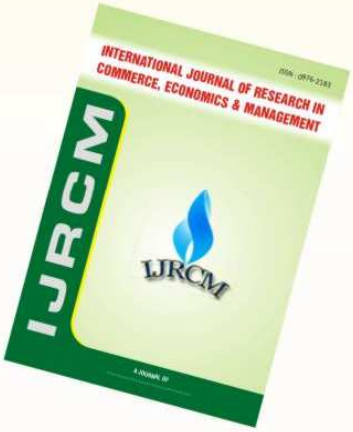



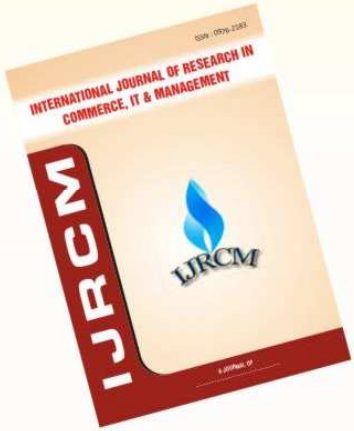

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डॉ. हरिदत्त शर्मा के एकाङ्कियों में प्रतिपादित समस्याएँ

डॉ. देवराज*

२१वीं शताब्दी के साहित्यकारों में डॉ. हरिदत्त शर्मा भी अग्रपंक्ति के साहित्यकारों में से एक हैं। इनका जन्म उत्तर प्रदेश के हाथरस नगर में २७ सितम्बर १९४८ ई. को हुआ। इनके पिता का नाम लहरीशंकर शर्मा तथा माता का नाम हरप्यारी देवी था। डॉ. शर्मा बचपन से ही मेधावी छात्र रहे हैं। इनकी उच्चतर शिक्षा इलाहाबाद विश्वविद्यालय से पूर्ण हुई है। इन्होंने संस्कृत काव्य एवं संस्कृत साहित्य में विशेष अध्ययन किया जिसके कारण इन्हें अनेकों सम्मान प्राप्त हुए हैं। इनकी अनेकों रचनाएँ जिनमें निबन्ध-निकुञ्जम्, गीतकन्दलिका, उत्कलिका प्रमुख रूप से प्रकाशित हुई है। इसके अतिरिक्त त्रिपथगा और आक्रन्दनम् एकाङ्की संग्रह प्रमुख है। त्रिपथगा में तीन तथा आक्रन्दनम् में चार एकाङ्कियों का संग्रह है। इनका प्रत्येक एकाङ्की किसी न किसी समस्या पर आधारित है। इसी कारण से इनके एकाङ्कियों में प्रतिपादित समस्याओं को उजागर करने का प्रयास किया जा रहा है।

भारत में सामाजिक समस्याएँ हमारे जीवन का अविभाज्य अंग बनकर रह गई हैं, क्योंकि मानव समाज इन समस्याओं से न तो कभी पूर्णतया मुक्त रहा है और न ही कभी इन समस्याओं से मुक्त हो पायेगा। यद्यपि आधुनिक भारत में जन संचार और शिक्षा के माध्यम से मानव इन समस्याओं के प्रति सजग और संवेदनशील तो हो गया परन्तु ये समस्याएँ आज भी हमारे समाज में विद्यमान है। जिस प्रकार समाज में परिवर्तन तीव्र गति से हो रहा है उसी प्रकार समस्याएँ भी बढ़ती ही जा रही हैं। मानव समाज इन समस्याओं के निराकरण के लिए सदा प्रयत्नशील भी है; क्योंकि ये समस्याएँ समाज में विघटन की स्थिति पैदा करती हैं जिससे समाज के अस्तित्व को खतरा पैदा हो जाता है।

भारतीय समाज में आज अनेकों समस्याएँ विकराल रूप लिए खड़ी हैं। यद्यपि राज्य एवं समाज इन समस्याओं के निराकरण के लिए प्रयासरत हैं फिर भी इन समस्याओं से सम्प्रति समाज ग्रसित ही है। डॉ. हरिदत्त शर्मा ने भी किसी न किसी समस्या को लेकर अपने एकाङ्कियों की रचना की है। **त्रिपथगा** इनका प्रथम एकाङ्की संग्रह है जिसमें 'साक्षात्कारीयम्' पहला एकाङ्की है। यह एकाङ्की हमारे समाज में व्याप्त भ्रष्टाचार की समस्या को उजागर करता है।

भ्रष्टाचार की समस्या

भ्रष्टाचार दो शब्दों के मेल से बना है - भ्रष्ट+आचार। भ्रष्ट का अर्थ होता है- पतित और आचार का अर्थ होता है - चरित्र। इसलिए पतित चरित्र वाले व्यक्ति को भ्रष्ट आचार वाला कहा जाता है। व्यक्ति जिन कर्मों से समाज और राष्ट्र का बुरा सोचता है ऐसे कर्मों का भ्रष्टाचार कहते हैं। भारत में भ्रष्टाचार ने अपनी जड़ें मजबूत की हुई है। आज भारत में मध्यमवर्गीय व्यक्ति अपनी आवश्यकताओं को पूर्ण करने तथा अपने

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ज्योति कुशवाहा
प्रधान सम्पादिका

डॉ. नरेश सिहाग, एडवोकेट
सम्पादक

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प्रशान्तराघवम् नाटक की कथावस्तु का नाट्यशास्त्रीय विवेचन

–डॉ. देवराज

सहायक आचार्य, संस्कृत, अन्तर्राष्ट्रीय दूरवर्ती शिक्षा एवं मुक्त अध्ययन केन्द्र हिमाचल प्रदेश विश्वविद्यालय शिमला

प्रशान्तराघवम् नाटक अभिराज राजेन्द्र मिश्र का प्रथम नाटक है। इसकी रचना नाट्यकार ने 2008 ई. मं की है। यह नाटक सात अंकों में विभक्त है। इस नाटक का उपजीव्य काव्य रामायण है। वाल्मीकि रामायण में सीताविषयक लोकापवाद के लिए श्रीराम को सीता का परित्याग करते हुए देखा जा सकता है किन्तु अभिराज राजेन्द्र मिश्र ने अपनी प्रतिभा से इस प्रसंग को अनूठा बना दिया है।

नाटककार ने विदेहनन्दिनी सीता के प्रति अयोध्या में रजकापवाद का निवारण अपनी अनूठी कल्पना से शान्त किया है। इसके निराकरण के लिए नाटककार ने ऐसे पात्र का चयन किया है जिसके अकाट्य तर्कों का कोई भी खण्डननहीं कर सकता। वह गुरु वशिष्ठ के माध्यम से सीता की महाविष्णुता तथा लक्ष्मीभाव की विश्वसनीयता तथा दिव्यचरित्र की प्रतिष्ठा को साक्ष्यों और अकाट्य तर्कों से सिद्ध करते हैं। जनसभा में उपस्थित सभी जनों और रजक में सीता–राम के प्रति अखण्ड आस्था तथा श्रद्धा जगा दी जाती है। इस प्रकार सीता के प्रति लोकनिन्दा का निराकरण तृतीय अंक में ही हो जाता है। इसके पश्चात् नाटककार अपनी कल्पना से देवर्षि नारद और ब्रह्मा का संवाद परिकल्पित कर घटना को नया मोड़ देता है। उनके संवाद से देवी सीता के जुड़वे पुत्रों के जन्म तथा कुमार भरत के द्वारा इस अवसर पर अयोध्या में एक महोत्सव आयोजित करने की सूचना मिलती है। षष्ठी महोत्सव के इस अवसर पर ऐन्द्रजालिक अपनी विद्या से अनूठे चमत्कार प्रदर्शित करता है। यह दृश्य हर्षदेव की रत्नावली नाटिका का स्मरण करवाता है। हो सकता है कि नाटककार उनसे प्रभावित हुआ हो जिससे उसने यह कल्पना कर डाली हो। रामायण में लव–कुश के जन्म की घटना वाल्मीकि के आश्रम में होती है किन्तु प्रशान्तराघव में नाटककार ने इस घटना को अयोध्या में ही घटित दिखाया है। उसने वाल्मीकि आश्रम का चयन केवल लव–कुश की शिक्षा निमित्त ही किया है।

महर्षि वाल्मीकि स्वयं ही अयोध्या आकर लव–कुश को शिक्षा निमित्त ले जाते हैं। सीता भी अपने पुत्रों के साथ वाल्मीकि आश्रम को जाती है। वाल्मीकि रामायण की सीता अन्त में पृथ्वी में समाहित हो जाती है किन्तु प्रशान्तराघव की सीता राम के विछोह में दुःखी रहती है। श्रीराम भी बच्चों और सीता के वियोग रात्रि व्यतीत करते हैं। श्रीराम नाटक के अंत में स्वयं ही वाल्मीकि आश्रम से सीता के ले जाते हैं।

भारतीय नाट्यशास्त्र की दृष्टि से नाटक के तीन तत्त्व होते हैं – वस्तु, नेता और रस। यही तत्त्व हैं जो एक नाटक को दूसरे से भिन्न करते हैं। कथावस्तु को यदि नाटक का शरीर कहे तो कोई अतिशयोक्ति नहीं होगी। कथावस्तु के बिना नाटक की कल्पना उसी प्रकार नहीं की जा सकती जिस प्रकार बिना शरीर के प्राणी की कल्पना नहीं की जा सकती। दशरूपक में कथावस्तु के दो भेद किए हैं– आधिकारिक और प्रासंगिक। प्रधानभूत कथावस्तु को आधिकारिक और अप्रधान कथावस्तु को प्रासंगिक कहते हैं।

प्रशान्तराघव नाटक में श्रीराम और सीता के वृत्तान्त से सम्बन्धित सभी घटनाएँ आधिकारिक है जिसके अन्तर्गत

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EFFECT OF CONSTRUCTIVIST TEACHING ON THE ACADEMIC ACHIEVEMENT OF ELEMENTARY SCHOOL STUDENTS IN RELATION TO THEIR SOCIO ECONOMIC STATUS

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DR. SHER SINGH PRINCIPAL, HIMACHAL COLLEGE OF EDUCATION, NALAGARH, DISTT SOLAN, HP-174101.

ABSTRACT

BACKGROUND OF THE STUDY: The National Curriculum Framework (NCF-2005) has recommends that curriculum should help the learners to become constructors of knowledge and emphasizes the active role of teachers in relation to the process of knowledge construction. The quality of education in schools and especially the effectiveness of teaching and learning have drawn the attention of educational policy planners and practitioner. Researchers conducted by NCERT and other research institutes in the context of minimum levels of learning (MLL), District Primary Education Programme (DPEP) midterm Assessment surveys and achievement surveys indicate the attainment of students is much below the desired levels.

AIM: The present study was undertaken to study the effect of teaching methodology i.e. Constructivist teaching on the academic achievement of elementary school students in relation to their Socio Economic Status.

METHOD AND PROCEDURE: The present study was experimental in nature. Quasi experimental research design was used to achieve the purpose of the present study. The study was designed on the basis of Non equivalent pretest- posttest control group design. The study was conducted on 140 6th grade students of A Government and A private Senior Secondary School in District Solan of Himachal Pradesh. The sample of the study was divided in to two groups termed as 'Experimental Group' (70)and this group was given treatment through new methodology based on constructivist Approach while the other group continued with the routine and conventional activities of the school and termed as 'control group'(70). Tools which are used in the study are: **.i.** Verbal Intelligence test by R.K. Ojha and K.Ray Choudhury **ii.**Socio-economic status scale R. L. Bharadwaj **iii.**Science Achievement test iv.Lesson Plans based on Constructivist Paradigm

MAJOR FINDINGS: There was no a significant difference between the mean achievement scores of the Upper class, Upper middle class, Middle class, Upper lower class and Lower class Socio economic status students of experimental and control group at Pre test level however a significant difference was found at Post Test and Delayed Post test level of all the categories of SES (Upper, Upper middle, Middle, Upper lower, Lower), when the students were taught by using new and traditional Interventions.

CONCLUSION: On the basis of the analysis and interpretation of the collected data and information it was concluded that teaching methodology (Constructivist Teaching) has a positive effect to enhance the academic achievement of elementary students in relation to all the classes of the their Socio Economic status,. Which reflects the effectiveness of the new intervention, hence it is being suggested that such kind of intervention should be encouraged to be used by the teachers in the teaching learning process at all the level of education to realise the goals of education.

KEY WORDS: CONSTRUCTIVIST TEACHING, ACADEMIC ACHIEVEMENT, ELEMENTARY SCHOOL STUDENTS

INTRODUCTION:

In the words of Benjamin Disraeli- "Experience is the child of Thought, and Thought is the Child of Action-We cannot learn men from books." India is one of the world's fastest growing countries; its dominance on the various sectors has been acknowledged world over. The education sectors and has an important role in achieving this position. Education is the most important medium in making a

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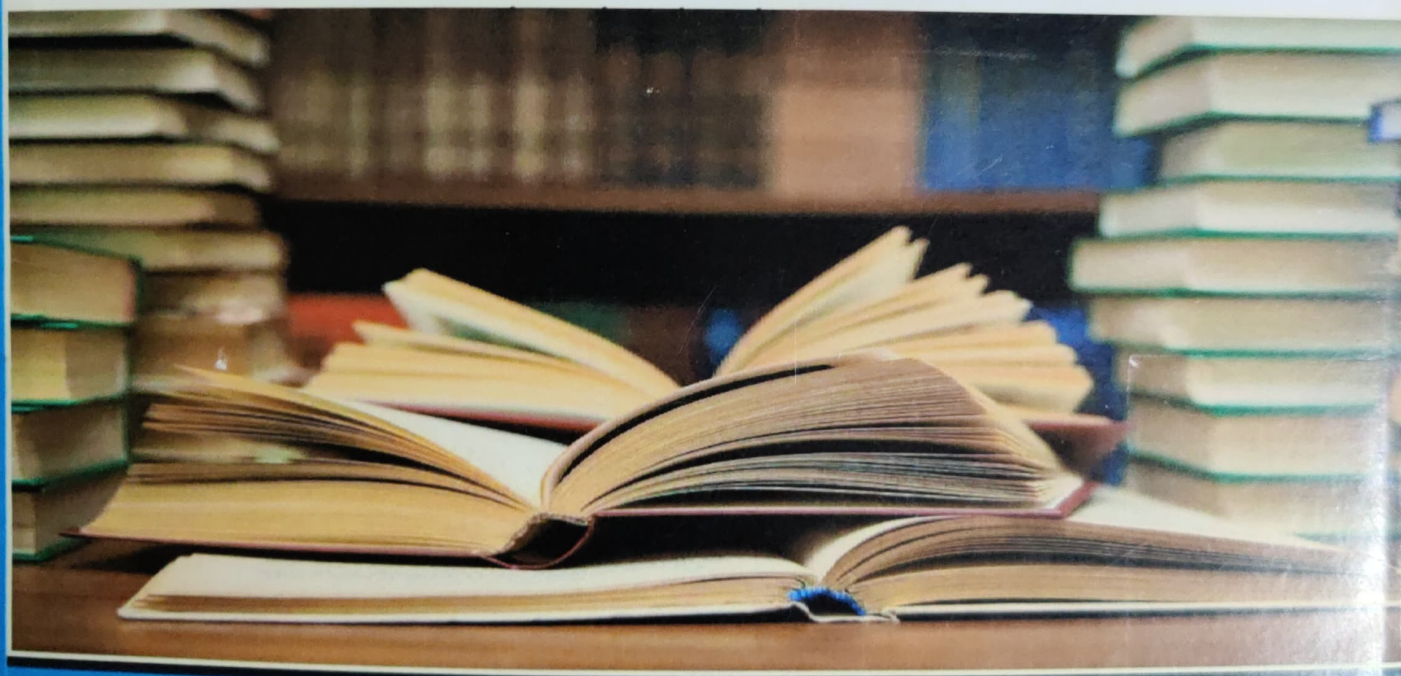

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YOGIC PRACTICES AND EMOTIONAL INTELLIGENCE AS THE TRUE MEDICINE TO MAINTAIN THE INTELLECTUA POWERS OF THE SECONDARY SCHOOL PRE-SERVICE TEACHERS

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ABSTRACT

In the present pandemic situation, human being is facing many problems related to their economic status, ethical values, day today's life, physical problem professional issues because this pandemic has crushed the whole world and it is affecting the lifestyle, goals, relationships, attitude of the people as wel professionals like doctors, engineers, teachers etc.. It is decreasing the emotional and spiritual values among people. So in this crucial stage yoga has come as medicine to maintain the intellectual powers of the professionals. Yoga is practising by the whole world because yoga is considered as "controlling of the mind the reunion of the body, mind and spirit. Yogic practice includes specific techniques such as "Asanas", "Pranayama" and "Dhyana". These are true medicines to the highest level of consciousness and to balance the emotional intelligence. Emotional intelligence consist empathy, self-control, successful relationships and motivation. But due to rapid change in the world, these values are decreasing. Emotional intelligence is an ability to monitor once on and other's feelings and emoti Studies reveal that emotional intelligence is the key to success. It is necessary for teachers to balance their emotions so that they could maintain their intelle powers. It is possible through the yogic practices that are helpful to maintain the emotions.

KEY WORDS: Yogic practices, emotional intelligence, intellectual powers, pre-service teachers.

INTRODUCTION:

Yoga is considered as the "controlling of the mind". It is also considered as the foundation of Indian philosophy and ancient technique that involves physical exercises, relaxation of the body and mind through meditation. It is a technique to balance our internal and external environment (Joseph & Fincey, 2019). Yoga comes from the Sanskrit word "YUJ" which mean "union", spiritual union of the individual soul with the universal soul (Jha, 2015). Yoga affects the aspects of our mind i.e. intellect, ego, reason and sub consciousness. These aspects make an individual empathetic, motivated and self-considered (Bulut Jakavljevic, 2011). Patanjali yoga sutra considered yoga as the central context of the yoga; Patanjali follows eight spiritual practices i.e Yam, Niyam, Asana, Pranayama, Pratyahara, Dharna, Dhyana and Smadhi that help in the internal and external purification. (Joseph, Fincy, 2019).

Yogic practices:

The root of yoga is *'Hinduism'* but it is not a religion. It is a variation of methods, exercise and practice of life with religious and spiritual goals (Bulut,2011). Yogic practices help to increase purity. The three levels of purification i.e. body, nervous system, and mind (Joseph Fincey, 2019). Yogic practices include the three basic aspects such as *"Asanas"* (posture), *"pranayama"* (breathing) and *"dhyana"* (meditation) (Patanjali Yoga sutra).

Asana:

Asana is referred to the sitting position. Posture is that where there is no trembling of body (Jha, 2015). It is a posture that opens the energy channels and psychic centres (Hath yoga Pradipika, 2013). Asana is a method to purify and strengthen the body (Joseph and Fincey, 2019).

Some techniques of Asanas:-

Asanas	Benefits
Padamasana	Disorder of disease, change in the metabolic structures and brain patterns, balance in the whole system of the body (Muktibodhnanda, 2012).
Swastika Asana	Induces fertility, creativity and auspiciousness, Essential for meditation, straighten the spinal cord; can pass nervous impulses freely to the brain.(muktibodhnanda,2012).
Bhujanga Asana	Improves and deepens breathing systems, removes back ache, tones gynaecological disorder.(saraswati,2015).
Shavasana	Useful for awareness of body and mind, revitalise the entire system of the body, useful in yogic management of high blood pressure, anxiety, cancer, hysteria and neurosis, relaxes the mind and develops dharna and dhyana (muktibodhnanda, 2012).

Meditation:

Meditation is the fixing of the mind on a definite locus. When there is one- pointedness, uniform flow – uninterrupted by any other cognitions of the contemplation of the contemplated object on that locus that is meditation (Jha, 2015).

Some techniques of meditation:-

Meditation	Benefits
Mindful meditation	Treats four areas of mind: anxiety, somastication, depression and social dysfunction (Yunesian et al, 2008).
Transcendental Meditation	Effective treatment for cardio vascular diseases, effects on right orbito-frontal cortex, right thalamu left temporal, gyrus inside the brain. Improves me well-being and sleep pattern (Balaji, 2012).
Mantra Meditation	"Sound can help and sound can heal", activates the frontal gyrus, pre-frontal cortex, middle cortex, pre central cortex (Tomasino et. Al.2013) used in depression and epilepsy, remove negative thoughts, create positive energy and find peace (Mehta, 2010
Vipasana Meditation	Reduces anxiety, increase productivity, facilitates t clarity of thoughts, concentration, better-decision making, reduce physical and psychological distress.(Chandiramani,1994).

Emotional Intelligence:

Emotional intelligence is an ability to motivate oneself and persist in the face frustration, to control impulse, to regulate one's mood and read and deal effe tively with other people's feeling (Goleman, 2013). Emotional intelligence defined by five elements given by Goleman i.e. self-regulation, self-awarenes social-awareness, self-motivation and empathy (Goleman, 1995).

- Self – regulation is an ability to monitor one's own emotions and to iden tify and name that state of emotion.
- Self-awareness is an ability to understand and recognise the personal moods, drives and emotions.
- Social awareness is an ability to manage the relationships and build rap port in the society.
- Self-Motivation means to direct one's emotions to recognise the oppor tunities and to achieve goals.
- Empathy is a skill to understand the emotional state of other people and act accordingly.

Relation between Yogic Practices and Emotional Intelligence:

Yogic practices and emotional intelligence is integrated as a whole; yoga teaches to regulate and control instincts in order to gain master over one's self (Joseph & Fincey, 2019). Practicing the yoga that is considered as the way of life bring

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A STUDY OF TEACHER EFFECTIVENESS OF SECONDARY SCHOOL TEACHERS IN RELATION TO THEIR GENDER, LOCALE, EDUCATIONAL QUALIFICATION AND TEACHING EXPERIENCE

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ABSTRACT

Teachers are the strengths of any country. They are charged with the greatest responsibility for "Nation Building". The teacher plays an essential role in increasing the efficiency of the school. An effective teacher is one who has a repertoire of various organizational strategies and teaching techniques. In the present investigation an attempt has been made to study teacher effectiveness among secondary school teachers in relation to their gender and stream. The survey method of the research has been utilized as a part of this research study. To collect the data, Teacher Effectiveness Scale (TES) developed and standardized by Puri and Gakkhar (2010) was used. For this study, a sample of 400 secondary school teachers was selected by using systematic random sampling technique from the two districts Chamba and Solan of Himachal Pradesh. The information collected was broken down by using mean, standard deviation and 't' test.

KEY TERMS Teacher Effectiveness, Secondary School Teachers, Gender, Locale, Educational Qualification and Teaching Experience.

Introduction

Teacher has a pivotal role in the educational system. The quality of teachers to a large extent depends upon the quality of teaching. At the root of teacher lies the learning, unless a teacher is not willing to learn. Teachers use a range of teaching strategies to effectively meet the needs and solve problems of individual learners. A school may have excellent material resources, equipments, building, library and other facilities along with a curricular appropriately adopted to suit the community need but if teacher are not effective and efficient and they are misfit, unsatisfied and indifferent to their responsibilities the whole programme is likely to be ineffective and wasted. For teaching the students effectively the teachers have to be effective.

The teaching is the fundamental duty of a teacher and it has to be made effective in order to make a successful teacher. The main important function of a teacher is to create a good learning environment that motivates the students to learn better. Only an effective teacher can meet the growing needs and challenges of the present scenario. An effective teacher can respond to rapidly changing cultural, economic, sociological and economic developments. A successful teacher can be understood as a teacher who helps to improve essential skills, understanding, appropriate propensities, attractive attitudes, self-esteem and sufficient individual change of learners. Effective teachers also encourage better school performance and an overall improvement in learners.

Need of the Study

Every year a large number of studies are allocated to educational issues of teachers, students and for the strategies for improving educational standards. In the educational system, teachers are playing a role in the forefront of educational reforms. But it is noteworthy that how far the teachers insist on the requirements of their profession and act as active agents, faithful to the goals of the educational system and how much they have internalized their professional values, and to what extent this internalization of professional values has affected their effectiveness. Teacher effectiveness is the competence and ability of a teacher to teach effectively. Teacher effectiveness is a matter of central importance to all educational institutions as it affects the process of learning and classroom management. Numerous theorists and researchers identified a variety of individual factors essential for facilitating student's achievement in terms of cognitive, affective and psychomotor learning or in promoting effective learning. Teacher effectiveness involves a set of teaching behaviors which are especially effective in bringing about desired changes in student's learning. In order to identify the teacher effectiveness the role and contribution of the teacher to the product of education needs to be examined. This enfolds that good teachers should possess the knowledge of learners characteristics learning process, classroom management, requisite skills to contribute significantly to the outcomes of educational process which is the growth of students in the right direction. Keeping this into view it is worthwhile to investigate the teacher effectiveness of secondary school teachers with other demographical variables.

Related Literature Review

Mohanta (2017) studied teacher effectiveness of secondary school teachers in relation to gender location and academic stream. For this study a sample of 130 secondary and higher secondary school teachers were randomly selected in and around Nadia and Murshidabad districts of West Bengal. The Teacher Effectiveness Scale developed by Kulsum (2006) was used for collecting the data. The data was analyzed by using mean, standard deviation,'t'- test and co-relation. The study highlights that the male school teachers and female school teachers do not differ significantly in their teacher effectiveness. The study uncover that there is a significant difference in teacher effectiveness among the school teachers with respect to locality, class handled (secondary and higher secondary) and academic streams (arts and science).

Chahal (2017) studied teacher effectiveness in relation to type of school and level of experience in Sirsa district of Haryana. The sample of the study was randomly selected 100 secondary school teachers. The tool used for the purpose of data collection was Kulsum's Teacher Effectiveness Scale by Kulsum (2011). The

data was analyzed by using mean, standard deviation and't'- test. Study found that the teacher effectiveness of government school teachers is higher than private school teachers, gender and locality does not have any significant role in teacher effectiveness. Results of the study revealed that the teachers having more than 10 years of experience are highly effective as compared to those having less than 10 years of experience in secondary schools.

Sharma (2018) studied teaching effectiveness of secondary school teachers in relation to demographical factors. For this study a sample of 400 secondary school teachers were selected through multistage probability sampling technique. To collect data Teacher Effectiveness Scale developed and standardized by Puri and Gakhar (2010) was used. The data was analyzed by using mean, standard deviation and't'- test. Study found; (i) Significant difference between male and female secondary school teachers, male teachers were found to be more effective than female teachers. (ii) Significant difference between govt. and private teachers, govt. secondary school teachers were more effective than private teachers.

Kavita (2019) studied teacher effectiveness of secondary school teachers in Panjab. For this study a sample of 186 teachers were selected by adopting simple random sampling technique. Teacher effectiveness scale constructed and validated by Kumar and Mutha (1999) was used to collect the relevant data. The data was analyzed by using mean, standard deviation and't'- test. It was found that the secondary school teachers have high level of effectiveness. Analyses were also done by testing the hypothesis to find out the significant difference in which it was found that there was no significant difference in their effectiveness level with reference to their gender, educational qualification, stage in which they are teaching. However there was a significant difference found in the level of effectiveness of teachers based on the years of their experience.

Objectives of the Study

The investigator of the present study has formulated the following objectives;

1. To compare the teacher effectiveness of secondary school teachers in relation to their gender (Male and Female).
2. To compare the teacher effectiveness of secondary school teachers in relation to their locale (Rural and Urban).
3. To compare the teacher effectiveness of secondary school teachers in relation to their educational qualifications (UG and PG).
4. To compare the teacher effectiveness of secondary school teachers in relation to their teaching experience (<10 and >10 years).

Hypotheses of the Study

The following hypotheses have been designed to achieve the objectives of the study;

Ho:1 There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their gender (Male and Female).

Ho:2 There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their locale (Rural and Urban).

Ho:3 There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their educational qualifications (UG and PG).

Ho:4 There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their teaching experience (<10 and >10 years).

Research Method

The present study was conducted by adopting descriptive survey method of research.

The Sample

To obtain the required information from the respondents, the researcher selected 400 secondary school teachers from two districts of Himachal Pradesh by adopting the procedure of systematic random sampling technique.

The Tool Used

Following tool was used to collect the relevant data for the study;

1. Teacher Effectiveness Scale by Puri and Gakkhar (2010).

Statistical Techniques Used

For hypothesis testing, data analysis were made employing descriptive statistics such as, Mean, Standard Deviation, inferential statistics such as test of significance difference between two groups means i.e. 't' test.

Data Analysis

Hypothesis 1, "There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their gender (Male and Female)."

Table 1

Comparison of Teacher Effectiveness Scores on the Basis of Gender

Gender	N	Mean	SD	't'-Value	Level of Significance
Male	200	245.78	14.98	1.30	NS
Female	200	247.965	18.05		

NS-Not Significant

The table no 1, shows that't'-value of teacher effectiveness of male and female secondary school teachers is found to be 1.30, which is less than the tabulated value (1.97) at 0.05 level of significant with df (198). It means the teacher effectiveness of male secondary school teachers (M=245.26) is do not differ significantly from their counterpart (M=248.49) female secondary school teachers. So first hypothesis, "There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their gender (Male and Female)" was accepted. Further, the result shows that teacher effectiveness of male and female secondary school teachers is equal.

Hypothesis 2, "There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their locale (Rural and Urban)."

Table 2

Comparison of Teacher Effectiveness Scores on the Basis of Locale

Locale	N	Mean	SD	't'-Value	Level of Significance
Rural	200	245.21	15.83	2.03	0.05**
Urban	200	248.53	17.16		

****Significant at 0.05 Level**

The table no 2, shows that't'-value of teacher effectiveness of rural and urban secondary school teachers is found to be 2.03, which is more than the tabulated value (1.97) at 0.05 level of significant with df (198). It means the teacher effectiveness of rural secondary school teachers (M=245.21) is differ significantly from their counterpart (M=248.53) urban secondary school teachers. So first hypothesis, "There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their locale (Rural and Urban)" was rejected. Further, the result shows that teacher effectiveness of rural and urban secondary school teachers is not equal. It means that urban secondary school teachers have better teacher effectiveness than rural secondary school teachers.

Hypothesis 3, "There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their educational qualifications (UG and PG)."

Table 3

Comparison of Teacher Effectiveness Scores on the Basis of Educational Qualification

Educational Qualification	N	Mean	SD	't'-Value	Level of Significance
PG	200	248.04	18.63	1.82	NS
UG	200	245.35	14.17		

NS-Not Significant

The table no 3, shows that't'-value of teacher effectiveness of post graduate and undergraduate secondary school teachers is found to be 1.82, which is less than the tabulated value (1.97) at 0.05 level of significant with df (198). It means the teacher effectiveness of post graduate secondary school teachers (M=248.04) is not differ significantly from their counterpart (M=245.35) undergraduate secondary school teachers. So first hypothesis, "There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their educational qualification (PG and UG)" was accepted. Further, the result shows that teacher effectiveness of postgraduate and undergraduate secondary school students is equal.

Hypothesis 4, "There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their teaching experience (<10 and >10 years)."

Table 4

Comparison of Teacher Effectiveness Scores on the Basis of Teaching Experience

Teaching Experience	N	Mean	SD	't'-Value	Level of Significance
<10 Years	200	248.49	17.79	2.09	0.05**
>10 Years	200	245.26	15.13		

****Significant at 0.05 Level**

The table no 4, shows that't'-value of teacher effectiveness of <10 years teaching experience and >10 years secondary school teachers is found to be 2.09, which is more than the tabulated value (1.97) at 0.05 level of significant with df (198). It means the teacher effectiveness of >10 years secondary school teachers (M=248.49) is differ significantly from their counterpart (M=245.26) >10 years secondary school teachers. So first hypothesis, "There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their gender" was rejected. Further, the result shows that teacher effectiveness of secondary school teachers having <10years teaching experience and >10 years secondary school teachers is not equal. It means that <10years teaching experience secondary school teachers have better teacher effectiveness than <10years teaching experience.

Findings of the Study

The major research findings are;

1) There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their gender (Male and Female). It means that teacher effectiveness of male and female secondary school teachers is equal.
2) There is significant difference in the teacher effectiveness of secondary school teachers in relation to their locale (Rural and Urban). Further, the result shows that teacher effectiveness of rural and urban secondary school teachers is not equal. It means that rural secondary school teachers are less effective than urban secondary school teachers.
3) There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their educational qualifications (UG and PG). The result of the study shows that teacher effectiveness of postgraduate and undergraduate secondary school teachers is equal.
4) There is no significant difference in the teacher effectiveness of secondary school teachers in relation to their teaching experience (<10 and >10 years). The result of the study shows that teacher effectiveness of above 10 years teaching experience secondary school teachers and below 10 years teaching experience secondary school teachers is not equal. Thus, it means teacher having <10 years and above teaching experience are more effective than less than >10 years teaching experience.

Suggestions for Future Research

Following are the suggestions for future research;

1) The present study is just limited to a population of 400 secondary school teachers. The same can also do with a larger population.
2) The study could be extended to other parts of country and different other grades of educational institutions i.e. primary or even at the college levels.
3) The present study shows the result for only two districts i.e. Chamba and Solan of Himachal Pradesh. A study with more districts can also be done.
4) Similar study can be done with some other variables like age, marital status and social category etc.

Conclusion

In the light of above findings it can be concluded effective teaching leads to engaged and intelligent learning. Effective teaching consists of those teaching decisions about actions, routines and techniques that increase the decision making capabilities of students. Teacher effectiveness at secondary stage is likely to have significant influence on the performance and future prospects of individual students as well as over all development of the school in the immediate future.

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CONSTRUCTION AND STANDARDIZATION OF TEACHER EMPOWERMENT SCALE FOR SECONDARY SCHOOL TEACHERS

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Abstract

This research paper highlights the process of construction and standardization of a scale for secondary school teachers to measure their teacher empowerment. Initially, a pool of items was formulated by reviewing related literature, which was then given to the experts for analyzing the content. After preliminary try out and item analysis was done, only items with‘t’ value 1.75 and above as suggested by Thurstone and Chave (1929) were retained for the final form of the scale. The final form of the scale thus consists of 49 items. The reliability of the scale was ascertained by Karl Pearson’s Product Moment Correlation, Test-Retest method and Spearman-Brown Prophecy Formula of Split Half method and it was found to be relatively high. As far as validity is concerned, the content validity and face validity were also established. Norms were also established for the interpretation of the obtained score.

KEYWORDS Teacher Empowerment, Secondary School Teachers, Reliability, Validity and Norms

Introduction

Teachers need to be empowered so that they can develop the competence to take charge of their growth and be able to resolve their problems in their everyday practice. To develop skills and competence needed in making important collaborative decisions and a display of commitment that in turn will create room for significant collaborative participation and democratic understanding. It enables teachers to exercise power over their educational lives and even resists controls that are detrimental to their work. Research supports the assumption that teacher empowerment relates to greater organizational effectiveness (Barth, 1990; Blase & Blase, 2001. Teacher empowerment has also been defined as the possession and exercise of power in the pursuit of occupational improvement, professional autonomy, and the overall improvement of the educational process (Smith & Lotven, 1993). Empowerment also means simply to be able to effect change (Kreisberg, 1992). In the above definitions, empowerment is both the knowledge that one can make a difference and the actual ability to act (Kreisberg, 1992). Dunst (1991) suggested that empowerment consists of two issues; (i) enabling experiences, provided within an organization that fosters autonomy, choice,

control, and responsibility, which (ii) allow the individual to display existing competencies that support and strengthen functioning. Starratt (2004) conveyed that a leader's 'enabling presence' may empower teachers to participate in addressing school issues, own their professional development, and bring to the effort of school improvement their talents and creativity (p.103).

In education, teacher empowerment has less to do with the ability to boss others but more to do with teacher professionalism (Blase & Blase, 2001). It is the ability to exercise one's professional ability with quiet confidence and to help shape the way the job is done by having meaningful input into the decision-making process and policy development (Maeroff, 1988). Also, teachers who perceive themselves as empowered have improved motivation, self-esteem, confidence, commitment, innovation, autonomy, and reflection (Blase & Blase, 2001). Bolin (1989) stated that teacher empowerment requires, 'investing in teachers the right to participate in the determination of school goals and policies and the right to exercise professional judgment about the content of the curriculum and means on instruction' (p.83). Teacher empowerment provides teachers the opportunities for choice and autonomy in the workplace to demonstrate their competencies as educators (Short, 1994; Zimmerman & Rappaprt, 1988). According to Kirby (1991), three key elements in teacher empowerment are; a) the ability to act, b) the opportunity to act, and c) the desire to act. Empowerment involves both personal and organizational issues. Empowerment focuses on the development of personal competence, as well as the opportunities a person have within the organization to demonstrate competence (Short, 1998). In other words, empowered teachers are highly competent and work in schools that provide opportunities to show competence (Short, 1998). A school that values the empowerment of teachers and students will be better at finding and developing resources than a school that does not support or hold an empowerment philosophy (Short, 1998). Glenn (1990) suggested that the real power behind the construct of teacher empowerment is authority derived from teacher command of the subject matter and essential skills necessary to successfully teach students. Empowered teachers believe they have the skills and knowledge to act on a situation and improve it (Short, 1994).

Rationale for Construction of the Tool

The demand and need for the development of the new and standardized tool are growing to a certain extent because most of the tools are having reliability and validity in the context of a particular area only. Though several scales and questionnaires are there to measure the principal's empowerment and women empowerment we all know that teachers are the custodian of the future so they need to be empowered. Besides; most of the assessable questionnaires/scales are foreign tools which are not fit Indian conditions. Only a few Indian tools are there out of which most of them are meant for school principals and for empowering women. So, no recent reliable and valid tools are available which is solely meant for assessing teacher empowerment. Hence, for accomplishing his research investigator intended to construct a tool that is solely meant for assessing the empowerment of secondary school teachers.

Objectives

The following were the objectives of the study;

1. To prepare the preliminary draft of the teacher empowerment scale for secondary school teachers.
2. To carry out item analysis of a preliminary draft of teacher empowerment scale.
3. To estimate the reliability of the teacher empowerment scale through test-retest and split-half methods.
4. To ascertain the validity of teacher empowerment scale.
5. To establish the norms for interpretation of scores obtained on the teacher empowerment scale.

Methodology

For construction and standardization of teacher empowerment scale, a survey technique under the descriptive method of research was used.

Sampling

In this study, the sample was drawn from the secondary school teachers. The sample for this investigation was drawn by employing multistage sampling along with purposive sampling techniques. Firstly, for item analysis of the preliminary draft, samples of 130 secondary school teachers working in govt. schools of Solan district, of Himachal Pradesh, were taken. At the second stage, a sample of 50 secondary school teachers to compute test-retest reliability and 100 secondary school teachers working in govt. schools of Shimla district of Himachal Pradesh, purposively selected to estimate split-half reliability. At the last stage, samples of 1360 secondary school teachers were chosen from 6 districts of Himachal Pradesh for its norms establishment.

Preparing and Editing the Scale

There are no universal traits/qualities of empowering teachers but certain requirements for teacher empowerment do exist across diverse situations. Therefore, a continuous effort for enumerating qualities/dimensions of teacher empowerment has been witnessed since the time of emergence of study on teacher empowerment. In this connection, different sources i.e. relevant literature, different research studies, existing inventories, questionnaire scales on teacher empowerment, were reviewed. In this way, 125 dimension wise statements were prepared. The statements were written in Hindi and English both languages. More than five rounds of checking and reframing of statements were made to ensure the appropriateness and uniqueness of the statements. The list of positive and negative statements so prepared was reviewed. The statements were judged from a language point of view. Based on experts' opinion the preliminary draft of the scale consisted of 79 test items.

Try Out of Preliminary Draft of Teacher Empowerment Scale

For carrying out item analysis, the preliminary draft of the Teacher Empowerment Scale was tried out on a sample of 130 secondary school teachers. After getting the filled upscale from the respondents, the scoring was done. The responses of the subject were rated on a five-point rating scale ranging from; Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree. The scoring pattern for positively worded items was done by awarding 5 to Strongly Agree, 4 to Agree, 3 to

Undecided, 2 to Disagree, and 1 to Strongly Disagree. For the negatively worded items, the scoring pattern was reversed in order. The scoring for positively and negatively worded items was given in such a way that the higher the score more is the empowerment of secondary school teachers.

Item Analysis

Afterward, the scoring of the Teacher Empowerment Scale for each respondent was done by following the procedure mentioned earlier. The total score on the preliminary draft of the Teacher Empowerment Scale ranged from 79-395. The researcher further proceeded with the technique of item analysis for the selection of the statements for the final draft of the Teacher Empowerment Scale. To compute 't' value, the top 27% of secondary school teachers (36 teachers) with the highest total score and the bottom 27% (36 teachers) of secondary school teachers with the lowest score on the teacher empowerment scale were taken. These two groups were named as 'top group having high score' and 'bottom group having low score' respectively. The high and low scorer groups were considered for item analysis as they provide criterion groups in terms of which to evaluate the individual statements. The middle 46% of booklets were discarded and not considered for further analysis. The value for all 79 statements was computed and arranged in an order to form the final scale. Thurstone and Chave (1929) suggested that 't-value' equal to or greater than 1.75 may be consider significant. So the statements having 't' value equal to or greater than 1.75 were selected for the final draft of the Teacher Empowerment Scale and other having 't-value' less than 1.75 were rejected. The calculated 'value' of each 79 statements is given in table 1.

Table 1: 't' Values in Respect to 79 Items of Final Format of Teacher Empowerment Scale

Item No	't' Value	Item No	't' Value	Item No	't' Value	Item No	't' Value
1.	3.12	21.	2.71	41.	*1.66✘*	61.	*1.37✘*
2.	4.65	22.	*1.57✘*	42.	*1.38✘*	62.	4.40
3.	6.62	23.	4.87	43.	4.52	63.	3.49
4.	5.69	24.	5.54	44.	6.86	64.	*1.42✘*
5.	3.56	25.	*1.37✘*	45.	3.70	65.	4.79
6.	*1.63✘*	26.	*1.50✘*	46.	*1.38✘*	66.	5.58
7.	6.70	27.	*1.37✘*	47.	*1.42✘*	67.	6.07
8.	6.47	28.	*1.61✘*	48.	4.52	68.	2.83
9.	*1.63✘*	29.	*1.20✘*	49.	3.73	69.	*1.66✘*
10.	3.25	30.	5.76	50.	2.77	70.	3.73
11.	2.12	31.	5.69	51.	*0.86✘*	71.	*1.38✘*
12.	*1.33✘*	32.	5.29	52.	*1.51✘*	72.	3.01
13.	*1.64✘*	33.	4.88	53.	*1.62✘*	73.	2.38
14.	6.65	34.	3.16	54.	*1.48✘*	74.	3.49
15.	6.30	35.	*1.66✘*	55.	*1.57✘*	75.	3.64
16.	5.25	36.	4.04	56.	5.54	76.	5.71
17.	2.12	37.	*1.52✘*	57.	4.81	77.	*1.37✘*
18.	2.87	38.	4.16	58.	3.41	78.	*1.42✘*
19.	*1.60✘*	39.	5.05	59.	6.11	79.	*1.52✘*
20.	*1.50✘*	40.	6.21	60.	6.58		

Note:** 't' values shown in bold and Italic letters indicate rejected items* ***(t<1.75)

Final Draft of the Teacher Empowerment Scale

After analysis of the first draft of item analysis, the final form of the scale was prepared. Out of 79 items, 49 items were retained and 30 items were rejected. Dimension wise distributions of items in Teacher Empowerment Scale after item analysis given in table 2.

Table 2: Dimensions wise Distribution of Teacher's Empowerment Scale

Sr. No.	Dimensions	Positively Worded Items	Negatively Worded Items	Total
1.	Self Esteem	06	03	09
2.	Team Working Skill	07	03	10
3.	Teacher Morale	07	04	11
4.	Communication Skill	06	03	09
5.	Decision Making	07	03	10
	Total	33	16	49

Reliability of Teacher Empowerment Scale

The reliability of the scale was determined employing two methods of reliability i.e. test-retest method and split-half method.

1. **Test-retest Reliability:** The test-retest reliability of the teacher empowerment scale was estimated by administering the final draft of the scale on 50 secondary school teachers with a time gap of approximately three weeks. For this purpose, the scale was administered on those 50 secondary school teachers who had not been included in the initial draft of the test. The test-retest reliability was measured by calculating the value of the correlation between scores obtained by secondary school teachers at the first administration and second administration of the scale. For this, the method of Karl Pearson's Product Moment Correlation was applied. The dimension wise and overall value of the correlation coefficient is shown in table 3.

Table 3: Dimensions Wise Test-Retest Reliability of the Teacher Empowerment Scale

Sr. No.	Dimensions	Test-retest Reliability	Total Reliability
1.	Self Esteem	0.77	0.82
2.	Team Working Skill	0.81	
3.	Teacher Morale	0.76	
4.	Communication Skill	0.84	
5.	Decision Making	0.83	

2. **Split Half Reliability**: For estimating the reliability of teacher empowerment scale by the split-half method was administered on a sample of 100 secondary school teachers. In the split-half method, the test was first divided into two equivalent halves and the correlation was calculated for those half tests.

The reliability of the scale was obtained by correlation scores on the odd and even numbers. To calculate the reliability co-efficient through the split-half technique, the Spearman-Brown Prophecy Formula was used. The reliability coefficient obtained for dimension wise and total teacher empowerment scale is given below in table :4

Table 4: Dimensions Wise Split-Half Reliability of the Teacher Empowerment Scale

Sr. No.	Dimensions	Split Half Reliability	Total Reliability
1.	Self Esteem	0.79	0.84
2.	Team Working Skill	0.83	
3.	Teacher Morale	0.81	
4.	Communication Skill	0.85	
5.	Decision Making	0.83	

The Validity of the Teacher Empowerment Scale

The validity of the Teacher Empowerment Scale was ascertained in terms of item validity, content validity, and cross validity and cross validity. The teacher empowerment scale was considered valid enough in terms of item validity because only those items were retained in the final draft of the scale which was having 't' values equal to or greater than 1.75 (highly discriminating items). The content validity of the teacher empowerment scale was established by carrying out critical discussions with field experts at the time of development of the preliminary draft of the scale. The experts of the opinion that the statements in the teacher empowerment scale were appropriate and relevant to measure the empowerment of secondary school teachers. In addition to this, only those statements were retained in the preliminary draft of the teacher empowerment scale for which there has been approximately 90% agreement among a panel of experts. Thus, the teacher empowerment scale was found to possess adequate content validity. Furthermore, the teacher empowerment scale can be considered to have adequate intrinsic validity because the split-half reliability of the scale was found to be 0.84 which showed a very high correlation index. The cross validity of the teacher empowerment scale was ensured by taking entirely different samples of secondary school teachers to carry out item analysis, establishing reliability, and developing norms.

Norms for Interpreting Teacher Empowerment Score

Before establishing the norms for interpretation of teacher empowerment scores obtained by secondary school teachers, the obtained data is verified for possessing normality. This was done by computing the values of skewness and kurtosis for overall scores of sampled teachers (N=1360) on the scale. The value of skewness came out to be .0.96. It is showing that the distribution of total teacher empowerment scores is normally skewed. In addition to this, the value of kurtosis was calculated to be 0.67. It also indicates that the distribution of the total teacher empowerment score is somewhat mesokurtic. Further, based on collected data, the mean and standard deviation in respect of teacher empowerment scores of all sampled teachers were calculated which came out to be 175.04 and 18.524

respectively. Then, the raw teacher's empowerment scores were converted into z-scores by taking into consideration the values of the mean and standard deviation to establish norms for interpretation of obtained teacher's empowerment scores.

Table 5: Z- Score Norms for Teacher Empowerment Scale

Raw Score	Z-Score	Raw Score	Z-Score	Raw Score	Z-Score	Raw Score	Z-Score	Raw Score	Z-Score
117	-3.13	**140**	-1.89	**163**	-0.65	**186**	+0.59	**209**	+1.83
118	-3.07	**141**	-1.83	**164**	-0.59	**187**	+0.64	**210**	+1.88
119	-3.02	**142**	-1.78	**165**	-0.54	**188**	+0.69	**211**	+1.94
120	-2.97	**143**	-1.73	**166**	-0.48	**189**	+0.75	**212**	+1.99
121	-2.91	**144**	-1.67	**167**	-0.43	**190**	+0.80	**213**	+2.04
122	-2.86	**145**	-1.62	**168**	-0.38	**191**	+0.86	**214**	+2.10
123	-2.80	**146**	-1.56	**169**	-0.32	**192**	+0.91	**215**	+2.15
124	-2.75	**147**	-1.51	**170**	-0.27	**193**	+0.96	**216**	+2.21
125	-2.70	**148**	-1.46	**171**	-0.21	**194**	+1.02	**217**	+2.26
126	-2.64	**149**	-1.40	**172**	-0.16	**195**	+1.07	**218**	+2.31
127	-2.59	**150**	-1.35	**173**	-0.11	**196**	+1.13	**219**	+2.37
128	-2.53	**151**	-1.29	**174**	-0.05	**197**	+1.18	**220**	+2.42
129	-2.48	**152**	-1.24	**175**	-0.02	**198**	+1.23	**221**	+2.48
130	-2.43	**153**	-1.19	**176**	+0.05	**199**	+1.29	**222**	+2.53
131	-2.37	**154**	-1.13	**177**	+0.10	**200**	+1.34	**223**	+2.58
132	-2.32	**155**	-1.08	**178**	+0.15	**201**	+1.40	**224**	+2.64
133	-2.26	**156**	-1.02	**179**	+0.21	**202**	+1.45	**225**	+2.69
134	-2.21	**157**	-0.97	**180**	+0.26	**203**	+1.50	**226**	+2.75
135	-2.16	**158**	-0.92	**181**	+0.32	**204**	+1.56	**227**	+2.80
136	-2.10	**159**	-0.86	**182**	+0.37	**205**	+1.61	**228**	+2.85
137	-2.05	**160**	-0.81	**183**	+0.42	**206**	+1.67	**229**	+2.91
138	-2.00	**161**	-0.75	**184**	+0.48	**207**	+1.72	**230**	+2.96
139	-1.94	**162**	-0.70	**185**	+0.53	**208**	+1.77	**231**	+3.02
								232	+3.07

The following range of z-scores on a continuum can be used as suggestive norms for interpreting scores obtained on the scale for measuring teacher's empowerment given in table 6.

Table 6: Norms for Interpretation of Level of Teacher's Empowerment Scale

Sr. No.	Range of Z-Score	Scores	Levels of Teacher's Empowerment
1.	**+2.01 and Above**	**216 & above**	**Extremely High Teacher Empowerment**
2.	**+1.26 to +2.00**	**200-215**	**High Teacher Empowerment**
3.	**+0.51 to +1.25**	**184-199**	**Above Average Teacher Empowerment**
4.	**-0.50 to +0.50**	**168-183**	**Average Teacher Empowerment**
5.	**-0.51 to -1.25**	**152-167**	**Below Average Teacher Empowerment**
6.	**-1.26 to 2.00**	**136-151**	**Low Teacher Empowerment**
7.	**-2.01 and Below**	**120 & below**	**Extremely Very Low Teacher Empowerment**

Conclusion

The present study was done to construct and standardized a scale for measuring teacher empowerment of secondary school teachers. The Teacher Empowerment Scale (TES) is very reliable and valid in terms of item, content, and face validity. Moreover, norms have been established which serves as a frame of reference for interpreting the obtained scores. Therefore, Teacher Empowerment (TES) is reliable and valid and can be used by administrators, school principals, policymakers and other researchers are who are interested in finding out the empowerment of teachers.

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PROFESSIONAL COMMITMENT OF GOVERNMENT SENIOR SECONDARY SCHOOL TEACHERS IN RELATION TO GENDER IN HIMACHAL PRADESH

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ABSTRACT

The present study aims to study the level of professional commitment of male and female senior school teachers on the basis of sex.100 Sample male and female School teachers were selected by randomly by the draw of lots. 50 male and 50 female teachers were selected from the each selected school through systematic random sampling technique. Professional Commitment Scale for Teachers (PCST) developed by Ravinder Kaur, Sabjit Kaur Ranu and Sarvjeet Kaur Brar (2011) was used for data collection. To study the significant difference between professional commitment of male and female senior secondary schools teachers, significant difference between commitment to the learner, commitment to the society, commitment to the profession,, commitment to achieve excellence, commitment to basic human values of male and female senior secondary schools teachers, In these cases, t-test was used. Major findings of the study were: The male and female government senior secondary school teachers do not differ from each other on the level of professional commitment. The male and female government senior secondary school teachers do not differ from each other on the level of commitment to the learner. The male and female government senior secondary school teachers do not differ from each other on level of commitment to the society. The male and female government senior secondary school teachers do not differ from each other on the level of commitment to the profession. The male and female government senior secondary school teachers differ from each other on the level of commitment to achieve excellence and the male and female government senior secondary school teachers do not differ from each other on the level of commitment to basic values.

KEYWORDS: *Professional Commitment, Government Senior Secondary school teachers, Gender and Himachal Pradesh*

INTRODUCTION

Education moulds the behavioural and personality attributes of children and prepares them to become well adjusted, productive and meaningful members of their social orders. "Profession is a special type of occupation, one whose members exhibit high levels of such characteristics as expertise, autonomy, a belief in the regulation of the profession by its members" **(Kerr, 2005)** Commitment is part of a teacher's affective or emotional reaction to their experience in a school setting. It is a part of a learned behaviour of a teacher. Teachers make conscious and subconscious decisions about their level of willingness from these affective reactions. **Basu (2016)** studied the professional commitment and job satisfaction of secondary school teachers and the relationship between them. The study was conducted on 98 secondary school teachers from Bareilly district. The findings of the investigation reveal that while gender and length of teaching experience influenced the professional commitment of secondary school teachers, the type of school did not have any significant effect. Also gender, type of school and length of teaching experience were found to be significant factors which influence the job satisfaction of the secondary school teachers. **Gill &**

Kour (2017) have conducted studies on the professional commitment among senior secondary school teachers. Found out that there was no significant interaction effect of (a) gender & teaching experience, (b) stream and teaching experience on professional commitment among college students. **Habib (2019)** have conducted a study on the professional commitment of secondary school teachers working in government schools of district Ganderbal, Jammu &Kashmir. The findings of the investigation revealed that female secondary school teachers have higher professional commitment as compare as to male secondary school teachers and no significant difference found in the Self-efficacy of secondary school teachers and significant positive correlation was found between Professional Commitment and Self-efficacy of secondary school teachers **Malik (2020)**studied the professional commitment among secondary school teachers of Gurugram district in relation to personal stress in covid-19 pandemic. The main aim ofthe study was to assess both direct and indirect relationship between Professional Commitment and Personal Stress in secondary school teachers of Gurugram district.The findings of the investigation revealed thatProfessional Commitment is influenced by the Personal Stress of a teacher. Secondary school teachers with Low Personal Stress were having less Professional Commitment as compared to Secondary school teachers with High Personal Stress and Professional commitment is influenced by personality, teaching attitude, sense of humour, occupational stress, self-efficacy, teacher freezing and in return influences the teaching effectiveness of teachers.

OBJECTIVES

- To compare the overall level of professional commitment of male and female government senior secondary school teachers.
- To compare the level of commitment to the learner of male and female government senior secondary school teachers.
- To compare the level of commitment to the society of male and female government senior secondary school teachers.
- To compare the level of commitment to the profession of male and female government senior secondary school teachers.
- To compare the level of commitment to Achieve Excellence by male and female government senior secondary school teachers.
- To compare the level of commitment to Basic Human Values of male and female government senior secondary school teachers.

HYPOTHESES

H_{01}: There is no significant difference between professional commitment of male and female government senior secondary schools teachers.

H_{02}: There is no significant difference between commitment to the learner of male and female government senior secondary schools teachers.

H_{03}: There is no significant difference between commitment to the society of male and female government senior secondary schools teachers.

H_{04}: There is no significant difference between commitment to the profession of male and female government senior secondary schools teachers.

H_{05}: There is no significant difference between commitment to achieve excellence of male and female government senior secondary schools teachers.

H_{06}: There is no significant difference between commitment to Basic Human Values of male and female government senior secondary schools teachers.

TOOLS

"Professional Commitment Scale for Teachers (PCST-KRB)" Hindi/English developed by Ravinder Kaur, Sarbjit Kaur Ranu and Sarvjeet Kaur Brar (2011) was used to assess the professional commitment.

METHODOLOGY

To achieve the objectives effectively the descriptive survey research method was followed.

SAMPLING

In the present study,only two districts namely Shimla and Solan out of the twelve districts of Himachal Pradesh were selected randomly by the draw of lots. From the selected Districts,only 08 government senior secondary schools were taken on the basis of convenience. From the government senior secondary schools 'Shimla and Solan', a sample of 50 male and 50 female teachers were selected from the each selected school through systematic random sampling technique. In this way, 100 secondary school teachers were selected by constituted the final sample for the present study.

STATISTICAL TECHNIQUE

The scores obtained were subject to statistical treatment using proper statistical techniques. For this purpose Mean, Standard Deviation, t- test, was used.

Variables

- Independent Variables: Gender (Male and Female)
- Dependent Variable: Professional Commitment.

RESULTS AND DISCUSSIONS

H_{01}: There is no significant difference between professional commitment of male and female government senior secondary schools teachers.

The mean scores of professional commitment of male and female government senior secondary school teachers along with number, S.D., SE_{DM}, df and t-value are given in Table 1 below:

Table 1 shows that t-value for comparison of professional commitment scores at two levels of gender, male and female teachers came out to be 1.14, which is non-significant at 0.05 level of significance for 98 df.

This indicates that there is no significant difference in the professional commitment scores of government senior secondary school teachers at two levels of gender i.e., male and female.

Hence the H_{01}as stated above: "There is no significant difference between professional commitment of male and female government senior secondary schools teachers" was accepted.

From Table 1, it can be seen that the means on professional commitment scores for government senior secondary school male and female teachers are 170.08 and 174.0 respectively.

Figure 1 is also indicating of the fact that the mean scores mean scores of professional commitment of government senior secondary school male and female teachers do not differ significantly.

Table 1: Gender Wise Difference in Professional Commitment of Government Senior Secondary School Teachers

Variable	Gender		SE_{DM}	df	t-value
	Male (N=50)	Female (N=50)			
Professional Commitment	Mean=170.08	Mean=174.00	3.414	98	1.14
	S.D.=17.00	S.D.=17.14			

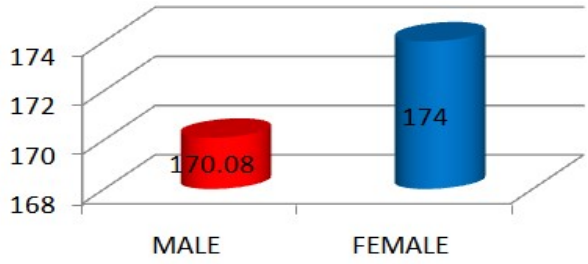

Figure 1: Mean Scores for Government Senior Secondary School Male and Female Teachers on Professional Commitment.

From the above Analysis, it may be Interpreted that:

The male and female government senior secondary school teachers do not differ from each other on the level of professional commitment.

H_{02}: There is no significant difference between commitment to the learner of male and female government senior secondary schools teachers.

The mean scores of commitment to the learner of male and female government senior secondary school teachers along with number, S.D., SE_{DM}, df and t-value are given in Table 2 below:

Table 2 shows that t-value for comparison of commitment to learner scores at two levels of gender, male and female teachers came out to be 0.86, which is non-significant at 0.05 level of significance for 98 df. This indicates that there is no significant difference in the commitment to learner scores of government senior secondary school teachers at two levels of gender i.e., male and female.

Hence the H_{02} as Stated Above: "There is no significant difference between commitment to the learner of male and female government senior secondary schools teachers" was accepted.

From Table 2, it can be seen that the means on commitment to learner scores for government senior secondary school teachers are 36.08 and 35.32 respectively.

Figure 2 is also indicating of the fact that the mean scores of commitment to the learner of government senior secondary school teachers do not differ significantly.

Table 2

Variable	Gender		SE_{DM}	df	t-value
	Male (N=50)	Female (N=50)			
Commitment to the Learner	Mean=36.08	Mean=35.32	0.874	98	0.86
	S.D.=4.503	S.D.=4.235			

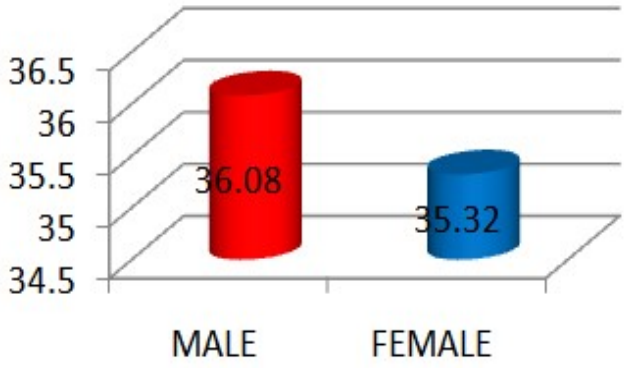

Figure 2: Mean Scores for Government Senior Secondary School Male and Female Teachers on Commitment To The Learner.

From the above Analysis, it may be Interpreted that:

The male and female government senior secondary school teachers do not differ from each other on the level of commitment to the learner.

H_{03}: There is no significant difference between commitment to the society of male and female government senior secondary schools teachers.

The mean scores of commitment to the society of male and female government senior secondary school teachers along with number, S.D., SE_{DM}, df and t-value are given in Table 3 below:

Table 3 shows that t-value for comparison of commitment to the society scores at two levels of gender, male and female teachers came out to be 0.13, which is non-significant at 0.05 level of significance for 98 df. This indicates that there is no significant difference in the commitment to the society scores of government senior secondary school teachers at two levels of gender i.e., male and female.

Hence the H_{03}as Stated Above: "There is no significant difference between commitment to the society of male and female government senior secondary schools teachers" was accepted.

From Table 3, it can be seen that the means on commitment to the society scores for male and female government senior secondary school teachers are 34.48 and 34.34 respectively.

Figure 3 is also indicating of the fact that the mean scores of commitment to the society of male and female government senior secondary school teachers do not differ significantly.

Table 3

Variable	Gender		SE $_{DM}$	df	t-value
	Male (N=50)	Female (N=50)			
Commitment to the Society	Mean=34.48	Mean=34.34	1.037	98	0.13
	S.D.=5.38	S.D.=4.98			

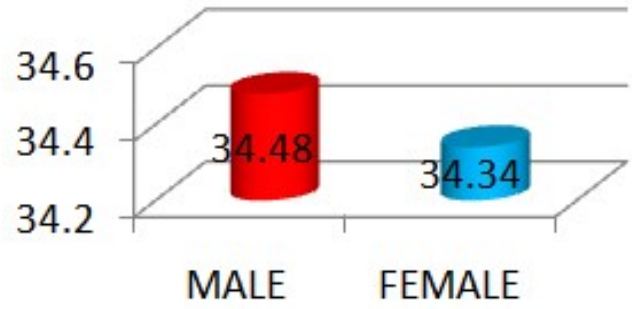

Figure 3: Mean Scores for Government Senior Secondary School Male and Female Teachers on Commitment to the Society

From the above Analysis, it may be Interpreted that:

The male and female government senior secondary school teachers do not differ from each other on level of commitment to the society.

H_{04}: There is no significant difference between commitment to the profession of male and female government senior secondary schools teachers.

The mean scores of commitment to the profession of male and female government senior secondary school teachers along with number, S.D., SE $_{DM,}$ df and t-value are given in Table 4 below:

Table 4 shows that t-value for comparison of commitment to the profession scores at two levels of gender, male and female teachers came out to be 1.52, which is non-significant at 0.05 level of significance for 98 df. This indicates that there is no significant difference in the commitment to the profession scores of government senior secondary school teachers at two levels of gender i.e., male and female.

Hence the H_{04} as stated above: "There is no significant difference between commitment to the profession of male and female government senior secondary schools teachers" was accepted.

From Table 4, it can be seen that the means on commitment to the profession scores for male and female government senior secondary school teachers are 33.26 and 34.66 respectively. Figure 4 is also indicating of the fact that the mean scores of commitment to the profession of male and female government senior secondary school teachers do not differ significantly.

Table 4

Variable	Gender		SE $_{DM}$	df	t-value
	Male (N=50)	Female (N=50)			
Commitment to the Profession	Mean=33.26	Mean=34.66	0.919	98	1.52
	S.D.=4.26	S.D.=4.90			

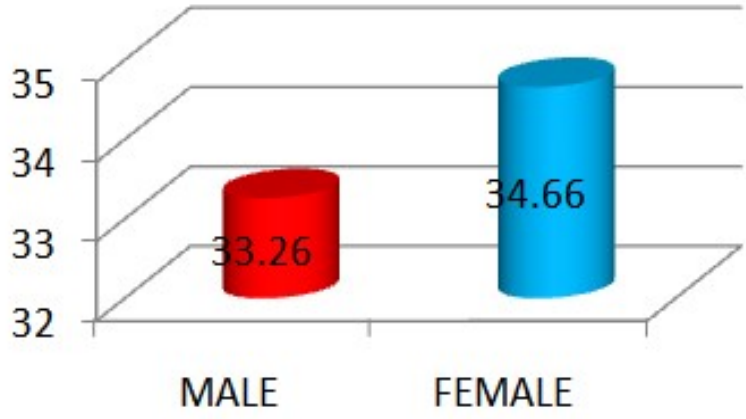

Figure 4: Mean Scores for Government Senior Secondary School Male and Female Teachers on Commitment to the Profession

From the above Analysis, it may be Interpreted that:

The male and female government senior secondary school teachers do not differ from each other on the level of commitment to the profession.

H_{05}: There is no significant difference between commitment to achieve excellence of male and female government senior secondary schools teachers.

The mean commitment to achieve excellence of male and female government senior secondary school teachers along with number, S.D., $SE_{DM,}$ df and t-value are given in Table 5 below:

Table 5 shows that t-value for comparison of commitment to achieve excellence scores at two levels of gender, male and female teachers came out to be 3.65, which is significant at 0.05 level of significance for 98 df. This indicates that there is significant difference in the commitment to achieve excellence scores of government senior secondary school teachers at two levels of gender i.e., male and female.

Hence the H_{05}as stated above: "There is no significant difference between commitment to achieve excellence of male and female government senior secondary schools teachers" was not accepted.

From Table 5, it can be seen that the means on commitment to achieve excellence scores for male and female government senior secondary school teachers are 31.46 and 34.58 respectively.

Figure 5 is also indicating of the fact that the mean scores of commitment to achieve excellence of male and female government senior secondary school teachers differ significantly.

Table 5

Variable	Gender		SE_{DM}	df	t-value
	Male (N=50)	Female (N=50)			
Commitment to Achieve Excellence	Mean=31.46	Mean=34.58	0.853	98	*3.65
	S.D.=4.44	S.D.=4.08			

* Significant at 0.05 level of significance for 98 df.

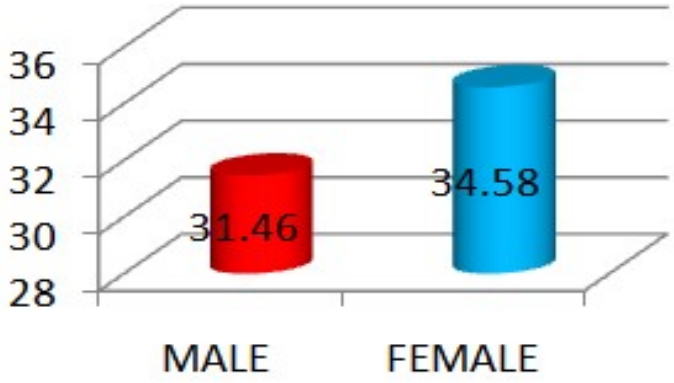

Figure 5: Mean Scores for Government Senior Secondary School Male and Female Teachers on Commitment to Achieve Excellence

From the above Analysis, it may be Interpreted that:

The male and female government senior secondary school teachers differ from each other on the level of commitment to achieve excellence.

H_{06}: There is no significant difference between commitment to Basic Human Values of male and female government senior secondary schools teachers.

The mean scores of commitment to basic human values of male and female government senior secondary school teachers along with number, S.D., SE_{DM}, df and t-value are given in Table 6 below:

Table 6

Variable	Gender		SE_{DM}	df	t-value
	Male (N=50)	Female (N=50)	0.840	98	0.35
Commitment to Basic Values	Mean=34.80	Mean=35.16			
	S.D.=4.495	S.D.=3.887			

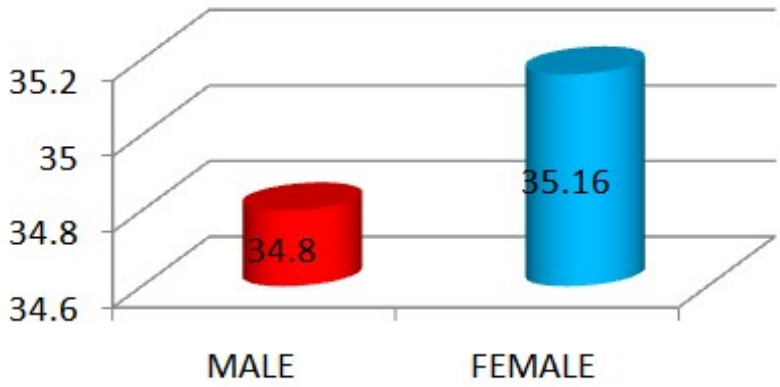

Figure 6: Mean Scores for Government Senior Secondary School Male and Female Teachers on Commitment to Basic Human Values

CONCLUSIONS

On the Bases of the Results of the Study, Following Conclusions have been Drawn.

- There is no significant difference in the professional commitment scores of government senior secondary school teachers at two levels of gender i.e., male and female. The male and female government senior secondary school teachers do not differ from each other on the level of professional commitment.
- There is no significant difference in the commitment to learner scores of government senior secondary school teachers at two levels of gender i.e., male and female. The male and female government senior secondary school teachers do not differ from each other on the level of commitment to the learner.
- There is no significant difference in the commitment to the society scores of government senior secondary school teachers at two levels of gender i.e., male and female. The male and female government senior secondary school teachers do not differ from each other on level of commitment to the society.
- There is no significant difference in the commitment to the profession scores of government senior secondary school teachers at two levels of gender i.e., male and female. The male and female government senior secondary school teachers do not differ from each other on the level of commitment to the profession.
- There is significant difference in the commitment to achieve excellence scores of government senior secondary school teachers at two levels of gender i.e., male and female. The male and female government senior secondary school teachers do differ from each other on the level of commitment to achieve excellence.
- There is no significant difference in the commitment to basic human values scores of government senior secondary school teachers at two levels of gender i.e., male and female. The male and female government senior secondary school teachers do not differ from each other on the level of commitment to basic values.

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STUDY AND COMPARE ENVIRONMENTAL AWARENESS OF SENIOR SECONDARY SCHOOL STUDENTS IN RELATION TO GENDER AND TYPE OF SCHOOL IN SHIMLA DISTRICT OF HIMACHAL PRADESH

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Abstract

The present study aims to study the level of environmental awareness of senior secondary school students in relation to gender and type of school in Shimla district of himachal Pradesh. The sample of the study comprised of 160, 11th and 12th Class students studying in different government and private senior secondary schools of Shimla district of Himachal Pradesh. 80 male and 80 female students were selected from the each selected school through systematic random sampling technique. Environmental awareness is taken as the scores obtained by the senior secondary school students on environmental awareness. "Environmental awareness scale for students" by Taj, Haseen (1981) was used to collect the data for the purpose. The data were analyzed using descriptive (Mean, Standard Deviations) and inferential ('t'- test) statistics. The findings of the present study revealed that there is no significant difference in environmental awareness of senior secondary school students across gender i.e. boys and girls. From analysis of result, it was found that there were significant differences in the environmental awareness of senior secondary school students at two levels of type of school i.e. government and private.

Keywords: *Environmental Awareness, Senior Secondary School Students, Gender, and Type of School.*

Introduction

The origin of life on the earth was decided and controlled with a set of environmental condition. Through these past millions of years, for the sustenance of life environment has played a major role, and it will continue to be so for all the times (Gouri, 2007). Man, ever since appeared on the surface of earth became a part of his environment. Awareness of his physical and biological environment was not something new for him. He observed and enjoyed nature. Today he is living in a world of crisis. i.e. environmental pollution. Man thought himself to be a master, not slave and he started utilizing his environmental resources to meet his ever-increasing wants for a better living. But for satisfying our desire we exploit our natural as well as

artificial environment. Pareek & Kumar (1998) conducted a study of environmental awareness among secondary school students. Their result shows that 40 percent students showed poor environmental awareness and the remaining 60 percent students were well versed with their surroundings and had appreciable good to excellent knowledge about various environmental issues. Rajinder and Manpreet (2009) conducted a survey on environmental awareness of secondary and senior secondary students. Result shows that rural students and urban students studying in government schools were still not aware of the various threats of environment, natural calamities and most of the government , rural schools did not possess basic literature related to environment. Poonam (2012) compare the environmental awareness between Govt. and Private Secondary School Students along with the different dimensions. Found that there exists a significant difference between government and private secondary school students on environmental awareness and its components. Dhanya and Pankajam (2017) assessed the environmental awareness among secondary school students. The investigator adopted survey method to study the environmental awareness among secondary school students. For this study a sample of 300 secondary students. Their result shows that there is no significant environmental awareness among secondary school students. Rathee, Neeru and Thakran, Suman (2017) examine the Environmental Awareness among secondary school students of Rohtak district of Haryana. Environmental Awareness Ability Measures (EAAM) by Praveen Jha was used on sample of 80 students to measure environmental awareness. Their result shows that there exists no significant difference in environmental awareness of rural and urban secondary school students and also found that there exists no significant difference in environmental awareness of male and female secondary school students. Environment, Environmental Awareness, Secondary school students. Mittu (2019) studies the attitude of secondary school students towards environmental pollution with respect to locale and type of school. To study the attitude of secondary school students towards environmental pollution descriptive survey method has used as research method. A sample of 200 secondary school students. Their result shows that there exists statistical significant difference in attitude of urban and rural secondary school students towards environmental pollution; and there exists statistical significant difference in attitude of private and government secondary school students towards environmental pollution.

Objectives:

1. To study and compare the environmental awareness among male and female senior secondary school students.

2. To study and compare the environmental awareness among government and private senior secondary school students.

Hypotheses:

H_{01}: There will be no significant difference between environmental awareness of boys and girls senior secondary school students.

H_{02}: There will be no significant difference between environmental awareness of government and private senior secondary school students

Tools:

Environmental Awareness Scale developed by by Dr. Haseen Taj (1981) was used to assess the environmental awareness.

Methodology:

To achieve the objectives effectively the descriptive survey research method was followed.

Sampling:

In the present study, only one district namely Shimla out of the twelve districts of Himachal Pradesh was selected randomly by the draw of lots. From the selected District, only 10 schools were taken on the basis of convenience. However, while choosing the schools it was observed that they are well distributed in the District, are situated at a considerable distance from each other, represent boys and girls. The investigator selected five government and five private senior secondary schools. Boys, girls were selected from the each selected school consisting of studying in 11th and 12th class through systematic random sampling technique. The sample of present study consisted of 160.

Statistical Technique :

The scores obtained were subject to statistical treatment using proper statistical techniques. For this purpose Mean, Standard Deviation, t- test, was used.

Variables: (i) Independent Variables:

1. Gender: Gender refers to the male and female students.

2. Type of School: Students who are studying in 11th and 12th class of government and private senior secondary school students of Shimla district of Himachal Pradesh.

(ii) Dependent Variable: Environmental Awareness.

Environmental awareness is taken as the scores obtained by the senior secondary school students on Environmental awareness Scale developed by Taj, Haseen (1981).

Results and Discussion:

H_{01}: There will be no significant difference between environmental awareness of boys and girls senior secondary school students.

The mean scores of environmental awareness of boys and girls along with number, S.D., SE_{DM}, df and t- value are given in table 1

TABLE 1

Gender Wise Difference in environmental awareness of boys and girls senior secondary school students

Gender			SE DM	df	t-Value
Variable	Boys (N=80)	Girls (N=80)	1.284	158	0.974
	Mean=84.01	Mean=82.76			
Environmental Awareness	S.D.=8.39	S.D.=7.83			

Table 1 shows that the computed value of t- value for studying the significance of the difference between means of environmental awareness senior secondary school boys and girls come out to be 0.974, which is non – significant at 0.05 level of significance for 158 df.

This indicates that there is no significant difference in the environmental awareness of senior secondary school students at two levels of gender i.e. boys and girls.

Hence the hypothesis (1) as stated above: **"There will be no significant difference between environmental awareness of boys and girls senior secondary school students"** was accepted.

From Table 1, it can be seen that the means of environmental awareness of senior secondary school boys and girls are 84.01 and 82.76 respectively.

Figure 1

Mean scores for senior secondary school boys and girls on environmental awareness

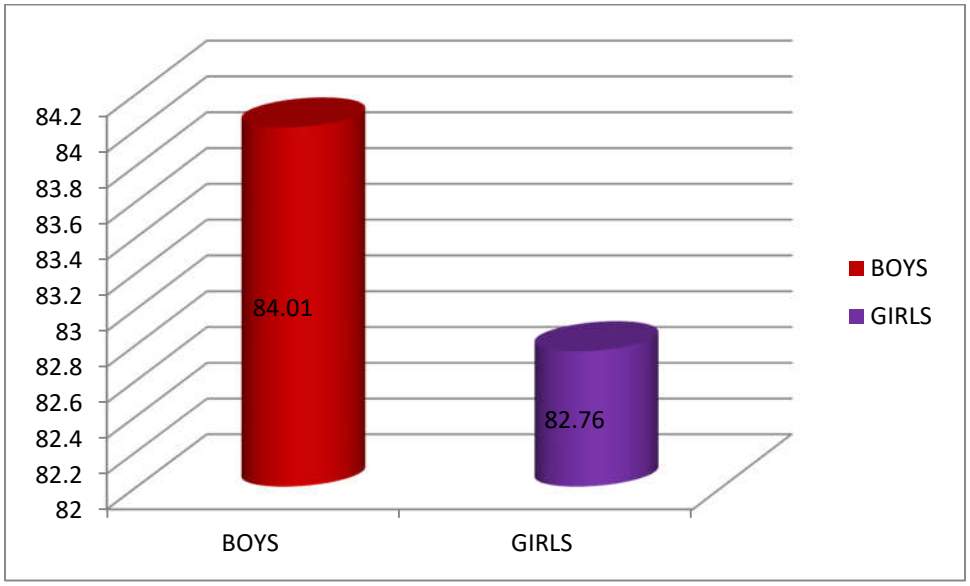

Figure 1 is also indicating of the fact that the mean scores of environmental awareness of senior secondary school boys and girls do not differ significantly.

From the above analysis, it may be interpreted that:

The senior secondary school boys and girls do not differ from each other on the environmental awareness. But, it is evident that the boys (84.01) are more aware about environmental awareness than girls (82.76) .

H_{02}: There will be no significant difference between environmental awareness of government and private senior secondary school students.

The mean scores of environmental awareness of type of school i.e., government and private high school students along with number, S.D., SE_{DM}, df and t-value are given in the table 2 below:

Table 2

School wise difference in environmental awareness of government and private senior secondary school students

Type of School			SE_{DM}	df	t-Value
Variable	Government (N=80)	Private (N=80)	1.330	158	*2.359
	Mean=85.90	Mean=82.76			
Environmental Awareness	S.D.=8.94	S.D.=7.83			

* Significant at 0.05 level of significance for 158 df.

Table 2 shows that the computed value of t- value for studying the significance of the difference between means of environmental awareness of government senior secondary school and private senior secondary school come out to be 2.359, which is significant at 0.05 level of significance for 158 df.

This indicates that there is significant difference in the environmental awareness of senior secondary school students at two levels of Type of school i.e. government and private.

Hence the hypothesis (2) as stated above: "**There will be no significant difference between environmental awareness of government and private senior secondary school students"** was not accepted.

From Table 2, it can be seen that the means of environmental awareness of government senior secondary school students and private senior secondary school students are 85.90 and 82.76 respectively.

Figure 2

Mean scores for government senior secondary school students and private senior secondary school students on environmental awareness

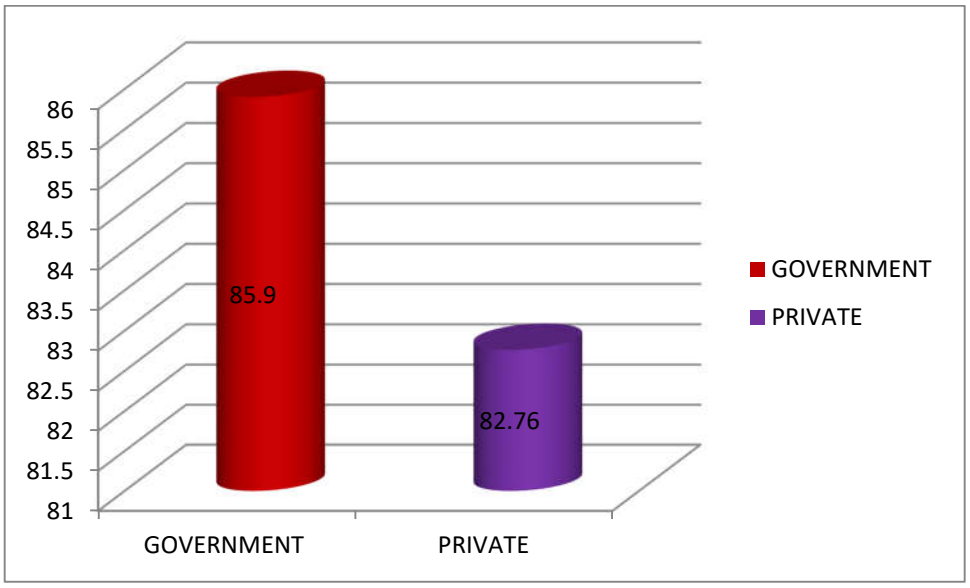

Figure 2 is also indicating of the fact that the mean scores of environmental awareness government senior secondary school students and private senior secondary school students do differ significantly.

From the above analysis, it may be interpreted that:

The government senior secondary school students and private senior secondary school students do differ from each other on the environmental awareness. It is evident that the government senior secondary school students (85.90) more aware about environmental awareness than private senior secondary school students (82.76).

Conclusions:

On the bases of the results of the study, following conclusions have been drawn.

- There is no significant difference in the environmental awareness of senior secondary school students at two levels of gender i.e. boys and girls. The mean scores of environmental awareness of senior secondary school boys and girls do not differ significantly.
- There is significant difference in the environmental awareness of senior secondary school students at two levels of Type of school i.e. government and private. The mean scores of environmental awareness government senior secondary school students and private senior secondary school students do differ significantly

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Teachers' Perception towards National School Lunch Programme (Mid-Day Meal Scheme) In District Kangra of Himachal Pradesh at Elementary Level

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Abstract

The purpose of this study was to study the teacher's perception towards national school lunch programme (mid-day meal scheme) in district kangra of Himachal Pradesh at elementary level. A sample of 100 teachers, which included 74 female and 26 male teachers, were selected using purposive sampling technique. Teachers' perceptions towards national school lunch programme (Mid-Day Meal Scheme) studied by using questionnaire. The information collected through teacher's questionnaire, was put to percentage analysis to give meaning to data. This study will be very helpful to the teachers, policy makers and all others who are concerned with the mission to develop elementary education and reach the goal of universalization of Elementary Education in India.

KEYWORDS: Teachers Perception, National School Lunch Programme, MDM, Elementary level Himachal Pradesh.

Introduction

The Mid day Meal Scheme was launched by Government of India with the objective of giving a boost to universalisation of education by increasing enrollment, attendance and retention and simultaneously improving the nutritional status of students in primary/upper primary classes. Mid Day Meal in schools has had a long history in India. In 1925, a Mid Day Meal Programme was introduced for disadvantaged children in Madras Municipal Corporation. Levinger (1994) the impact of School Feeding Programmes (SFPs); National Council of Educational Research and Training (2000) improve the enrolment and retention of girls in schools; Grewal et al. (2004) Nutritional Status of Rural Punjabi Children; Rana (2005) Utilization of Resources at Primary Stage; De et al. (2005) Mid Day Meal Scheme (MDMS) ; Kumar (2005) Effectiveness of National Programme of Nutritional Support to Primary Education (Mid Day Meal scheme); Gangadharan (2006) Mid Day Meal Scheme (MDMS) (termed as noon-meal scheme in Kerala); Gupta (2006) Effectiveness of National Programme of Nutritional Support to Primary Education (Mid Day Meal scheme); Deodhar (2007) Mid Day Meal Scheme; Hadi (2009) Mid Day Meal Schemes; Sharma et al. (2010) Impact of wholesome mid day meal (MDM) program; Mehta and Kour (2012) The nutritional contribution of MDM to the actual daily dietary intake of children; Paul and Mondal (2012) Impact of Mid-day Meal Programme on Academic Performance of Students; Kales (2014) Mid-day meal scheme; Chhabra and Rao (2014) The Challenges and interventions in meeting delivery of nutrition in mid-day meal scheme; Grover and Kaur (2014) examine the execution of Mid Day Meal Scheme; Lalita (2016) examine the nutritional contribution of MDM norms at Upper primary Classes; Jayalakshmi and Jissa

(2017) The Nutritional status of Mid-Day Meal programme beneficiaries and Samal and Dehury (2017) Family Impact Analysis of Mid-day Meal (MDM) Scheme in India with Special Focus on Child Education and Nutrition.

Need:

Almost all of the above studies were conducted on enrolment and retention, utilization of Resources at Primary Stage, effectiveness of national programme of nutritional support to primary education (Mid Day Meal scheme) and no efforts have so far been to see the teachers perception towards national school lunch programme (mid-day meal scheme). So, to study the teachers perception at elementary level this study was selected.

OBJECTIVES:

1. To study teachers' perceptions towards national programme of nutritional support to elementary education in Kangra district of Himachal Pradesh with regard to achievement of objectives of mid day meal scheme.

2. To study teachers' perceptions towards national programme of nutritional support to elementary education in Kangra district of Himachal Pradesh with regard to quality of meal provided under mid day meal scheme and its preparation.

3. To study teachers' perceptions towards national programme of nutritional support to elementary education in Kangra district of Himachal Pradesh with regard to perceived effect of value inclination and development of hygienic habits among students.

4. To study teachers' perceptions towards national programme of nutritional support to elementary education in Kangra District of Himachal Pradesh with regarding their own role.

5. To study teachers' perceptions towards national programme of nutritional Support to elementary education in Kangra District of Himachal Pradesh with regard to perceived effect of mid day meal scheme with respect to some miscellaneous factors.

Tools:

To conduct the study effectively a questionnaire was developed by the researcher for the purpose of obtaining responses from the teachers. This questionnaire consisted of three parts in which Part-I is introductory, Parts-II consisted of closed type 30 items concerning all the important aspect of Mid-Day Meal Scheme and Parts-III consisted of open ended questions in which teachers were allowed to write down freely the problems related to implementation of Mid-Day Meal Scheme and also the suggestions for its improvements and making the scheme more effective.

Methodology:

To achieve the objectives of the present study effectively survey technique under descriptive method of research was used.

Sampling:

A sample of 100 Government primary school teachers both 26 males and 74 females was selected by using purposive sampling procedures.

Statistical Technique:

The data collected through questionnaire was analyzed. In the study percentage was used for the interpretation of data. The percentage means that the results are calculated and discussed from per 100 in order to understand the results in a better manner.

Results and Discussion:

Major Findings of the Study based on Teachers' Perceptions towards national school lunch programme (mid-day meal scheme) in district Kangra of Himachal Pradesh at elementary level

- 92% government elementary school teachers were of the view that Mid Day Meal Scheme is helping to achieve the goals of Universalization of Elementary' Education and 53% teachers responded that there is no increase in enrolment at all.
- Maximum 59% teachers responded that there is no increase in the attendance of students as a result of Mid Day Meal Scheme and 80% of the teachers are against the reduction in number of dropouts.
- Improvement in learning levels as per the reviews maximum number of 80% teachers responded that there is very little improvement in learning levels and 49% government school teachers were of the view that a very little improvement in nutritional status by the Mid Day Meal Scheme.
- 98% government elementary school teachers were of view that Mid Day Meal scheme is helping to balanced and nutritious diet and 90% school teachers are in favour whereas rest 10% teachers are of the view that Mid Day Meal scheme is helping to some extent only.
- 98% government school teachers are in favour that the quality of food grains (rice) provided by F.C.I. is good in quality and 99% teachers are with the view that all the precautions has been adopted by the staff while preparing Mid Day Meal.
- 98% teachers are in favour of inculcation of values through this Mid Day Meal scheme and as per the statistic 100% teachers are in favour of scheme to eradicate discrimination.
- Sitting arrangement of children from different castes as per the result 100% teachers are in favour of sitting together children of all caste.
- 100% teachers of the government school supported the idea of development of hygiene habits through this Mid Day Meal and 82% teachers are not taking the Mid Day Meal as a problem whereas 14% teachers are taking it as a problem.

- 91% teachers responded that they should be free from the responsibility of Mid Day Meal Scheme and 77% teachers are no problem of motivation for proper implementation of Mid Day Meal Scheme.
- 88% teachers that implementation of various schemes like Mid Day Meal . Sarav Shiksha Abhiyan etc. scheme is primary concern in government elementary schools and 82% teachers were in favour of Mid Day Meal Scheme in Himachal Pradesh they realized its need in the H.P.
- 91% teachers were that Mid Day Meal Scheme is not a wastes the teaching-learning time of teachers and students and 95% teachers were in favour of providing hot cooked mid day meal daily to the students in the school.
- 97% teachers were that after the launching of cooked Mid Day Meal Scheme there is inspection by parents/guardian of children in the context to this scheme and 63% teachers have expressed that students do not feel sleepy after taking mid day meal.
- 100% teachers perceived that the meal, which is provided to the children under Mid Day Meal Scheme is liked by the students and 100% teachers responded that there is no help received on the part of local people for the implementation of Mid Day Meal Scheme.

Major Findings of the Study based on Problems Related to Mid-Day Meal Scheme in district Kangra of Himachal Pradesh at elementary level

- In district Kangra mostly there is no separate kitchen in the elementary schools for preparation of mid day meal and the preparation of meals in the same surrounding near the classes disturb the students and teachers.
- The attention of students is distracted due to this inappropriate distance of kitchen from classrooms.
- Proper storage provisions are not available in most of the elementary schools.
- There are no safety provisions in case of any accident like fire, leakage of gas cylinder etc.
- The grant for National School Lunch Programme (Mid Day Meal) is not made available timely by the concerned department dealing with Mid Day Meal Scheme.
- There is no participation and help received from the local community for the implementation of National school lunch programme (Mid-day meal).

Major Findings of the Study based on Suggestions for Making the Scheme More Effective in district Kangra of Himachal Pradesh at elementary level

1. Elementary School Teachers should be relieved of all National School Lunch Programme (Mid Day Meal) responsibilities, except supervising the preparation and distribution of mid day meal.

2. Separate kitchen-cum- store should be made available to all government elementary schools and it should be at an appropriate distance from the classrooms.

3. The National School Lunch Programme (Mid Day Meal) should be implemented in such a manner that in any circumstances it does not adversely affect teaching-learning activities in schools.

4. The grant for National School Lunch Programme (Mid Day Meal) should be increased by taking into consideration the inflation rate and should be provided monthly well in time.

5. Encourage the participation of the local school management committee in the implementation of National School Lunch Programme (Mid Day Meal).

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ART & AESTHETICS IN INDIAN ART

Sangram Singh

Assistant Professor, Art History (Deptt. of Visual Arts) Himachal Pradesh University, Shimla, H.P, Indi

"This is an art, which does mend nature, change it rather, but the art itself is nature ..."

Shakespear

We have examples of pre-historic art, but they are rare, and the context of their production and use is not very clear, so we ca little more than guess at the aesthetic doctrines that guided their production and interpretation.

India is a land of very rich diversity. Various culture, religions or languages have built up our country and bound each other in th inspirations of various different customs and beliefs, arts, way of life and the India's natural features from study deserts to tropic rainforest & Himalayan snows, is extremely huge, different types of its nature & every region has its own style and pattern of art culture & heritage that's attract the every people of the world.[1]

The notion of traditional concept in art is flourished since time immemorial, when man assumed to create beauty out of his sense and enjoyed pleasure out of his delight. "Any subject is available for beauty if it is treated beautifully". It is clear concept aesthetic, richness of art has nothing to do with the expression of its subjects many times. It is prevalent everywhere, either it assumed out of tradition or out of contemporary trends. A creative work of art is a form of the existence of art, a system beautiful artistic mages, which add up to a single notion of expression. All creations of art, to whatever expression tradition contemporary style they belong. Express creative and permanent values, if they have the breath & quality of life, they are p excellent in their attractiveness & charisma. Therefore it is possible for the onlooker or visualiser to enjoy a concept designed o of traditional forms and thoughts and figurative or non-figurative painting (arts) with abstract appeal contemporary aesthet trends.[2]

Art is not stone, brick, words or tricks of trade, it is above all the reflection of the artists soul, the visible expressions of the force which drive him" (Gosland, 1965, 254-255).

Art helps in spiritual upliftment, as we know that Indian art is derived from the philosophy & not from the external beauty. Truth goodness and beauty is the base of all the art. God is described the most beautiful in Indian theory and art. So art is more spiritu in nature. It is also considered essential for spiritual upliftment. An artist feels oneness with god and with nature through art.

Art helps in the finding the truth, it is art which helps person to found reality of the world or life. Art pieces are the result of a artists independent thinking, truthfulness and knowledge clear and strong. Art makes a person socially reliable & self-dependen In the realm of art, the manual work of great importance but in one society it was seen as degraded job, but nowadays, an arti enjoys an covalent status as a man with highly designated.

Art develops aesthetic sense, art helps in the development of aesthetic sense in human being, with this sense a person is able t appreciate or criticize the hidden civility behind the art piece that is architecture, sculpture, painting & many more.

Philosophical aesthetics not only has to speak about art and produce judgements about art works but also has to give a definitio of what art is. Art is an autonomous entity for philosophy, because art deals with the senses (i.e. the etymology of aesthetics) an art is such free of any moral or political purpose.

Indian art evolved with an emphasis on inducing special spiritual or philosophical states in the audience, or with representing ther symbolically. According to Kapila Vatsyayan. "Classical Indian architecture, sculpture, painting, literature (*Kāvya*), music, an dancing evolved their own rules conditioned by their respective media, but they shared with one another not only the underlyin spiritual beliefs of the Indian religio-philosophic mind, but also the procedures by which the relationships of the symbol and th spiritual states were worked out in detail."

Of particular concern to Indian drama and literature is the term *rasa* referring generally to the emotional flavors crafted into th work by the writer and relished by a 'sensitive spectator' or *sahridaya*. Poets like Kālidāsa were attentive to rasa, which blossome into a fully developed aesthetic system. Even in contemporary India the term *rasa* denoting "flavor" is used colloquially t describe the aesthetic experiences in films; "masala mix" describes popular Hindi cinema films which serve a balanced emotiona meal, savored as rasa by the spectator.

Rasa theory blossoms beginning with the Sanskrit text Nāṭyashāstra (*nāṭya* meaning "drama" and *shāstra* meaning "science of"), work attributed to Bharata Muni where the Gods declare that drama is the 'Fifth Veda' because it is suitable for the degenerate ag as the best form of religious instruction. While the date of composition varies wildly among scholars, ranging from the era o Plato and Aristotle to the seventh century CE. The Nāṭyashāstra presents the aesthetic concepts of rasas and their associated bhāva in Chapters Six and Seven respectively, which appear to be independent of the work as a whole. Eight rasas and associated bhāva are named and their enjoyment is likened to savoring a meal. rasa is the enjoyment of flavors that arise from the peopc

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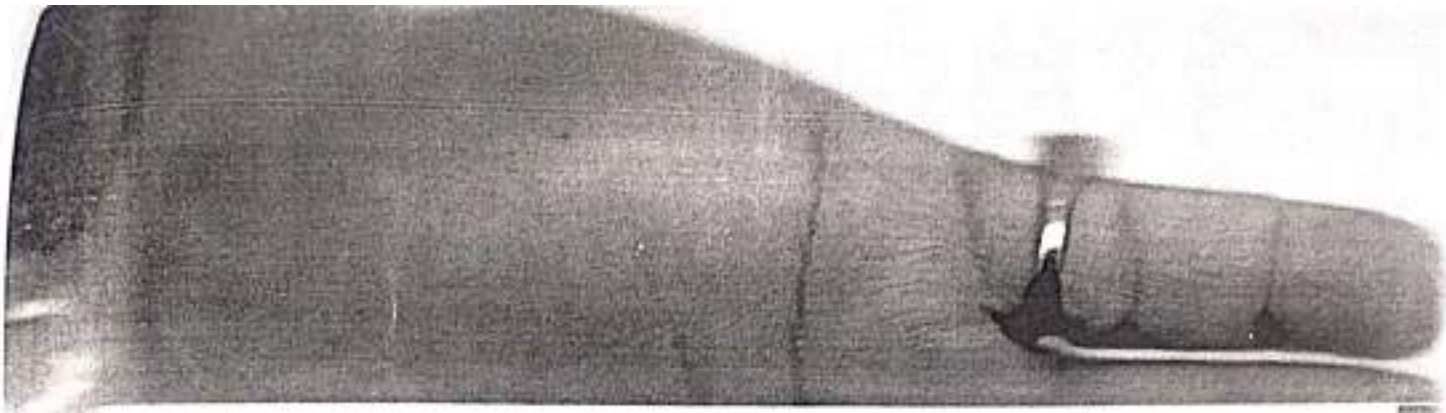

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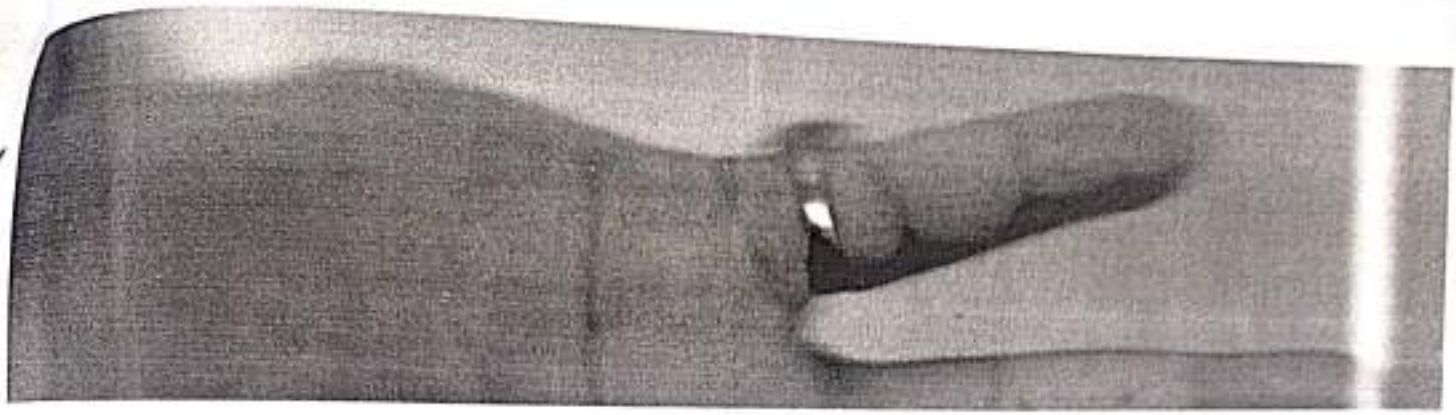

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शोध-आलेखानुक्रम

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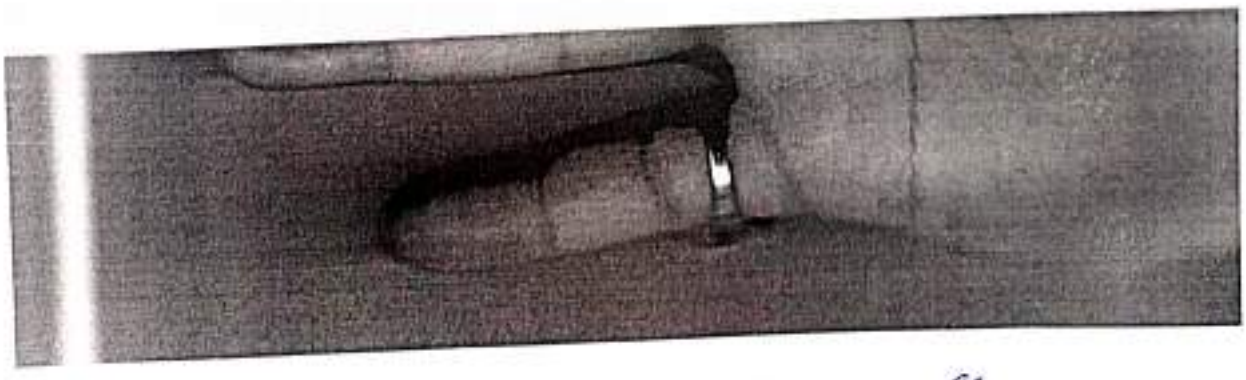

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कला और सौन्दर्य का सम्बन्ध

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शोध-आलेख सार

मानव सौन्दर्य के प्रति सदैव सजग रहा है, आदिकाल से जब भी मानव ने रचना की, सर्वप्रथम जाने पहचाने रूपों की ही रचना की, सदियां एवं शताब्दियां बीत गयी लेकिन रूपों की रचना नहीं रूकी। उसने आस पास की दुनियां में ही सौन्दर्य की तलाश की तथा अपने वातावरण को सौन्दर्यमय बनाना। आदि मानव के सौन्दर्य का स्रोत जंगली जानवर एवं उसकी अपनी स्वत: जरूरत थी ।

मुख्य-शब्द : कला, सौन्दर्य, वातावरण, आनन्द ।

Beauty is that wine which intoxicates both the holder & beholder.

- Shakes

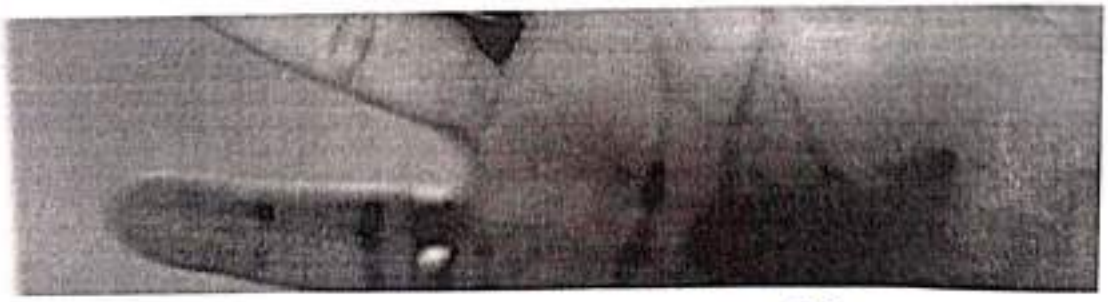
मानव इतिहास का प्रथम अध्याय कला के द्वारा ही लिखा गया। जब मानव का भाषा तक ज्ञान नहीं था, उसने तब भी चित्र बनाए। उसने अपनी इच्छाओं को व्यक्त करने के लिए चित्रों एवं प्रतीकों का लिया। आदि मानव ने जीवन के संघर्ष, हर्ष एवं संताप तथा इच्छाओं को कला रूप में धारण करके नि में अमरत्व प्राप्त कर लिया।

मानव सौन्दर्य के प्रति सदैव सजग रहा है, आदिकाल से जब भी मानव ने रचना की, सर्वप्रथ पहचाने रूपों की ही रचना की, सदियां एवं शताब्दियां बीत गयी लेकिन रूपों की रचना नहीं रूकी आस-पास की दुनियां में ही सौन्दर्य की तलाश की तथा अपने वातावरण को सौन्दर्यमय बनाना। आदि म सौन्दर्य का स्रोत जंगली जानवर एवं उसकी अपनी स्वत: जरूरत थी।

सौन्दर्य के लिए मानव सदैव पिपासु रहा है। कलाएं सौन्दर्य का स्रोत रही है। पाषाण काल से मानव द्वार कन्दराओं में जंगली पशुओं के चित्र और आखेट के दृश्य अगर आप देखें तो आपको किसी (कहने) पूछने और समझने की जरूरत नहीं पड़ेगी।

'सौन्दर्य एक भावना है। हम संसार में अनेक वस्तुएँ देखते है। इन वस्तुओं के हमारे मन पर जो पड़ते है उनमें से एक सुन्दरता का प्रभाव भी है। इस दृष्टि से हम वस्तुओं को सुन्दर कहते है। अनेक की सुन्दरता के अनुभव के आधार पर हम सभी वस्तुओं में निहित एक सामान्य सौन्दर्य गुण को कल्पि है। पर यह सौन्दर्य गुण रूप में कहीं भी उपलब्ध नहीं है। इसका कुछ अंश ही उपलब्ध होता है "सौन्दर्य" एक काल्पनिक प्रत्यय मात्र है जो वस्तुओं की सुन्दरता के आधार पर विकसित हुआ है।

सौन्दर्य के विषय में दो मत है : एक मत यह है कि सौन्दर्य वस्तु में निहित होता है। इस सौन्दर्य कहा जा सकता है। दूसरा अभौतिक अथवा मानसिक सौन्दर्य है। इन दोनों भेदों को क्रमश: (objective) तथा आत्मगत (subjective) सौन्दर्य भी कहा जा सकता है।



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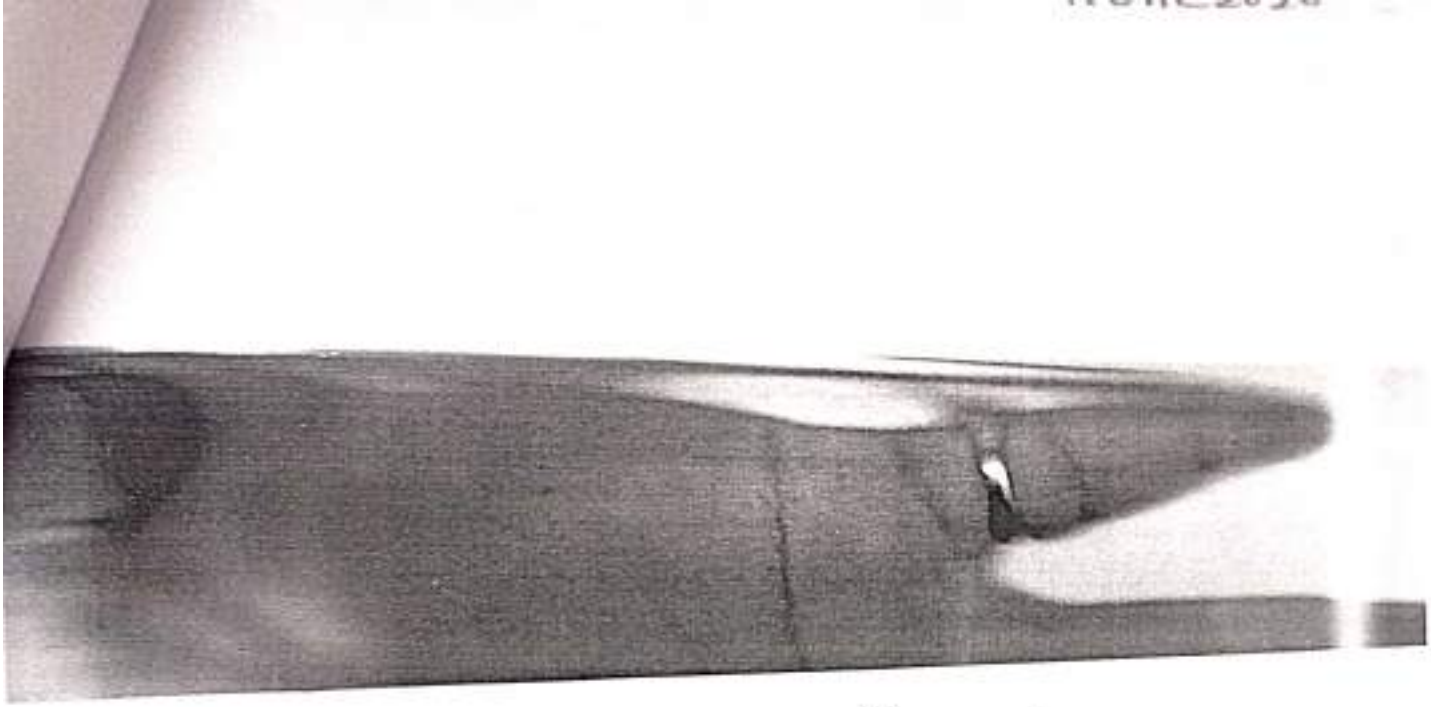

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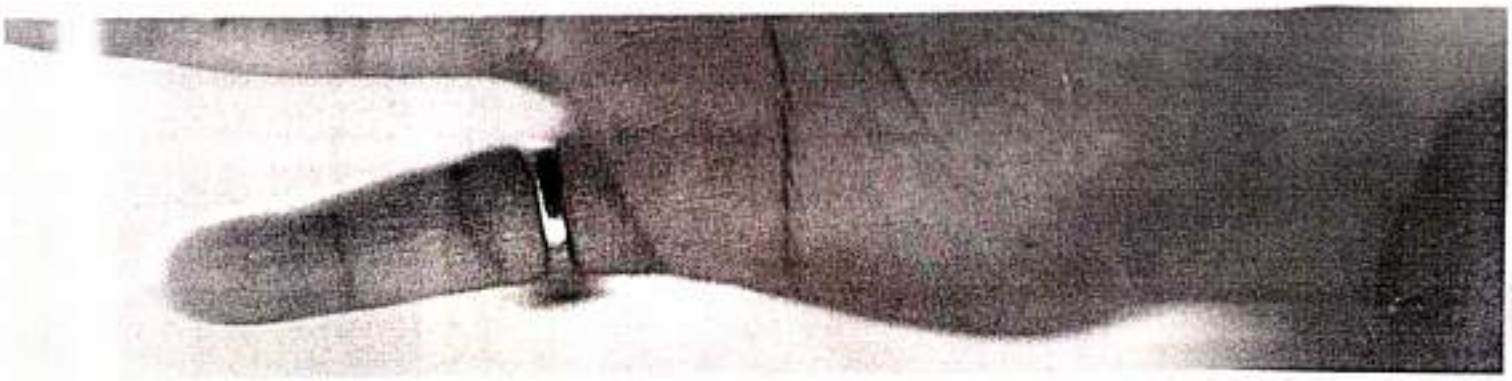

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Art as a Discipline

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Abstract

Art is a phenomenon from which people perceive the work) aesthetically. Art can be recognized in every moment of a human life. Humans can see it in a morning breakfast plate or in their clothes (Brommer and Horn, 1985; as cited in: Mercin and Alakus, 2007). Since the evolution of mankind, art has been defined in various ways. It would be useful to touch some definitions of art to elicit further understanding of this discourse. Schiller defines art as a "path to freedom and self-actuality". For Read, art "provides a governing mechanism for life; without art, all living creatures lose their balance. They are faced with social and spiritual confusion" (as cited in Artut, 2001: 19). Art helps individuals to balance and organize their emotional world.

Key-Words : Literature, Music, Culture.

"Literature, music, and the arts, all are necessary for the development and flowering of a student to form an integrated total personality" - Rabindraitath Tagore

In a globalized world, art is becoming like any other commodity or product exported and imported worldwide. Small artists benefit from a larger platform to sell their works and, if successful, they can reach anyone, anywhere in the world. Larger corporations that deal in the buying and selling of artwork are weathering the economic storm innovating with the Internet to expand their marketplace. The Internet is equalizing the art world allowing anyone anywhere to buy and view pieces; no longer is the art world constrained by location.

Not all of the impacts are positive, as local cultures suffer when their art treasures leave their borders and the local people are not able to see these pieces in accessible, local museums and galleries. Others benefit as they learn about other cultures and societies through seeing the artwork. One thing is certain; artwork of high quality is still a good investment.

Fine Arts, Applied Arts and Crafts, According to Herbert Read, an eminent art historian:

The actual phrases, 'Fine Art' and 'Applied Art' may be largely the creation of the machine age, but the underlying distinction is a product of the Renaissance. Before the Renaissance, the so-called Fine Arts (architecture sculpture, painting, music and poetry) were not explicitly named nor distinctly recognised, as a separate class; even in classical Greece there was only one word 'techne', for both kinds of art... The use of the term 'Fine Arts' is closely bound up with the history of academics of art, which is usually academics of 'Fine Art'. The first use of the phrase in English recorded by the Oxford English Dictionary is in 1767. The Royal Academy in England was founded in 1768. It was, of course, preceded by similar academies abroad—at Vienna and



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About the Book

It is essential to emphasize and understand gender equality in the 21st Century. Even in the developed countries where females legislatively have equal rights with males, discrimination also appears prominently. The best way of ensuring equality is to start living and asking ourselves what each one of us can do to contribute to an equal society where individuals, regardless of any external attributes, can live and thrive without any distinction.

The present volume titled "Gender Issues and Discourse in 21st Century: Inter and Trans Disciplinary Perspectives" is the outcome of selected research papers from the International Interdisciplinary Webinar, Organized by IQAC, Kanya Mahavidyalaya, Guwahti, Assam and IQAC, Bilasipara College, Bilasipara, Dhubri, Assam on the subject, Gender Issues and Discourse in 21st Century as a follow up of the UGC Directive.

About the Editor



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Inter and Trans Disciplinary Perspectives

Editor
GUPTAJIT PATHAK

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Gender Issues & Discourse in 21st Century: Inter & Trans Disciplinary Perspectives

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Abstract

The Indian republic had started its journey with the ideals of liberty, equality and gender justice, making the Indian women feel secure with promises of survival. By thinking about the arc of women's studies, feminist thinking and gender studies, it is quite spontaneous that this gender studies has always been an interdisciplinary field of study. The article aims to open up debate over what the constructive possibilities are of a focus upon gender, and what the relationship is between theory and activism. Society has fixed standards and rules to validate both masculine and feminine identities. We are expected to perform these individual roles and reproduce the very conditions that perpetuate it. Gender studies, therefore, is a study of production, reproduction, and resistance to norms that produce inequality between men and women.

Gender facilitates greater understanding of social relations and divisions as well as describing them. A focus on gender generates different and often innovative methodologies as well as a plurality of theoretical approaches, which are directed at making sense of inequalities and at celebrating the experiences and contributions of hitherto marginalized groups. Gender studies offer scope for innovation in methods as well as having established a tradition of mixed methods in response to social change. The development of gender studies as an interdisciplinary field retains the dynamism of different and often very productive conversations, across generations, empirically in terms of lived experience and theoretically through intellectual dialogues. I wish to quote here, "Men Are from Mars and Women Are from Venus," It means that most relationship problems occur between men & women due to the psychological differences. Hence they both are from different planets. In nutshell, this article encompasses the gender studies chronology along with societal expectations vis-à-vis to the present scenario of gender complexities and inequality in India.

Keywords: *Feminist, Interdisciplinary, Resistance, Inequalities, Social Change.*

Introduction

Women's studies have provided new and improved perspectives on major themes – women's issues, gender, sexuality, caste to name a few – that have a significant impact and role to play in society. It has also long been a part of the larger feminist movement in India. Since long, Women's Studies has been referred to as "multidisciplinary, intradisciplinary, neo-disciplinary, trans disciplinary, cross-disciplinary, critical interdisciplinary, intersectional, intertextual, and pluri-disciplinary" (Ginsberg, 2008, p. 13). The proponents, favouring Women's Studies as a discipline, argue that Women's Studies programs will never receive the time or resources they deserve if faculty members have a primary obligation to serve another department and if program directors must constantly negotiate for consistent degree requirements and sufficient funding (Schmitz, Butler, Rosenfelt, & Guy-Sheftall, 1995). A second debate that shaped the evolution of Women's Studies involved differing opinions about the primary goal of women's efforts in changing the higher education curriculum. Some argued that the ultimate goal should be transformative curriculum change and that women should focus on revising the traditional male-dominated curriculum.

Gender has become the preferred term for referring to social difference, partly because of its wider scope. Women's studies and feminism not only put gender into the agenda but also offered new ways of understanding gender as a social, cultural and political process and structure through which societies are organized. Although many earlier accounts suggested a division between sex as anatomical and biological and gender as the social and cultural manifestations of sex, there are strong arguments for sex as shaped by cultural forces and made through social practices. One of Butler's major contributions to gender studies and to the study of social relations and the operation of power across disciplines is her critique of sex and sexuality as well as gender as performative. Sex, as much as gender, is produced by the processes and practices through which it is defined and classified. Butler's (1990,1993) work has generated questions and debates about the materiality of sex, the fluidity and the transgressive properties of sex, gender and sexuality. Debates within gender studies about the nature of sex and gender invoke the need for interdisciplinary approaches as well as drawing upon a range of disciplines and theoretical frameworks.

To radically change the existing systems of oppression and discrimination, some worried that the movement would lose its political mission if it had to conform to the preexisting patriarchal structure of higher education.

Women Studies Vs. Gender Studies

Despite this success, Women's Studies practitioners continued to struggle with the debates from previous decades, such as what the primary agenda of Women's Studies programs should be, how to define women, and where Women's Studies belonged in relation to the overall higher education curriculum. A new debate began in the 1990s and early 21st century on whether the programs should still have Women's Studies as a title. Some within the field have proposed to changing the name from Women's Studies to Gender Studies. By broadening

the title, the field could appear more inclusive to different gender and sexual identities. Also, proponents of a broader title argue that a title focused solely on women will perpetuate the idea that men are the norm and that women can only be the focus of study in special programs.

Although the debate over the appropriate placement of Women's Studies programs within the structure of higher education continues, the ultimate focus should be ensuring that these programs exist in the future. Students of all genders should have a community within their academic institution that encourages them to reflect on their personal experiences, values their individual perspectives, fosters an understanding of diversity and social justice issues. Women's Studies programs have given women a voice in the society, and until all forms of oppression have ended, it is essential for that voice to be heard.

Gender studies have incorporated studies of masculinity (Connell, [1995] 2005, 2014) and interdisciplinary approaches have stressed the possibilities of transformation of traditional stereotypical masculinities (Hooks, 2004). Gender is not just about women, as has so often been the case in the promotion of policies of equal opportunities in neo-liberal democracies in recent times. Men are gendered too and the interrogation of hegemonic masculinity raises challenges to power structures in a vast range of social, economic, cultural and political systems where traditional, seemingly gender neutral norms are called into question. Gender is both an empirical category and a theoretical conceptualization, which facilitates greater understanding of social relations and divisions as well as describing them.

Gender Studies as Interdisciplinary Approach

Interdisciplinary approaches also need to be necessitated through the exploration of some of the interrelationships between biology, genetics, bodies and social systems. Gender studies have been most creative and productive in embracing mathematics, science, psychology and technology to understand how sex and science and technology are enmeshed, for example, in Harraway's (1997) work on technoscience and Franklin's (2013) research on genetics.

Gender studies offer scope for innovation in methods as well as having established a tradition of mixed methods in response to social change. The development of gender studies as an interdisciplinary field retains the dynamism of different and often very productive conversations, across generations, empirically in terms of lived experience and theoretically through intellectual dialogues (Woodward and Woodward, 2009).

Gender studies also offer a means of exploring what is involved in interdisciplinary work and the relationship between multidisciplinary and trans disciplinary approaches, which emerge from interdisciplinary studies as an established field of enquiry with its own capacities and distinct features. Gender is itself a contested category an exploration of which creates new ways of thinking about the relationship and interdependence between gender and society. Gender is both an empirical category and a theoretical conceptualization, which facilitates greater understanding of social relations and divisions as well as describing them. A focus on

gender generates different and often innovative methodologies as well as a plurality of theoretical approaches, which are directed at making sense of inequalities and at celebrating the experiences and contributions of hitherto marginalized groups.

THE ECONOMIC DIMENSIONS OF GENDER INEQUALITY IN INDIA .

In India, discriminatory attitude towards men and women have existed for generations and thus it affect the lives of both genders. Although the constitution of India has granted men and women equal rights, but gender gap still remains. Female discrimination violates human rights. Women have been actively involved in economic activities and labor force in contemporary times. In the agriculture sector for instance, 74% of the labor force consists of women. Yet, the wage gap between men and women across the Indian economy despite the active involvement of reformists and feminists who have been fighting for equal pay.

Women are also discriminated in terms of credit lending and property ownership. This situation can be again drawn back to the patriarchal system prevalent in the Indian economy: women have always been disbanded from share in the properties as it is believed that men are the ones who actually carry their generation forward and earn bread and butter for the family, while women would just sustain upon the money earned by men.

Women also lag behind the corporate and government sectors. Various government programs and schemes have been launched in an attempt to provide equal opportunities for men and women. Reservations have helped to rise the number of jobs of women in government sector. This growing trend also lead to changes in the corporate sector. Earlier, not a single woman was to be seen in the top tier of the corporate world. Today, there has been escalation in the number of woman in these top sectors. Even though there have been reforms and number of women have increased in jobs but still they lag behind in the total percentage of jobs.

These issues are very debatable why women still lag behind men despite the increase in the number of opportunities and affirmative action programs. These debates in my opinion would always lead to the issue of patriarchy. Patriarchy, according to me is so entrenched in the Indian society that even though one may try their hardest to uplift women to the level of men, patriarchy would pull them down. I believe until and unless patriarchy is removed, nothing can bring equality among men and women.

In India as well as other lesser developed countries, commonly, a male child is considered a blessing and his birth is celebrated as opposed to a female child where her birth is not celebrated and is considered more of a burden. The 2011 Indian census shows there are 940 females per 1000 boys. Similarly, educating a boy is seen as an investment as they are expected to earn and provide for their ageing parents. Whereas, an educated girl will have a higher dowry expense because they need an educated partner. It is also believed to be a waste of resources to educate a girl child as she will eventually get married and be a homemaker. If a family cannot afford to educate all their children, the male child will get preference.

Finally, a nationwide campaign is needed to reignite India's core values and traditions that respect and nurture women and children. This can only be borne out of consensus in society. Awareness amongst men of the scope of this issue is critical. Men who turn a blind eye to such brutal acts in their own neighborhoods, communities and families are just as culpable as those that perpetrate these acts. Action from courts and police will not suffice if the community remains defiantly opposed to change.

Conclusion

Gender studies are part of a developing field, which retains the excitement of interdisciplinary innovation, which characterizes feminism and women's studies, but extends this field of research by presenting engagements with pressing contemporary debates and issues. Many of the tensions and contradictions of gender studies are those of interdisciplinary studies at a time when there has also been a move towards the reinstatement of single disciplines in the field of higher education suffering from financial constraints and reduced resources. Gender studies present productive possibilities for contributions to knowledge, which are distinctively interdisciplinary and go far beyond attempts to mainstream gender into conventional disciplinary structures.

Gender inequality subsists in Indian economy and prevails in all sectors of life like health, education, economics and politics. Men have always had the upper hand in these fields, depicting how deeply patriarchy is entrenched in India. Even though gender equality soars to great heights in post-independence era, many steps have been taken in various sectors of life to bridge the gap between men and women and to bring them up to the same level. In nutshell, I wish to quote the following lines of Lord Denning in reference to the present article and in the favour of both the pillars of the society i.e. gender equality:

"A woman feels as keenly, thinks as clearly, as a man. She in her sphere does work as useful as a man does in his. She has as much right to her freedom - to develop her personality to the full - as a man. When she marries, she does not become the husband's servant but his equal partner. If his work is more important in the field of the community, her is the more important in the life of the family. Neither can do without the other. Neither is above the other or under the other. They are complementary to each other. They are equal."

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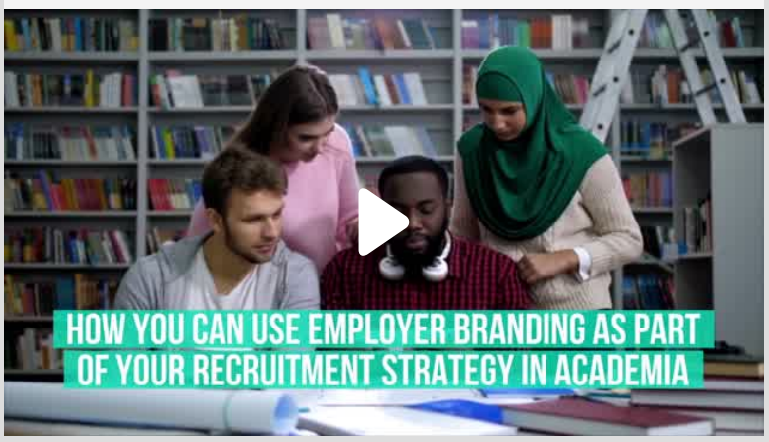

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Locality of Reference- The Basis for Modifying Aadhaar Architecture

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ABSTRACT

The biometric based large scale civilian identification system in India i.e. Aadhaar is based on the centralized database architecture. An identification system that uses centralized database architecture lacks locality of reference. Aadhaar has been implemented to provide unique digital identity to the individuals of the country, to enable them to access various welfare and non- welfare services extended by the government and non- government organizations. In a biometric based identification system, the major processes that take place are: **(i)** de-duplication, carried out to facilitate the process of identification, **(ii)** authentication, carried out to establish unique identity of an individual, and **(iii)** the processes of update/ correction of the biometric/ demographic data. In all the three types of the processes, the biometric/ demographic data about the residents is captured by the respective organizations and it is communicated to the centralized identity data repository for the purpose of processing. Majority of the welfare and non- welfare services extended by the government and non- government organizations are accessed by the residents locally i.e. near the place of their living. In any of the processes, if it is identification, authentication or update/ correction, the need for a particular process starts near the place of living of the residents and the request is processed by the centralized identity database. In general, the distance between the source of data and the processing unit plays a major role in determining the performance of the system in terms of response time, throughput and accuracy. The current architecture of Aadhaar, in which the resident centric data is kept in the centralized identity database has affected the performance of Aadhaar in terms of various implementation challenges, such as poor coverage of the population for the purpose of enrolment, poor recording of births (i.e. enrolment of children at the time of birth), non- cancellation of Aadhaar numbers of those who have ceased to exist, delays in update/ correction, accuracy in terms of false rejection and false acceptance and the problem of single point of failure etc. With the introduction of internet and eventually the evolution of the distributed computing, the principle of locality of reference has proved to be the basis to determine the performance of the systems that fit in the paradigm of distributed computing. The present paper has discussed various resident centric services that uses Aadhaar to ensure unique identification of the residents and proposed a modified distributed database architecture to re- implement Aadhaar in India, based on the principle of locality of reference, in order to address various implementation challenges.

Keywords: *Aadhaar, Authentication, Database, De- Duplication, Distributed Database, Locality of Reference.*

1. INTRODUCTION

Aadhaar is inevitably employed by most of the government and non- government organizations in order to establish unique identity of the residents, in the process of extending various resident centric services such as the welfare and non-welfare services [1]. The welfare services extended by the government to the residents of the country can be categorized as **(i)** cash based welfare services, such as scholarships and welfare pensions, **(ii)** subsidy based welfare services, such as Public Distribution System (PDS), LPG subsidy, subsidy to farmers on seeds and equipment, and **(iii)** the social welfare services, such as to provide land to the landless poor, homes to the homeless people and work to the unemployed individuals [2]. The non-welfare services include the services related to income tax, to issue a SIM card, to open a bank account etc. In either of the services, if it is a welfare service or a non-welfare service, the primary job of the concerned organization is to uniquely identify the legitimate beneficiaries so that the benefits/ services should reach the intended individuals [3]. In most of the cases people access services near the place of living and therefore the process to establish his/ her unique identity also starts locally. This unveils the fact that the resident centric data, already stored in the centralized identity database, is referenced from the locality of the residents i.e. villages and towns. In the existing identity system of India i.e. Aadhaar, the credentials (biometric and demographic data) of the residents are kept in the centralized data depository, known as Central Identity Data Repository (CIDR). The central identity data repository is responsible to carry out the operations of: **(i)** authentication of identity of the individuals, as requested by various government and non-government organizations in an electronic mode, while extending services to the individuals, and **(ii)** to carry out the operations of de-duplication, when a new person has to be enrolled in to the identification system, in order to provide him/ her, the unique digital identity. The centralized identity database i.e. CIDR is also responsible to execute the operations of update and correction [4]. The term 'de-duplication' is concerned with the process of enrolment of an individual into the identification system. 'De-duplication' ensures that no duplicate identity be issued to the already enrolled individuals by comparing the credentials of an individual as read by the scanner at

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any terminal across the country with the already stored credentials of the individuals, who are already enrolled into the identification system. In order to enrol a new person into the identification system, the answer to the question '*Who Am I*' is sought with high degree of certainty to be '*You Are Not Known*' using 'de-duplication'. Once such an answer is given by the identification system, the credentials of the individual are added to the identity database. The present paper explores various services, where Aadhaar is used to establish unique identity of the individuals in section 2. Section 3 discuss various implementation challenges that are related to the performance of the identification system i.e. Aadhaar that arise due to the underlying centralized architecture. The solution to various implementation challenges are discussed in section 4 and section 5 is about the conclusion and the future scope.

2. USE OF AADHAAR IN THE SERVICE DELIVERY SYSTEM

As soon as, an individual is enrolled into the identification system and is provided identity in the form of 12 digit unique identity number, the enrollee and the identification system set up a long term, legal relationship with one another. It is the service provider agencies that come in to picture and start utilising Aadhaar number of the individuals in order to uniquely identify them, so that services should reach the legitimate beneficiaries. Presently, almost every government/ non- government organizations have made it mandatory for the applicants/ beneficiaries to have Aadhaar number at the time of requesting a particular service. The launch of Digital India has widened the scope of the use of Aadhaar, as a unique digital identity. Some of the resident centric services that uses Aadhaar as a proof of unique identification of the individuals are studied and are discussed. Against every service discussed, the tables have been given (where applicable) that contains the relevant fields (demographic data and Aadhaar number about the residents) that are required to be filled up by the applicants, to request for a particular service.

2.1 BETI HAI ANMOL YOJNA

Table 1 and Table 2 corresponds to the "Beti Hai Anmol Yojna" [5], which was launched by the Government of Himachal Pradesh to provide financial assistance to the girl child of BPL families in Himachal Pradesh and mainly to combat the female foeticide [6].

The fields along with their descriptions are enlisted as follows:

Table 1: The Application Form to fill up the Details of the Mother of the Girl Child

Field Name	Description
Aadhaar Number	Enter Aadhaar number of the mother
First name	Enter first name of mother
Middle Name	Enter middle name of mother
Last Name	Enter last name of mother
Number of Daughters	Enter the number of daughters
Mobile Number	Enter the mobile number of mother
E-Mail	Enter the e-mail ID of mother
BPL Number	Enter BPL number of family
Image of Mother	Upload the image of the mother

In order to enter the BPL Number, one has to search and fetch the family details either by opting Aadhaar Number or family number or by the name of the family member. Table 2 corresponds to the details about the Girl Child.

Table 2: Details of the Girl Child that are to be Filled Up in the Application Form

Field Name	Description
Aadhaar Number	Enter the Aadhaar number of the girl child
Date of Birth	Enter the date of birth of the girl child
First Name	First name of the girl child
Middle Name	Middle name of the girl child
Last Name	Last name of the girl child

2.2 RATION CARD (CONSUMER CARD) UNDER PUBLIC DISTRIBUTION SYSTEM

In this section the application form for Ration Card has been explored [7], which is used to access the services under Public Distribution System (PDS), which is the oldest welfare scheme of the Government of India.

Table 3: Particulars of Family Members for which Ration is required

Field Name	Description
Name of Family Members	Enter the names of the family members in the space provided
Relationship with Head of Family	Specify the relation of each family member with the head of family
DoB	Enter the date of birth of every member of the family
Aadhaar No.	Enter the 12 digit Aadhaar number of every member of the family
Mobile No.	Enter the mobile number of every member of the family

It has been specifically mentioned in the application form to give consent to use Aadhaar number and biometric details for getting ration under. As a practical scenario, the ration is delivered to a particular family after getting the biometric details verified in the real time of any family member.

2.3 DIGITAL LOCKER

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Digital Locker commonly known as DigiLocker is an Aadhaar enabled initiative under the Digital India Program to empower the residents of the country to store the documents such as documents of academic qualifications, driving license, vehicle registration certificate etc. in digital form in the cloud database, provided by the government. The stored digital documents can be used as and when required by the requesting authority in an online mode thereby enabling the residents not to hold the physical documents all the times. In order to register in DigiLocker, it requires authenticating the mobile number of the intended individual. The next step is to submit the Aadhaar number in order to be linked with the DigiLocker account and this completes the process of the registration [8]. It has proved to be the digital empowering tool to the residents of the country. The process followed for registering in the DigiLocker is shown as follows:

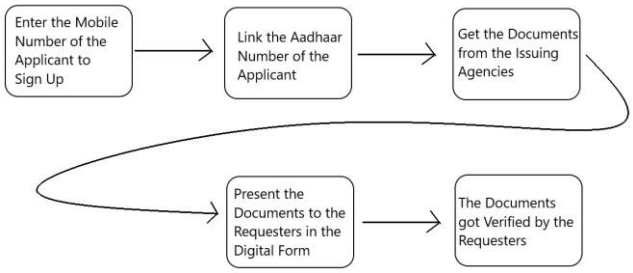

Figure 1: Use of Aadhaar as the Unique Identity, for using services of DigiLocker [8]

2.4 PRADHAN MANTRI JAN DHAN YOJNA (PMJDY)

PMJDY is an initiative of the Government of India to provide bank accounts to the financially excluded segment of the population, those who were not having bank account. The proof of identity was the major reason, people could not have procured the bank account to meet the financial needs. Prior to the launch of Aadhaar, only a few number of the identity documents were in practice to open the bank account such as PAN card, Passport, voter card and driving license etc. More importantly the Know Your Customer (KYC) was one of the major barriers behind getting a bank account by the poor and marginalized people in the country [9]. Government of India has launched PMJDY as a welfare scheme, for the financial inclusion of the residents of the country. Aadhaar has enabled the residents of the country to prove their unique identity. Table- 4 represents the application form that has to be filled up by the applicant under the scheme.

Table 4. Application Form to be filled- Up for the Registration into Pradhan Mantri Jan Dhan Yojna (PMJDY) [10].

Field Name	Description
Full Name	Enter full name of the applicant, who wish to open a bank account for the financial inclusion
Marital Status	Enter the marital status of the applicant
Name of Father/ Spouse	Enter either the name of the father or the spouse
Address	Enter the complete address of the applicant
Pin Code	Enter the Pin Code
Telephone and Mobile Number	Enter the contact number of the applicant
Aadhaar/ EID Number	Enter either the Aadhaar number of the applicant or the Enrolment ID Number
MNREGA Job Card Number	Enter the job card number of the applicant.
Occupation/ Profession	Enter the occupation of the applicant
Annual Income	Enter the annual income of the applicant
Number of Dependents	Enter the number of dependents on the applicant
Detail of Assets	Enter the detail of assets the applicant owns
Existing Bank Account of Family Members/ Household	Enter the details of the bank account numbers of the family members of the applicant
Kisan Credit Card	Enter the detail of the Kisan credit card, if the applicant holds

Most of the times, the services discussed above are availed by the common residents near the place of their living, as the common people are not much mobile. As a result thereof, the need to establish unique identity of the residents also arises locally. As a corollary to this, in the process of establishing unique identity of the residents, it requires references to the already stored data in CIDR, from the locality of the residents i.e. villages and towns.

The next section discuss various implementation challenges that arise due to the centralized architecture of the large scale civilian identification system of India i.e. Aadhaar.

3. IMPLEMENTATION CHALLENGES WITH AADHAAR

Implementation challenges, as the name implies are the difficulties that are faced by the residents, the government and the service provider agencies, with the operation of a large scale civilian identification system. Over the passage of time, with the operation of Aadhaar, various implementation challenges have come into picture, that are: **(i)** Poor coverage of the population of the country for the purpose of enrolment into Aadhaar, **(ii)** Poor recording of births (i.e. enrolment of newly born children) into Aadhaar, **(iii)** Distantly located enrolment centres from the place of living, **(iv)** Non- cancellation of Aadhaar of the individuals, who are not alive, **(v)** Aadhaar saturation more than 100%, **(vi)** Delay in update and correction in the credentials of the residents in the already issued Aadhaar, and **(vii)** Poor Reliability due to the errors

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of false acceptance & false rejection and the single point of failure that persists in Aadhaar, because of the centralized architecture.

The present paper discuss the issues of Poor coverage of the population of the country for the purpose of enrolment into Aadhaar, abnormality in Aadhaar saturation, delayed process of update/ correction and poor reliability in the following sections.

3.1 POOR COVERAGE FOR ENROLMENT

Enrolment is very first step which is carried out by the enrolment agencies that are set up or accredited by the foundational identification system. It is by virtue of the enrolment of the residents into the identification system, that the residents get unique identity. The successful implementation of an identification system can be assessed in terms of the capabilities of an identification system to cover the entire population of the country for the purpose of enrolment. The statistics about the enrolment of the residents into Aadhaar is released by UIDAI as 'Aadhaar Saturation Report'. The statistics reveal that many of the states/ union territories of India are having very poor performance in terms of the enrolment. Some of the states/ union territories show good performance in terms of the enrolment of the residents into the identification system and the numbers of enrolments comes out to be close to 100%. In case of an identification system, in which the enrolments approaches 100%, seems to be showing good performance in terms of the statistics. However, for an identification system to be truly inclusive, the enrolment must be exactly 100% and every individual of the country must have been enrolled and have got unique identity. The poor rate of enrolment is also attributed to the fact of difficulties faced by the residents in order to approach the distantly located enrolment centres, among others.

3.2 ABNORMALITY IN AADHAAR SATURATION

The percentage of enrolment of the residents can either be 100% or less than 100%. In no case, it must cross 100%. It is revealed by the Aadhaar saturation report that some of the states/ union territories show very abnormal behaviour towards enrolment, as the enrolment of the residents has crossed the limit of 100% [Figure 1]. The enrolment of the residents into identification system more than 100% i.e. more people are enrolled into the identification system in a region than the actual population of the respective region, raises serious concerns over the actual enrolment. The abnormality in Aadhaar saturation is primarily due the fact that there is no provision in Aadhaar for the automatic recording of deaths of the residents and without having such mechanism, it is not possible to figure out the Aadhaar numbers of those, who are not alive, in the centralized database of Aadhaar. It is certain that in the existing Aadhaar, the percentage of enrolments also includes the residents who are not alive. In order to count the exact enrolment of the residents into the identification system, it needs to revisit the enrolment data and to suggest and devise mechanisms for the automatic recording of deaths.

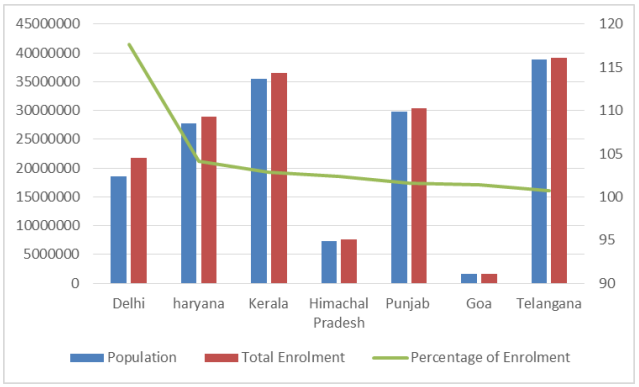

Figure 2. More Enrolments than the Actual Population of a Region [15].

3.3 DELAYS IN THE PROCESS OF UPDATE AND CORRECTION

As with the software systems, maintenance plays a major role in the successfulness of the software and its longevity to provide services for which it is developed. This holds true for an identification system as well. When an individual is enrolled into the identification system, he/ she is provided with a unique identity. With the passage of time, the need may arise to update and/ or correct the biometric and demographic details about an individual. The change in the living place of an individual and the requirement to update the biometric details of an individual leads to the process of update to be followed. Errors in name or in other such details leads to the process of correction to be followed. However, in order to realize the update/ correction in the credentials of the individuals, it takes a long period and as specified by UIDAI, it may take up to 90 days [16]. For instance, if the fingerprints of an individual fail to establish his/ her unique identity in the process of authentication and he/ she follows the process of update of the fingerprints, the Aadhaar authentication suspends till the update is materialized. In practicality, it has been identified that most of the people have experienced repeated efforts to ensure update/ correction.

3.4 POOR RELIABILITY

A number of cases of false rejection and false acceptance have been reported from the study. If the identification system fails to establish the unique identity of a legitimate individual, it deprives him/ her from accessing the services, for which he/ she was otherwise legally eligible. The error is known as false rejection and if during the process of de- duplication, the identification system incorrectly responds 'you are known', it will deny an individual from getting enrolled into the identification system and in turn it will deprive him/ her from getting unique identity. In a biometric based identification system, the rate of false acceptance increases with the increase in the size of the identity database i.e. with increase in enrolments. The errors of false acceptance can be mitigated by way of filtering based on the demographic

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data; however, it increases the rate of errors of false rejection [11]. The denial of services to the residents by the service provider agencies, due to the problem of authentication failure i.e. false rejection is quite common in the welfare and non- welfare service delivery system. Shailesh Gandhi, former Central Information Commissioner, faced the issue of false rejection. While completing his know-your-customer (KYC) procedure at HDFC bank, the system refused to validate his Aadhaar through fingerprints. After the incident, he wrote, "I could do my KYC with other documents, but the horror of this hit me. If the system cannot recognize people from its database with the fingerprint impression, what would happen to those whose food grains, pensions or employment guarantee scheme, wages depend on it?" [12].

The study reveals that the people who were able to enrol with all their biometrics, many have troubled with the fingerprint authentication issues. The government has admitted high authentication failures and the UIDAI's statistics show that the Aadhaar-based biometric authentication for government services has a 12% failure rate [13]. In another statement issued by UIDAI, it has been stated that 100% authentication rate is not possible. Under Aadhaar authentication, the performance of the identification system depends upon various variables such as network connectivity and the machine failures etc. [14].

4. LOCALITY OF REFERENCE AS THE BASIS TO MODIFY AADHAAR ARCHITECTURE

Locality of Reference commonly known as Data Locality is a fundamental principal of computing [17]. The principal of locality of reference refers to the fact of predictability that exists in the sequence of accessing the memory addresses during the execution of a program. It is mainly of two types: temporal locality of reference and spatial locality of reference. During execution of a program, when the same memory locations are accessed multiple times over a small interval of time, the program is said to exhibit temporal locality of reference, such as the execution of a loop. The spatial locality of reference refers to the fact that during the execution of a program, when the data from a particular memory location is accessed, there is a probability that the nearby memory locations will be accessed over a small period of time. The systems/ programs that exhibit this type of the behaviour are referred to as exploiting the spatial locality of reference [18].

The principle of locality of reference finds its applications in various fields of computer science, to name a few, such as cache memory in processors to hold the most referenced data, in web browsers to hold the recent web pages and in search engines to find the most relevant responses to the queries [16]. In essence, the principle of locality of reference states that the data should be kept near the place, where it is most likely to be used. Inherently, the resident centric data is generated near the place of living of the individuals. Most of the times, an individual avails various types of the services offered by the government and non- government organizations, near the place of living. Eventually, the need to establish unique identity arises locally i.e. villages and towns, in order to avail the services, which is also evident from the discussion in section–2. In the existing Aadhaar architecture, every time one has to authenticate his/ her identity, the service provider entities communicates with the centralized identity data repository (CIDR), which is prone to failure due to various variables such as network failure, low internet bandwidth and/ or machine failure, software failure, virus attack, militant attack and the size of the centralized database etc. Therefore, it requires to have changes on the architectural level in the existing Aadhaar architecture.

In order to address various implementation challenges effectively, as are observed in the foundational identification system of India i.e. Aadhaar, the principle of locality of reference has been proposed as the base model to modify the architecture of Aadhaar from centralized database architecture to distributed database architecture. It has been envisaged that the credentials of the residents should be kept and managed near the place of the living of the residents i.e. the place where residents live and avail services, which are offered by various government and non-government organizations, so that the identity of the individuals can be authenticated by using the locally available data about the residents. This can be accomplished using distributed database technology, allowing the local bodies (Panchayats/ Municipal Corporations etc.) to maintain data about the residents of their jurisdiction. Keeping data about the residents locally, it will address various implementation challenges effectively.

In the modified architecture of Aadhaar, the database systems at the local body level will: **(i)** execute the operations of authentication, **(ii)** capture the resident centric data for the purpose of enrolment, **(iii)** issue Aadhaar number, **(iv)** execute the operations of update and correction, and **(v)** recording of births/deaths into Aadhaar.

In addition to the identity database systems at the local body level, identity database systems at the district body level will also be set up. The database systems maintained at the district body level will: **(i)** execute the operations of de- duplication to facilitate enrolment, **(ii)** generate Aadhaar number for the newly born child, and **(iii)** segment out the biometric and demographic data about the deceased individuals from the active identity database tables. The identity database tables that are actively involved in the process of identification and authentication have been referred to as the active identity database tables.

4.1 ENROLMENT IN THE MODIFIED AADHAAR

The data generation about the residents is a continuous process. It is the local bodies that keep the data about its residents, such as the data about births, data about deaths and the data about the parentage. Whenever,

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a birth/ death takes place, along with updating data in to the official documents of the local bodies, the data will be updated in the identity database systems maintained at the local body level. Every time a birth is registered with the Panchayat/ Municipal Corporation, a unique ID, to be called as *Birth Id* will be generated, with the issuance of the birth certificate and the details of the child will be communicated to the district level database to issue unique identity to the child. It will help and will ensure identity to every child. In case of enrolment of the residents (except newly born children), their credentials will be captured at the local body level and will be synchronized to the respective identity database system at the district body level for the purpose of de- duplication. Designating the local bodies as the enrolment centers will help people to approach to the office of a local body easily and conveniently, as the local bodies are always located in the periphery of the living place of the residents and therefore will ensure the universal coverage of the residents for the purpose of enrolment.

4.2 IDEAL AADHAAR SATURATION

In case of a deceased individual, at the time of issuance of death certificate at the local body level, a unique id to be called as *Deceased Id* will be generated, which will be synchronized to the respective identity database system at the district body level, to segment out the credentials of the deceased individual from the active identity database tables to the inactive identity database tables. It will help to achieve the ideal state of the Aadhaar saturation and in turn, will help to identify the individuals who don't have unique identity.

4.3 REAL TIME UPDATE AND CORRECTION IN BIOMETRIC/ DEMOGRPHIC DATA

In modified Aadhaar, the update and correction in the biometric and demographic data of an individual could be materialized at the local body level in real time, because of the availability of the already stored credentials with the local bodies. If the fingerprints of an individual do not work for the purpose of authentication, he/ she could approach the Panchayat/ Municipal Corporation as the case may be, and could request for the update and/ or correction in the biometric and demographic data. Allowing the local bodies to facilitate update and correction will help the common people of the society to avail uninterrupted access to welfare and non- welfare services, delivered by various government and non-government organizations.

4.4 IMPROVED RELIABILITY IN THE MODIFIED AADHAAR

The principle of locality of reference will ensure the availability of data about the residents near the place, where it is to be used to establish unique identity of the residents through the process of authentication, in order to avail various welfare and non- welfare services. Since, authentication is a multi- time process, allowing the local bodies to execute the operations of authentication, will overcome the adverse impacts of the variables, such as network failure, low internet bandwidth, machine failure, software failure, virus attack, militant attack and heavy size of the identity database system. The modified distributed architecture will handle the processes of authentication and identification at separate database systems. It will reduce the size of the identity database systems, equal to the population of a local body/ district body, and therefore it will directly benefit to mitigate the high rate of false acceptance and false rejection.

5. CONCLUSION AND FUTURE SCOPE

A foundational large scale civilian identification system has the responsibility to provide unique digital identity to every resident of the country and mechanisms to authenticate identity thereof, in order to enable them to access various welfare and non- welfare services, extended by the government and non- government organizations. The existing identification system of India i.e. Aadhaar is based on the centralized database approach that has raised various implementation challenges. The principle of locality of reference has been proposed to modify the existing centralized architecture of Aadhaar to the distributed database architecture. As a future scope of the present research work, research could be extended in the direction to provide security to the distributed setup of Aadhaar that will include the communication security and the security of the resident centric data spread over various identity database systems, at the local bodies and district bodies.

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A framework on energy efficient routing protocol in wban

Author: Rajat Sharma and Aman Kumar Sharma

Subject Area: Physical Sciences and Engineering

Abstract:

In this paper, we have examined various routing protocol of wireless body area network (WBAN), and find out the optimum protocol for its domain. The comparison of different routing protocols has been done on various performance measuring metrics and parameters. And we have also improved existing routing protocol with help of different parameter. During the last few decades, Wireless Body Area Networks (WBAN) have appeared into many applications such as medical, military, sports, entertainments, traversing and monitoring. Due to improvement in wireless technology small sensor nodes with less power, lightweight, interfering or non-interfering are deployed in, on or around the human body to monitor the health situation. Basically, WBAN work on three different Tier Architecture. Tier-1 as Intra-body Communication, and also called sensor nodes. Tier-2 as Inter-WBAN or Internet. Tier-3 as Extra-Body Area Network and also called the servers communication. In this each server like medical server communicate with in its own domain. Routing protocols play very significant role to improve the overall performance of the network in terms of throughput, path loss, residual energy, packet dropped, network lifetime and to improve the different quality of services (QoS) in WBAN. Routing in WBAN is categorized as Postural based, Temperature aware, Cross layer network-based, Clusters-based routing, QoSbasedrouting. These categories are further divided into various protocols. This paper also a review of some of the existing routing protocols of WBAN. Also, the comparison of SIMPLE (Stable Increased-throughput Multi-hop Protocol for Link Efficiency) and IEE-SIMPLE (Improved Energy Efficient-Stable Increased-throughput Multi-hop Protocol for Link Efficiency) protocol has been done by simulating in MATLAB.

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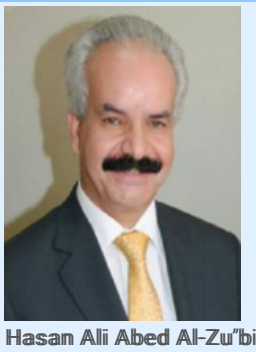
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Original Article

Supervised Machine Learning Classifiers: Computation of Best Result of Classification Accuracy

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Abstract *- Sentiment Analysis is one of the fastest spreading research fields in computer science, originating it demanding to observe the trace of all the activities in the region. The focus of sentiment analysis is to release data on the features of the author or speaker about an exclusive subject or the total variance of a record next to examine textual data assemble from the countless origin. The indicated paper is conferring an equivalent study to evaluate and formulate a list of three supervised machine learning techniques (Support vector machine, K-Nearest Neighbor, and Random Forest) based on a literature survey that has opted in this research work. To evolve and validate a mechanism to compute better classification accuracy results from among the selected best-supervised machine learning classifiers.*

Keywords *- Sentiment Analysis, Sentiment Classification, Opinion Mining, Feature selection, Machine Learning, Supervised Learning, Support Vector Machine, K- Nearest Neighbor, Random forest, Ensemble learning, Jupyter Notebook.*

I. INTRODUCTION

Sentiment Analysis, also called opinion mining, is the evolution of determining and detecting emotional information using natural language processing, text analysis. Opinion mining is an especially narrow NLP issue because the framework only needs to acknowledge the polarity of emotion, i.e., positive or negative opinion of each sentence and the target entities or aspects. The entity can symbolize individuals, events, or topics. These topics are usually acceptable to be covered by reviews. The two indications of SA or OM are equivalent. They signify the same meaning. However, some researchers stated that OM and SA have marginally singular perceptions [1]. The particular public ideas are acquired from certain network 2.0 and appearance-related blogs, online data sets, movie reviews, and brand review slots [2]. Its use of NLP andarithmeticstrategies to automate the set of judgments from ordinarily unstructured text.OM is a series of strategies and tools for finding and extracting specific information, such as perspective and conclusion, from language [3]. Usually, emotions have been

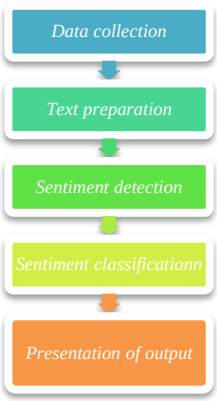

Fig. 1 Sentiment Analysis Process

along with opinion polarity, i.e., positive, neutral, or negative opinions regarding something [4]. Sentiment analysis is a varied transaction with five phases for indexing sentiment data.

Sentiment analysis can occur at different levels: document -Levelpurpose to categorize review as positive, negative, or neutral. The main operation of the document level sentiment classification is to relate the similarityof User Generated Content (UGC).The sentence-level aims to identify the relationship between each sentence is calculated.Sentence-level objective to allocate ideas communicate in an individual sentence. Essentially the first step is to determine even if the sentence is biased or unbiased. Wilson et al. [5] obtain that learning statements are not fundamentally based on nature. After all, inside no symbolic characteristics between document and sentence level arrangement because sentences are brief equitable documents. Aspect-level objective to allocate opinions with respect to specialized aspects of existence. Firstly it classifies

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the substance and then aspects because the judgment titleholder can allow the various suggestions for different aspects of the equivalent entity.

Opinion mining is not only enforced on a production survey but can also be activated on traditional business [6, 7], broadcast things [8], or official arguments [9]. Feature selection in sentiment classification. The first step in the SC problem is to take out and select text features. Some of the current features are Term presence and frequency: The present simulation consists of uni-gram or n-Grams and their frequency. *Parts of speech Information:* Identification words to the POS identity help express differently and assist in leading feature selection. Including POS identification, the whole world in order is indicated as a label, and the label implements the format of the word in the grammatical text. *Negation* argument performs an essential appearance to appropriate into functions because negations accept possible to reversal the opinion. *Opinion Words and phrases* are exchanged and codified, examining either a positive or negative perspective. Dictionary-based and numerical based is the fundamental approach to classifying the linguistic direction of sentiment conversation.

Section II distributes a review of related work executed on a comparative study of SA approaches. Section III illustrate different SC techniques like Machine Learning, Lexicon Based Approach. The indicated paper only spotlights the supervised machine learning approach used for sentiment analysis and also grants a short introduction to other approaches. Section IV explains the methodology adopted. Section V portrays the simulation results of the experimental work. Section VI concludes the present research work, and Section VII is rapid describes the future scope of the study.

II. RELATED WORK

Opinion Mining originated its roadmap across the year 2000 &proceeding improvement in the research area over the last ten to fifteen years. OM is a sub-area of NLP, but it acquires that SA gets a more advancing trend than NLP in the earlier years. There are multiple articles introduced every year in the SA field, and the number of articles has been increasing over the years. The reader can find some refined and detailed surveys, including [10, 11]. Many research papers and survey papers have been published relevant to SA research work, and a few of the extensive papers from which the current study gets inspired are examined below:

Rehab M. Duwairi and Islam Qarqaz [12]carry out an anidenticalinquiry of three classifiers: Naive Bayes, SVM, and K-NN. They organize their intimate training dataset by assembling tweets and Facebook comments taken away from the internet. They form the use of the Rapid miner tool for this approaching study and regulate that SVM delivers the highest Precision, although K-NN contributes the highest recall.

Vinodhini and RM Chandrasekaran[13]provide a complete survey on SA and OM in their paper. The present survey paper talks about several opinion classification strategies and their challenges. The indicated study compared certain other papers written on SA and OM approaches based on four independent features accuracy, Precision, recall, and F1.

Nasukawa and Yi.[14]represent an opinion mining approach to take out sentiments associated with polarities of positive or negative for special subjects against a document, quite of classifying the entire document nearing positive or negative. The mandatory topics in opinion mining recognise how sentiments are indicated in texts and whether the expressions indicate favourable or unfavorablesentimentabout the subject.

Ding et al.[15]prefer an essential technique for recognizing semantic orientations of emotionextract by reviewers on outcome features. It is accomplished to examine two major problems with the existing methods, (1) sentiment words that semantic directions are situation dependent, and (2) combined multiple opinion words in a similar sentence. For (1), a holistic technique is suggested that can perfectly infer the semantic orientation of emotion based on the rating situation. For (2), a new function to combine multiple sentiments in the same sentence is present.

Van de Camp and van den Bosch. [16]introduce SVM and NN also used to categorise particular relations in biographical texts and establish historical biographical information expressing people in a specific state, zone, and time frame. They specify that their classifiers can label certain relations over a majority class baseline score. They show that SVM and one layer NN (1-NN) algorithm attain the highest scores.

Rui and Liu. [17] In their work, they were investigating whether and how twitter word of mouth (WOM) attacks movie sales by evaluating a dynamic panel data model. They used NB and SVM for the classification objective. Their results suggest that the effect of WOM on product sales from Twitter users with more followers is significantly larger than that from Twitter users with fewer followers and establish that the effect of pre-consumption WOM on movie sales is wise than that of post-consumption WOM.

Reyes and Rosso [18]aimed to define a feature model to mean part of the personal knowledge, which is key to such reviews and efforts to narrate salient characteristics of irony. They used NB, SVM, and DT for classification resolve, and the results with the three classifiers are adequate, both in terms of accuracy, as well as Precision, recall, and F-measure.

Cover and Hart [19]show the fault of the nearest neighbour rule is having bounds above by twice the Bayes

error below certain logical undertaking. Also, the error of the general KNN method asymptotically methods that of the Bayes error and can be nearly new to approximate it.

Pang et al. [20] used three supervised machine learning procedures to classify the text named SVM, Naive Bayes, and Maximum Entropy. In this paper, an individual feature selection technique was used, and results pinpoint that achievement of Naive Bayes classifier is gained on small feature set while the performance of SVM is adequate for the large feature set andmoreoveroriginate that Maximum Entropy has a better result than Naive Bayes for the large feature set.

Ashmeet Singh and R Sathyaraj [21]correlated three supervised machine learning algorithms that employ Rapid Miner named Naive Bayes, Random Forest, and Decision Tree based on six parameters such as accuracy, precision, recall, true positive, false positive, and f-measure. Two datasets, particularly a short and huge number of the pattern, were used for each classifier. In this paper, it has been established that Naive Bayes results in better achievement alternative two in the smaller dataset, although the Decision Tree is the best match for the large dataset, and Random forest executes as an average in both the cases.

Ashok Badresiya et al. [22]differentiate five review spam detection supervised learning capabilities for their execution. The five techniques were Naive Bayes, SVM, K-NN, Logistic Regression, and Decision Tree. In this relative study, they originate that SVM has greater accuracy (83.19%) than the substitute way and the Decision tree has very little accuracy, only 51.00 %.

Ghosh, Fassnacht [23] SVM is often claimed to be the finest at dealing with complex classification issues such as tree species differentiation, followed by RF using the information in a broader electromagnetic spectrum (450–2500 nm) focused on classifying five tree species in managed forests of central Germany using SVM and RF on Hyperion and HyMap data. Apply only spectral information. The overall classification accuracies on a 4-m pixel hyperspectral image were 71% for SVM and 72% for RF. Both classifiers showed similar results for this scale.

L. I. Kuncheva and J. J. Rodriguez et al. [24], among the few popular combination schemes, majority voting and weighted voting for classification are generally used. Simple majority voting is a decision rule that selects one of many alternatives based on the predicted classes with the most votes. The majority voting does not require any parameter tuning once the individual classifiers have been trained.

III. SENTIMENT CLASSIFICATION TECHNIQUES

Sentiment allocation procedure can be branched into machine learning techniques, dictionary-based techniques, and hybrid techniques [25]. Classification of text is done towards noticeable levels such as sentence based, document-based, and aspect or sentiment-based [26]. All the approaches and techniques this paper shows a comparison of supervised machine learning techniques, which are illustrated in this region down:

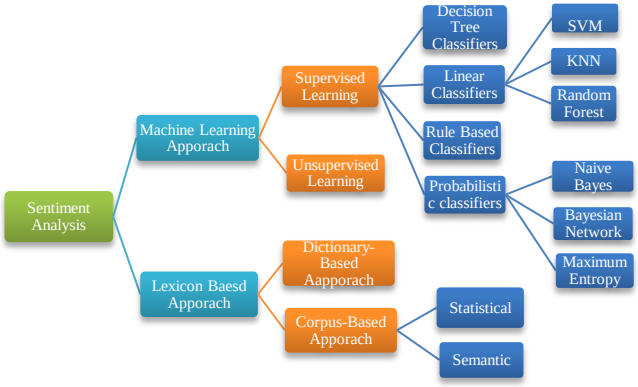

Fig. 2 Sentiment Classification Techniques

A. Machine Learning

Normally it depends upon the important machine learning approaches to figure out the SA as rectify text distribution drawback that makes use of static or pattern arrival. *Text distribution Problem Definition:* We have a set of training documents $D = \{Y_1, Y_2, \ldots, Y_n\}$ where the individual file is classified into a class. In a machine, learning-based classification requires two sets: One is the Training set, and another one is the Test set. A training set is used to set a mechanical classifier for learning the distinct features. A test set is employed for validating the presence of the classifier. The former is utilized by automated classifiers for learning the differentiable features of documents, while the latter is utilized for validating the performance of the automated classifier. Machine learning facilitates data processors to increase, customize, and determine, although they are identified as a unique input [27]. There are various groups of machine learning techniques classified as supervised and unsupervised learning described below:

In supervised learning, the training set (Xn, Yn), an algorithm, train a model that is efficient to predict the output for every new input, as displayed in fig.4. Supervised learning helps classification and regression facilities to develop a predictive model and depends on the labelled training documents containing words related to the topic as a key feature.

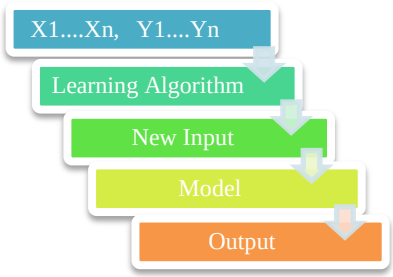

Fig. 3 Supervised Learning

Numerous supervised learning executions that acquire correlated in this paper are characterized below:

A linear classifier classifies an object into specific classes to whatever they apply according to the arrival or attributes. A linear classifier adopts a narrow arrangement of X and Y to create the distribution results. Three linear classifiers used in this study are SVM (Support vector machine), K-NN (K Nearest Neighbors), and RF (Random Forest):

a) SVM In machine learning, support vector machines (SVMs, also support vector networks) are supervised learning models with correlated learning algorithms that analyze data used for classification and regression analysis. The objective of SVM is to divide the datasets into classes to find a maximum marginal hyperplane (MMH). Support Vector Machines (SVM) [28] examine a must-try, and it offers one of the most robust and accurate methods among all well-known algorithms.

b) K-NN K-nearest neighbour is one of the simplest machine learning algorithms established on a supervised learning strategy and is mostly used for classification problems. K-classification [29,30] finds a group of k objects in training set near the test object and bases the allocation of a label on the predominance of a particular class in this neighbourhood. KNN is specifically well suited for multi-modal classes and applications in which an object can have many class labels. The K Nearest Neighbors Algorithm can feel the necessity for the recall division to inventory group of the knowledge, but only put away prediction (or study) when forecasting is essential.

c) Random Forest (RF) is one of the great machine learning algorithms used for supervised learning; this means learning from labelled data and making predictions established on the learned arrangements. A Random Forest is an ensemble technique efficient to accomplish both regression and classification missions with the use of multiple decision trees and a technique called Bootstrap and Aggregation, frequently known as **bagging**. However, it is mostly used for classification problems. The random Forest algorithm generates decision trees on data samples and then gets the prediction from each of them, and finally determines the best solution by means of voting. It is an ensemble method that is better than a single decision tree because it reduces over-fitting by averaging the result. In unsupervised learning, this technique is mainly used in the creation or design of trained class labelled documents that are investigated to the most complex method. Unsupervised learning is no pre-classified training samples or training datasets. This technique is used for the document-based clustering analysis as it does not depend on pre-defined labelled training documents.



Fig. 4 Unsupervised Learning

Clustering is the mechanism of combining similar entities and is also used in the classification text. K-means clustering is an unsupervised machine learning algorithm. The goal of this unsupervised machine learning procedure is to find the correlation in the data point and group corresponding data points together.

B. Lexicon-Based Approach

The lexicon-based approach depends on finding the opinion lexicon, which is used to analyze the text. There are also opinion phrases and idioms, which are called opinion lexicons. There are two methods in this approach. The dictionary-based approach depends on finding opinion seed words and then searching the dictionary for synonyms and antonyms. The corpus-based approach begins with a seed list of opinion words and then finds other opinion words in a large corpus to help find opinion words with context-specific orientations. This could be done by using statistical or semantic methods.

IV. METHODOLOGY

The indicated paper examines three supervised machine learning classifiers, especially SVM (support vector machine), K-NN (K-nearest neighbour), and RF (random forest), based on six parameters (Training Accuracy, Testing Accuracy, Total Accuracy, Recall, Precision, and F1 score). In this consideration, the Jupyter Notebook tool is used to examine these techniques. Jupyter is a part of Anaconda (prepackaged Python distribution).

Evaluation metrics involves using a combination of these individual evaluation metrics to test a model or algorithm. Using evaluation metrics are critical in ensuring that your

model is operating correctly and optimally. Entire parameters are established on Evaluation metrics, resulting in the execution of individual classifiers. These parameters are explained as follows:

- ***Training accuracy:*** It is usually the accuracy that applies the model to the training dataset.
- ***Testing accuracy:*** It is the accuracy of testing the data. Normally it is sometimes useful to compare these identify overtraining.
- ***Total accuracy****:* This parameter defines the number of classifications divided by the total number of documents.

  Accuracy = Number of correct predictions / Total number of predictions.

- ***Recall***: This parameter defines how many true positives were recalled (found). High Recall indicates the class is correctly recognized (a small number of FN).

  Recall= Total no. of correctly classified positive examples / Total no. of positives examples.

- ***Precision***: It is also called positive predictive value. We divide the total number of correctly classified positive examples by the total number of predicted positive examples. High Precision indicates that an example labelled as positive is positive (a small number of FP).

  Precision = Positive correctly classified / Total predictive positive.

- ***F1 Score:*** This parameter defines a weighted average or harmonic mean of precision & recall values and calculated as:

  F=2pr / (p+r), where p=precision& r=recall.

A.The stepping procedure for identification based on the above-mentioned performance is inclined in fig.5

In this study, we use seven datasets, and it consists of a collection of documents or files. All the datasets are accessed from Kaagle (ML). The names of the datasets are:

1. Iris dataset{Range Index: 150 entries (0 to 149) & Data column: 6}. [31]
2. Heart Disease {Range Index: 303 entries (0 to 302) & Data column: 14}. [32]
3. Breast Cancer Analysis and Prediction {Range Index: 599 entries (0 to 598) & Data column: 33}. [33]
4. Bank Marketing + Classification {Range Index: 41188 entries (0 to 41187) & Data column: 21}. [34]
5. Fake News Detection *{Range Index: 10240 entries (0 to 10239) & Data column: 2}. [35]*
6. COVID-19 *{Range Index: 368 entries (0 to 367) & Data column: 8}. [36]*
7. Instagram fake spammer genuine accounts *{Range Index: 120 entries (0 to 119) & Data column: 12}. [37]*

- All datasets consist of a collection of documents or files.
- Data preprocessing (clean and alter) the raw data in a useful and efficient format. Now use feature selections to enable the machine learning algorithms to train faster. It reduces the complexity of a model and improves its accuracy of the model.
- After this, use Label Encoder to convert the labels into a numeric form into a machine-readable form.
- In classifications, for each dataset, training the model by using machine learning techniques to find better accuracy.
- Use ensemble methods that combine the prediction of multiple machine learning models to improve predictions based on their highest probability.

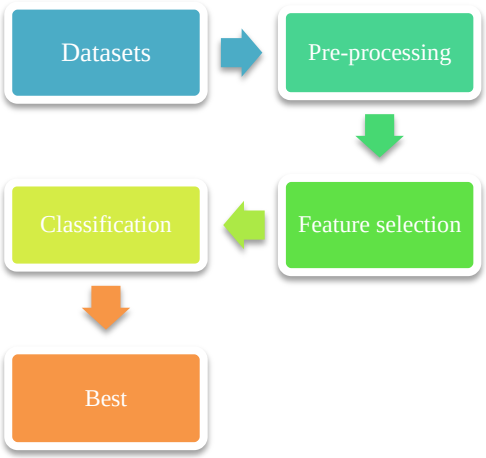

Fig. 5 Task Accomplishment Methodology

V. SIMULATION RESULTS

Simulation Results of Supervised Learning Techniques on various Datasets show the performance by utilizing their merits using the highest probability of being predicted by each classifier using ensemble methods.

Table 1. Simulation Results of Supervised Learning Techniques on various Datasets.

Algorithms	Iris	Heart Disease	Breast Cancer	Banking Marketing	Fake News Detection	COVID-19	Instagram fake spammer
SVM	1	81.97	97.87	85.56	54.58	71.31	50.00
KNN	1	90.16	96.27	90.48	55.08	95.90	80.00
RF	1	85.25	95.21	90.97	1	95.90	92.50
ENSEMBLE | VC	**1**	**90.16**	**97.87**	**90.97**	**1**	**95.90**	**92.50**

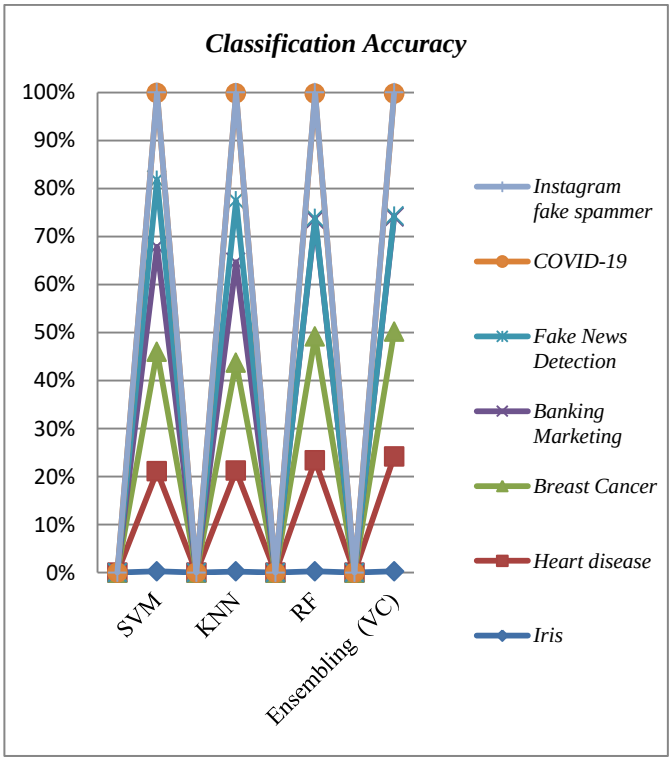

Fig. 6 Classification Accuracy on the line graph

Figure 6 shows the following results:

- Using simulation on various datasets, we have different Classification accuracy of SVM, KNN, and RF.
- They used ensemble learning to predict an output (class) based on the highest probability of chosen class as the output.
- It simply aggregates the findings of each classifier passed into Voting Classifier and compute the output class based on the highest majority of voting.

VI. CONCLUSION

Sentiment Analysis is a technique meanwhile that the polarity of unregulated textual data is resolute. Sentiment analysis has many applications in information systems, including classifying reviews, summarizing reviews, and other real-time applications. Sentiment Analysis is a part of Natural Language Processing. This research work describes a specific performance on sentiment analysis and various supervised machine learning algorithms used in Opinion Mining. This research work covers every aspect to understand the concept of sentiment analysis and its approaches. This work has considered three sentiment classification techniques, such as Support vector machine, k-Nearest Neighbor, and Random Forest, and has compared them using simulation in python. All the techniques are compared using simulation based on six parameters (Training Accuracy, Testing Accuracy, Total Accuracy, Recall, Precision, and F1 score) for different training datasets, which are used to train and test the various classification models that have opted. This paper gives a detailed stepwise step experimental implementation of the research work. Various results have been analyzed for all the sentiment classification techniques and conclude that:

- I am using ensemble learning to enhance machine learning models to produce better predictive performance compared to a single model, i.e., Improvement in predictive accuracy.
- It has been discovered that ensembles are often much more accurate than the individual classifiers, which make them up and also known as committee-based learning or learning multiple classifier systems, train multiple assumptions to clarify the close trouble.
- Generating models from data is called learning or training, and the learned model can be called a hypothesis or learner. The training algorithms that formulate a set of classifiers and later classify new data points by catching a choice of their predictions are known as Ensemble methods.
- Ensemble methods are well known for their ability to boost weak learners.

VII. FUTURE SCOPE

This study compares the Supervised Learning techniques that are used in Sentiment analysis. All these techniques are compared for their performance using simulation, but more future work is needed to improve the performance of such techniques further. This is a magnificent demand for the utilization of sentiment analysis because of the aim to reach and truly understand the significance of social media interactions. In the future, different kinds of approaches shall be combined to overcome their drawbacks and enhance their enforcement by utilizing their merits. In the future, a multiclass of a sentiment classification such as positive, negative, neutral, and so on might be considered. This will lead to a superior understanding of natural language

sentiments. The concept of Sentiment Analysis can also be added to the computer system being used nowadays like PDA (Personal Digital Assistants), computer systems, automatic cars, etc., which could detect the negative mood of an individual and respond positively.

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Generative Adversarial Networks in Security and Data Privacy Sector: A Survey

Shivam Sharma, Dr. Aman Kumar Sharma

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ABSTRACT

In the modern era, most of the data exists in the digital form, however existing security measures are insufficient to protect this data since they do not have enough ability toanticipate malicious attacks. With an upsurge in the number of security challenges, data protection systems along with security defense and attack mechanisms must keep up with the rapidly changing threats. In this survey, we review the Generative Adversarial Networks (GANs) and its different variants that have been employed to provide data privacy protection to systems, security defense, along with security attack capability to systems. The main goal of this survey is to investigate the recent developments in the field of security along with data protection based upon GANs architectures. The GANs applications, challenges along with potential solutions from recent research developments have also been discussed in brief.

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A Comparative Study on Cross-Platform Development tools

Shivam Sharma, Dr. Aman Kumar Sharma

PDF

ABSTRACT

The tools available for cross-platform application development is rapidly increasing. Thus, it becomes important to properly understand the working, performance, ease of use, platforms support among other factors of each development tool before making the right choice. The research paper proposes to compare the six most popular cross-platform application development tools based on some reviews and also the above-mentioned parameters. As per the comparison, Flutter SDK has been found to have the best performance and is also among the most popular available frameworks.

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Exploring the Possibility of Sybil Attack in Position Based Routing Protocols in VANETs: A Case Study of Greedy Perimeter Coordinator Routing (GPCR)

Nishtha & Manu Sood

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Abstract

Infrastructure-less Vehicular Ad hoc Networks (VANETs) in the absence of any centralized controlling authority are highly vulnerable to various types of malicious attacks. Amongst these attacks, Sybil attack is one such deadly attack that can disrupt the normal functioning of most of the VANET protocols without getting detected easily. In this attack, a legitimate vehicle with malicious intentions enters the network and can mischievously launch a few virtual vehicles camouflaging these virtual vehicles in such a way that these appear to be the legitimate vehicles for all other legitimate vehicles in the network. These superficial vehicles are known as Sybil vehicles and intend to affect the routing mechanism in a VANET by helping the malicious node to assume control of the network. In this paper, we have explored the possibility of Sybil attack disrupting the normal functioning of Position-Based category of Routing Protocols in a VANET. Our exploration here focuses only on one of the significant protocols in the category known as, the Greedy Perimeter Coordinator Routing (GPCR) protocol. With the help of the results of experimental setups, it has been shown that it is always possible for the Sybil attack to disrupt the functioning of GPCR protocol in a VANET. We are also in the process of exploring the impact of Sybil attack on other significant routing protocols for VANETs separately.

Keywords

Malicious vehicle **Sybil vehicle** **Sybil launcher** **Sybil attack**

GPCR **Vehicle to Infrastructure (V2I)** **Vehicle to Vehicle (V2V)**

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Performance Analysis of the ML Prediction Models for the Detection of Sybil Accounts in an OSN

Ankita Kumari & Manu Sood

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Abstract

The Online Social Networks (OSNs) as such have significantly become huge platforms for information sharing and social interactions for a variety of users across the globe. In the backdrop of fast transformations, these OSNs are undergoing illegal activities especially in the form of security attacks, and have already started reflecting serious harmful effects on these interactions. One of the prominent attacks in such environments, the Sybil attack, is jeopardizing various categories of social interactions as the number of users having Sybil accounts on these social platforms is experiencing phenomenal growth. The existence of such Sybil accounts on OSNs may threaten to defeat the very purpose of these OSNs. The presence of these Sybil accounts of malicious users is really almost impossible to control and, very difficult to detect. In this paper, with the help of Machine Learning (ML), an attempt has been made to uncover the presence of such Sybil accounts on an OSN such as Twitter. After the acquisition and preprocessing of available datasets, the Correlation with Heatmap and Logistic Regression-Recursive Feature Elimination (LR-RFE) feature selection techniques were applied to get a set of optimal features from these datasets. Then the prediction models were trained on these datasets by using Random Forest (RF), Decision Tree (DT), Logistic Regression (LR) and Support Vector Machine (SVM) classifiers. Further, the effects of biasing of genuine accounts with fake accounts on feature selection and classification have been presented. It is concluded that the prediction models using the DT algorithm outperformed all other classifiers.

Keywords

Feature selection **Support vector machine** **Random forest**

Logistic regression **Decision tree** **Sybil account** **Biasing**

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Implementation of Ensemble-Based Prediction Model for Detecting Sybil Accounts in an OSN

Priyanka Roy & Manu Sood

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Abstract

Online Social Networks (OSNs) are the leading platforms that are being used these days for a variety of social interactions generally aimed at fulfilling the specific needs of different strata of users. Normally, a user is allowed to join these social networks with little or negligible amount of antecedent verification which essentially leads to the coexistence of fake entities with malicious intentions on these social networking websites. A specific category of such accounts is known as the Sybil accounts where a malicious user pretending as an honest user, creates multiple fake identities to manipulate/harm honest users, creating an illusion of the real users in the OSN that these are real identities. In the absence of stringent control mechanisms, it is difficult to identify and remove these malicious accounts. But, as every single interaction on a social media website leaves its digital trace and a huge number of such interactions every day culminates into huge datasets, it is possible to use Machine Learning (ML) techniques to build prediction models for identifying these Sybil accounts. This paper is one such attempt where we have used ML techniques to build prediction models that can predict the presence of Sybil accounts in Twitter datasets. After preprocessing the data in these datasets, we have selected an optimal set of features using one filter method namely Correlation with Heatmap and two wrapper methods namely Recursive Feature Elimination (RFE) and Recursive Feature Elimination with Cross-Validation (RFE-CV). Then using 8 classifiers (SVM, NN, LR, DT, RF, NB, GPC, and KNN) for the classification of accounts in the datasets, we have concluded that the Decision Tree classifier gives the best prediction performance among all these classifiers. Lastly, we have used an ensemble of 6 classifiers (SVM, NN, LR, DT, RF, and KNN) by using Bagging (max voting) to achieve better

results. But it can be concluded that due to the inclusion of weak learners like SVM, NN, and GPC in the ensemble, DT has given the best possible prediction outcomes.

Keywords

Data preprocessing **Feature selection** **Classifier**

Ensemble of classifiers **Bagging** **Max voting** **Sybil attack**

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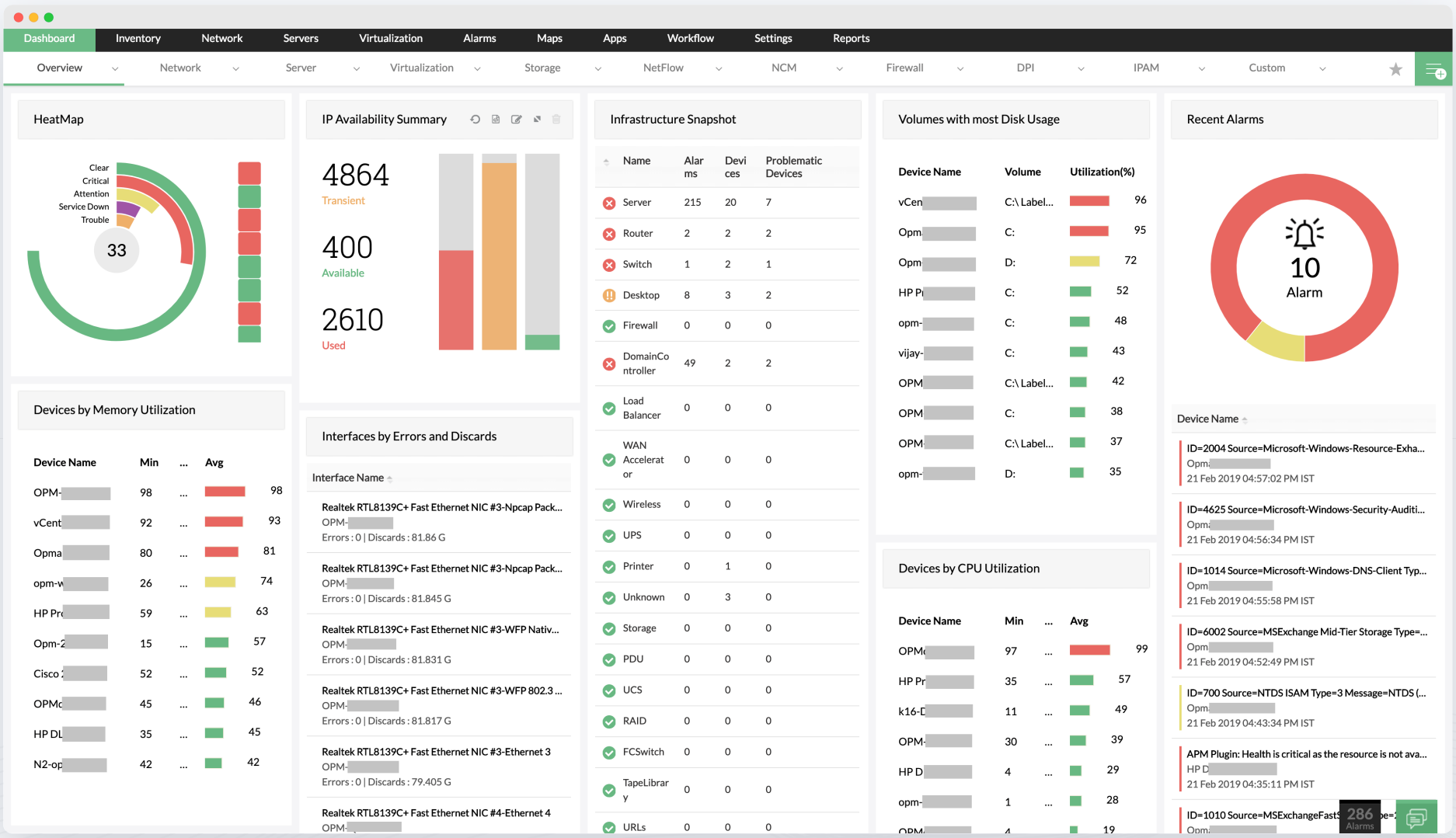

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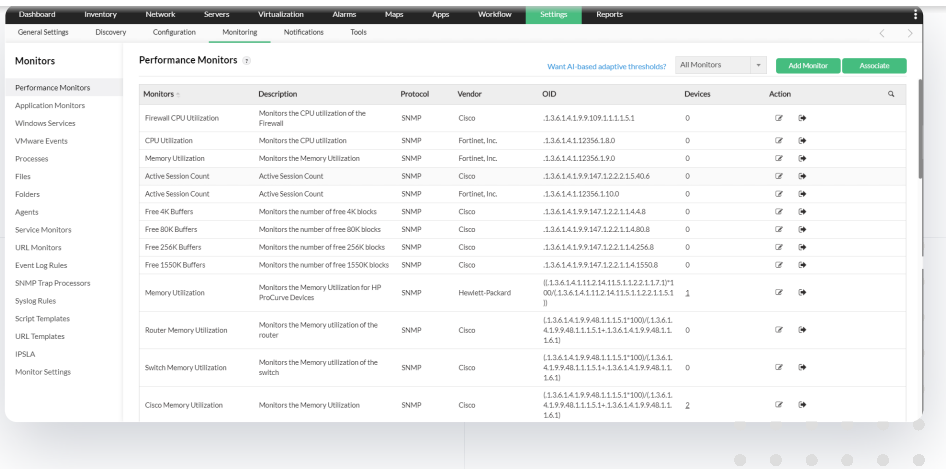

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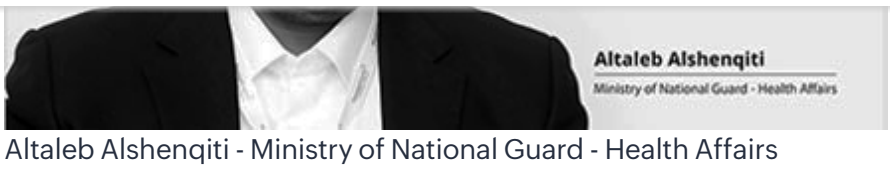

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Exploring Feature Selection Technique in Detecting Sybil Accounts in a Social Network

Shradha Sharma & Manu Sood

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Abstract

Machine learning (ML) provides us the techniques to carve out meaningful insights into the useful information embedded in various datasets by making the machine learn from the datasets. There are different machine learning techniques available for various purposes. The general sequence of steps for a typical supervised machine learning technique includes preprocessing, feature selection, building the prediction model, testing and validating the model. Various ML techniques are being used to detect the presence of fake as well as spambot accounts on a number of Online Social Networks (OSNs). These fake/spambot accounts especially the Sybil accounts appear in these networks with malicious intentions to disrupt or highjack the very purpose of these networks. In this paper, we have trained various prediction models using appropriate real-time datasets to detect the presence of Sybil accounts on online social media. Since the data is collected from various sources; it necessitates the preprocessing of the dataset. The preprocessing has mainly been carried out for (a) removing the noise from this data and/or (b) normalizing values of various features. Next, three different feature selection techniques have been used for the selection of the optimal set of features from the superset of features so as to remove the features that are redundant and irrelevant in making accurate predictions. The three feature selection techniques used are Correlation Matrix with Heatmap, Feature Importance and Recursive Feature Elimination with Cross-Validation. Further, K-Nearest Neighbor (KNN), Random Forest (RF) and Support Vector Machine (SVM) classifiers have been deployed to train the proposed prediction models for predicting the presence of Sybil accounts in the OSN dataset. The performances of the proposed prediction models have been analyzed using six standard

metrics. We conclude that the prediction model based on the Random Forest classifier provides the best results in predicting the presence of Sybil accounts in the dataset of an OSN.

Keywords

Data preprocessing **Feature selection** **Classification**

K nearest neighbor classifier **Random forest classifier**

Support vector machine classifier **Datasets** **Sybil account**

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Evaluating the Impact of Feature Selection Methods on the Performance of the Machine Learning Models in Detecting DDoS Attacks

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Abstract. Heaps of Data lie in network equipment of the organizations. To break down this information and reach some significant inferences is inconceivable for the present day IDS (*Intrusion Detection System*). Moreover, their signature-based defense mechanisms are ineffective in tackling emerging threats like DDoS attacks. The central premise of building Machine Learning Classifiers is to detect DDoS attacks efficiently and effectively. However, their accomplishment of machine learning models to distinguish DDoS attacks relies upon how one picks the 'relevant' and 'minimal' attributes in the network streams. The questions: "Does features choice influence the classification precision, to what extent and what is the best feature selection for boosting the performance of Machine Learning Classifiers in detecting DDoS attacks" motivate this investigation.

This paper presents how to apply ML techniques in detecting DDoS attacks. There are three feature selection categories and our work demonstrates the application of the feature selection methods, one each from the three categories. In addition, five machine learning models have been utilized in our work. Random Forest classifier with Lasso-RFE, a feature selection strategy beat others. The other significance of this research paper, we believe, is a first of its kind scenario, where a real-life multidimensional dataset having diverse network traffic and recent DDoS attacks have been used unlike in most of the studies carried out to date.

Key-words: DDoS detection, DDoS attack, machine learning, feature selection, SciKit-Learn, network traffic classification.

1. Introduction

Keeping computer network safe is a task for organizations. Complex and mutating DDoS attacks are the primary vectors for causing damage to the networks, data and, availability of services. With the development of Big Data, IoT (Internet of things) and BYOD (*Bring Your Own*

Device), and social networking applications, the network traffic has increased many folds and so are the network threats [1][2][3]. Traditional Intrusion Detection Systems are not that shrewd to recognize advanced attacks. Therefore, there is a need to devise new strategies/arrangement, which can go up against these threats. The other real obstacle in utilizing existing strategies is 'human intervention', which is required at present for the elucidation of threat recognition. With the establishment of a large campus-wide area network, internet facilities, Wi-Fi, attack-surfaces have multiplied.

Heaps of Data lie with any organizations' network equipment such as switches, firewalls, controllers and so forth. To break down this information and reach some significant inferences is inconceivable for the present day IDS (Intrusion Detection System) frameworks because of vast information estimate. Moreover, their signature-based defense mechanisms are ineffective in tackling emerging threats. Thus, analyzing the data and draw some meaningful conclusions is next to impossible for the present day IDS (Intrusion Detection System) systems. Filtering the relevant data requires a huge amount of human effort.

The role of machine learning in intrusion detection particularly DDoS attacks are now well established. Machine learning (ML) and the information mining techniques, together are exceptionally viable in such circumstances. The use of ML-based classifiers in getting rid of the need for human mediation is a potent way of recognizing inconspicuous attacks, which is yet odd for other security machines. The ML-based classifiers learn on the training data and anticipate the Intrusion identification and DoS attacks. The success of classifiers vastly depends upon relevant features and classification accuracy. Classification accuracy is the ratio of the number of correct predictions to the total number of input samples [4]. Feature selection helps in retaining only the meaningful features and drops the redundant and correlated features in order to boost prediction accuracy reduce computation complexities and prediction latency. To train the machine learning models attaining adequate accuracy need extensive data. Huge data generally has a noise that affects the performance of machine learning models adversely. Thus, the data need cleansing and removal of redundant and irrelevant features for machine learning models to make predictions with high accuracy. Redundant features are those, which correlate strongly, and removal of them does not affect the accuracy of the model. Similarly, many features in the dataset, which does not influence the prediction of machine learning models are termed as 'irrelevant' and are dropped during feature selection. Thus, 'noise removal' plays an important role in building ML models.

Optimizing the performance of feature selection techniques is an optimizing problem in mathematical terms. Feature selection has a three-fold impact on the overall performance of machine learning models: 1) increasing the accuracy of machine learning models, 2) helps in reducing the performance latency of various ML algorithms and 3) diminish the computational complexity to analyze their correlation.

This examination embarks to explore the aptness of machine learning in network traffic classification by using the results obtained from various feature selection methods. The contribution of this work can be summarized as below:

- We present a study of detecting DDoS attacks in an extensive dataset with diverse normal traffic and the latest DDoS attacks unlike other studies carried out to date.

- We present the study over the CICIDS2017 dataset, which is a real-life dataset with over 225,000 rows and over 84 features. To the best of our knowledge, this study is the first one where this contemporary dataset has been put to use. We also show the impact of feature selection and we were successful in achieving an accuracy above 95 and 96% using

just 12/15 features in case of KNN and Random Forest ML models respectively, without compromising on the accuracy.

This paper organizes into five sections. Section II outlines the work done by researchers in the literature to explore network flow classification. Section III of this paper gives an overview of the dataset chosen for this experiment, feature selection methods and classifiers used for the detection of DDoS. Section IV describes our experiment and the selection of tools for analysis. Of all the sections, section IV is the most vital section as it divulges details about the results and the manner they are obtained. Section V wraps up the work and also indicates the avenue for future work.

2. Related Work

Feature selection has an imperative impact in boosting the accuracy of a model. Recent studies have revealed that selected features were successful in increasing or maintaining the accuracy of the machine learning models.

N.T. Nguyen *et al.* [5] looked at the performance of feature selection approaches namely correlation-feature-selection (CFS) measure and the *minimal-redundancy-maximal-relevance* (mRMR) measure with SVM-wrapper, Marko blanket, and *Classification & Regression Trees* (CART) algorithms as well as the recently proposed *generic-feature-selection* (GeFS) method. They used the KDD dataset and were able to remove more than 30% features while achieving better classification accuracy. However, the results are based on the KDD dataset which is outdated now for not having the current DDoS attacks. H. Nkiama *et al.* [6] demonstrate the impact of recursive feature elimination with decision tree classifier for feature selection. The classifier showed good performance over the NSL-KDD dataset. They achieved more than 99% accuracy.

Feature selection methods like IG, Gain ration and relief F, etc. along with classifiers such as J48, random and one R etc. in [7] establish the relation between classifiers and feature selection methods.

Work in [8] contrasts different feature selection strategies to discover that entirety of term frequency. This work additionally examined the combined effect of multiple feature selection models and Osanaiye et al. in [9] even propose a multi-filter feature selection method and evaluated the feature selection methods like Info gain, gain ratio, chi-squared and relief. The metrics used were classification accuracy, detection rate, false alarm rate and time to build models. Similarly, Pekta *et al.* [10] talk about identifying prominent features for the detection of botnets in the network. They examined the execution of three feature selection algorithms namely Lasso, RFE, and decision tree-based feature selection. The metrics employed for their evaluation were precision, F1 score, recall, and accuracy. The Random forest was the best performer in their case. They could accomplish 93% accuracy in the case of random forest classifier, alongside the feature selection methods.

Peyman Kabiri and Gholam Reza Zarga [11] proposed a feature-based detection of DoS attacks where their work identified the relevant features for the detection of different classes present in the dataset using PCA (*Principal Component Analysis*). The accuracy achieved by the authors for this experiment was more than 97% which is very good.

Prafulla Kalapatapu1 et al. [12] compared various feature selection methods e.g. genetic algorithm, Forward feature selection, information gain and correlation based on four classifiers

Table 1. Features in cic ids 2017 dataset

SNo	S NoFeature Name	SNo	Feature Name	SNo	Feature Name	SNo	Feature Name
1	Flow ID	22	Flow Packets/s	43	Fwd Packets/s	64	Fwd Avg Packets/Bulk
2	Source IP	23	Flow IAT Mean	44	Bwd Packets/s	65	Fwd Avg Bulk Rate
3	Source Port	24	Flow IAT Std	45	Min Packet Length	66	Bwd Avg Bytes/Bulk
4	Destination IP	25	Flow IAT Max	46	Max Packet Length	67	Bwd Avg Packets/Bulk
5	Destination Port	26	Flow IAT Min	47	Packet Length Mean	68	Bwd Avg Bulk Rate
6	Protocol	27	Fwd IAT Total	48	Packet Length Std	69	Subflow Fwd Packets
7	Timestamp	28	Fwd IAT Mean	49	Packet Length Variance	70	Subflow Fwd Bytes
8	Flow Duration	29	Fwd IAT Std	50	FIN Flag Count	71	Subflow Bwd Packets
9	Total Fwd Packets	30	Fwd IAT Max	51	SYN Flag Count	72	Subflow Bwd Bytes
10	Total Backward Packets	31	Fwd IAT Min	52	RST Flag Count	73	Init_Win_bytes_forward
11	Total Length of Fwd Packets	32	Bwd IAT Total	53	PSH Flag Count	74	Init_Win_bytes_backward
12	Total Length of Bwd Packets	33	Bwd IAT Mean	54	ACK Flag Count	75	act_data_pkt_fwd
13	Fwd Packet Length Max	34	Bwd IAT Std	55	URG Flag Count	76	min_seg_size_forward
14	Fwd Packet Length Min	35	Bwd IAT Max	56	CWE Flag Count	77	Active Mean
15	Fwd Packet Length Mean	36	Bwd IAT Min	57	ECE Flag Count	78	Active Std
16	Fwd Packet Length Std	37	Fwd PSH Flags	58	Down/Up Ratio	79	Active Max
17	Bwd Packet Length Max	38	Bwd PSH Flags	59	Average Packet Size	80	Active Min
18	Bwd Packet Length Min	39	Fwd URG Flags	60	Avg Fwd Segment Size	81	Idle Mean
19	Bwd Packet Length Mean	40	Bwd URG Flags	61	Avg Bwd Segment Size	82	Idle Std
20	Bwd Packet Length Std	41	Fwd Header Length	62	Fwd Header Length	83	Idle Max
21	Flow Bytes/s	42	Bwd Header Length	63	Fwd Avg Bytes/Bulk	84	Idle Min

(Decision tree C4.5, K-Nearest neighbors, neural network and support vector machine. They claim to achieve higher accuracy with these feature selection methods than otherwise.

This work is better on three grounds from similar works. First, the use of the CICIDS2017 data set, which has an edge over other datasets in terms of being realistic and entailing contemporary DDoS attacks. Secondly, it covers all the three categories of feature selection and finally, the feature selection, in our case we were able to remove 82% feature which is well below the works considered here.

3. Data Pre-processing and Feature selection

A. Dataset

Among the available choices for the IDS dataset, we picked CIC IDS 2017 dataset [13]. The dataset includes contemporary DoS attacks and benign network flows to imitate the real scenario [14]. The attacks used for the generation of data are Brute Force FTP, Brute Force SSH, DoS, Heartbleed, Web Attack, Infiltration, Botnet, and DDoS. The dataset involves about eleven criteria such as attack diversity, labeling, complete capture, complete interaction etc. the experimental setup was comprised of physical machines and tools like curl have been used to generate normal network traffic. The network topology used for capturing the network traffic includes most of the network devices and the dataset is complete capture. Network protocols *e.g.* HTTP, HTTPS, SSH, FTP, SMTP, IMAP, and POP3 have been used for the generated traffic to make it more real. They capture data for five days and we chose data captured on Friday for our experiments, which included dos attacks and benign traffic. The dataset runs into GigaByte and was provided as labeled data as a '.csv' file format. With about 85 features as mentioned in Table I, the dataset is an ideal choice for demonstrating the effect of feature selection on how five Machine Learning based classifiers are chosen for this study perform.

B. Feature selection

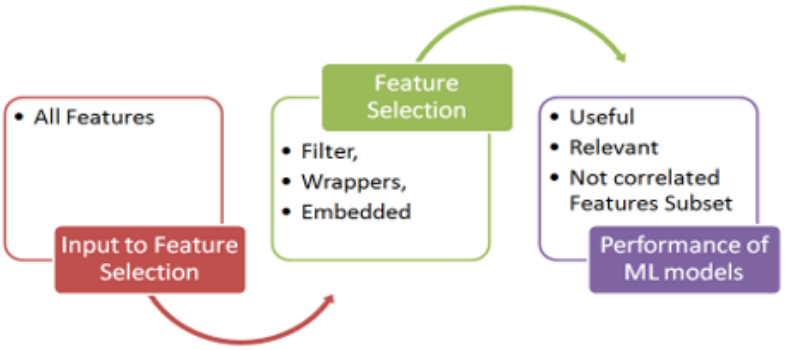

Fig. 1. Feature Selection Process.

Feature selection [15][22] as the name suggests, is the selection of the features out of the total available attributes or features in order to reduce the computational latency and complexity, increasing accuracy and doing away with 'overfitting'. It is three types 1) Filter methods, 2) Wrappers Methods and 3) embedded methods. In filter methods, correlation of the features with the dependent variable ascertains their relevance while wrapper methods use the actual classifier to weigh the worth in subset of the attributes. Filter methods are much faster and less computationally intensive as compared to the wrapper methods as they do not involve training the models. Feature selection methods [15] categorize into Filter, Wrappers, and Embedded Methods.

Recursive Feature Elimination [16] is an embedded method that works with machine learning algorithms like Support Vector Machines, Lasso, etc. Here the model construction happens by repeated removal of the features with low weights. Embedded methods have computational complexity between wrappers and filter methods.

Selectfrommodel [17] strategy is more or less the same as RFE but is less robust. Here the features are chosen in view of weights and as per the threshold. The estimator is a parameter for this method which is machine learning algorithms like Random Forest, lassoCV, etc.

SelectPercentile [18] is another feature selection method that can be implemented using Scikit-learn which assigns percentile to the features based on their score. Subsequently, features can be selected to a cutoff percentile considering the performance of a classifier.

PCA (Principal Component Analysis) [19] projects correlated features on a different plane making them uncorrelated i.e. with maximum variance. In mathematical terms, it can also be defined as an orthogonal linear transformation. For a given set of k-dimensional vectors of weights w(k) , there exists map x(i) from X to orthogonal vector Y(i) is represented by Y(i) = x(i).w(k). In PCA, the dimensionality of data is reduced but the original features are not retained by this method unlike in other feature selection methods.

C. Classifiers

A classifier in machine learning is a statistical function that classifies network traffic. We used five supervised ML-based classifiers for our study. These are Support Vector Machine (SVM), Gaussian Nave Bays (GNB), and K nearest neighbor and Random Forest. Support Vector Machine [20,21] is a supervised machine learning algorithm that finds a line of categories by

learning from the dataset. The major benefit of using this classifier is that it doesn't 'overfit'. The classification is carried out by searching for a hyperplane to classify the classes in the best possible way. We have used Linear SVM which is a type of SVM and is very efficient. Nave Bayes Classifier [20,21] is amongst the most prominent learning methods based on Bayes Theorem of Probability. It is a very fast method and is capable of making almost real-time predictions. The main downside of this method is its supposition regarding independent predictors which is not possible practically. Logistic regression [20,21] is a statistical method for analyzing the dataset having one or more independent variables for determining the outcome. Random Forest [20, 21] is the group learning method used for classification. Random Forest is a group learning method used for classification. It creates several decision trees during its training and uses votes from these decision trees for predicting an output. K-nearest neighbor algorithm [20, 21] is generally used for both classification and regression. This is also known as the lazy learning algorithm. It stores every single accessible case and predicts the class of the information in view of these cases.

4. Experiments & Results

A. Testbed

The experiments were carried out over Ubuntu (64-bit) based virtual machine having windows 10 as host. The memory of the physical machine was 4 GB. With a Core 2 Duo processor, it was a robust machine in the business segment and was tuned for best performance i.e. we disabled most of the graphics/ redundant processes running in the background. The software application was written by the authors in Python programming language using Scikit-learn Library [20]. The pseudo-code of the same is given in Fig. 2.

B. Metrics

We used five machine learning models and as many feature selection methods. The accuracy of the classifiers and number of the features selected by the feature selection methods without compromising on the accuracy of the classifier were utilized as metrics for the evaluation of our experiments. The accuracy of Machine Learning classifiers can be calculated as below:

Accuracy = correct predictions/ total number of instances

C. Outcome

We ran the experiment initially without pre-processed data; the results are illustrated in Fig. 3 & Table I. The drawback observed was the higher computational latency. The dataset was subjected to various data pre-processing techniques such as removing blank values and replacing NaN with median values and Infinity values with '0'. 'Infinity' values are very large values and NaN is 'Not a Number' generally creep in instead of the intended observation when something goes wrong during the happening of an experiment. It was logical to replace/drop these values with appropriate methods referred above.

A software module was written to compare the feature selection techniques. The same was developed using 'python' and python based libraries such as Scikit-learn [20], Numpy and Pandas, etc. The pseudo-code snippet in Fig. 2 depicts the logic of the code and Fig. 3 is the screenshot of the actual results obtained during the trial. We used 10 fold cross-validation, which

is a far advanced technique than 'train_test_split' strategy [23]. It divides the dataset into 10 segments of equal size and each segment is used iteratively for testing and training of the model. We picked classification accuracy as the metric to evaluate the performance of feature selection methods.

```
IMPORT important libraries including Scikit Learn
IMPORT the dataset
PRE-PROCESSING to impute missing values, replace NaN (Not a
Number) and Infinity values in the dataset
DROP redundant/ irrelavant features
SCALE the data
STOREvarious Machine Learning Models in a variable 'models'
SET scoring equal to accuracy, Name as name of the machine learning
models
FOR Name, Model in models:
      Store value of model  selection using 10 splits in a variable
       Calculate and store results using cross_val_score method of
        model_selection in sklearn by imputing Train and Testing data
        Append results in list of existing results
        Print mean accuracy and standard deviation
END FOR
```

Fig. 2. Pseudo Code snippet for DDoS traffic classifier.

It was observed that there was a clear difference in execution time in the two scenarios *i.e.* with and without scaling. Without scaling of data, the classifiers took longer to finish. However, after applying feature selection methods, the time taken by the model to finish was much shorter. Thus, we deduce that feature scaling and feature selection methods influence the performance of classifiers. We applied several feature selection methods *e.g.* Recursive Feature Elimination (RFE with Lasso and Linear SVC) 'SelectFromModel', 'SelectPercentile' and PCA (Principal Component Analysis). The results of the same have been illustrated in Table II.

It can easily be verified that the number of the features was reduced from 85 to 12/15 in most of feature selection methods without compromising on the accuracy of the classifier. We also replaced the categorical labels i.e. BENIGN and DDoS with '0' and '1' respectively as the machine learning models require float/ numerical values.

Apart from the application of feature selection methods, we also picked PCA for a comparison viewpoint. PCA is not a feature selection method per se but is a dimensionality reduction technique used by us to have a wider perspective of the reduced number of attributes over performance in classifying network flows in DDoS detection. The subsets selected using different feature selection methods are given in Table IV.

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Table 2. Experimental Results: Mean Accuracy of Classifiers alongside Feature Selection methods

#	Machine Learning Models	Without any feature selection with all 85 features		SS & Select Percentile (k=15)		SS & RFE (model= linearsvc and components=15)		SS & PCA(n=25)		SS and lasso CV select frommodel (threshold=0001) feature selected =12		SS with Lasso (alpha=.05) & RFE(feature to select=15)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	Logistic Regression	83.33	.268	82.4	.003	81.2	.002	82.5	.005	82.85	.300	82.53	.308
2	K Nearest Neighbour	94.12	.167	94.3	.001	80	.028	94.2	.001	95.92	.1666	95.84	.161
3	Gaussian NB	60.72	.438	81	.002	51.3	.002	51.8	.003	73.77	.263	59.82	.498
4	Random Forest	93.80	0.256	96.1	.001	82.4	.002	95.6	.001	96.5	0.170	96.65	.116
5	Linear SVM	84.16	.292	82.3	.002	82	.002	82.9	.002	83.64	0.352	83.24	.299



Fig. 3. Screen Shot of results obtained in one of the Trials.

Apart from the application of feature selection methods, we also picked PCA for a comparison viewpoint. PCA is not a feature selection method per se but is a dimensionality reduction technique used by us to have a wider perspective of the reduced number of attributes over performance in classifying network flows in DDoS detection. The subsets selected using different feature selection methods are given in Table IV.

Table 3. Feature selected with different methods

#	Feature selection methods	Feature selected
[1]	Features selected using RFE witht linearsvc and n_features_to_select =15 and step=5 (pp StandardScaler)	11, 12, 13,15, 16, 33, 41, 47, 59, 60, 70, 72, 74, 75
[2]	Feature selected after using SelectPercentile(12 features percentile=15) and using standardscaler	3, 17', 19, 20, 23, 24, 25, 29 ,30, 61, 81, 83
[3]	Lasso cv(toi=.0001) with SelectFromModel(model,threshold=-05) and StandardScaler	3, 8, 9, 23, 24', 32, 34, 47, 54', 59, 60, 61
[4]	RFE (n_features to select 15) with Lasso(alpha=.05) and StandardScaler(results reverified)	3, 5, 6, 9, 10, 11, 12, 13, 19, 24 , 54, 61, 76, 81

We were able to show the following aspects of feature selection in this study:

a) Random Forest and KNN turned out to be the best Machine Learning model to detect DDoS attacks. With feature selection methods, the Random Forest classifier was top performer and KNN performed well without using any feature selection i.e. keeping all the 85 features.

b) The classifiers perform differently with different feature classification techniques i.e. Correlation exists between classifier and feature selection algorithm.

c) The Machine Learning classifiers performed fantastically with adequate prediction accuracy over a real-life dataset which entails contemporary DDoS attacks and diverse network traffic.

d) We were successful in reducing the feature from 85 to 12/15 without compromising on the accuracy of the classifier.

e) Feature selection does boost crease the performance and accuracy of the classifier.

f) We illustrated the effect of feature selection methods belonging to all three categories e.g. Filter, wrapper, and embedded methods.

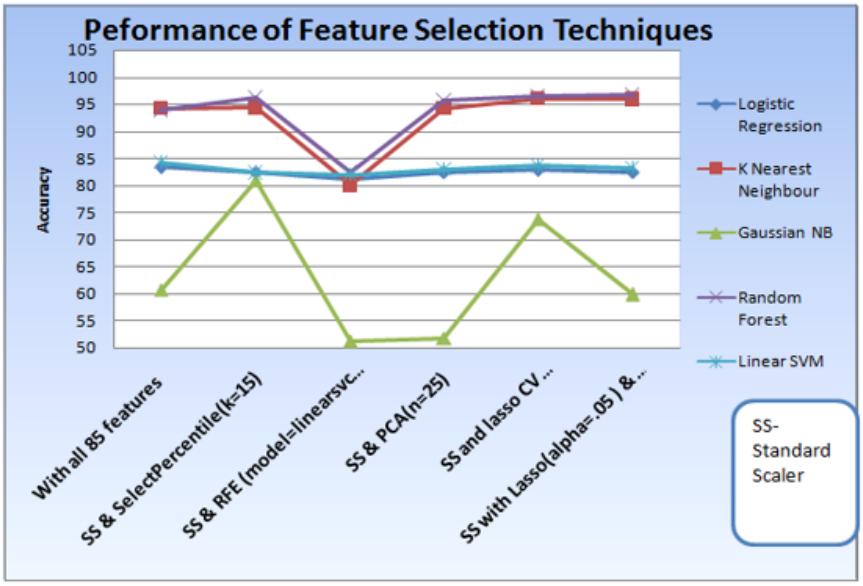

Fig. 4. Performance of machine learning models with different feature selection methods.

E. Discussion

We developed and used a Python-based software application for analyzing the network traffic dataset. The feature selection methods were chosen to evaluate all the three categories of feature selection/ elimination helped in generalizing the results. Results were obtained in a reasonable time frame. The finding of our experiments though ranked performances of the classifiers yet we cannot call any classifier 'the best' in every situation. Picking different machine learning algorithms alongside feature selection techniques altered the outcome which will be investigated in our future work.

In ordinary 'train_test_split' strategy', the machine learning models perform inadequately due to 'underfitting' or 'overfitting'. Overfitting refers to the learning of a machine learning model over the data and noise as well and adversely affects the performance of the models. Underfitting is another unwanted phenomenon when machine learning models fail to fit the training data well. There is every chance that the left-out data contain important patterns that induce the error by bias. Thus, we used K=10 Fold cross-validation for evaluation and comparison of our machine learning models and it indeed helps in avoiding these situations and results can be validated over the whole of the data.

F. Limitations

We evaluated our experiments with two metrics namely accuracy and number of features. More metrics as Precision, Recall, and F-measure can certainly present a more generalized view.

5. Conclusion

Feature selection is very vital from the perspective of the application of Machine learning algorithms. They boost the performance of these algorithms, reduces the complexity and time of execution. In other words, ML models become efficient with the application of feature selection. It removes irrelevant, redundant features without any considerable loss of information. Redundant features are those features that have do not have strong correlations with other features and thus their removal does not impact the outcome and the same applies to irrelevant features.

Detecting DDoS attacks at an early stage could spare the organizations from monitory, data and reputation loss. We evaluated feature selection methods one each from the entire three categories namely: Filter, Wrappers and Embedded methods. Our work has illustrated that feature selection has a direct impact on the outcome of machine learning-based classifiers for the detection of DDoS attacks. We validated the results using two metrics. The outcome of our experiments promptly concluded that KNN & Lasso CV with the SelectFromModel method and Random Forest alongside Lasso-RFE have performed better than the rest of the feature selection methods & classifiers. Further, we were successful in reducing the features from 85 to 12/ 15 without compromising on accuracy. Our results are more relevant as we used dataset having contemporary DDoS attacks. In fact, the accuracy of both the classifiers was improved with the feature selection. In the future, common features in multiple datasets will be evaluated as their impact on accuracy will be a fascinating study.

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Implementation of SimpleRNN and LSTMs based prediction model for coronavirus disease (Covid-19)

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Abstract

Deep learning is a powerful technique which is inspired by the structure as well as processing power of the human brain. This technique uses deep neural network to perform complex tasks such as time series prediction, image classification, and cancer detection. In this research work, we used Covid-19 time series datasets and with the help of deep learning we built the model for prediction of Covid-19 cases. For the model building, we used two deep learning neural networks, Recurrent Neural Networks (RNN) and Long Short Term Memory Networks (LSTMs). We built a prediction model using RNN in the first instance and subsequently the second model was built using LSTMs. Out of these two neural networks, we got promising results from the model based on LSTMs with an overall accuracy of 98%. As the cases of Covid-19 are increasing day-by-day at a very high rate, we proposed these models using neural networks to help in predicting the future trends of Covid-19 confirmed, deaths and recovered cases.

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An Efficient Authentication Scheme for Mobile Cloud Computing Using a Key Server

Sunil Mankotia & Manu Sood

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Abstract

In today's world, mobile devices and smartphones are used heavily and have become one of the essential requisites of everyday life. The development of several applications feasible for those devices has revealed that there is a huge demand for applications of mobile. A technology which aroused in the IT sector provides an opportunity to solve those issues, namely mobile computing and cloud computing. The modern mobile architecture integrates cloud computing and mobile technology to produce Mobile Cloud Computing (MCC). Processing, data storage, and computation accompanied by the applications are moved off the mobile device to be a robust centralized platform of computing that resides in the cloud. The significant risk of mobile cloud computing is securing remote applications and data from illegal access. There is a possibility of unauthorized access, which is accessed by third parties. Therefore the issue of security in mobile cloud computing becomes one of the major research areas. It is necessary to implement strict authentication controls in MCC. The proposed research work is an attempt for secure authentication in a mobile cloud by using a key server and AES-256 algorithm for cryptographic purposes.

Keywords

Smartphone **Authentication** **Mobile cloud computing** **AES-256**

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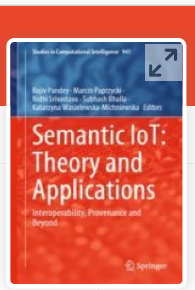

Semantic IoT: Theory and Applications pp 245–262

Semantic IoT Interoperability and Data Analytics Using Machine Learning in Healthcare Sector

Pratiyush Guleria & Manu Sood

Chapter | First Online: 13 April 2021

663 Accesses

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Abstract

With the exponential growth of data in electronic form, it becomes a complex and tedious task to extract meaningful information. The vast collection of data has resulted in big data that may be in indeterminate form. The challenge is to extract meaningful data from internet sources that are spreading across multiple domains and to enable consistent resource sharing, interoperability on multiple IoT platforms. The use of emerging technologies like Machine Learning and IoT is realized on multiple platforms, systems, and service applications. The introduction of predefined libraries on Natural Language Processing in Machine learning platforms has emphasized on the semantic web technologies and its IoT future directions. In this chapter, authors have discussed the role of the semantic web, three layered framework for IoT interoperability, and have framed a web ontology structure for semantic interoperability in IoT for the healthcare sector. Authors have also proposed the text analytics model for the healthcare sector and performed semantic data classification on synthesized healthcare dataset to predict the patient diagnosis using Machine learning techniques.

Keywords

Healthcare **IoT** **Learning** **Machine** **Python** **Semantic** **Structured**

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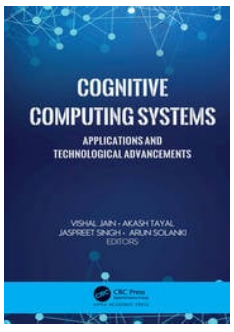

Chapter

A Convergence of Mining and Machine Learning: The New Angle for Educational Data Mining

By Pratiyush Guleria, Manu Sood

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ABSTRACT

In the digital era, there is an accumulation of large volume of data, and the biggest challenge being faced by humans is to derive meaningful information from these data. In such a scenario, data mining techniques become important to unearth the hitherto unknown relationship from data. There is an urgent need for scientific research in education, as it aimed at enhancing student's cognitive learning and social development. With increasing educational institutions, the large amount of data is accumulated, which is unstructured and not useful neither for students nor for teachers. Therefore, the major stress is on improving the quality of learning in schools and institutions, and there is a need to make significant progress on access to schooling and quality of learning in students. The computational intelligence is achieved through data mining techniques, which can break down information to enable it to make predictions. This chapter aims at discussing the utilization of educational data mining, learning analytics, and predictive intelligence techniques in educational field and models of machine learning, that is, unsupervised and supervised learning. There are some inbuilt libraries, such as Tensor flow, Keras, and Python libraries, discussed in this chapter, which helps in building, training, and applying it into educational data classification.

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Chapter 3

Battery and Energy Management in UAV-Based Networks

Santosh Kumar, Amol Vasudeva, Manu Sood

Book Editor(s):Vandana Mohindru, Yashwant Singh, Ravindara Bhatt, Anuj Kumar Gupta

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Summary

Unmanned aerial vehicles (UAVs) technologies are attracting great attention with growing demands for autonomy for commercial, military, and other purposes. UAV-based communication networks play an important role in application presently using UAVs and upcoming potential future applications. Besides the number of pros, there are many challenges like line-of-sight communication, distance from the data receiver, limited access to the communication spectrum, energy constraints, and most concerning limited battery power. The focus of this chapter is on studying the techniques available for effective battery and energy manage-ment in UAV-based communication networks. The mechanisms for the optimal utilization of energy resources by UAVs to maximize their lifespan or deployment in a network are critically examined. This helps in a significant reduction in the usage of network energy resulting in a prolonged network lifetime. Further potentially promising areas for future research are also explored.



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Computational Vision and Bio-Inspired Computing pp 263–277

Handling Security Issues in Software-defined Networks (SDNs) Using Machine Learning

Deepak Kumar & Jawahar Thakur

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Abstract

Software-defined networks are scalable, flexible, easier to manage, and also support adaptive nature. Our objective is to focus on how machine learning can make SDN more secure and robust. The use of machine learning not only increases efficiency but also helps to take optimal decisions. This is because machine learning algorithms can monitor each layer of the SDN paradigm and provide security both at the hardware and software levels. It also keeps track of packets flow and other malicious activities. The continuous flow of packets can be utilized as a datasets to train the SDN controller. Thus, using machine learning, we can make the controller intelligent to overcome security issues in a better way as it can detect abnormal behavior of devices, flooding of packet flows, and also it makes features such as load balancing, traffic classification, firewall monitoring, and QoS even more efficient. SDN has gained attention among researchers as its integration with emerging technologies make it more interesting. For emerging networks, SDN is the best available choice, as it is flexible, scalable, programmable, reliable, robust, and secure.

Keywords

Data centers **5G** **Machine learning** **NFV** **QoS**

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Preface

In the twenty-first century, organizations are facing many new challenges. Some people would argue that society and the economy have changed so radically that the last century's management practices and theories are no longer relevant. The truth is management has become more important than ever. Almost everything we do today as individuals or organizations requires us to interact with large-scale institutions, such as government agencies, banks, health-care providers, insurance companies, school systems, universities, online retailers, and technology service providers. How has management theory and practice evolved to manage this new organizational and business environment? Interestingly, it has become both more specific and more general.

Several forces are significantly shaping management practices today, including the pace of change, technology, globalization, diversity, and social expectations. Keeping these things in mind this book was conceptualized with an objective to publish the researches being done on various Advances in Management, Social Sciences and Technology. conference.

We hope that this book will be prove to be helpful to students, research scholars, academicians and business executives in having a better understanding of the concept of Advances in Management, Social Sciences and Technology.

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Nothing can be possible without the Blessings of the Almighty. I bow to the supreme power for always being there with us in all our endeavors.

This Edited Book is the hard work of all the dedicated researchers. We are indebted to all of them for their quality work and for making this book a possibility.

I am thankful to my parents Ms. Nazma Rahman & Mr. Nakibur Rahman for making me understand the importance of education and for making me a confident individual.

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Dr. Tazyn Rahman

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A STUDY OF STRESS COPING SKILLS OF COLLEGE

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ABSTRACT
In the present investigation an attempt has been made to measure the Stress coping skills of post graduate students of Bijapur city in Karnataka. Stress coping skills inventory by Jerabak, Answer sheet, Scoring key and Norms were used. The mean and standard deviations were computed from the raw data for the selected sample. To find out the significant difference between the sub-groups t-test was employed. The results show that there is a high level of Stress Coping Skill among college and university students of Bijapur city of Karnataka state. There is significant difference between sub-groups such as UG & PG, women university and Karnataka university, govt. college and private college, arts and science, arts and social science, arts and commerce, arts and education, education and commerce, arts and science, Govt. and private arts, science and commerce in their level of Stress Coping Skill. There no significant difference between Govt. college and Private college, arts and science, arts and social science faculties of women university in their level Stress Coping Skill. The is a significant deference between English and kannada, kannada and Bioinformatics, MCA and Pharmaceutical Chemistry, Economic sand Sociology, Economics and Women's studies, Economics and Social work, Sociology and Women's studies, Sociology and Social work, Women's studies and Social work, M.Ed, and M.Com, M.Com and MBA in their level of Stress Coping Skill.

INTRODUCTION
Stress is the demands placed on the individual that are perceived as threatening and demands that tax the individual's resources. Stress thus involves a perceived threat which an individual thinks that may strain or exceed his/her resources. Stress includes tightening of muscles, increased heart rate and breathing seems more rapid. Both the person who is lethargic to do anything and the person who always has to do something may be experiencing stress.

The term stress refers to situations that pose demands, constraints, or opportunities. However, a stress-arousing situation for one person might be a neutral event for another, whether a creation situation is stressful for us or not depends on how we appraise a life event and how we rate our ability to deal with it.

Coping Skills: Coping Skills are characteristic way of dealing with difficulties-influence how we identify and try solving problems. People who cope successfully do not only know how to do thing, they also know how to approach situation for which they do not have a ready available response.

Stress and illness: There is growing evidence that stress plays an important role in illness and health. Selye proposed a model of stress reaction in the body called the General Adaptation Syndrome(GAS) which has three phases; Alarm reaction, Resistance and Exhaustion. Alarms reaction is a familiar sensation to everybody and is best known as "fight" or "flight" responses. In resistance, the distinctive reactions of the alarm fade and disappear and the body seems to "return to normal". Exhaustion is one in which badly resources are depleted and the organism loses its ability to resist so that further exposure to the stress can lead to disintegration and death.

The causes of stress are many. Pressures or stresses also come from within,

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from the beliefs, attitudes and expectations about the world and ourselves from our habits and behavior and from our personality. Stress falls into different groups, physical, environment stresses, such as noise and pollution, cultural expectations and more personal social expectations from family, friends and colleagues. For many people, it is the small daily events which cause the most stress.

Stress affects both physical and emotional well-being of an individual. Coronary heart disease is prominent when it comes to them and stress along with hypertension following heart disease; the second most common stress-related illness and probably those of the alimentary canal ranging from indigestion to ulcer. Two major problems are peptic ulcer and irritable bowel syndrome. Other illnesses include certain skin disorders and various types of mental and emotional disorders.

Stressful Situations: Stress can have undesirable effects on behavior, thought, and bodily functioning, because different people react to stressors and their effects on the different bodily symptoms is often low. It is particularly hard for people to deal with several stressors that occur at nearly the same time.

Stress-arousing Situations: Stress can arise either from specific situations or from developmental transitions. Stressful events vary in several ways: duration, severity, predictability, degree of loss of control, self-confidence of the person, and suddenness of onset.

Life Transition: Life transitions, such as going to college, getting a job, having a baby, and moving, may also be stressful. Adolescence is a time of particular stress because of physical changes, role changes, and changes in parent-child relationships.

CLINICAL REACTIONS TO SRTESS

Among the disorders that seem most related to stress are adjustment disorders, posttraumatic disorders, and dissociative disorders.

Adjustment disorder: An adjustment disorder is a reaction to recent stress and usually disappears when the stress level decreases. Common symptoms of adjustment disorders are depression, anxiety, disruptive or reckless behavior, sleep problems, deterioration in performance, and social withdrawal.

Posttraumatic disorders: Posttraumatic stress disorder (PTSD) may after an extreme stress such as a natural disaster, a serious accident, or participation in battle or other war-related situations.

Dissociative disorders: Sudden temporary alterations of consciousness that bolt our painful experiences are characteristic of dissociative disorders

TREATING STRESS RELATED PROBLEMS

A variety of approaches are used other alone or in combination to treat stress-related disorders.

Supportive Therapy: In Supportive Therapy the therapist provides acceptance and a noncritical attitude in orders to give the clients an opportunity to relax enough to engage in problem solving.

Drugs and sedatives: Drugs and sedatives act on the nervous system to allow the person to feel a temporary decrease in stress. This treatment is often combined with a psychological therapeutic approach.

Relaxation Training: Relaxation Training is a structured approach to tension reduction that also helps to decrease feelings of stress enough that the person can focus on working out problems.

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Systematic Desensitization: Systematic Desensitization is a process designed to eliminate fear in specific types of situations by pairing relaxation techniques with imagining the presence of the anxiety-associated stimuli.

Cognitive Modification: Cognitive Modification **is** the process of learning to think about or construe anxiety-producing situations in a different way.

Social Intervention: Social Intervention involves treating not just the individual with the problem, but also involving family members in the treatment process.

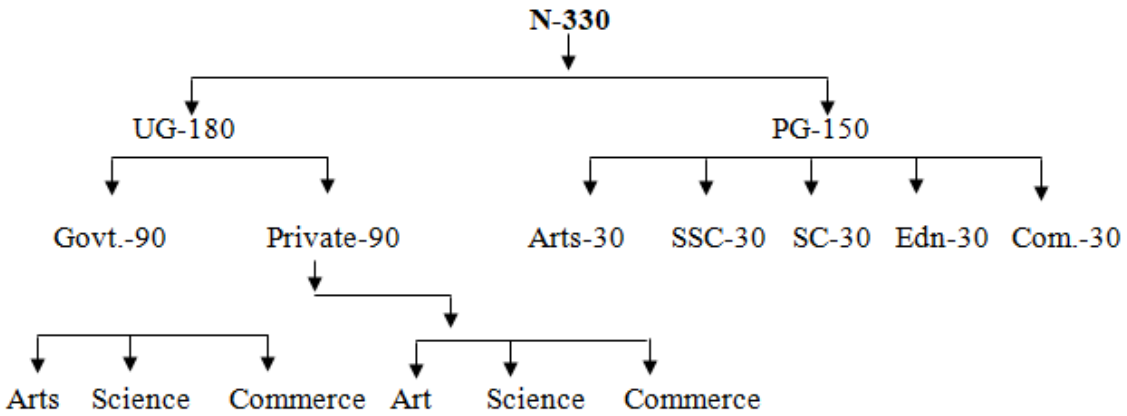
1) STATEMENT OF THE PROBLEM:

"A Study of Stress Coping Skill of Graduates and post-graduate students of Bijapur City"

3) METHOD

a) Sample

The study was conducted on a sample of 330 under graduate and Post-graduate students of Bijapur city in the of Karnataka state. The stratified random sampling was adapted for the present study. The sample design is as follows:



b) Materials

Stress Coping skills inventory by Jerabak, Answer sheet, Scoring key and Norms.

c) Procedure

The students were seated comfortably; the answer sheet was given to the students and was asked to fill in the personal detail. Then the inventory was handed over and following instructions were given, "This test is designed to evaluate how you cope with your stress. Read every statement carefully and indicate how often it applies to you. In order for the test to be valid, all the questions must be answered. There is no time limit but usually this test can be completed within 20 minutes". After completion by the students, the responses were scored as given in the scoring key.

4) RESULTS AND DISCUSSION

The means and standard deviations were completed for the selected sample. To find out the significant difference between sub-groups 't'-test was employed.

Null hypothesis 1: There is no Stress Coping Skill among the college and university students.

Table-1: Mean score of Stress Coping Skill of college and university

Group	N	Mean	SD
All UG and PG students	360	223.16	41. 81

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As per the table-1, all post-graduate and under-graduate students fall under category high Stress coping skill. The Stress Coping Skill was dispersed widely in PG and UG students as per the standard deviation value cited in table-1. Hence, the null hypothesis was rejected in favor alternative hypothesis. Therefore it is concluded that there is a high level Stress Coping Skill among under-graduate and post-graduate of women's university of Karnataka state in India.

Null hypothesis 2: There is no significant difference between the respective sub-groups in their level of Stress Coping Skill.

Table 2: Significant difference between the different sub-groups in their Stress Coping Skill.

Variable	Sub-group	n	Mean	SD	Obtained 't'-value	Level of significance
level of education	Under-graduate	120	210.85	19.47	133.99	Significant at 0.05 level
	Post-Graduate	300	205.85	20.46		
Institution	Women university	300	224.96	37.51	21.87	Significant at 0.05 level
	Karnataka university	60	225.66	32.47		
level of education	Govt. college	40	220.5	29.15	0.46	Not Significant at 0.05 level
	Private college	60	238.33	39.37		
Faculty	KSWUB-ARTS	80	220.5	29.15	0.45	Not Significant at 0.05 level
	KSWUB-SCIENCE	40	229.5	29.71		
Faculty	KSWUB-ARTS	80	220.5	29.15	1.43	Not Significant at 0.05 level
	KSWUB-SOCIAL SCIENCE	40	213.0	34.88		
Faculty	KSWUB-ARTS	40	220.5	29.15	3.43	Significant at 0.05 level
	KSWUB-COMMERCE	60	221.0	37.13		
Faculty	KSWUB-ARTS	80	238.33	39,37	19.41	Significant at 0.05 level
	KSWUB-EDUCATION	60	229.5	29.71		
Faculty	KSWUB-EDUCATION	40	238.33	39.37	26.48	Significant at 0.05 level
	KSWUB-COMMERCE	60	213.0	34.88		
Faculty	GOVT.ARTS	40	238.33	39.37	13.8	Significant at 0.05 level
	GOVT. SCIENCE	80	221.0	37.13		
Faculty	GOVT.ARTS	40	238.33	39.37	13.8	Significant at 0.05 level
	GOVT.COMMERCE	80	229.5	34.88		
Faculty	GOVT.SCIENCE	40	238.33	29.71	87.65	Significant at 0.05 level
	GOVT.COMMERCE	40	221.0	37.13		

The table - 2 reverts that the obtained t – values such as 133.99, 21.87, 3.43, 19.41, 26.48, 13.8, 13.8, 13.8, and 87.65 are greater than the table t – values respectively. Hence the framed null hypothesis was rejected in faviour of alternative hypothesis. Therefore, it was concluded that there is a significant difference between the respective sub - groups in their level of Stress Coping Skill.

And the table – 2 also reveals that the obtained t – value0.46. 0.45 and 1.43 are less than the table t – value at 0.05 level of significance. Hence, the framed null hypothesis was accepted in the case of Arts and education students of Women's university Therefore, it was concluded that there is no significant difference between the respective sub - groups in their level of Stress Coping Skill

Null hypothesis 3: There is no significant difference between the respective sub-groups in their level of Stress Coping Skill.

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Table 2: Significant difference between the different sub-groups in their Stress Coping Skill.

Variable	Sub-group	n	mean	SD	Obtained 't'-value	Level of significance
Department	English	20	217.5	29.91	12.61	Significant at 0.05 level
	KANNADA	20	221.0	28.61		
Department	MCA	20	260.0	32.86	12.81	Significant at 0.05 level
	Bioinformatics	20	223.0	30.51		
Department	MCA	20	260.0	32.86	88.42	Significant at 0.05 level
	Pharmaceutical Chemistry	20	232.0	43.34		
Department	Economics	20	218.0	24.89	35.22	Significant at 0.05 level
	Sociology	20	227.0	24.71		
Department	Economics	20	218.0	24.89	48.99	Significant at 0.05 level
	Women's studies	20	231.0	28.61		
Department	Economics	20	218.0	24.89	37.87	Significant at 0.05 level
	Social work	20	229.0	39.23		
Department	Sociology	20	227.0	24.71	15.10	Significant at 0.05 level
	Women's studies	20	231.0	28.61		
Department	Sociology	20	227.0	24.71	6.89	Significant at 0.05 level
	Social work	20	229.0	39.23		
Department	Women's studies	20	231.0	28.61	6.69	Significant at 0.05 level
	Social work	20	229.0	39.23		
Department	M.Ed.	40	213.0	34.88	60.16	Significant at 0.05 level
	M.Com	40	213.0	33.15		
Department	M.Com	20	204.5	31.85	10.29	Significant at 0.05 level
	MBA	20	234.5	36.15		

The table - 2 reverts that the obtained t – values such as 12.61, 12.81, 88.42, 35.22, 48.99, 37.87, 15.10, 6.89, 6.69, 60.16, and 10.29 are greater than the table t – values respectively. Hence the framed null hypothesis was rejected in favor of alternative hypothesis. Therefore, it was concluded that there is a significant difference between the respective sub - groups in their level of Stress Coping Skill.

5) FINDINGS AND CONCLUSIONS

1) There is a high level of Stress Coping Skill among college and university students of Bijapur city of Karnataka state.

2) There is significant difference between sub-groups such as UG & PG, women university and Karnataka university, govt. college and private college, arts and science, arts and social science, arts and commerce, arts and education, education and commerce, arts and science, Govt. and private arts, science and commerce in level of Stress Coping Skill.

3) There no significant difference between Govt. college and Private college, ARTS and SCIENCE, ARTS and SOCIAL SCIENCE faculties of women university in their level Stress Coping Skill.

4)The is a significant deference between English and kannada, kannada and Bioinformatics, MCA and Pharmaceutical Chemistry, Economic sand Sociology, Economics and Women's studies, Economics and Social work, Sociology and Women's studies, Sociology

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and Social work, Women's studies and Social work, M.Ed. and M.Com, M.Com and MBA level of Stress Coping Skill.

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USE OF FLEXIBLE MATERIALS FOR STABILITY OF SLOPE

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ABSTRACT

Soil nailing is a development procedure used to upgrade the quality of ground that guarantees the security of new or existing area inclines. The fortifying activity of the ground is expanded by means of the nail inclusion process which in returns increments malleable power in soil nail. The principle part of the opposition becomes from the development of pivotal power, which is a strain power. In particular, cutting and bowing may contribute little to the obstruction. Various bars are introduced into a incline during the top-down unearthing. The exhuming support is a compelling and efficient approach to construct a maintenance divider to help peak, connect projections and parkways. This procedure is viable on lopsided soils, broken stone, shale and hard surface conditions. In this exploration, a physical model is readied that contains pressure measure, Acrylic sheet, flex sensor, Multimeter and steel bars. The soil for the model is gathered from the grounds of Chandigarh University. Strainer examination is performed to decide the sort of soil. To decide the adequacy of the readied mode various tests have been performed. Two materials named as Drainage Geo net and Expanded metal mesh were used with three different nail arrangements and for each nail arrangements Expanded metal mesh is able take more stress than the Drainage Geo net.

Keywords – Flexible materials, flexible facing, physical model, stress, strain

1. INTRODUCTION

The development of hilly and far-off areas, the dam's construction and hydroelectric projects in hard terrain, all needs stabilized ground in one way or another way. In the past, many stabilization methods have been developed to combat these situations. Stabilization of the Earth such as mechanical and chemical land stabilization, drilling, earthworks, crushed stone and ground gravel, are useful in providing structural and service-oriented stability. In this paper, the detail description of one such technique utilized for ground stabilization known as soil nailing is provided.

Soil nailing technology is employed to offer reinforcement for natural and steep slopes on site. If unstable existing grounds require support and nearby buildings are sensitive to deformation, the utilization of soil nailing provides stability through temporary construction or permanent support structures and take appropriate measures to decrease ground movement.

Soil nailing walls are a widely used technique for keeping vertical cuts on any slope that is even more vertical in the ground with vertical slopes and normal angles. A large part of the cost of landing is related to the construction of the reinforced concrete surface. Soil facing mechanism helps to provide the stability between soil and inserted nails. In addition, the top layer facilitates surface erosion, weathering and moisture loss from the surface of the soil nail system. In this manner, to get better stylish look of the nail structure, confronting assumes a significant job.

2. LITERATURE REVIEW

Soil nail innovation was first utilized in France to assemble a perpetual holding divider cut in delicate shake. The task, attempted in 1961, was where steel nails were utilized to fortify a

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holding divider. The main soil nail divider to utilize current soil nailing procedure was worked close Versailles in 1972. The method included introducing high-thickness, grouted soil nails into a 60-feet-high divider and confronting it with strengthened system.

G.L. SivakumarBabu., (2009) havestudiedsoil nailing is being utilized in numerous geotechnical applications to enhance dependability of unearthed vertical cuts and existing slants. This paper shows a couple of contextual analyses on the adjustment of a vertical cut and enhancement of incline security utilizing soil-nailing strategy. It was discovered that the vertical cut soundness/slant dependability enhanced because of the fortifying impact of nails. In the paper, a couple of contextual analyses on soil nailing have been displayed showing its points of interest. There is a need to utilize this strategy on vast scale in India in numerous framework extends wherever materials to understand the specialized and monetary favourable circumstances related with the procedure.

Cheng et al., (2015) have studied that the utilization of traditional steel in corrosive area faces many problems. Therefore it become essential to used shielded steel such as carbon fiber reinforced polymer (CFRP) / glass fiber reinforced polymer (GFRP) in loose fill soil. The test has been carried out with various materials and different kinds of steel bars in Hong Kong, Korea.

A.Karthikeyan Santosh Kumar (2017)in this investigation displayed a contextual analysis in which soil-nailed divider was planned and built. The dirt nailing was done in a mind boggling ground conditions having both soil spread and endured hard shake. The haul out test directed has affirmed that the structured nail limit. Cost investigation performed by looking at the structured soil-nailed divider and customary holding divider for this site showed that the dirt nailed divider was efficient for the present contextual investigation. Hence this technique ends up being progressively effective in holding steep slants where less space is accessible for development of ordinary holding dividers.

Rawat et al., (2018) presented a model to determine the failure of soil slope under various load conditions. In this research, the authors have inserted nails at different angle such as 10 degree, 15 degree and 30 degree respectively. Homogeneous soil slope has been prepared and subjected to various loads. The resistive as well as driving forces are taken into account for the calculation of safety. From the test it has been analysed that the safety factor has been lessen by increasing the seismic acceleration.

3. MATERIALS AND METHODOLOGY

Initially, the soil is collected from Chandigarh university campus and then various properties were studied on the basis of code (IS2720). The properties such as moisture content, specific gravity, compaction characteristics and unconfined compression strength have been analysed.

Table 1 Properties of soil

Properties	Values
Water Content (%)	11
Specific Gravity	2.56
Optimum moisture content (OMC)(%)	7.3
Maximum dry density(MDD) (g/cc)	1.98
Coefficient of Uniformity	5.6
Coefficient of Curvature	0.64
Unconfined Compressive Strength (Kg/cm^2)	0.118

From the above results the soil was categorized as poorly graded sand.

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Physical Model

A physical model was prepared with the Perspex sheet (acrylic sheet) of thickness 8mm. The dimensions of the model such as length, width and height were taken as 60 cm, 40 cm and 50 cm respectively. Three types of nail arrangements were used namely as square, rectangular and staggered. The dimensions and nail length were selected according to the soil nail manual.

The model drawing is shown is figure below

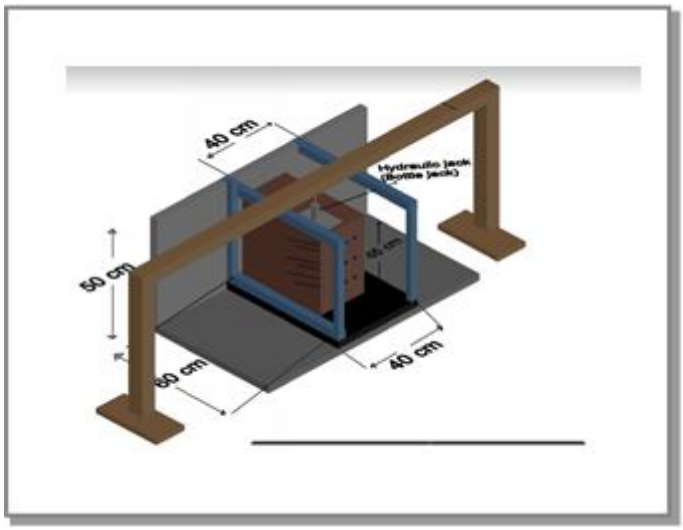

Fig 1. Physical Model Drawing

The various components used in the physical model are described below.

Pressure hydraulic jack (bottle jack)

Pressure hydraulic jack of bottle jack having weight 5 ton is used and placed in between the Perspex sheet. It is used to lift heavy loads and works on the principle of screw action.



Figure 2. Perspex sheet model and hydraulic jack

During the research, hydraulic jack is placed in between the Perspex sheet of 8mm thick as shown in above figure

Flex sensor

The flexible sensor is just like a variable resistor. As the nails bend, the resistance of the flexible sensor increases. Sensors like this are used in Nintendo Power Glove. A multi-meter is attached to the switch to measure the resistance sensed by flex sensor and then strain is calculated by using the formula written below:

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$$Strain = \frac{\Delta R/_R}{\Sigma_c}$$

Here Σ_c stands for gauge factor, its value lies between 2 to 2.5 and for 200 KΩ, the value of gauge factor is 2.1.

At last, the design model is tested, the tested setup of the proposed model. Copper wire is attached with each nail and resistance is measured using digital multimeter.

Various flexible materials used in this research work are as follow-

- Drainage Geo net
- Expanded metal mesh

These materials are chosen for the research work as these materials have tensile strength which is required to balance the tensile stresses that are acting on the slope.

4. RESULTS AND DISCUSSIONS

As mentioned above, two materials were used for this research and three types of arrangements i.e square, rectangular and staggered are discussed for both the materials.

Table 2: Stress and Strain reading for Drainage Geo net using 4 nails in square pattern

Stress (N/mm^2)	Strain in N1	Strain in N2	Strain in N3	Strain in N4
0	0	0	0	0
0.49	0.154	0.023	0.227	0.124
0.98	0.209	0.087	0.281	0.148
1.96	0.280	0.150	0.354	0.208
3.92	0.289	0.291	0.461	0.253
4.9	0.303	0.420	0.476	0.336

Table 3: Stress and Strain reading for Drainage Geo net using 6 nails in rectangular pattern

Stress (N/mm^2)	Strain in N1	Strain in N2	Strain in N3	Strain in N4	Strain in N5	Strain in N6
0	0	0	0	0	0	0
0.98	0.039	0.019	0.002	0.016	0.044	0.041
1.96	0.044	0.006	0.005	0.021	0.060	0.041
2.94	0.077	0.019	0.005	0.029	0.062	0.136
3.92	0.103	0.024	0.003	0.031	0.177	0.142
4.9	0.130	0.049	0.019	0.067	0.224	0.179
5.88	0.282	0.093	0.096	0.132	0.329	0.260
6.370	0.442	0.095	0.098	0.132	0.342	0.308

Table 4: Stress and Strain reading for Drainage Geo net using 8 nails in staggered pattern

Stress (N/mm^2)	Strain in N1	Strain in N2	Strain in N3	Strain in N4	Strain in N5	Strain in N6	Strain in N7	Strain in N8
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.980	0.006	0.002	0.002	0.004	0.002	0.004	0.004	0.014
1.960	0.013	0.017	0.023	0.011	0.013	0.009	0.040	0.022
2.940	0.019	0.026	0.028	0.044	0.019	0.026	0.050	0.032
3.920	0.027	0.045	0.042	0.044	0.023	0.032	0.050	0.017

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4.900	0.037	0.071	0.065	0.061	0.029	0.037	0.061	0.026
5.880	0.050	0.069	0.083	0.065	0.064	0.077	0.097	0.049
6.970	0.062	0.074	0.085	0.068	0.086	0.100	0.141	0.095

Table 5: Stress and Strain reading for expanded metal mesh using 4 nails in square pattern

Stress (N/mm^2)	Strain in N1	Strain in N2	Strain in N3	Strain in N4
0	0	0	0	0
0.49	0.047	0.135	0.662	1.047
0.98	0.088	0.198	0.725	1.092
1.47	0.125	0.238	0.748	1.178
1.96	0.162	0.31	0.81	1.258
4.9	0.225	0.365	0.858	1.342

Table 6: Stress and Strain reading for expanded metal mesh using 6 nails in Rectangular pattern

Stress (N/mm^2)	Strain in N1	Strain in N2	Strain in N3	Strain in N4	Strain in N5	Strain in N6
0	0	0	0	0	0	0
0.98	0.0107	0.0269	0.0262	0.0219	0.0033	0.0173
1.96	0.0607	0.0748	0.0692	0.0632	0.0130	0.0342
2.94	0.1142	0.0748	0.0935	0.0610	0.0181	0.0360
3.92	0.1451	0.0966	0.1201	0.0865	0.0164	0.0190
4.9	0.2252	0.1526	0.1816	0.2341	0.1636	0.0486
5.88	0.3193	0.3329	0.3633	0.2459	0.4195	0.2268
6.86	0.3392	0.3683	0.3745	0.2623	0.4366	0.2841

Table 7: Stress and Strain reading for expanded metal mesh using 8 nails in staggered pattern

Stress (N/mm^2)	Strain in N1	Strain in N2	Strain in N3	Strain in N4	Strain in N5	Strain in N6	Strain in N7	Strain in N8
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.98	0.019	0.005	0.006	0.004	0.002	0.004	0.051	0.002
1.96	0.028	0.017	0.043	0.016	0.059	0.012	0.062	0.012
2.94	0.053	0.027	0.117	0.094	0.084	0.022	0.102	0.015
3.92	0.099	0.040	0.169	0.118	0.084	0.041	0.102	0.028
4.9	0.116	0.060	0.184	0.153	0.090	0.055	0.118	0.051
5.88	0.129	0.064	0.203	0.160	0.114	0.087	0.135	0.049
7.056	0.210	0.111	0.241	0.190	0.145	0.090	0.153	0.051

DISCUSSIONS

We require facing material so as to hinder deformation thus limiting the mobilization of shear stress along nails. Flexible facing is designed to provide the necessary restrains to areas of slope between the bearing plates as well as erosion control.

From the above Tables it is found that Expanded metal mesh have taken up maximum stresses as compared to the Drainage Geo net. In general both the flexional and axial stiffness of facing controls the deformation.

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In the present research work we had studied three types of arrangements for soil nailing i.e square, rectangular and staggered arrangements and from the Table no 5,6 and7 it can be concluded that maximum stresses are taken up by the Expanded metal mesh as this particular material have higher stiffness as compared to other material, and further there is increase in normal force and shear resistance along the potential slip surface in frictional soil.

Further we can conclude that flexible facing approach also represents environmental benefits as it would allow the growth of vegetation and use of flexible materials may also provide significant savings. In addition to this if one nail becomes overstressed for any reason it will not cause failure in the entire system but it would redistribute its overstress to the adjoining nails.

5. CONCLUSIONS

- From the experiment performed on design model using different material, it can be concluded that the present study will lead to an increase in the soil slopes load handling and slope stability
- This research can be used as construction technique that even reflects cost-effective and low environmental impact.
- Maximum stresses are taken up by Expanded metal mesh for all the nail arrangements due to its higher stiffness.

6. CONFLICT OF INTEREST

- The author declares that I have no conflicts of interest.

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A VOTING BASED CLASSIFIER FOR CREDIT CARD FRAUD DETECTION

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ABSTRACT
Credit card fraud is a major problem now days and it is increasing day by day. The reason behind the tremendous increase in the credit card fraud is due to the rise of digital payment systems. Credit card frauds can be detected by previous history of transactions and also by analyzing the real time transaction details. Various simple and hybrid machine learning models are used in the past for detecting credit card fraud. In this paper a voting based classifier which is an ensemble model is used to detect the credit card fraud. Different machine learning classifiers like Naïve Bayes, Decision Tree, Random Forest, K Nearest Neighbors etc. are used in this voting classifier. The results of this study conclude that the ensemble of LR, RF and DT gives best results using hard voting.

Keywords: Credit card fraud, machine learning, Voting Classifier, KNN, DT, Hard Voting, Soft Voting.

I. INTRODUCTION
Credit card fraud is defined as the unauthorized use of other person's card. This type of fraud results in the large financial losses every year. The people are interesting in online shopping and cashless transactions now days. With the increase of interest of people in online and cashless transactions, the fraudulent activities are also increasing day by day. According to Federal Trade Commission, in 2018, they processed 1.4 million fraud reports which results in loss of $1.48 billion. Credit card fraud can be detected by many methods. The purchasing is done by credit card is either physically or virtually. In Physical card purchase, the cardholder presents the card to merchant physically. Here fraudster has to steal the card for attempting a fraud. In the second category which is of virtual card purchase, card is not needed physically. Only some of the important information about the card is needed. Fraudster has to obtain that important information for committing a fraud. Various machine learning algorithms are used in this paper. A voting classifier is used to detect the credit card fraud in this paper. Voting classifier mainly has two types hard voting and soft voting. This paper is mainly organized into sections six sections. The first section gives the introduction about the credit card frauds. The second section discuss about the related works and literature review regarding this problem. The third section gives the details about voting classifier and various machine learning classifier used in this study. In this study random forest, decision tree, Naïve Bayes, K Nearest Neighbors, Logistic Regression and Voting classifiers are used. The fourth section discusses about the experimental setup and dataset used and fifth section contains the results. The last section contains conclusion and future works.

II. RELATED WORK
Ghosh and Reilly used a fraud detection system based on neural network. They used a dataset of Mellon Bank's transactions of 2 months period. Neural network was trained on frauds due to lost cards, application frauds, stolen cards, counterfeit cards, mail order fraud and NRI frauds[1]. Leonard presents a rule based expert system. It helps to alert banks and other financial institutions for the fraudulent activities. It takes data from a real Canadian bank[2]. Chan, Luo, Liang, Lee presented an approach which prevents frauds before the initial use of cards. This approach does not use any real transaction data. They use SVM and ANN for

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investigating the time varying fraud problems[3]. Shen, Tong and Den tested three different classification models: Decision trees, neural networks and logistic regression for their applicability in credit card fraud detection and find that NN and LR performs better than D[4]. Gadi, Wang and Lago used 5 different classification methods for credit card fraud detection: Neural network, Bayesian Networks, Naïve Bayes, Artificial Immune System and Decision trees. They compare these classification models and conclude that DT and AIS are best methods in this experiment[5]. Panigrahi, Kundu, Sural and Majumdar presents a fusion approach using Dempster- Shafer theory, rule based filtering and Bayesian learning which combines the current as well as past behavior[6]. K.K and Chezhian constructs an efficient fraud detection system which taken into account behavior changes by combining classification and clustering techniques and then generate association rules. They use BOAT decision tree classification and K-means clustering technique[7]. Sahin and Duman developed classification models based on ANN and LR for detecting credit card fraud. The transactions are identified as legitimate or normal on the basis of the suspicion score produced by the classifiers[8].Salazar, Sofent, Soriano, Vergara presents an automatic credit card fraud detection data mining technique. It is linear signal processing technique. Discriminant based classifiers and advanced non-Gaussian mixture classification methods are used to classify the fraudulent and non fraudulent transactions[9]. Sahin, Bulkan and Duman used a cost sensitive decision tree approach for fraud detection. It minimizes the sum of misclassification costs. Here misclassification costs are taken as varying[10]. Olszewski presented a unsupervised method for fraud detection which is based on user accounts visualization and threshold type detection. Self organizing maps are employed as visualization technique here[11]. Pozzolo, Boracchi, Caelen, Alippi and Bontempi proposed a realistic fraud detection system. They address that delay in finding accurate labels and the interaction between alerts and supervised information have to considered[12]. Bahnsen, Aouada, Stojanovic, Ottersten proposed a credit card fraud detection system which taken into the account feature engineering strategies. They proposed a new set of features based on analyzing the behavior by expanding the transaction aggregation strategy[13]. Avoyemi, Adentumbi and Olowadara present a comparative analysis of credit card fraud detection using machine learning techniques. The performance of naïve bayes, k-nearest neighbor and logistic regression is evaluated and results show that naïve bayes performs better than other two[14]. Pumsirirat and Yan proposed a deep learning based models for detecting frauds in credit card. They used models of deep Auto-encoder and Restricted Boltzmann machine to find anomalies[15]. Randhawa, Loo, Seera et al. proposed a credit card fraud detection model using adaboost and majority voting and finds that majority voting is giving better results[16]. Kumar, Soundarya, Kavitha, Keerthika Aswini used Random Forest to detect credit card fraud and shows that it gives 90% accuracy[17].Table 1 gives the details about various related works in detecting credit card fraud.

TABLE I: LITERATURE REVIEW

S.No	Title of the Paper	Year	Techniques Used	Results
1	Credit card fraud detection with a neural network	11994	Feed forward neural network with 3 layers	Detected more fraud compared to rule based
2	Personalized approach based on SVM and ANN for detecting credit card fraud	22005	SVM and ANN	ANN has highest training accuracy
3	Credit card fraud detection using Hidden Markov Model	22008	Hidden Markov Model	System accuracy is close to 80%

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4	Boat Adaptive Credit Card Fraud Detection system	22010	K- means clustering and BOAT classification algorithm	High performance than existing decision tree algorithms
5	Detecting credit card fraud by using genetic algorithm and scatter search	22011	Genetic algorithm and scatter search	Performance of existing solution increased by 200%
6	A cost sensitive decision tree approach for fraud detection	22013	Cost sensitive decision tree	Performs better than traditional DT, ANN and SVM
7	Credit card fraud detection and concept-drift adaptation with delayed supervised information	22015	Sliding window approach and Ensemble Approach	Feedback on delayed samples provides precise results
8	Credit card fraud detection using machine learning techniques: A comparative analysis	22017	Naïve bayes classifier, k-nearest neighbor, logistic regression	Naïve bayes performs better than other two
9	Credit card fraud detection using Adaboost and majority voting	22018	Adaboost and Majority Voting	Majority voting is giving better results than Adaboost
10	Credit card fraud detection using Random Forest Algorithm	22019	Random Forest	Gives 90% accuracy
11	Credit card fraud detection using machine learning	22020	Random Forest and Adaboost algorithm	Random forest works better

III. VOTING CLASSIFIER

A voting classifier consists of ensemble of two or more classifiers. The prediction is made by each classifier and then voting based classifier gives the highest majority voting class as output class. In other words voting is the simplest way of combining the predictions from multiple machine learning algorithms. It is mainly of two types: Hard voting and Soft Voting. In a hard voting classifier, predicted output class is the one which has the highest majority of voting. And in the soft voting classifier, predicted output class is the average of the probabilities of all given classes. Various machine learning models for voting classifiers are used in this paper like Random Forest, Decision tree, K Nearest neighbor, Logistic Regression, etc.

Decision Tree: In decision tree model, algorithm is considered to be a decision tree. Decision tree models are used to develop classification systems. These classification systems are able to classify future observations on the basis of a set of decision rules.

Naïve Bayes: It is used for classification of data. The classification is done the basis of Bayes theorem. According to Bayes theorem,

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$$P(A|B) = \frac{P(A|B)P(A)}{P(B)}$$

Here probability of happening of A can we find when B has occurred. A is taken as hypothesis and B is taken as evidence. Features are independent here and they do not affect each other. This is the reason that it is called as naïve.

K- Nearest neighbors: K- nearest neighbor is a classification and regression method. It is a supervised machine learning algorithm. This method stores all the available cases and used to classify new cases based on the similarity with the stored cases.

Logistic Regression: It is a statistical model used to model the probability of any event or class. It uses a logistic function to model a binary dependent variable.

IV. EXPERIMENTAL SETUP

The experiment is performed in Python on Jupyter Notebook 6.0.1. Dataset is taken from Kaggle which contains the transaction of European cardholder done in 2 days in September 2013. It contains total of 284,807 transactions out of which 492 are fraud. 10 folds cross validation is used to carry out the experiment. A voting classifier has been used to find the best results and both the hard voting and soft voting has been performed. The machine learning classifiers used

in the voting classifier are decision tree(DT), Naïve Bayes(NB), Random Forest(RF), K Nearest Neighbor(KNN), Logistic Regression(LR), etc. The performance is evaluated on the base of cross validation score given by the different classifiers.

V. RESULTS

This study used various classifiers like Random Forest, Decision Tree, Naïve Bayes, Logistic Regression, K Nearest Neighbor, Voting Classifer. The cross validation score of each classifier is evaluated using the 10 folds cross validation. The results are compared on the basis of cross validation scores. It is clear from the results that the ensemble of Logistic Regression, Random Forest and Decision Tree using hard voting gives the best results as compared to individual classifiers. There is a slight difference in the score of hard voting and soft voting. Both hard and soft voting gives almost same results. Table II contains the results of individual classifiers and voting classifier respectively.

TABLE II: RESULTS OF INDIVIDUAL CLASSIFIERS

Classifier	**Cross Validation score**	
	Mean	**Standard Deviation**
Logistic Regression	0.967827	0.011632
Random Forest	0.865357	0.116833
K- Nearest Neighbor	0.954398	0.015488
Decision Tree	0.998640	0.000526
Naïve Bayes	0.873654	0.118756

The results of the individual classifiers show that decision tree gives the best cross validation score and random forest has the worst score. Table III contains the cross validation score (mean and standard deviation) when voting classifiers is used. The results shows that the ensemble of LR, RF and DT gives best results using hard voting when voting classifier is used.

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TABLE III: RESULTS USING VOTING CLASSIFIER

Voting Classifier	Hard Voting		Soft Voting	
	Cross Validation score		Cross Validation score	
	Mean	Standard Deviation	Mean	Standard Deviation
LR+RF+NB	0.974399	0.021221	0.974123	0.021601
LR+KNN+NB	0.966183	0.027084	0.965975	0.028373
DT+LR+NB	0.974148	0.021223	0.974324	0.021198
KNN+RF+NB	0.990234	0.008989	0.990584	0.008687
LR+RF+DT	0.999387	0.000124	0.999343	0.000147

VI. CONCLUSION AND FUTURE WORK

Credit card fraud detection is a challenging problem and increasing at a very fast rate due to the rise of digital payment systems. In this paper, voting classifier is used for detecting credit card frauds. Voting classifier is providing better results as compared to individual machine learning classifier. Here in this experiment we use the ensemble of 3 classifiers at a time. In future we can use the ensemble of more than 3 classifiers and check the effect on results.

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AN EMPIRICAL STUDY ON THE FACTORS INFLUENCING WORKING WOMEN'S PREFERENCE FOR ONLINE SHOPPING OF DRESSES IN MUMBAI CITY

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ABSTRACT
Women are known to be fond shoppers of attires and accessories, especially those based in urban set up. more specifically, those who are working. With the evolution of online shopping, which offers safety, variety and trendy ways of shopping, many of the working lot have been offered a time-saving, safe shopping experience in platter. Studies have proved that working women prefer frequent shopping of dresses online through various apps than taking time out of their routine and physically going to shops. With e-commerce paving its way to the retailers, online shopping has become a way of life for most of the Indians especially working women. Indian online market is has grown extensively Main reasons of growing preference for online shopping are internet penetration, increasing number of e-tailors (online retailers), ease of shopping, flexibility in delivery, increasing purchasing power etc. According to Gizmobaba's report online transaction of women has doubled in past two years. As per one Google study, it is expected to drive 25 per cent of the total organized retail sales in India by 2020 and is expected to reach $60 billion in gross merchandising value. This study is an attempt to analyse online attire buying pattern of working women based in Mumbai during work from home period.

Keywords: attire shopping, e-commerce, online shopping, working women, e-tailers.

INTRODUCTION
Women are proven shoppers, be it attire, food or other essentials. Most of the women call "shopping a hobby, where they used to take time out to visit various shops, see, touch and feel every single product/ brand that they buy. Especially, when it comes to clothing and accessories, they, try out various outfits and then buy the product. Internet is redefining the shopping behaviour of people across the globe. It has become a hotbed of advertising, shopping and commercial activity (Rowley, 1998). People's daily life is influenced by internet more so as compared to past (Hsieh et al., 2013). Consumers are getting used to virtual experience from physical experience, adapting to online purchases. According to Lee and Zhang (2002) after e-mail usage, instant messaging and web browsing, online shopping is the third most popular internet activity. The process a customer takes to purchase a service or product over the internet is referred as online shopping (Jusoh & Ling, 2012) where a consumer buys from an online store from home at his/her convenience. Online shopping is growing in India (Suresh & Shashikala, 2011). According to the reports of IAMAI-KPMG[1], the total number of Internet users in India (out of a total population of 1.25 billion) would reach 600 million by 2020. According to PricewaterhouseCoopers[2] report, e-commerce sector in India has grown by 34% (CAGR) since 2009 and was expected to be in the range of USD 60-70 billion by 2019.

Extensive research on attracting and retaining consumers from a consumer-oriented or a technology-oriented view was triggered by the rapid growth of online shopping (Jarvenpaa & Todd, 1996). Examining consumers' prominent beliefs about online shopping, that may influence purchase channel selection is the focus of consumer-oriented view. Predicting consumer acceptance of online shopping by analysing technical specifications of an online store

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is the scope of technology-oriented view. Internet is being used as a channel of information and commerce in the rapidly growing online businesses.

Online shopping an E-Commerce form is on the roar and this trend is accelerating at a fast pace. This form of shopping has altered the perception of the people to shop and made them risk takers in this regard. This study is one of its kind in which the previous literature are studied in exhaustive form and different researcher' side as are put forth. The literature from the past studies was reviewed which impelled the researcher to conclude that the women play a dominant role when it comes to shopping, however in the context of Online shopping they are lagging behind the men. Online shopping proves to be convenient and time saving and no need to travel or wait in queue. They exist all time and they are available anytime and anywhere (Elizabeth Lloyd et. al., 2014). online stores extend consumers with unlimited and affluent information about products and services(Ward and Lee 2000). They furthermore have some online tools to 2 help consumers compare, make a purchase decision among various products and services. In the recent years, online buyers have more control and negotiating power than consumers of retail stores because the online shopping offers more communicating activities between consumers (Kumar and Maan 2014) and online retailers as well as greater accessibility of information about products and services (Delafrooz et. al., 2009).

Trust seems the main factor hindering the women to shop online. Most of the women especially young prefer to shop where there is positive word of mouth. The literature also reveals that the risk factor plays a dominant role in the women mindset due to the technicality of e-shopping sites.

Due to changes in the economic environment, the number of young working women are interested to shop over the internet (Hernandez et. al., 2010). In India, 80% women choose to interact with stylists while buying fashion and lifestyle products through online when given an option (Rajput et. al., 2012). Younger women felt that online shopping is a convenient shopping mode. However, nowadays most of the fashion portals have expert stylists who 3 help them to choose a product which perfectly suits their personality, hence making their online shopping experience much more stress-free and organized (Passyn et. al., 2011).

REVIEW OF LITERATURE

Marketing to women delivers a better return on the marketing dollar through both higher customer acquisition and greater customer retention. Because women are more inclined to long term brand relationships, enhanced loyalty means every marketing dollar invested in acquiring female customers' results in a higher retention rate (Barletta, 2003).

Studies on the women buying behavior dimensions suggest that Females are more pro-environmental while shopping than their male counterparts (Zelezny et al., 2000). Farhurst et al., (2007) concluded from their study that word of mouth from consumer families and friends can influence decision style, as what and where to buy.

Park and Lennon (2004) concluded that television advertisements can highly influence women buying behaviours along with information received from their friends (Sheers 2007), as females in comparison to males are highly knowledgeable about price and types of stores (Scheers, 2007), and hence this knowledge can influence the retailer management strategies.

Kassarjian (1981) has implied a positive relationship between socioeconomic status and purchasing involvement, and in fact describes his "low- low involvement" consumer as being a member of the lower socioeconomic class. This would lead to the assumption that higher income might be associated with higher purchasing involvement. The positive relation- ship found between income and search effort (Clax- ton, Fry, and Portis 1974) Newman and

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Staelin(1972) would provide some indirect support for this notion. However, it would seem that the marginal utility of purchasing involvement would be low for high in- come groups, since they can purchase almost anything they want and value their free time more than the money that they could save by wise purchasing. Thus it seems that a curvilinear relationship could be expected between purchasing involvement and income, with moderate levels of income producing the highest levels of purchasing involvement and low and high in- come groups relatively less involved.

RESEARCH METHODOLOGY

This research follows a relative logical strategy and attempts to observe the apparel shopping patterns and determinants of working women of various age groups of women during "work from home period" residing in select suburbs of Mumbai City.

AREA OF STUDY

Select suburbs of Mumbai (Mulund, Ghatkopar, Chembur and Matunga)

Primary Source

A purposive sampling method was adopted to elicit information from among working women in select suburbs of Mumbai City. The data collected by administering questionnaires through google forms to 150 women. Out of the total 100 surveys, some were incomplete and some were filled in an incorrect manner. Excluding these flawed surveys, 132 complete surveys were available to conduct the analysis.

Period of data collection

July 1, 2020 to July 31, 2020

Secondary Source

i. Data analysis

To evaluate the data, analysis is carried out, to acquire the results, a descriptive technique is used and inferential statistics such as Chi-Square test of association was employed.

OBJECTIVE OF THE STUDY

The objectives of the current study are –

1. To ascertain the perception of working womens' shopping of attires online
2. To assess the factors influencing the respondents to adopt to shopping of dresses online
3. To ascertain the level of satisfaction of respondents on shopping dresses online.

Limitations of the Study

The following are the limitations of the present study:

1. The study covers the limited geographical area of select suburbs of Mumbai City. So, the result of the study may not be justified to other metros

2. The targeted population of the study is only the parents whose daughters of the age group 20 to 50 years old.

Current study is focused on highlighting how the shopping pattern of dresses of working women

RESULTS AND DISCUSSION

1. Demographic profile of the respondents

Figure 1 Age wise distribution of the respondents who shop dresses from online portals during work from home period

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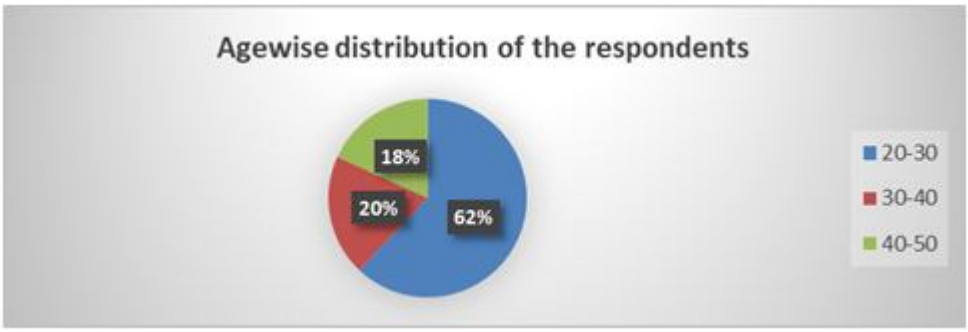
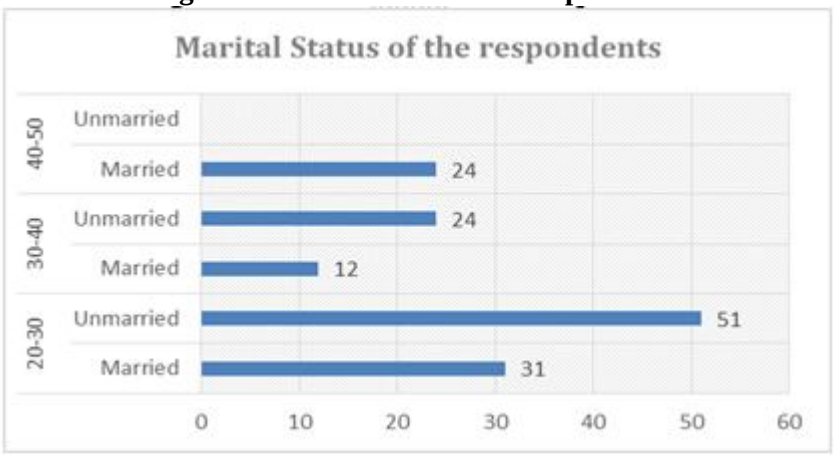


Source: Analyses were based on the sample surveyed

2. Marital status of the respondents

Figure 2 Marital status of the respondents



Source: Analyses were based on the sample surveyed

Hypotheses Testing Using Chi-square Analysis

H0:There is no significant impact of respondents' income on their online shopping of attire.

Table 1: Chi Square analysis to test the significant association of respondents' income on their online shopping habit of dresses.

Income	Online shopping of dresses		Total	Chi-Square	Df	P value
	Yes	No				
Below2500	2	0	2	13.39	6	.0.05
2500-5000	20	22	42			
5000-10000	42	1	43			
10000-15000	27	0	27			
15000-20000	4	0	4			
25000-30000	3	10	13			
Above 30000	1	0	1			
Total	99	33	132			

Source: Analyses were based on the sample surveyed

From the above table it is observed that $p<0.05$, income plays an important role in the adoption of online shopping of dresses and proved that this is positively correlated with the income level of the respondent

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Table 4 Educational profile and their frequency of shopping dresses online while on work from home period

Education	frequency of shopping dresses online while on work from home period						
	Fortnightly	Monthly once	Once in two Months	Total	Chi-Square	Df	P value
High school	6	2	3	11	26.623	7	.006
UG	22	13	25	63			
PG	3	5	19	58			
Total	31	20	47	132			

Source: Analyses were based on the sample surveyed

From the above table it is observed that $p<0.05$, education also plays an significant role in the frquency of online shopping of dresses by working women during "work from home" period and proved that this is positively correlated with level of the respondent.

Respondents' perception about online shooping of dresses during work from home period

1. **Figure 3 Respondents reasons for preferring to shop dresses online**

Table 6 Reliability Statistics for preference factor

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No of Items
.649	.692	6

Source: Analyses were based on the sample surveyed

Table 7 Inter Correlation Matrix for preference factor

Inter-Item Correlation Matrix							
Factors	Saves time	Saves travel	Variety of brands offered	Feel it safe and reliable	Offers convenience of getting delivered at home	Easy return and refund	24*7 access for buying, returning etc
Saves time	1.000	.677	.315	.374	.158	.355	
Saves travel	.777	1.000	.238	.372	-.011	.218	
Variety of brands offered	.415	.238	1.000	.092	.121	.197	
Feel it safe and reliable	.474	.372	.092	1.000	.227	.254	
Offers convenience of getting delivered at home	.157	-.011	.121	.227	1.000	.205	
Easy return and refund	0.81	.218	.197	.254	.205	1.000	
24*7 access for buying, returning etc	0.51	0.362	0.492	0.326	0.256	0.326	1.000

Source: Analyses were based on the sample surveyed

Over 80 percent of the respondents prefer shopping dresses online as it 24*7 access, time saving and its easy to learn and use the app. While over 33 percent of them opined that they use online ways to shop dresses because of propmt service, ease of transactions, high reliability and simple service.

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Cronbach's reiabilty show the factors resonsible for the popularity of online shopping of dresses by women. These six factors have contributed greatly to the popularity of online shopping of dresses habits among the respondents of the are.

Table 8 depicts the problemsor ceoncerns of digital shopping of attires as opined by the respondentsas perceived by them

Table-8 Accessibility factors

Concerns of the users	No of respondents
Safety of personal information and hacking	26
Worried about security IN transaction	27
Digital battery consumption of the apps	70
Customer queries getting resolved promptly	69

Source: Analyses were based on the sample surveyed

Over 70 percent of the respondents were worried about their safety and personal information getting leaked, how secure would their transactions be, avoiding getting hacked and dicsconnection of network or the specific transaction while transacting. They were a;so concerned about the receptivity of the services and how soon their queries would addressed by the customer care executives.

Table 9 Reliability Statistics for Accessibility factors

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No of Items
.710	.716	4

Source: Analyses were based on the sample surveyed

Their satisfaction parameters could be measured by frequency of usage. About 51 percent of them put through dress shopping transactions using their mobile phones everyday. While over forty per cent of them used it several times a day and they opine that ease of use, time saving factor and user friendly are the aspect that made them use online shopping apps.

The reliability statistics table

Table 10 Inter-Item Correlation Matrix for Risk factors

Factors	Safety of personal information and Hacking	Worried about security IN transaction	Digital battery consumption of the apps	Customer queries getting resolved promptly
Safety of personal information and hacking	1.000	.684	.376	.374
Worried about security IN transaction	.684	1.000	.238	.272
Digital battery consumption of the apps	.376	.238	1.000	.374
Customer queries getting resolved promptly	.374	.272	.374	1.000

Source: Analyses were based on the sample surveyed

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Table 11 Reliability Statistics for Risk factors

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No of Items
.663	.675	2

Source: Analyses were based on the sample surveyed

Table 12 Reliability Statistics for Receptive factor

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.747	.731	4

Source: Analyses were based on the sample surveyed

Table 13 Item-Total Statistics for Receptive factor

Factors	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Safety of personal information and hacking	11.3700	2.417	.654	.623	.620
Worried about security IN transaction	11.3600	2.374	.717	.699	.583
Digital battery consumption of the apps	11.6400	2.293	.652	.463	.619
Customer queries getting resolved promptly	12.0400	3.635	.182	.096	.846

Source: Analyses were based on the sample surveyed

Table 14 Reliability Statistics for accessibility

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No of Items
.744	.744	7

Source: Analyses were based on the sample surveyed

Table 15 Item-Total Statistics for availability

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
q21	20.4600	5.705	.491	.356	.706
q22	20.4600	5.867	.484	.449	.708
q23	20.4700	5.646	.615	.457	.677
q24	20.9000	6.394	.367	.219	.733
q25	21.0600	6.340	.397	.194	.727
q26	21.1200	6.187	.493	.292	.707
q27	21.0300	6.474	.369	.210	.732

Source: Analyses were based on the sample surveyed

q21 --wide range of anytime, anywhere access to all brands, any type of fashion/ fabric

q22 --wide range of anytime, anywhere access to all brands, any type of fashion/ fabric

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q23 --Bank providing information /data related to the usage of net banking

q24 --Apps/ portals provides right details associated with its services related to the usage

q25 --Address security concerns by outlining security measures related to the usage of online shopping apps or portals

q26- Popular colourful advertisements, based on consumer preferences, makes it easy to locate the required kind of dress

q27 Websites that allow an easy visualization related to the usage of Apps for shopping and payment

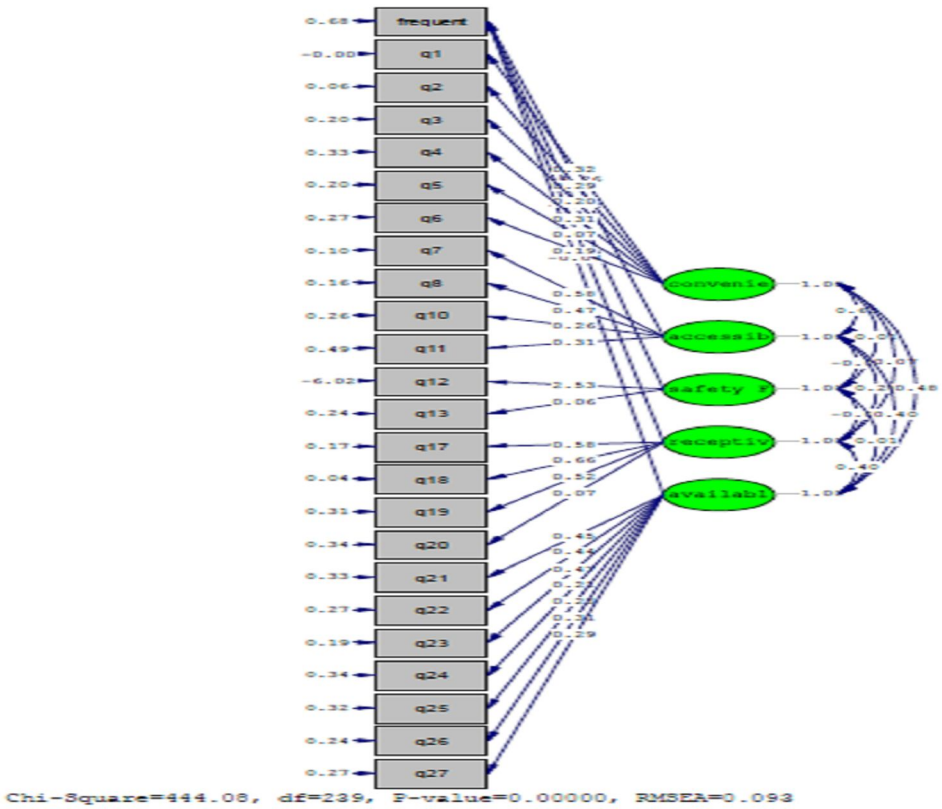
Table 16 CRONBACH'S RELIABILITY TEST

S.No	Groups	Cronbach's Alpha
1	Convenience	0. 637
2	Accessibility	0.610
3	Risk	0.774
4	Receptive	0.763
5	Available	0.824

Source: Analyses were based on the sample surveyed

Table 16 depicts that customer satisafaction is based on the above four factors as the Cronbach's Alpha is above 65% for Convenience, Accessibility, Risk, Receptive, Available.

Figure -5 path diagram for respondents shopping of dresses online during work from home period



Source: Analyses were based on the sample surveyed

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Table -17 Chi-Square Test of Model Fit

Value	444.08
Degrees of Freedom	239
P-Value	0.00
χ^2 /df	1.86

Source: Analyses were based on the sample surveyed

The null hypothesis is that there is no difference between the patterns observed in these data and the model specified. So, unlike many cases where you are hoping to reject the null hypothesis, in this case, the null hypothesis cannot be rejected as the chi-square value above, this model is acceptable.

The Chi-Square Test shows the model fit and p value shows its signifinance level, Although the seems good, it is also appropriate to check the value of Chi-Square divided by df (Wheaton, Muthen, Alwin and Summers,1977) as the Chi-Square statistic is particularly sensitive to sample sizes (that is, the probability of model rejection increases with increasing sample size, even if the model is minimally false), and hence chi-square divided by degrees of freedom is suggested as a better fit metric (Bentler and Bonnett, 1980). It is recommended that this metric not exceed five for models with good fit (Bentler, 1989). For the current CFA model, as shown in above table Chi-Square is 1.86, suggesting acceptable model fit.

Another measure of goodness of fit is the root mean square error of approximation (RMSEA).

Table-18 RMSEA Test of Model Fit

Estimate	0.093	
90 Percent C.I.	0.079	0.11
Probability RMSEA	< 0.05	0.00

Source: Analyses were based on the sample surveyed

An acceptable model should have an RMSEA less than .05. You can see above that the estimate for RMSEA is .093, the 90 percent confidence interval is 0.11, .079 and the probability that the population RMSEA is less than .05.Again, consistent with our chi-square, the model appears to fit. This can be interpreted as meaning that the model explains the correlation to within an average error of 0.093 (Hu and Bentler, 1990). Hence the model shows an overall acceptable fit. The model is an over identified model.

Table-19 Inter Construct Correlation Matrix

	Convenience	**Accessibility**	**Risk**	**Receptive**	**Available**
Convenience	1				
Accessibility	0.66	1			
Risk	0.03	0	1		
Receptive	0.08	0.24	-0.04	1	
Available	0.49	0.3	0.01	0.52	1

Source: Analyses were based on the sample surveyed

Table 19 depicts the correlation matrix of independent the hypotheses is tested relating to the pattern of causal structure linking several variables that bear on the construct of usage intention of internet banking. Usage Intention is influenced by the Convenience, Accessibility, Risk, Receptive andAvailable on online attire shopping.

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Table-20 Hypotheses testing of working womens' preferences for shopping dresses online

Hypotheses	β	Supported/ not supported
Convenience related to the usage of net banking	-0.36*	Supported
Accessibility related to the usage of net banking	-0.26*	Supported
Risk related to the usage of net banking	0.47*	Supported
Receptive related to the usage of net banking	-0.039*	Supported
Available related to the usage of net banking	0.59*	Supported

*Significant at 0.01 level Source: Analyses were based on the sample surveyed

All hypotheses are accepted. Online shopping of dresses of women is influenced by Convenience (β=- 0.36), Accessibility (β=0.26), Risk (β=0.47), Receptive (β=0.039), and Available (β=0.59).

Hypotheses	Latent construct	β	Supported/ not supported
Saves time	Convenience	0.43*	supported
Saves travel	Convenience	0.38*	supported
Variety of brands offered	Convenience	0.20*	supported
Feel it safe and reliable	Convenience	0.31*	supported
Offers convenience of getting delivered at home	Convenience	0.071*	supported
Easy return and refund	Convenience	0.19*	supported
No need to preserve dockets/ receipts	Accessibility	0.58*	supported
Customer review	Accessibility	0.47*	supported
Saves travel	Accessibility	0.26*	supported
Variety of brands offered	Accessibility	0.31*	supported
Free of unsafe personal information related to the usage of net banking for payment	Risk	2.53*	supported
Worried about security IN transaction related to the usage of net banking	Risk	0.063*	supported
online shopping inquiries receive responses within the stipulated turnaround time related to the usage of net banking	Receptive	0.61*	supported
Employees are knowledgeable to queries related to the shopping isuues	Receptive	0.68*	supported
customer concerns related to the usage of net banking	Receptive	0.57*	supported
flexible to customers' need related to the usage of apps/ portals	Receptive	0.072*	supported
a high number of software's related to the usage of net banking while payment	Receptive	0.47*	supported

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gateways are used			
wide range of anytime, anywhere access to all brands, any type of fashion/ fabric	Available	0.47*	supported
Bank providing information /data related to the usage of net banking	Availability	0.49*	supported
Apps/ portals provides right details associated with its services related to the usage	Availability	0.24*	supported
Address security concerns by outlining security measures related to the usage of online shopping apps or portals	Availability	0.26*	supported
Popular colorful advertisements, based on consumer preferences, makes it easy to locate the required kind of dress	Availability	0.33*	supported
Websites that allow an easy visualization related to the usage of Apps for shopping and payment	Availability	0.31*	supported

*Significant at 0.01 level Source: Analyses were based on the sample surveyed

All hypotheses are accepted. Consumer intention to use online shopping portals/ apps for dresses is influenced by Convenience factor which contains 24h Accessability(β=0.43), travel saving (β=0.38), prompt service (β= 0.20), speedy retrieval of account information services(β=0.31),;easy and quick (β=0.071) and reliable (β=0.19). In according to accessibility is influenced by not much training (β=0.58), not require a mental effort(β=0.47), easy learning (β=0.26), and Simpler/clearer service (β=0.31). Under risk factors safe personel information (β= 2.53),security in transaction (β=0.063). Under Receptive factor Mobile banking inquiries receive responses within the stipulated turnaround time (β=0.61), Employees are knowledgeable to queries(β=0.68), customer concerns (β=0.57) and flexible to customers' need (β=0.072). In respective to availability factor, a high number of software's (β=0.47), wide range of anytime, anywhere access to all brands, any type of fashion/ fabric, (β=0.47), Bank providing information /data(β=0.49), Apps/ portals provides right details associated with its services related to the usage (β=0.24), Address security concerns by outlining security measures (β=0.26), Address security concerns by outlining security measures related to the usage of online shopping apps or portals.(β= 0.33) and Websites that allow an easy visualization related to the usage of Apps for shopping and payment (β=.31).

To sum up, the research was carried to have better understanding on the driving factors that influence the usage of online shopping of dresses by women . Here we classified the factors under five factors say convenience, accessibility, risk, receptive and availablility which helps to judge the intensity to adopt net banking were emprically validated with model fit for online shopping of dresses by women during work from home period was successfully verified.

CONCLUSION

The empirical results of the current study show that there is a direct relationship between online shopping habits of dresses of women and service quality, customer perception and satisfaction of the customers (in a metro city --Mumbai) dimensions and customer satisfaction with the online way . An understanding of the factors, revealed in the study, though there were security concerns, the advantages were more prominent than the drawbacks. This has led to the popularity of usage of online apps and portal for shopping by working women. Surprisingly, the

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trend to shop attires and the reasons for them to go in for online shopping of dresses did not go down, even though they are not going out much.

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AN IMPLEMENTATION OF BLOCKCHAIN AND MACHINE LEARNING ALGORITHMS TO REDUCING THE FAKE NEWS IN TWITTER

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ABSTRACT
The problem of fake news gets worse every day and has very damaging effects in various fields such as politics. Due to the availability of social media, it is very easy to spread fake news and it becomes difficult to identify the culprit. Since the culprit of such action has not been identified, the problem remains. Therefore, it is necessary to identify the source or origin of such fake news in order to take the necessary actions. With microblogging platforms like Facebook, Instagram, Pinterest, Twittter, and Tumblr, users can write new posts that are publicly visible. Twitter has distinguished itself as an overwhelming press team providing information to the global..It is Not uncommon for users of this website indicate an advanced feature events such as natural disasters, political events, etc. Because of the popularity of Twitter, this led to the spread of false positive data on the accused. This in-depth program aims to reduce the spread of bugs on Twitter through an algorithm based blokcheyna and establish algorithms and machine learning. "Tweet" is generated based on the node checks blockchain. Commission acts on the basis of the concept of tweets.

Keywords: Blockchain, Microblogging, Politics, Sentimental Analysis, Tweet, Twitter.

I. INTRODUCTION
Based on the concept of blockchain in social media, our network uses the security, instability and transparency of blockchain to build trust between shared messages. We will focus on speculation that may be posted in selected areas of the community that verify the authenticity of other messages among users. For many of this generation, social media offers all kinds of world and local news. But this does not work if the person / organization uses him or her to spread false news. Because media click stories take less time to spread exponentially. The news goes viral around the world in a matter of days. These organizations allow other people to take advantage of people's desire to share interesting news without knowing the facts or the consequences.

Social media was interested in the introduction in 1840 of the Telegram to the United States, which united the country. Since then, the use of social networks is increasing daily [1].

The growing popularity of Twitter on social media is the reason why spammers spread false information. Therefore, Twitter needs to be protected from fraudulent information providers or spammers. Companies are working to fix fake tweets to make Twitter safer. For example, Trend Micro filters out unwanted URLs using the Web Replication Technology (WRP) encoding filter.

Due to time constraints, the URL could not be written before it reached the user. To solve this problem, researchers used algorithms based on the law to extract unwanted theta [7]. Because industries that rely on the media to run their business, having spam tweets is a major security breach. This necessitated finding ways to reduce and download spam. False stories are meant to mislead readers, and their circulation today is eighty-five percent more than it was in 2017. [8]

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There are many algorithms to detect inaccurate information, but it is very difficult to know the origin or origin of these records. So acquit the guilty. Access to social networks and open access to social networks have exacerbated this problem. Anyone can access the media, and thus the spread of false news quickly leads to more serious casualties. Because anyone can post on social media, the amount of false information is growing rapidly. The main purpose of this article is to study the literature on various forms and search for these styles. Once again, we have identified shortcomings and created a new type of problem-solving, carefully monitoring and evaluating text messages using blockchain technology. We believe that as soon as the origin of this type of untruth becomes known, the necessary steps can be taken to find it and the problem is gradually solved. Inspired by all the questions in this article, the goal is to reduce the spread of false news on Twitter with the blockchain Proof of Work (PoW) algorithm built into group algorithms and machine learning. .

II. RELATED WORK

There are a number of research studies on the discovery of lies in social media, other research studies have also used the blockchain approach for their own sake [7]. In a research study, Guild examined the use of different methods of false perception [8].

One search engine used the classic Naive Bayesian classifier to display incorrect text messages [9]. In the search study, the non-correlated non-K algorithm was used to compare faulty messages as reliable information [10].

Youngkyung Seo, Deokjin Seo, and Chang-Sung Jeong set the example by looking at false stories using storytelling. Shivam B. Parikh and Pradep K. Atreus conducted color studies to expose false stories [12].

In search of a veeter classifier for technological improvements [13].

Kai Shu, Huang Liu and Suhang Wang developed data with real knowledge [15]. In two customer interviews, they delivered two messages (false and real) [20]. One meeting had experienced clients (who easily see false news), and the other meeting was false (usually relying on false positives) [16]. They conducted similar surveys of these customer groups based on the strengths of those who are open and honest. Experiments showed that they were able to detect color mismatch messages from real text messages [18].

The authors have developed a new way of learning-finding the myths that are associated with this news story with high-profile sites. They made their contribution in the Facebook Messenger chat and approved it with the help of the program '. is true and shows an analysis of 81.7% of the results is a false conclusion [19].

Shaban Shabani; Maria Sokhn suspected fraud and provided the information available, promoting advice that evaluates public safety groups and considers whether public information is required or not.

Some developers have recently become addicted to the blockchain and have taken a different approach. For example, Shitang Yu; Bo Zhang; Zhou Shao and others created a character quo with a blockchain that surpassed the old version. They used the compliance agreement of the PBFT-DPOC agreement to understand the self-autonomy of electronic devices.

III. PROPOSED METHOD

When a user sends a tweet and accesses a Twitter server, the tweet is sent to the study section of the machine that converts the information into a political and apolitical message. Tweets that are advertised as non-political are advertised without continuous advertising or tweets. If the message is classified as a political message, it is displayed according to its hearing and is

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determined by the weight of the value. In the case of a tweet that is a period of time, the threshold is set by dividing the number of active N N sites in the blockchain area by 2, which is H. If 50% of the names agree that the tweet is true, it is considered reliable. Part of the threat tweet time - 25%. For example, imagine a tweet about someone's death. The tweet is then sent to the blockchain control node with a threshold set at the previous level. The control node sends a tweet to all corresponding nodes. Nodes then intensify the tweet and mark it as clear or unambiguous. Then they put the tweet and its digital signature on the blockchain. The nodes referred to here are personal or system nodes and false alarms that report information capabilities in real time. After a while, the control node touches the string. When the day of deportation arrives, the tlog is released. If the reliability number is below the threshold, the tweet will remain unsolicited and the user's role in disseminating false information will be announced on Twitter. The full functionality of the described mode is shown in Figure 1 in the architecture diagram.

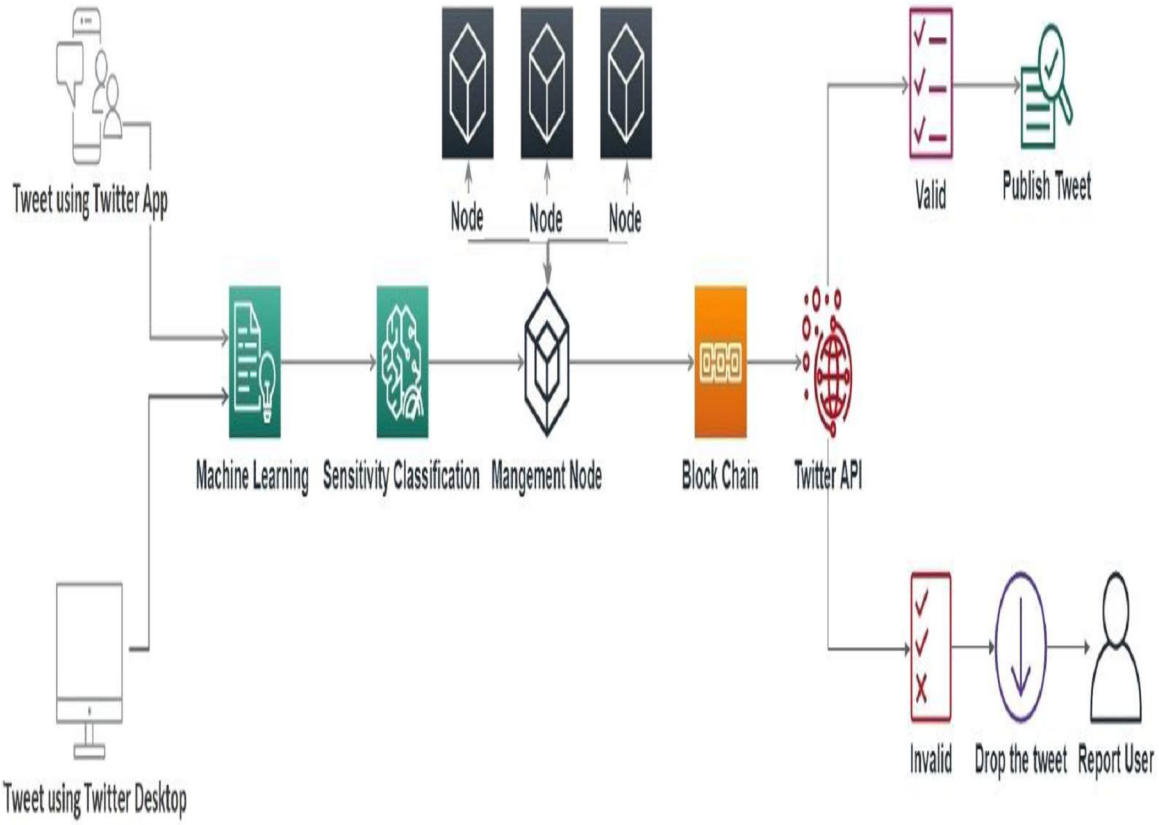

Fig. 1(a). Architecture diagram of the proposed system using blockchain

OBTAINING AND CLASSIFYING TWEETS

The experimental methods collected by the experiments were integrated using Python messaging using the Twitter library. Tweets are divided into political and non-political using machine learning algorithms designed using the same custom planning API. The data is generated as colored messages and is shown in Figure 3. The internal content is sorted according to the feel of the tweet and transferred to the blockchain authorization. In this program, the sound of a tweet is read using search terms that search for complex words, such as death, funeral, death, and so on. Based on a word list, and it certainly comes back when there are words in the description.

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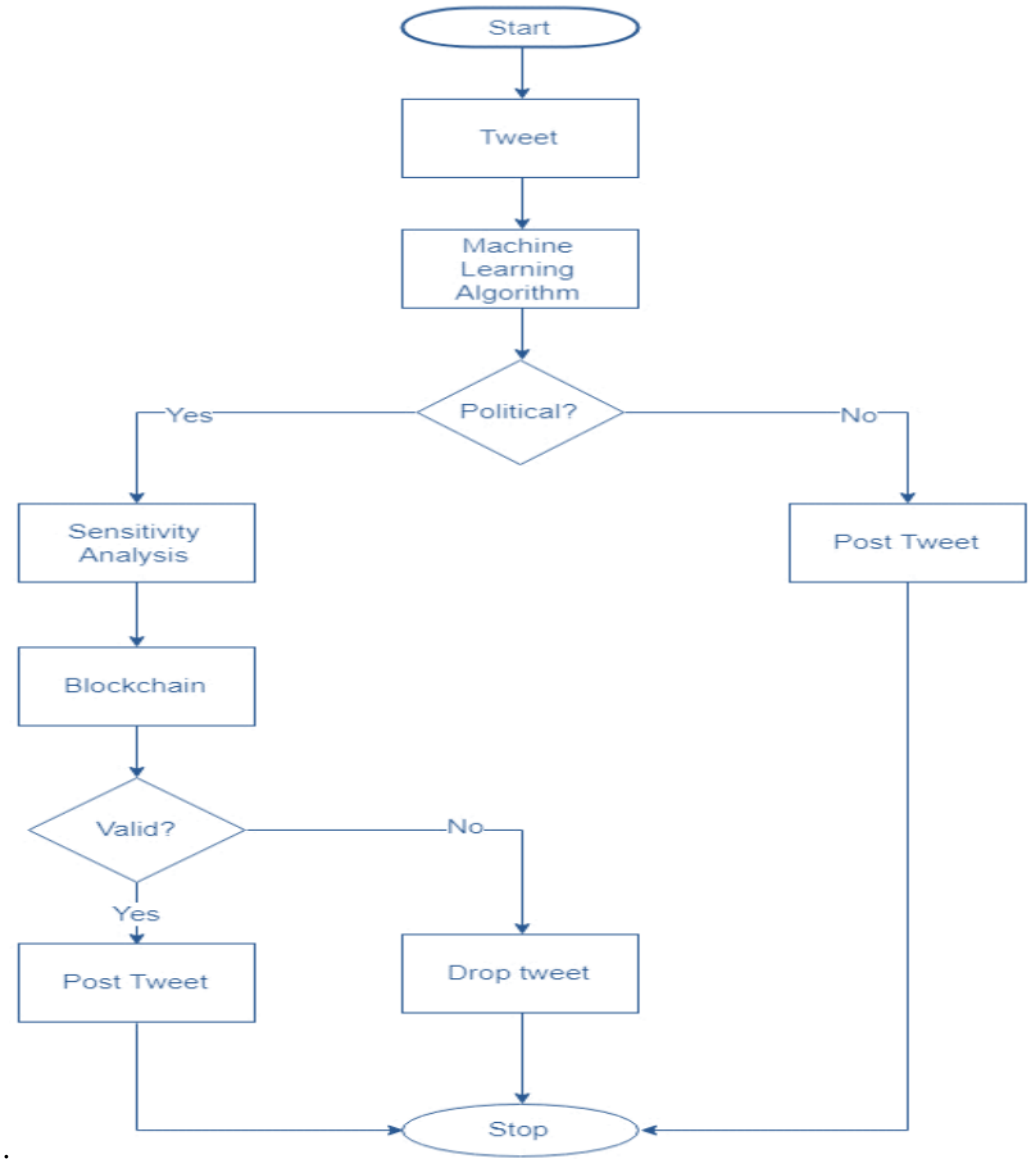

Fig 1(b). Working model of Proposed Method

IV. BLOCKCHAIN - PROOF OF WORK

These strategies are used to increase sales before adding them to the blockchain. This saves the log entry for all exchanges taking place. The valve will be designed for this information, and the miner will add to the curtain after adjusting the hash manual [11]. Bitcoin-based cryptographic methods are difficult to adapt due to the built-in protection against joint attacks, due to the large amount of pressure required to adjust the hash value [12].

Blockchain Buildings

The site is hosted by Node JS, which uses blockchain to interact with transparent, crypto-js, body-parser, ws (WebSocket) and file system library. It is the launch of HTTP and P2P services from two different angles. The HTTP service is used to communicate between a user and a node, while the P2P service is used to communicate between that node. When the server starts, the first block with this index, followed by the hash, timestamp, data, hash, and digital

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signature, enter the blockchain as parliament. The subscription sends all tweets to the appointed manager. Blockchain browsers use web links to interact with each other. Once the name is intended for management, it begins to interpret the tweet and then develops a broker with cut-out data and a digital signature of the names. This section is attached to the blockchain.

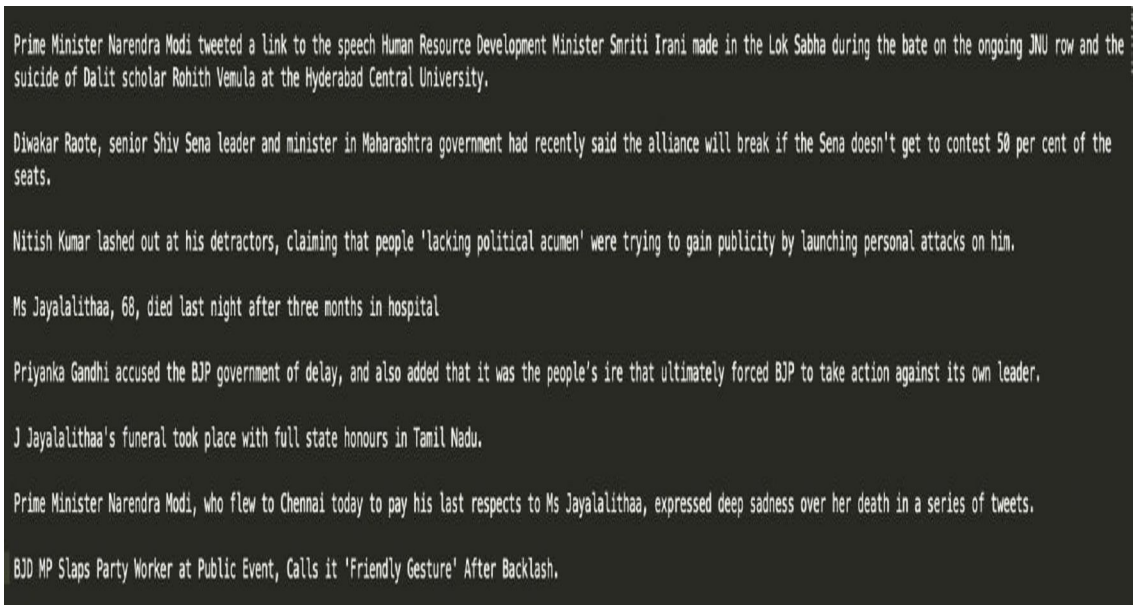

Fig 2. Loading of Sample Dataset

Figure 3 shows the tweet that was added to the blockchain after using node A. The cover is then sent to all connected nodes. Any node can save the lock and confirm the message as well. Figure 4 shows that Tweets are transmitted from node A to node B. After a while, the control node creates a chain and sends its capture and operation to the Twitter server.

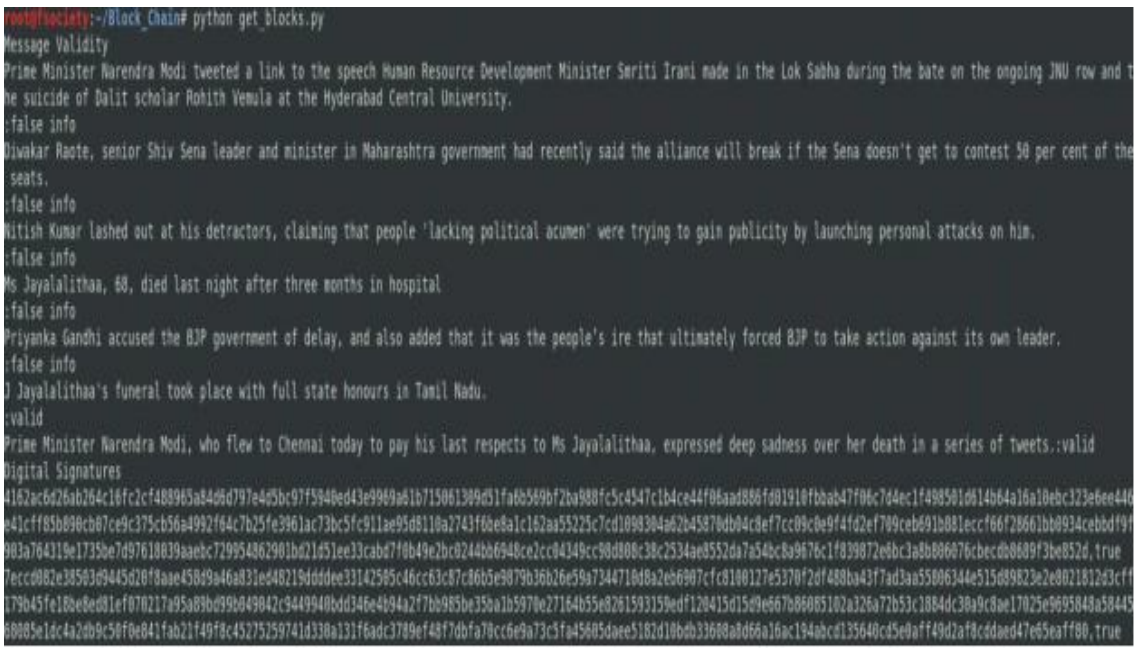

Fig. 3. Validation Message after broadcast by Node A

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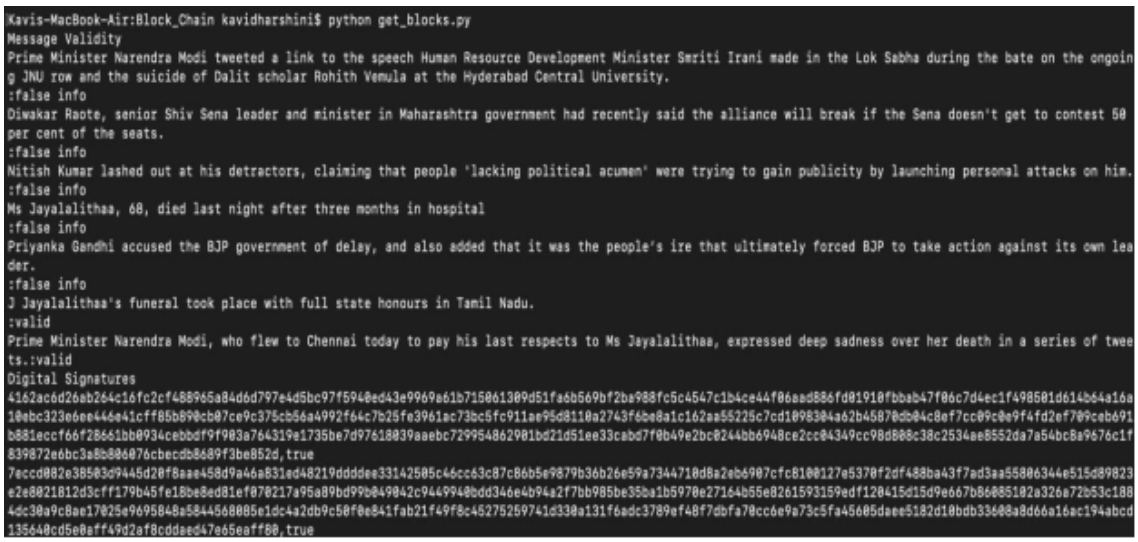

Fig. 4. Messages retrieved at Node B

WORKFLOW STEPS

Step- 1: Retrieve the Tweets from Twitter using the Python library.

Step- 2: Tweet the custom parallel authorization manager to classify it as Non-political and political.

Step- 3: Send the tweet as soon as it seems downloaded using the Tweepy Python library.

Step- 4: Insert the tweet into the sensitivity analysis algorithm and click on the tweet with the threshold from the sensor.

Step- 5: Tweet the Blockchain Nodes.

Step- 6: When the time is up, the blockchain nodes resend the the reliability of the tweet, as shown in Figure 5.

Step- 7: Post the tweet if it's valid by nodding using the Tweepy Python library. This is shown in Figure 6.

Step- 8: If the nodes say it is a fake, delete the tweet and warn the user on Twitter.



Fig. 5. Validation Result of the System

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Fig. 6. Server posted the Tweet after validation

V. CONCLUSION

The aim of the current investigation was to investigate the use of a new blockchain-based algorithm to detect and prevent fake messages and misleading information on Twitter. In this study, I presented how the blockchain consensus algorithm Proof-of-Work (PoW) as well as classification and machine learning algorithms work. Extensive experiments with the data set collected on Twitter have shown that the system can prevent the spread of fake news better than the methods described in the literature.

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BUILDING CAPACITY THROUGH INCREMENTAL LEARNING APPROACH (ILA) BY POSHAN ABHIYAAN IN NORTH LAKHIMPUR, ASSAM

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ABSTRACT

A key programme pillar under the POSHAN Abhiyaan is an innovative learning-by-doing approach called the Incremental Learning Approach (ILA). The approach aims at building the capacity and motivation of program functionaries, which is critical for effective service delivery and behaviour change at the community level. POSHAN Abhiyaan aims to reduce malnutrition, through a life-cycle concept, adopting a synergized and result-oriented approach. Implemented by the Ministry of Women and Child Development (MWCD), Government of India, the target of the mission is to bring down stunting in children 0-6 years of age from 38.4% to 25% by 2022. It also aims to reduce anaemia among women and adolescent girls in the age group of 15-49 years and reduce low birth weight. In this regards the District Social welfare office of North Lakhimpur, Assam in collaboration with Department of Home Science, North Lakhimpur College organized an Incremental Learning approach (ILA) training for the ICDS officials like the supervisor, Block Coordinator and Project assistant from different nine blocks of North Lakhimpur, Assam. Total participants for the training programme were 113 and the duration of the training was for four day. The ILA training framed some modules which focus on different contents like maternal, child health and nutrition umbrella under the POSHAN Abhiyaan. In order to make these sessions interactive and interesting, the experts used different participatory methods of training, such as role-play, group discussion, and periodic question and answer session. At the end of the training they were evaluated through an examination and the feedback shows a positive outcome. ILA has resulted in greater satisfaction among the participants as well as increased engagement during the training. Findings highlighted the perception of frontline functionaries in terms of the impact of these training on their day-to-day work. The participants felt that there has been an improvement in terms of clarity on the subject matter, their approach to home visits, and perceived effectiveness of their counselling to the beneficiaries.

Keywords: ICDS, ILA, Malnutrition, Poshan Abhiyaan,

Objectives of the paper

To enumerate the concept of ILA

To organized and evaluate the ILA training

INTRODUCTION

India embarked on an ambitious effort in 2018 – the Prime Minister's Overarching Scheme for Holistic Nourishment called POSHAN Abhiyaan -- to address multiple forms of malnutrition. Recognizing that malnutrition levels in India are high and have been slow to change over the last decade, this National Nutrition Mission attempts to address key essential components recognized to be critical in the fight against malnutrition. This is a flagship programme of the Ministry of Women and Child Development (MWCD), Government of India, which ensures convergence with various programmes i.e., Anganwadi Services.

The vision of Poshan Abhiyaan is to ensure attainment of malnutrition free India by 2022. The objective of POSHAN Abhiyaan is to reduce stunting in identified Districts of India with the

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highest malnutrition burden by improving the utilization of key Anganwadi Services and improving the quality of Anganwadi Services delivery. Its aim to ensure holistic development and adequate nutrition for pregnant women, mothers and children.

Poshan Abhiyaan envisages establishing a system where programme functionaries will become more effective to plan and execute each task correctly and consistently through methodical, ongoing capacity building, called **'Incremental Learning approach (ILA)'**. Such a system use opportunities in the form of existing supervisory interactions at different levels, through which practical and guided learning may be accomplished.

The proposed system envisages breaking down the total learning agenda into small portions of doable actions as the range of skills and tasks to be learnt is quite substantial, and since adults naturally learn by doing rather than through theory alone. The approach is to build incrementally on small amounts of learning at a time, until all skills, understanding and actions have been put into regular practice, and have been internalized by the functionaries and a supportive supervisory mechanism is put in place.

The ILA trainings are delivered in a cascade from state to sector level by the ICDS officials, and supervisors. The approach aims to create 'ongoing learning platforms' for field functionaries, where the face-to-face sessions help them imbibe and apply new knowledge to their day-to-day work, with time to reflect on whether and how the content of the training was useful in improving services.

The programme

- **Objectives:** The specific objectives of the ILA are:

o Build skills based on understanding of priorities among frontline workers, through a learning-by-doing approach;

o Strengthen supervisory structures and skills through a similar approach;

o Enable coordinated functioning of ICDS and health programmes to achieve common goals.

- **Key elements of the ILA**

o Structured supervisory interactions for ongoing learning, planning and review;

o Planned learning agenda with clearly defined outputs and outcomes;

o Use of evidence, for learning and improving performance;

o Mechanisms for enabling convergent actions between ICDS and health programmes;

o External facilitators/ resource persons

o Cascading system of controlled monthly inputs

o Technical and training responsibilities

o Administrative and managerial responsibilities

Thematic Content: ILA modules

The content focuses on the maternal, child health and nutrition umbrella under the POSHAN Abhiyaan. These topics have been organized in thematic modules or flipbooks, which contain detailed technical information related to each topic. A total of 21 such modules (Table 1) have been developed so far in Hindi, English, Marathi and Telugu. The key feature of these modules is the simple manner in which the technical information is explained. It also addresses locally prevalent myths and misconceptions. For the trainings at state and district level, a triad of

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modules on similar themes is covered. However, a single module per session is covered for the block and the sector level trainings.

An illustrated list of these 21 modules is shown in the table below.

Table 1: ILA MODULES

Modules	Topics
1.	Why this monthly meeting?
2.	Making or updating home visit planner & initiating home visits
3.	Planning and organizing Community Based Events at AWC
4.	Observing breastfeeding in newborn babies – Why and How?
5.	Identification and care of a weak newborn baby
6.	Complementary feeding: diet diversity
7.	Preventing anemia in women
8.	Assessment of growth in children
9.	Ensuring complementary feeding improves over time
10.	Ensuring exclusive breastfeeding
11.	Care of the weak newborn – How many weak babies are we missing?
12.	How to ensure timely initiation of complementary feeding?
13.	Identifying and preventing severe acute malnutrition
14.	Feeding during illness
15.	Supporting mothers with issues in breastfeeding
16.	How to take care of weak newborn with the help of Kangaroo Mother Care
17.	Identification and referral of sick newborn
18.	Preventing illnesses to avert malnutrition and death
19.	Prevention of anemia in girls and adolescents
20.	Birth preparedness – for institutional and home delivery
21.	Preparation during pregnancy – for newborn care and family planning

Source: ILA guidelines of Poshan Abhiyaan

Training Modality

Frequency

The training frequency and the volume of content covered under each session have been finalized based on the educational levels and learning capacity of the ICDS officials and functionaries. A two-day training session, covering three ILA modules, is organized every quarter for the state and district groups, while one thematic module is covered in each monthly cycle for the block level and the AWWs. This helps the participants absorb the technical knowledge thoroughly as well as develop skills to plan and deliver services to beneficiaries as envisaged. For AWWs, the monthly sector meetings are utilized to conduct these trainings.

Training session

Conducted by a facilitator and a co-facilitator, the sector level ILA training encompasses three crucial steps, as illustrated below. At the start of the session, the facilitator reviews the status of implementation of agreed actions in the last training. This is followed by covering the content of the selected topic, and finally guiding the participants to develop an action plan for implementing the acquired knowledge on the ground.

The actions planned for delivery/ implementation are the expected outputs for that month, and are monitored during supervisory interactions. Over a period of time, these actions are expected to produce changes in specific outcome indicators such as coverage of services and maternal

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nutrition practices as well as infant and young child feeding and caring behaviours. In order to make these sessions interactive and interesting, the facilitators are expected to make use of different participatory methods of training, such as role-play, group discussion, and periodic question and answer session.

Monitoring and supervision

Regular supervisory visits by the state/ district/ block ICDS officials and pre and post training assessments are undertaken to ensure quality of training delivered and to assess AWWs' knowledge and skills, respectively. Standardized reporting of these sessions is done through reporting formats. The reports are collated at different levels so that the status of implementation of the entire cascade is available with the state every month.

Methodology

Four days ILA training programme was organized by the Departments in North Lakhimpur College. Total participants were divided into two groups i.e., two days training for each group. It is important to do thorough planning for effective execution of the trainings. The preparatory steps include – sanction, allocation and timely disbursement of budget; translation of modules/ takeaways in local languages; printing and timely distribution of modules; preparing a calendar of sessions; and ensuring availability of facilitators**.** The agenda for the training were prepared by the officials such as District Resource Group (DRG) and programme coordinator. Out of 21 modules, seven modules were included in the agenda for the training. The modules include in-built questions, discussion points, and exercises to guide the facilitators. When followed, the sessions were delivered more effectively ensuring better understanding among the participants. The modules were simple to use and easily understandable. The details of the ILA training modules are listed below.

Table 2: ILA Modules for the training

Day 1		
TIME	SESSION	FACILITATOR/RESOURCE PERSON
10.00 am - 10.15 am	Inauguration of the program	Honorable Deputy Commissioner
10.15 am – 10.30 am	Welcome speech by DSWO and Introduction of participants along with 4 day orientation agenda.	District Social Welfare officer (DSWO)
	Overview on NNM and its key components- ILA, CAS, CBE, JAN ANDOLAN	
	Understanding about Maternal and Child Health Status & Importance of 1000 days interventions.	
10.30 am- 11.00 am	**Pre test**	
11.15 am – 12.15 am	**ILA Module 1**: Why this Monthly meeting?	CDPO (Karunabari block)
12.15 pm- 1.15 pm	**ILA Module 2:** Making or updating Home Visit planner & initiating Home visits.	Supervisor , Narayanpur ICDS
2.00 pm to 3.00 pm	**ILA Module 3:** Planning and Organizing Community Based Events at AWC.	CDPO (Nowboicha block)
3.00 pm to – 4.00 pm	Interaction and Discussion, wrap up for day 1	

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Day 2		
9.30 am – 10.00 am	Recap on Module 1,2, and 3	
10.00 am – 11.00 am	**ILA Module 4:** Observing Breastfeeding in Newborn babies – Why and How?	District Project Assistant
11.15 am- 12.15 pm	**ILA Module 5:** Identification and care of a weak newborn baby	District Coordinator
12.15 pm- 1.30 pm	**ILA Module 6:** Complementary feeding: diet diversity	HOD, department of Home Science, NL College
2.15pm – 2.30 pm	Orientation on Module 6 continued…..	HOD, department of Home Science, NL College
2.30 pm – 3.30 pm	**ILA Module 8:** Assessment of growth in children	District Coordinator
3.30 pm 4.00 pm	Post test	
4.00 pm – 5.00 pm	Planning Exercise for Sector level orientation	
	Feedback	

Evaluation

The ICDS officials (DPOs/ CDPs) are primarily responsible for supervision and review of the IL sessions and their quality of implementation. After every round of IL, structured review of process done in the subsequent rounds. Pre- and post- training assessments and field visits were undertaken to ensure quality of training delivered and to assess AWWs' knowledge and skills, respectively. Standardized reporting of these sessions is done through reporting formats. The reports are collated at different levels so that the status of implementation of the entire cascade is available with the state every month.

Results

Findings of the training highlight improvement in knowledge among functionaries as well as beneficiaries on aspects related to maternal and child nutrition. Some of these findings include, improved knowledge among the participants regarding care of weak newborns (percentage AWWs who responded that weak newborns should not be bathed immediately and not given anything other than breast milk increased from 50% to 65%), improved knowledge among pregnant women on exclusive breastfeeding (from 51% to 60%) and improved practice among lactating women on exclusive breastfeeding (from 48% to 56%).

ILA has resulted in greater satisfaction among the participants as well as increased engagement during the training. Findings highlighted the perception of frontline functionaries in terms of the impact of these trainings on their day-to-day work. The participants felt that there has been improvement in terms of clarity on the subject matter, their approach to home visits, and perceived effectiveness of their counselling to the beneficiaries.

Feedbacks

"Earlier we would give information to the beneficiaries even if we met them on the way. But now we prepare for home visits like we've been told in the ILA training. We first decide what we should say when we go to a lactating woman so that we don't miss any point. Also, we make sure to engage the family members in the discussion." - Participant

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"Earlier the pregnant women were not taking proper food, iron tablets, or rest during the day. But now they have started doing all of it. I guess it is partly because I have explained the importance of doing so, in great detail. Now these pregnant women willingly come to the AWC and ask us to update their names in the register for different services." - Participant

"After attending the ILA training, my concept on different topics is very clear. I'm very much benefited from this training and able to make understand others regarding mother's health, complementary feeding, breastfeeding, etc. " - Participant

CONCLUSION

The ILA has made way for a more creative, yet systematic method of capacity building, where a standard training package is delivered for every cadre in ICDS. It is participatory in nature and the focus is not just on the delivery of content, but also on the 'planning and use' of that content for effective service delivery and supporting behaviour change among beneficiaries.

The MWCD recognizes the importance of quality implementation of this capacity building intervention, which is critical in ensuring effective service delivery under the POSHAN Abhiyaan. The Ministry has issued guidelines and conferred with the states to help systematically plan and execute these trainings, along with the introduction of a simple quality checklist for the supervisory cadre.

ABBREVIATIONS

AWC	Anganwadi Centre
AWW	Anganwadi Worker
BRG	Block Resource Group
CAS	Common Application Software
CDPO	Child Development Project Officer
CPMU	Central Project Management Unit
DPO	District Programme Officer
DRG	District Resource Group
ICDS	Integrated Child Development Scheme
ILA	Integrated Learning Approach
LBW	Low Birth Weight
MWCD	Ministry of Women and Child Development
NHM	National Health Mission
POSHAN	Prime Minister's Overarching Scheme for Holistic Nutrition
SNRC	State Nutrition Resource Centre
SPMU	State Project Management Unit
WCD	Women and Child Development

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EFFECTS OF HEALTH INSURANCE SCHEMES ON OUT-OF-POCKET SPENDING

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ABSTRACT
Not only the World Bank had warned against the possible exclusion of the poor from having access and using health care services, it also strongly believed that the poor tend to suffer more from the kind of health problems that can best be addressed by government preventive programs. And also that the poor can also be protected through enrollment to health insurance companies or other risk sharing schemes. Rather than protecting the poor, the implementation of these measures did not abolish out-of-pocket expenses. Insurance companies for instance, do not cover small predictable costs such as low-cost curative care while inefficiencies and shortcomings of free health care schemes push beneficiaries to spending out-of-pocket money. And conditions for referral health care services and copayments are set to reduce the miss use of these services. Thus, rather than reducing financial burdens, health insurance mechanisms contribute in impoverishing their enrollees and beneficiaries. Analysis of existing literature on health insurance schemes in Burundi shows that this readymade model has failed to protect their members from illness risk and has caused them financial looses.

Keywords: Health insurance, protection of the poor, risk sharing

INTRODUCTION
Insured persons need health insurance companies for their health while health companies need contributions from enrolled members to sustain their businesses. However, this win-win situation is always complicated trough unilateral mechanisms aiming to limit expenses of the insurance company. The long waiting time at health care facilities resulting from a long list of documents and signatures, the limitation of health coverage, the balance health costs covered by the member in terms of percentage of the total cost, etc., are some of the major pushing factors to spending out-of-pocket money. In Burundi for instance, the financial burden of cost of inefficiencies of the mandatory government health insurance company and free health insurance funded trough taxes, is put on the shoulders of both the members and beneficiaries. This unproved situation in health Insurance business has financially ruined their members. For instance, despite the gaps between national health systems(NHS), insured persons in the North and uninsured persons in the South share in common that individual or/and households pay exorbitant out-of-pocket money for health care services. The narrow coverage network and the conditionality to limit the use of health services make some persons to avoid buying insurance or enrolling to government subsidized insurance because it makes no difference in terms of extra direct payments of out-of-pocket money on health care services. Also Specialty medicines are not included in the package list, the administrative burdens discourage the members to wait for long time, the unclear charges on generic medicines as the contribution of the member, etc., make the enrolled to spend either his savings, selling a portion of his property, taking loans, avoiding conventional health care services or simply waiting home hopelessly the will of the Almighty God. Instead, health insurance should result into significant reduction of cost barriers to receiving care services, including prohibitive out-of-pocket (OOP) payments. This paper explores the ways through which health insurance companies are making profits from deductions from employees' salaries and voluntary individual contributions. I have used the secondary data to analyze this confusing game in the health sector.

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1. Major social protection systems in Burundi

The country accounts for three major social protection systems that include social (i) insurance system based on employment and financed by both the employer and the employee; (ii) social insurance systems subsidized through taxes and (iii) private micro social insurance systems financed mainly by voluntary and individual social contributions.

1.1 Mandatory Government Health Insurance

Mutuelle de la Fonction Publique (MFP) is a government compulsory health insurance that enjoys autonomous management (PNDS 2006-2010). It was created to cover health care for public servants and their dependent, and it had a coverage network of 10 percent of the then total population. The employer contributes 6 percent while the employee pays 4 percent. This government health insurance company pays 80 percent of medical acts, hospitalization and pharmaceutical products but only 70 percent for specialty pharmaceutical products (PNDS 2006-2010). But due to some inefficiency some members choose to cover 100 per cent of the total cost of the health care services and pharmaceutical products. The MFP is the country's largest health insurance that covers a range of services provided by public and religious health facilities, both contributors are not associated in its management. The contribution required from members of MFP has not significantly changed in terms of percentage which remains comprised between 10 to 30 percent. However, from the 80s when MFP was created till today the nominal value of public servant salaries has dramatically changed due the devaluation of national currency and other economic related problems.

2. Social Insurance Systems Subsidized Through Taxes

2.1 The free care insurance was introduced in 2006 and it covers all pregnant women and children under five years across the country. In 2009, this policy was coupled with the Results based financing (RBF) to increase the demand and supply of curative health care services that provide direct benefits to the client(patient). As per this policy, beneficiaries pay zero fees at government or private health facility that implement it. But, due to inefficiencies in implementing this policy, beneficiary households are still making direct payments at local health centers. Pregnant women pay money on delivery to nurses on duty in order to receive good care. This amount paid depends on the ability of the family to pay and the nurse on duty. Household beneficiaries spend more money on drugs at private pharmacies (Buregeya E. and Mehender S. 2019). This free health care policy has failed to abolish direct and indirect payments from the patients making health centers and nurses benefiting from the policy. Thus, by trying to game this policy, the health care facilities try to illegally recover user fees from beneficiaries particularly in rural areas.

2.2 Medical Assistance Card (CAM) is a voluntary insurance scheme for the informal and rural sector, allowing families to enroll in the system. . The cost of one CAM is BIF 3000 (=$1.69) and is bought by household. The government pays subsidies to health centers according to the quantity of patients received. The beneficiaries of medical assistance card (CAM) include two categories of people: (i) children aged more than 5 years to 13 years old and from 14 years and above. Outpatient for the first category pays BIF 800 (=$0.45) while outpatient for the second category pays BIF 500 (=$0.25). And admitted patients for the two categories pays BIF 1000 (=$0.56) per day. And the government reimburses BIF 3200 (=$1.80) to health centers for health care services provided to a patient aged between 5 years and 13 years and BIF 2000 (=$1.12) for a patient aged 14 years and above. With regards to admitted patients, the government reimburses BIF 360 (=$0.20) per day.

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The problem with this insurance scheme is that decision makers did not take into account the real sources of income and the purchasing power of rural beneficiaries. The results of a 2019 study in one of the rural commune of Burundi show that 42 per cent of rural population had an monthly income comprised between zero US $ and five US$. The 20 per cent contribution exceeds the monthly incomes of most CAM holders and due to regular problems of stock-outs of drugs at local health centers and due to the non respect of government fixed tariffs, CAM holders have to pay extra money for their medical consultations and also buy all prescribed medicines at local private providers (Buregeya E. & Mahender S. 2019). Local health centers not only benefit from both reimbursements from the government and direct payments from CAM patients but also they rely on illegal user fees to buy drugs.

2.3 The indigent insurance. This income based insurance was introduced in 1984 and targeted indigent children enrolled in schools and any other poor person approved as such by both the current Ministry of National Solidarity and Health. Its care coverage includes consultation, drugs, childbirth, etc for health centers and district hospitals. Health care services are free of charge because they are paid by both the Ministry of National Solidarity and the balance by respective municipalities. A total of 10 percent of Burundi population was benefiting from this insurance scheme in 2012. Insufficient allocation of the budget for this insurance scheme and less than a dollar per indigent, limited number of hospitals to 2 per province where health care services can be provided to beneficiaries are the main reasons pushing these beneficiaries to spending out-of-pocket money at both government and private health care providers.

3. Private Micro Social Insurance Systems

3.1 Health Insurance in the Structured Private Sector

The formal private sector doesn't have health insurance in the real sense. The type of health insurance consists of direct payments to health care providers by employers. From 1993 until 2003, the association of employers of Burundi (AEB) has been trying unsuccessfully to set up an insurance system similar to the Mutuelle de la Fonction Publique (PNDS 2006-2010).

3.1.1 The country lacks a functioning national health insurance system though there is a presence of a range of private insurances that have been developed since 2010. They provide different arrangements for employers to cover their worker's health care costs, ranging from institutionalized care in large companies, to providing a purchase order or vouchers, establishing a custom designed health insurance fund in companies or contracting with a private insurance company. At the Mutuelle de Santé des Caféiculteurs du Burundi (MUSCABU), hospital expenses are capped at US$ 51 per year while at the Union pour la Coopération et le Développement (UCODE), private or denominational care is limited to US$ 20. These private insurance also have inefficiencies that make the member pay out-of-pocket expenses. For instance, there is lack of government capacity to control and enforce the law in terms of company's compliance. Another problem is due to the lack of central reporting and/or tracking system for the coverage of medical care by employers. The determination of care services coverage is left to the employer.

3.2 Health Insurance in the Informal Private Sector

Community health insurance (CHI) were created in few provinces but their number was still insignificant. This was related to the lowest purchasing power of the population and the high level of indigent persons due to political conflicts in the country (PNDS 2006-2010).

3.3 Community based insurance (CBI). The country accounts for over 30 community health mutual. They mainly cover health care services such as consultations, laboratory, hospitalization and medicines at public, private and non-profit health facilities and in some exceptional cases, they can cover inpatients care services. They target rural and informal populations who are

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entitled to make direct payments of 20 percent in government health facilities and 40 to 50 percent in private clinics depending on coverage conditions set by every mutual association.

CONCLUSION

All health insurance managers have set up sophisticated ways of recovering money through voluntary (or involuntary) created shortcomings and package lists that push members to making out-of-pocket expenses. The most common ones are (a) delays to issue good care ("*bon de soins*"), (b) insufficient reimbursements, (c) lack of sustainable funding, (d) low enrolment, (e) limited coverage network, and (f) outdated tariff system, (g) absence of regulation and (h) unclear responsibilities (UNICEF, 2017, Buregeya E. and Mahender S. 2019). These shortcomings are partially solved through different ways. Some health insurance company managers set up some strategies that save their businesses from collapsing on the one hand but which financially ruin their members. As results, members of government, private or community based health insurance scheme complain about out-of-pocket expenses. There is always mismatch between the money they contribute in health insurance and the benefits they receive from it.

All insurance schemes available in the country are not able to abolish direct payments from enrolled members. Those enrolled in mandatory government health insurance contribute predefined out-of-pocket money defined in terms of percentages set by the government. In the private sector, the limited health care services coverage to only curative health care services that provide personal benefits to the member and to a certain age group also constrain members to spending out-of-pocket money. I also found that all these schemes are characterized with all sorts of inefficiencies but which are beneficial to them. Members once they don't receive all required services from their insurance companies and in due time, they are constrained to get these services from other providers through direct payments from their savings or by taking loans to save their lives. And there is no room for members to claim refund of the money they spend in such circumstances. There is in fact a puzzling egg-chicken question here. The health insurance company's business and the members' health: which one is really insured? This question can also be raised at the community base insurance levels where they are supposed to work with poor people.

SCOPE FOR FURTHER RESEARCH

1. Further studies are needed to reduce inefficiencies of health insurance schemes in order to maximize benefits of the enrollees and beneficiaries and therefore create a win-win situation.

2. For mandatory health insurance schemes, further studies are needed to establish the final end of the money generated through lack of compliance of their agents to the existing rules and regulations.

3. Managers of community based insurance schemes are also making profits from contributions made by poor people due to lack of legal framework. There is a need for further studies to analyze their financial impacts on these voluntary enrollees.

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HR ANALYTICS – NEW INSIGHT IN HUMAN RESOURCE MANAGEMENT

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ABSTRACT

Human Resources have always been a very important asset of an organization. Human Resource function should be aligned with business goals, employees should be treated as resource to have a competitive advantage and thus organizations can achieve success in the competitive market. HR analytics helps in aligning the HR strategy with the business strategy. HR managers use HR Analytics to formulate strategies that enable the organization to have competitive advantage over its competitors.HR Analytics helps in the improvement of workforce performance thus increasing the productivity of the employees which in turn increases revenue of organization. This paper highlights the integration of HR Analytics within a company and suggests some tools used in HR Analytics. The study includes the development of HR analytics is based on integration of data across disciplines and IT infrastructure. It identifies that HR analytics has different dimensional views. It is not restricted to data collection, measurements, statistical analysis and logical reasoning but also relevant capability set for organizations needs to be identified.

Keywords: HR Analytics, People Analytics, Workforce Analytics, Dimension

1. INTRODUCTION

Over the decade HR department has evolved as a vital function. Human Resources have always been a very important asset for an organization. With the emergence of new technology, much of the traditional work has been automated. It focuses on managing people within the organizations, emphasizing on policies and systems. Human Resource function should be aligned with business goals, employees should be treated as resource to have a competitive advantage and thus organizations can achieve success in the competitive market. HR analytics helps in aligning the HR strategy with the business strategy. HR managers use HR Analytics to formulate strategies that enable the organization to have competitive advantage over its competitors.

Human resource analytics refers to the application of the analytic processes to the human resource functions in an organization so as to improve the employee performance and therefore improving return on investment. HR Analytics, is the quantification of people drivers on business outcomes. Analytics tracks the impact of metrics on business performance. Decision making is one of the critical organizational processes including behavior, performance of motivation and stress of employees (Griffin and Moorland, 2011[18]). HR Analytics provides statistically valid data that can be used as an evidence for creating decisions and new strategies. it consists of various modeling techniques like behavioral modeling, predictive modeling, impact analysis, cost-benefit-analysis and ROI analysis (Levenson, 2005[34]) required for strategic HR decision-making. It helps managers to focus on hard facts instead of intuition (Falletta, 2014[14]). Though many organizations have started using the HR analytics but there still remains an immense room for growth in this area.

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The present study is aimed at exploring the existing literature about the relationship between Human Resource Analytics and the role it can play in improving the existing range of managerial and HR-related tasks. The investigation of this literature will be helpful in providing insight into to what extent organizations are using analytics in HR and its relevance in decision making. It highlights to what extend HR Analytics is used within a company and suggests some HR Analytics tools used in HR Analytics. It focuses on various dimensional views on HR analytics. HR analytics has a huge implication in improving the managerial decision-making process.

2. RESEARCH AIMS AND OBJECTIVES

The following research aims at exploring the existing literature to understand the relationship between human resource and analytics and analyzing the importance of its role in the improvement of the existing range of managerial and HR related research.

The present study enumerates the following objectives.

1. To examine the existing literature on the HR analytics, its evolution and how much is it implemented within the organizations and to evaluate the existing studies qualitatively.
2. To examine the various dimensional views on HR Analytics.

3. LITERATURE REVIEW

3.1 Integration of HR Analytics within a company

3.1.1 Term - HR Analytics

Analytics, in general, refers to "the use of analysis, data and systematic reasoning to make decisions" (Davenport, Harris, & Morison, 2010[10]).The term HR Analytics refers to the application, statistical and data mining techniques on the data concerned with the people working in the organization. HR Analytics is a process and not a tool as it produces valuable innovative insights (Smeyers & Delmotte, 2013[42]) into decisions made by the management. The "Garbage in –Garbage out" strategy can be applied here as the poor data when combined with the excellent analysis will produce results that are of of little value. The main objective of HR Analytics is to bring support in decision making regarding managing people in the organization. (KPMG, 2013 [31]).

Human resource analytics is an art of applying research and numerical processes to the human resource vertical of an organization with an intent of enhancing employee performance with a view to get a better ROI. HR analytics is the quantification of people drivers on business outcomes. Applying analytics helps to understand the impact of various metrics on the performance of the organization.

It helps to answer the following example questions:

1. How does learning & development investment impact sales performance for my account managers?
2. Will quicker promotions help us retain our top talent?
3. What can we do to retain employees and thus save money?
4. How can we best improve customer satisfaction through smart people processes?

HR Analytics represent statistical techniques and experimental approaches that can be used to show the impact of HR activities, including more sophisticated solutions, based on 'predictive models' and 'what-if scenarios.'

Few of the practices of human resources are empowered by information technology which utilizes descriptive, pictorial, and statistical analyses of Human Resources data like human

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capital, processes of human resources, performance of the organization to establish influence on business and facilitate decision-making that is data driven (Marler and Boudreau (2017)[37]).

Gustafsson(2012)[19], stated different terms for HR analytics that can be used interchangeably – Talent Analytics(Davenport, Harris and Shapiro, 2010[11]), HR Analytics (Mondore, Douthitt and Carson, 2011[40]), Talent Intelligence (Snell, 2011[43]), or Workforce Analytics (Hoffman, Lesser and Ringo, 2012[23]).

HR Analytics helps in forecasting the demand and supply of people, identifying training needs of employees, suggests suitable employments tests which suit applicant's profile, implementing performance related pay and maintains effective employee database. Overall it helps in decision making based on available data about career planning, trainings, rewards, recruitments, retention and organizational effectiveness and efficiency.



Figure 1: Human Resource Analytics

(Source : Analytics India magazine ,2015)

3.1.2 Evolution of HR Analytics

The history of HR analytics can be traced back to the late 1900‟s when Fredrick W. Taylor analyzed the job performance of the employees and laid down the measurement of performance to do the job in the factory in his Scientific Management studies. He also initiated time management exercises. Henry Ford measured the speed of assembly lines. Analytics received more attention as computer aided models in the form of decision support system came into existence during late 1960"s. Then in the early "80s when the reporting and basic metric capabilities were introduced, widespread use of HRMS - Human Resources Management System and benchmarking opportunity started happening. The prime focus was on the adoption of HRIS and automation of HR practices (DeSanctis, 1986[13]; Mathys & LaVan, 1982[39]; Lederer, 1984[33]; Magnus & Grossman, 1985[36]; Taylor & Davis, 1989[44]).In the year 1990, both academic research and organizations started collecting evidence on how to reduce the administrative tasks of HR process by using HRIS. Organizations started using computer systems in HRM (Kossek, et al., 1994[30]; Mathieson, 1993[38]; Hannon, Jelf, & Brandes, 1996[21]; Haines & Petit, 1997[20]).In the subsequent years, with the growth of internet, more companies started using HRIS. In 2000, a new term electronic HRM (e-HRM) was evolved. Although majority of the organizations used administrative e-HRM there was an increase in the use of strategic applications such as talent acquisition, performance management and compensation management (CedarCrestone, 2006[5]).

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Forward to today, 'Big Data' has made its entry in HR Operations and can be described as data that is very large in volume, diverse in variety, high in velocity, fine-grained in resolution, exhaustive in scope, relational in nature, but still it can be flexible in nature (Kitchin, 2014[29]).In addition to digitalization of HR, concept of HR Analytics has gained importance. Boudreau & Ramstad, 2005 argued that with such a paradigm shift – HR can be used as a strategic function such as finance and marketing to enhance decisions about people just as marketing enhances decisions about customers and finance enhances decisions about money (Boudreau & Ramstad, 2005[3]). Encouraged by many success stories of organizations using HR Analytics, generating savings up to $100 million and at the same time improving the retention rate and productivity of employees, advanced HR analytics is really becoming mainstream within no time (Fecheyr-Lippens, Schaninger, & Tanner, 2015[15]) and all the time more is considered as an essential HR tool (Boston Consulting Group, 2014[2]).

3.1.3 Comparison of HR Metrics and HR Analytics

HR Functions have a direct impact on organizational performance. The organizational performance is improved by the introduction of HR Analytics in HR functions. For this, proper HR metrics is required. Appropriate analytic models and measures of company performance are very necessary to evaluate the effectiveness of HR programs on company's performance

People generally interchangeably use the term metrics and analytics. However, it is very important to distinguish between HR metrics and HR analytics. Since the time, Jac Fitz-enzd(1984)[16] published 'How to Measure Human Resources Management' ,outlining the metrics that can be used to effectively measure employee performance and Kaplan and Norton's introduction on the concept of balanced scorecard (Kaplan & Norton, 1996[27]), the use of metrics in human resource management has gained a lot of popularity. Standard practices for calculating and reporting common metrics – like turnover, headcount and time to fill and financial based metrics such as cost per hire, led to efforts etc became very common. This data can be viewed from different perspectives and in different formats (Liberatore & Luo, 2010[35]) example through tables, charts and graphs; this data can be summarized in a more comprehensible manner. Metrics are just the measurements that help to evaluate the effectiveness and efficiency of a function. It helps to compare different data points. Metrics does not tell anything about a cause, why something is happening and what is the likelihood of any event to reoccur in future. Hence metrics precedes analytics. In HR Analytics, value chain evolves from opinions, data, metrics, analytics, and insights, and ultimately leads to actions (Dekas, 2011[12]). Hence it describes, input can be transformed into output which adds value to a product. HR Analytics helps the managers to make decisions based on changing state of Human Capital based on facts and figures. To evolve as a true strategic partner, Human Resource needs to develop better analytics and metrics (Lawler, Levenson, & Boudreau, 2004[32]). HR analytics capitalizes on the information retained on the human resource information system.

3.1.4 Types of HR Analytics

Different forms of analytics can be categorized into descriptive, diagnostic, predictive, and prescriptive analytics (Jim Watson 2016[46]). Descriptive Analytics is the first type of analytics. It involves understanding of past behavior and outcomes (Fitz-enz 2010[17]). It tells about what has already happened in the past and is happening in the current situation. Examples can be dashboards which gives details about how many people have left last month and how many people are currently employed. Based on this past data, predictive analytics can be done for the future. Secondly, Diagnostic Analytics is the causes of the event that has taken place. Example if employees have left the organization in past, then what is the reason they have left the organizations and then the causes are ranked accordingly. Thirdly Predictive Analytics can be

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used for identifying what might happen in future. Example who is the top performing employees in the organization and whether they will leave the organization or stay in the organization, how many people will leave the organization in next 30 days? Lastly, Prescriptive Analytics which suggests the decisions, options and actions to be taken based on predictions. Example what actions should be taken to retain top performing employees of the organization?

3.1.5 HR Analytical Tools

The major HR analytics vendors include Oracle (US), SAP (Germany), Infor (US), Workday (US), Sage Software (UK), Kronos (US), MicroStrategy (US), IBM (US), Tableau (US), Zoho (India), Crunchr (Netherland), Visier (Canada), TALENTSOFT (Paris), GainInsights (India), and Sisense(US). Oracle HR Analytics by Oracle is a solution tool which helps with data analysis of performances of employees, background screening, and suggests ways of encouragement. IBM Kenexa can significantly be used for retaining top employee talent and getting maximum output from their current workforce. SAP Success Factors Workforce Analytics provides tangible insights on the workforce data to assist business make important strategies not only for today but also that are future forward. R is the most widely used HR analytics tool which helps in statistical analysis and visualization of massive data sets. Python is another programming language and can be used for statistical analysis and visualization.

Jasmit Kaur and Alexis A. Fink (2017)[28] interviewed 22 respondents from 16 companies, found that for data analysis and visualization; most of the companies (94%) are using R Studio followed by Tableau (83%), Python for data analysis, data cleaning and data management. Traditional and trust worthy tools such as SPSS and Excel are also used by some companies for analysis. Few new technology tools such as Intel's Saffron, HireVue's video analytics, IBM's Watson Talent, are sanctioning Artificial Intelligence. However, HR analytics is still at experimentation stage and there is long way to go in the future.

3.2 Different Dimensional Views of HR Analytics

The development of HR analytical systems has been accelerated by technology, which is rapidly consolidating the analytics landscape. The future progression of HR analytics, which is conquered by models that basically focus on the progress of the analytical component itself. Jac Fitz-enz (2010)[17], in his book 'The new HR analytics', discussed the 5-step value ladder of measuring people analytics. The very first step marks the start of HR measurement which refers to the recording the HR data related work such as hiring, training, supporting or retaining. The second step links this recorded work to the objectives of an organization, which the managers set periodically and review on a regular basis. The third step involves the benchmarking process. Step four constitutes the descriptive analytics which analyses past behavior, outcomes, and trends of recorded HR data. The final step is predictive analytics, which transforms data into meaningful information by observing the patterns in the previous step of descriptive analytics and helps to predict the future based on data based models.(Fitz-enz, J. (2010)[17]).

Other models related to Hierarchy of analytics ascend from descriptive analytics, through correlation analytics, to predictive/prescriptive analytics (Sesil, 2014[41]), or from reactive - operational reporting, through Proactive - advanced reporting and Strategic analytics, to predictive analytics (Bersin by Deloitte, 2013[1]).Whatever hierarchy the organizations follow, they aim toward what can be considered as the holy grail of HR analytics: predictive analytics (Harvard Business Review, 2013[22]).

However, there is much more to HR analytics than measurements and statistics (Cascio and Boudreau (2011)[4]). Models need to be developed in logical manner so that the relationship between the variables can be analyzed truly. Thus the positioning of HR analytics within the HR

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department or within a general business intelligence department may be influenced considerably on the logically developed models.

Coolen and IJselstein (2015)[7] stated that HR analytics is not just restricted to measurements, statistics, and some logical reasoning. Identification of HR analytics relevant capability set for your organization is also very necessary. They introduce the HR analytics capability wheel and stated that "only those organizations that manage to create and maintain a balanced blend of different relevant capabilities will be successful in HR analytics" (Coolen & IJselstein, 2015[7]). These 'relevant capability set' were described as perspectives such as - the business perspective (doing research relevant to business); the human resources perspective (knowing about HR processes, available HR data, and ethics of examining employee data); the consultant viewpoint (selling HR analytics to business and presenting results in a conclusive manner); the data scientist view (conducting statistical analyses, and also being able to work with more cutting edge developments such as machine learning algorithms); the IT architect perspective (understanding the HR IT landscape and data warehousing); and the software perspective (in-depth knowledge of working with analytical software, depending on whether this is outsourced or conducted inhouse) (Coolen & IJselstein, 2015[7]). The last two perspectives indicate the use of Information technology in HR analytics. The next big thing Coolen (2015)[6] foresees is the use of analytical business-user-friendly self-service analytical software. Table 1 identifies various dimensions of HR Analytics according to various researchers.

Table 1: Dimensions of HR Analytics

1	•An evidence based view of HR Analytics
2	•Measurment of HR Functions using HR Metrics
3	•Roadmap for Decision Making
4	•Used as Predictive Analytics-Helps in Decision Making
5	•Necessary Logical Model Development for implemention
6	•Prioritization of HR Investments Patterns
7	•Balanced blend of different relevant capabilities
8	•Link between academic and industry interface

Source: Author's Research

4. CONCLUSION

HR analytics is therefore an evidence-based methodology for improving individual and organizational performance by making better judgments on the employee's side of the business. It can undoubtedly enhance the credibility of the HR functions by improving the HR effectiveness, policies and practices and contributing to the competitive advantage of organizations that develop it as a core competency. HR analytics expose the redundant efforts,

resources and budgets which are not producing any relevant impacts on productivity of the organization, and hence improves the effectiveness of HR. As such, HR functions and professionals can develop a strategic responsibility in collaboration with marketing and finance department and develop new skills and capabilities. Along the way, HR professionals will need to address ethical dilemmas. Undoubtedly; HR analytics takes effort to minimize these current challenges being faced by many organizations. An integrated IT infrastructure is required to assist the use of multi-source data in analyses. The data collected from all disciplines should be centralized in a single database to so that the combined analyses can be carried out. Today, every function has independent analytics team. In future, focus will be on a centralized analytics team for all functions in an organization. This team will then be focusing on identification of opportunities for improving business performance. Technology was seen as the main driver for the development of HR analytics. Developments are seen in the automation of data collection and data preparation activities, which are very time consuming. Furthermore, offering access of self-service applications to line managers may help to speed up the analyses and helps in development of HR analytics considerably.

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IMPLEMENTATION OF AUTOMATIC IRRIGATION SYSTEM FOR GREEN HOUSE AND OPEN FIELDS USING IOT

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ABSTRACT
Agriculture is very essential for the development of any country. India depends upon agriculture more than 50 % of Indian population works in the sector of agriculture. Agriculture sector or agribusiness can be strong if new and modern technologies were implemented to it, IoT can play a vital role in it. Sensor used for the implementation of the IoT circuits have the capability to sense the environment properly and provide the accurate information regarding their surroundings. IoT has the potential to reshape the world their role in the agri-sector can change the traditional methods used in.

Keywords: Internet of Things, sensors, smart agriculture.

1. INTRODUCTION
Agriculture products are the basic needs for any civilization this contains the clothes we wear two the food we eat agriculture is everywhere. Agriculture is very essential what the development of any country modernization of the Agri business is required because in India, we are still using the traditional methods for the agriculture. To develop this sector we need to develop the traditional methods of agriculture. Agriculture can be defined as the art science and occupation off growing various crops developing the dirt and raising animals this process includes:

- conservation of water resources
- financing cultivation marketing processing and the distribution of the products
- Small scale industries, supply, Farm production

In India the techniques used for the generation of crops are traditional and they are passeddown from generation to generation which is not effectiveshow me need to implement the current science and innovationin the agriculture sector to increase the cultivation show that farmers can take advantage using the common sources on which the agriculture and horticulture rely upon[1]. With the use of IoT we can keep an eye on our fields which are far away from the farmers home. IoT we can help in collecting, monitoring and processing the data related to the crops which we use to grow in our fields smart agriculture usesIoT and wireless sensor networks for the remote connectivity it not only enables the new techniques for the ranchers for farming their fields but it can also reduce the workload of the Ranchers[2].The base of IoT is embedded electronics or embedded system technology as it is a combination of both hardware and software, this allows the IoT systems to communicate in inside the environment and outside the environment [3]. Although it is easy to implement the IoT systems, these IoT devices also faces few challenges Like hardware systems, security issues, data analysis, Network challenges etc. Data analysis plays a vital role in almost all the applications of wireless sensor network and IoT as all the decisionsimplemented by the user directly depends upon the data collectedby the digital or analog sensors from its surrounding environment. All IoT gadgets are deployed in an open environmentso they may face the harsh conditions. These harsh conditions may damage the embedded system.Security plays a very important role in any industry similarly farmers need to have the knowledge about the security and safety of the technology used by them in a

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proper way to execute each and every instruction accurately. But in case of India most of the farmers do not have the proper knowledge regarding the technology as they are still using the traditional methods for the agriculture processing. In this paper we have proposed a system for the smart irrigation of open fields as well as a system for the green house to implement the smart irrigation in. we have used ESP8266, ArduinoMicrocontrollers to achieve this process in case of an open field scenario we have used soil moisture sensor, water flow sensorto control the ignition in the open field, whereas in case of a greenhouse we have used DHT22 a digital humidity and temperaturesensor to control the flow of irrigation hen greenhouse, later sections of this paper describes about literature survey propose system and conclusion.

2. LITERATURE SURVEY

Title	Author	Year	Sensors	Microcontroller	Findings System and achieved Result
Internet of Things-Based Hardware and Software for Smart Agriculture: A Review[1]	Brij Bhushan Sharma and Nagesh Kumar	Jan 2020	-	-	➢ IoT will play a vital role in smart agriculture process. ➢ Monitoring of Moisture Mineral Level, Humidity and pH level is required to implement IoT in agribusiness. ➢ IoT can reduce the workload of Rancher's
Applicability Of Wireless Sensor Networks & Iot In Saffron & Wheat Crops : A Smart Agriculture Perspective[2]	Mohammad Wasi Rasooli, Brij Bhushan Sharma, Nagesh Kumar	Feb 2020	-	-	➢ WSN and IoT applications are capable enough to enhance the agricultural fields. ➢ WSN and IoT can play a vital role in monitoring the properties of growth of the crops and soil. ➢ IoT devices are easy to Interface.
Opportunities and Challenges with WSN's in Smart Technologies: A Smart Agriculture Perspective[3]	Nagesh Kumar and Brij Bhushan Sharma	Jan 2020	-	-	➢ Agricultural machinery including IoT can be used to maintain the agricultural fields. ➢ Pest control and crop diseases can be controlled easily using IoT.
GREENHOUSE MONITERING	S.Muthupavithran, S.Akash,	Mar 2016	cozir sensor	cc3200 ARM cortex M4	➢ With the use of COZIR sensor and

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USING INTERNET OF THINGS[4]	P.Ranjithkumar			microcontroller	CC3200 ARM Cortex M4 Microcontroller designing of green-house automation is implemented ➢ Monitoring of the greenhouse is possible in all situations. ➢ Values of three parameters Temperature, carbon-dioxide, and humidity is analyzed and shown using graphs.
Do-it-Yourself Digital Agriculture Applications with Semantically Enhanced loT Platform[5]	Prem Prakash Jayaraman, Doug Palmer, Arkady Zaslavsky, Dimitrios Georgakopoulos	April 2015	Soil Moisture Sensor, Phenonet-OpenIoT	JAVA-based semantic sensor stream processor. Arduino	➢ Implementation of enhanced digital system for agriculture is presented. ➢ Open platform for IoT has been introduced in this paper.
IoT based Smart Greenhouse[6]	Ravi Kishore Kodali, Vishal Jain and Sumit Karagwal	Oct 2017	Temperature and Humidity, ultrasonic sensor	Intel Galileo Gen 2 and Arduino	➢ With the use of IoT advantage is introduced that smart devices in greenhouse can remove the insecticide and pesticides from crops. ➢ Hibiscus is grown under the generated environment, introduced implementation where authors have noted that they were able to reduce the water requirement upto 70 to 80%. ➢ Growth rate is also increased
DATA MINING TECHNIQUES FOR INCREASING SMART FARMING	Vandna, K.L. Bansal	Feb 2020	-	-	➢ Various Data extraction techniques were discussed for

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IN AGRARIAN SECTOR[7]					various parameters. ➢ They have shown that in case of agronomy lesser number of data mining techniques were introduced.
Internet of Things Based Smart Greenhouse: Remote Monitoring and Automatic Control[8]	Mohammad Woli Ullah, Mohammad Golam Mortuza, Md Humayun Kabir, Zia Uddin Ahmed, Sovan Kumar Dey Supta, Partho Das, Syed Mohammad Didar Hossain	2018	Soil Moisture Sensor, LDR, Temperature and Humidity Sensor	AtMega328	➢ Proposed model used to monitor the Temperature Humidity and Soil Moisture. ➢ For the future purposes database is introduced so that data can be used for the utilization of the system properly. ➢ They have compared the device with other devices and found that their system is more stable. ➢ They have used GSM AND GPRS MODULE to transmit the data over internet.
Internet of Things for Greenhouse Monitoring System Using Deep Learning and Bot Notification Services[9]	Nuttakarn Kitpo, Yosuke Kugai, Masahiro Inoue, Taketoshi Yokemura and Shinichi Satomura	2019	Temperature, Humidity and Illuminance	----	➢ IoT system is proposed for the agricultural solutions. ➢ Image analysis were performed using the deep learning in 6 growth stages of tomato. ➢ System is able to detect between green and red colors of the crop. ➢ System has a accuracy of 91.5% . ➢ Due to capability of the system to identify in between the red and green color harvesting date

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					can be predicted with accuracy of 91.5 %
IoT enabled Plant Sensing Systems for Small and Large Scale Automated Horticultural Monitoring[10]	Sherjeel Khan, Muhammad Mustafa Hussain	2019	Ultra-lightweight flexible sensory, Flexible lightweight plant growth monitoring sensor, LARGE SCALED REMOTE SENSING SENSORS, Winged Sensor Platform		➢ Lightweight platform can be placed on the plant's leaf to monitor the microclimate so that plant growth can be monitored as plant growth can only be monitored through leaf of the plant. ➢ Strain Sensor is used to measure the growth of the plant by measuring it on the micrometer scale. ➢ Flexible sensors are converted to lightweight platforms equipped with the wings made of paper. ➢ minimalistic compact dropping mechanism is used.
AGRO-TECH: A DIGITAL MODEL FOR MONITORING SOIL AND CROPS USING INTERNET OF THINGS (IOT)[11]	O.Pandithurai, S.Aishwarya, B.Aparna, K.Kavitha	2017	Humidity sensor (DHT11), Temperature Sensor (LM35), Soil moisture sensor, PH sensor	ArduinoUNO, AT89s52 MCU	➢ Authors have proposed a software names as AGRO-TECH ➢ Several sensors have been used like DHT11 for humidity and LM335 analog sensor for the temperature monitoring and
IOT Based Crop-Field Monitoring and Irrigation Automation[12]	Rajalakshmi.P, S.Devi Mahalakshmi	2018	Soil moisture Sensor, DHT11 Temperature and humidity Sensor, Light Dependent Resistor, Ultrasonic Sensor	Arduino Mega	➢ Mobile application and Web application have been developed by the authors to control the automation from anywhere. ➢ Ultra-sonic sensor has been used to

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					monitor the water level in the tank ➢ Water wastage has been removed as the system works in an effective manner.
IOT BASED SMART CROP-FIELD MONITORING AND AUTOMATION IRRIGATION SYSTEM[13]	R. Nageswara Rao, B.Sridhar	2018	Soil moisture sensor, Temperature sensor (LM35)	RASPBERRY PI 3 MODEL B	➢ Irrigation system based on Raspberry pi Microcontroller has been Implemented. ➢ For the storage of data cloud computing is used. ➢ Controlling of the irrigation process has been achieved
Agricultural Crop Monitoring using IOT- A Study[14]	Dr. D.K. Sreekantha, Kavya.A.M	2017	---	------	➢ IoT enables the crop monitoring in an easy and effective manner. ➢ Various Sensor can be used to fetch the data regarding agricultural parameters. ➢ There may be a challenge regarding the energy consumption
Effective Utilization of IoT for Low-cost Crop Monitoring and Automation[15]	Petcharat Suriyachai, Jakkapong Pansit	2018	DHT11	NodeMCU ESP8266	➢ Authors have designed and implanted IoT based crop monitoring system ➢ Temperature and Humidity value will be store to the cloud based platform. ➢ Open weather API has been used for the weather predictions
Rice Crop Monitoring System - A IoT Based Machine Vision	Tanmayee.P	2017	Webcam	Raspberry Pi	➢ The developed system is capable in monitoring and detecting the affective area.

Approach[16]					➢ It has the capability to moving in forward and backward directions. ➢ The webcamCapture the images and after processing these images, if affected area found then the system can spray the pesticide.
A Novel Framework for Smart Crop Monitoring Using Internet of Things (IOT)[17]	Kamal Kumar Ghanshala, Rahul Chauhan, R.C Joshi	2018	Metos NPK Sensor, Moisture Sensor, Humidity & temperature sensor, Soil pH	Arduino Mega2560	➢ Framework has been proposed in this paper to monitor the crops in agricultural fields. ➢ NPK values are measured so the farmer can have the knowledge regarding the fertilization requirement of the fields ➢ Soil Moisture Sensor and temperature sensor will provide the value of humidity and Temperature. ➢ Zigbee Protocol has been used with Arduino Mega for the communication purposes.
Design of IoT Blockchain Based Smart Agriculture for Enlightening Safety and Security[18]	M. Shyamala Devi, R. Suguna, Aparna Shashikant Joshi, Rupali Amit Bagate	2019	------	------	➢ Proposed system has been implemented by the authors using Ethereum Private Blockchain network ➢ IoT device were simulated using the LivCoAP.
IoT and Analytics for Agriculture[19]	Prasant Kumar Pattnaik Raghvendra Kumar Souvik Pal	2020	Soil moisture sensor	ESP8266, Arduino Uno	➢ Solar Power based automatic drip irrigation system has been implemented.

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	S. N. Panda				➢ Water flow from the overhead tank is controlled using the solenoid valve.
AgriSys: A Smart and Ubiquitous Controlled- Environment Agriculture System[20]	Aalaa Abdullah, Shahad Al Enazi and Issam Damaj	2016	Temperature, Humidity, pH, Soil Moisture, Light Sensor	Fuzzy Controller MIMO	➢ Authors introduced a system namely Agrisys based on Fuzzy Controller. ➢ Experimental results provide Increased productivity, Enhanced safety, Easier agriculture procedures, Instant interventions around the clock, Advanced lifestyle
Smart Farming – IoT in Agriculture[21]	Rahul Dagar, Subhranil Som, Sunil Kumar Khatri	2018	Water Volume Sensor, Motion Detector Sensor, Soil pH sensor, Soil Moisture Sensor, Air Temperature Sensor	Node MCU ESP8266	➢ Agricultural process can be made more efficient and accuracy can be increased. ➢ Various sensors have been used to monitoring the agricultural fields.
Smart Drip Irrigation System for sustainable Agriculture[22]	Kavianand G,Nivas V M,Kiruthika R,Lalitha S	2016	TemperatureLM35, humiditySY-HS-220, moisture, soil pH and soil nitrogen sensor	ARM9 processor AT91SAM9G45	➢ Fully automatic drip irrigation system has been introduced. ➢ ARM Processor has been used to fetch the real time controlling.
Implementation of an Automated Irrigation System for Agriculture Monitoring using IoT Communication[23]	Deep Rani, Nagesh Kumar, Brij Bhushan	2019	Soil Moisture Sensor, pH Sensor, water flow sensor	Arduino Uno and ESP8266	➢ A system is designed for the management of water supply to the paddy crops. ➢ ESP8266 provides the data to the server for further future proposes

3. PROPOSED SYSTEM

This paper proposes the system for the green house and open fields. The proposed system is based on the development of device by embedding various sensors, which can detect the various parameters like temperature, humidity, and moisture content of the soil to control the irrigation of the green-house and open-fields for agriculture.

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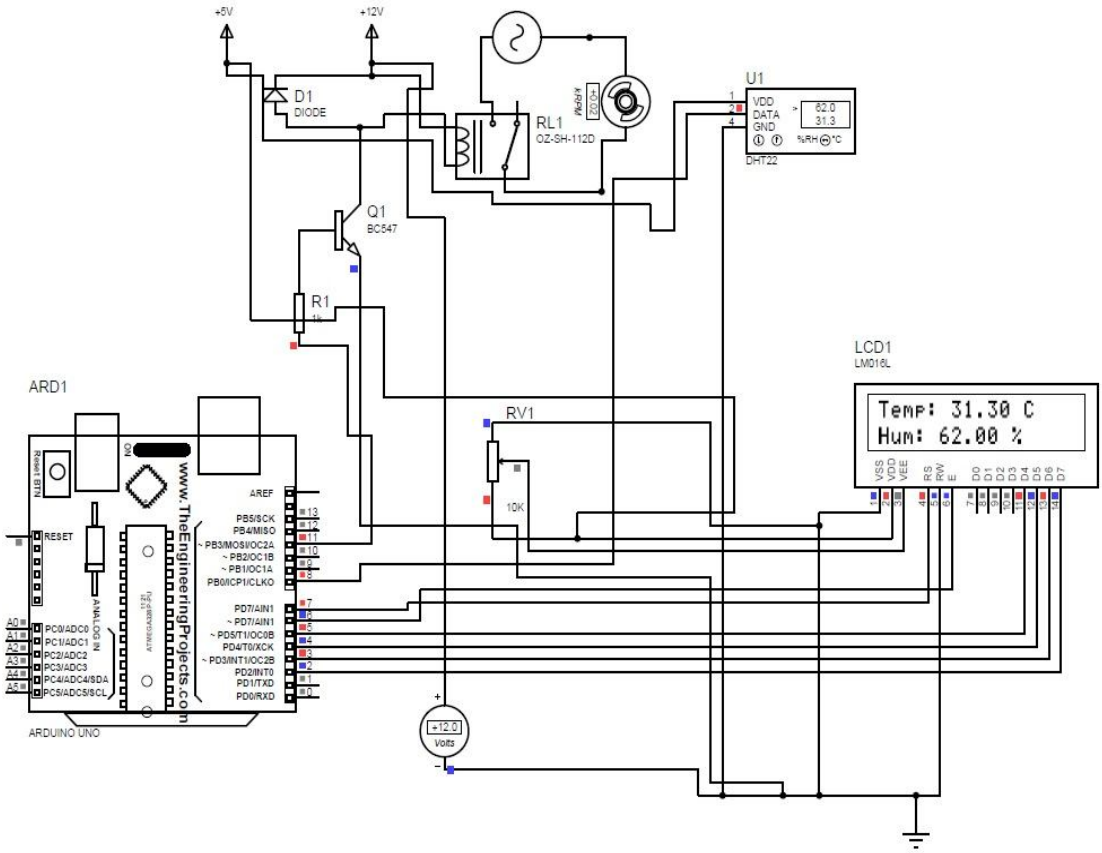

Figure 1. Circuit diagram of proposed system.

Hardware Description:

- Arduino Uno Rev3
- Node MCU ESP8266
- Solenoid Valve
- Relay Module
- Soil Moisture Sensor
- DHT22 (Digital Temperature and Humidity Sensor)
- 16X2 LCD

Software Description

- Arduino IDE

Cloud Based Platform

- NETPIE

Working and Experimental Analysis

In the proposed system NodeMCU ESP8266 is used for the transmission of the data to the NETPIE where we can analyze the data for future purpose. After embedding the sensor to the system we have implemented it in a green-house where experimental results showed us that the

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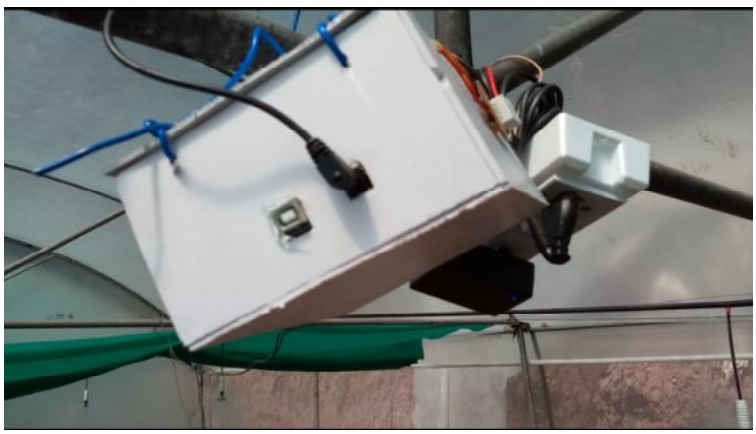
system was perfectly controlling the irrigation, and we were able to control the supply of water for irrigation using a solenoid valve. If talk about the working of the circuit, DHT22 (Digital Temperature and Humidity Sensor) continuously monitors the parameter of humidity and temperature and at a specific value of the parameters it starts and stops the supply of water automatically, similarly to counter any false reading we have introduce the soil moisture sensor to this circuitry which will continuously monitor the moisture content of the soil. On the basis of the experimental setup in the green house we can say that our system provides:

- Easier agriculture procedures
- Fast response system
- Low-cost
- Reliable



(a) (b)



(c)

Figure 2. (a, b, c): Implemented project inside green house

Figure2. a, b, c represents the execution of the proposed system in greenhouse. Although during the implantation of this system we realized that we could switch to solar power for the working of the whole system. However, we also come to know that we need an open water tank to maintain the pressure of water in the sprinklers. As we had faced a problem to maintain the pressure in sprinklers with overhead water tanks due to the role of atmospheric pressure being not applied to the overhead water tanks as they are closed. Readings taken from the proposed system are shown below in table 2. We have checked the readings of the temperature and humidity every hour throughout a day from 6 AM to 7 PM.

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Table 2. Real Time Monitoring of the greenhouse

Temperature (℃)	Humidity (RH%)	Time	Status of Fogging System
19 ℃	65%	6 AM	OFF
19℃	65%	7 AM	OFF
19℃	68%	8 AM	OFF
20℃	68%	9 AM	OFF
24℃	71%	10 AM	OFF
26℃	75%	11 AM	OFF
30℃	78%	12 PM	OFF
33℃	80%	1 PM	OFF
35℃	85%	2 PM	ON
38℃	83%	3 PM	OFF
36℃	84%	4 PM	OFF
35℃	85%	5 PM	ON
34℃	84%	6 PM	OFF
32℃	84%	7 PM	OFF

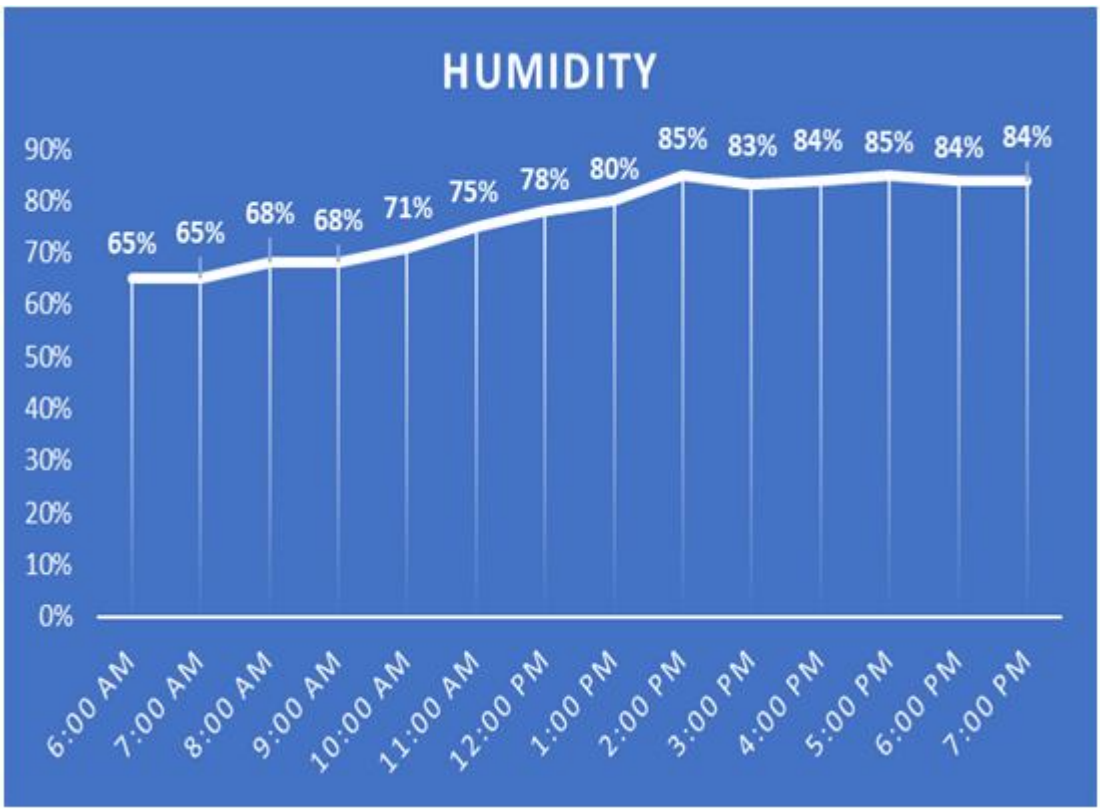

Figure 3: Humidity level measured inside green house.

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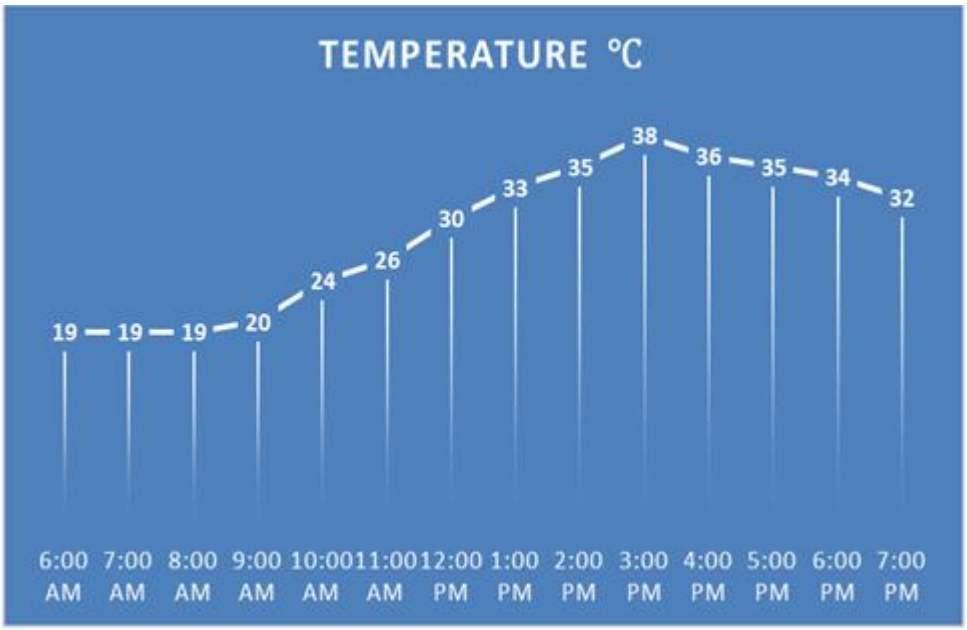

Figure 4: Temperature measured inside greenhouse

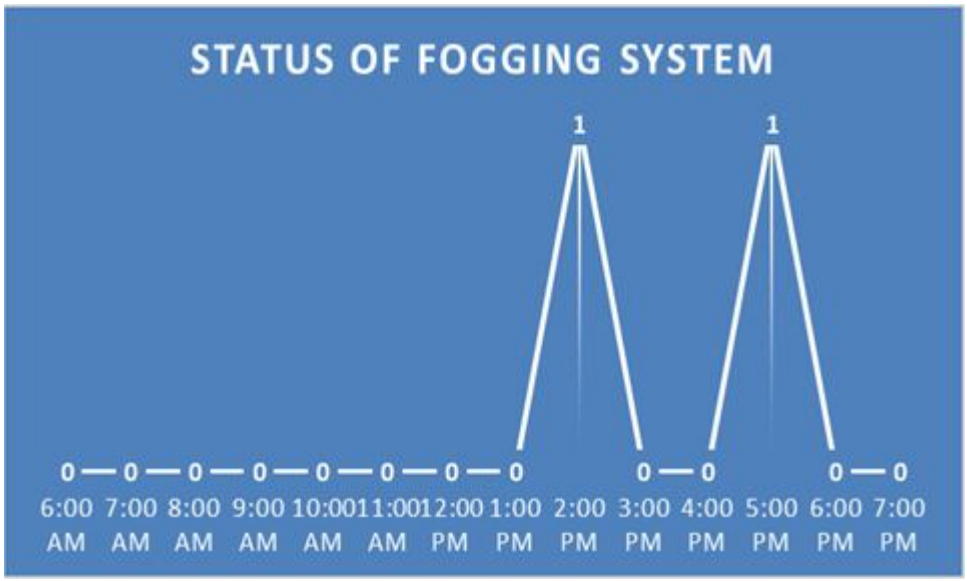

Figure 5: Status of the fogging System inside greenhouse

4. CONCLUSIONS

This paper has presented the design and Implementation of the IoT Based automatic irrigation system. In the proposed system various sensors like DHT22 and Soil Moisture Sensor have been used to sense the specific parameters. For the storage of data IoT Cloud based platform using NETPIE is used for future purposes. Real-time data reading was shown on the LCD screen, as the proposed system using soil moisture sensor and Humidity, temperature sensor we are able to reduce the wastage of water, which always takes place during the traditional methods of irrigation. So, we can say that we have designed and implemented a system for the farmers, which is low-cost device and requires almost zero knowledge of the electronics to use it.

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ISSUES AND CHALLENGES OF WOMEN EMPOWERMENT IN KASHMIR: A STUDY

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ABSTRACT
Women empowerment has been an issue of immense discussions and contemplation over the last few decades worldwide. Today the empowerment of women has become one of the most important concerns but practically women empowerment is still an illusion of reality. Women are the most vulnerable section owing to violence caused by armed conflict and militancy in Kashmir. They are facing many issues and challenges related to education, domestic violence, employment and economy. For human evolution and existence of humanity we need both men and women but still we have witnessed inhumane, unethical and immoral practices against women in Kashmir. It is the fact that women in Kashmir have been denied equal opportunities, equal status and equal position at mostly all sectors of our society especially in Kashmir.In this context, the present study has been prepared in order to know the various issues and challenges faced by women in Kashmir.Based on primary and secondary sources of data and other relevant sources wherever necessary the paper attempts to identify the status of Kashmiri women in the present day changing society related to health, domestic violence & job opportunities and to examine the significance of various policy measures which are being undertaken by the government for the upliftement of women.The author found that there has been a significant impact on these variables.

Keywords: Women, issues & challenges, empowerment, Kashmir

1. INTRODUCTION
History has ineffectively witnessed women's suffering in the formof discrimination, subjugation, exploitation, degradation, aggression and humiliation. In Kashmirwomen are regarded as the inferior. The society of Kashmir is multicultural in nature. Its socio – economic setup have also defined and shaped by varying indigenous and exogenous forces and factors such as political instability, conflict and unrest. Violence aganist women are a result of gender relations that assumes men to be superior to women. Given the subordinate status to women much of gender violence is considered normal and enjoys social sanction. Violence includes physical aggression, sexual abuse, burns, emotional and economic threats and control over speech and actions. Women have been confined within four walls and have limited exposure to modern communication tools, low level of education with limited freedom. Gender discrimination is on rise due to prevailing social, economic and political turmoil's. Women in Kashmir also face a lot of issues and challenges i.e.; domestic violence, unorganised health sector, lack of decision making authority, illiteracy and ignorance and also many cultural practices and customs hinder the women empowerment. Rising inequality can lead to social instability, undermining long term human development progress. The high male sex ratio at birth reflects women's status in society, entrenched patriarchal mores and prejudices, which are an aspect of deep rooted socio cultural beliefs. The key driver however is the combination of patriarchal mores and greatereconomic value of boys in the presence of a dowry system. In contemporary times women are suffering from the issues of domestic violence, sexual harassment, child marriage, female feticide/ infanticide, illiteracy etc. The women's world is limited within domestic sphere also in which for her every activity. She has to follow the patriarchal decisions. She is socialized in such a way that she could perform expected roles in proper manner. Consequently she has been put away from receiving education which restrict her

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to avail employment opportunity to be aware of her rights and duties and to participate in decision making and political affairs of the society in Kashmir. The condition of women is further wretched by the conflict situation. The conflicting situation of Kashmir has snatched women's rights and hit their hardships. A large number of women became widow and half-widows. Though for women empowerment in Kashmir requires strong and sustained commitment by governments and other stakeholders.

2. REVIEW OF LITERATURE

Bader, C (2013) the author stated under this research that women were not safe during the 18th century and that they had to face all sorts of social atrocities and the biggest one was prostitution. Not only women above the age of 18 years but girls who were as young as 10 years of age, were traded by the kashmiri men just because they were getting lucrative sum of money for selling women to the visitors as well as to the men of other states mainly Lahore, Calcutta, Bombay Delhi and Peshawar. Further Punjab, Lahore and Ludhiana were considered as the states where rein most prostitutes from Kashmir were sold. **Gopalan S (2001)** In their research mentioned that remarriage of a widow was banned in Jammu and Kashmir because any women who was widowed was considered as unfortunate for the family of her husband and so it was believed that remarrying her will ultimately lead to the death of her new husband too. All the women of Kashmir were made to pay the cost of superstition in which the people of Kashmir lived for years till they were made aware of the fact that remarrying a widow was not wrong and that women too deserved to live their life freely without any limitations on them. **Bhagat P (2002)** the study reveals that the Kashmir government earned a lot from the taxes that were paid by the registered prostitutes of the state but still the government was never bothered to spend for the empowerment of women. No emphasis was ever laid on the education or development of these women and rather they treated as machines which generated cash for the state irrespective the vegetative state that all the women in the state were living in.

3. RESEARCH METHODOLOGY

3.1. Universe of the study

The universe of the present study constitutes rural and urban areas of Srinagar district of Kashmir valley. As per the census, 2011 of Jammu and Kashmir the total population of Srinagar district is 1,180,570; of which male and female are 618,790 and 561,780 respectively. The literacy rate of women in Srinagar district is 61.81 percent and male literacy rate is 75.87. And the general sex ratio is 895.

3.2. Sampling plan and design of the study

The sampling plan of the present study is based on a sample of 150 respondent selected through stratified random sampling method from rural and urban areas of Srinagar district of Kashmir. Descriptive research design was used to get information from the respondents within the study area and the information was collected through interview schedule.The respondents are stratified on the basis of residence.

3.3. Hypotheses of the study

The hypotheses of the study are as under:

Women empowerment is a very serious issue in the present day changing society. From the past several decades, Kashmir has witnessed that women are suffering from various issues challenges due to domestic violence, unemployment and domestic violence. They are being discriminated in every sphere of life, their social and educational conditions are very miserabledue to the lack of awareness patriarchal nature of society and conservative approach of the people towards women empowerment. This kind of attitude of the people has hindered the

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process of women empowerment in Kashmir which has increased the vulnerable position and women are lacking behind in the process women empowerment.

3.4. Objectives of the study

1. Toanalyse the status of Kashmiri women in the present day changing societyand to identify the various issues and challenges related to health, domestic violence, economy job opportunities in the study area;

2. Toexamine the significance of various policy measures which are being undertaken by the government for the upliftement of women in the study area;

4. RESULTS AND DISCUSSIONS

The findings of the study are as follow:

4.1. High level of domestic abuse due to their vulnerable position

Domestic abuse is a major concern of the present society. Women are suffering from domestic abuse and these have been seen in past few years. In this context the respondents were asked to express their opinion which is shown in the below table:

Table 1: Domestic abuse & vulnerable position of women

S.No	Theme	Response	Number	percentage
High level of domestic abuse due to their vulnerable position		Yes	98	65.33
		No	52	34.66
Total			**150**	**100.00**

Source: Based on field study carried out in Srinagar, in the year 2020

The above table depicts that out of 150 respondents, 98 respondents (65.33 percent) are of the view that women in Kashmir are definitely subject to high level of domestic abuse specifically with rise in domestic violence cases that are extremely nerve wracking and also reveals the evil side of the society and the remaining 52 respondents (34.66 percent) are of the opinion that kashmiri women are extremely powerful and strong because of which today even after suffering from domestic violence they have the option of going to the court and claiming their rights. The study further reveals that the majority of the respondents show that women are definitely in a vulnerable position and this is the reason because of them being subjected to high amount of domestic violence that shall be eliminated by taking specific legal measures that could help and empower the status of Kashmiri women in the present contemporary era.

4.2. Kashmir conflict substantially impacted the position of women in present scenario

Kashmir conflict becomes an ongoing problem. It causes stress, depression, anxiety and resentment among all especially women. In this context the data is collected from the respondents shown in the below table:

Table 2: Kashmir conflict & the position of women in the present

S.No	Theme	Response	Number	Percentage
Kashmir conflict substantially impacted the position of women in present scenario		Yes	150	100
		No	0	0.00
Total			**150**	**100.00**

Source: Based on field study carried out in Srinagar, in the year 2020

The above table indicates that 150 respondents, (100 percent) of the respondents are of the view that the position of women has deteriorated substantially after the initiation of insurgency and conflict within the Kashmir. The study shows that all the women have definitely suffered a lot because of the state insurgency and conflict. The reason for such is that due to excessive and

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daily conflict women are unable to come out of their homes, thus hampering their ability to go out and work for their family.

4.3. Government policies implemented effectively for upliftement of women

There are number of government policies for the upliftement of women but these policies are not implemented effectively. In this context the respondents were asked to express their views which are shown in the below table:

Table 3: government policies for upliftement of women

S.No	Theme	Response	Number	Percentage
Government Policies implemented effectively for upliftement of women		Yes	60	40.00
		No	90	60.00
Total			**150**	**100.00**

Source: *Based on field study carried out in Srinagar, in the year 2020*

The above table shows that 60 respondents (40 percent) are of the view that many policies and measures are effectively implemented for the upliftement of women and 90 respondents (60 percent) are saying that the steps taken by the government are not implemented effectively. Thus the study indicates that most of the respondents are of the view that many policies and programmes for the upliftement of women are taken from time to time by the government but no such results of these policies has come out yet and despite these policies there is no improvement in the condition of the women. No doubt many policies and schemes benefited to some extend but still they are victims of many social evils like dowry, illiteracy, rape and molestation.

4.4. Government efforts to create better employment opportunities for women

Unemployment is a social issue of serious concern at the present both in Kashmir and national level. Work opportunities have not kept pace with the increasing population. Unemployment rate is high and the problem of unemployment is more prevalent among women in Kashmir. In this context the respondents were asked to express their opinion which is shown in below table:

Table 4: Employment opportunities and women

S.No	Theme	Response	Number	Percentage
Government efforts to create better employment opportunities for women		Yes	40	26.66
		No	110	73.33
Total			**150**	**100.00**

Source: Based on field study carried out in Srinagar, in the year 2020

The above table depicts that 40 respondents (26.66 percent) are of the view that the government is taking effort to create employment opportunities for women and 110 respondents (73.33 percent) are of the view that the government is not really taking any significant efforts for generating employment opportunities for kashmiri women. Thus the study shows that there is no employment opportunity for women and they believed that the opportunities which are available are not enough to provide them equal opportunity as opposed to men.

5. SUMMING UP

Thus the women in Kashmir are treated as inferior. She spends most of the time in domestic chores. They are confined into four walls of the houses. They are facing so many issues and challenges like sexual harassment, dowry system, economic and emotional threats, illiteracy, ignorance, domestic violence, molestation etc. the women condition further wretched by the conflict situation. This situation in Kashmir snatched all the rights and freedom of women and number of women becomes widow and half widow. The policies and schemes of the

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government try to address the issues and challenges of women to some extend but all these are not sufficient for women empowerment. There is need of the time that the government should take some concrete steps and remove all the barriers which comes into the way of women empowerment.

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OUTLINE OF THE RAJBANSHIS CULTURE OF WEST DINAJPUR: A BRIEF ANALYSIS

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ABSTRACT
'Culture' means the life of creation. The inner idealism which manifested by the creation of a man is called 'culture'. People's livelihood, their eating habits, movements, mourning, joy, pain, education, language, dress, behavior, story-telling, daily work etc. are called together 'culture'. The culture of all humnan beings are not be the same, yet the citizens of the same country. There are different types of cultures in different geographical locations, different ethnic and religious groups of people. Although cultures flourish on languages yet, there noticed different cultures among the same language speaking communities due to the contrast on belief and attitude among them. Therefore, despite being the same caste or community, there is a distinction between the culture among them. That is why culture is not the same between the Bengali-language speaking Bengalee communities and Bengali-speaking Rajbanshi community. There may also be differences between Bengali-language speaking Rajbanshi people and Hindi-speaking Rajbanshi people. There are both similarities and differences between the culture of the Rajbanshis of different districts. It is true that the life of the people, the social and cultural characteristics of the people is different according to their geographical location, environment and surroundings. Therefore, the characteristics of the culture of the Rajbanshis is not the same of every districts of North Bengal. 'The outline of the Rajbanshis culture of West Dinajpur district' is formed by the ingredients of geographical location of West Dinajpur, surroundings of the district, life-style of the Rajbanshis, status of education, socio-economic condition, languages, rituals, customs etc.

Keywords: Rajbanshi, Indigenous People,Society, Culture, Formation,Transformation etc.

INTRODUCTION
Nobody is born as a caste on earth. After birth of a child, his identity sets up the existing social system. So a person's identity becomes changed in terms of time. As a result, a persons conduct and behavior may be differ among the ancestors and descendants, even the overall socio-cultural systems became fragile and took new identity of the human society. The identity of a strong group of people takes too much time to disappear, but relatively the less dominant group of people does not take much time to disappear. In terms of time or obligation, the identity of a person may be change. Many times the old identity disappears and they get new acquaintance in the society. In different historical periods, many tribal people abandoned their profession and took agriculture as a profession and later occurred evolution towards their caste and culture. So no caste on earth is a pure caste today. Every caste has become a mixed caste today.

In the discussion, the caste identity of the Rajbanshi might have been different and they has been named as "Rajbanshi" through the time of evolution. However, today the Rajbanshis are bear the identity of an established ethnic group of North Bengal. Rajbanshi refers to the descendants of the Kshatriya king and they are known as 'Rajbanshi Kshatriya'. Once they were the descendant of the Kshatriya ruler, so they are known as the 'Kshatriyas'. The Kshatriya kings were dominated in the early-medieval period. So their descendants and followers are known as 'Kshatriya Rajbanshi'.

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Rajbanshi refers to the descendent of the King. Those who belong to the king are called 'Rajbanshi'. The Rajbanshis are the descandents of which king, it is clearly not mentioned anywhere. In ancient times, various dynasties ruled in India and their followers were called themselves as descendants of that king. However,the real descandent of the king is hidden among the primitive caste and communities. Because there was no separate identity of every ethnic group during that time, identity of the other members of any community was revealed by the identity of their leader of the concerning tribe. Therefore, the people of every backward community were known to be the clerical leaders or the loyal subjects of the king. But when the king's fall, the common people were afraid of losing their identity. So they tried to find their existence by identifying the corresponding king. In this way, the Rajbanshi caste has emerged as a special follower of the king. Once the region of Dinajpur was known as Pundravardhana. So the people of this region were known as 'Pundra' or 'Pod'. And those who were associated with the Royal administration, they came to be known as Kshatriya or 'Paundra Kshatriya'. It is known from the sources that in the contemporary period of ancient Indus Civilization, a strong state was created in eastern India called '*Pundradesh*' or the land of 'Pundra',whose capital was named Mahasthangarh. The place is currently located in Bangladesh. An advanced civilization was developed centred by the capital named Mahasthangarh in the land of Pundra which spread throughout Pundra-Radha-Banga. The main center of this great civilization of Pundradesh was Kotivarsha. It was an ancient city and administrative center located in the middle of West Dinajpur.

Once the people of different blood group were lived in this region like, Australians, Mongolians, Alpine, Adi Ardic, Austric etc. In the era of the Mahabharata, there ruled a powerful king named Basudeva Pundra in this region. All the people of this land once used to bear the identity of the Kshatriya king.So the people of Pundradesh were called '*Pundra*'. The king of Poundra was himself belonged to Kshatriya, so he called the king of 'Poundra Kshatriya' and the people of that country were called '*Pandra Kshatriya'*. Among the Pundra Kshatriyas, there lived people belonging to different ethnic groups like *Andhra, Pundra, Sarbar, Pulind, Mutib, Ashura* etc. in the subsequent period, people of different ethnicities received different titles based on occupation and work. But the backward class of people who were majority of the society were not able to attain self-reliance in the society based on their own work or profession. They have been living in this region for a long time bearing the identity of the king.

Most of the ethnic group of people of that region, were belonged to Pundra, Kshatriya, Poundra Kshatriya etc. In the Maurya era, many people of Pundra's country were convinced in Ajibik, Sahajiya, Jaina, Buddhism and collected their own designations through the nature of their occupations. '*Pundradesh*' became 'Pundravardhana Bhukti' in Gupta era and most of the people of that region were converted into Vedic Brahminic religions and were employed in different occupations. Later, in the Pala period, the Pala kings were Buddhist, so some portion of the people were transformed into Buddhism. Some parts of Pundravardhana are included in the Varendra region during the Pala period. The people of this region were engaged in different occupations and activities in the Pala period and got separate identity. During the Sena age, the influence of Vedic Brahminic religion increased in this region. As a result, the people of these regions have an impact on religious and social life. But after the arrival of Islam in 1204, people have been suffering in the lives of local residents. Most local residents were converted to Islam due to fear the sword or influenced by the idealism of the Islam. Although they did not behave in Islam, their next descendants became converted to Islam. And those who could keep playing Kshatriya religion, one part of them is now living as the identity of other ethnic groups as the upper class of society. The rest of the people live in the name of 'Rajbanshi Kshatriya' or

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'Rajbanshi' with the name of the greater Rajbanshi community. They are the people of the Rajbonshi community recognized by the constitution today.

In the first half of the sixteenth century, the rise of the Koch-Dynasty in the centered by Kuch Bihar, led to the formation of a community as a follower of the king. In fact, the dynasty established by the King of Koch Bihar is known as 'Koch-dynasty'. The followers of the Koch-kingdoms were borne as the descendants of the Koch-King. As a result, the followers of the Koch-Kings were also revealed by self-expression as 'Rajbanshi'. But along with the Koch-dynasty, the existence of the 'Rajbanshi Kshatriya' caste was also present. Of course, the number of Kshatriya Rajbanshis was low. It is seen, in this way, people of different ethnic groups have become the followers of the king. Actually, instead of bowing down to Islam's strict repression in Bengal, most of backward people became a follower of the Koch-King. In this way, Kshatriyas were also got mixed with the followers of the Koch-dynasty. As a result, the Koches and the Rajbanshis became involved in the same society and culture. So, the British officials have identified of both of the 'Koch' and 'Rajbanshi' as the same ethnic group of people in different census repots.

Western part of greater Dinajpur,i.e.the land of West Dinajpur was under the administration of Islam rule for a long time, so there was no power and influence of the Rajbanshi people. The number of Rajbanshi families are reduced from the land of Dinajpur due to conversion into Islam. Therefore, the Rajbanshis of this region lived for a long time with their own society and culture as a minority community. It is worth noting that the Rajbanshi and Muslim villages were located nearby, but they did not have any communal disputes. Rather, social relationships were developed between them. Thus, some of the religious rituals of Islam have entered into the Rajbanshi society. Rajbanshis were minor, so it was possible. After the forty decade of the 20th century or since the beginning of India's independence, occurred penetration of the Rajbanshis to West Dinajpur. After 1947, the political and religious crisis was created in East Pakistan for various reasons during the years of 1952, 1962, 1971. As a result, the Rajbanshi people were entered to India from different districts like Dinajpur, Thakuragao, Panchagarh, Rangpur, Bogra, Naogaon, Gaibandha, Joypurhat, Nawabganj of East Pakistan. After entering India, they took shelter in various police stations of border areas of West Dinajpur. The density of population in this region of greater Dinajpur was not so much at that time. Though there was a large number of Muslim families, some of the prosperous families of Rajbanshis lived in this region. With the help of them, the Rajbanshi refugee families from the East Pakistan were took easy accommodation in West Dinajpur. Although many families of the refugee Rajbanshi took shelter in the government camp, some refugee Rajbanshi families were able to build houses on government vest lands by the help and sympathy of the local Rajbanshi Jotedar families.However, some Rajbanshi families were bought land in different areas of West Dinajpur with their own money. Ofcourse, only those who had relatives in West Dinajpur areas were successful.Later, they built houses in that field. In fact, the relatives of Rajbanshis were spread across different regions of undivided Dinajpur and in 1947, when their partition was done, their own relatives were divided in the same way. As a result, with the help of the Rajbanshis living in the Indian state of West Bengal, the Rajbanshis of East Pakistan were able to buy land in different parts of the state. It was also for the families of the non-Rajbanshi people.

Bangladesh was independent in 1971 but the refugees who came to India before 1971, they did not return to Bangladesh. They lived in different villages and tows in West Dinajpur district. Subsequently, they made Indian citizenship by submitting the receipt of land revenue or by the help of various political parties.Thus, in the period from 1947 to 1992, the number of Rajbanshis increased due to enter the Rajbanshis from the East Bengal to West Dinajpur district.

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So, after the subsequent census reports of 1941, it was found that the number of Rajbanshis of West Dinajpur district increased significantly. Thus, the number of Rajbanshis increased in the census report of 1971, 1991 and 1991. In the initial stage, there is a social and cultural conflict among the Rajbanshi families who had come from East Pakistan with the local Rajganshis, gradually they are mixed in the process of mutual coexistence and association with each other. The relations of both the Rajbanshis of two neighbouring countries have developed due to living in te same land and same environment for long time.The greater Rajbanshi society was developed in West Dinajpur district by organizing social programs, commuting, eating, and marriage. Rajbanshis are generally conservative in their social and cultural practices, customs, worship, popular culture etc. So it took a long time for easy interaction and coordination between the Rajbanshis of the two countries. However, among the Rajbanshis of West Dinajpur district, some non-Rajbanshi people have entered in different ways. The number of Rajbanshis has increased by establishing marital relations, getting the constitutional benefits, raising their social status, due to lack of census reports etc. Thus Rajbanshi society of the West Dinajpur district was formed with the Rajbanshis of the two countries today.

FORMATION OF THE RAJBANSHI CULTURE

The ancestors of the Rajbanshis lived in group-wise. If the number of families with general interest is more or less the share of each other, then the sum of families is called a group. But the term of the group can not last long. So at the same time, the same purpose, interests, thoughts and equal groups together form a separate society. The Rajbanshis have been formed in their own society beyond the greater society, by living the same geographical environment, same place for long and following the same language, the use of food, dress and customs, social customs, public beliefs and ideas of people etc. Various customs and rituals were introduced to the Rajbanshi society in different ways. These customs and rituals have long been well cared for and celebrated by them. By the way, those customs and rituals have become their own customs. Once these customs and rituals were not confined to the Rajbanshi society, it was spread out in the larger society. Other communities of greater society have become suitable for the era by adopting modern education. But for the conservative mindset, the Rajbanshis could not leave the old customs and rituals of the society. In the process, the social customs and rituals abandoned by the larger society have become the customs of Rajbanshi society.

It is true that, the characteristics of life, society and culture is varied according to geographical location. Therefore, the characteristics of the society, culture and living conditions of the Rajbanshis of all districts of North Bengal are not the same. A mixed culture has been created among the Rajbanshis of West Dinajpur district. In the mixed culture, there is seen to be touched of the Rajbanshi culture, Bengalee culture as well as Islamic culture. The word of 'culture' was first imported into English literature at the end of the sixteenth century by Francis Bacon. In the middle of the twentieth century, the use of the term 'culture' in the writings of English scholars in broad and deep sense by Robert Era Park and Tailor etc. The meaning of 'culture' means that any society or nation has a standard use rule in a matter, it is called the culture of the respective community of people in the form of a fairly universal character, behavior or attachment. In essence, culture is an individual personality, or culture of community and the community is culture. So in the life of the Rajbanshis of West Dinajpur district, there developed own culture by the ingredients of different communities cultures.

In every society, there are some disciplines that govern man's behavior, and a person follows the social customs in his conduct. These customs, which are common and established in the society and conduct the behavior of the dwellers of the society, are called Social Custom. According to E.S.Rogardus "Customs and traditions are group accepted techniques of control that have become well established that are taken from generation to generation." As the medium of social

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control, the influence of customs is observed in all societies of the world. Tradition is permissible by the society and the various rituals of acceptable conduct to the public. In the Rajbanshi society, they have to follow their customs and social customs in the society simultaneously.

People live in the environment of nature and have created some special methods of conduct for life and livelihood. Special behavioral methods have emerged in different areas of the life of the people which involved in society. Consumption of food items, preservation, preparation and adoption, marriage and sex life, dress-wear etc. All these methods of conducting behavior in different areas of society are followed in the society. These rituals are known as 'folklore' or popular usage. The folklore is not prescriptive but has existed in society for a long time and they got access to scripture by supporting a part of the priests.

The geographical location of West Dinajpur district is different from other districts of North Bengal, which is east of the long border of Bangladesh, Bihar on the west, Darjeeling district on the north and Malda district in the south. At the same time, the social, cultural and living conditions of residents of Bangladesh, Bihar, Darjeeling and Malda districts affect the residents of West Dinajpur. Rajnanshi is not majority in West Dinajpur, but their effect of work is not easy to influence on other communities. But in other districts of North Bengal, especially in the districts of Jalpaiguri and CoochBihar, their influence falls on other communities due to the majority people of the Rajbanshi community. Rajbanshis of West Dinajpur was deprived from other districts of North Bengal and completely outside the influence of Calcutta. As a result, the society and culture of the Rajbanshis of West Dinajpur have met together by the culture of local Rajbanshi people, the Rajbanshis of different districts of Bangladesh, culture of refugees, culture of Malda and Bihar residents. Besides, there has been the influence of Islamic culture among the local residents due to the continuation of Muslim rule in West Dinajpur region for a long time. Until the Partition of 1947, two types of cultures had high prominence in the adjoining West Dinajpur region. One Muslim culture and other is Rajbanshi-Polya culture. There was a similarity with the Rajbanshi-Polyaya culture of West Dinajpur to the culture of Rajbanshis in other other districts of North Bengal at that time. But since the independence, the cultural elements of this region have changed a little bit. Although the material of Muslim culture is one, but there imported different cultural ingredients into the culture of Hindu and Rajbanshi society.

So the information about the Rajbanshis is not available in various books to build the outline of the Rajbanshi culture of West Dinajpur. Most of the information is absent from Rajbanshi culture of West Dinajpur. Among the Rajbanshi cultures of West Dinajpur, there are 60 percent of the cultural elements are present from the Rajbanshis of North Bengal. Out of the remaining 40 percent of the cultural component, 20 percent cultural materials of the Rajbanshis of the eastern Bengal, 10 percent Vedic Hindu culture and 10 percent Islamic cultural elements have been entered into the culture of the Rajbanshis of West Dinajpur. As a result, the culture of the Rajbanshis of West Dinajpur, is not pure Rajbanshi culture. The culture of the Rajbanshi society of West Dinajpur has become a 'mixed culture'. Rajbanshis are usually simple and liberal in nature, so they can easily adapt any other culture of different communities. So the social relations between the Rajbanshis are very strong. In most Rajbanshi families, there is a virtuous priest who is called '*Guru Thakur'* or '*Guru*'. Once there were accustomed the '*Tradition of Jajamani'* among the Rajbanshis of the West Dinajpur. Rajbanshis of West Dinajpur were adopted discipleship with initiation of 'mantras' or 'chant' from '*Jajman*' or Priest. Naturally, according to the instructions of the 'Yajaman' or Priest, all family rituals and customs were run in the Rajbanshi familis. The virtuous priests or '*Jajmanas*' are usually the Brahmin clan. As a result, Brahmin culture and behavior were introduced in the Rajbanshi families through the

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Brahmin Priest. So, the ingredients of upper Hindu cultures are seen in the Rajbanshi culture of West Dinajpur.

Since 1947, Rajbanshi people came to West Dinajpur to the people of Hindu communities from East-Pakistan or present Bangladesh. People of the Rajbanshi community who came to West Dinajpur did not come from a particular region or districts. They came from different districts of East Pakistan or Bangladesh. Therefore, there was no similarity to the mutual cultural elements among the people of the Rajbanshi community coming from East Pakistan. Besides, along with the culture of local Rajbanshi-Poliya-Cultural component of West Dinajpur, combined with the cultural elements of the Rajbanshis people of East Pakistan or Bangladesh and formed rich Rajbanshi culture by mixed cultural elements. That is the Rajbanshi culture of West Dinajpur which combined with the culture of Greater Dinajpur, culture of Thakuragao district, culture of Panchagarh district, culture of Rangpur, Culture of Bogra, culture of Naogaon district, culture of Gaibandha region, culture of Joypurhat region, culture of Nawabganj region, culture of Rajshahi district is one of the them. It is not the end here, the cultural elements of the Rajbanshis of West Dinajpur have been combined with the culture of the neighbouring Bihar state and cultural elements of Malda district.

Since 1947, the traditional social customs and rituals of the Rajbanshi family came under coup. The people of the Rajbanshi community took shelter at West Dinajpur with the people of other communities of Hindu society from different districts of East Pakistan, like Thakurgao, Panchagarh, Rangpur, Bogra, Naogaon, Gaibandha, Joypurhat, Nawabganj, Rajshahi etc. due to partition of India in 1947.People of the Rajbanshi community who came from East-Pakistan or Bangladesh, they mainly took shelter in Rajbanshi villages of different blocks of West Dinajpur district. Once only the people of the Rajbanshi community were lived in the Rajbanshi inhabited villege and there did not live any families of other communities. Since 1947, Non-Rajbanshi people have started living in the Rajbanshi inhabited villages of West Dinajpur district. As a result, the customs and rituals of other communities have been infiltrated with the culture and society of the Rajbanshis of West Dinajpur.

INGREDIENTS OF THE RAJBANSHI CULTURE

Prior to 1947, the cultural elements of Rajbanshis were fairly similar in the adjoining areas of West Dinajpur district. But since 1947, cultural elements of the Rajbanshis of East-Pakistan or Bangladesh met together with the local Rajbanshi-Paliya cultural materials. Thus, the traditional culture of the Rajbanshi society of West Dinajpur came together with folk culture of the Rajbangshi families comming from different regions or districts of East-Pakistan or Bangladesh. As a result, the folk culture of West Dinajpur is full of variety of diversity. This cultural theme of West Dinajpur has been combined with the Islamic cultural element, the cultural elements of the lower caste Hindus and the cultural elements of upper-caste Hindus. The cultural elements are exchanged among the inhabitants of different religions and communities due to living together in the same land. As a result, the folk culture of West Dinajpur spread among the different religions communities and it is very difficult to separate them from the each communities. Although, most of the elements of folklore have disappeared among the various communities, it is remained as folkculture among the Rajbanshi community. Because the Rajbanshis have adopted and kept many aspects of their folk culture for decades. In course of time, folk cultural elements have become their own culture.

Thus, some folk dances were entered into the Rajbanshi culture, like *Palatia songs, Chikni dance, Ghamhira song, Behar dance, Hudum dao dance, Mashan dance, Mask dance* etc. Various folk games were involved in the Rajbanshi culture like, *Leaf hiding, Iching Biching, Jumping,* leaf, *Gollachat, Baichi, Hidding* and Dhappa, *Gadol, Ashkash, Marbel, Buraburi, Kut-*

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kut,ekka-dokka, Bag-Bakri game, danguli game etc.The rituals of ritualistic gods are mixed in the Rajbanshi culture. For example, *Lokbatta, Dala Puja, Nabnana, Amait or Ambubachi, Hudum Deo, Banger Biyao, Gumbhira Puja, Pusuna* or *Paush Parwan, Kashpuja, Gite Pooja, Gochhorpon or Gachibuna* etc. Besides, there includes in the Rajbanshi culture, like folk-riddles, folk tales, folk songs, folk fairs, crafts, tradesmiths, shola art, kantha art, idol industry etc. Among the Rajbanshis, there is a trend of folk dances such as *Gram Devata, Mashan Puja, Worship of Mather, Worship of Folk God* etc. There are some songs that are popular in the society, but they are found only in Rajbanshi society alone. For example, *Kandani Bishahari song*, song of Rice paddy cutting, song of the peasant etc. The use of different musical instruments such as *Do-tara, Khanjani* etc. have been used in the Rajbanshi society for a long time. Besides, the Rajbanshis have their own spoken language or mother language. In addition to speaking in Bangla, Rajbanshis used their mother tongue as Rajbanshi or Kamtapuri language as the medium of communication. Gearson First observed this language, according to him, "When we cross the river (Bhramhaputra) comming from Dacca,we meet a well marked form of speech in Rangpur, and the districts to the north and east. it is called Rajbanshi."

RECENT TRENDS

Rajbanshis are the original inhabitants of greater North Bengal. Rangpur, Dinajpur, Cooch Behar, Jalpaiguri, Rajshahi, Mymensing etc. are the original inhabitants of Rajbanshis. Community. The Rajbanshis living in the West Dinajpur district have coexisted together in greater Dinajpur, Thakuragaon, Panchagarh, Rangpur, Bogra, Naogaon, Gaibandha, Joypurhat, Nawabganj and Rajshahi districts of West Dinajpur. From the time of 1947, the evolution of the original inhabitants of the Rajbanshis took place and spread to abroad. Some families of Rajbanshis spread across Tripura, Assam, Bihar and West Bengal. After the central government's rehabilitation process, some displaced families were given rehabilitation in Orissa and Dandakaranya. In this way the life and livelihood of the Rajbanshis evolved. Once upon a time the Rajbanshis used to depend on the local economic source. So, the Rajbanshis did not have any particular occupation. Over time, the livelihood of the Rajbanshis has changed.

Since the seventy decades of the twentieth century, it has observed the tendency towards the Rajbanshi families to get out of their conservative mindset. For the conservative mindset, the Rajbanshis used to live for a long time continuing their primitive society, culture and way of life. Over time, all the primitive falk culture, the society and the cultural elements are identified as the culture of the Rajbanshi of the society. As a result, easily fall back to other communities of the contemporary. As a result, they were identified as a separate community of people in the larger society. However, they are the indigenous inhabitants of West Dinajpur district. Their overall development should be the first but they gone back to the last row of the society due to lack of modern education. The introduction of modern education among the Rajbanshi society and the changing of social customs and rituals were done in various ways. Thus, till 1947-1992, the traditional customs and rituals of the Rajbanshi society have been changed in different ways these are social customs, rituals, folk foods, cloths, folk technology, faith, cultural activities etc. As a result, some traditions and customs of Rajbanshi society were lost, and some of those were added.

In order to livelier, people collect cultural material from a larger society. In course of time those are turned into their own cultural materials. Various elements of folk culture of different districts of East-Pakistan or Bangladesh have been merged in the Rajbanshi society of West Dinajpur. But in time, all those folk cultures have become virtuous in the Rajbanshi culture. After a long time being implemented as a part of the Rajbanshi society, in course of time those cultural elements have changed. As a result of the entry of the light of modern education among

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Rajbanshi society, some elements of the cultural activities have eliminated from the Rajbanshi society. Again, some elements of Rajbanshi culture evolved and some gradually disappeared.

Gradually, the popularity of folk cultures like, *Palatia songs, Chikni dance, Ghamhira song, Behar dance, Hudum dao dance, Mashan dance, Mask dance* etc. were reduced in the Rajbanshi society. This folk dance has been completely closed from many areas of West Dinajpur district. Various people's activities in the Rajbanshi society, such as *Leaf hiding,Iching Biching, Jumping, Gollachat, Baichi, Hidding and Dhappa, Gadol, Ashkash, Marbel, Buraburi, Kut-kut,ekka-dokka, Bag-Bakri, Danguli* etc. were disappeared from the Rajbanshi society. Instead of these games, some popular game has introduced like, cricket, Football, Batminton etc. As a result, the compatibility of large-scale sports has been preserved.

Ritualistic rituals mixed in and adorned in the Rajbanshi culture. There is a decrease of some folk festivals like, *Lokbatta, Dala Puja, Nabnana, Amait or Ambubachi, Hudum Deo, Bunger Biyao, Gumbhira Puja, Pusubuna or Paush Parwan, Kashpuja, Gite Pooja, Gochhorpon or Gachibuna* etc. Once in every Rajbanshi family, it is a form of compulsory behavior, but these rituals are not present today.Many Rajbanshi families have no idea about those practices. These rituals seems to like a phantasy story to the new generation.

Apart from this, there is no practice towards some folk cultures among the Rajbanshi society today like, folk tales, folk songs, folk story listening etc. Folk festivals arose from the Rajbanshi society as well as cottage art,crafts,shoal art,idol art etc. At one time, many Rajbanshi families were engaged in crafts, cottage art, shoal art, and folk festivals. Rajbanshi elderly women used to stitch their Kanthas. When did sewing in exchange for his work and money. Those works were seen very often in the Rajbanshi villages.

Once upon a time, some songs were present on the occasion of various activities in Rajbanshi society. For example, Kandani Bishahari song, song of Rice paddy cutting, song of the peasant etc. In that village, the land is all but there is no longer a farmer or song. The use of different musical instruments during private or home occasion such as Dotara, Khanjani etc. were used in Rajbanshi society for a long time. When any program started at home, all those people would be doing domestic shows with musical instruments. Especially in the month of Bhadra(Bengali month), these songs were held in the program. But there is no practice pf those falk song in the Rajbanshi families today.

CONCLUSION

As a result of continuing to live in the same land and to follow the same social customs, rituals, beliefs, food clothes, language and culture, a separate society and culture have developed among the Rajbanshis. That is the Rajbanshi society and culture. This society and culture of the Rajbanshis possess a slightly different trait from the larger human society. Since the formation of West Dinajpur district in 1947, the society and culture of Rajbanshis of greater Dinajpur were divided. A stream of Rajbanshi culture was known as the Rajbanshi culture of Bangladesh and another stream of Rajbanshi culture was developed in the name of Rajbangshi culture of West Bengal. From the time of India's independence, elements of different cultures came into being in Rajbanshi culture and grew up in a mixed culture, which is different from the Rajbanshi culture of pre-independent India. In the culture of the Rajbanshis of West Dinajpur, the elements of the Hindu culture is seen as a variant of the Rajbanshi culture, and there are also some features of Islamic culture. However, the culture of the Rajbanshis of West Dinajpur district is composed by the Rajbanshi and Non-Rajbanshi cultural elements like, languages, food, clothing, rituals, customs, customs etc. But gradually the evolution of the culture of the Rajbanshis continued due to modern education. During the period from 1947 to 1980, the culture of Rajbanshis of West Dinajpur was formed with mixed elements of ther communities and since the 1980s, the

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Rajbanshi culture of this district has been started. Since that decade, the Bengali Hindu culture of West Dinajpur started entering. Even the differences between the culture of the residents of the town and the educated Rajbanshis and the culture of the little educated rural Rajbanshi people. As a result, the modern trend in the Rajbanshi culture and traditional and old continues simultaneously. As the rate of education increases among the Rajbanshis, the old trend continues to be decaying to the modern trend. So since the 1990s, the modern trend of Rajbanshi culture became strong and many elements of the old trend were suppressed. The number of old-fashioned holders and carriers continued to decline and the modern trend became the subject of Rajbanshi culture. So since 1947, different elements of Rajbanshi culture have changed in every decade. Of course, now many elements of Rajbanshi culture are extinct and there is an addition to the new cultural material. As a result, with the Rajbanshi culture component of West Dinajpur district, there is very little difference between Bengali Hindu culture. Although not only in the rural areas but also in rural areas of West Dinajpur.

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PERFORMANCE EVALUATION OF APACHE HADOOP, APACHE SPARK, AND APACHE FLINK

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ABSTRACT

The applications of big data processing is continuously extending to wide range of areas such as social media analytics, public administration, Business analytics, scientific research, recommendation systems, human sentiment analysis, etc. Therefore there is an urgent need to have conclusive and decisive evidence to determine the big data tools which provide high performance mainly in terms of speed of throughput, scalability, type of data big data processing (static/stream). This study aims to provide an empirical support for the performance of three very widely used tools in big data. Apache Hadoop, Apache Spark, and Apache Flink have gained a lot of attention due to their distinct characteristics for processing and analytics of big data. Although these frameworks are independent of each other and based upon different working principles they can all be categorised as big data processing tools. All these tools can be used for batch data processing. However Hadoop Mapreduce framework ca not be used for stream data processing therefore in this study only batch data has been considered for performance evaluation.

Keywords: Big data processing, Business analytics, computational power, datasets, data analytics, decision making, performance.

1. INTRODUCTION

In the past decade the amount of data being created has skyrocketed. More than 30,000 gigabytes of data is generated every second [1], and the rate of data creation is only accelerating. The data we deal with is diverse. Users create content like blog posts, tweets, social network interactions, and photos. Servers continuously log messages about what they're doing. Scientists create detailed measurements of the world around us. Big data analytics is being used to monitor traffic and detect route damages in real time. Big data is also transforming many public administration sectors such as waste management, healthcare services, employment services, optimising tax collection [2]. Internet is the largest source of data and is continuously becoming incomprehensible. The alarming growth in data has deeply affected businesses. Services like social networks, web analytics, and e-commerce often need to manage data at an extensive scale which is too big for the traditional databases and a result complexity increases with scale and demand. Fortunately, scalability and simplicity are not mutually exclusive. Big Data systems use many machines working in parallel to store and process data, which introduces some fundamental challenges unfamiliar to most developers. Traditional database systems, such as relational databases, have been pushed to the limit and everywhere these systems are breaking under the pressure of Big Data. Traditional systems, and the data management techniques associated with them, have failed to scale to Big Data. To tackle the challenges of Big Data, a new class of technologies has emerged. Many of these new technologies have been grouped under the term NoSQL. In some ways, these new technologies are more complex than traditional databases, and in other ways they're simpler. These systems can scale to vastly larger sets of data, but using these technologies effectively requires a fundamentally new set of techniques. Big data industry is constantly increasing in size, applications and intensity. With broad range of services dependent on big data, the need for performant and cost effective big data processing techniques has surged tremendously. There are plenty of tools and techniques available in the market, each having its own usage and

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limitations. Tools are mainly divided into 3 broad categories on the basis of their usage: Data Management tools, Data storage tools, Data Analytics tools [3]. Organizations and individuals have variety of options to choose as per their requirements but the dilemma arises when there are multiple options for similar requirements. At this point the tools which best suites the needs of the user should be selected. Primary parameters are performance and cost-effectiveness and on top of that there are be more fine parameters for evaluating a tool based upon its category of usage. Suitability of a tool for specific type of tasks can be determined through research and development.

2. PREVIOUS WORK DONE

This Section provides an overview of the previous studies in this field. In [5] authors performed a comprehensive survey of big data processing techniques, technologies, challenges, and applications. Authors have discussed also discussed several underlying methodologies to handle the data deluge. In [6] authors conducted an extensive analysis of big data analytical methods and big data challenges in order to help others understand this landscape with the objective of making robust investment decisions. In the study [7] authors discusses the Big data technology along with its importance in the modern world and existing projects which are effective and important in changing the concept of science into big science and society too. The various challenges and issues in adapting and accepting big data technology, its tool are also discussed in detail along with the problems Hadoop is facing. The authors in [8] put their focus on three main things: why big data is different from past Very large database techniques and what the most challenging aspects of big data are, to determine how can industry and academia collaborate towards solving Big Data challenges, to consider the role of the data management community within the Big Data solutions ecosystem. The study [9] compares Apache Hadoop and Apache Spark frameworks and figure out their strengths, weaknesses, unique characteristics and try to answer whether Spark can replace Hadoop or not. In the study [10] authors reviewed recent trends of storage and computing tools with their relative capabilities, limitations and environment they are suitable to work with. It also aims to find some available computing and storage paradigms and tools that are being used in current scenario to address challenges of Big Data processing. Study [11]conducted a review on the key features of Apache Spark for big data analytics. This review focuses on the key components, abstractions and features of Apache Spark.

3. BIG DATA PROCESSING

Big data processing consists of both storage and processing the data for analysis. The traditional tools and techniques were based on the principle of simple data structure, but big data is mainly composed of unstructured data. Therefore, big data requires non-traditional technologies to gather, organize, process and to gain insight from large data sets.

Big data processing and analytics

Big data processing includes collecting, storage and processing large sets of data of structured and unstructured data to gain useful insights and discover meaningful patterns which are otherwise hidden. The insights and patterns help businesses in the decision making process, improving their operational efficiency, and in gaining an edge over other business rivals. There are many open source big data analytics tools such as Apache Hadoop, Apache Spark, Apache Flink and others used by many large organizations for their big data processing

a) Apache Hadoop

Apache Hadoop is an open source architecture used for building big data processing systems. Hadoop is most widely used as batch/static big data processing framework. The key to its success is its distributed storage and parallel processing of data. Hadoop distributed file system

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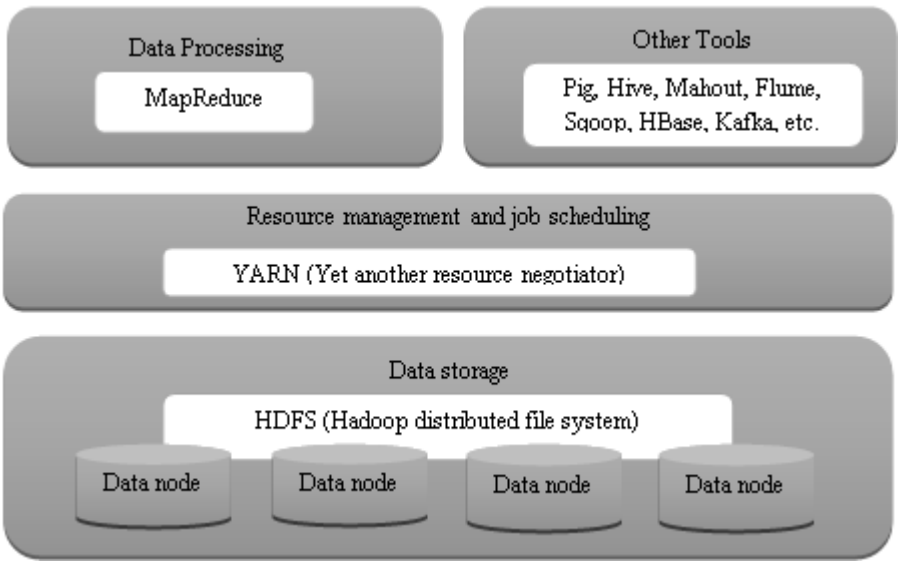
is responsible for the distributed storage of data and MapReduce is responsible for the parallel processing of data. There are other components such as YARN (yet another resource negotiator), Hadoop Common libraries which are responsible for different services and functions in the Hadoop framework. Also on top of Hadoop many different abstractions have been developed which provides new capabilities to this framework and these abstractions on top of Hadoop forms the Hadoop ecosystem. Figure 1. Shows the Hadoop architecture [12].



The core concept of Hadoop is the distributed storage of data. The data is divided into blocks of equal sizes and each data block is stored in a replicated manner across different nodes. Splitting the data into static chunks and replication provides efficiency and fault-tolerance and also is very crucial for parallel processing of that data. The MapReduce framework is very efficient in processing large datasets in a scalable and fault-tolerant manner. The computation is done using map and reduce functions which make the use of Key-Value pairs. Hadoop program first determines the location of the input data and then launches multiple map tasks each for every node containing data blocks of the input file. Each of these tasks is assigned a subset of the input and executes map function on that subset of data. These map tasks produces key-value pairs as output which are sent to all the reduce tasks. The reduce tasks are responsible for sorting the key-value pairs by key. Each map task distributes its output to all the reducer tasks. Hadoop framework avoids a lot amount of data traffic on the network by dividing the tasks into smaller and independent tasks and sending the task functions to the nodes which contains the data.

b) Apache Spark

It is an Apache open-source in-memory cluster computing framework used for big data processing. Spark has received huge popularity in the field of big data processing mainly due to its ability to provide low latency and high throughput for huge data sets in contrast to many other frameworks. Spark provides a general-purpose framework suitable for different big data processing tasks such as batch processing, interactive queries, stream processing, graph processing, etc. Spark isn't any more general or scalable than Hadoop MapReduce, but its model allows it to have much higher performance for algorithms that have to repeatedly iterate over the same dataset because Spark is able to cache that data in memory rather than read it from disk every time. Many machine-learning algorithms iterate over the same data repeatedly, making Spark particularly well suited for such use cases.

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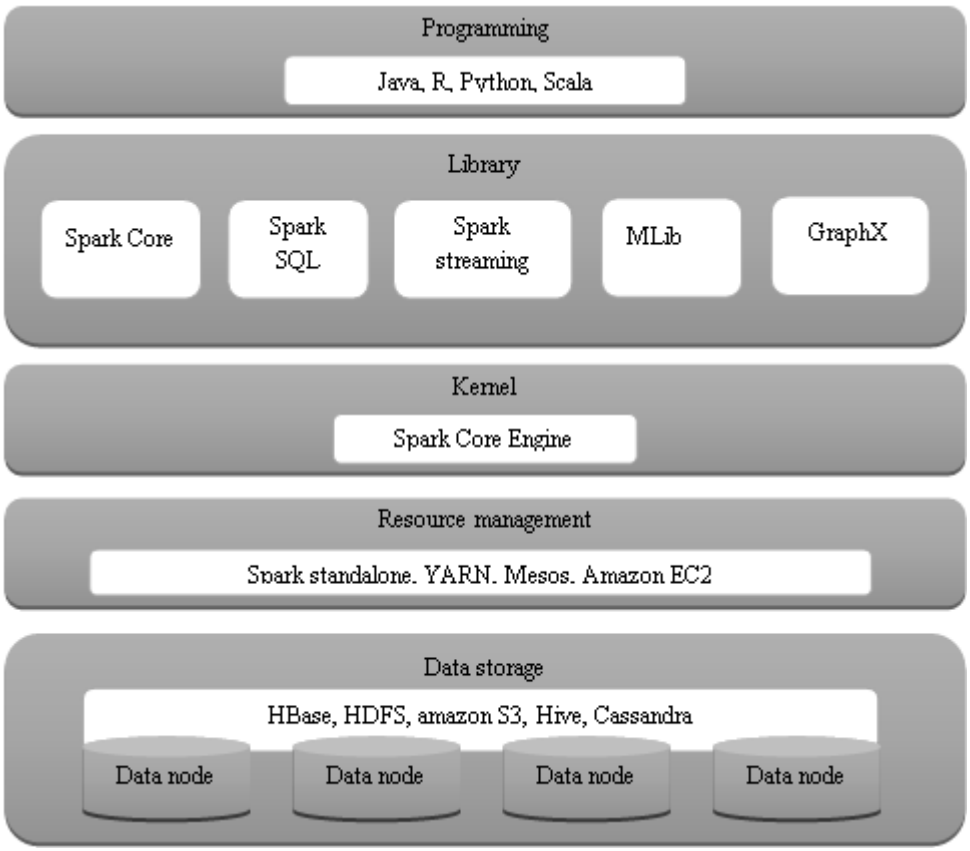

Spark uses in-memory cluster computing framework for big data processing. It is fundamentally based upon resilient distributed datasets (RDD) which are data sets stored in distributed fashion and available in read only mode. These datasets are maintained in a fault tolerant manner. Spark uses its own cluster management and hence cannot be categorised as modification of Hadoop. It can also use external cluster managers such as Hadoop YARN, Apache Mesos or Kubernetes. For distributed storage spark can use different interfaces such as HDFS, Alluxio, MapR File System, Cassandra, Amazon S3, and others.

c) Apache Flink

Apache Flink is an in-memory processing framework used for both batch and stream processing of big data. Flink provides high-throughput and low-latency output for both the real time and batch data types. Flink is highly fault-tolerant in case of machine failures. Flink Programs supports various programming languages such as Java, Scala, Python, and SQL. Flink has a specialized API for processing static data sets, uses specialized data structures and algorithms for the batch versions of operators like join or grouping, and uses dedicated scheduling strategies. The result is that Flink presents itself as a full-fledged and efficient batch processor on top of a streaming runtime.

Apache Flink is based on the distributed streaming data-flow engine. Flink provides 2 different APIs i.e. the DataSet API for processing static/batch data sets, and the DataStream API for processing unbounded/real-time data streams. Flink executes arbitrary dataflow in parallel and pipelined manner. There are 3 different types of processes in Flink. First is the client that takes the program code, transforms it to a dataflow graph, and submits it to the JobManager. The JobManager coordinates the distributed execution of the dataflow. It tracks the state and progress of each operator and stream, schedules new operators, and coordinates checkpoints and

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recovery. A TaskManager executes one or more operators that produce streams, and reports on their status to the JobManager. The TaskManager maintain the buffer pools to buffer or materialize the streams, and the network connections to exchange the data streams between operators. Flink's pipelined runtime system enables the execution of batch and stream processing programs. It has high fault tolerance to steadily recover the state of data streaming applications. This process creates continuous snapshots of the distributed data stream and operator state. In case of failure, the system can rely on these snapshots and revert back.

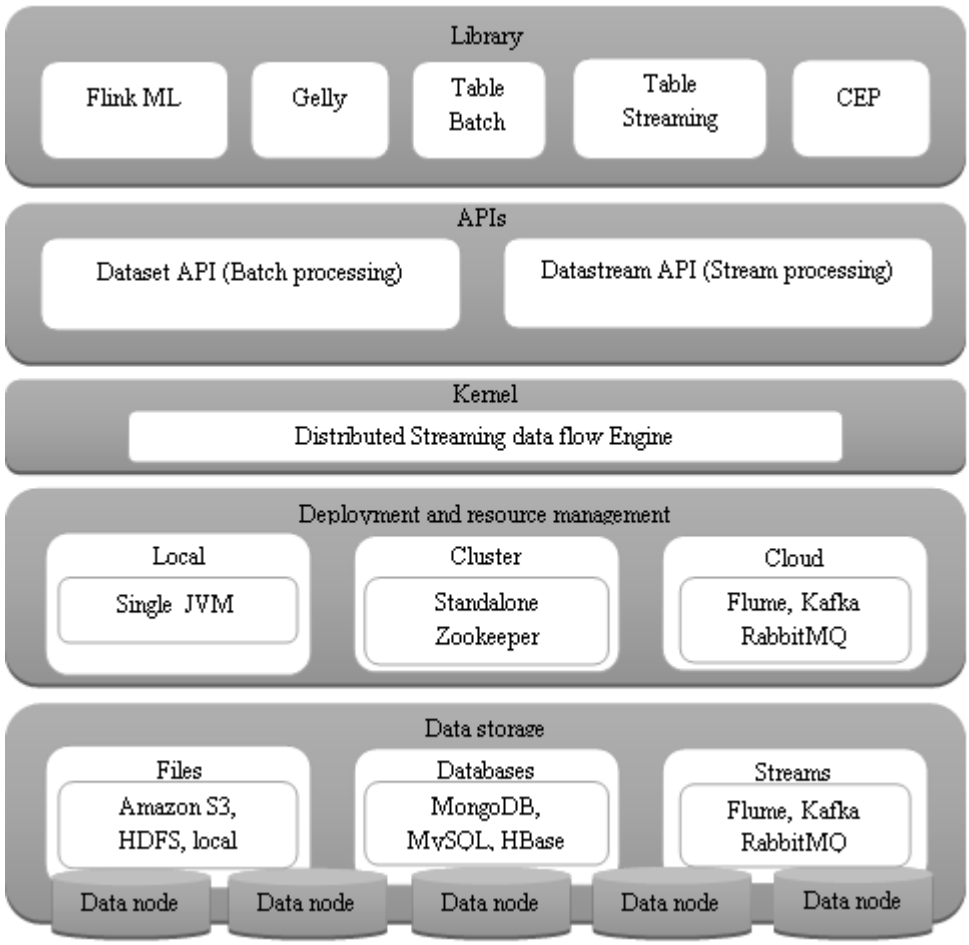

Figure 3. Flink Architecture [10]

4. RESULTS

In this study the performance comparison of Hadoop, Spark and Flink has been done using the Word Count algorithm. For comparing and evaluating the performance of these tools, datasets of different sizes are used and there execution time of these different datasets is used for comparing the performance of these tools. A single node clusters is used for the purpose of running these tools. The performance of the word count algorithm for all the three tools i.e. Hadoop, Spark, Flink is compared using the runtime for different datasets. For the purpose of equitable & justified comparison following metrics have been applied while running these tools:

- All tools have been run as single node cluster.
- Tools ran on the same cluster machine

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- HDFS was used as the storage system for all 3 tools.
- Implementation of the algorithm used is based on the same programming language.

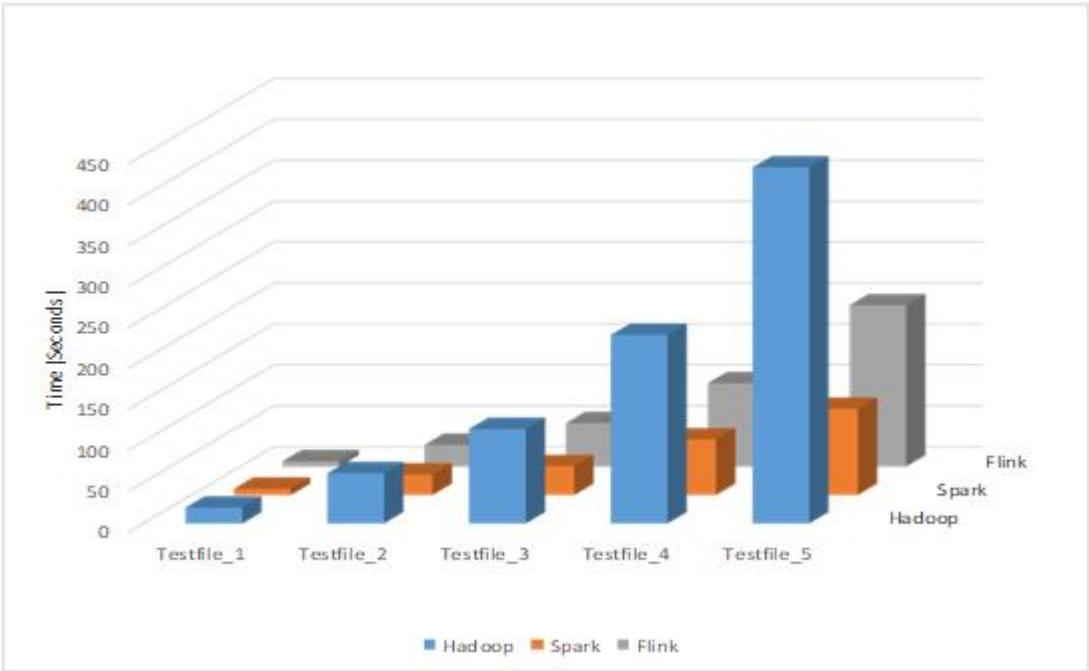
In this study, the performance comparison of Hadoop Map Reduce, Apache Spark and Apache Flink is done based on the execution time using the word count algorithm on the datasets of different sizes. Table x.1 shows the Execution time comparison of all the three tools for the datasets of different sizes. The observations are as follows:

Table 1. Word count execution time comparison table

Dataset	Dataset size	Execution time (seconds)		
		Hadoop	Spark	Flink
Testfile_1.txt	45.3 MB	19.506	7.792	6.542
Testfile_2.txt	185.6 MB	61.527	25.015	26.430
Testfile_3.txt	371.2 MB	115.480	35.263	53.048
Testfile_4.txt	748.5 MB	230.381	67.823	101.829
Testfile_5.txt	1.4 GB	434.997	105.216	197.110

The time taken for the execution of different datasets has been noted for all the three tools i.e. Hadoop, Spark, and Flink. Figure 1 shows the graphical representation of the results for the time taken for execution by all the 3 tools on the word count algorithm on different datasets.

Figure 1. Column graph representation of word count execution time



From the above illustrated figure it is evident that as the size of the dataset increases, the difference in the execution time of different tools becomes significant. Spark has proved to be the most efficient batch processing tools among the three. The performance of Flink is also considerable as compared to the Hadoop. However Flink is primarily a stream processing tools which processes the static data (batch data) in the same manner as it does the stream processing. Although Apache Spark and Apache

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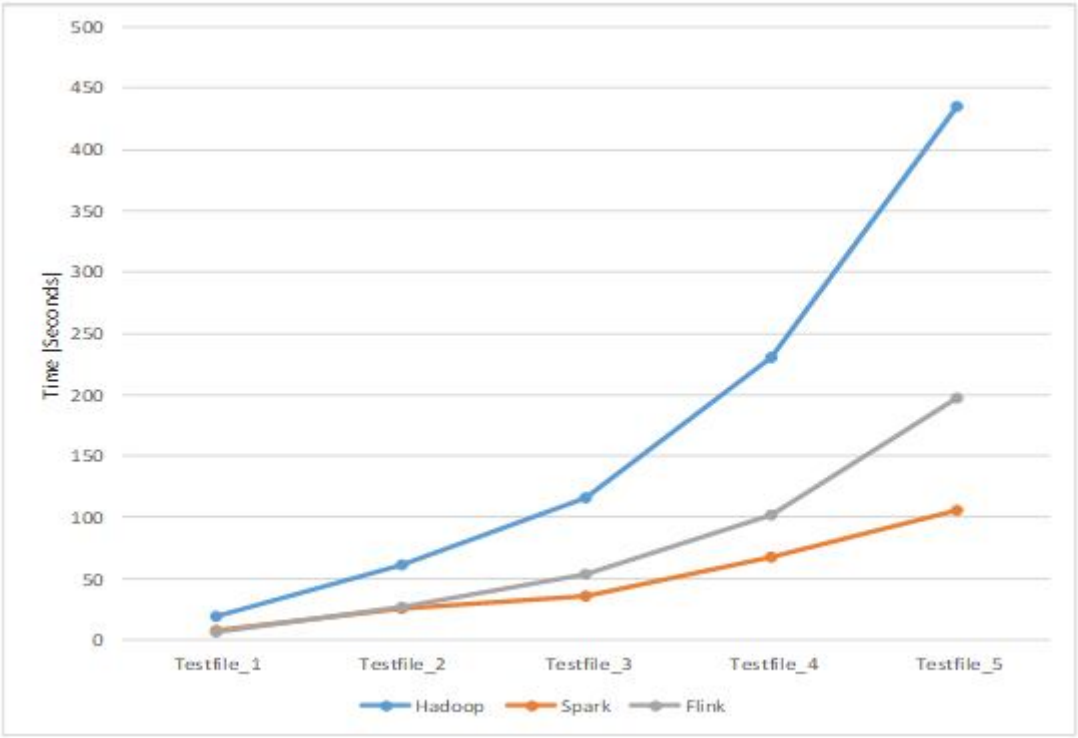
Figure 2. Line graph representation of Word Count execution time



Flink can be setup with different file systems, in this study for the purpose of non-biased comparison they have been used in integration with the Hadoop distributed file system. The performance of these tools in integration with different file systems can a topic for another research.

5. CONCLUSION

This study gives the empirical evidence for the performance of batch data processing using three different tools named Apache Hadoop, Apache Spark, and Apache Flink. A word count algorithm has been used for executing five dataset files of different sizes. From the results it can be concluded that Apache Spark gives the best possible performance for batch processing of text data files. The reason for the better performance of the Spark is the concept of resilient distributed datasets which are data sets stored in distributed and fault tolerant manner. These RDDs are available in read only mode. Spark is able to cache that data in memory rather than read it from disk every time providing it a high performance for tasks that have to repeatedly iterate over same datasets. The reason for the low performance of the Hadoop MapReduce is the working of map and reduce functions. Reduce function requires all values associated with a given key therefore a reduce task can't begin until all map tasks are complete which results in significant delay. Flink is based on Kafka architecture and is primarily a stream processing framework which processes the batch/static data as a special case of stream processing. Flink provides significantly improved performance than Hadoop. Although it is generally claimed that Flink is faster than Spark also but in our findings the Flink execution is slower than the Spark execution of datasets. This may be due to the case that we have used an older version of Flink due to its incompatibility with the integration of newer Hadoop version. Therefore older version of Hadoop had to be used for storing data in Flink.

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As the older version of Flink may have been a limitation for a non-biased evaluation of the performance of these tools therefore it can serve as a scope for future investigation into this area. Older Flink versions are available with pre-bundled Hadoop files however integrating newer Hadoop version with the new Flink version is a challenge that we were unable to address in this study. For future work Flink integration with Hadoop version should be considered.

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USE OF MATHEMATICS IN COMMERCE: - A SHORT STUDY

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ABSTRACT
Mathematics is used in most aspects of day to day life. Mathematics plays important role in business, business mathematics and business management.Konwledge of mathematics is essential for understanding basic concept of commerce. Mathematics usually used in commerce includes elementary algebra and arithmetic, probability and statistics. Mathematics most effective by use of advanced mathematics such as fraction,decimal,percentage, matrix algebra, calculus, differential equation, integral calculus, numerical analysis, Linear programming. Mathematics is used by commercial enterprises is also known as Business Mathematics.

Keyword: Business, Mathematics, Application, University, Finance.

INTRODUCTION
Mathematics is, in fact, an independent subject. But subject like physics, chemistry, Computer Science of pure science, Economics and Commerce of social science are widely dependent on Mathematics. With the help of innovation of Mathematician, researchers of pure and social science proceed in their work. For example, the theories of economics and Business like 'Demand is dependent on price,' 'Saving is dependent on income" are dependent on the concept of functional relationship in mathematics. Also the concept of elasticity in economics is associated with the concept differential co-efficient or derivative of differential calculus. Now days, 'Mathematics is important part of commerce because without this subject commerce is not applicable.

It is clear that the use of mathematics tools has been on the increase day by day in Business arena and now a days Business mathematics is a compulsory course in all business related disciplines.

Mathematics scientists ***William L.Schaaf*** state that "*Mathematics is on the artistic side a creation of new rhythms, order, designs, harmonies, is a systematic study of various rhythms, orders.*

Following Universities in curriculum use mathematics paper

(1) NATIONAL UNIVERSITY AND U.S
Subject: - Management (Hons)

Course:-business Management

(2) ASIAN UNIVERSITY OF BANGLADESH
Course: - BBA

(3) EAST –WEST UNIVERSITY
- Basic concept: Concept of numbers system, fraction, exponents, equation, factoring, polynomial, ordered pairs, relation, functions.
- Set Theory
- Logarithm
- Equation System

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- Geometry
- Differential calculus
- Integral calculus
- Matrix Algebra
- Mathematics of Finance.
- Elementary mathematics & Stastics

Business management can be made more effective in some cases by use of more advanced mathematics such as calculus, matrix Algebra and linear. Programming, Probability. Another meaning of business mathematics, some times called commercial math or consumer used in commerce and day to day life.

The practical application typically includes checking accounts, price discounts, markup and markdown, payroll calculations, simple and compound interest, consumers and business credit and mortgages. Mathematics provides many important tools for economics and other business field. All transactions within a business have to be recorded in the company accounts and quite often involve very large sum of money. If you work as sales assistant in many stores you now need to have the ability to calculate the cost of goods and change the customers requires without using the till. Understanding business mathematics is important to maintain profitable operation and accurate keeping of record .Mathematics plays a major role in business management because it helps maximize profit by using techniques such as analyzing production cost , determining ideal pricing, discerning sales patterns and projecting futures sales.

Some Mathematical application in Commerce

(1)Exponential & Logarithm function

The concept of exponential & logarithmic functions is very useful in various part of mathematics. We shall look at some very important application of these function here & mathematics of finance. Until forty years ago, student labored with extensive tables of logarithm & exponential values, but today we are fortunate to have these numerical values at our fingertips via the scientific calculator & computer.

Application of Logarithm in business

Problem on compound interest and annuity can be solved by using logarithm. We find there how the use of logarithm helps in solving problem on *compound interest and annuity*

(2) Combination of n thing not all different taken some or all at a time

Consider n thing of which are of one kind, q thing are second kind, r thing are of third kind and all the rest are different. Here $p+q+r \leq n$.

Consider first kind things. The p- things can be dealt in (p+1) ways, for we take 1 things or 2 things or 3 things or……. or p things or none n any selection. Similarly the like thing can be dealt in (q+1) ways and r like thing in (r+1) ways. Since each way of any kind must be associated with the ways of other kind things .the number of ways is (p+1) (q+1)(r+1).

The remaining {n-(p+q+r)} thing is different .So these things can be dealt in $2^{n-p-q-r}$ways . Since every thing is associated to each other the total number of ways

$= (p+1)(q+1)(r+1)2^{n-p-q-r}$

But this number includes the case in which all things are left. Therefore, the total number of combination of n things not all different taken some or all at a time

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$= (p+1)(q+1)(r+1)2^{n-p-q-r}-1.$

(3)Determinant and Matrix

The working knowledge of determinants and Matrices is a basic necessary for the students of mathematics, business mathematics, physics, chemistry, statistics, economics and engineering. In **1683** a Japanese Mathematician Kiowa first devised the idea as well as the notion of determinants and aj.aj.Sylvester was first man who introduced the word "Matrix **in1850.** Gabriel Cramer successfully applied determinants in solving system of linear equation in **1750.** At present matrix is a powerful tool of modern matrix.

(4)Function and equation

A function can be viewed as an input-output device. The significant relationship in mathematically model typically are represented by function. In business application, we sometimes are interested in determining whether there are values of variable, which satisfy several attributes. We will also be concerned with the process used to determine whether there are values variables, which jointly satisfy a set of equations.

(5) Mathematics of finance

Simple interest and the future interest, Bank discount, compound interest effective interest rate.

(6) Differentiation & its application

Differential calculation is the most important parts of mathematics. The word differentiation means the rate of change in one variable with other variables. then there is a dependent variables which gets an impulse for changing in the dependent variables. The differential calculus is concerned with the average rate of changes, whereas integral calculus, by it nature considered the total rate change in variables. It has a large use in business problems.

(7) Integration & its application

Integral calculus is also the most important part of mathematics. There are two types of integration 1. Indefinite 2. Definite Indefinite integration deals with the inverse operation of differentiation. Definite integration is the limit of a special type of addition process of infinite-simal part of region. So it may be expressed as the area enclosed by a set of curves. Integral calculus has a great use in business problems.

(8) Linear Programming

Liner programming is a technique for determing an optimum schedule (such as maximizing profit or minimizing cost) of interdependent a divities in view of the available resource.

The British and American military management invited large of scientists to apply a scientists techniques of resources allocation in a effective manner. All these techniques are known as operations Research techniques .linear programming is one of the most frequently used operation research operation research techaniques.It is used to allocate scarce resources in an optimal way so that the allocator can optimize the results in terms maximization of profit or minimization of cost. The Noble Laureate, *George B. Dantzing* innovated this techniques known as 'Simplex Technique' in 1947 while he was working for U.S Although initially this technique was applied to solve problem relating to assignment and transportation .yet, subsequently the application of this technique was extended to almost every functional area of management ,production planning and control ,personnel management ,advertising etc.

(9) Trigonometry

Trigonometry is the branch of mathematics which deals with the measurement of angles. It is most powerful tool of mathematics. But till now it has no mentiable application in business world.

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(10) Assignment problems

A special case of the transportation model is assignment in a situation, which involves the assignment to resources to tasks with minimum cost or maximum profit (e.g. assign n persons to n different task or jobs.) Also in production & human resource management it is very necessary to study assignment problems.

(11) Transportation problems.

It gets its form its application to problems involving transporting product form several origin (factories) to several destinations (market).The two common objectives of such problems either minimize the cost of shipping n units to m destinations or maximize the profit of shipping n units an especial types of liner programming problem.

CONCLUSION

We conclude that knowledge of mathematics should be made compulsory of Commerce and Management as it plays a key role in any business. Mathematical formulae use business to do financial analysis using ratios, percentage, equationsStatistcs uses in presentartion, collection analysis of data to arrive at conclusion. There are jobs around where you can escape from using any mathematics at all refuse collector, builder's, labouer, farm hand etc.

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FACTORS IMPACTING THE PERFORMANCE OF WOMEN ENTREPRENEURS IN MSMEs

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ABSTRACT

The Indian economy is a homogenous mix of variety of segments which ranges across industries. A major contributor to the GDP is MSME segment which is rapidly growing. In today's moment of economic unrest due to the COVID pandemic, Indian government is focusing on the Mantra of AtmaNirbhar Bharat. Given this situation, the role of MSMEs becomes all the more crucial for building a sustainable tomorrow. Amongst these, a very important sub segment are the Women driven MSMEs.

However, the journey of a woman entrepreneur in the MSME segment is not the same as their male counterparts. Needless to say, even today India is a male dominating society and with a set of prejudices and expectations from women. Family and homecare is, till date, considered a women's primary responsibility and therefore career takes the backseat in many cases.

In these circumstances, there are a plethora of factors that come into play when a women entrepreneur's performance is measured. This research has identified 9 such factors through extensive study of available literature. Based on these factors, structured interviews were conducted to get first-hand responses. The focus was on understanding a pattern in the response, to know factors making the most impact on their performances.

The results of the study have given useful insights on how four specific factors, that fall under the common cluster of 'Core Factors' (based on results of Factor analysis), come out as the most impactful cluster. The factors in this cluster are Managerial Skills, Networking, Entrepreneurial Skills and Opportunity Recognition – all four directly impacting the business acumen of the entrepreneur.

However, the result showed another very astonishing fact. Though these factors came as dominant cluster, the most impacting factor was not a part of this cluster, it was a non-business acumen related factor – 'Family Support'.

The research concluded that despite core factors being the most important aspect impacting the performance of women entrepreneur, Family Support was rated of the highest importance. We can therefore safely conclude that even today in Indian society, women entrepreneurs perceive that their family's support is the key for their professional performance.

Keywords: Factors, Family Support, MSME, Performance, Women entrepreneur

1. INTRODUCTION

The year 2020 brought along a new set of challenges for world at large and India in specific, in form of the Covid-19 pandemic. While the pandemic affected health and lives primarily, a major impact is seen on the economic growth. India's response to this situation of unrest was the approach of 'Atma-nirbhar Bharat' (Self- dependent India). Due importance is given to the 'Made in India' initiatives. In this journey, along with large scale industries, a key role will be

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played by MSMEs (Micro, Small and Medium Enterprises). With 3.6 crores such enterprises employing over 8 crore people in India, MSMEs contribute to 37.54% of GDP and accounts for 45 % of total industrial production, 40% of total exports. (https://msme.gov.in/)

While these number justifies the role of MSMEs in making India Atma-Nirbhar, it is imperative to understand a sub section of MSME that is Enterprises driven by Women. In India, out of a total of 58.5 million entrepreneurs, 13.76%, i.e., 8.05 million are women. Studies show that 35% of start-ups in India are led by women entrepreneurs. This goes on to show how women are not just contributing to the economic growth of the nation but are also creating employment opportunities for others. As per a survey, around 71% women, employ around 5 or less people in India.(https://www.startupindia.gov.in/)

Though in this patriarchal society, women are gradually and consistently making a deep impact as entrepreneurs, their journey of growth is way different from that of their male counterparts. There are various factors that play a decisive role in the performances of the women entrepreneurs.

This paper predominantly focuses on 9 selected factors and tries to understand their impact on the performances of the women entrepreneurs. The paper also aims to understand the most important factor amongst these and study its relation with the demographic variables of the respondents of this empirical study.

2. LITERATURE REVIEW

According to the Global Entrepreneurship Monitor (2010), women represent more than one-third of all people involved in global entrepreneurial activity. However, the way women conceive their businesses is very different from the way men do. By the virtue of this difference the factors that impact business performances of women are also distinctive. Numerous studies have helped in bringing to life few factors that have irrefutable contribution in the success of women entrepreneurs.

Family Support - Eddleston & Powell (2012) mentioned in their study that family members' moral/emotional support may encourage women to become entrepreneurs or provide psychological help in dealing with business problems. Welsh, Kim, Memili, Kaciak, (2014) have found that in case of Korean female entrepreneurs' family support seems to be directed toward helping female entrepreneurs cope with their personal problems so that the female entrepreneurs can succeed in their ventures and increase rm performance. They also found that family moral support has no significant positive effects on rm performance but it appears that family support is effective in preventing negative effects of personal problems on rm performance. Cetindamar et al., (2012) analysed that for a woman entrepreneur to be able to launch and grow her business venture, family financial support may be valuable and indispensable.

Personal Problems - Welsh, Kim, Memili, Kaciak, (2014) have found that Korean female entrepreneurs' personal problems have negative effects on rm performance.

Financial Capital Assistance - A research by Omwenga, Mukulu & Kanali (2013) have found that the financial and capital assistance, networking, education, training and counselling are the determinants of performance of women-owned small and medium enterprises in Kenya. Mamun & Isidore (1996) examined the effects of education, entrepreneurial competencies and access to credit on microenterprise performance.

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Education - Omwenga, Mukulu & Kanali (2013) have found that the financial and capital assistance, networking, education, training and counselling are the determinants of performance of women-owned small and medium enterprises in Kenya. Mamun & Isidore (1996) examined the effects of education, entrepreneurial competencies and access to credit on microenterprise performance.

Training - Omwenga, Mukulu & Kanali (2013) have found that the financial and capital assistance, networking, education, training and counselling are the determinants of performance of women-owned small and medium enterprises in Kenya.

Networking - Boyd, (2005) said that networks have long been hailed as essential to the survival of female-run establishments. Carter et al., (2006) mentioned in their study that network is a critical element for entrepreneurs in gaining access to capital/loans, advice and information needed for initiating and operating a new venture easily. A research by Omwenga, Mukulu & Kanali (2013) have found that the financial and capital assistance, networking, education, training and counselling are the determinants of performance of women-owned small and medium enterprises in Kenya. Hisrich & Brush (1987) suggested that support systems, mentors, and advisors; business associates and friends; participation in trade associations and women's groups are the significant networks which are positively associated with business performance.

Opportunity recognition - Hasan & Almubarak, (2016) identified factors influencing women entrepreneurs' performance and corresponding challenges in SMEs in Bahrain. They also examined the opportunity recognition as a mediator between influencing factors and performance

Entrepreneurial Skills - Krishnan & Kamalanabhan, (2013) showed a significant direct relationship between entrepreneurial competencies like conceptual skill, strategic skill and learning leading to entrepreneurial success. Mamun & Isidore (1996) examined the effects of education, entrepreneurial competencies and access to credit on microenterprise performance.

Managerial Skills - According to Lerner and Hisrich (1997) conducted a study on Israeli women entrepreneurs and categorised the factors that affect their performance into five perspectives, that is, motivations and goals; social learning theory (entrepreneurial socialization) ; network affiliation (contacts and membership in organizations); human capital (level of education, business skills) ; and environmental influences (location, sectoral participation, and socio-political variables). (Birley & Norburn, 1987; Brush & Hisrich, 1991; Hisrich & Brush, 1984; Hoad & Rosko, 1964) have identified that managerial skills and particular strengths in generating ideas and dealing with people were important for a woman entrepreneur in establishing a business

Against this background, the researchers now turn to investigate the impact of the above-mentioned factors on the performance of women entrepreneurs in Gujarat.

3. RESEARCH OBJECTIVES

- To find out the most impacting cluster of factors affecting the performance of women entrepreneurs in MSMEs
- To understand the most important factor and study its relation with the demographic variables

4. RESEARCH METHODOLOGY

A survey of women entrepreneurs was conducted to understand the impact of factors affecting their performances. The area of the survey was Gujarat, covering the cites - Ahmedabad & Gandhinagar, Vadodara, Rajkot, Mehsana, Patan and Gandhidham. The respondents were

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women entrepreneurs from varied industries like Bakery & Fast food, Tiffin services, Health and Wellness, Boutique, Beauty parlour & Salon, Jewellery, Pre-school and Day care, Educationist, Toy rental services. Food blogger, Builder and Customised wooden gift articles manufacturer. The sample size of respondent was 100 and were selected using judgement sampling.

Primary data was collected by using structured personal interview. The questionnaire used in the interview focused on list of factors which were derived using literature review of existing theoretical and empirical research. The questions were designed to fetch responses based on the perceptions and experiences of the respondents. The factors affecting the performance of women entrepreneurs were measured with a 5 point Likert scale. The choice ranged from, for respective factor, least affecting to most affecting their performances.

Factor analysis was conducted in order to identify clusters of factors affecting the performance of women entrepreneurs that loaded onto each group. Descriptive Statistics was used to find the cluster, which most impacts the performance of the women entrepreneur. Also, the most impactful factor was found and its impact was studied in light of the demographic variables, using cross tabulation.

5. DATA ANALYSIS AND DISCUSSION

The data has been analysed in four sections. The first section presents the demographic profile of the women entrepreneurs which includes age, education, marital status and prior work experience. The second section presents the business profile of the women entrepreneurs. The third section discuss the factor impacting the performance of the women entrepreneurs. The fourth section presents the discussion of the data analysis.

5.1 Demographic Profile of Women Entrepreneurs

Table 1: Demographic Variables

Demographic Variable: Age			
Age	Frequency	Percent	Cumulative Percent
21-25	13	13	13
26-30	9	9	22
31-35	16	16	38
36-40	19	19	57
41-45	25	25	82
46-50	12	12	94
51-55	3	3	97
56-60	3	3	100
Total	**100**	**100**	

Demographic Variable: Educational Qualification			
Educational Qualification	Frequency	Percent	Cumulative Percent
Secondary	4	4	4
Higher Secondary	9	9	13
Graduate	31	31	44
Post Graduate	33	33	77
Technical/Professional	23	23	100
Total	**100**	**100**	

Demographic Variable: Marital Status			
Marital status	Frequency	Percent	Cumulative Percent
Married	75	75	75
Unmarried	20	20	95
Widow	1	1	96
Divorced	4	4	100
Separated	0	0	
Total	**100**	**100**	

Demographic Variable: Prior Work Experience			
Prior Work Experience	Frequency	Percent	Cumulative Percent
No	34	34	34
Yes	66	66	100
Total	**100**	**100**	

From the above table 1, it can be seen that the majority of the women entrepreneurs are in the age group of 41- 45 comprising of 25% of the total respondents, followed by the age group of

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36-40 comprising of 19% of the total respondents. The age of respondents varies from twenties to fifties. The lowest age of the respondent is 22 years whereas the highest age is 58 years.

Looking at the educational qualification of the respondents, it can be clearly stated that most of the women entrepreneurs surveyed are post graduate (33%) followed by graduates (31%) and Technical/professional (23%). Only 4% respondents amongst the sample are having secondary as their educational qualification.

Majority of the respondents participated in the survey are married (75%) followed by unmarried (20%). Remaining 4% and 1% respondents of the survey are divorced and widow respectively.

The maximum respondents (66%) are having prior work experience before starting their own entrepreneurship.

5.2 Business profiles of the Women Entrepreneurs

In the following section, the business-related profiles of the women entrepreneurs have been discussed.

5.2.1 Age of the entrepreneur at inception of the business

The following table 2, shows the age of the women entrepreneur at the time of inception of the business. It can the clearly seen that 37% of the entrepreneurs have started the business in the age group of 20-25 years followed by 20% in 31-35 years.

Table 2: Entrepreneurs age at the inception of business

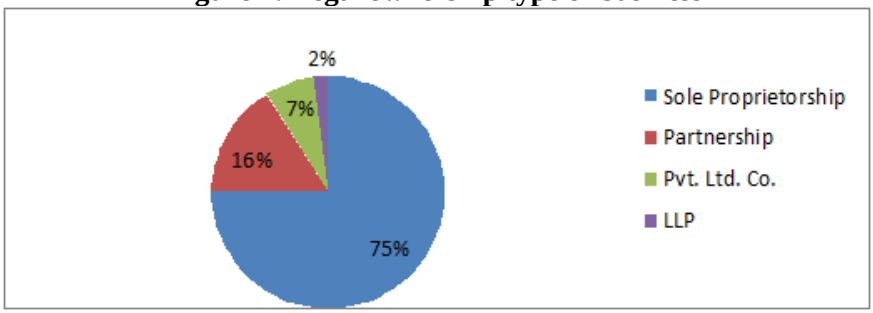
Age	Frequency	Percent	Cumulative Percent
20-25	37	37	37
26-30	19	19	56
31-35	20	20	76
36-40	16	16	92
41-45	6	6	98
46-50	2	2	100
Total	**100**	**100**	

5.2.2 Legal ownership type of business organisation

From the below figure 1, it can be seen that the majority of the women entrepreneurs have the legal ownership of business in form of sole proprietorship (75%) followed by partnership (16%). The other forms are Pvt. Ltd. Co. (7%) and LLP (2%) respectively. One more type of business i.e Public Ltd co. was given in the survey instrument but none of the respondents were in the category.

The major reason for establishing the business under sole proprietorship type were ease in formation and ease in legal formalities as answered by the respondents.

Figure 1: Legal ownership type of business



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5.2.3 Nature of Business

As per, Micro, Small and Medium Enterprises Development Act, 2006) MSMEs are segregated in two types Manufacturing Enterprises and Service Enterprises.

From the below table 3 and 4, it can be seen that out of 100 respondents, 55 business enterprises are service enterprises and 43 are manufacturing. There are 2 enterprises which are manufacturing units and provide customised services as well. Out of the total manufacturing enterprises, 82% enterprises falls under the Micro enterprises category whereas 73.7% enterprises fall under Micro category out of the total service enterprises.

Table 3: Nature of Business

	Frequency	Percent	Cumulative Percent
Manufacturing and Service both	2	2	2
Manufacturing	43	43	45
Service	55	55	100
Total	100	100	

Table 4: Bifurcation within Manufacturing and Service industry

	Manufacturing			Service		
	Frequency	Percent	Cumulative Percent	Frequency	Percent	Cumulative Percent
Micro	37	37.0	82.2	42	42.0	73.7
Small	5	5.0	93.3	12	12.0	94.7
Medium	3	3.0	**100.0**	3	3.0	**100.0**
Total	45	45.0		57	57.0	

5.2.4 Source of Finance of the business

From table 5, it is clear that 46% respondents have used their own funds to commence with the business followed by 20% getting funding from their friends & relatives. This reflects how personal source of finance and savings of women is important compared to formal sources of finance in supporting entrepreneurship in the state. Only 14% of respondents have accessed finance from commercial banks followed by 4% from private money lenders, husband, family and father respectively. The pro le of the women entrepreneurs and the discussions in the previous researches shows that women in Gujarat have both their own funds and strong support from the family, friends and relatives. (Myers and Majluf, 1984) indicated that SME owners mostly depend on their savings or funds obtained from their family and friends as initial sources of finance. This was majorly because they have limited resources and their income from operations is not sufficient to repay their debt obligations.

Table 5: Source of Finance

Source	Frequency	Percent
Development Bank	3	3.0
Commercial Bank	14	14.0
Non-Banking Financial Institutions	1	1.0
Private money lenders	4	4.0
Friends & Relatives	20	20.0
Own fund	46	46.0
Father	4	4.0
Husband	4	4.0
Family	4	4.0
Total	100	100.0

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5.3 Factors affecting the performance of women entrepreneurs

Table 6: Survey Responses of women entrepreneurs regarding factors affecting their performance

Factors	Least Affecting(%)	Not Affecting(%)	Neutral (%)	Affecting (%)	Most Affecting(%)
Family Support	9	5	12	29	**45**
Personal Problems	14	18	22	**41**	5
Financial Capital Assistance	10	15	23	**37**	15
Education	20	18	**24**	21	17
Training	8	18	20	**36**	18
Networking	7	4	15	**48**	26
Opportunity Recognition	6	8	14	**48**	24
Entrepreneurial Skills	7	5	24	27	**37**
Managerial Skills	7	6	15	**38**	34

There are various factors which affect the performance of women entrepreneurs in the MSME sector. To understand the impact of the same, a factor analysis of the 9 factors impacting the performance of women entrepreneurs was conducted. The "best t" factor analysis accounts for 39.16 percent of the variance and was obtained by using principal component factor analysis with a Varimax with Kaiser Normalization rotation method. As recommended by Hair et al. (2006), all factor loadings are greater than 0.40, and all communalities exceed 0.50.

The Cronbach's alpha model was used and values over 0.50 were considered. The Cronbach's alpha of the entire instrument came as 0.775. The Cronbach's alpha-values for all the 9 factors impacting the performance of women entrepreneurs ranged from 0.719 to 0.797 indicating that the scale was internally consistent and reliable (Cronbach, 1951; Nunnally, 1978).

The table 7 of communalities which shows how much of the variance in the variables has been accounted for by the extracted factors. The top four variables are 80% of the variance in managerial skills, 78% in opportunity recognition and 73% in entrepreneurial skills and education is accounted for.

Table 7: Cronbach's alpha-value and Communalities

Factors	Cronbach's Alpha values	Communalities
Family Support	.763	.439
Personal Problems	.797	.721
Financial Capital Assistance	.770	.551
Education	.759	.738
Training	.750	.704
Networking	.740	.681
Opportunity Recognition	.733	.778
Entrepreneurial Skills	.740	.739
Managerial Skills	.719	.799

5.3.1. Descriptive Statistics

The descriptive statistics for all the variables under investigation are calculated below in table 8. The mean, standard deviation and number of respondents (N) who participated in the survey are given. Looking at the mean, one can conclude that family support is the most important variable affecting the firm's performance of women led businesses. It has the highest mean of 3.96.

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Table 8: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Family Support	100	1	5	**3.96**	1.263
Personal Problems	100	1	5	3.05	1.167
Financial Capital Assistance	100	1	5	3.32	1.197
Education	100	1	5	2.97	1.374
Training	100	1	5	3.38	1.204
Networking	100	1	5	3.82	1.086
Opportunity Recognition	100	1	5	3.76	1.093
Entrepreneurial Skills	100	1	5	3.82	1.192
Managerial Skills	100	1	5	3.86	1.164
Valid N (listwise)	100				

5.3.2. Kaiser-Meyer-Olkin: The KMO measures the sampling adequacy which should be greater than 0.5 for a satisfactory factor analysis to proceed. A common rule suggests that a researcher has at least 10-15 participants per variable. Kaiser (1974) recommend 0.5 as minimum (barely accepted), values between 0.7-0.8 acceptable, and values above 0.9 are superb. Here the KMO as per table 8comes out to be 0.755; hence we can go ahead to process with factor analysis

5.3.3 Bartlett's test: (Bartlett, 1954) is indication of the strength of the relationship among variables. This tests the null hypothesis that the correlation matrix is an identity matrix. An identity matrix is matrix in which all of the diagonal elements are 1 and all off diagonal elements are 0.We can see from the table 9 that, Bartlett's test of sphericity is significant. That is, its associated probability is less than 0.05. In fact, it is actually 0.00, that is significance level is small enough to reject the null hypothesis and accept the alternate hypothesis.

Table 9: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.755
	Approx. Chi-Square	314.825
Bartlett's Test of Sphericity	Df	36
	Sig.	.000

5.3.4 Factor analysis

Factor analysis is a statistical data reduction and analysis technique that strives to explain correlations among multiple outcomes as the result of one or more underlying explanations, or factors. The technique involves data reduction, as it attempts to represent a set of variables by a smaller number. Factor structures for the study were identified on the basis of significance and clarity of the factor loadings and the interpretability and meaningfulness of the factors within the theoretical framework. The final framework comprised three clusters with 9factors. The factor loadings are mentioned in the below table 10.

Table10: Results of Factor analysis

		Factors		
		1	2	3
6	Networking	**0.776**	0.252	-0.126
7	Opportunity Recognition	**0.875**	0.104	0.034
8	Entrepreneurial Skills	**0.856**	0.027	0.074
9	Managerial Skills	**0.834**	0.125	0.296
3	Financial Capital Assistance	0.01	**0.661**	0.338
4	Education	0.085	**0.846**	0.12

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5	Training	0.307	**0.767**	-0.147
1	Family Support	0.363	0.161	**0.531**
2	Personal Problems	-0.061	0.055	**0.845**

5.3.5 Factor Interpretation

The first cluster have been grouped as **"Core factors"** as they includes:

- Networking
- Opportunity Recognition
- Entrepreneurial Skills
- Managerial Skills

The second cluster have been grouped as **"Know-how factors"** as they include:

- Financial Capital Assistance
- Education
- Training

The third cluster have been grouped **as "Human factors"** as they include:

- Family Support
- Personal Problems

5.4 Discussion

The results of the factor analysis indicate that the means of the variables under the first cluster 'Core factors' comprising of Managerial Skills (3.86) Networking (3.82), Entrepreneurial Skills (3.82)and Opportunity Recognition(3.76) got the second, third and fourth rank respectively. So, the researchers come to the conclusion that this is the most important cluster that impact the performance of women entrepreneurs in the MSME sector.

Such outcomes were also found in other studies. (Birley &Norburn, 1987; Brush & Hisrich, 1991; Hisrich & Brush, 1984; Hoad & Rosko, 1964) identified that managerial skills and particular strengths in generating ideas and dealing with people were important for a woman entrepreneur in establishing a business. Boyd, 2005 said that networks have long been hailed as essential to the survival of female-run establishments. (Carter et al., 2006) mentioned in their study that network is a critical element for entrepreneurs in gaining access to capital/loans, advice and information needed for initiating and operating a new venture easily. Hisrich & Brush (1987) suggested that support systems, mentors, and advisors; business associates and friends; participation in trade associations and women's groups are the significant networks which are positively associated with business performance. Krishnan & Kamalanabhan, (2013) showed a significant direct relationship between entrepreneurial competencies like conceptual skill, strategic skill and learning leading to entrepreneurial success. Hasan & Almubarak, (2016) identified factors influencing women entrepreneurs' performance and corresponding challenges in SMEs in Bahrain. They also examined the opportunity recognition as a mediator between influencing factors and performance.

Having said that, researchers also analysed that the 'Family support' having the highest mean of 3.96 under 'Human factor' is the most crucial variable which impact the performance of women entrepreneurs. Indian society in general is a male dominated society and it is still believed that the responsibility of managing home and taking care of children is the sole responsibility of the

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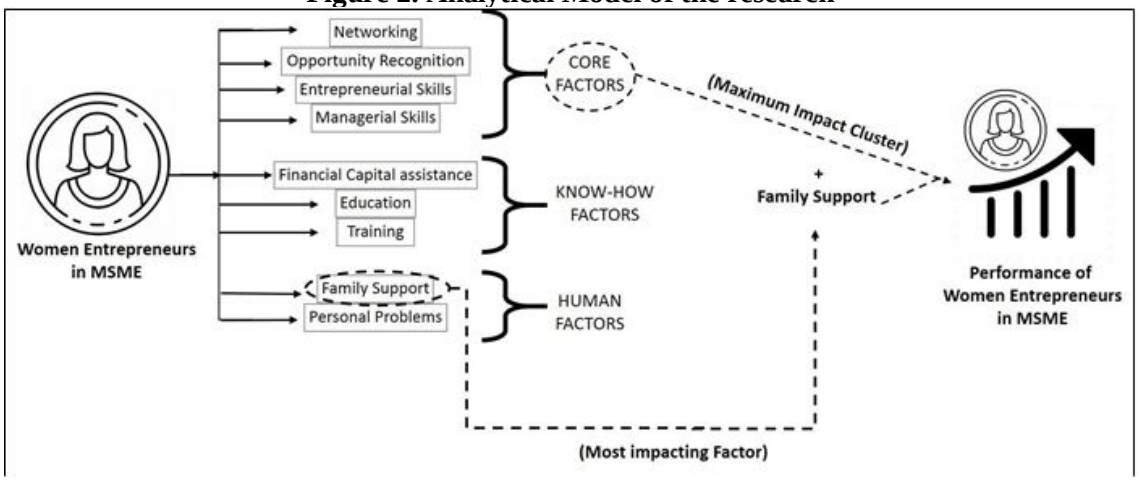
women of the house. In this situation if there is not ample support from all family members, it becomes difficult for the woman to manage house and work.

Thus, it is found that the family moral support is inevitable for the performance of women entrepreneurs. Family members' moral/emotional support may encourage women to become entrepreneurs or provide psychological help in dealing with business problems (Eddleston & Powell, 2012). Family moral support gives a woman entrepreneur confidence that she can manage her family-work responsibilities, thereby increasing the chances of business growth. Along with Moral support, Financial support from the family is equally important for starting the business and sustaining it. This has a positive impact on the performance of women entrepreneurs. For a woman entrepreneur to be able to launch and grow her business venture, family financial support may be valuable and indispensable (Cetindamar et al., 2012). If a women is secured financially with support from the family, then she can concentrate better on the managing and developing the business. We can see from the survey responses that 46% entrepreneurs in our study has used own fund for financing the business followed by 32% entrepreneurs started the business by takings fund from friends and family.

With this analysis, the researchers have developed an Analytical Model that depicts how the 'Core factors' along with the variable 'Family support' from the cluster of 'Human factors' impacts the performances of the women entrepreneurs. The model is depicted in the below figure 2.

Figure 2. Analytical Model of the research



The analytical model in figure 2, shows that the factors which impact the performance of women entrepreneurs can be clustered in three groups namely 'Core factors', 'know-how factors and 'Human factors', The factors under the cluster 'Core factors' have the maximum impact on the performance of the women entrepreneurs as they have the means ranking between 2 to 5. But interestingly 'family support' is the factor which have the highest mean, doesn't fall under the 'Core factors' cluster. Rather, it falls under the 'Human factors'. So, the researchers identified that 'Core factors' along with the factor 'Family support' impacts the performance of the women entrepreneurs in the MSMEs.

Having identified that the top most impacting factor i.e. 'Family Support', for women entrepreneurs' performance doesn't fall under the cluster which is most impacting, the researchers have further tested the importance of this factor by cross tabulating it with all the demographic variables like age, marital status, educational qualification and prior work experience.

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Given below is the analysis of the relation between each demographic variable and the factor 'family support'.

Table 11: Demographic Variable: Age

		Family Support					
		Least Affecting	**Not Affecting**	**Neutral**	**Affecting**	**Most Affecting**	**Total**
Age	21-25	1	2	2	4	4	13
	26-30	2	0	2	3	2	9
	31-35	0	2	1	6	7	16
	36-40	2	0	3	6	8	19
	41-45	3	0	2	5	15	25
	46-50	1	1	2	4	4	12
	51-55	0	0	0	1	2	3
	56-60	0	0	0	0	3	3
Total		9	5	12	29	45	100

It can be seen from the above results that women across age group has said that family support is the most affecting factor which helps them in their performance.

The majority of our respondents (25%)are in the age group of 41-45 years, of them 80% have stated that family support is affecting / most affecting their performance. Even in the second largest age group, 36-40 years, which comprises of 19% respondents, 73% women have admitted that Family Support impacts their performance. If we further understand these two age groups, these are the women who have the maximum responsibility of managing their homes and children along with their business venture as compared to their younger counterparts. So without family support a work life balance cannot be maintained by them.

Table 12: Demographic Variable: Educational Qualification

		Family Support					
		Least Affecting	**Not Affecting**	**Neutral**	**Affecting**	**Most Affecting**	**Total**
Educational Qualification	Secondary	0	0	1	1	2	4
	Higher Secondary	0	0	0	1	8	9
	Graduate	2	1	5	9	14	31
	Post Graduate	5	3	2	11	12	33
	Technical/Professional	2	1	4	7	9	23
Total		9	5	12	29	45	100

From the table 12, it can be seen that out of 100 respondents 64 respondents are atleast graduates and of them 33 are post graduates. Thereby these two groups cumulatively have the maximum (64%) respondents. Out of these, 72 % respondents have agreed that family support is either affecting or most affecting their performance. This shows that despite higher educational background, women entrepreneur need support from families for better performance of their business. Moreover, if we see the groups with least education, it can be seen that 12 out of 13 women agree that Family Support is important and the remaining 1 is neutral about it.

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Table 13: Demographic Variable: Marital Status

		Family Support					
		Least Affecting	**Not Affecting**	**Neutral**	**Affecting**	**Most Affecting**	**Total**
Marital status	Married	6	4	9	21	35	75
	Unmarried	3	1	2	7	7	20
	Widow	0	0	0	0	1	1
	Divorced	0	0	1	1	2	4
	Separated	0	0	0	0	0	0
Total		9	5	12	29	45	100

It is evident from the table 13 that 75% of the total respondents are married thereby creating the largest group. Of these 56 respondents (74%)mentioned the importance of their family support on their performance. In our Indian society where marriage is an institution that connects families, this response from married women makes it all the more clear that family support is inevitable for success of women entrepreneurs.

Table 14: Demographic Variable: Prior work experience

		Family Support					
		Least Affecting	**Not Affecting**	**Neutral**	**Affecting**	**Most Affecting**	**Total**
Prior work experience	No	3	3	3	6	19	34
	Yes	6	2	9	23	26	66
Total		9	5	12	29	45	100

The table 14 shows that the respondents having work experience are 66 out of the total 100 respondents. Out of 66 respondents, 49 respondents (74%) mentioned that family support is affecting their performance. Herein we can see that despite the exposure through prior work experience, majority of these respondents agree that family support is very crucial in their professional journey.

6. CONCLUSION

The research showed that the factors were grouped in three clusters namely, Core Factors, Know-how Factors and Human Factors. Core Factors had all 4 factors that impact the business acumen of an entrepreneur directly. The Know-how factor comprised of factors that depicts the Knowledge of entrepreneur. The third cluster, Human factor focused on the human aspects of the entrepreneur.

The research found that the Core factor stands out to be the most impacting cluster as all 4 of its factors are appearing in the top 5 factors derived using descriptive statistics. The four factors in this cluster were:

Managerial Skills – This reflects that it is very important for women entrepreneurs to understand the nuances of business management and thereby handle the various aspects of business.

Networking – Networking is the key especially for startups and businesses which are operating in the MSME segment. A robust network help in variety of aspects such as financial assistance, technological assistance, marketing, business development, logistics and many more. In today's world a good network is one of the most important non-tangible asset that one can possess.

Entrepreneurial Skills – While many of the respondents had prior work experience, the role of an entrepreneur is completely different than that of a professional. Therefore it is very important to not just possess the skill set of an entrepreneur but also the attitude. Especially in case of

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women entrepreneurs this becomes all the more important as the society at large is still predominantly patriarchal.

Opportunity Recognition – Generally for any business and specifically for MSMEs, opportunities are limited, so as an entrepreneur, one needs to have an eye for sensing the market demand and perform accordingly to grow.

While the above four factors stood out as an impactful cluster, the top most (rank 1) of the factor affecting women entrepreneurs was not a part of this cluster. It came from the cluster – Human Factors. This factor was 'Family Support'. The research shows that even today for a women to perform well in her career, she believes, her family plays a very crucial role. The family support is broadly understood in two sub parts – Financial Support and Moral Support.

With this understanding the researchers conclude that 'even today in Indian society, women entrepreneurs perceive that their family's support is the key for their professional performance however the core business acumen stands a close second.'

7. PRACTICAL IMPLICATIONS

The outcome of this research has brought to light some concrete implications which have the potential to strengthen India's dream of becoming AtmaNirbhar Bharat. Stated below are these practical implications that primarily focuses on two segments of our society- the policy makers and the educational & developmental institutions.

1. Policy Makers

The policy makers can give incentives that motivates the families to encourage aspiring women entrepreneurs take up their ventures. This incentives can be in form of:

- Proving initial financial support to dependent members of the family for a specific time period (1 to 1.5 years depending on the nature of business)
- Ensuring the physical safety of entrepreneurs.
- Reduction of the societal pressure that families face by promoting the importance of entrepreneurship through public interest advertising.

2. Colleges, Universities and Incubation centres

These institutions can play a vital role by identifying interested students and horne their entrepreneurial skills using techniques like seminars, townhalls, workshops, pep-talks by existing entrepreneurs and also vocational trainings. At the same time to ensure family support for these aspiring entrepreneurs in the years to come, these institutions should organise consultation sessions for the family members by subject matter experts.

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A STUDY ON ATTITUDE OF STUDENTS, PARENTS, TOWARDS STUDENT PARTICIPATION ON PHYSICAL EDUCATION AND SPORTS IN GOVERNMENT AND PRIVATE SCHOOLS

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ABSTRACT
The purpose of the present research was to describe and A Study On Attitude Of Students, Parents, Towards Student Participation On Physical Education And Sports In Government And Private Schools The method of the study is descriptive analyses, age group 14 to 17 years school boys and girls total fifty samples representing selected and To collect the data the Students , standardized scale devised by T.S. Sodhi .and parent standardized scale also T.S. Sodhi has administered on the subject who are participating in sports later't' test was applied to assess the significant difference in Students, Parents attitude towards Student Participation on Physical Education and Sports in Government and Private Schools" the conclusion was drawn that Government school have possessed the high comparing to their counterpart, it was rationalized that nature of Private Schools participation develops and cultivates the Students, Parents.

INTRODUCTION
Sports and games in the modern era occupy a very prominent and important place in the life of people and also in every sphere of life. Sport consists of physical activity carried out with a purpose for competition, for self-enjoyment, to attain excellence, for the development of a skill, or more often, some combination of these. Sports differ in their dependence upon a set of individuals or team skills, as well as in the ways in which they have their participants compete. As fitness and sports go hand in glove there is a need to develop the ability in an individual to play the game with good skill and perform consistently well.

The popular adage 'health is wealth' throws light on the need to maintain good health for the overall well-being of individuals and societies. As against this, there is a growing tendency, especially, among the youth to lead a sedentary life devoid of stress and strain. There are enough reasons why they are indifferent to sports, the whole world is on their finger tips, then why waste youthful energy on very ordinary things? Such an attitude bodes well for easy-going people, but not for the genuine practitioners of healthy living. 'All work and no play make Jack a dull boy' is an oft quoted proverb. Here, the emphasis is actually on the need to do regular physical exercise. Our perception of health is so ill-conceived that we tend to go for healthy foods instead of following a strict exercise regimen and good eating habits. No wonder, several people turn obese in their mid-twenties! 'A sound mind in a sound body' is the English translation of a Latin proverb quoted in academic circles everywhere. Our forefathers were ever mindful of the attributes of good health and were practitioners of regular physical activities. It is, therefore, very apt to go deep into the attitude of college students towards physical activity in general.

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An attitude is more than a state of mind. It is a generalized tendency to think or act in a certain way in respect to some objects or situations, often accompanied by feeling. It is an enduring predisposition or readiness to behave in a particular way towards a given object or situation.

In this way attitudes are to a great extent responsible for a particular behavior of a person towards an object, idea or a person. But by this it should not be concluded that one‘s behavior is an absolute function of one‘s attitude. Behavior by all means is a function of both characteristics of behaving person and the situations in which he behaves. Hence a person may hold strong attitude and yet under circumstances, may behave in quite contradiction to those attitudes.

Parents’ attitude towards child’s education is important in determining school attendance and academic achievement of the child. Favorable attitude towards schooling and education enhances parents’ involvement in children’s present and future studies .Parent’s attitude towards their children’s education is affected adversely by low Socioeconomic Status of parents; it is assumed that the attitude of parents of tribal children will be unfavorable towards education. Parents’ attitude is a measure or an index of parents’ involvement. A child, brought up with affection and care in the least restrictive environment would be able to cope up better with the sighted world. Therefore, the family shapes the social integration of the child more than a formal school.

PURPOSE OF THE STUDY

The purpose of the study was to find out the “A Study on Attitude of Students, Parents, Towards Student Participation on Physical Education and Sports in Government and Private Schools”

HYPOTHESIS

1. It was hypothesiesied that there may be difference in the attitude of Students, Parents of government and private schools.
2. There would be a significance difference attitude of Students, Parents between of government and private schools.

METHODOLOGY

The purpose of the present research was to describe and A Study on Attitude of Students, Parents, Towards Student Participation on Physical Education and Sports in Government and Private Schools The method of the study is descriptive analyses, age group 14 to 17 years school boys and girls total fifty samples representing selected and To collect the data the standardized scale devised by T.S. Sodhi has administered on the subject who are participating in sports later‘t’ test was applied to assess the significant difference in Teachers attitude towards Student Participation on Physical Education and Sports in Government and Private Schools” the conclusion was drawn that Government school have possessed the high comparing to their counterpart, it was rationalized that nature of Attitude of Students, Parents, Private Schools participation develops and cultivates the Teachers. statistically analyzed by dependent’s’ test which is used to find out the significant improvement on selected criterion variables and Analysis of Covariance (ANCOVA) was used to find out the significant difference between the Government and Private Schools” on each variables separately. All the cases 0.05 level of confidence was fixed as a level of confidence to test the hypotheses.

Table-1: students of government and private schools with attitude scores towards student’s participation in physical education and sports

Schools	Mean	Std. Dev.	Std. Error	t-value	P-value
Government-students	8.53	1.51	0.39		
Private-students	5.87	1.68	0.43	4.5712	0.0001,S

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From the results of the above table, it clearly shows that, the calculated value of t test is 4.5712 and the critical value of t with 28 degrees of freedom at 5% level is 2.0480. It indicates that, the calculated value i.e. 4.5712 is greater than 2.0480. It means that, a significant difference was observed between students of government and private schools with attitude scores towards student's participation in physical education and sports. Thus, the null hypothesis (H_0) is rejected and alternative hypothesis (H_1) is accepted. It means that, the students of government schools have significant higher attitude scores towards student's participation in physical education and sports as compared to students of private schools. In another words, the students of government schools are more interested in participation of physical education and sports than their counterparts i.e. students of private schools The mean and SD of attitude scores towards student's participation in physical education and sports is also presented in the figure given below.

Figure-1: students of government and private schools with mean attitude scores towards student's participation in physical education and sports

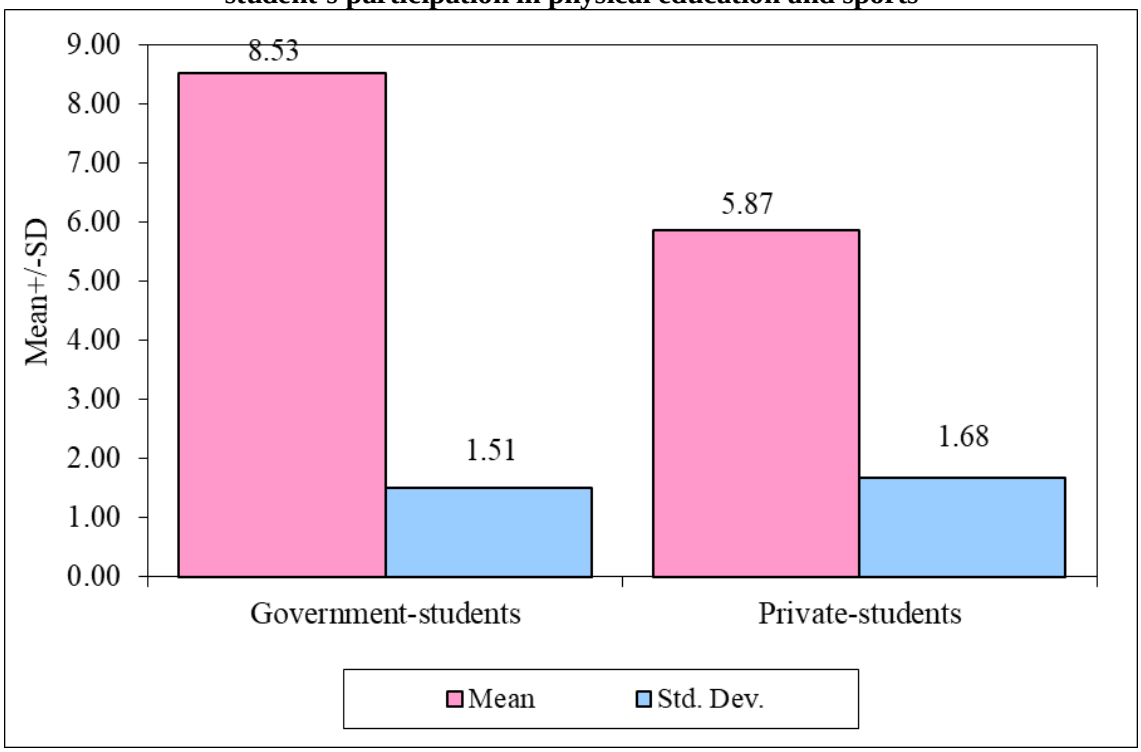

Table-2: parents of government and private schools with attitude scores towards student's participation in physical education and sports

Schools	Mean	Std. Dev.	Std. Error	t-value	P-value
Government-parents	129.67	14.28	3.69		
Private-parents	108.80	16.65	4.30	3.6844	0.0010,S

From the results of the above table, it clearly shows that, the calculated value of t test is 3.6844 and the critical value of t with 28 degrees of freedom at 5% level is 2.0480. It indicates that, the calculated value i.e. 3.6844 is greater than 2.0480. It means that, a significant difference was observed between student parents of government and private schools with attitude scores towards student's participation in physical education and sports. Thus, the null hypothesis (H_0) is rejected and alternative hypothesis (H_1) is accepted. It means that, the student parents of government schools have significant higher attitude scores towards student's participation in

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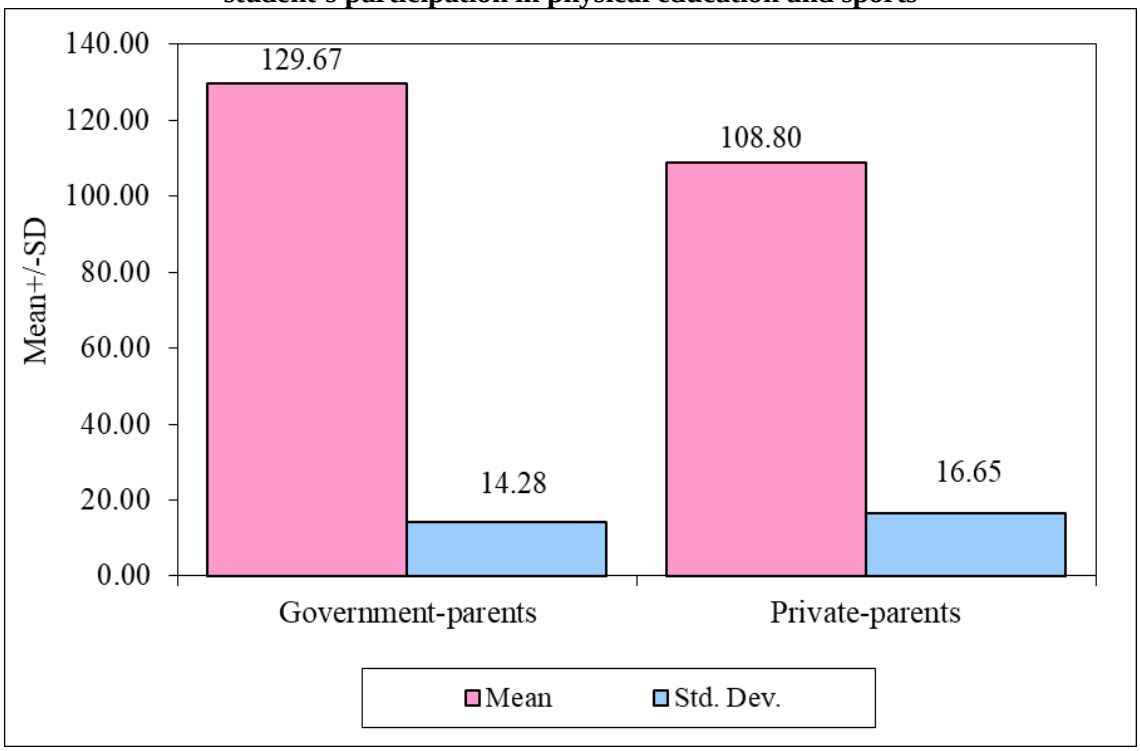
physical education and sports as compared to student parents of private schools In another words, the student parents of government schools are more interested in participation of physical education and sports than their counterparts i.e. student parents of private schools The mean and SD of attitude scores towards student's participation in physical education and sports is also presented in the figure given below.

Figure-2: parents of government and private schools with mean attitude scores towards student's participation in physical education and sports



CONCLUSION

The students of government schools have significant higher attitude scores towards student's participation in physical education and sports as compared to students of private schools. In another words, the students of government schools are more interested in participation of physical education and sports than their counterparts i.e. Students of private schools. The parents of government schools have significant higher attitude scores towards student's participation in physical education and sports as compared to student parents of private schools. In another words, the student parents of government schools are more interested in participation of physical education and sports than their counterparts i.e. Student parents of private schools.

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EFFECT OF SPECIFIC TRAINING PROGRAMME ON DRIBBLING PERFORMANCE AMONG UNIVERSITY HOCKEY PLAYERS

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ABSTRACT
The purpose of the study was to find out the effect of specific training on dribbling performance among university hockey players. To achieve this purpose of the study, thirty men hockey players were selected as subjects who were from the Bangalore central university. The selected subjects were aged between 18 to 28 years. They were divided into two equal groups of fifteen each, Group I underwent specific training and Group II acted as control that did not participate in any special training apart from their regular sports and games practices. The subjects were tested on selected criterion variables such as dribbling prior to any immediately after the training period. The selected criterion variable such as dribbling was measuring by w dribble test. The analysis of covariance (ANCOVA) was used to find out the significant differences if any, between the experimental group and control group on selected criterion variable. The 0.05 level of confidence was fixed to test the significance, which was considered as an appropriate. The result of the present study has revealed that there was a significant difference among the experimental and control group on dribbling performance.

Keywords: Specific Training, Dribbling & Hockey.

INTRODUCTION
The primary objective of sports training is to stress various bodily systems to bring about positive adaptation in order to enhance sporting performance. To achieve this objective, coaches and athletes systematically apply a number of training principles including overload, specificity and progression, organized through what is commonly termed per iodization. The application of these principles involves the manipulation of various programme design variables including choice of exercise, order of training activities/exercises, training intensity (load and repetition), rest periods between sets and activities/exercises and training frequency and volume in order to provide periods of stimulus and recovery, with the successful balance of these factors resulting in positive adaptation (1). Sport specific training is simply fitness and performance training designed specifically for athletic performance enhancement. Training programs for athletic performance enhancement could include such areas as strength, speed, power, endurance, flexibility, mobility, agility, mental preparedness (including goal setting), sleep, recovery/regeneration techniques and strategies, nutrition, rehabilitation, pre-habilitation, and injury risk reduction. A general program should include all of these components and a more specific program may only include a few, depending upon the athlete's specific needs (based on strengths, weaknesses and/or imbalances) and the demands of the sport they participate in (2). Every shot in hockey is not just one motion, but a combination of many subtle movements. Every part of your body is working together to generate power, accuracy, lift and control of the puck. If one part of your shot is lacking, or incomplete this will result in less power and accuracy (3). Field Hockey coaches are constantly on the lookout for drills and skills that are going to make their players better. Further, being able to put those drills together with a practice plan to reinforce those skills makes it all the more effective. Repetition of skills is the best way

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to get your players to perform better. Knowing what to do when the opportunity presents itself is one of the hallmarks of a good player. The more practice, the more inclined your players are to do the right thing at the right time. Skill development in essential to having a good field hockey team.

- Ball Control Drills
- Passing, Shooting and Attacking
- Offensive and Defensive Drills and Tactics

The dribbling drills can be inserted at any time during the practice. "Dribbling"; where the player controls the ball with the stick and moves in various directions with it to elude opponents. To make a pass the ball may be propelled with a pushing stroke, where the player uses their wrists to push the stick head through the ball while the stick head is in contact with it; the "flick" or "scoop", similar to the push but with an additional arm and leg and rotational actions to lift the ball off the ground; and the "hit", where a swing at ball is taken and contact with it is often made very forcefully, causing the ball to be propelled at velocities in excess of 70 mph (110 km/h). In order to produce a powerful hit, usually for travel over long distances or shooting at the goal, the stick is raised higher and swung with maximum power at the ball, a stroke sometimes known as a "drive" (5). While there may be some sense of specificity to a program designed for an athlete of a specific sport, the truth is that there is a limit to the amount of application/carryover of a sports performance exercise to a sports skill. The most sports specific training that can be done is the sport itself. Sports specific skills practiced for the sport are as specific as one can get. The same is true for shooting the puck. However, while there are sports specific skills necessary for each sport, there are also physical skills necessary for each sport. Sports preparation is necessary for the sport specific skills (shooting a basketball, pitching a baseball, etc.) and physical preparation is needed for specific performance enhancement such as foot speed, strength, power, etc.

1. Objectives of the Study

The main objective of the study was to assess the effect of specific training on dribbling which would help to enhance performance of hockey players. The present study was designed to obtain the data on the men players from various faculties of Bangalore central university.

2. Statement of the Problem

The purpose of the study was to determine the effect of specific training programme on dribbling among Bangalore central university hockey players.

3. Delimitations

a. The study was delimited to Bangalore central university.

b. The study was delimited to 30 hockey players; their age was 18 to 28 years.

c. The study was restricted to the dependent variable is dribbling performance and independent variables are specific training.

4. Significance of the Study

a. The findings of the study may be helpful for university hockey players to apply specific training which will help in better performance.

b. The findings of the study would be helpful for the trainers to know the role of dribbling influence their performance.

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c. The results of the study may be helpful to fitness trainers, coaches, physical educationist and exercise physiologists to design proper training protocol for other populations.

METHODOLOGY

In the present study all the students studying in various faculties, Bangalore central university were considered as population for the study. A representative sample of 30 hockey players in the age of 18-28 years was chosen as sample for the study. The selected participants were divided into two groups. Group I underwent specific training and group II act as control group. The experimental groups underwent eight weeks of training in their particular workout. For this study dependent variable is shooting.

Test Administration – W Dribble Test

Purpose

The purpose of this test is to measure the dribbling ability of the hockey players.

Equipments and Materials

Hockey stick, balls, cones, stop watch, measuring tape, paper and pencil were used.

Scoring

The score is the elapsed time to the nearest tenth of a second between the starting from A to E and return back from E to A.

Analysis of Data

The data obtained were analyzed by analysis of covariance (ANCOVA). Analysis of covariance was computed for any number of experimental groups, the obtained 'F' ratio compared with critical F value for significance (7)

Results

The statistical analyses of dribbling performance due to specific training have been presented in Table I.

Table – I: Analysis of Covariance on W Dribble Test of Specific Training Group and Control Group

	Experimental Group	Control Group
Mean Pre test	**9.94**	**9.90**
SD	**0.19**	**0.31**
Mean Post test	**9.38**	**9.96**
SD	**0.15**	**0.23**

Significant at .05 level

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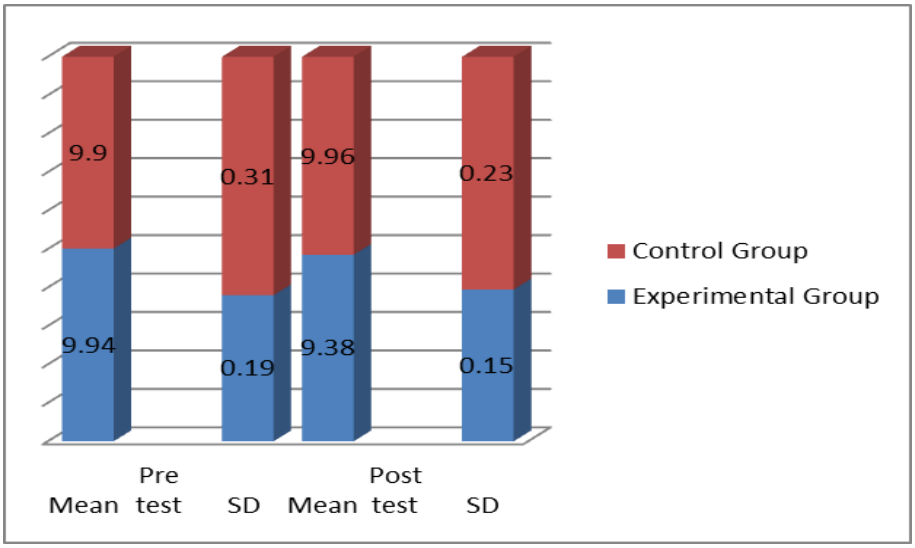
Graph -1: Analysis of Covariance on W Dribble Test of Specific Training Group and Control Group



Showed that the pre-test values of W dribble test for specific exercise training group and control group were 9.94 ± 0.19 and 9.90 ± 0.31 respectively. The obtained 'F' ratio value of 0.14 for pre-test score of specific exercise training group and control group on W dribble test was less than the required table value of 4.20 for significance with df 1 and 28 at .05 level of confidence. The post-test mean values of W dribble test for specific exercise training group and control group were 9.38 ± 0.15 and 9.96 ± 0.23 respectively. The obtained 'F' ratio value of 37.25 for post-test scores of specific training exercise group and control group was more than the required table value of 4.20 for significance with df 1 and 28 at .05 level of confidence. The results of this study showed that there was a significant difference among specific exercise training group and control group on W dribble test.

CONCLUSIONS

The results of the study proved that there were significant differences between control group and specific training group. The eight weeks of experimental treatment significantly influence on dribbling performance in university hockey players.

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UTILITY AND RISK OF SOCIAL MEDIA IN HEALTHCARE AND ITS REGULATORY FRAMEWORK IN INDIA

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ABSTRACT

Social media is increasingly becoming a powerful tool with more and more people and institutions embracing it. Growing usage of social media has created unprecedented impacts, benefits and risks for people in every aspect of life including healthcare. Social media platforms like Facebook, Twitter, YouTube, Instagram, blogs etc. have become the medium of choice for patients, professional and healthcare institutions. The user generated content has its own utility for the stakeholders in health care. Patients get instant information about a disease, its treatment, medical procedures, and medicines. Social media help them to connect with similar patients and various online help groups. This provides them the emotional support. They are able to easily connect to the health providers. They also get an opportunity to share health information, review doctors and hospitals. Patients/people also like to get health and diet tips on social media platforms.

For professionals/ Doctors, social media platforms provide a link to connect with peers and experts. They are able to provide patients education and online consultancy. The relationship of patients and professionals is becoming more equal due to enhance knowledge and connectivity. The health care service providers such as hospitals, pharmaceutical companies, insurance companies get a wider reach and social media help them provide better services at reduce cost.

However, the invasion of social media in daily lives has caused unpleasant experiences and unwanted impacts on physical and mental wellbeing. Many a times inaccurate and incomplete information put the lives of patients in danger. They feel that their privacy and confidentiality is lost. There is lack of security due to possible frauds, cyber bullying and abuse.

For professionals/health providers, social media is a pilferage of time. Undesired breach of patients' confidentiality may bring the risk of legal action, loss of professional image. Unprofessional behavior can even cause them loss of their profession license.

Thus, creating a regulatory framework to mitigate the risks and threats of social media has become a necessity. In India, up till now, there is no one specific legislation governing social media. However, there are varieties of other laws which provide relief. These are-

1. *Indian Constitution confers the right to privacy in India.*
2. *Indian Penal Code: Sections 292-294, 499, 503, 504, 153(A) and 295(A) provide protection against certain crimes.*
3. *Indian Medical Council (Professional Conduct) Etiquette & Ethics) Regulation, 2002 have set the professional standards & it regulates the nature and extends of doctor patients confidentiality.*
4. *Information Technology Act 2000 and 2008 provides safeguard against Technology based data breaches. Important section is 43(A), 72, and 72 A.*

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5. *Personal Data Protection Bill 2020. The Ministry of Electronic and Information has introduced a data protection bill in the parliament during December 2019.The bill is applicable to processing of personal data. However ,bill is still with JPC (Joint Parliament Committee) and waiting to be passed*

Keyword: Social Media, Health Care, Utility, Risks, Regulatory Framework

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THE USE OF SOCIAL MEDIA AS MARKETING TOOL FOR HOTEL INDUSTRY

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ABSTRACT

The emergences of social media technologies have benefited many service industries in promoting their services locally as well as globally. Hotel industry is also no exception. The importance of social media marketing is gaining popularity for the promotion of brand in Hotel Industry. The online content such as customer experiences, user feedback and product reviews generated by user in various social media websites become the important source of information for both consumers as well as business. This study aims to explore the implementation, challenges, and methods used to measure the role of social media platform in Hotel Industries of India. The study takes on a qualitative approach and the data collection has been done by using a semi structured interviewing technique. Content analysis has been adopted to derive the findings of the research. The findings of the study provide significant insights to the researcher, Hotel management and the consumer. It contributes in understanding the consumer behaviour in social media and the impact on boosting the sales revenue for this specific industry. Also the research work suggests some strategies to effectively design the user content in social media platforms to enhance consumer preferences for service quality and evaluate service performance.

Keywords: Social media marketing, Content analysis, Service quality, User Feedback, Consumer Behaviour

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IMPACT OF YOGASANA AND PRANAYAMA ON PHYSICAL AND MENTAL HEALTH OF SCHOOL STUDENTS

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ABSTRACT
Yoga gives controlled stretch to the muscles and improves the flexibility which is basic need for good physical health of school students. Asana help to relax the body and mind, by controlling the prana one can control the mind. Pranayama helps to gain control over the breathing, anulom and viloma has a soothing effect on the mind. By practicing meditation one can easily concentrate and relax. Present study is focused on finding Impact of Yogasana and Pranayama on physical and mental health of school students

***Keywords**: Physical and mental health, breathing practices, physical fitness.*

INTRODUCTION
The conceptual background of yoga has its origins in ancient Indian philosophy. There are numerous types of yoga, each having its own specific impact regarding the relative content of physical postures and exercises, breathing techniques, deep relaxation, and meditation practices that cultivate awareness and consciousness. The application of yoga as a therapeutic intervention, takes advantage of the various physiological benefits of the practices. The asana increase physical flexibility, coordination of mind and remaining body, strength. The breathing practices and meditation helps to be calm and focus the mind to develop greater awareness and diminish anxiety, and thus result in higher quality of life. Other beneficial effects might involve a reduction of stress, blood pressure, and improvements in resilience, mood, and metabolic regulation.

Yoga controls mental health, prevent depression, fatigue, anxiety, stress, posttraumatic stress disorder. It maintains physical fitness, sympathetic parasympathetic activation, and cardiovascular endurance. Regular practice of Yogasana improves cardio pulmonary conditions, hyper tension, pulmonary functions, metabolic processes, endocrine gland working, glucose regulation, musculoskeletal functions.

OBJECTIVE OF STUDY
- Evaluation of physical and mental health of female school students who don't practice yoga.
- Evaluation of physical and mental health of female primary school students who practice yoga.

HYPOTHESIS
- There is no significant impact of yoga on physical and mental health of female school students.

METHODOLOGY
Descriptive survey method was adopted for present study. 100 female school students were randomly selected as sample. 2 groups of students i.e., control and experimental group were prepared. Each group consists of 50 female students. Students of experimental group practiced yoga regularly for 40 to 50 minutes. Students of control group didn't practice yoga. Sample

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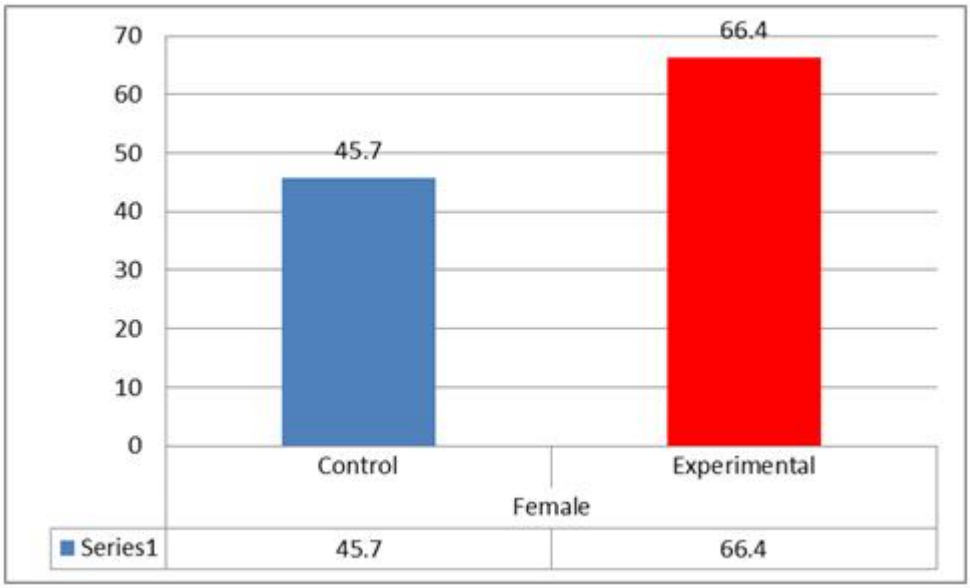
students were evaluated for their physical and mental health using a self prepared test paper. Collected data was tabulated and comparatively analyzed using mean, standard deviation and t value.

FINDING AND ANALYSIS

Table: Impact of Yoga on Physical and Mental Health of Primary School Students.

Gender	Group	Physical and Mental Health Status			
		Mean Value	Standard Deviation	t Value	Significant Level
Female	Control	45.7	1.34	0.78	0.05
	Experimental	66.4	1.0		

Fig: Impact of Yoga on Physical and Mental Health of Primary School Students



Data shows that yoga influence student's physical and mental health status of students. Female students, control group students have mean value 45.7 with standard deviation 1.34 while experimental group students have 66.4 mean values. For experimental group students mean found as 66.4 with standard deviation 1.04. Calculated t value is 0.78 which is significant at 0.05 levels. Hence hypotheses there are no significant impact of yoga on physical and mental health of female school students is rejected.

CONCLUSION

Yoga is helpful to keep better physical and mental health of school level students. The difference of impact on girls is not significant. Yoga increases self-confidence and self-efficacy. Govt. has accepted the importance of yoga that's why specific training sessions are organized for school teachers and students.

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EFFECTS OF FARTLEK AND PLYOMETRIC TRAINING ON SPEED PERFORMANCE OF FOOT BALL PLAYERS VIJAYAPURA

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ABSTRACT

The purpose of the study was effects of fartlek and plyometric training on speed performances of Foot Ball players Vijayapura. 45 from various schools. The selected subjects were of age group ranging from 14 to 16 years. The subjects were randomly divided into three groups and each group consisted of 15 subjects. Group-I underwent isolated fartlek training, Group-II was isolated plyometric training, and group-III act as control group was not given any special treatment. The experimental period was 12 weeks. Pre-test and posttest were taken before and after the training programme. The selected physical variables were Speed. During the intervention phase, a modified training program was offered by a well-trained to the experimental group under the supervision of the researcher at a school in Vijayapura. All participants were encouraged to continue their standard physical activities and routine procedures. The intervention phase 12 weeks and included morning 60 minutes and evening 60 minutes for alternative days in a week. To find out the significant Effects of fartlek and plyometric training on selected physical variable. The ANCOVA statistical technique was used to find the mean difference between the groups on physical variables. The results of the study revealed a significant group × test interaction ($p < 0.05$). Follow-up analyses indicated that while no group differences in physical variables existed between the four groups of the pre-test. In posttest all the experimental groups were found to have significantly ($p < 0.05$) better performance on the physical variables than the control group. The findings of the present study suggest that plyometric training improved the physical variables in school.

INTRODUCTION

Sports are integral part of the system of education. Training is a system of process in which Foot Ball players improve their fitness to meet the demands of their sport. Training uses both general and specific exercises to develop the Foot Ball players for their sport. Fartlek training refers to the training that uses some kind of fartlek to the contraction of a muscular force. In this training, the effort is normally performed more efficiently operating the Foot Ball players. Plyometric training involving repeated running to increase Speed. The plyometric training system can provide great amounts of energy but this system fatigues quickly. People participating in speed or power events like, football very familiar with this form of energy production.

METHODOLOGY

To achieve the purpose of the present study, 45 football players were selected from Vijayapur school, who had participated in the inter-school level tournaments. They were selected at random as subjects. All the subjects were of Vijayapura they had a similar academic work and regular activities in accordance with the requirements of their college curriculum. The selected subjects were of age group ranged from 14 to 16 years. The subjects were randomly divided into three groups and each group consisted of 15 subjects. Group-I underwent isolated fartlek training, Group-II was isolated plyometric training, and group-III act as control group was not given any special treatment. The study was conducted 12 weeks training schedule.Speed was selected as a dependent variable and it was tested through 50 meters run test. Pre test-post test-

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random group-research design was followed in this study. To find out the significant effects of aerobic and anaerobic training on selected Speed, analysis of covariance (ANCOVA) was computed (Clarke and Clarke, 1972) for the data collected aerobic, anaerobic, combined and control groups during pretest and posttest separately for each variable

Further to state, since four groups were involved, whenever the F ratio was significant, Scheffe's post hoc test was used determine which of the paired mean differed significance 0.05 was fixed.

RESULTS AND DISCUSSION

The statistical analysis comparing the initial and final means of agility due to effect of fartlek and plyometric training on selected physical fitness variable namely, Speed among Foot Ball players is presented in Table I.

Table –I Computation Of Analysis Of Covariance Of Agility.

	Faertlek training	Polymetric training	control	Source of varience sum of squares	Sum of squares	df	Mean squares obtained F	obtained
Pre test	**13.05**	**12.96**	**12.9**	**between**	**0.36**	**3**	**0.12**	**1.68**
				within	**5.45**	**76**	**0.07**	
Post test mean	**12.80**	**12.76**	**12.9**	**between**	**0.53**	**3**	**0.18**	**2.96**
				within	**4.73**	**76**	**0.06**	
Adjustmented post test mean	**12.83**	**12.77**	**13.9**	**between**	**0.87**	**3**	**0.29**	**17.79***
				within	**1.23**	**76**	**0.02**	
Mean Diff	**-0.16**	**-0.20**	**0.01**					

Table F-ratio at 0.05 level of confidence for 3 and 76 (df) =2.73, 3 and 75(df) =2.73 .*Significant

As shown in Table I, obtained F ratio of 1.68 on pre test means of the groups is not significant at 0.05 levels. This shows that there is no significant difference among the means of the groups at the initial stage and hence the random assignment of the groups is successful. The obtained F ratio on post test means is 2.86, and is significant at 0.05 level, being greater than the required F value of 2.73 to be significant at 0.05 level. Taking into consideration the pre test means and post test means, adjusted post test means are determined and analysis of covariance is done and the obtained F value 17.75 is greater than the required value of 2.73 and hence it is accepted. This shows that there are significant differences among the adjusted means on the Foot Ball players. Since significant improvements were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results are presented in Table II.

Table II Schaffer's Confidence Interval Test Scores on Speed

Fartlek training	Polymetric training	Control group	Mean diff	C.l
12,03	12.77		0.16*	0.12
12.83		12.96	0.13*	0.12
	12.77	12.96	0.29*	0.12

* Significant at 0.05 level.

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The post hoc analysis of obtained ordered adjusted means prove that (1) there are significant differences between fartlek training and plyometric training groups (2) fartlek and control group (3) plyometric and control group and . It is found that (1) there was no significant difference between fartlek and plyometric group .The ordered adjusted means are presented through bar diagram for better understanding of the results of this study.

Discussions On Findings As shown in Table I, the obtained F value on the scores of pre test means (1.68) is less than the required F value, which proves that the random assignment of the subjects were successful and their scores in Speed before the training were equal and there were no significant differences. Taking into consideration the pre test means and post test means, adjusted post test means are determined and analysis of covariance is done and the obtained F value 17.75 is greater than the required value of 2.73 and hence it is accepted. This shows that the interventional programmes significantly improve Speed of the Football players. The post hoc analysis of obtained ordered adjusted means prove that there are significant differences between (1) fartlek group and control group (2) plyometric group and control group. Comparing between the treatment groups, it is found that (1) there are significant differences between fartlek group and plyometric group .Thus, it is proved that while fartlek group and plyometric group improve Speed of the Football players compared to control group, plyometric group is better than improving Speed of the Football players the differences are significant at 0.05 levels. Bames Schilling and Falvo (2007) found large magnitude of differences on Speed performance among different categories of athletes and Speed covers 34% of the variance of performance. Under the twelve weeks fartlek and plyometric training the subjects were induced to exert more energy and training themselves. The findings proved that the twelve weeks fartlek and plyometric training had significant influence in improving Speed of the Football players. The finding of this study is in agreement with the findings of Bames Schilling and Falvo (2007) who found significant improvement in run time, a Speed improved performance due to frequent training protocol

CONCLUSIONS

1. It is concluded that effects of fartlek and plyometric training significantly improve Speed of the Foot ball Players.
2. The comparing among the treatment groups, the plyometric training would be better than fartlek training group and control Speed of the Foot ball Players. .

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A SURVEY ON THE PERCEIVED IMPACTS OF PRIVATIZATION OF PUBLIC SECTOR UNDERTAKINGS

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ABSTRACT
Human resource management as a discipline has developed over the years and now it mainly focuses on training of individuals, providing opportunities to learn new skills, distributing beneficial resources besides concentrating on other development activities. India is expected to add about 250 million to its labor pool by the end of this year and the structure of domestic labor market has huge ramifications on labor outsourced by any nation with India being no exception. Privatization of public sector undertakings has been rampant in India since the 90s and the trends have increased in recent times. Under this backdrop, the present paper makes an honest attempt to assess the perceived impact of privatization of public sector undertakings on the society from a survey conducted on the general population on this issue. The results show that privatization of loss making public sectors are welcomed by the masses as they presume that it would enhance accountability, reduce negligence, give importance to customer service and satisfaction, and improve customer relationships.

Keywords: *customer, efficiency, employment, privatization, satisfaction.*

INTRODUCTION
Economist John R Commons first coined humans as resources in 1893 and the concept has grown since then. The main aspects of hiring, evaluating and compensating employees have taken a backseat today and full satisfaction of human resources is the present day mantra for sustainable development of nations. Human resource management as a discipline has developed over the years and now it mainly focuses on training of individuals, providing opportunities to learn new skills, distributing beneficial resources accordingly and concentrates on other development activities. It also ensures a match between the needs of an organization and that of an individual.

Human resource management is extremely crucial for India as she is one of the global hubs for labor outsourcing. India is expected to add about 250 million to its labor pool by the end of this year with additions at the rate of about 80 million a year, which is more than the entire labor force of the many countries. The structure of the domestic labor market has huge ramifications on labor outsourced by any nation and India is no exception. Migration also depends on various other factors like work pressure, job security, growth opportunities and incremental benefits besides the prime indicator named remuneration.

Privatization, described as the transfer of state-owned enterprises to private owners, is a common economic policy tool in the world. Privatization is not new to the government, although the government has always been vigilant about private sector participation in public enterprises. It has been argued that privatization of public sectors improves efficiency, curtails red tapes, reduces unnecessary costs and enhances accountability. On the other hand, it has been observed that human workforce productivity has improved under privatization but only when there are more job opportunities, the human resources can be provided with adequate rewards. Privatization of public sectors forces the companies to be efficient, or at least find some way to

make profit in order to revive the loss making public sector but, it has also led to less transparency and inflexibility.

However, the transformation of public sector units to private sector has a questionable effect on human resources. It is argued that the government should have clear and transparent regulations regarding numerous issues that can create problems to employees due to privatization such as the management structure, concerns about labor performance and dealing with financial crisis. There shouldn't be any hidden policy and the undertaking must be approached separately so that the performance level improves.

REVIEW OF LITERATURE

According to Ojta (2013), there can't be universal rules for all countries. One standardized method may not be appropriate for some countries. Therefore, one should correspond to privatization based on local conditions. There should be transparency in implementing the sale process; otherwise, fraud and corruption charges can't be stopped in society. According to their study, Gooderham et al (2018) showed that human resource development has progressed a lot as an educational discipline and people understand much more than they did four decades ago. However, to move forward, they suggested, HRM needs to adopt a theoretically well-established approach to HRM in multilevel reference, such as, serving multiple stakeholders and recognizing the importance of time. The comparative contextual framework gives us the rationale that future HRM research agendas will need to put special emphasis on external references which is considered institutionally as the best theory. Earl and Shapak (2019) stated that although economic analysis of privatization has largely focused on a more controversial question, it often impacts a firm and its employee's performances. Both policy makers and scholars feel that employment and wage effects are negative and activists around the world react to the possibility of privatization with protest and attacks, especially when foreign bosses are involved. Rachman and Sari (2019) showed that in terms of human resources, improvement in public service development has a growing impact with future-oriented training and team building methods, motivation and performance of all existing personnel, improvement in pattern of services rendered and increase the ability of knowledge, skills and attitudes in providing services to community. Public service reforms in the perspective of strengthening organizational culture changed the mindset and cultural setup of each personnel, based on value, integrity, professionalism and government ethics. So, a service culture that is high accountable is established which is service oriented to the interests of the community.

Jerset (2012) conveyed through his study that there were neutral effects of the process of privatization on the performance of employees and their salaries. There was no statistically significant difference due to the effect of privatization process. Employees' performance just accounted for their demographic variables. Philippovic (2005) stated that privatization, with appropriate structural reforms, creates incentives for improving economic efficiency, increasing investment and adopting new technologies. In addition, personalization plays an important role in creating ways to implement, paves the way for the right incentives and proper economic restructuring. It is necessary to note that the success of privatization largely depends on the government's commitment towards regulatory reforms.

Moynihan and Pandey (2007) found that recognizing the impact of public sector management means identifying a simultaneous set of organizational responsibilities. One of the alleged practical benefits of public sector management is that it helps to recruit individuals in the public sector and strengthens employee relations, provides a foundation for loyalty, motivation and commitment, which is more effective than monetary incentives. Public organizations should be aware of the impact on management systems and other organizational institutions. According to

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them, reducing and improving regulations that clarifies the goals and employees can have a positive impact on public sector management.

OBJECTIVES OF THE STUDY

Privatization is considered as one of the issues which attract lots of attention in the economic sphere. The aim of the present study is to assess how privatizations affect human resources and also examine if transformation of the public sectors would have far reaching consequences on labor, social security and employment relationship (as per the perceptions of the masses). In this backdrop, the present paper makes an honest attempt to assess the under mentioned issues through surveys conducted on sample of different ages about their perspectives on the subject.

1) The prevailing perceptions about the public sector and private sector undertakings.

2) Impact on human resources due to privatization of public sectors.

3) Perceptual impact on society due to privatization of public sector.

DATA AND METHODOLOGY

For the purpose of the study, a close ended questionnaire was designed by the researchers. It contained questions related to privatization of public sector and its impact on the human resource, economy, market and customers. 80 people residing in Bengal were chosen through purposive sampling technique as samples for study. The sample consisted of people belonging to various professions and having an employable age (ranging from 20-50 years). The sample has equal representations of both genders. The respondents were personally interviewed and their responses were tabulated in excel. The data so obtained were summarized and meaningful inferences were drawn.

FINDINGS FROM THE SURVEY

		Female N=40	Male N=40
Age	• Below 25 • 25-40 • Above 40	50% 42.5% 7.5%	42.5% 55% 2.5%
Occupation	• Service • Business • Self Employed • Others	27.5% 7.5% 15% 50%	42.5% 2.5% 20% 35%
Which Sector will you prefer to work for?	• Public/ Govt. Sector • Private Sector	62.5% 37.5%	65% 35%
Do you think Privatization of public sector will revive the loss making public sector?	• Yes • No • Maybe	35% 20% 45%	45% 32.5% 22.5%
According to you, which of the following sector should not be privatized?	• Education • Defense • Railways • Oil and Natural gas • Health Care • Insurance • Private security • Others	20% 37.5% 20% 2.5% 15% 2.5% 2.5% 0%	7.5% 37.5% 25% 7.5% 7.5% 0% 5% 15%

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As per the results from the survey, it is observed that more number of females and males surveyed prefer to work for public sector over private sector. Thus, employees till date wish public sector for employment. It is seen that both genders do not want few sectors to be privatized, primary among them being the defense sector, followed by education and railways. However, the sample had mixed views on the issue of privatization of public sectors for revival of losses.

Human Resource:

According to you, which sector focuses on talent for promotion?	• Public Sector • Private Sector • Both	17.5% 40% 42.5%	7.5% 62.5% 30%
According to you, what is the main cause for the underperformance of public sector?	• Lack of accountability • Lack of skilled labor • Too much job security • Unequal distribution of responsibility • Lack of proper training and guidance • Irresponsible consumer behavior • Others	10% 17.5% 30% 15% 17.5% 10% 0%	20% 7.5% 37.5% 7.5% 15% 7.5% 5%
Do you think privatization of public sector will create more job opportunities?	• Yes • No • Maybe	30% 30% 40%	37.5% 30% 32.5%
Do you think privatization of public sector will provide better and efficient training to the employees?	• Yes • No • Maybe	52.5% 15% 32.5%	65% 12.5% 22.5%
Do you think privatization of public sector will increase the efficiency and work ethics?	• Yes • No • Maybe	62.5% 15% 22.5%	67.5% 17.5% 15%
Do you think privatization of public sector will bring positive changes to the top level management?	• Yes • No • Maybe	50% 15% 35%	52.5% 17.5% 30%
Do you think in-house politics is more in private sector than public sector?	• Yes • No • Maybe	52.5% 17.5% 30%	45% 32.5% 22.5%

The result shows that private sector acknowledges talent more than the public sector. Thus, reward for efficiency in the form of promotion is more in the private sectors. It has been found that both the genders have the same perceptions regarding the cause of inefficiency of public sector. They feel that too much job security is the main factor for underperformance of public sector. Lack of skilled labor and lack of accountability are also deemed important factors in this regard.

The sample has mixed responses regarding creation of job opportunities due to privatization. The sample is confident that privatization of public sector will provide better and efficient training to the employees and also increase the efficiency and work ethics. Although most in the

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sample feel that in-house politics is more in private sector than public sector but still, they think that privatization of public sector will bring positive changes to the top level management.

Economy:

Do you think Privatization of public sector will contribute more to the economy?	• Yes • No • Maybe	25% 40% 35%	40% 40% 20%
Do you think privatization of public sector will help reducing the public finance crisis?	• Yes • No • Maybe	17.5% 35% 47.5%	35% 45% 20%
Do you think Privatization of public sector will increase the inflow of Foreign Direct Investment (FDI)?	• Yes • No • Maybe	50% 15% 35%	60% 17.5% 22.5%

The sample is indecisive about the contribution towards economy after privatization of public sectors. Thus from the nation's perspective, the sample is undecided about the gains. The sample is also not sure if privatization of public sector will help reducing the public finance crisis. But, the sample feels that inflow of Foreign Direct Investment (FDI) would increase due to privatization, as half of the total percentage of female and above 50% of the total percentage of male agreed on positive inflow of FDI after the privatization process.

Market

Do you think privatization of public sector will run the business more efficiently due to the profit motive?	• Yes • No • Maybe	65% 25% 10%	65% 12.5% 22.5%
Do you think privatization of public sector will lead open market economy?	• Yes • No • Maybe	47.5% 12.5% 40%	50% 32.5% 17.5%
Do you think privatization of public sector will encourage the shareholders to invest more?	• Yes • No • Maybe	45% 17.5% 37.5%	55% 25% 20%
Do you think privatization of public sector will reduce the cost of production?	• Yes • No • Maybe	50% 15% 35%	30% 52.5% 17.5%

Both the genders are optimistic that after privatization of public sector, the working efficiency would be enhanced. This view is shared by 65% of the sample. On the question leading to open market economy due to privatization of public sector, 47.5% of female and 50% of male acknowledged on it. 45% of female and 55% of male agreed that privatization of public sector will encourage the shareholders to invest more. In spite of the above benefits, the sample is indecisive whether privatization of public sector will reduce the cost of production.

Customers:

Do you think privatization of public sector will give more importance to customer service and satisfaction?	• Yes • No • Maybe	65% 5% 30%	67.5% 12.5% 20%
Do you think privatization of public sector will reduce the customer negligence towards the property?	• Yes • No	60% 15%	52.5% 30%

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	• Maybe	25%	17.5%
Do you think privatization of public sector will improve customer relationship?	• Yes • No • Maybe	70% 7.5% 22.5%	57.5% 17.5% 25%

The customers are regarded as god by modern marketers and privatization seems to have positive effect on their satisfaction. Both genders share the same beliefs on the issue that the customers will get better service and satisfaction after the privatization of public sector. More than half of the total sample believes that pragmatic and beneficial effect will come after privatization of public sector regarding negligence of customers towards the public property. A high percentage of respondents (70% and 57.5% of female and male respectively) agreed that privatization of public sector would lead to improvement of customer relationship.

CONCLUSION

Privatization of public sectors has been a topic of discussion in every economic forum. One school of thought strongly argues for it and another against it. A survey among general employable masses residing in Bengal show that privatization of loss making public sectors are welcomed by the masses as they presume that it would enhance accountability, reduce negligence, give importance to customer service and satisfaction, and improve customer relationship. The sample also believes that there would be better management of assets and enhanced inflow of FDI due to privatization. Interestingly, the sample is not so sure about reduction in the cost of production, investment by general public in the newly transformed company, creation of newer jobs and reduction of public finance burden.

As regards to human resources, the sample is of the opinion that privatization would increase work efficiency, improve methods of performance through training and development of employees, improve overall work culture and create stimulus for institutional growth. However, the sample has strong opinions against privatization of few important sectors like defense, education, railways, health, etc. It is believed that privatization of these sectors would be injurious to the society in the long run. The prime cause of inefficiency and underperformance of public sector, according to the sample, are job security of employees, lack of accountability, lack of adequate skills or training etc. Interestingly, when personally enquired, the sample would prefer to work in the public sector in spite of these hindrances at workplace. It can thus be comprehended that privatization is welcomed by the general masses in public sectors (barring few sectors) but the general employees till date prefer to work in the public sector undertakings.

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ABOUT THE BOOK

In the new millennium many old theories have now become redundant, and the study of Management, Social Sciences and Technology is now faced with new challenges. This book is an attempt to capture this transformation not just in practice but also in research. It tries to answer the challenges faced by the practitioners of management, social sciences and technology in their everyday lives by attempting to bring together both academics and practitioners together. This book presents a holistic view of the emerging trends in Management, Social Sciences and Technology on consumer behavior, financial ecosystem, human resources, quality management and international business in the global economy. This book not only highlights the issues hampering growth but also provides relevant solutions to foster economic growth and development.

We believe that this book will contribute to the colossal interest of scholars, researchers, policy makers, management practitioners, administrators and academicians in augmenting their intellectual growth and facilitate future research in the field of Advances in Management, Social Sciences and Technology.

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वर्ष १३ अंक ४ पौष मास कलियुगाब्द ५१२२ जनवरी २०२१



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निरमण्ड का इतिहास, सामाजिक, आर्थिक व देव परम्पराएं

डॉ. अंकुश भारद्वाज[1]
कौशल्या देवी[2]

शोध सारांश

प्रस्तुत शोध पत्र में निरमण्ड के सामाजिक, आर्थिक परिवर्तन और आध्यात्मिक आस्था के विभिन्न आयामों को प्रदर्शित करता है, इस शोध पत्र के (अधीन) अन्तर्गत पौराणिक कथाओं, जनश्रुतियों तथा सामान्यकरण के माध्यम से निरमण्ड क्षेत्र के इतिहास को समझने का प्रयास किया गया है। इस शोध पत्र में महत्त्वपूर्ण स्थल कैसे जनभावना का केन्द्र बन गए तथा उनके पौधे को ऐतिहासिक बोध को समझने का भी प्रयास किया है। भारतीय विरासत की ऋषि परम्परा को समझते हुए इस क्षेत्र में हो ने वाले परिवर्तनों जिसमें सामाजिक-आर्थिक घटनाक्रम आधुनिक भारत तक समझ गया है। इस क्षेत्र में होने वाले सांस्कृतिक घटनाक्रम जिसमें खेलकूद तथा जीवन के मनोरंजक पलों को विभिन्न आयामों को भी दृष्टिपात किया गया है।

संकेत शब्द : *निरमण्ड, कालखण्ड, इतिहास, सामाजिक, देव परम्परा।*

नाम की उत्पत्ति

पौराणिक ऐतिहासिक ग्रन्थ में दक्ष प्रजापति की बात निरमण्ड के इतिहास में आती है। जब भगवान शंकर के ससुर दक्ष प्रजापति के घर में यज्ञोत्सव चल रहा था। भगवान शिव और दक्ष प्रजापति के मध्य चल रहे मनमुटाव के कारण दक्ष प्रजापति ने शिव को यज्ञ में आमन्त्रित नहीं किया। हठ करके सती बिन बुलाए यज्ञशाला में पहुंच गई। यज्ञ में शिव का स्थान न देखकर सती यज्ञाग्नि में कूद पड़ी। शंकर जी को जब इस घटना का पता चला तो क्रुद्ध होकर वह यज्ञशाला में पहुंचे तथा सती का मृत शरीर त्रिशूल पर लटकाकर दिगम्बर रूप धारण कर भूमण्डल में भटकने लगे। शिवजी के इस मानसिक असंतुलन व क्रोध को देखकर भगवान विष्णु ने सुदर्शन चक्र का आह्वान किया। सुदर्शन चक्र से सती के अंग कटकर भूमि पर गिरने लगे। जहां-जहां जो अंग गिरा उसी के नाम से उस स्थान का नामकरण हुआ तथा वे शक्तिपीठ कहलाए। शंकर जी जब इस निरमण्ड स्थान पर पहुंचे तो त्रिशुल पर शेष बचा सती का सिर यहां गिरा और त्रिशूल मुण्डवहीन अर्थात् निर्मुण्ड हो गया। इसलिए यहां का नाम नृमुड पड़ा जो बाद में निरमण्ड बन गया।[1]

भौगोलिक स्थिति

निरमण्ड क्षेत्र जिला कुल्लू के अन्तर्गत आता है। यह क्षेत्र आनी, बंजार तथा शिमला जिले के भूक्षेत्र से घिरा हुआ है। निरमण्ड क्षेत्र के साथ ही सतलुज नदी जिसका उद्भव तिब्बत स्थित ऊंचाई १८५०० फीट मानसरोवर झील के पार्श्व से होता है, बहती है। राजस्व रिकार्ड के अनुसार निरमण्ड गांव ९३ बीघा, ५ बिस्वा क्षेत्र में बसा है, १२० अंश का कोण बनाते हुए यह गांव चारों दिशाओं में फैला हुआ है।[2] इस क्षेत्र की मुख्य खड्ड 'कुर्पन' है जो श्रीखण्ड कैलाश (५१८२ मीटर) के समीप 'नैनसर' नामक

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Women's participation in National Movement : Role of Socio-religious Reform Movements

Dr. Ankush Bhardwaj

ABSTRACT

The entire story of the freedom movement is replete with the saga of bravery, sacrifice and political sagacity of great men and women of the country. In the long tale of the struggle for freedom with political and social reform activities had their part to play. It may be that some leaders might have emphasized one while others laid stress on the other, but generally the consciousness of their mutual impact on the effort towards independence was present all the time. The reform movement in nineteenth century was hastened by Western impact but its inspiration was indigenous, and it was but a continuation of the earlier reform movements which derived their inspiration from the essence of ancient Indian cultural traditions. Abuses in the religious and social spheres at everytime in the history of India have been sought to be remedied by recourse to the purity of the teaching of Vedas and Upanishads and the great treasure of our cultural heritage. Therefore, in this paper, an attempt has been made to understand the inter-relationship of socio-religious reform movement and struggle for freedom.

Keywords: *Social reforms, Nationalism, Asharam, Society, Struggle, Freedom.*

The passion for all round reform which had animated a host of medieval saint-reformers in India and many centuries earlier had inspired the Buddha and Mahavir to strive for the regeneration of man, manifested itself again in the nineteenth century.[1] The effective interpretation of India by the West, alike on the social and economic plane, may be said to have begun about 1800.[2] And the intellectual awakening in India which was one of its primary result and which in its turn was to produce far-reaching changes in Indian society, became distinctly visible shortly thereafter.[3]

The 19th and 20th centuries witnessed the beginning of many socio-religious reform movements in different parts of India. As part of the national renaissance, movements like Arya Samaj, Brahma Samaj, Prarthana Samaj and Theosophical Society spearheaded the social reformation in the various parts of India. Along with the generation of a national feeling, such movements fought against the evils like sati, infanticide, child marriage and other kinds of discriminations like caste system and untouchability.

Social reform and nationalism were but two facets of the Renaissance that began to convulse Indian life from the beginning of the Nineteenth century. One can broadly agree with "Zacharias" that movements for social reform and political emancipation were closely connected, that it is impossible to understand Indian political aspirations and activities if one divorces them from that nations great new

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Traders of Western Himalayas: Study of Land Routes and Commodities of Trade in Sirmaur region in Himachal Pradesh

Neelam *
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Abstract

The geographic location of district of Sirmour in Himachal Pradesh in Western Himalayan region has provided link routes between Himachal Pradesh, Uttar Pradesh and Haryana. Traders of Sirmour never left their agricultural occupation and traded only the commodities of need, not luxury in the past. The present paper is a literary and empirical study of traders involved in various occupations and commodity exchange from colonial period to till today. The present study covers various land routes crossing various villages from Sirmur to Sarahan(in Himachal Pradesh), to Saharanpur (in Uttar Pradesh) and Jagadhari (in Haryana) for import and from Dadahu to Ambala (Haryana), Shimla and Yamunanagar (Haryana) for export. The formation of small *haats* and bazaars in-between provided spaces for exchange, inter-change and addition to their trade commodities for the next station that forms the base of this panoramic study.

It concludes that trade routes formed the life-line for import-export, exchange and purchase for new commodities in and around Sirmaur area with many neighbouring states. The present study involves besides available literary sources, the interview of a traders who remained involved in trade activities for more than six decades of their life. Present paper is the narration of their experiences as a trader. It concludes with important observation of change in life-style, attitude, economy and income of people from colonial times to the present century.

Keywords: Commodities, Export, Import, Sirmaur, Trade, trade-routes, Western Himalaya

Introduction

Sirmour, is one of the districts of Himachal Pradesh, but its socio-cultural and economic spheres extended far beyond its political boundaries to the adjoining parts of Uttar Pradesh, Haryana, Punjab and Uttrakhand. The references of trade activities in this region are scanty due to want of literary, numismatic and epigraphic sources. Still paper tries to streamline the facts involved in trade activities in this region through available literary sources and field interviews for better empirical understanding.

None of the hill states during colonial period in western Himalayan region was economically self-sufficient. It can be admitted that traders' class initially was not existing in Sirmaur. Agriculturists used to deal in various small trade/ occupations when they were free from their seasonal agricultural activities. Potters, weavers, tanners were part of village economy but were not traders in real sense as their consumers were their villagers only. They were a part of symbiotic relation of village agriculturist economy. Traders of Sirmaur were basically agriculturists who never left their agricultural occupation and traded only the commodities of need, not of luxury.

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THE CULTS OF NAG DEITIES IN THE SHIVALIK HILLS

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Abstract

Worship of *Nagas* is prevalent throughout India and as old as Indian civilization. Himachal Pradesh is among all those places where worship of *Nagas* traced back to Christian era. The people of Himachal Pradesh have great belief in snake worship. The temples of serpent are found in each and every village of Himachal Pradesh. But here two kinds of faiths are popular among inhabitants of Himachal Pradesh, one in the upper hills and other in the lower hills. Both are separate in their identity. Worship of snakes in the upper hills traces its origin from epic age, while in the lower hills (District- Chamba, Kangra, Hamirpur, Bilaspur, Una, Solan and Sirmaur of Himachal Pradesh) from medieval times. In the lower hills the cult of *Gugga* is prevalent. But the cult of *Gugga* had been prevalent in *rajputana* long before it was introduced into Western Himalayas. But traces of serpent worship goes back to early century, early inhabitants were familiar with the worship of venomous reptiles. Although strayed evidences found at *Dehra Gopipur* and *Bharoli* in the Kangra district indicate that life must be started very early in this region.

Keywords

Snake, Worship, Lower Hills, Shivalik Hills, Naga and Local Cult.

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Religion and spiritual convictions are closely interlinked with society and culture of Western Himalayas. It has been become essential to study the religious practices and beliefs of hills, while discuss about the socio-cultural life of hills. Religion cannot be neglected from the socio-cultural life of hills. The people of hills are very devotional minded (Thakur, 1997) and obviously because religion and rituals have important role in their daily life. They have great belief in their local deities besides the pan Hindu pantheon of Indian sub-continent. These deities worshiped for the prosperity and well-being of the generations, protection of animals and safety from the natural calamities. These Devi's and Devtas are believed to be the manifestation of Lord Brahma, Vishnu and Mahesh. Mostly the local devtas are believed to be manifestations of Shaivites; worship of Shiva is more common in mountainous areas. The people of Himachal have a unique way of celebrating fairs and performing traditional rituals to mark births, deaths, harvests, or good rain fall. Ancient folk deals with stories of gods or war heroes or chieftains. The people of Himachal love festivals and participate with great enthusiasm in local festivals and fairs. In the western Himalayas no religious function is considered complete without the presence and blessings of the devta. The various cults of spatial origin are prevalent in Himachal Pradesh each village has its own deity called as Gram Devta (Village God) in Local language. The people of different ethnicity had migrated from various parts of the subcontinent. The process of migration was slow, but continued from centuries, up to the 18th century. They have different reasons for the migration; the most common was the safety of life during political turmoil of the plains. The people who had come to hills are not only physical migrations but they had brought their socio-religious practices. The worship of snake deities is one of them. Worship of snakes gods under the various twist of the

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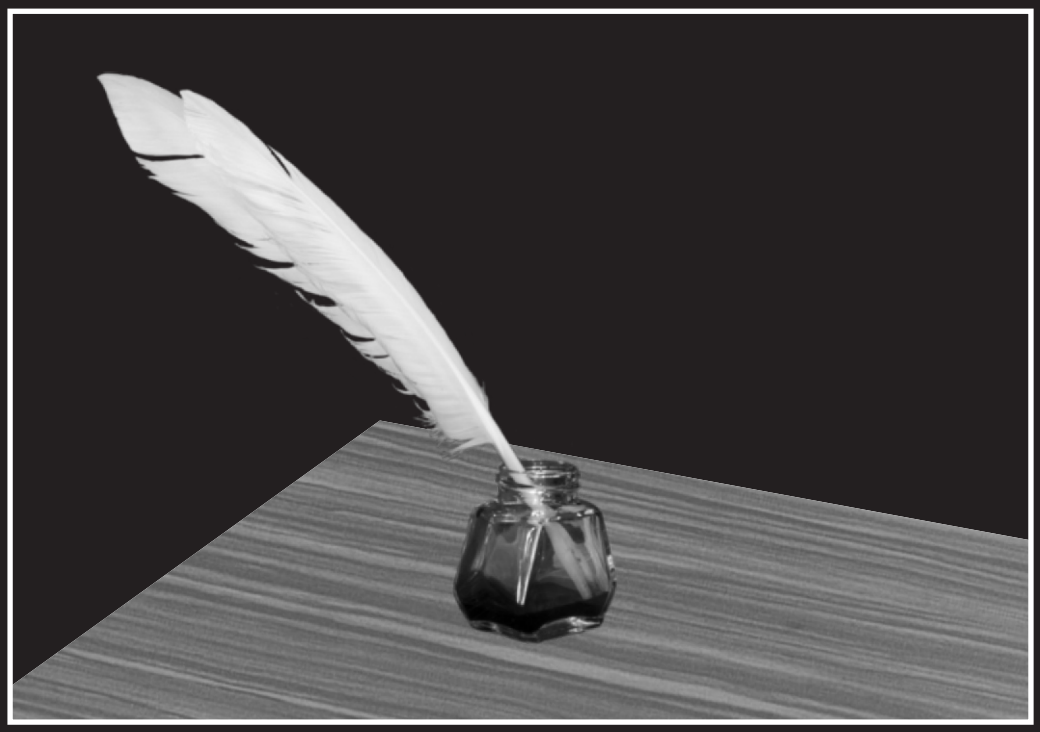

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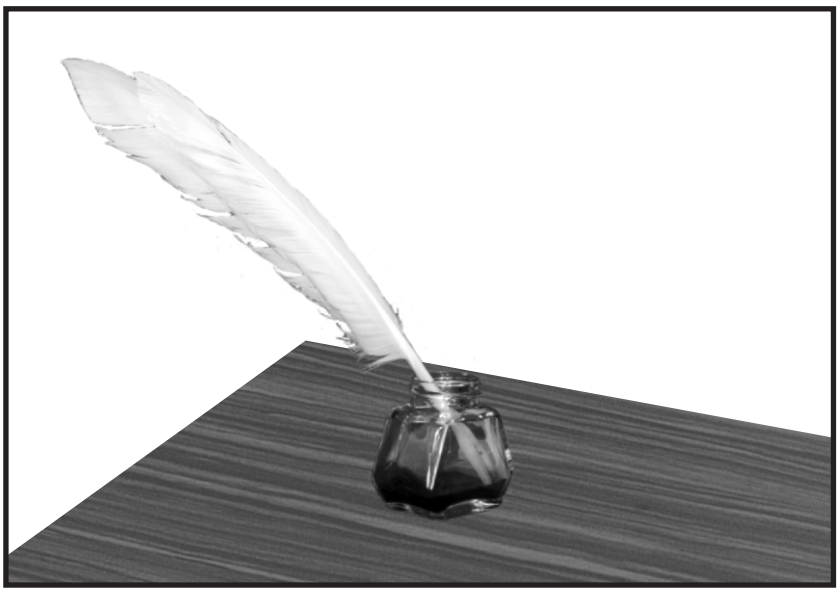

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A RE-LOOK ON PROTECTION OF THE RIGHTS OF FOREST DWELLERS VIZ-A-VIZ MINING ACTIVITIES IN INDIA

- Dr M P Chengappa* & Ms Manisha Kayal**

INTRODUCTION

India is a very rich land when it comes to mineral resources, and most of these resources are located in the dense forests, which are the home to various indigenous people. The increase in various mining activities has lead to the exploitation of these indigenous populations, which are for commercial gain at the cost of the livelihood of these people. Every sustainable model of development should aim at the indigenous people having rights over their land and the improvement of their livelihood. The Constitution of India, 1950, and various other welfare legislations been enacted for protection of these tribal populations from being exploited, and they deserve the same rights and respect as any other person in the society.

The industrial development and urbanization process has been the cause of the destruction of major portions of the forests throughout the world. Mining activities are one of the activities which causes threat to enviorment as well as promotes economic development of the country which can lead to a negative impact on the forest, ecology, environment and the people living residing near such activities. These adverse impacts on the people and the environment can be prevented by following proper mechanisms and taking necessary precautionary measures.[1] There have been various instances where mining activities have bypassed the various provisions of law as it takes place in remote places where it is impossible to keep a track if 10 hectares of land is permitted and the concerned industry uses 15 hectares of land and damages further 5hectares.

Many people have been forcefully displaced from their land and have been shifted to other places, especially the forest dwellers, and the tribal population has been highly affected by such mining activities. These displacement processes not only take away the land from the tribal people but also affect their health, education, and economic status by forcing them to other places where they have no means of livelihood. The Supreme Court of India has played an active role by looking into the concerns of these people and has tried to create an equilibrium between

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1. Philippe Cullet, 'Mining, Land and Water Law: Ensuring Sustainable and Equitable Outcomes' (The bloomsbury, 11 January 2017)<http://www.bloomsbury.ac.uk/studentships/studentships-2017/mining-land-and-water-law-ensuring-sustainable-and-equitable-outcomes-soas-bbk> accessed 30 March 2019.

the rights of the tribal population and the development projects. The tribal groups in India have been under the constant fight for protecting their rights against the development schemes, which affect their livelihood and force them to be displaced.

The ***Orissa Mining Corporation***[2] case has not only protected the rights of the tribal community but the Court also portrayed that development projects which are a platform for major employment opportunities for many people cannot be implemented by disregarding the rights of the tribal communities and the forest dwellers who mainly depend on the forests for their daily livelihood.This judgment was a landmark case after which the Indian Judiciary has evolved its approach to uphold the rights of the forest dwellers and protect them from unjust encroachment of their land and livelihood.

THE RIGHTS OF THE FOREST DWELLERS

'Tribe' is, in its common meaning, means the people of a social group living in primitive conditions in a fixed territory. They are the people who reside in the forests since the primitive ages and continue living there in modern society[3]. Forest dwellers are these tribal people who live in the forest land and depend on the forest products for their livelihood. They are considered to be a part of the forest itself as they are adapted in the various conditions of the forests. There are still various incidents where many indigenous communities are at the risk of being evicted without a necessary rehabilitation scheme being implemented. The legislative schemes,in many instances, have not beenable to protect the tribal community from large corporations that attempt to amass control over the collective resources of these tribal people and often end up destroying their life support system in the process.

Article 366 (25) of The Constitution of India, 1950, states that Scheduled Tribes are the people of the tribes or the tribal groups, as mentioned under Article 242, and Article 242 states that these are the tribes as declared by the President by the issuance of a public notification. Post-independence various legislations have been enacted to empower the Indian tribal group and upholding their rights like the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (hereinafter referred to as the "FRA") and the panchayats Extension to Scheduled Areas (hereinafterreferred to as the "PESA") Act, 1996.

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2. *Ibid.*
3. Anuj Kumar, 'Rights of tribals in india with respect to access to justice' (Legal desire , 25 June 2016) <http://www.legaldesire.com/rights-of-tribals-in-india-with-respect-to-access-to-justice/> accessed 15 March 2019.

Both the Acts aresocial welfare legislation to protect and promote the different traditions and practices of the forest dwellers.

The FRA states about various customary rights of the forest dwellers and the tribal people for usage of forest land. Sec. 2(o) of the FRA states that a person who lives in the forest or the forest lands and depends on it for his/her livelihood for three-generation is a 'forest dweller.' Sec. 2(c) of the FRA provides that a person belonging to the Scheduled Tribe is also eligible for the rights under FRA, and Sec. 4(1) discusses that a person who resides in the Scheduled Areas is also entitled to the rights under the FRA.

The FRA provides for three types of rights, land rights, use rights, and the right to protect and conserve. The land rights are for the rights over the land that the forest dwellers have been cultivating for their livelihood and residing under Sec. 4(3) and Sec 3(1)(a). Sec 4(4) of the FRA mentions the fact that these lands cannot be sold or transferred and has to be passed only by inheritance. Sec 3(1)(c) states that the forest dwellers are permitted to use the forest products which are traditionally collected by them, and Sec. 3(d) of the Act provides for the rights of using the grazing grounds for cattle and usage of water bodies. Sec. 3(1)(i) of the FRA grants a right and power to the forest dwellers to protect and conserve the forest land and the forest resources. Sec. 6 of the FRA discusses a three-stage process for deciding the rights of the forest dwellers. It states that the Gram Sabha has to propose who should be entitled to use the forest land for cultivation and forest resources. These suggestions have to be sent to the Taluka Committee, and the District Level Committee for their approval and the District Level Committee is empowered to take the final decision. But the Gram Sabha is the main authority to decide the people who would be eligible for any of the rights under this Act.

The PESA was implemented by the Government of India for the purpose of providing the authority to the Gram Sabha of the tribal regions to govern them. The PESA empowers the Gram Sabha to independently make laws about the traditions, customs, land, etc. of the tribal people, and the State legislations are not implemented on them. The Gram Sabha is also entrusted to be consulted before any land is acquired in the tribal area for any development schemes. The recommendations of the Gram Sabha have to be compelled with the purpose of any such development programs .[4]

4. *Supra* Note 4.

The advancement of any country is directly related to the well being and the rights of the common people. Most parts of the lands which belong to the tribal people are immensely rich in minerals and attracting mining based projects, both domestic as well as international investment. This leads to a dispute between the tribal community and the state when the state attempts to exploit these resources for the economic growth of the country[5]. In spite of the existence of stringent mechanisms for ensuring the protection of the tribal people and their rights, there are very fewer instances of strict implementation of them by the State.

JUDICIAL INTERPRETATION OF THE RIGHTS OF FOREST DWELLERS

The Supreme Court of India has been trying to keep a balance between the rights of the forest dwellers and the tribal community with the development projects while taking into consideration the genuine interests of the local inhabitants and protection of the forest lands. In ***Kailas v. State of Maharashtra,***[6] the Supreme Court of India had expressed its concern about the Scheduled Tribes who have been a victim for many years and the community's approach should change towards them and they should be granted social dignity, and their rights should be upheld and protected.

In ***BanwasiSeva Ashram v.State of Uttar Pradesh & Ors.***[7] , the main dispute was relating to the demands of the Adivasis(the tribal population) for their land and land-related rights as the land was being acquired for setting up a thermal power project by the State. The Court, while trying to address the issue,realized that there has to be a balance between development and the traditional rights of the forest dwellers and directed for the settlement of the rights of the Adivasis and also stated that they should be given proper title deeds. In ***Fatesang Gimba Vasava& Ors. v. State of Gujarat & Ors.***[8] , a complaint was filed by the Adivasis as they had been harassed by the Forest Department officers who were depriving them of their rights, such as the collection of forest products like bamboo. The Court upheld the claims and stated that they were entitled to collect forest products on which they have been dependent on primitive times. In ***Pradeep Krishen v. Union of India***[9] , the government had permitted the tribal people to collect leaves from sanctuaries and national parks as a part of their traditional rights which was challenged for

5. Shreya Sood and Shreya Mishre, 'Mineral Rights of Tribal with special reference to the Threesiamma Jacob Judgement' 8 NUALS Law Journal 231 (2014).
6. 1 SCC 793 (2011).
7. 1 SCR 374 (1987).
8. 1 GLR 219 (1987).
9. 8 SCC 599 (1996).

protecting the ecology and the wildlife at those places. The Court stated that the livelihood of the tribal people could not in any manner, destroy or hamper the wildlife or the environment and directed for precautionary measures to be implemented.

In ***Samatha v. State of Andhra Pradesh***[10], the government had by the execution of a lease deed permitted private mining companies to operate in tribal land, but the Supreme Court of India took the side of the tribal people and declared such lease deed to be null and void. Further, the Supreme Court of India issued guidelines to assess any application of mines in the forest area and stated that any mining operation could not be allowed to operate, which is detrimental to the forest growth and violates the rights of the forest dwellers. The case of ***Tarun Bharat Sangh, Alwar v. Union of India***[11] is one of the examples where the Court issued directions for the prevention of mining operations in the forests. The mining of limestone and marble had to lead to the drying of the water bodies in the forests, and the dynamites had mostly destroyed the hills. The Court permitted the mines situated outside the forests but passed immediate order to prevent the mines for operation which were inside the forests and had been damaging the forest.

Thus the Indian Judiciary in the various past instances has been trying to protect and promote the rights of the indigenous people in instances of their exploitation. In most instances, the Courts have realized that these tribal communities are not aware of their rights, and their grievances are not taken into account by the State, and in such a situation, the Courts have acted in a manner to safeguard these people.

THE FOREST DWELLERS' RIGHTS IN LIGHT OF ORISSA MINING CORPORATION LTD V. MINISTRY OF ENVIRONMENT & FOREST JUDGMENT

a) Factual Background

The state of Orissa is one of the richest states concerning minerals in the country. Various international companies like Vedanta Ltd, POSCO, and Arcelor-Mittal have constructed or proposed to construct projects in the state for its rich minerals. The Niyamgiri Hills, located in Orissa, is home to a huge population of tribal groups. These people have resided near the hills and worshiped the Niyamgiri Hills as abode of their god Lord Niyam Raja. A joint-venture project was entered into by the State-run Orissa Mining Corporation (hereinafter "OMC"), and London originated Vedanta Aluminium Ltd's subsidiary in India, Vedanta Resources Plc.For the

10. 2 SCR 305 (1997).
11. 3 SCR 21 (1993).

purpose of extracting bauxite over 250 square kilometers in the Niyamgiri region, which affected 12 villages of the tribal group. The tribal people were against the implementation of this project.

A writ petition had been filed before the Supreme Court of India by OMC against the order passed by the Indian Ministry of Environment and Forest, which had rejected the Stage II clearance of forest lands for mining of bauxite.This rejection was done based on three issues:

- Violation of the rights of tribal groups, which included the primitive tribal group, scheduled tribes, and traditional forest dwellers.
- Violation of provisions of the Environment Protection Act, 1986
- Violation of provisions of the Forest Conservation Act, 1980, dealing with adverse impact on the ecology and biodiversity.

Vedanta Ltd. and Steriline Ltd. were permitted Stage I clearance to set up an aluminum refinery, but the Stage II clearance was rejected for violation of forest laws on the suggestions made by the Saxena Committee. The Saxena Committee, in their report, expressed the grievance of the tribal people whose livelihood and habitat were being affected by the concerned project. Even their religious place which was located on the top of the mountain would be demolished by the mining activities. This raised a major concern among the tribal group and they had expressed their grievances. The forest areaand the environment were also being damaged and highly hampered by the concerned authorities for the execution of the project leading to depletion of soil and drying of flora and fauna.

b) Court's observation on the Rights of the Tribal people

The Supreme Court of India discussed the case of the ***Union of India v. Rakesh Kumar & Ors.***[12] , where it had stated about the rights of the primitive tribal groups and stated that these people were directly or indirectly being deprived of their rights by this mining activity if the clearance was permitted. The mining and the refinery activities were part and parcel of the same bauxite project, and such cannot be permitted to take away the rights of the locals residing in the forest land and forest resources, and their rehabilitation was a major concern. The Court discussed these issues and stated that tribal community plays an important role in developing and managing the environment with their traditional knowledge and traditional practices and the

12. 4 SCC 50 (2010).

State is under the obligation to promote them for effective, sustainable development, and it cannot in any manner take away these rights from the tribal group.

The Court further noted that Articles 244, 342, 362 and 366 of the Indian Constitution, 1950which provides for the socio-economic rights of the tribal people and the forest dwellers who are there to create an ecological balance. Also, the Court stated that religious rights protected under Articles 21,25, and 26 of the Indian Constitution, 1950,cannot be curtailed by the State in any arbitrary manner as the Niyamgiri Hills was a religious place of the tribal it needed to be protected. The Court also stressed on the fact that cultural, sustainability and customary rights of the tribal by looking into various international obligations like International Labour organization (hereinafter "ILO"), Convention on Indigenous and Tribal Populations Convention, 1957, Convention on Biodiversity, 1992 Rio Declaration, 1992 (Agenda 21) and the Earth Summit, 1992, India being a signatory to all these conventions[13]. There was also an international obligation on India to promote and protect the rights of the tribal population while protecting the forest land and not permitting any development project which would damage the environment in any manner.

In this case, the Supreme Court of India protected the rights of the forest dwellers, and by these types of judicial activism, the Court tries to keep a balance and set an example that industrial development cannot hamper the environment and the livelihood of the primitive people. The Court further discussed how the FRA and the PESA should protect and preserve the traditional cultures of the Scheduled Tribes and the forest dwellers, their rights to the community resources, and how the government cannot in any situation deprive them of their rights in the name of industrial development. In a situation where the legislation provides for a wide range of rights for the benefit and welfare of the forest dwellers and the Scheduled Tribes which includes their customary and traditional rights as a community, then they cannot be deprived of it for expansion of industrial development and the rights should be preserved. Most of the tribal population is not aware of their rights and privileges and does not have financial means to fight against the large corporations which damage their cultural heritage[14]. It is an implied responsibility of the State to make the tribal people aware of these rights for the management of the environment and sustainable development. The FRA is not limited to protect the rights of the

13. *Supra* Note 1Para 37-38.
14. *Supra* Note 1 Para 39.

forest dwellers in case of loss of habitat but also for their right to conserve the forest.

c) The Power of Gram Sabha

The main claim of OMC was that the FRA and its rules did not put any mandate on them to acquire the consent of the Gram Sabha to acquire the forest lands if the State government would permit them. The Court discussed the role of the Gram Sabha under the FRA, which had the competent authority to decide the grievances of the locals of the forest area against any mining activity. Sec. 6 of the FRA empowers the Gram Sabha to be the competent authority that had the power to assess the community as well as the individual rights of the forest dwellers. The Gram Sabha after considering them, has to communicate it to the Ministry of Environment and Forest, and the Ministry would take the final measure to protect them. The FRA provides the tribal people various rights, and the Gram Sabha is the central body to administrate the affairs of the tribal people, protect them and empower the tribal people with their rights .[15]

The Court also addressed the religious rights of the affected tribal people and stated that the Gram Sabha had the sole authority to decide over such matters. It stated that the tribal population residing in the forests have a fundamental right to profess religion under Article 25 and 26 of the Constitution and the State was under a mandate to protect such right. The Gram Sabha protected these rights under the FRA.

The decision was a huge disappointment for concerns like Vedanta and OMC as it addressed the grievances of the local habitats and imposed the consent of the Gram Sabha to be mandatory[16]. The Court also directed the State Government along with the Ministry of Tribal Affairs to help the Gram Sabha in settling all individual as well as community claims. The Gram Sabha had to decide in three months of the filing of these claims and had to inform the Ministry about the same, which had the authority to take the final decision and provide for its approval.

Mining activities that cause soil erosion damage the plants and streams of the area an affect the people, and the animals living in the forest area have to be closed down at once. Such activities not only damage the environment presently but also affect the environment for its future use. Any industrial development cannot be permitted to operate at the cost of environmental harm and needs to be stopped. The Indian Judiciary, in various past instances, has taken affirmative action against such activities, which in any manner causes serious damage to the environment.

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15. *Supra* Note 1 Para 55.
16. *Supra* Note 1 Para 36.

Environment protection is the duty of every individual, as well as the State and any activity for the purpose of economic development, cannot be allowed at the cost of environmental damage.

THE PRESENT STATUS OF FOREST DWELLERS' RIGHTS

There are major loopholes in both FRA and PESA, like the claim settlement process operates at a very slow pace because of many structural issues. These Acts fall weak before the industrial development and before the proper mechanisms of its implementation[17]. In most instances, the rights of the forest dwellers have been considered to be secondary when there has been a requirement for extracting resources in the name of development. The traditional customs and the rights of the tribal population and the forest dwellers have to be balanced by the legal framework to empower them to a better future.

In ***K.Guruprasad Rao v. State of Karnataka & Ors***[18], was decided in July after the passing of the judgment of ***Orissa Mining corporation*** case in April, the Court again got the opportunity to discuss the rights of the forest dwellers about this case. The main issue was relating to mining operations being carried out near a temple which has been declared as a "protected monument" by the Government of Karnataka and also 200 meters of the temple was declared as a "safe zone," and no mining activity was supposed to be there. The State had granted a mining lease near the temple, and these activities were damaging the structure of the temple and affecting the lives of the population residing near it. The Supreme Court discussed the principle of sustainable development and how there is a need to keep a balance between development with environmental protection. The Court then referred the case of ***Orissa Mining Corporation Ltd,***[19] where it had previously discussed the customary and cultural rights of forest dwellers that have to protected and preserved and concluded that there is a need to protect the cultural, social, political, and economic rights of the forest dwellers. These rights are inherent rights which need to be respected and promoted. The forest dwellers are a part of the forest, and their rights cannot be separated. The Court then referred to ***AmritlalAthubhai Shah v. Union Government of India***[20], where it had stated that the rights of the forest dwellers have to be protected, and Gram Sabha is under the mandate to protect these rights. The Court finally stated that mining activities

17. MayankVikas , 'Commentary on The Global Indigenous Peoples Movement: It's Stirring in India' [2016] 2(141) Journal of Law, Property, and Society <http://alps.syr.edu/wp-content/uploads/2017/02/JLPS-2016-11-Vikas.pdf> accessed 28 March 2019.
18. 8 SCC 418 (2013).
19. *Supra* Note 1.
20. 4 SCC 108 (1976).

generate financial wealth, and historical monuments are the cultural and historical wealth, and both these have to be balanced. The Court directed for the creation of a buffer zone of 2Km from the protected area and 1 Km of the core zone beyond which mining activities will not be permissible and for control usage of blasting mechanisms.

In ***Wildlife First v. Ministry Of Forest And Environment and Ors.***[21] , it was seen that the FRA is a positive move by the government to address the historical wrongs and flaws to protect the rights of the forest dwellers and prevent their alienation from their land, which is a factor leading to the destruction of forest lands. The FRA is a remedy with its flaws to provide a cure for the historical injustice done to the forest dwellers. The mechanism of setting up the Gram Sabha to protect the rights of these forest dwellers and to allow them to use the forests in a sustainable way for their livelihood is a key factor in the protection of their rights. In furtherance to the same, the Gram Sabha is the body responsible for the conservation of the forest natural resources.

The legislation and the Courts have upheld the rights to the tribal population in most instances, but the problem arises when the industries do not follow the proper mechanisms and try to continue activities for their benefit. The ***Orissa Mining Corporation*** case is a major example as to how the rights of the forest dwellers should be protected and promoted and industries should compel with all the directed guidelines before carrying out mining activities.

CONCLUSION

The decisions of the Supreme Court in the Orissa Mining Corporation case is a major precedent for any issues which arise relating to the rights of the tribal population as it clearly states about the competent authorities to address the issues and also for prohibition of mining activities which might have an adverse impact on the ecology causing a loss to the biodiversity[22]. There have been various legislations and judicial decisions that have been made in favor of the tribal population and the Scheduled Tribes[23]. The Indian Judiciary has been playing an active role in trying to create a balance between the twin needs of the development and preservation of the traditional rights of the forest dwellers. It, in many instances,the proper mechanisms for the rehabilitation of the tribal people who are displaced due to development projects have highly

21. WP 109 (2008).
22. ZubairNazeer, 'Supreme Court Must Safeguard Tribal Rights OverNiyamgiri Hills in Odisha' (The wire, 17 March 2016) <https://thewire.in/25043/supreme-court-must-safeguard-tribal-rights-over-niyamgiri-hills-in-odisha/> accessed 14 March 2019.
23. *Supra* Note 14.

been criticized as the competent authority has not properly implemented them. The rights of these protectors of the forest land have to be taken into account while addressing any such instance.

The struggle between the tribal of the Niyamgarh Forest and one of the most powerful corporations of the world is a historical saga that demonstrates the passion of the tribal population over their forest and habitat. The Indian Government faced severe criticisms for affecting the whole tribal life and their place of worship while destroying a hundred streams that flowed through the region. The first fault done by the Government was permitting Vedanta to construct an aluminum refinery near the bauxite reserves in Niyamgarh Forest. It was obvious from Vedanta's point of view that they would want to get their supply of raw materials from the forest rather than various other regions.

The judgment has also shed some hope in the minds of the tribal people whose rights get violated at the cost of development schemes. First, the banning of mining activities in the State of Karnataka and then this judgment indicates that blind mining activities cannot be encouraged and until the corporations and the industries provide for proper rehabilitation schemes and follow proper mechanisms to get clearance for mining activities, it has become a difficult task to achieve.

With the development of the approach of the Indian Judiciary through time, the approach towards the forest dwellers has been an affirmative one when, in most instances, the Judiciary has attempted to protect the rights of these indigenous people rather than luring after economic benefits. These people and their rights have to be protected to enable them a better living and livelihood. The Bill on the forest dwellers' rights, which is pending at the Parliament, is a classic example that the rights of these people have to be protected, which has been accepted and is being attempted to be protected. In this modern world, it cannot be denied that progress cannot be achieved at the cost of someone else's livelihood, and it can only be achieved which goes hand in hand with every person in the society and their rights.

ADULTERY AND INSTITUTION OF MARRIAGE: AN ANALYSIS WITH SPECIAL REFERENCE TO JOSEPH SHINE V. UOI (2018 SC 1676)

-Dr Devinder Singh* & Mr Varun**

INTRODUCTION

Recently in ***Joseph Shine v. Union of India***[1] a five judges' bench of Supreme Court of India,has struck down the whole Section 497 of the Indian Penal Code, 1860[2] (herein after mentioned as IPC) and Section 198(2) of the Code of Criminal Procedure, 1973[3] (herein after mentioned as CR.PC). It has not been general practice, in the institutional history of Indian Judiciary to strike down the entire provision of the Penal Code. The reason provided by the Apex Court is the discriminatory nature of the said provision in the hands of husband, which violate the Article 14 and 21 of the Constitution of India, 1949 (hereinafter mentioned as Constitution). Section 497 of IPC imposed punishment on the male who had committed consensual sexual intercourse with a married woman knowing her to be married (that is, the male who trespassed into the institution of marriage). But the requirement of "consent and connivance of husband" to bring the adulterous act out of ambit of proscribed punishable offence provided for section 497 of IPC, has been held to be antithesis to the doctrine of equality and personal liberty of a married women[4] without qualifying doctrine of reasonable classification and intelligible differentia as per nature of modern Indian society. Thus, as per section 497 of IPC, a married man can have sexual relations with unmarried women without any proscription, but at the same time, it is held to be discriminatory by the judiciary that the act of consensual sexual intercourse with a married woman by any male, other than her husband was put in the category of an offence. By striking down the adultery law, the Apex Court has overruled the five judges bench judgment of the Supreme Court in ***Yusuf Abdul Aziz v. State of Bombay*** [5], three judges bench decision in ***Sowmithri Vishnu v. Union of India***[6] and the two judges bench decision in ***V. Revathi v. Union***

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1. 2018 SC 1676, 2018 SCC Online SC 1676 (Nov. 12, 2019, 11:20 AM), https://www.scconline.com.
2. Act no. 45 of 1860.
3. Act no. 2 of 1974.
4. *Supra* note 1.
5. AIR 1954 SC 321
6. AIR 1985 SC 1618

of India[7] in which Indian Judiciary upheld the validity of Section 497 by holding that it did not offend either Article 14, Article 15 or 21 of the Constitution.

CONCEPT OF MARRIAGE AND ADULTERY

Since initial days of civilisation in India, marriage has been considered as the most important social institutions. It has been considered as the foundation of peace and order of society.[8] It is a sacred and unique relationship between the husband and wife. The institution of marriage is the foundation of family and thus, directly related with the development of any civilized society in the world. However, the nature and concepts of marriage under various personal laws keep on changing with the changes in the society and the social order.[9] But, marriage is considered as a sacred union even by those societies who view it as a civil contract.[10] In Indian civilisation marriage has been considered as a sacramental union, and this continued to be so during the entire period. Mutual fidelity worked as the main thread to keep the tie intact in this institution.[11] The act of infidelity occurs in the marital tie, when one of the spouses voluntarily gets engage in sexual intercourse with an individual (stranger) of the opposite gender other than one's marital partner. Adultery is regarded as a sin by society and a matrimonial offence, as it shake the mutual thread of faith and trust between spouses towards each other and disturbed the institution of marriage and then family. If one of the spouses gets involved in an extra-marital affair, it will breach the marital vows and can collapse the marital tie beyond hope of its repair. According to the Old Testament, "Marriage is not just a social contract between man and woman; it involves God as well."[12] "God is witness to all marriage agreements and insists that couples should be devoted and completely faithful to each other."[13]

The word adultery derives its origin from the French word *avoutre*, which has evolved from the Latin verb *adulterium* which means "to corrupt."[14] As per Black's Law Dictionary, "adultery is the voluntary sexual intercourse of a married person with a person other than the offender's

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7. AIR 1988 SC 835
8. B.K Sharma,Hindu Law, 35 (Central Law Publication, Allahabad, 4th ed. 2014).
9. Endre Nizsalovsky, Order of the Family, (Nov. 12, 2019, 11:20 AM), https://www.scribd.com/document/268446433/Ch-1.
10. *Supra* note 8
11. Dr. Paras Diwan,Modern Hindu Law, 62-66 (Allahabad Law Agency, Faridabad, 22nd edn. (Reprint), 2015)
12. Adultery Divorce,(Nov. 12, 2019, 11:20 AM), https://www.advocatekhoj.com/library/lawareas/divadultery/3.php?Title=Adultery%20Divorce&STitle=Adultery%20marriage.
13. *Ibid.*
14. *Supra* note 1.

husband or wife"[15]. According to Encyclopaedia Britannica[16], "Adultery means sexual relations between a married person and someone other than the spouse"[17] . According to Merriam-Webster dictionary it is "voluntary sexual intercourse between a married person and someone other than that person's current spouse or partner"[18]. From above definitions we can see that, definition of 'adultery' not limited to specific gender only; it may be committed by either of the Spouse/Sex. But it is very unfortunate, that under most of the statutes owing to patriarchal set up of society, it has been gender favoured and in most of the cases prescribes 'female adultery'. And it is the married woman whose extra-marital consensual sexual intercourse with any male other than his husband without the consent or connivance of her husband is an essential condition for the offence of adultery as per section 497 of IPC, 1860.[19] The current definition of adultery provided in PC, 1860 has been inherited from the cultural context of Victorian morality at the time of British era, where women was considered as the property of her husband and the offence was committed only by the adulterous man.[20] In this concept the act of wife corrupting the marital bond with her husband by having a relationship outside the marriage, was termed as adultery.[21]

HISTORICAL BEDROCK

Almost all ancient religions/civilizations punished the sin of adultery.[22] In one of the oldest, namely, in Hammurabi's Code, death by drowning was prescribed for the sin of adultery, be it either by the husband or the wife.[23] In Indian civilisation also the social condemnation for act of adultery is not new. An incident mentioned in Mahabharata, where Indra comes to Gautama's ashram in the disguise of a Brahmin, and when the sage is away, impersonate his face and asks Ahalya to have sexual act with him.[24] "After the act committed, Gautama orders his son Cirakarika to kill his mother, and leaves for the forest, where he repents for his hasty decision.

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15. *Ibid.*
16. Encyclopaedia Britannica, Adultery, (Nov. 12, 2019, 01:20 PM), http://www.britannica.com/EBchecked/topic/6618/ adultery.
17. *Ibid.*
18. Merriam-Webster Dictionary,Adultery, (Nov. 13, 2019, 11:20 AM), https://www.merriam-webster.com/dictionary/adultery.
19. *Supra* note 1.
20. *Ibid.*
21. *Ibid.*
22. *Supra* note 1.
23. *Ibid.*
24. Rohini Bakshi, Thestory of Ahalya and Indra: Was it really adultery?, (Nov. 15, 2019, 12:30 PM), https://www.dailyo.in/arts/ahalya-indra-purana-hindu-mythology-ramayana-mahabharata-sujoyghosh-lord-rama/story/1/5173.html .

He blames Indra for polluting his wife because of his passion, My wife is thus in no way a culprit in the crime. The son ponders and concludes that a woman is not guilty if she has not consented to the act of adultery willingly; that women are physically weak and have to submit to the desires of men. So if a man leads a woman to adultery, the woman is not to blame."[25]

According to Vishnu Purana verse 3.11 even the thought of adultery has been condemned by stating that "A man should not think incontinently of another's wife, much less address her to that end; for such a man will be reborn in a future life as a creeping insect. He who commits adultery is punished both here and hereafter; for his days in this world are cut short, and when dead he falls into hell."[26] In Bhagavad Gita Chapter 1, versus 40-42[27] it has been mentioned that, "when a family declines, ancient traditions are destroyed. With them are lost the spiritual foundations for life, and the family loses its sense of unity. Where there is no sense of unity, the women of the family become corrupt; and with the corruption of its women, society is plunged into chaos. Social chaos is hell for the family and for those who have destroyed the family as well"[28]. Islamic law has considered adultery as one of the most serious offence, known as Hadd[29] offence, and adultery has been expressly condemned in Quran[30]. Further in verse 17.32 of Quran explained adultery as "Approach not adultery: for it is a shameful deed and an evil, opening the

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25. *Ibid.*
26. H.H Wilson, TheVishnu Puráńa: A System of Hindu Mythology and Tradition, (Nov.15, 2019, 03:00PM), https://books.google.co.in/books?id=rpVTAAAAcAAJ&pg=PA309&lpg=PA309&dq=Let+him+not+think+incontinently+of+another%27s+wife,+much+less+address+her+to+that+end;+for+such+a+man+will+be+born+in+future+life+as+a+creeping+insect.+He+who+commits+adultery+is+punished+both+here+and+hereafter;+for+his+days+in+this+world+are+cut+short,+and+when+dead+he+falls+into+hell.+Thus+considering,+let+a+man+approach+his+own+wife+in+the+proper+season,+or+even+at+other+times.&source=bl&ots=h1BsZfO1IB&sig=ACfU3U3cgvAnxYIRYnjXZ40u58PhOGmVsQ&hl=en&sa=X&ved=2ahUKEwjwz-mQ2_jmAhWipOkKHewzDTMQ6AEwAHoECAkQAQ#v=onepage&q=Let%20him%20not%20think%20incontinently%20of%20another's%20wife%2C%20much%20less%20address%20her%20to%20that%20end%3B%20for%20such%20a%20man%20will%20be%20born%20in%20future%20life%20as%20a%20creeping%20insect.%20He%20who%20commits%20adultery%20is%20punished%20both%20here%20and%20hereafter%3B%20for%20his%20days%20in%20this%20world%20are%20cut%20short%2C%20and%20when%20dead%20he%20falls%20into%20hell.%20Thus%20considering%2C%20let%20a%20man%20approach%20his%20own%20wife%20in%20the%20proper%20season%2C%20or%20even%20at%20other%20times.&f=false.
27. [illegible]
(Nov. 15, 2019, 07:00PM), https://www.holy-bhagavad-gita.org/chapter/1/verse/42.
28. *Ibid.*
29. Oxford Dictionary of Islam,Hadd,It meansLimit or prohibition; pl. hudud. A punishment fixed in the Quran and hadith for crimes considered to be against the rights of God, (Nov. 16, 2019, 04:00PM), http://www.oxfordislamicstudies.com/article/opr/t125/e757.
30. In Islam, in An-Nur, namely, Chapter 24 of the Qur'an, Verses 2 and 6 to 9 read as follow, "The adulteress and the adulterer, flog each of them (with) a hundred stripes, and let not pity for them detain you from obedience to Allah, if you believe in Allah and the Last Day, and let a party of believers witness their chastisement."Supranote 1.

road to other evils."[31] In the Western Societies, adultery met Biblical condemnation[32] . The Common law recognised the "obvious danger of foisting spurious offspring upon her unsuspecting husband and bringing an illegitimate heir into his family."[33]

It is important to note that the original draft of Indian Penal Code, 1860, had not provided for the offence of 'adultery'. It was only after the recommendation of the Second Law Commission that it was added to the Code.[34] It isto be noted that in India, as per section 497 of IPC, a wife is not punished as an adulteress or an abettor for the offence of adultery.[35] It is only the man(stranger) who has such unlawful sexual intercourse with married woman will be punished under Section 497, IPC.[36] The reason given that why the wife would not be punished has been provided as, "The condition of the women of this country is, unhappily, very different from that of the women of England and France; they are married while still children; they are often neglected for other wives while still young. They share the attention of a husband with several rivals to make laws for punishing the inconsistency of the wife, while the law admits the privilege of the husband to fill his *'zenana'* with woman, is a course which we are most reluctant to adopt. We are not so visionary as to think of attacking by law an evil so deeply rooted in the manners of the people of this country as polygamy…"[37] Moreover, the wife of the adulterer has no locus *standi* to file a complaint against her deviated husband. It is only the husband of the (adulteress) wife who can file a complaint and upon whose complaint the Court can take cognizance of the offence as per Section 198(2), CR.PC, 1973.[38] The reason behind this position is that, women were treated as the victims and not the authors or abettor of the crime.[39]

It is important to mention here the recommendation of the Law Commission of India in its 42nd

31. Ankith Jain,Overview of section 497 on adultery, International Journal Of Legal Developments And Allied Issues Volume 4 Issue 5 September 2018,(Nov. 16, 2019, 04:00PM), http://ijldai.thelawbrigade.com/wp-content/uploads/2018/09/Ankith-Jain.pdf.
32. Gabrielle Viator, The Validity of Criminal Adultery Prohibitions after Lawrence v. Texas, 39 Suffolk University Law Review 837, 838 (2005), (Nov. 17, 2019, 04:00PM), https://www.google.com/search?client=firefox-b-d&ei=uL4VXsrjHaiN4EPvb23oA0&q=Gabrielle+Viator%2C+%E2%80%9CThe+Validity+of+Criminal+Adultery+Prohibitions+after+Lawrence+v.+Texas%E2%80%9D%2C+39+Suffolk+University+Law+Review++837%2C+838+%282005%29.&oq=Gabrielle+Viator%2C+%E2%80%9CThe+Validity+of+Criminal+Adultery+Prohibitions+after+Lawrence+v.+Texas%E2%80%9D%2C+39+Suffolk+University+Law+Review++837%2C+838+%282005%29.&gs_l=psy-ab.3...115473.115473..115807...0.0..0.0.0.0.......1....2j1..gws-wiz.N9Xgt631sY8&ved=0ahUKEwjKn6rr9PPmAhWoxjgGHb3eDdQQ4dUDCAo&uact=5.
33. Charles Torcia, Wharton's Criminal Law 210, at 528 (15th ed. 1994).
34. Ratanlal & Dhirajlal, Law of Crimes, Vol. 2, (Bharat Law House, 26th ed., 2007).
35. K.D. Gaur, Text Book on the Indian Penal Code, 1052, (Universal Law Publication , 6thed., 2004).
36. *Ibid.*
37. *Id.* at page 1053.
38. *Supra* note 1
39. *Supra* note 35.

report in 1971 where it has suggested substituting section 497 of the IPC, the substituting provision is "Section. 497. Adultery – Whoever has sexual intercourse with a person who is, and whom he or she knows, or has reason to believe, to be the wife or husband, as the case may be, of another person, without the consent or connivance of that other person, such sexual intercourse by the man not amounting to the offence of rape commits adultery, and shall be punished with imprisonment of either description for a term which may extend to five years, or with fine, or with both"[40] Later in 2005, Malimath Committee on Criminal Justice Reforms has recommended that men and women should be made to stand at the same footing.[41] It has been hold in the report that "A man commits the offence of adultery if he has sexual intercourse with the wife of another man without the consent or connivance of the husband. The object of this Section is to preserve the sanctity of the marriage. The society abhors marital infidelity. Therefore there is no good reason for not meeting out similar treatment to wife who has sexual intercourse with a married man."[42] Further "The IPC (Amendment) Bill, 1972 suggested that special privilege granted to women under section 497 be done away with."[43] But section was not amended as per suggestion.

The object of the law under Section 497, is to inflict punishment on those who interfere with the sacred relation to marriage,[44] the reason being that as adultery is an anti-social and illegal act [45], no peace loving citizen or person of good morals would like that it should be permitted to be indulged in before his very nose.[46]

JUDICIAL APPROACH

PRE JOSEPH SHINE APPROACH

Within one year of advent of the Constitution of India, 1949, section 497 IPC was assailed on the ground that it goes against the spirit of equality and personal liberty (Article 14 and 21) embodied in the Constitution, in the case of ***Yusuf Abdul Aziz v. The State of Bombay.***[47] A five judges bench of the Supreme Court[48], taking into consideration Article 15(3), opined that

40. Law Commission of India, 42nd Report on Indian Penal Code, page 327, (June, 1971).
41. Government of India, Report: Committee on Reforms of Criminal Justice System, page 190, para 16.3, (Ministry of Home Affairs, 2003)
42. *Ibid.*
43. *Supra* note 35.
44. *Ibid.*
45. *Ibid.*
46. Hatim Khan v. State, AIR 1963 J&K 56.
47. *Supra* note 5.

Section 497 is a special legislative provision in favour of women, taking note of vulnerable status of women in the society.[49] Rebutting the contention that Article 15(3) should be restricted to provisions beneficial to women and should not be used to give them a licence to commit and abet a crime with impunity, the Apex Court opined that, "We are unable to read any such restriction into the clause; nor are we able to agree that a provision which prohibits punishment is tantamount to a licence to commit the offence of which punishment has been prohibited."[50]

Supreme Court's judgement in ***Yusuf Abdul Aziz v. The State of Bombay***[51] upholding the validity of Section 497 of IPC came for reconsideration in ***Sowmithri Vishnu v. Union of India***[52] on the contention that, it being contrary to Article 14 of the Constitution, makes an irrational classification between women and men as it provide power to the husband to prosecute the adulterer but it does not confer a corresponding right upon the wife to prosecute the woman with whom her husband has committed adultery. Further no equal right is there with the wife to prosecute the husband who has committed adultery with another woman, and the provision excluded the cases where the husband has sexual relations with unmarried women, with the result that the husbands have a free license under the law to have extramarital relationship with unmarried women.[53]

The Supreme Court rejected all these arguments and ruled that Section 497 does not offend either Article 14 or Article 15 of the Constitution. Next important Apex Court decision on Section 497 of IPC was ***V. Revathi v. Union of India***[54] where, a wife challenged the validity of Section 198(2) of CR.PC, contended that it discriminatingly empower the husband of the adulteress wife to prosecute the adulterer but does not equally empower the wife of an adulterer husband to prosecute.[55] The Supreme Court observed that, "The community punishes the 'outsider' who breaks into the matrimonial home and occasions the violation of sanctity of the matrimonial tie by developing an illicit relationship with one of the spouses subject to the rider that the erring 'man' alone can be punished and not the erring woman. There is thus reverse discrimination in 'favour' of the woman rather than 'against' her. The law does not envisage the punishment of any of the spouses at the instance of each other. Thus there is no discrimination

48. *Ibid.*
49. *Ibid.*
50. *Ibid.*
51. *Ibid.*
52. *Supra* note 6.
53. *Ibid.*
54. *Supra* note 7.
55. *Ibid.*

against the woman insofar as she is not permitted to prosecute her husband. A husband is not permitted because the wife is not treated as an offender in the eye of law. The wife is not permitted as Section 198(1) read with Section 198(2) does not permit her to do so. In the ultimate analysis the law has meted out even-handed justice to both of them in the matter of prosecuting each other or securing the incarceration of each other." [56]

POST JOSEPH SHINE APPROACH

In the landmark ***Joseph Shine v. Union of India***[57] , case the Apex Court of India declared that Section 497 to be unconstitutional on ground of violation of Articles 14, 15 and 21 of the Constitution. And consequently, Section 198(2) of the CR.PC, 1973 which contains the procedure for prosecution under Chapter XX of the Indian Penal Code, 1860 are held to be non-applicable, to the extent it was applicable to the offence of Adultery under Section 497, IPC. And the decisions in ***Yusuf Abdul Aziz, Sowmithri Vishnu*** and ***V. Rewathi*** are hereby stand overruled.[58]

The five-judge bench of the Supreme Court has struck down Section 497, IPC and decriminalised adultery in India, however adultery still remains a civil wrong and ground for divorce under all personal laws as it previously stands. The judgment put blow of judicial review on the patriarchal and unequal provision of section 497 of IPC on following considerations

Autonomy and personal liberty of wife: The provision of "connivance or consent of husband" to put the adulterous act out of prescribed nature of wrong as per section 497 of IPC, 1860, has been considered in this judgement. It has been held that, a husband is not the master and equality is the governing parameter and the beauty of the Indian Constitution.[59] The Court referred the constitution of India and asserted that "Such a magnificent, compassionate and monumental document embodies emphatic inclusiveness, which has been further nurtured by judicial sensitivity when it has developed the concept of golden triangle of fundamental rights."[60] The court further held that, "It treats her as the property of man and totally subservient to the will of the master. It is a reflection of the social dominance that was prevalent when the penal provision was drafted."[61] The Supreme Court clearly lays down that autonomy, desire, choice and identity

56. *Ibid.*
57. *Supra* note 1.
58. *Ibid.*
59. *Ibid.*
60. *Ibid.*

are the important aspects of the dignity of a woman.[62]

Equality: As per the Apex Court, "Adultery is the voluntary sexual intercourse of a married person with a person other than the offender's husband or wife. However, the provision has made it a restricted one as a consequence of which a man, in certain situations, becomes criminally liable for having committed adultery while, in other situations, he cannot be branded as a person who has committed adultery so as to invite the culpability of Section 497 IPC."[63] The Supreme Court further opined that "Sub-section (2) of Section 198 treats the husband of the woman as deemed to be aggrieved by an offence committed under Section 497 IPC. It does not consider the wife of the adulterer as an aggrieved person. The offence and the deeming definition of an aggrieved person, as we find, is absolutely and manifestly arbitrary as it does not even appear to be rational and it can be stated with emphasis that it confers a licence on the husband to deal with the wife as he likes which is extremely excessive and disproportionate. We are constrained to think so, as it does not treat a woman as an abettor but protects a woman and simultaneously, it does not enable the wife to file any criminal prosecution against the husband. If the entire provision is scanned being Argus-eyed, we notice that on the one hand, it protects a woman and on the other, it does not protect the other woman. The rationale of the provision suffers from the absence of logicality of approach and, therefore, we have no hesitation in saying that it suffers from the vice of Article 14 of the Constitution being manifestly arbitrary."

Privacy and Right to life: The Apex Court refers the landmark judgement on right to privacy delivered in the case of ***K.S. Puttaswamy and another v. Union of India and others***[64] , where a nine judges' bench stated that importance has been given to the dignity of an individual. The judiciary held that "Having stated about the dignity of a woman, in the context of autonomy, desire, choice and identity, it is obligatory to refer to the recent larger Bench decision in ***K.S. Puttaswamy and another v. Union of India and others***[65] , which, while laying down that privacy is a facet of Article 21 of the Constitution, lays immense stress on the dignity of an individual[66]" Therefore, the Apex Court after analysing the whole concept of right to privacy and equality of women declares that section 497 of Indian Penal Code violates Article 21 of the Constitution, as equality and dignity of woman cannot be curtailed in such cases.[67]

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61. *Ibid*
62. *Ibid.*
63. *Ibid.*
64. (2017) 10 SCC 1.
65. *Ibid.*
66. *Supra* note 1.

Adultery as a crime (criminal wrong): The Supreme Court asserted that "There can be no shadow of doubt that adultery can be a ground for any kind of civil wrong including dissolution of marriage. However, the pivotal question is whether it should be treated as a criminal offence. When we say so, it is not to be understood that there can be any kind of social licence that destroys the matrimonial home. It is an ideal condition when the wife and husband maintain their loyalty. We are not commenting on any kind of ideal situation but, in fact, focusing on whether the act of adultery should be treated as a criminal offence. In this context, we are reminded of what Edmund Burke, a famous thinker, had said, a good legislation should be fit and equitable so that it can have a right to command obedience. Burke would like to put it in two compartments, namely, equity and utility. If the principle of Burke is properly understood, it conveys that laws and legislations are necessary to serve and promote a good life."[68]

CRITICAL ANALYSIS

In this decision, the Supreme Court has struck down Section 497 IPC. Dilution in the institution of marriage can be the result, upon which the strong foundation of the Indian family system and civilisation rests. The deterrence effect on stranger to marriage to prevent him from trespassing this sacred institution has been out rightly blown. This cessation will lead to rapid profiling in the acts related to adultery. Adultery is no longer a criminal offence now. It is just a civil wrong for which divorce is the remedy.[69]

Judiciary held that a moral wrong is different from legal right and thus morality has not been the only base of state policy while enacting the law. Criminal law also meant to protect the historical cultural roots and moral principles of the society.[70] Moral wrong can shake the conscience of the society and can result into conflict and chaos in the society, especially when a strong cultural and civilisation root of society is interfered.

Declaring adultery as a criminal offence, no doubt amounts to intervention in the right to privacy, but also wrecks the life of another partner in institution of marriage. Further, it not only affect spouse but also takes down with it the children and the other family members. It is to be remembered that rights have corresponding duties and absolute rights can destabilise the

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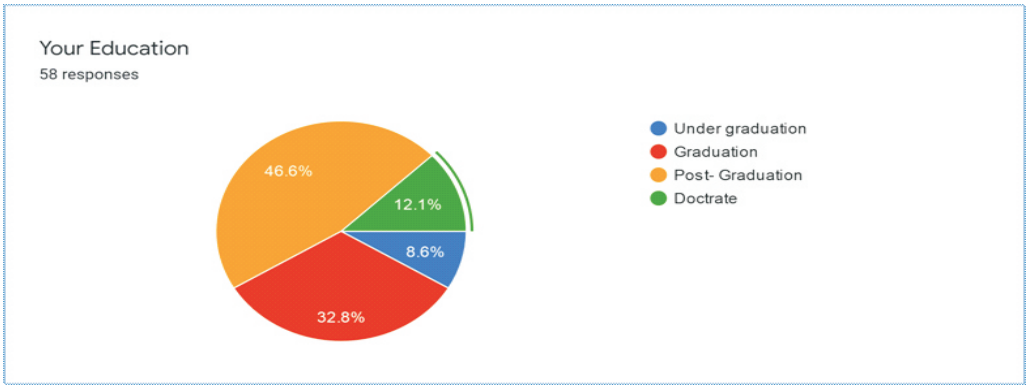
67. *Ibid*
68. *Ibid.*
69. Akar Srivastava and Monica Chhabra,Critical Analysis on the Judgement of Adultery, ILSJCCL,Volume 1 Issue 1, (Nov. 16, 2019, 04:00PM), https://journal.indianlegalsolution.com/2019/01/15/critical-analysis-on-the-judgement-of-adultery-akar-srivastava-and-monica-chhabra/.
70. *Ibid.*

society. The moral and psychological effect on children will be most adverse and severe.

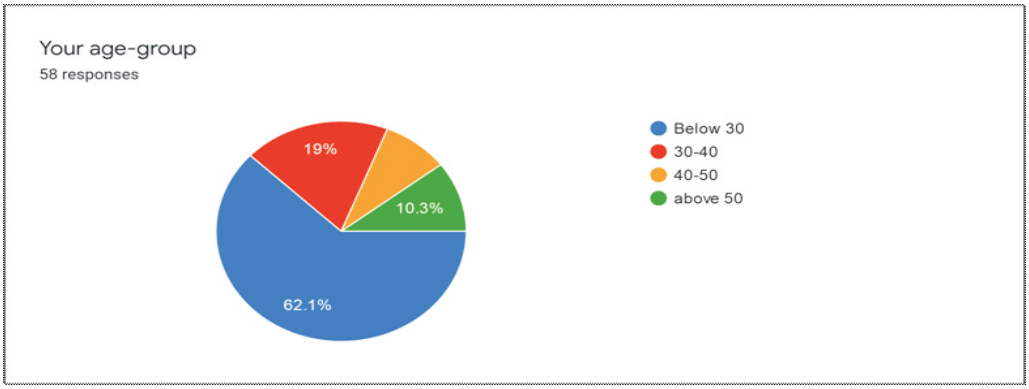
EMPIRICAL STUDY

A survey was conducted through online and offline questionnaire method to get responses from section of the society comprising both males and females who are either married or unmarried; most of the respondents are educated. The object was to know the view of society regarding act of adultery and its effects on the institution of marriage in the age of equality of rights. As a crime is a wrong which shake the sense of security or conscience of the society at large. In modern changing times when the very nature and form of institution of marriage is gradually changing, the perception of society may also be changed. The results of study is analysed as follows:



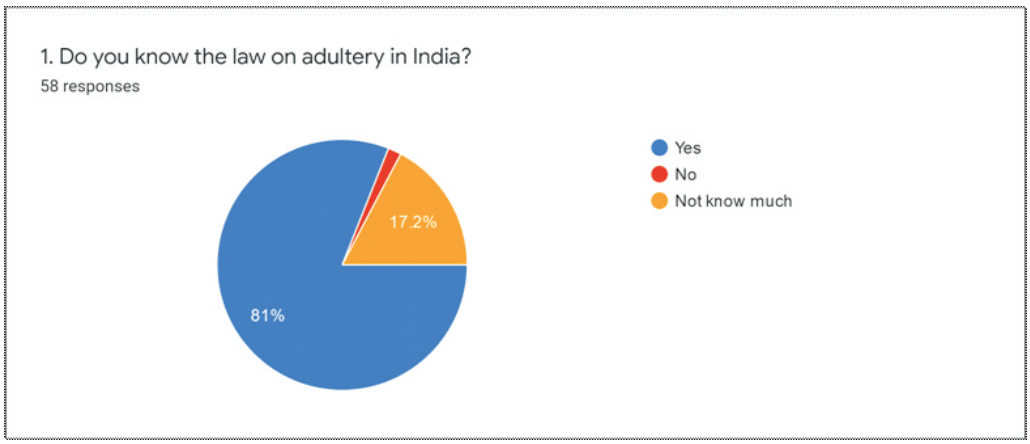
Pie Chart 1

Majority of the respondents are post graduate and least are under graduates.



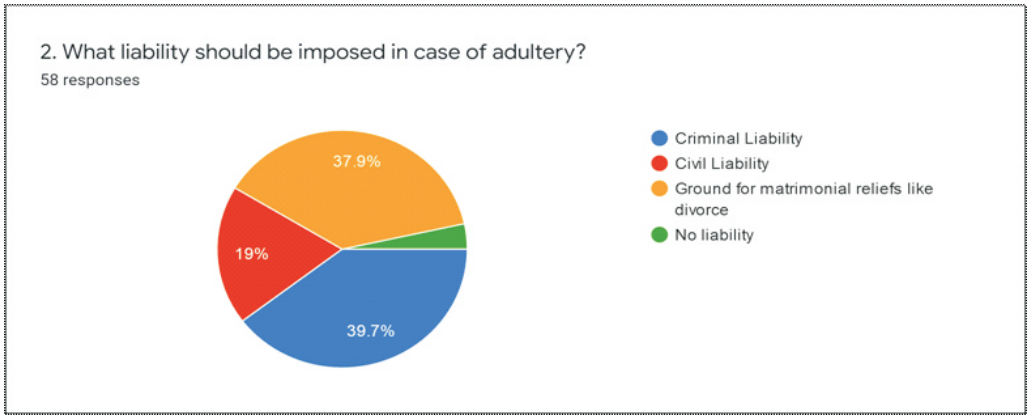
Pie Chart 2

Majority of respondetnts are below 30 years of age.



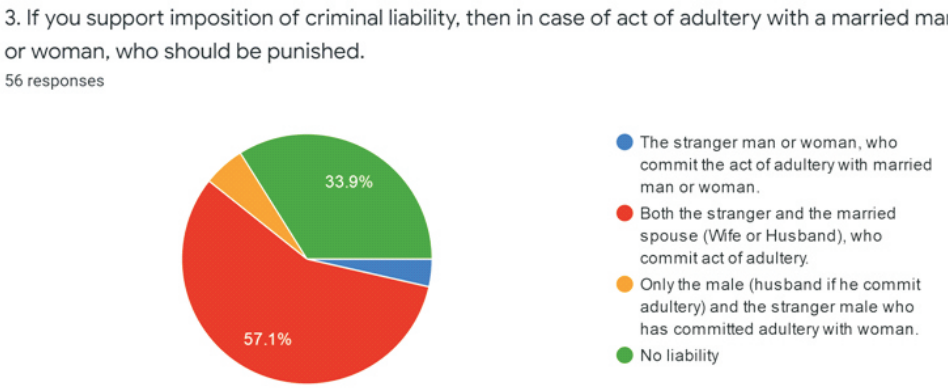
Pie Chart 3

Majority of respondetnts that is almost 4/5th know the law and only 2 percent are totally ignorant of it.



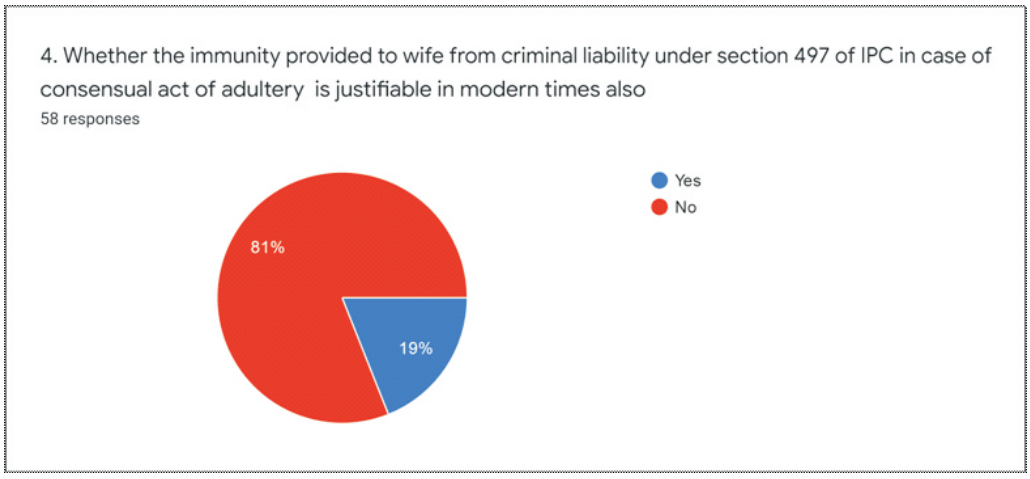
Pie Chart 4

Majority of respondents, i.e. approximatly 40 percent feels that criminal liablity should be imposed to regulate the wrong of adultery, while almost 38percent said that adultery should be limited as ground to dissolve the marriage. Only 19 percent feels it to be regulated by civil laws. And 3 percent respondent want it to be not legally regulated, i.e. a act free from state interferance.



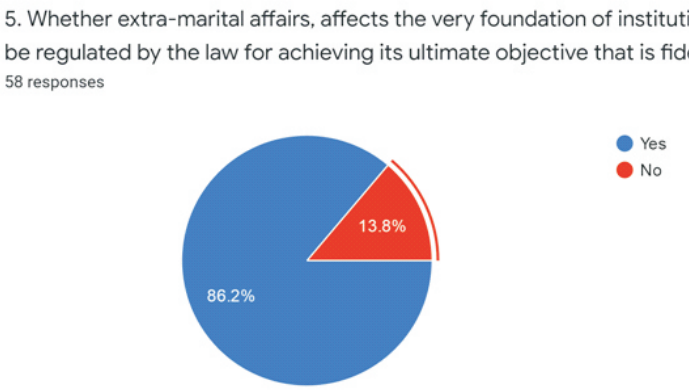
Pie Chart 5

This question is to further get the opinion of respondent regarding the persons to be put under ambit of criminal liability. Majority of respondetnts want to put both the stranger and the married spouse (wife or Husband) who has commited the act of adultery under criminal liablity.where as the respondents who does not support criminal liability in pie chart 3, either choose no liability option or leave this option unfilled.



Pie Chart 6

Majority of respondetnts that is almost 4/5th feels that immunity to wife as provided earlier in Section 497 of IPC, 1860, is not justifiable in modern times.



Pie Chart 7

Majority of respondetnts, that is almost 86 percent, opined that the act of adultery affects the very foundation of institution of marriage and need to be regulated by law for achieving its object of mutual fidelity.

CONCLUSIONS AND SUGGESTIONS

Since the ancient era, almost in all the societies, adultery is a matter of consideration and has been rigorously condemned and punished, usually as a violation of the husbands rights.

In India, the wrong of adultery has been declared as a proscribed act as per state policy, by declaring it a criminal offence as per Section 497 of IPC. As per Section 497 of IPC, a male for committing the act of consensual sexual intercourse with the legally wedded wife of another with knowledge or reason to believe of her to be the wife of another man and without the consent or connivance of that man, shall be punished with imprisonment of either description for a term which may extend to five years, or with fine, or with both. But as per Section 198(2) of CR.PC only husband can initiate such criminal proceeding, as it has been specifically provided that no person other than the husband of the woman shall be deemed to be aggrieved by any offence. So the legal provision is discriminatory and derogates doctrine of equality against wife as not providing her equal right to initiate proceeding against in case act of adultery by her husband. Further the word consent or connivance of husband to put the act of sexual intercourse out of

required actus rea of section 497 of IPC make sexual autonomy of wife a property of husband, which is against spirit of article 21 of the Constitution of India ,i.e. life and personal liberty. Earlier many times the Apex Court of India upheld the validity of section 497, even in five judges' bench in the case of ***Yusuf Abdul Aziz v. State of Bombay***[71], but in the judgment of ***Joseph Shine v. Union of India***[72] an equal five judges bench has struck down Section 497 IPC and Section 198(2) CR.PC. It is a question of discussion as to whether an equal bench of the five judges can overrule a previous judgement of equal bench.

It is to be noted, that the issue in the case of ***Joseph Shine v. Union of India***[73] is discrimination of provision under Article 14 and 21 of the constitution. The word "consent and connivance" and sole right to husband to prosecute the stranger male who has committed consensual sexual intercourse with his wife has been under consideration in the present case. And declaring the whole provision as unconstitutional is need to be considered by the legislation, that whether Section 497 of IPC need to be redrafted or not.

Section 497 of IPC, 1860 provides special protection to wife as a victim in case of her consensual act of adultery with a male other than her husband. In ***Yusuf Abdul Aziz v. The State of Bombay***[74] , the five judges bench held that Section 497 is a special provision made for women and therefore is saved by clause (3) of Article 15.[75]

As per Indian civilisation setup family is vital social institution and marriage is the foundation of family. No doubt, in the modern era of democracy all social relationships and institutions are undergone a gradual change in India. Liberty, Equality and Fraternity which are three main pillars of idea of democratic society as per Indian constitutional is fully applicable on institution of marriage and consensual sexual relations also. But the institution of marriage can't be allowed to be disintegration or weakened in influence of western idea of marriage and consensual sexual relationships. In India marriage has been considered as sacred and special social institution and not just a civil contract meant to regulate opposite genders consensual sexual relationship and procreation of children. Among Hindus it is considered as holy union[76]

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71. AIR 1954 SC 321.
72. *Supra* note 1.
73. *Ibid.*
74 Supra *note 5.*
75. *Ibid.*
76. *Supra* note 8

and among Muslims as *ibadat* and *maumalat.* [77] Though as per its nature and effect adultery may not be such a serious wrong that it can shake the conscience or sense of security of the society, but it can play chaos in the lives of the people concerned. Thus it can effect concept of marriage, and then family and ultimately of Indian Society. Adultery may not be gravest of crimes but it can bring out grave consequences. The person committing the adulterous act is always aware of the fact that he or she is violating the basic norms and obligation of the institution of marriage, as the very credibility and trustworthiness of one spouse is being targeted.

In the judgement only criminal liability for the act of adultery has been removed. But it is still applicable for ground of divorce along with other matrimonial and civil remedies. But it has not expressly provided in the judgements, though clear if we read in between the lines. Not expressly clearing position for civil liability and consequences under personal law for adultery can be taken as a message to providing it a walk-in and walk-out relationship.

In ***Yusuf Abdul Aziz v. State of Bombay***[78] the Apex Court of India, upheld the validity of section 497 of IPC as per Section 14 and 15 of the Constitution. The Supreme Court declared that Article 15 is not absolute as far as prohibition of discrimination on ground of ex is concerned, as Article 15(3) of the constitution provides for legislation in favour of women. As we understand, that in cases of adultery, there are two types of considerations, one is that wife is not prosecuted, this provision favours the woman and the other is only husband can prosecute the third person (Stranger who trespass the institution of marriage) involved in act of adultery. In our view the Supreme Court in Joseph Shine[79] judgement has addressed the second point, which authorised the husband on behalf of wife or to protect the institution of marriage to take action against such third person. But first point which protects the wife is still open as far as this judgement is concerned. Therefore, we feel too verrule the ratio of Supreme Court in ***Yusuf Abdul Aziz v. State of Bombay***[80] case should have been appropriately considered by the larger bench. In case review by the Supreme Court does not take place because of legal technicalities involved in it, it

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77. Abdur Rahim,Nikah, (Nov. 16, 2019, 04:00PM), https://books.google.co.in/books?id=QrMZY vwqYDUC&pg=PA33&lpg=PA33&dq=abdul+rahim,+marriage+id+ibadat+and+muamalat&source=bl&ots=GjcH9DzXTN&sig=ACfU3U26pSJe-BtKFKP49o_uh5a-CsKDdQ&hl=en&sa=X&ved=2ahUKEwie6aj96-bmAhV27nMBHfEhAaQQ6AEwBXoECAoQAQ#v=onepage&q=abdul%20rahim%2C%20marriage%20id%20ibadat%20and%20muamalat&f=false.
78. *Supra* note 5.
79. *Supra* note 1.
80. *Supra* note 5.

is further suggested that legislature can bring an amendment in consonance with the constitutional provision of Article 14, 15 and 21 to provides the best social engineering considering the very basic structure and beliefs of Indian society, rather than repealing or removing the penal provision completely. Legislation should bring husband and wife at equal footing by providing penal provision for act of consensual extra marital sexual intercourse by any stranger (man or woman) with a wedded man or woman. Further punishment should be decreased from five years to sex months.

Proposed legislation for Section 497 of IPC "Adultery — Whoever has sexual intercourse with a person who is and whom he knows or has reason to believe to be the wife or husband of another man or woman, all such persons; wife, husband and third person are individually guilty of the offence of adultery, and shall be punished with imprisonment for the a term of six months."

Proposed legislation for Section 198(2) of CR.PC "Both the husband and wife shall be deemed to be aggrieved by any offence punishable under section 497.

APPLICABILITY OF RES JUDICATA IN EXECUTION AND WRIT PROCEEDINGS

- Mr Gurpreet Singh*

"Res judicata changes white to black and black to white, it makes the crooked straight and the straight crooked." [1]

INTRODUCTION

Laws of each and every land are based on principles. These principles control the entire domain of jurisprudence in a nation. Such principles navigate legislation, give legitimacy to judicial pronouncements and defend the citizens of a nation. The judiciary embodies such principle in deciding cases and provides conformity by the legislature and executive to suchlike principles.

Res *judicata* is such a principle, whose origin cannot be amply traced. This notion exists in all jurisdictions of the world. Res *judicata* is based on public policy and has universal practice.[2] India has adopted the rule of res *judicata* in section 11 of the Code of Civil Procedure, 1908. Present day society is fraught with disputes and litigations. The courts are fraught with slow, frivolous and cumbersome cases. The incarnation of a rule like res *judicata* is one of the needs in our country. With regard to bring finality to litigation and preclude a person from being dragged to court again and again, res *judicata* is mandatory in any society.[3]

Res *judicata* is a plea accessible in civil proceedings under section 11 of the Code of Civil Procedure, 1908. Its primary aim is to bring finality to "lis" in first or appellate proceedings. The principle implies that an issue or a point once adjudged and accomplished finality should not be permitted to be revived and re-agitated again. Res *judicata* basically means 'a matter adjudged; a thing judicially acted upon or decided; a thing or matter settled by judgement'. This regulation engrants with a reason that a judgment delivered by a court of competent jurisdiction on the merits is final with respects to the privileges of the parties and their privies and establishes a flat bar to successive action concerning the same demand, claim or cause of action. Plea or right of res *judicata* is not accessible where there is no dispute on an issue among the parties and there is no aware adjudication of an issue.[4]

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1. Black's Law Dictionary 1337 (8th edn., 2004).
2. T.L. Venkatarama Aiyar,Mulla on The Code of Civil Procedure 50-51(Tripathi Private, Bombay 1965).
3. Law student, Res Judicata and Code of Civil Procedure, Law Teacher (Jul, 26, 2019) https://www.lawteacher.net/free-law-essays/constitutional-law/res-judicata-and-code-of-civil-procedure-constitutional-law-essay.php?vref=1.
4. Escorts Farms Ltd. v. Commissioner, Nainital, (2004) 4 SCC 281.

With regard to decide the issue whether a subsequent proceeding is precluded by res *judicata*, it is mandatory to examine the issue with reference to:

a) The form or a competence of the court;

b) The party and the representatives;

c) Matters in issue;

d) Matters which ought to have been made ground for defence or attack in the former suit;

e) The final decision.[5]

The principle of res *judicata* embodies norms of public policy and rule of private justice. It is based on the need of giving finality to judicial decisions and the right of individual to be saved from vexatious multiplicity of proceedings.[6]

CONSTITUTIONAL ASPECT

Constitution of India has been awarded extraordinary remedies as provided under the Act against the State activities. Conferral of such constitutional remedies operates as a check against the misuse of power by the various agencies of State. Article 32, Article 226 and Article 227 of the constitution are most germane articles in this respect. Under these articles certain types of writ petitions can be filed but these articles mainly emphasis on the protection of the fundamental rights of the citizen which are enshrined in the constitution. Our constitution provides fundamental rights under Part-III and also gives liberty to approach the Supreme Court under Article 32 if any of the infringement is done in fundamental rights. Problem aroused in the Supreme Court, whether the rule of res *judicata* will apply to the fundamental rights of the citizen under Article 32? There were numerous conflicted decisions of the Supreme Court which started from the ***Ramesh Thapper vs. State of Madras*** case[7] to ***Srinivasa Reddy vs. State of Mysore***[8] case and the applicability of rule remained silent with respect to the fundamental rights. And finally in ***Daryao vs. State of U.P.***[9] case, the Apex Court stated that no doubt the rule has some technical aspect but it is footed on the rule of public policy i.e. giving finality to litigation and nobody is vexed twice. From these principles, the rule of res judicata will be applicable to writ petitions. The court further added that if a writ petition entertained under

5. Solil Paul and Anupam Srivastava, The Code of Civil Procedure 160-161(Butterworths, New Delhi, 2011).
6. I.T.C. Ltd. v. Central Exicise Commissioner, AIR 2005 SC 1370.
7. (1950) SCR 594.
8. AIR 1960 SC 350.
9. AIR 1961 SC 1457.

Article 226 is dismissed on merit the parties will be bound by the decision until and unless the petition is modified or reversed in appeal or other appropriate proceeding allowed by the law of land.

APPRAISAL OF RES JUDICATA IN EXECUTION PROCEEDINGS

It is found during the research that prior to the Amendment Act, 1976 there were conflicting views regarding the provisions of section 11 of the Code of Civil Procedure, 1908, are applicable to the execution proceedings.[10] The section 11 is not comprehensive on the issue of res *judicata* and its universal principle is applicable to the execution proceedings also. Virtue of the landmarkjudgment of the Privy Council in the case of ***Ram Kirpal vs. Rup Kauri***[11] held in 1883, where Privy Council made a strong base for the application of res *judicata* in execution proceedings. Prior to this decision the general rules of the doctrine are only applicable to the civil suits not in execution proceedings. Privy Council remarked that though the section 11 in terms did not apply to the execution but the doctrine will be applicable in such proceedings. The report of Joint Committee justified that it had been already held by the *Privy Council* as well as the Supreme Court that the doctrine of constructive res *judicata* applies to the execution proceedings. The Committee, therefore, feels that in place of inserting new section 11(A), section 11 should be so amended as to make sure that the doctrine of res *judicata* may apply in its full magnitude, to proceedings in execution; but the insertion of a new explanation VII to section 11 has only codified the judicial dicta.[12]

An order passed in the absence of another party is named as an *ex-parte* order. *Res judicata* does not strictly apply to *ex-parte* orders but the catena of Supreme Court judgments states that in the situations where the courts satisfy that the notice is served upon the defendant, *res judicata* operates. Practically, the defendant takes a vague plea; the court enforces the discretionary power enshrined under section 151 of CPC and restores the particular case which violates the basic rule of public policy (no person be vexed twice). A stringent law must be formed which should state that *res judicata* must be completely applicable in ex-parte proceedings in execution so that there are no loop holes left.T he Orissa High Court in ***Bangsidhar vs. Jagmohan*** case[13] laid down that after the court is satisfied that the notice was served upon the

10. CPC (Amendment) Act 104 of 1976.
11. (1883) 11 IA 37.
12. Report of the Joint Committee, Gazette of India 804(1976).
13. AIR 1945 Ori 21.

respondent, an ex-parte order was granted in execution proceedings, operate as *res judicata.* A notice of attachment of sale is received by the judgement-debtor but cannot claim exemption at initial stage under sec 60(1) (c) subsequently is barred from claiming such exemption at the time of proclamation of sale; constructive res judicata would apply in such cases[14]. But res judicata will not be applicable in *ex-parte* orders in the following circumstances:

i. When no notice is issued,

ii. When the notice is not duly served,

iii. When the notice does not clearly and plainly specify the nature of the claim.

iv. When an application for set aside of *ex-parte* order within limitation period.

Section 11 of the Code of Civil Procedure requires a suit to have been "heard and decided" by a court in order toapply as res judicata in a subsequent suit. However, not all cases conclude with a decisionfollowing full blown adjudication. In many cases, a suit may be brought to an end by acompromise entered into between the parties which may be formalised into a consent decree. A question that has arisen frequently in this context is whether such consent decrees can operate as *res judicata* in subsequent suits between the same parties.

As per the 144th Report of the Law Commission,[15] courts in India have vacillated over whether section 11 would apply in such situations. The High Courts of Sind,[16] Rajasthan,[17] Delhi,[18] Bombay[19] and Guwahati[20] have expressed the view that section 11 would not apply to consent decrees. On the other hand, in a few instances the High Courts of Bombay,[21] Calcutta[22] and Punjab[23] have held that section 11 would apply. The Supreme Court had itself wavered between the two positions between 1954 to 1991. In this context, the Law Commission expressed the need for legislative intervention in the area and recommended the insertion of a new explanation to the section which would clarify that consent decrees would also have a *res judicata* effect. No such amendment to section 11 has however been introduced.[24]

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14. Bhaskar Traders v. MinikipachaKunhiraman, AIR 1988 Ker 227.
15. Law Commission of India, 144th Report on Conflicting Judicial Decisions Pertaining to The Code of Civil Procedure, 1908 (April1992).
16. Ratanchand v. Anandrai, AIR 1933 Sind 53.
17. Bhanwarlal v. Raja Babu, AIR 1970 Raj 104.
18. Manohar v. Naraindass, AIR 1987 Del 226.
19. Minalal v. Kharsetji, (1906) 8 BomLR 296.
20. UphrasLapasam v. Ka Esiboll, AIR 1986 Gau 55.
21. Bhai Shankar v. Morarji, lLR (1912) 36 Bombay 283.
22. Krishna v. Dhanpati, AIR I957 Calcutta 59.
23. Naidermal v. UgerSain, AIR 1966 Punjab 509.
24. *Supra* note 15.

CRITICAL AND COMPARATIVE APPRAISAL OF JUDICIAL DECISIONS

Judiciary in every country plays a prominent role not only in judicial decision but also safeguarding and protecting the interest of society, citizens and State. Judiciary renders direction to the legislature and finds out the weaknesses and ambiguities. The courts in India have acknowledged the principle of *res judicata* in their numerous judgments in positive sense and magnified the scope of the principle by applying the general rule of *res judicata.* As the principle of *res judicata* is salutary one, which is applicable not only to matters governed by the clauses of the Code of Civil Procedure, 1908, but to all proceedings and litigations. The principle of *res judicata* has been applied by the courts with stipulation that there should be no unwanted litigation and whatever claims and defenses are liberal to parties shall all be put up at the similar time so that the finality should attach to the binding adjudication of the courts and the parties should not be vexed again with the identical kind of litigation.

In ***Mohan Lal Goenka vs. Binoy Krishan Mukherjee*** case[25] , Supreme Court follows the Privy Council decision wherein it stated that the rules of constructive *res judicata* would apply even in execution proceedings but this rule would not be applicable wherein the parties and title in subsequent suit are different from the previous suit or the previous application is not heard and finally decided. And in ***Barkat Ali & Another vs. Badri Narain*** case[26] , Supreme Court observed that the matter which has been finalised or deemed to have been finalised at preliminary stage, that matter cannot be re-opened not only in separate proceeding, but also in the later proceedings of the same suit.

For the application of res *judicata*, it is mandatory that the previous application must have been heard and decided. In ***Jethmal vs. Sakina***[27] case, court stated that if an application for execution is rejected for the default of appearance, a subsequent fresh petition cannot be barred by the rule of res judicata. Similarly in ***Kishore Bun vs. Prosuno Coomar***[28] case, an execution application filed under Order XXI rule 32 was rejected as decree-holder did not give an opportunity to the judgement-debtor to obey the decree. It was also stated that after such an opportunity has been provided to the judgement-debtor, later execution application is not restrained by the law of *res*

25. AIR 1953 SC 65.
26. AIR 2008 SC 1272.
27. AIR 1961 Raj 59.
28. (1894) 21 Cal 784.

judicata.

Pursuant to the recommendations made by the Law Commission in its *Fourteenth*[29] and *Twenty Seventh* Report[30] , the amended Code of Civil Procedure expressly provided that all questions including questions of title are to be settled finally in execution proceedings itself and not by a separate suit. So, it is the duty of the executing court to adjudicate all the claims raised before it. In ***Ravinder Kaur vs. Ashok Kumar*** case[31], the Apex Court reiterated that the claim may not be rejected on the sole ground that the claimant has an opportunity to prefer a claim or objection at an earlier stage of the proceeding. The court has to look into the circumstances of the case and come to a conclusion about whether the present claim is aimed at unnecessarily delaying the proceedings. Hence, by considering the above provisions the executing court has to decide the claim petitions effectively. Pleas which have already been adjudicated upon by the trial court cannot be agitated again in execution proceedings under section 47 and Order 21 rule 58 of Code of Civil Procedure because the executing court is not competent to go behind the decree and substitute its own opinion to the one expressed by the court which passed the decree.[32]

In ***Asgar and others vs. Mohan Verma and others*** case[33], the appellants are strangers to the decree. They were required to get that claim adjudicated in the course of their execution application which was under the provisions of Order XXI rule 97. Having failed to assert the claim at that stage, the deeming fiction contained in explanation IV to section 11 is clearly attracted. An issue which the appellants might and ought to have asserted in the earlier round of proceedings is deemed to have been directly and substantially in issue. It has been held that the observations that the appellants were free to pursue an appropriate remedy for the redressal of their grievances in accordance with law contained in the order of court cannot be construed to mean that the respondents would be deprived of their right to set up a plea of constructive *res judicata* if the appellants were to raise such a claim. This must necessarily be construed to mean that all defences of the respondents upon the invocation of a remedy by the appellants were kept open for decision. The liberty granted by this court was not one-sided. It encompasses both the ability of the appellants to take recourse and of the respondents to raise necessary defences to the

29. Law Commission of India, 14th Report on The Reforms of Judicial Administration (September 1958).
30. Law Commission of India, 27th Report on The Code of Civil Procedure, 1908 (December 1964).
31. AIR 2004 SC 904.
32. *Ibid.*
33. 2019(1) ARC 560 (S.C.)

invocation of the remedy. The Hon'ble court held that constructive res judicata, in the same manner as the principles underlying res judicata, is intended to ensure that grounds of attack or defence in litigation must be taken in one of the same proceeding. A party which avoids doing so does it at its own peril. In deciding whether the matter ought to have been urged in the earlier proceedings, the court will have due regard to the ambit of the earlier proceedings, and the nexus which the matter bears to the nature of the controversy.

RES JUDICATA IN WRIT PROCEEDINGS

When we read the explanation of section 141 of the Civil Procedure Code, 1908 section 11 is not applicable to the proceedings under Article 226 of the constitution. But the rule of *res judicata* applies to writ petitions under Article 226 in spite of the fact that section 11 has no space in writ mechanism. When there is any violation of the fundamental right of a citizen then the applicability of the rule is stringent. Any issue decided under Article 226 or under Article 32 constitutes *res judicata* in later proceedings. While applying the rule, former decision must be a speaking order with proper reasoning. The res judicata is based on the public policy that when any decision attains finality it is not permissible under the law of land to take a plea that it ultravires Article 14 of the constitution; the parties will not be allowed to re-open the matter already adjudged.[34] The discussion and interpretation of *res judicata* in various Supreme Court judgments expands the scope and applicability of universal rules of res judicata in writ petitions registered under Article 226 and Article 32 of the constitution. As *res judicata* is applicable to various proceedings of the civil law, similarly, if a conclusion has arrived in the initial writ petition, successive writ petitions with regard to same subject matter will be restricted by the rules of res judicata, if challenged again under Article 32.[35]

WRIT OF HABEAS CORPUS IS AN EXCEPTION TO RES JUDICATA.

Where the issue of right to life or liberty is involved, *res judicata* will not be applicable. There is an only exception to the applicability of *res judicata* in writ mechanism i.e. habeas corpus. The English and American courts both agree on the fact that the rule of *res judicata* is not applicable to a writ of habeas corpus. Likewise, Indian courts too, the rule of res judicata is not made applicable to cases of habeas corpus.

In whole of the constitution Article 21 is supreme; neither substantive lawnor any procedural

34. Sir DinshahFardunji Mulla,The Code of Civil Procedure349 (Lexis Nexis, Nagpur, 2011).
35. Sudipto Sarkar and V.R. Manohar, Sarkar's The Code of Civil Procedure 180-181 (Lexis Nexis, Gurgaon, 2011).

law can curtail its scope. In ***Srikant vs. District Magistrate, Bijapur and others*** case[36] the petitioner filed a *habeas corpus* petition under Article 32 of constitution which was opposed by the State and other respondents by taking a plea of *res judicata*. The State urged that the previous petition was also dismissed on similar grounds and the present petition is totally devoid of merits; did not include any new fact or ground. While giving the judgement, the Supreme Court took into consideration the referred judgements of ***Ghulam Sarwar vs. Union of India and others***[37] (pronounced by Constitution Bench), ***Lallubhai Jogibhai Patel vs. Union of India and others***[38] along with ***Daryao vs. State of U.P.***[39] stated that the rule of constructive res judicata is only applicable to civil action. Wherein the issue of personal freedom or illegal detention is involved, the rule of public policy is inapplicable and the successive writ petition of habeas corpus under Article 32 is not barred.

A conflict between Article 21 and the applicability of *res judicata* is cited again in a recent judgement.A set of writ petitions under Article 226 and 227 of constitution are filed in ***Abdul Razak vs. State of Karnataka*** case,[40] in which the Full Bench of Karnataka High Court before pronouncing a judgement framed three issues; which were related to detention. The court reiterated that the rule of *res judicata* does not strike when it conflicts with the Article 21 and second writ petition is maintainable on fresh or new grounds, assailing the same detention order which were dismissed previously. Even the non-mentioning of the period of detention in the previous writ petition would not vitiate the second writ petition.

In ***T.P. Moideen Koye vs. Govt. of Kerala,***[41] the petitioner files a writ of *habeas corpus* before High Courtunder Article 226 against his detention and the petition is rejected (speaking order or by a non-speaking order) and the said order is not questioned by preferring a special leave petition under Article 136 and is permitted to become absolute, it would still be liberal for him to institute an independent *habeas corpus* writ petition under Article 32 of the constitution. The rule of public policy is not completely binding on an illegal detention and does not preclude a next writ petition of *habeas corpus* under Article 32.

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36. (2006) Cri LJ 1557.
37. AIR 1967 SC 1335.
38. AIR 1981 SC 728.
39. AIR 1961 SC 1457.
40. (2017) SCC OnLine Kar 2855.
41. AIR 2004 SC 4733.

CRITICAL AND COMPARATIVE APPRAISAL OF JUDICIAL DECISIONS

The doctrine of *res judicata* does apply to all writ petitions under Article 226 and Article 32 of the constitution. Therefore, the position is that when once a writ petition has been filed in a High Court or Supreme Court and has been dismissed there on merits, then a successive writ cannot be filed in the same court on the similar cause of action. However, this vision of the Supreme Court has been condemned by various jurists. They have asserted that judiciary has diminished the fundamental right in Article 32 by applying the golden rule. It is submitted that the researcher agrees with the view of the Supreme Court that there has to be finality to litigation. Gazing at the slow process of judicial remedy and frivolous proceedings in our community, it is rather indispensable that the doctrine of *res judicata* be given as liberal as interpretation and its scope and applicability should not be curtailed. Where the applicability of *res judicata* in writ petitions is concerned, the judgment delivered in ***Daryao vs. State of U.P***.[42] strikes first; without which the constitutional aspect of its applicability is incomplete. Thus universal rules laid down by the Supreme Court inthe aforesaid case has been taken as a benchmark for deciding application of *res judicata* in subsequent cases with respect to writ petitions instituted under Article 226 and Article 32 of the Constitution.The Supreme Court has described the following basic principles for the applicability of res judicata:[43]

a) The parties are barred to move Supreme Court under Article 32 with respect to same matter with same facts which was contested previously in a writ petition and was dismissed on merit would bind the parties until and unless it is reversed or modified by appeal.

b) A subsequent petition under Article 32 is not prohibited by law, if a former writ petition is dismissed because of latches or the party had some other alternative remedy but not on the merits.

c) The former petition dismissed in *limine;* subsequent writ petition totally depends upon the order pronounced by the court previously i.e. whether the bar of *res judicata* is to be enforced or not.

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42. Daryao, *supra* note 9.
43. *Ibid.*

In ***Sharma vs. Krishna Sinha*** case,[44] the issue of the applicability of *res judicata* in writ proceedings under Article 32 was raised in the Supreme Court for the first time where the Apex Court had delivered its judgement with positive effects to widen its scope.Prior to this case there was no proper check or limitation on the repeated petitions under Article 226 or Article 32. The court stated that once the writ petition is decided on merit then it is not liberal to a party to move High Court under Article 226 or to Supreme Court under Article 32 for deciding the same issue again unless the order is reversed or modified in appeal.

In ***Pawan Kumar Singh vs. State of U.P. case,***[45] petitioner appealed for the compensation along with the interest in lieu of acquisition of plot under the provisions of the Land Acquisition Act, 1894. The respondent stated that the same petition was filed previously which was dismissed by the High Court on same cause of action and the instant petition is not maintainable under Order 23 rule 1 of CPC. The High Court referred many cases of the Supreme Court and mainly relied on the judgment given in ***Forward Construction Co. vs. Prabhat Mandal case***,[46] where it is held that res judicata is applicable on the order that dismissed the first writ petition and the petitioner has no right to institute another petition on the similar facts and on similar cause of action.

There is no hard and fast rule established by the law or any precedent settled by the court on the summary dismissal of the petition. In ***Hoshnak Singh vs. Union of India***[47] regarding the applicability of *res judicata* in decision without speaking order, the Supreme Court stated that the writ petition dismissed in High Court without speaking order cannot bar a subsequent petition on the same facts. The applicability of the rule would depend upon the order, the facts and circumstances of each case. The High Court in review petition can only correct errors which are face of the petition but the court have no jurisdiction to correct error decision which is decided on merit.

Any dismissal in *limine* of a petition may only prohibit the discretion of the court but lays no effect on the jurisdiction of the court in another writ petition. While pronouncing a judgment, court can consider the issue even the argument in *limine, res judicata* will apply on subsequent petition. *Res judicata* is applicableif a writ petition is dismissed on merit though in *limine*.The

44. AIR 1960 SC 1186.
45. (2019) 134 ALR 552.
46. AIR 1986 SC 391.
47. (1979) 3 SCR 399.

dismissal in limine of a writ petition without a speaking order implies no bar on the later writ petition. Withdrawal of a petition by a workman would not constitute as *res judicata* on another remedy claimed under Labor Court; Order 23, rule 1 is also not applicable to such suit.[48]

In ***Union of India vs. Javier case***,[49] Union of India and the Railway Administration filed a writ petition to quash the order of Central Administrative Tribunal. The respondent applied for the post of Junior EngineerII (Mechanical), Junior Engineer-II (Mechanical CADCAM) and Junior Engineer-II (Carriage and Wagon) and qualified the test but his name was not found in the list of final results. The respondent approached the Tribunal regarding the same. The Tribunal quashed the order and favored the respondent. The railway authority argued that the respondent had filed two different applications; initial before the Chandigarh Tribunal and the later before the Central Administrative Tribunal; and had committed fraud on the railway authority. The former application was dismissed and thus the application before Central Administrative Tribunal is not maintainable on the ground of *res judicata.* The High Court stated that the Chandigarh Tribunal gave liberty to file a fresh application while dismissing the original application, thus the issue framed by the Tribunal was never heard and finally decided. So, *res judicata* does not apply in this petition.

In ***P. Bandhopadhya & others vs. Union of India*** case,[50] the initial appeal was filed by the appellant before Bombay High Court for taking benefits of certain amount of his service in the government which is equal to Provident Fund. The court dismissed the petition and stated that this writ petition is not maintainable as this issue was squarely covered in the matter decided previously on merits by the Division Bench of this court in ***S.V. Vasaikar vs. Union of India*** case.[51] After the dismissal, the appeal was filed in the Apex Court. While awarding the judgment, the Apex Court upheld the Bombay High Court decision and heavily relied on the judgement pronounced by the Constitution Benchin ***Direct Recruit Class II Engineering Officers Association vs. State of Maharashtra & Others,***[52] wherein the court stated that 'general rules of *res judicata* are applicable to writ petitions'. The court further added that where the matter is finally adjudged by the High Court on the merit, later petition would not be

48. Haryana State Co-operative Land Development Bank v. Neelam, AIR 2005 SC 1843.
49. (2018) SCC OnLine All 1782.
50. Civil Appeal No. 3149 of 2019.
51. (2003) 2 MhL.J. 691.
52. (1990) 2 SCR 900.

maintainable on same facts and on similar grounds.

In ***Devilal Modi vs. S.T.O.*** case[53] , the petitioner challenged the validity of an assessment order under Article 226 in High Court. The petition was dismissed on merits and an appeal against the same was also dismissed on merit by the Apex Court. Another writ petition was filed in the same High Court on some additional grounds against the same assessment order and the petition was dismissed again by the High Court. On appeal, the Apex Court stated that the petition is barred by the rules of constructive *res judicata.* If constructive *res judicata* is not applied to such like proceedings, the petitioner will come up with few new facts every time which leads to the violation of the rule of public policy and the doctrine of finality of judgement will never be achieved.

In ***Amalgamated Coalfields Ltd. vs. Janapada Sabha*** case[54] , first time the matter of constructive *res judicata* in writ proceedings arose before the Supreme Court. The court stated *"constructive res judicata is a special and an artificial form of res judicata enshrined in section 11 of CPC should not usually be applied to petitions under Article 226 or Article 32 of the constitution."* No doubt constructive *res judicata* is said to be very technical but after reading a catena of judgements of the High Courts and Supreme Court the rule of constructive *res judicata* is also applicable to the writ proceedings.

CONCLUSION

The judicial system of India has many loopholes which lead to the disposal of cases in quiet slow and ineffective manner. Moreover, if multiplicity of litigations is permitted for the same issues it will not merely make the parties suffer immensely but also lead to the increased burden on the judicial system and also waste its assets by conducting trial on the similar issue. To curtail these issues and problems the principle of *res judicata* is mandatory to be enforced in an effective manner.With the landmarkjudgement of the Privy Council in ***Ram Kirpal vs. Rup Kauri***[55] the principle is widely applied by the court in execution proceedings and finally the amendment in CPC in 1976 give codification to this judgement in the way of explanation VII in section 11. The rule of law has been made applicable even to writ proceedings. The principle laid down in ***Daryao vs. State of Uttar Pradesh*** case[56] has been termed as a landmark judgement for the

53. (1965) 1 SCR 686.
54. (1963) Supp 1 SCR 172.
55. Ram Kirpal, *supra note* 11.
56. Daryao, *supra note* 9.

application of res judicata in subsequent writ proceedings. Some jurists criticise the Supreme Court view regarding applicability of the rule in fundamental rights which challenge the validity of Article 226 and Article 32. But according to present circumstances as the long backlog of cases prevails, there is a need of such principle in the modern society. Keeping in mind the slow process of the judicial decision, it is significant that the scope and applicability of the rule should not be curtailed.

BASIC STRUCTURE DOCTRINE: WIDENING HORIZONS

Dr Monika Ahuja *

Time is not static Time changes and, therefore, the life of a nation is not static but dynamic and living.Its political, social and economic conditions change continuously. Social mores and ideals changes from time to time creating new problems and altering the complexion of the old ones. It is, therefore, quite possible that a Constitution drafted in one era, and in a particular context, may be found inadequate in another era and another context.[1]

Though, the process of judicial interpretation goes on in every constitution to a greater or lesser extent, yet it assumes a crucial importance in a country in which the formal method of constitution¬al amendment is very tardy and difficult.

The best example where this process has been used effectively for adaptation of the constitution is the United States, where the Supreme Court has from time to time given a new meaning tophrases and words in the constitution so as to make the 18th century, *laissezfaire* era document sub serve the needs of a vast, expanding and highly industrialized civilization of the twenty first century without many formal amendments being effectuated in its text.

The US Constitution being brief and couched in general language offers a vast scope for judicial creativity. For example, the First Amendment to the US Constitution guaranteesfreedom of speech in very broad terms. The Amendment says: "Congress shall make no law...abridging the freedom of speech or of the press". The provision lays down no limits or restrictionson the Fundamental Right to freedom of speech. But there can be no unlimited right. Therefore, theUS Supreme Court has taken upon itself to spell out the restrictions on this right.[2]

To a limited extent, in Canada and Australia also, the judiciary has adapted the constitution to the changing circumstances. The process of judicial interpretation is in progress in India as well. The Supreme Court by holding that it can reconsider its decisions from time to time has kept the way open for adjustmentsin constitutional interpretation so as to adapt the Indian Constitution to new situations. The Courthas on several occasions changed its views about the significance and meaning of several constitu¬tional provisions.[3]

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1. M.P. Jain, Indian Constitutional Law 1724 (Lexis Nexis, 8th Edn., 2018).
2. *Ibid.*
3. *Ibid.*

Even though, due to the Indian Constitution being very detailed, and its language being rather specific, and not general, opportunities available to mould the Constitution by the judicial interpre¬tative process are somewhat limited, yet, there have been several outstanding judicial decisions which have had a deep impact on constitutional development. Since 1978, the interpretative process has entered a very dynamic phase because of judicial creativity.[4]

FORMAL METHOD

Practically, every constitution has some formal method of constitutional amendment. This consists of changing the language of a constitutional provision so as to adapt it to the changed context of social needs.

In some countries, the process may be easier than in others, and, accordingly, the constitutions are sometimes classified into flexible or rigid. A flexible constitution is one in which amendment can be effected rather easily, as easily as enacting an ordinary law. The best example of such a Constitution is the British Constitution which can be amended by an ordinary Act of Parliament, and there is, thus, no distinction between ordinary legislative process and constituent process.[5]

A rigid constitution is regarded as the fundamental law of the land in the sense that it lays down the basic principles for the country's governance which are considered to be of a permanent value. It is, therefore, thought that the method of constitutional amendment should ensure that the basic principles are changed only after thorough consideration and deliberation and hasty and ill-considered changes under political pressures of the day are avoided. Accordingly, in such a Constitution, the process of constitutional amendment is more elaborate and difficult than the enactmentof ordinary legislation. There, thus exists a distinction between legislative and constituent process; the former denotes making of an ordinary law and the latter denotes amendment of the Constitution.

If a Constitution is amendable easily by passing an ordinary law, then it will lose all permanence and supremacy. A written constitution usually is of the rigid type. A federal constitution has to be rigid, for it seeks to achieve a balance of powers between the Centre and the States, and it ensures that this balance is not disturbed lightly or unilaterally.

The terms 'rigid' or 'flexible' constitution, the difference being one of degree, because, in the ultimate analysis, a constitution which is incapable of adjustment and adapta¬tion will fail to

4. *Ibid.*
5. *Id.,* at 1727.

endure, and even a constitution of the flexible type may not be lightly amended owing to political repercussions apprehended. A constitution which may be *prima facie* rigid may, in practice, prove to be easily changeable, as has been the case in India so far.

Formal amendment is perhaps the most significant way of adapting the constitution to changing circumstances. The judicial interpretation may help to some extent in this respect but it cannot change the wordings of the basic law. The judicial process is slow and a change may be desired early. At times, some principles laid down by the courts may appear to be against public mores and political needs. An example of such a situation is furnished by the several amendments made in India to Article 31 of the Constitution concerning the Fundamental Right to property to overcome inconvenient judicial interpretation.[6]

SCOPE OF THE AMENDING POWER OF THE PARLIAMENT

Since the commencement of the Constitution, a constitutional battle has been fought, in this regard, both in the Courts as well as, inside the Parliament. It appears that Parliament has been asserting its supremacy as enjoyed by the British Parliament, but the Supreme Court has been interpreting Parliament as a creature of the Constitution,[7] exercising powers under and not beyond the Constitution. The Constitution, though expressly confers amending power on the Parliament, but it is the Supreme Court, which is to finally interpret the scope of such power and to spell out the limitations, if any, on such amending power.

Amendment of Fundamental Rights

The question as to the *scope of the amending power of the Parliament,* came before the Supreme Court for the first time in ***Shankari Prasad v. Union of India.***[8] In this case, the constitutional validity of the Constitution (1st Amendment) Act, 1951,was challenged before the Supreme Court. The Constitution (1st Amendment) was enacted to remove certain difficulties brought to light by judicial pronouncements in regard to Fundamental Rights and the Directive Principles of State Policy.

Soon after the commencement of the Constitution in 1950, some State Governments initiated proposals for incorporation of laws relating to agrarian reforms. These laws contained

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6. *Ibid.*
7. Kesavananda Bharati v. State of Kerala, AIR 1973 SC 1461.
8. AIR 1951 SC 458. The Constitution (1st Amendment) Act, 1951 was enacted by the Constituent Assembly, acting as provisional Parliament.

provisions for the abolition of zamindari system, as well, for the compulsory acquisition of property for public purpose. One such measure was the *Bihar Land Reforms Act, 1950,* enacted by the Bihar Legislature. The Act, provided for the acquisition by the State of the estates and tenures of three leading 'zamindars' of the Bihar Province. The Act was challenged in ***Kameshwar Singh v.State of Bihar,***[9] before Patna High Court. The High Court struck down *the Bihar Act,* as unconstitutional and void as it contravened the provisions of *Article 14.* The Central Government felt that such judicial pronouncements would endanger the whole zamindari abolition programme. To overcome the difficulty, a new provision, *Article 31A,* was added by the Constitution (1st Amendment) Act, 1951.[10]

In ***Shankari Prasad v. Union of India***,[11] wherein the1st Amendment was challenged, the question before the Court was *whether an amendment of the Constitution made under Article 368* was included in the term "law" *in Article 13.*

The Court, upholding the constitutionality of the1st Amendment, observed that "Law" in Article 13 did not include an amendment enacted under *Article 368.* The Supreme Court distinguished between the *ordinary legislative power* and the *constituent power.* The Court held that, in the context of *Article 13,*"law" must be taken to mean rules or regulations made in the exercise of *ordinary legislative power* and not amendments to the Constitution made in exercise of constituent power. The Supreme Court, thus, laid down that *Article 368* conferred *constituent power* on the Parliament, in the exercise of which, it could amend every provision of the Constitution, including the Fundamental Rights.

Article 31-A as it stood before the Constitution (17th Amendment) Act, 1964,provided that a law in respect of acquisition by the State of any 'estate' would not be deemed to be void on the ground that it was inconsistent with Fundamental Rights contained in Articles 14, 19 or 31. The expression 'estate' had been defined differently in different States' Statutes, causing difficulties in regard to transfer of land from one State to another under the Scheme of re-organisation of States. To remove such difficulties, the Constitution (17th Amendment) *Act, 1964* modified the definition of the term "estate" in Article 31-A. The17th Amendment also added 44 Acts enacted by States in the *Ninth Schedule*.

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9. AIR 1951 Pat 91.
10. Prof. Narender Kumar, Constitutional Law of India1008 (Allahabad Law Agency, Reprint 2019).
11. AIR 1951 SC 458.

The validity of the Constitution (17th Amendment) Act, 1964, was questioned in ***Sajjan Singh v. State of Rajasthan.***[12] The challenge was not against the power of the Parliament to amend the fundamental rights, but on procedural non-compliance, It was contended that since17th Amendment (it added 44 Acts to 9th Schedule) was likely to affect the powers of the High Courts under *Article 226,*[13] it had attracted the Proviso to *Article 368,*[14] and as the impugned Amendment had not been ratified by half of the State Legislatures, it was invalid. Rejecting the contention, the Supreme Court held that the impugned Amendment did not attract the provision of CI. (b) of the Proviso to *Article 368.* The Court observed that the impugned Act did not purport to change the provisions of *Article 226* and that it could not be said even to have that effect directly or in an appreciable measure. Referring to Article 368, the Supreme Court expressed its full concurrence with the decision in ***Shankari Prasad v. Union of India,***[15] and laid down that *Article 13 (2)* did not affect amendments of the Constitution made under *Article 368*. The Court held that the constituent power conferred by Article 368 on the Parliament, included even power to take away *fundamental rights* under Part III.

Then came the celebrated judicial pronouncement in ***Golak Nath v. State of Punjab.***[16] In this case, the constitutional validity ofthe Constitution 1st Amendment 1951, 4th Amendment, 1955 and 17thAmendment, 1964, was questioned. The petitioners, the son, daughter and granddaughter of one Henry Golak Nath, who had died in 1953, challenged the validity of the *Punjab Security of Land Tenures Act. 1953,* under which a part of their land was declared surplus, to be acquired by the State. They alleged that the provisions of the Act, under which the said area was declared surplus, infringed their fundamental rights secured by *Article 19 (1)* and 31(2) and *Article 14*. As the *Punjab Security of Land Tenures Act, 1953,* was added to the9th Schedule bythe Constitution (17th Amendment) Act, 1964, the petitioners sought a direction from the Supreme Court for striking down the Constitution (1st Amendment) Act, 1951, Constitution (4th Amendment) Act, 1955, and the Constitution (17th Amendment) Act, 1964, so far as they affected their Fundamental Rights.

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12. AIR 1965 SC 845.
13. 44 Acts were added to the 9th Schedule, the High Courts, were excluded from looking into the constitutionality of these laws as a result of Article 31B.
14. The Proviso requires the ratification of the Amendment Bill having been passed by special majority in both Houses of Parliament, by half of State Legislatures.
15. AIR 1951 SC 458.
16. AIR 1967 SC 1643.

The Supreme Court by 6 : 5 majority overruled its earlier decisions in ***Shankari Prashad v. Union of India,***[17] and ***Sajjan Singh v. State of Rajasthan,***[18] and held that Parliament had no power to amend the Fundamental Rights. J. Subha Rao, C.J., speaking for majority, observed that *Article 368,* in terms, only prescribed the various procedural steps in the matter of amendment of the Constitution, but did not confer power on Parliament either expressly or impliedly to amend the fundamental rights. The Court held that an amendment was a legislative process and an amendment of the Constitution was made only by legislative process with ordinary majority or with special majority, as the case may be, and that *an amendment could be nothing but "law".*

The Supreme Court further declared that Parliament would have no power in future (i.e., from the date of Golak Nath decision on 27-2-1967) to amend any provision of Part III, so as to take away or abridge the Fundamental Rights enshrined therein.

In answer to the question as to whether there would be any way to change the structure of Indian Constitution or abridge the Fundamental Rights, J. Hidayatullah referring to the amending process under the French and the Japanese Constitutions, explained that

> *"Parliament could act in a different way to reach the fundamental rights. It could amend Article 368 to convoke another Constituent Assembly, pass a law under Item 97 of List I of Seventh Schedule, to call a Constituent Assembly. That Assembly might be able to abridge or take away the Fundamental Rights, if desired."*[19]

To nullify the effect of Golaknath decision and to provide expressly for Parliament, the power to amend any part of the Constitution, including Fundamental Rights, the Constitution (24th Amendment) Act, 1971 was *enacted.* The 24th Amendment *firstly,* inserted Clause (4) in *Article 13* to the effect that "Nothing in this Article shall apply to any amendment of this Constitution made under *Article 368". Secondly,* the marginal heading to *Article 368* which ran as *"Procedure for amendment of the Constitution",* was substituted by a new heading which runs as *"Power of Parliament to amend the Constitution and procedure there for".* Thirdly, a new Clause (1) was added to Article 368, to confer on Parliament, constituent power to amend by way of addition, variation, or repeal, any provision of the Constitution including Fundamental Rights. *Fourthly,*

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17. AIR 1951 SC 458.
18. AIR 1965 SC 845.
19. The majority of the Supreme Court also spell out this way to change or abridge the fundamental rights, but did not express the final opinion on the question.

it made it obligatory for the President to give his assent to the Bill having been passed by the Houses of the Parliament. Lastly, a new Clause (3) was inserted in *Article 368* to the effect that *"Nothing in Article 13 shall apply to an amendment made under this Article".*

The Constitution (24th Amendment) Act, 1971, thus conferred absolute, unlimited and uncontrolled amending power on the Parliament.

The Constitution (25th Amendment) Act, 1971

After ***Golak Nath v. State of Punjab,***[20] judgment, some important pronouncements came from the Apex Court in regard to *right to property* contained *in Article 31,* as it stood then. In these cases,[21] the Supreme Court applied the *doctrine of "just equivalent"* and observed that *adequacy of compensation* and the *relevancy of the principles laid down for determining compensation,* to be paid to a person for depriving him of his property, were justiciable and that the Court can go into the question whether the amount paid to the owner of the property was *"just equivalent"* of what he was deprived of.

These decisions struck a blow to the government's programme introducing socio-economic reforms and would have stood in the way of implementing the *Directive Principles of State Policy.* To surmount these difficulties, the Constitution (25th Amendment) Act, 1971 was enacted. This amendment substituted the word *"amount" for "compensation" in Article 31 (2)* and it was expressly declared that *"adequacy of the amount"* to be given for depriving a person of his property, would not be called in question in any Court. Further, a *new Article 31-C* was inserted in the Constitution to provide supremacy to the Directive Principles contained in *Articles 39 (b) & (c)* over Fundamental Rights contained in *Articles 14, 19 and 31.*

Fundamental Rights case *(His Holiness Sripadagalvaru Kesavananda Bharati& Ors.v. State of Kerala)*

The Constitution (24th Amendment) Act, 1971 and the Constitution (25th Amendment) Act, 1971 along with the Constitution (29th Amendment) Act, 1972, [22] were challenged before the Supreme Court in ***Kesavananda Bharati v. State of Kerala,***[23] popularly known as *Fundamental Rights case.* This case was heard by a Bench of 13 Judges of the Supreme Court.

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20. AIR 1967 SC 1643.
21. R.C. Cooper v. Union of India, AIR 1970 SC 564 ; Madhau Rao Scindia v. Union of India, AIR 1971 SC 530.
22. The 29th Amendment, 1972 inserted the Kerala Land Reforms (Amendment) Act,1969 and the Kerala Land Reforms (Amendment) Act, 1971, in the 9th Schedule,to provide protection of Article 31-B to these Acts.
23. AIR 1973 SC 1461.

Out of 13 Judges, 11 Judges delivered separate judgments. Its hearing took five long months. In the constitutional history of free India, the Court gave the longest judgment running into 595 pages.[24]

Though all the 13 Judges upheld the constitutionality of the 24th Amendment and held that Parliament under *Article 368* had power to amend the Constitution, they, however, differed among themselves as to the extent or scope of the power. Six of the Judges (Sikri C.J., Shelat, Hegde, Grover, Jaganmohan Reddy and Mukherjee, JJ.) held that the power of amendment contained in *Article 368* was subjected to certain implied and inherent limitations and that in the exercise of its amending power Parliament could not amend the basic structure or framework of the Constitution. They further held that the *fundamental rights* enshrined in Part III related to the basic structure or framework of the Constitution and, therefore, were not amendable. While, the other six Judges (Ray, Palekar, Mathew, Beg, Dwivedi and Chandrachud, JJ.) were of the opinion that there were no limitations on the power of the Parliament to amend the Constitution.[25]

Khanna J., appears to have reconciled the two divergent views and took a middle path and thus tilted the balance in forming the majority decision with Sikri, C.J., Shelat, Hegde, Grover, Jaganmohan Reddy, Khanna and Mukherjee, JJ. Khanna, J. laid down :

> "The power of amendment under Art. 368 does not include the power to abrogate the Constitution nor does it include the power to alter the basic structure or framework of the Constitution. Subject to the retention of the basic structure or framework of the Constitution, the power of amendment is plenary and includes within itself the power to amend the various Articles of the Constitution, including those relating to fundamental rights as well as those which may be said to relate to essential features. No part of a fundamental right can claim immunity from amendatory process by being described as the essence or core of that right. The power of amendment would also include within itself the power to add, alter or repeal the various Articles."

Khanna, J., thus, held that Parliament had wide power of amending the Constitution under

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24. Dissent Judges were Justice Ray, Justice Paleker, Justice Mathew, Justice Beg, Justice Dwiwedi, Justice Chandrachud. Majority judges were Chief Justice Sikri, Justice Hegde, Justice Mukherjee, Justice Shelat, Justice Grover, Justice Jagmohan, Justice Khanna.
25. *Ibid.*

Article 368, it extended to all the provisions of the Constitutions, including those relating to fundamental rights, but the *amending power is not unlimited and it did not include the power to destroy or abrogate the basic structure or framework of the Constitution.* The majority of the Supreme Court, thus, evolved the theory of Basic Structure.

Basic Structure of the Constitution

'Basic' means the base of a thing on which it stands and on the failure of which it falls. Hence, the essence of the 'basic structure of the Constitution' lies in such of its features, which if amended would amend the very identity of the Constitution itself, ceasing its current existence. It is not a 'vague concept' or 'abstract ideals' found to be outside the provisions of the Constitution. Therefore, the meaning and extent of 'basic structure' needs to be construed in view of the specific provisions, its object and purpose, and the consequences of its denial on the integrity of the Constitution as a fundamental instrument of governance of the country.

In India, the doctrine of Basic Structure is a judicial innovation, and it continues to evolve via judicial pronouncements of the Apex Court. The contours of the expression have been looked into by the Court from time to time, and several constitutional features have been identified as the basic structure of the Constitution, but there is not an exhaustive definition or list of what constitutes the 'basic structure of the Constitution- the Court decides from case to case, whether a constitutional feature can be regarded as basic or not.

Seven of the thirteen Judges in ***Kesavananda Bharati case,***[26] observed that Parliament in the exercise of its amending power under *Article 368,* could not alter *the basic structure or framework of the Constitution. The Basic Structure*[27] has been, thus, held to be a limitation on the amending power of the Parliament. It provides a touch-stone to test the extent of Parliament's power to amend the Constitution.[28] However, it is not possible to ascertain, from the opinions they delivered, as to what constituted the *Basic Structure* or which of the provisions of the Constitution, formed parts of the *basic structure.* Some of the Judges made observations in this regard.

Sikri, C.J., observed that the basic structure was built on the basic foundation, i.e., the dignity

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26. Kesavananda Bharati v. State of Kerala, AIR 1973 SC 1461 at 1903-4.
27. The "Doctrine of Basic Structure" is essentially developed from the German Constitution. M. Nagraj v. Union of India, AIR 2007 SC 7.
28 I.R. Coelho v. State of Tamil Nadu, AIR 2007 SC 861.

and freedom of the individual. The basic foundation of the basic features, in his opinion, could be easily discernible from the Preamble, as well as, from the whole scheme of the Constitution. He articulated the following features as to constitute the basic structure:[29]

(1) Supremacy of the Constitution

(2) Republican and Democratic forms of Government

(3) Secular character of the Constitution

(4) Separation of powers between the legislature, the executive and the judiciary

(5) Federal character of the Constitution

Shelat and Grover, JJ., held that the basic structure was not a vague concept. They maintained that the basic features could only be illustrative and could not be catalogued. According to them the following features constituted the basic structure :[30]

(1) The Supremacy of the Constitution

(2) Republican and Democratic form of Government and Sovereignty of the country

(3) Secular and Federal character of the Constitution

(4) Demarcation of power between the legislature, the executive and the judiciary

(5) The dignity of the individual secured by the various freedoms and basic rights in Part III and the mandate to build a Welfare State contained in Part IV

(6) The Unity and the Integrity of the Nation

Hegde and Mukherjee, JJ., illustrated the following as the fundamental features:

(1) Sovereignty of India

(2) The Democratic character of our polity

(3) The Unity of the country

(4) The essential features of the individual freedoms secured to the citizens

(5) The mandate to build a Welfare State and egalitarian society

Jaganmohan Reddy, J., observed that the mere fact that the essential elements constituting the basic structure could not be enumerated exhaustively, was no ground to deny their existence. In his opinion, a Sovereign, Democratic, Republic, Parliamentary Democracy, and the three organs of the State constituted the basic structure.[31]

Khanna, J., by way of instance, held that the *democratic government* could not be changed into

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29. Kesavananda Bharati v. State of Kerala, AIR 1973 SC 1461 at 1535.
30. *Id.,* 1603.
31. Kesavananda Bharati v. State of Kerala, AIR 1973 SC 1461, 1753-54.

dictatorship or hereditary monarchy, nor the Lok Sabha and the Rajya Sabha be abolished. Likewise, the secular character of the State could not be done away with. Khanna, J., however, categorically said that *right to property* was not the basic structure or framework of the Constitution.69

From the above discussion, it is not easy to identify with certainty, *the basic structure* or the provisions of the Constitution which constitute *the basic structure or the framework.* It *is, therefore, for the Supreme Court, to determine finally, as to what constituted the basic structure or what features and the essential features constituted the framework of the Constitution.* It may be stated that by laying down the concept of Basic Structure, the Supreme Court has assumed to itself the constituent power.

Hon'ble Chief Justice Chandrachud (as he then was), in ***Indira N. Gandhi v.Raj Narain,***[32] explained that for determining whether a particular feature of the Constitution was part of its basic structure :

> *One has perforce to examine in each individual case, the place of the particular feature in the scheme of our Constitution, its object and purpose, and the consequences of its denial on the integrity of the Constitution as a fundamental instrument of the country governance.*

The Supreme Court decision in *I.R. Coelho v. State of Tamil Nadu,*[33] on subjecting laws placed in the Ninth Schedule of the Constitution to judicial review¬ – on the ground of violation of fundamental rights forming part of the basic structure of the Constitution. It was in 1951 that Parliament through the first amendment to the Constitution carved out the Ninth Schedule as an enclave where laws could be placed beyond judicial challenge on the ground of violation on any of the fundamental rights. That move was a reaction to the spate of challenges to land reform laws. Originally, the Schedule was intended to cover land reform and nationalization laws besides laws to tackle concentration of economic power, and was only to be used sparingly. Yet, as the court has pointed out in its decision, the list expanded from 13 to 284, including many state laws. Parliament does not have a carte blanche to override all the fundamental rights, which is what the Ninth Schedule allows it to do. If in the early years of the Constitution, the courts had

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32. AIR 1975 SC 2299, quoted in I.R. Coelho v. State of Tamil Nadu, AIR 2007 SC 861.
33. AIR 2007 SC 861. The doctrine has been embraced in other countries like Germany having controlled constitution.

conceded to Parliament an unfettered right to amend it, the Kesavananda Bharati case in 1973 introduced the doctrine that the basic structure and framework of the Constitution would be beyond the amending power. Following this line of reasoning, the nine-judge bench of the Supreme Court has now held unanimously that laws placed in the Ninth Schedule after 1973 are subject to judicial scrutiny.[34]

In ***Supreme Court Advocates on Record Association v. Union of India,***[35] the Supreme Court held that there are declared limitations on the amending power conferred on Parliament which cannon be breached. Breach of a single provision of the Constitution is sufficient to render the entire legislation ultra vires the Constitution.

In ***Kuldip Nayar v. Union of India (UOI) and Ors.,***[36] the Supreme Court, while dealing with the question of political party system vis-à-vis democracy observed that "parliamentary democracy and multi-party system are an inherent part of the basic structure of Indian constitution. It is political parties that set up candidates at an election who are predominantly elected as Members of the State Legislatures."

34. B.L. Fadia and Kuldeep Fadia, Indian Government and Politics 169 (Sahitya Bhawan, Agra, 2019).
35. AIR 2016 SC 117.
36. AIR 2006 SC 3127.

Evolution of the Basic Structure of the Constitution[37]

.	Name of the Case (Year)	Elements of the Basic Structure (As Declared by the Supreme Court)
	Kesavananda Bharati case 1973) (popularly known as the Fundamental Rights Case)	1. Supremacy of the Constitution 2. Separation of powers between the legislature, the executive and the judiciary 3. Republic and democratic form of government 4. Secular character of the constitution 5. Federal character of the constitution 6. Sovereignty and unity of India 7. Freedom and dignity of the individual 8. Mandate to build a welfare state 3. Parliamentary System
	Indira Nehru Gandhi v. Raj Narayan (AIR 1975 SC 2299) (popularly known as the Election Case)	1. India as a sovereign democratic republic 2. Equality of status and opportunity of an individual 3. Secularism and freedom of conscience and religion 4. Government of laws and not of men (i.e., Rule of Law) 5. Judicial review 6. Free and fair elections which is implied in democracy
	Minerva Mills v. Union of India (AIR 1980 SC 1789)	1. Limited power of Parliament to amend the constitution 2. Judicial review 3. Harmony andbalance between fundamentalrights and directive principles
	S.P. Sampath Kumar v. Union of India (AIR 1987 SC 386)	1. Rule of law 2. Judicial review
	Delhi Judicial Service Association v. Union of India(1991 4 SCC 406)	Powers of the Supreme Court under Articles 32, 136, 141 and 142
	Indra Sawhney v. Union of India (AIR 1993 SC 477) (popularly known as the Mandal Case)	Rule of law
	Kihoto Hollohon v. Zachithu (AIR 1993 SC 412) (popularly known as Defection case)	1. Free and fair elections 2. Sovereign, democratic, republican structure
	S.R. Bommai v. Union of India (AIR 1994 SC 1918)	1. Federalism 2. Secularism 3. Democracy 4. Unity and integrity of the nation 5. Social justice 6. Judicial review
	Indra Sawhney II v. Union of India	Principle of equality

37. M. Laxmikanth, Indian Polity11.2 (McGraw Hill Education, 2019).

	[AIR 2000 SC 498)	
10.	All India Judge's Association v. Union of India[(2002) 1 SCC 119]	Independent judicial system
11.	M. Nagaraj v. Union of India (AIR 2007 SC 71)	Principle of equality
12.	I.R. Coelho v. State of Tamil Nadu (AIR 2007 SC 8617) (popularly known as IX Schedule Case)	1. Rule of law 2. Separation of powers 3. Principles (or essence) underlying fundamental rights 4. Judicial review 5. Principle of equality
13.	Namit Sharmav. Union of India [(2013) 1 SCC 745]	1. Freedom and dignity of the individual.
14.	Madras Bar Association v. Union of India (AIR 2015 SC 1571)	1. Judicial review 2. Powers of the High Courts under Articles 226 and 227

CONCLUSION

It is thus evident that so far, there has been no consensus in this regard laying down the features of the Constitution that may be considered 'basic'. The court has not foreclosed the list of the basic features as suggested by different judges in different cases. In Indira Gandhi's case Justice Chandrachud has observed that "the theory of basic structure has to be considered in each individual case, not in the abstract, but in the context of the concrete problem."

In Kesavananda's case it has been expressly held that the right to property is not a part of the basic structure of the Constitution and, therefore, any amendment can be made to the Constitution in total disregard of the right to property. The only restriction on the amending power is that the power cannot be used to alter or destroy the basic structure or framework of the Constitution.

Logically speaking, the limit to the amending power should be that the Constitution cannot be made to suffer a loss of identity through the amending process. The identity of the Constitution is the sum of its essential features,if the Constitution is not to suffer a loss of identity, each of its essential features has to be preserved.

These judgements of the Supreme Court somehow give the impression that there is a confrontation between Parliament and the judiciary. The confrontation is certainly unfortunate.

The parliament should enact laws with greater restraint and the restraint is more necessary in case of amending the Constitution. The amending power should not be used for political stunts and maneuverings.

INDIAN CONSTITUTIONAL MORALITY AND SECULARISM IN REFERENCE TO Dr AMBEDKAR'S PARADIGM

-Dr Bhupinder Kaur*

1. INTRODUCTION

India is a secular state or more correctly, a constitutionally secular state. Some other states are also considered to be secular such as USA, UK, Australia, France, Mexico, South Korea and Turkey, although none of these nations have identical forms of governance. It is many a times alleged that Indian secularism is an imported phenomenon from one or more of these countries, not essentially 'Indian' in character[1]. It is also assumed that as it now stands in the Constitution, is an imposed set of principles carried by some influential members of the Constituent Assembly, namely Pandit Jawahar Lal Nehru and Dr. Bhim Rao Ambedkar inculcated in their conception through the study of the West's medieval Church-State power clashes.

There were three kinds of groups in the Constituent Assembly, first led by Prof. K.T. Shah, an alumnus of the London School of Economics, which argued in favour of total divorce between religion and the state in the sense that for state there is no phenomenon like 'religion'. State does not believe in the legitimacy of religion's interference or obstruction in its way of governance for political, social and economic revolution and therefore, insisted upon the inclusion of the word 'Secular' in the clause 1 of Art.1 which defines the Union of India. The second group consisted of hard-core pro-religion leaders as well as some mild supporters of religious values, who unequivocally, though unable to define or elucidate, were of the view that religion can serve as a good check upon the powers of the State or can better realise it of its duty to protect Bhartiya Sanskriti, which is its sacred duty. The third group led by Pandit Nehru and Dr, Ambedkar rejected the contentions of both these groups. The duo, in the Constituent Assembly, through a majority of members, was successful in fixing the problem by creating a unique fabric of Fundamental Rights and Directive Principles of the State Policy along with the qualifications attached thereto. Ambedkar's approach to the concept of secularism arises more from the discourse of justice and equality than from an anti-religious position. Therefore, he rejected the religious bias of pro-religion statehood supporters as well as differed from the other group, in the Constituent Assembly in regarding the addition of the word 'Secular' as a redundancy.

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1. G.P. Tripathy, Constitutional Law- New Challenges 54(Central Law Publications, Allahabad, 1st ed. 2015)

The term 'secularism' was first used by the British writer George Holyaake in 1851. In relation to Christianity, Holyaake argued that "Secularism is not an argument against Christianity; it is one independent of it. It does not question the pretentions of Christianity, it advances other. Secularism does not say there is no light or guidance elsewhere, but maintains that there is light and guidance in secular truth whose conditions and sanctions exist independently, and act forever". Applying the same lines on our country in the context of majority-minority conflict, it can be retreated that "Secularism is not an argument against Hinduism or Islam or others; it is one independent of them. It does not question the pretentions of them, it advances other. Secularism does not say there is no light or guidance in these religions, but maintains that there is light and guidance in secular truth whose conditions and sanctions exist independently, and act forever". This secular truth is nothing but the rule of law guided by reason and evidence, a rule of law deep rooted with the sense of Justice, equality, freedom and dignity of the human beings and a rule of law which guards its beneficiaries against any assault or obstruction on its secular truth, as and when it comes from anywhere whether religious forces or non-religious forces. Certain constitutionalists name it 'Constitutional Morality' or 'Secular Humanism'. Secularism is neither 'Pro-God' nor 'anti- God', rather independent of both of them. It is in this sense; Indian Constitution retains it through the efforts of Dr. Ambedkar, among others.

2. INDIAN CONSTITUTIONAL LAW OF SECULARISM VIS-A-VIS CONSTITUTIONAL MORALITY

India is a secular state. The concept of secularism is implicit in the Preamble of the Constitution which declares India as a Sovereign, Socialist, Secular and Democratic Republic and the resolve of the people to secure to all its citizens 'Liberty of Thought, Belief, Faith and Worship'. The word 'Secular' was not included in the preamble or in the body of the Constitution at the time of its making in Constituent Assembly, but added by 42nd amendment in 1976, though not defined anywhere, rather, words 'Right to Freedom of Religion' have been used for Art.25 to 28. Thus a question arises- does the term 'Secular' used in preamble conjointly with words Sovereign, Socialist and Democratic means something more than 'Right to Freedom of

Religion' or less than it or equal to it or something else? It needs attention of legal scholars. Was it skipped from Preamble because it is not the same as right to freedom of religion? The problem arises in situations like that of Tripple Talaq when the opponents of Tripple talaq use secularism in their favour in the sense that state can make law to abandon this practice for the sake of justice and equality whereas the proponents of Tripple Talaq also use the same secularism in their favour saying that state cannot interfere in religion as religion has its own divine sanctity and state is a worldly creation and because it has chosen to be secular, now it cannot touch upon religion. Art.25 to 28 thus, do limit the state power in this sense, though opponents find room for them in the form of reasonable restrictions. Thus a quandary arises that whether the state can abandon it because it is a secular state, constitutional morality gives it powers to do so or whether the state cannot abandon it because it is a secular state and being a matter of religion, it is out of its jurisdiction. It may, however be assumed, with probability of error, that due to this slipperiness of the term 'Secularism', Dr, Ambedkar did not approve of the amendments moved by Prof. K.T Shah to include the word 'Secular' in the text of the Constitution.

However, another view is that in responding to this proposal, Dr. Ambedkar said nothing at all about 'Secularism'; his entire response was about the words 'Socialist Republic'. What did he say? "I regret that I cannot accept the amendment of Prof. K.T. Shah. My objections, stated briefly, are two. In the first place, the Constitution, as I stated in my opening speech in support of the motion I made before the House, is merely a mechanism for the purpose of regulating the work of the various organs of the state. It is not a mechanism whereby particular members or particular parties are installed in office. What should be the policy of the state, how the society should be organised in its social and economic side are matters which must be decided by the people themselves according to time and circumstances. It cannot be laid down in the Constitution itself, because that is destroying democracy altogether." Ambedkar went on to make his second point: "The second reason is that the amendment is purely superfluous. My Honourable friend, Prof. Shah, does not seem to have taken into account the fact that apart from the Fundamental Rights, which we have embodied in the Constitution, we have also introduced other sections which deal with Directive Principles of State Policy…. My submission is that these socialist principles are already embodied in our Constitution and it is unnecessary to

accept this amendment"[2] . Thus, Dr. Ambedkar did not say he was opposed to Shah's proposal, he actually said that it was superfluous and that was why he could not accept the amendment .[3]

Secularism in India means that the State has no religion of its own declared to be religion of the state; the State treats all the religions equally and that the State does not discriminate among its citizens on the ground of religion. State is conceived with the relation between individual and individual and not between individual and God. Now again question arises whether the marriage and eating beef is something between individual and individual or something between individual and God. If former is true, the state can regulate, however if the later is true, the state cannot.

The quandary is who is to and how is to decide it is between individuals or between individual and God, the state itself or the religious leaders? The debates of Constituent Assembly are divided on this matter, however, the weight of authority prescribes that Dr. Ambedkar was in favour of giving an influential hand to state in this regard. It is clear from his struggle for the emancipation and empowerment movements of scheduled castes, not only in his speeches but in the provisions of the Constitution under Art. 15 (Right to equality and freedom from discrimination), Art. 16 (Reservation for SCs and STs in public employment and Art. 17 (Abolition of untouchability) through firm state action. For orthodox Hindus, caste division, non-dissolution of Hindu marriage and negation of property rights to women were integral to Hinduism and necessary for Undivided Hindu Family System, however Dr, Ambedkar, in support with other progressive members of the Constituent Assembly, entirely rejected it and supported Hindu Code Bill as a strong reform movement in personal law, an area earlier ruled by religion.

Art. 25 incorporates that there shall be freedom of conscience and the right to freely profess, practise and propagate religion. This provision is however subject to some reasonable restrictions such as public order, morality, health and other provisions of Part-III as well as to the laws regulating or restricting any financial, political or other activity associated with religious practice or any law providing for social welfare and reforms or the throwing open to all persons

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2. Sabyasachi Bhattacharya, Secularism and the State (May 20, 2019) http://www.frontline.in/politics/ secularism - and -the-state.
3. *Ibid.*

the religious institutions, belonging to their religion or of a public character. Freedom of conscience means inner freedom of the person to mould his relation with God in whatever manner he likes. Profess indicates the declaration freely and openly of one's faith or belief. Practise means to perform the prescribed religious duties, rites and rituals and to exhibit his religious beliefs and ideas by such acts as prescribed by religious order in which he believes. The word propagate includes to speak and publicize one's religious views for the edification of others without any element of force, physical or mental

'Practice' is controversial term. Answering the question as to which practices can be said to be integral for a religion, the honourable Supreme Court held in ***Commissioner of Police v. Acharya Jagdeshwarnanda***[4] that the test is to find out whether the nature of the religion will be changed without that part or practice. If the taking away of that part or practice could result in a fundamental change in the character of that religion, then such part could be treated as an essential or integral part.

The honourable Supreme Court has declared the practice of Triple Talaq to be unconstitutional. The unconstitutionality has been declared on the basis of principles of constitutional morality as well as religious quandary as to its authenticity in Islam itself. The Court strongly reminded the legislature to play its part. Taking this in present scenario, it is again needful to well research the basic questions such as whether the beef ban is essential part of Hindu religion without which it will lose its character or having Teen Talaq is so essential for Islam that if not preserved, will fundamentally change its character? And further how to arrive at a conclusion whether and what fundamental change has it brought? Who will decide it- State or religious leaders? Therefore, we need to look back to the views of the makers of the Constitution. Whether these practices are fundamental for religion or merely associated with the religion? Mere association with certain religion, not able to change the character of religion- can serve as a test to validate or invalidate such practices.

However, this test is also not short of diversion of opinion. It is argued that "under the essentiality test, the court privileges certain religious practices over others. It does not have the expertise to decide which practice/ritual is essential or non-essential. These are purely religious questions, which is best left to clergy. Triple Talaq is certainly not an essential Islamic practice but its effect in dissolving marriage among most Sunni sects may be part of their core or essential

4. 2004(3) SCALE 146.

beliefs. No Judgement can change such beliefs but if the Muslim clergy itself comes forward, such beliefs may gradually change and the instant triple divorce may eventually end" [5].

Latham C.J. of the High Court of Australia, while dealing with the provision of section 116 of the Australian Constitution which inter alia forbids the Commonwealth to prohibit the 'free exercise of any religion' observed, "It is sometimes suggested in discussion on the subject of freedom of religion that, though the Civil Government should not interfere with religious opinion, it nevertheless may deal as it pleases with any acts which are done in pursuance of religious belief without infringing the principle of freedom of religion. It appears to me to be difficult to maintain this distinction as relevant to the interpretation of section 116. The section refers in express terms to the exercise of religion, and therefore it is intended to protect from the operation of any Commonwealth laws acts which are done in the exercise of religion. Thus, the section goes far beyond protecting liberty of opinion. It protects also acts done in pursuance of religious belief as part of religion" [6].

As early as in 1963, the Supreme Court of India observed in this connection that, "In deciding the question as to whether a given religious practice is an integral part of the religion or not the test always would be whether it is regarded as such by the community following the religion or not. This question will always have to be decided by the court and in doing so the court may have to inquire whether the practice in question is religious in character and if it is, whether it can be regarded as an integral or essential part of the religion and the finding of the Court on such an issue will always depend upon the evidence adduced before it as to the conscience of the community and the tenets of its religion" [7].

Appointments of clergy[8], determining the status of second marriage of a Hindu already having a lawful married wife[9], slaughter of healthy chattel[10], right of managers to share the offerings of the deity[11], use of loudspeakers at religious places[12], prohibiting untouchability and discrimination[13], prohibiting misuse of properties of religious places[14] etc. have been held to be

5. Faizan Mustafa, Supreme Court as Clergy, The Tribune (May 20, 2017).
6. Adelaide Company v. The Commonwealth (67 C.L.R. 116, 127).
7. Tikayat Shri Govindlalji Maharaj v. State of Rajasthan AIR 1963 SC 1638.
8. N. Adithayan v. Travancore Devaswom Board (2002) 8 SCC 123.
9. State of Bombay v. N.B.Mali AIR 1952 Bomb. 84.
10. Mohd. Hanif quareshi v. State of Bihar AIR 1958 SC 731.
11. Shri Jagannath Puri Temple Management Committee v. Chintamani Air 1997 SC 3839.
12. Church of God (Full Gospel) in India v. K.K.R.M.C Welfare Association AIR 2000 SC 2773.
13. Venkataramana Devaru v. State of Mysore AIR 1958 SC 255.
14. State of Rajasthan v. Sajjanlal AIR 1975 SC 706.

secular activities by the Courts and thus can be regulated by the state within the ambit of reasonable restrictions attached to the various Articles of the Constitution determining the secularism and providing for freedom of religion in India.

Art. 26 provides that every religious denomination or any section thereof shall have certain rights such as to establish and maintain institutions for religious and charitable purposes, to manage its own affairs in matters of religion, to own and acquire movable and immovable property and to administer such property in accordance with law. However, these rights are subject to reasonable restrictions such as public order, morality and health. Religious denomination must be a collection of individuals who have a system of beliefs which they regard as conducive to their spiritual well being, that is, common faith. It must have a common organisation and a distinct name. No person, under Art.27, shall be compelled to pay any taxes, the proceeds of which are specifically appropriated in payment of expenses for the promotion or maintenance of any particular religion or religious denomination.

On prohibition of religious instructions in educational institutions, Art. 28 provides that no religious instruction shall be provided in any educational institution wholly maintained out of state funds except in those institution which have been established under any endowment or trust which requires that religious instruction shall be imparted in such institution. No person attending any educational institution recognised by the state or receiving aid out of state funds shall be required to take part in any religious instruction that may be imparted in such institution or to attend any religious worship that may be conducted in such institution or in any premises attached thereto unless such person or, if such person is a minor, his guardian has given his consent thereto.

Art. 29(2) incorporates that no citizen shall be denied admission into any educational institution maintained by the State or receiving aid out of state funds on grounds only of religion, race, caste, language or any of them. Art. 30 guarantees that all minorities whether based on religion or language, shall have the right to establish and administer educational institutions of their choice. Where a law is made providing for the compulsory acquisition of any property of any

educational institution belonging to a minority, it shall be ensured that the amount fixed by or determined under such law is such as would not restrict or abrogate the right guaranteed under clause 1 of Art. 30. Clause 2 of Art. 30 further makes it clear that in granting aid to educational institutions, the State shall not discriminate against any educational institution on the ground that it is under the management of a minority, whether based on religion or language. The object is to recognise and preserve different types of people with diverse language and different beliefs, which constitute the essence of secularism. However, it cannot be taken as a privilege but a protection to religious and linguistic minorities to attain a status of equality and dignity with other religious or linguistic groups in India.

Explaining the necessity of Art. 28, Dr. Ambedkar stated in the Constituent Assembly on 7th December, 1948 -"Take a city like Bombay which contains a heterogeneous population believing in different creeds. Suppose, for instance, there was a school in the city of Bombay maintained by the Municipality. Obviously, such a school would contain children of Hindus believing in the Hindu religion, there will be pupils belonging to the Christian community, Zoroastrian community, or to the Jewish community. If one went further and I think it would be desirable to go further than this, the Hindus again would be divided into several varities: there would be Sanatani Hindus, Vedic Hindus believing in the Vedic religion, there would be the Buddhist, there would be the Jains- even among Hindus there would be the Shivites, there would be Vaishnavites. Is the education institution to be required to treat all the children on a footing of equality and to provide religious instruction in all the denominations? It seems to me that to assign such a task to the state would be to ask it to do the impossible" [15].

He further argued in the context of clause two of Art. 28 stating that , " There have been cases where institutions in the early part of history of this country have been established with the object of giving religious instruction and for some reason they were unable to have people to manage them and they were taken over by the State as a trusty for them. Now, it is obvious that when you accept a trust, you must fulfil the trust in all respect. If the State has already taken over these institutions and placed itself in the position of trustee, then obviously you cannot say to the Government that notwithstanding the fact that you were giving religious instruction in these institutions, hereafter you shall not give such instruction. I think that would be not only

15. D.N. Benerjee, Our Fundamental Rights-Their Nature and Extent (As Judicially Determined) 286(World Press Pvt. Limited, Calcutta, 2nd ed. 1968)

permitting the State but forcing it to commit a breach of trust"[16] .

Clause (3) of Art.28 achieves, to quote the words of Dr. Ambedkar, again two purposes. One is as he said "There we are permitting a community which has established its educational institution for the advancement of its religion or its cultural life, to give such instruction in the school. We have also provide that (the) children of other communities who attend the school shall not be compelled to attend such religious instruction which undoubtedly and obviously must be the instruction in the religion of that particular community unless the parent consent to it. As I say we have achieved this double purpose and those who want religious instruction to be given are free to establish their institutions and claim aid from the State, give religious instruction, but shall not be in a position to force that religious instruction on other communities"[17] . It may also be noted that, according to Dr. Ambedkar, once an educational institution, whether maintained by a community, or not, gets a grant out of State funds, it must be open to all communities. Presumably this follows from clause (2) of Art. 29 of the Constitution. The essence of these speeches provides enough light to the people of India to decide upon matters when certain political forces try to implement their religious agenda through government regulations and orders in the name of value-creation in kids.

Speaking on the limitations on fundamental rights, Dr. Ambedkar stated, "The rights of the American Constitution are not absolute. In support of every exception to fundamental rights set out in the Constitution, one can refer to at least one judgement of the U.S. Supreme Court. The purpose of the provisos (reasonable restrictions) was to prevent endless litigation and the Supreme Court having to rescue Parliament. The provisos permit the State directly to impose limitations on the Fundamental Rights. There is really no difference in the result"[18].

3. CONCLUSION

Concluding upon the loom, it can be certainly said that Dr. Ambedkar was a progressive leader as well an egalitarian constitutionalist. He, undoubtedly, held no intention to interfere with the religious sentiments, neither had he endeavoured to validate or invalidate their thoughts, however, he was firm believer of modern democratic values such as equality, justice, freedom

16. *Id* at p.287.
17. *Id* at p.287.
18. Granville Austin, The Indian Constitution: Cornerstone of a Nation 73(Oxford University Press, Oxford, 1st ed. 1972).

and participatory politics and their practical existence in matters of State and governance. He believed in the secular rule of law and wanted the excesses committed upon the women, minorities and backward classes to be eliminated as well as penalised, in appropriated ways backed by justice oriented juristic principles. He seems to have come forward in approving the intellect of the state, its power to bring equilibrium between religion and social reform. He believed in thoughtful legal reasoning to contest the matters in conflict with religion. He was also conceived of the idea that so far as the reforms are concerned, ideological constitutionalism should not come in the way of practical necessity and hinder the progress, an idea cherished by Sir Ivor Jennings that many a times, "the 'Principles' of constitutional lawyers become a dangerous foundation for the formation of policy"[19] .

The Constitution has, through Fundamental Rights and Directive Principles of the State Policy, cast a duty upon the State to continue the reform process till the goals set out in the Preamble are not achieved. This struggle is a continuing phenomenon. However, the co-operation of the masses is also needed. Change is the rule of nature. Dr. Ambedkar also believed that the thrust for it should also come from masses or be recognised by the people in general and reform agenda should be applied to all the creeds without any discrimination. National interest and Constitutional goals should be the guiding force for reforms and not hollow political categorical ideologies which are bound to disrepute the whole process. Thus, State should continue to endeavour to uphold the democratic values and Constitutional morality through an intelligent social engineering approach based on prudent legal postulates and broad consensus of masses as undertaken by the progressive leaders of the Constituent Assembly, including, prominently, the great Dr. Bhim Rao Ambedkar.

19. W. Ivor Jennings, The Law and the Constitution, 317 (University of London Press, London, 5th ed. 1967).

LAW RELATING TO WILLS: INDIAN PERSPECTIVE

-Dr Rattan Singh* & Ms Balwinder Kaur**

I. INTRODUCTION

Ironically, the most certain thing in one's life comes at the very end of it—the curtain call, the death. But life still goes on and beyond. And the dead lives among the alive—in their memories that he leaves behind besides other things. There cannot be a dispute regarding the fond memories, for they can be shared without dispute but the other material things most of the time become a bone of bitter contention. This is where enters the Will. Will is a legal document containing the desire of the dead regarding his/her other material things-his property. A Will goes a long way in precluding the probability of all possible disputes that might arise after the death of the testator among his/her legal heirs.[1] Since wealth is a well known corrupter of mind, which blinds humans from the distinction between the right and the wrong, it is important to preserve the confidentiality of the Will, for, the lack of confidentiality may pose a grave threat to the life of the testator.[2]

A Will is not an instrument of transfer of property by sale, gift, exchange, mortgage, lease or assignment, nor it is an agreement. These transactions need two living persons to execute them, whereas a Will is a unilateral declaration of a person fixing his own line of succession to his estate on his demise. The Will speaks as on the death of the testator. It is an instrument that contains the last desire of the testator. It may change the course of devolution of property as prescribed by law about intestate succession.[3] A Will was generally resorted to when a testator desired to distribute the property after his death according to his wishes contrary to the normal mode in which the property would have passed on the basis of the prevailing customary law.[4]

A coparcener governed by the Dayabhagha law always could and at present can dispose of his coparcenary interest by Will, subject to the claims of those who were entitled to be maintained by him. In case of persons governed by the Mitakshara law, the rule which existed before the promulgation of the Hindu Succession Act, 1956, has been considerably modified by Section 30 of the said Act and this section now permits one governed by the Mitakshara law to dispose of his

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1. H L Kumar, Make Your Will Yourself 322 (Universal Law Publishing, Gurgaon, 7th Edition, 2017).
2. *Ibid.*
3. R.C. Nagpal, Modern Hindu Law 995 (Eastern Book Company, Lucknow, 2nd Edition, 2015).
4. T.P. Gopalakrishnan, Law of Wills 6 (Law Book Company, Allahabad, 3rdEdition, 1975).

undivided interest in the coparcenary property by Will.[5]

II. HISTORICAL PERSPECTIVE

The origin of wills in India is shrouded in obscurity and its investigation is rendered all the more difficult as there is no text at all dealing with the subject expressly. According to Sir Thomas Strange there is no term in Sanskrit or in the local language to express the idea of a will. The seven kinds of documents in use among Hindus, as per description of documents given by the Sanskrit writers, were documents of partition, gift, purchase, mortgage, agreement, bondage and debt. Will was not expressly mentioned. The orthodox Hindu contemplated the claims of his children and dependants as indefeasible and they in their turn revered as laws the authority and wishes of his ancestors. Hence the scarcity of wills were also in ancient times. But it cannot be said that wills were wholly unknown to Hindu law. Gifts were undoubtedly very common and, as in other countries, the conception of a gift gave rise to the conception of a will.

The first known will was executed by the well knownOmichand in 1758. Omichand was a resident of Calcutta and was conversant with the English Laws and customs administered there. The probate of his will was granted by the court of Records of Calcutta. The validity of Wills made by Hindus was, however, not easily established. In 1786, Wills were considered valid by the Supreme Court in two cases.[6] In 1791, the Supreme Court of Calcutta held that the probate of a Hindu will could not be granted. In 1792, the Sudder Court decided in favour of a will by which a father bequeathed his entire Zamindari to his eldest son.[7] The Supreme Court laid down the same rule in 1793.[8] The validity of Hindu Wills was considered as undisputed in the matter of wills of *Raja NabaKissan*[9], NemiCharanMullick (1808)[10] in a Bengal case (1812) [11].

III. CONCEPT OF WILL: MEANING AND DEFINITION

Will is a translation of the Latin word "Voluntas", which was a term used in the texts of Roman law to express the intention of a testator. It is curious that the abstract term has come to mean the document in which the intention is contained. The same has been the case with several other English law terms, the concrete has superseded the abstract-obligation, bond, contract, are examples. The word 'testament' is derived from 'testatiomenties', it testifies the determination

5. S.K. Mitra, Hindu Law195 (Orient Publishing Company, New Delhi, 2nd Edition, 2006).
6. Munnoo v. Gopee and Russick v. ChitonMontrion290, 304.
7. Ehsan Chand v. Eshory Chand I.S.R. 2, 2 Stra H.L. 447.
8. Dial Chand v. KissoryMontriou 371 (India).
9. Gopee Krishna v. Raj Krishna Montriou 381 (India).
10. Ramtanoo v. Ram GopalMullick, Morl. Dig. 39 No. 314 (India).
11. Ram Coomar v. Kishan Kinker 2 S.D. 42 (India).

of the mind.[12]

Will means a continous act of gift up to moment of the donor's death and though revocable in his lifetime, is, until revocation, a continous act of gift up to the moment of death, and does then operate to give the property disposed of to the persons designed as beneficiaries.[13]

The expression "Will" has been defined in the Indian Succession Act, 1925, Section 2(h),'Will' means "the legal declaration of the intention of a testator with respect to his property which he desires to be carried into effect after his death."[14]

According to Judicial Dictionary, "a will is the legal instrument whereby a man declares what is to be done with his property after his death. Will means the legal declaration of the intention of the testator with respect to his property which he desires to be carried into effect after his death. The word 'will' shall extend to a testament and to a codicil and to an appointment by a will or by writing in the nature of a will in exercise of a power and also to a disposition by will.[15]

Bouvier's Law Dictionary defines will as the, "disposition of one's property to take effect after death. The term will, as an expression of the final disposition of one's property, is confined to English Laws and those countries which derive their jurisprudence from that source.[16]

TERMS RELATING TO WILLS

Probate: Probate means the copy of a Will certified under the seal of a Court of competent jurisdiction with a grant of administration to the estate of the testator. The term 'probate' in its strictest sense, signifies the copy of the Will which is given to the executor, together with a certificate granted under seal of the Court, and signed by one of the registrars, certifying that the Will has been proved. This probate or copy of the Will constitutes the executor's title to act, the original document being left in the registry. When the two documents differ, and questions of interpretation arise, the Court may look at the original Will.[17]

Codicil : It is a document executed in the same manner as a Will changing or altering or adding to the disposal made earlier in the Will. Just as a Will can be revoked by subsequent Will, a codicil can also be revoked by subsequent Will or Codicil. It may be noted that putting cross lines on the Will or codicil does not amount to cancellation or revocation of the Will/codicil unless such

12. Acharya Shuklendra, Hindu Law1134 (Modern Law Publications, 2004).
13. T.P. Gopalakrishnan, Law of Wills 22 (Law Book Company, Allahabad, 3rdEdition, 1975).
14. The Indian Succession Act, 1925 (Act 39 of 1925).
15. K. J. Aiyar, Judicial Dictionary, 1027, 13th Edition.
16. Bouvier's Law Dictionary, Third Revision, 3455.
17. *Id.,* at 1189.

cancellation follows the procedure required for making the Will and words are used to that effect.[18]

According to the definition as given in section 2 (b) of the Indian Succession Act, 1925, three things are evident:

i) That a codicil cannot be oral but must be an instrument in writing.

ii) It must have been made in relation to will which has already come into existence.

iii) Its object is to explain, alter or add to the disposition under the will.

Letter of Administration: Letter of Administration is certificate granted by the competent court to an administration where there exists a will authorizing him to administer the estate of the deceased in accordance with the will. If the will does not name any executor, an application can be filed in the court for grant of letter of administration for property. A letter of administration can be obtained from the court of competent jurisdiction to appoint an executor under will or where the executor appointed under a will refuses to act or where he has died before or after proving the will. This is one of the well established maxims of the law of grant of letters of administration that grant follows the interest. In other words letters of administration is to be granted to the person who has the maximum interest in the estate of the testator. The universal legatee is the testator's first choice and thereafter is the residuary legatee. Where there are several residuary legatees, the one who represents the maximum interest will be preferred.[19]

Testator: A male person who makes a Will. A female who makes a Will is known as testatrix.[20]

IV. LAWS APPLICABLE TO WILL

Following are the statutes relating to wills:

i) **The Constitution of India, 1950:** In Indian Constitution, under entry 5 of concurrent list, it is mentioned that all matters relating to wills in respect of which parties in judicial proceedings were immediately before the commencement of this Constitution subject to their personal laws.[21]

ii) **The Indian Succession Act, 1925:** The Indian Succession Act, 1925 is mainly related to the general law of testamentary succession. It is applicable to the wills made by Hindus, Buddhists, Sikhs, Jains, Parsis and Christians but not to Mohammedans. It is

18. H.k.s. Malik, Testamentary Disposition of Property Under The Hindu Succession Act, 1956, 1 (The Commercial Law Publications, Delhi, 1981).
19. The Indian Succession Act, 1925, section 232.
20. *Supra* note 1 at 30.
21. India Const. schedule 7.

only a consolidating and not an amending enactment, prima facie the same effect ought to be given to its provisions as way given to the provisions of the Acts of which it is substituted.[22]

iii) **The Indian Evidence Act, 1872:** A will must be executed in accordance with the formalities as laid down in the Indian Succession Act, 1925. The Evidence Act lays down that whenever a document is produced before a court as evidence at least one atlesting witness shall be called to prove the execution of the document. This principle will apply only if at least one of the giving evidence and subject to the process of the court.[23]

iv) **The Indian Registration Act, 1908:** Will is a document, registration of which is optional under the provisions of the Indian Registration Act, 1908. The registration of a document provides evidence that the proper parties had appeared before the registering officers and the latter had attested the same after ascertaining their identity. The non-registration of a will does not lead to any inference against the genuineness of a will. Once a will is registered under the Registration Act, it is placed in the safe custody of the Registrar.[24]

MUSLIM AND CHRISTIAN LAW ON WILL

Muslim Law: There is no codified law for Wills by Muslims. Wills by Muslims can be made as per their religious books. Further it may be kept in mind that the Muslim Law of Wills is not uniform for all the sections. There are many differences among the Shias and the Sunnis.[25]

It may be mentioned here that the Indian Succession Act, 1925, does not affect the provisions of Muslim Law relating to testamentary succession to the estate of a Muslim. The leading authority on Muslim Will is *Hedaya.* The *Hedaya* was composed by Sheikh Burhan-ud-din-Ali who belonged to *Hanafi* School. Another source is Fatwa *Alamgiri* which was composed by the author belonging the *Hanafi* School.[26]

Capacity to make Will under Muslim Law: Every Muslim who is of sound mind and has attained majority is competent to make a will. To make a valid will, it should satisfy two conditions, viz.:

i) The testator must have a sound mind at the time of making the will, and

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22. Sanjiva Row's, Indian Succession Act,2 (1985).
23. Act No. 1 of 1872.
24. Act No. XVI of 1908.
25. *Supra* note 35 at 112.
26. *Supra* note 1 at 107.

ii) The testator should be major as per Indian Majority Act, 1875.[27]

Limited Power

Muslim Law limits the power of bequests to one-third of the net assets. The two-third must in any case be distributed according to rules of intestacy, unless there are no heirs at all claiming adversely to the legatees, which is rather a remote contingency.

Thus, a Muslim can validly bequeath only one-third of his net assets, when there are heirs. The net assets are ascertained after payment of the funeral expenses of the deceased, his debts, etc.

If there are no heirs, testamentary power can be exercised over the entire property of the testator. If all heirs agree and give their consent, then one-third limit can be exceeded.[28]

Form of Will: A will by a Mohammedan, is not required to be in writing but it may be oral also. No writing is required to make a Mohammedan will valid and no particular form is there for it. Intention of the testator is the prime concern. A Mohammedan will though in writing does not require to be signed or attestation.[29]

Christian Law: According to Indian Succession Act, 1925, except for Muslims, the process and procedure of making or executing a Will is the same for every other community. Therefore, like others, a Christian can make a Will only when he is of sound mind and is free from duress or coercion or fraud. The mental power of a testator may be impaired by old age or disease, but he must be able to comprehend the nature and effect of disposition. He should possess memory and intelligence to form a proper judgment regarding the disposition. Old age itself is no incapacity. The mental capacity and memory must exist at the actual moment of execution.

The formalities required for a Christian to make a Will are--

i) That it must be in writing;

ii) That it must be duly signed or marked by the testator or signed by some other person in the presence of and under the direction of the testator himself;

iii) That it must be attested by two or more witnesses.

Simultaneous presence of both the witnesses is not necessary as such a Will can be proved by one of the attesting witnesses.

Here it must be noted that Christians have the facility to make Privileged Wills also, provided the testator is employed as a soldier in an expedition or engaged in actual warfare, or an airman. He

27. R.k. Bag And D.p. Dey, Wills Law And Practice 358 (Eastern Law House, New Delhi, 2018).
28. *Supra* note 1 at 108.
29. *Supra* note 52 at 360.

should be of 18 years in age. The soldier includes a civilian in actual military service, but a Will made in military hospital eighteen months after the cessation of active military service, cannot be admitted as a Privileged Will.

Privileged Wills may be made by word of mouth, words spoken in course of casual conversation will not constitute testamentary act of disposition. Cogent evidence must be adduced to prove the statements made by the deceased after executing the Will in order to find the contents of the Will.[30]

V. JUDICIAL ATTITUDE TOWARDS WILLS

The Indian judiciary has interpreted the provisions relating to wills, of which some famous cases have been discussed hereunder.

In Tagorev. Tagore case,[31] Privy Council point out that no new form of estate or no new line of inheritance could be started by the donor or testator in order to satisfy his personal whims. Principles governing the construction of a will apply, by and large, to the construction of a gift.

- Inheritance being a thing laid down by the State for reasons of public policy, a private person cannot lay down a mode of inheritance unknown to the law. Thus if a testator grants property to a person and his eldest nephew and the eldest nephew of such nephew, and so forth, here the mode of inheritance not being legal, it fails except as to those persons in whose favour it is valid by way of gift. Here the succession of life-estate, being repugnant to Hindu law, it fails as a mode of inheritance. It remains to be seen whether it can be upheld by the law of gift.
- Under the Hindu Law, in the case of a gift, the donee must be a person in existence.
- Trusts of various kinds have been reorganised and acted on in India and there is no reason why they should not be upheld, if created by Hindus. But the interposition of trustees in this case cannot cure the illegality of the will. Trusts for illegal purposes are invalid.
- The maintenance is sufficient. The amount of maintenance is to be determined by various circumstances among which the magnitude of the property is one; but it is not to have a fixed proportion to the extent of the property.
- A general provision in the will that the heir at law shall be disinherited is ineffectual,

30. *Supra* note 1 at 105.
31. (1872) 9 Beng.LR 377 (India).

without a valid bequest to another person.

- The principles of Hindu Law laid down in this case were a governing factor for half century. Now it has been superseded by the Hindu Disposition of Property Act (XV of 1916) which provided that a gift of bequest to an unborn person is valid, provided he is given an absolute interest and the gift is in conformity with Section 113 of the Indian Succession Act, 1925.

In ***ValliammaiAchi v. Nagappa Chettiar***,[32] the Supreme Court observed that where a person by his 'Will' professes to dispose of something which he has no right to dispose of, the person to whom the thing belongs shall elect either to confirm such disposition or to dissent from it and in the latter case he shall give up any benefits which may have been provided for him by the 'Will'. The property being joint family property, Pallaniappa's father was not entitled to Will it away and his making a Will would make no difference to the nature of the property when it came into the hands of Pallaniappa. A father cannot make the joint family property into absolute property by merely making a Will. A father in a Mitakshara family has a very limited right to make a Will. The character of the property would not change. No doubt, Pallaniappa had also taken the probate of the Will as a dutiful son, the property would still remain a joint family property in the hands of Pallaniappa.

In ***Raman Nadar Viswanathan Nadar v. Snehappoo Kasalamma***,[33] the Supreme Court held thatAlthough there is no authority in Hindu Law to justify the doctrine that a Hindu cannot make a gift or bequest for the benefit of an unborn person yet that doctrine has been engrafted on Hindu Law by the decision of the Judicial Committtee in Tagor's case, 1872 Ind App Supp 47 (PC). Though the decision is based on wrong reading of the relevant verse in Dayabhaga, yet it has taken roots, may be on the basis of the maxim, "communis error facit Jus". This doctrine has not been altered by further legislative measures by which no bequest shall be invalid by reason only that any person for whose benefit it may have been made was not born at the date of testator's death. This rule, however, is subject to the limitations and provisions contained in sections 113, 114, 115 and 116 of the Indian Succession Act, 1925.

In ***S. Rathinam @ Kuppamuthu v. L.S. Mariappan,***[34] in this case, Apex Court declared that the founder of the trust dedicated properties for the maintenance of the temple and performance of

32. AIR 1967 SC 1153(India).
33. AIR 1970 SC 1759(India).
34. AIR 2007 SC 2134(India).

Pujas consisting of four shop rooms in the front and a few residential buildings at the back of the temple. Disputes and differences arose between two branches of the family. It was held that a testator by his Will, may make any disposition of his property subject to the condition that the same should not be inconsistent with the laws or contrary to the policy of the State. A Will being not a transfer, the bar contained in section 6(d) of the Transfer of Property Act, 1882, will have no application and as such the Will is valid.

In ***B. Rajeogowdav. H.R. Shandaregowda***[35], the Apex Court observed that as per section 3 of the Transfer of Property Act, the essential condition of attesting is 1) two or more persons have seen the executants sign the instrument or have received from him a personal acknowledgment of his signature, 2) with a view to attest or to bear witness to this fact each one of them has signed the instrument in the presence of the executants. It is essential that the witness must have put his signature animoattestandi i.e. for the purpose of attesting that he has seen the executants sign or receive from him a personal acknowledgment of his signature. It is for the attesting witness to see the attesting of the document or must have knowledge of the acknowledgment of the signature of the executant.

In ***GurdevKaur v. Kaki***[36], Supreme Court pointed out that when execution of the Will is fully proved then in order to ascertain the wishes of the testator we have to look to the text of the Will. The intention of the testator has to be discerned from the language used in the Will. If a Will appears on the face of it to have been duly executed and attested in accordance with the requirements of the Statute, a presumption of due exception and attestation applies.

In***Mathai Samuel v. Eapen Eapen***[37], the Supreme Court held that subsequent events or conduct of parties after the execution of the document shall not be taken into consideration in interpreting a document especially when there is no ambiguity in the language of the document.

The Apex Court in ***Dr. ParkashSoni v. Deepak Kumar***[38], viewed the facts of the case and stated that the entire case revolved around the proof of due execution of the alleged Will and was surrounded by suspicious circumstances. The Court observed that as per the presented case, the Will was executed by the deceased Srimati Mooli Swarnkar on the date of her death and the

35. AIR 2006 Kant. 48 (India).
36. 2007 (2) A.L.D. 20 at p. 26 (S.C.) (India).
37. AIR 2013 S.C. 532 (India).
38. 2017 SCLT 2446 (India).

witnesses who were allegedly present also stated that hands of Srimati Mooli Swarnkar was shivering while signing the disputed Will.

Alleged Will not a result of testator's free will and mind: The Court pointed out that at the time of alleged execution of Will, SrimatiMooliSwarnkar was very weak and she was being ¬¬¬-administered drip. The Court also noted that on comparison of the disputed signature on the Will and other signatures of the deceased, it was observed that they were totally different.

The Court on the basis of facts and circumstances of the case, was of the view that the condition of the testator's mind and body was very feeble and debilitated. The signature of the testator was allegedly taken on the death bed while she was administered drip. The dispositions made in the will may not be the result of the testator's free will and mind.

To prove due execution of Will, suspicious circumstances shall be discharged satisfactorily: The Court held that in such cases, the Court would naturally expect that all legitimate suspicions should be completely removed before the document is accepted as the last will of the testator. The presence of such suspicious circumstances naturally tends to make the initial onus very heavy and unless it is satisfactorily discharged, Courts would be reluctant to treat the document as the last will of the testator.

The Court observed that in the instant case there were many suspicious circumstances hence the dispositions made in the alleged will may not be as a result of testator's free will and mind. The Court further held that the Respondents being the propounders of the will had failed in the case to satisfy the judicial conscience of this Court regarding due execution of the will.

VI. CONCEPT OF LIVING WILL

The issue of euthanasia has a long history stretching back to the Ancient Greeks, Romans, and Indians, the right to a death with dignity was brought to the fore recently. Before this right was considered, the arguments surrounding euthanasia related more to morality (as with the Roman Stoics)[39] and religion (for example, Judeo-Christian philosophy considered suicide to be irreligious).[40]

In ***Aruna Ramchandra Shanbaug v. Union of India***[41], the Supreme Court allowed passive euthanasia, but before the case of Aruna Ramchandra Shanbaug v. Union of India, little was clear in India about the law applicable to terminally ill patients who wished to die a natural death

39. Frederick Lowy, Douglas M Sawyer & John R Williams, "Canadian Physicians and Euthanasia: 4 Lessons from Experience" (1993) 148 CANADIAN MEDICAL ASSOCIATION JOURNAL (CMAJ) 1895.
40. Norman L. Geisler, Christian Ethics: Contemporary Issues And Options 171 (United States of America, Baker Academic, 2nd Edition, 2010).
41. (2011) 4 SCC 454 (India).

by refusing modern medical life-sustaining treatment. The 196th Report of the Law Commission of India had made a study of the law relating to euthanasia and its related facets and had proposed a Bill for its implementation. However, euthanasia was not given legal validity until this landmark judgment.

Common Cause ***(A Regd. Society) v. Union of India***[42], the Supreme Court declared right to die with dignity was a fundamental right and that an advance directive by a person in the form of living will could be approved. Advance Medical Directive cannot operate in abstraction. There has to be safeguards. They need to be spelled out. We enumerate them as follows:

i) The Advance directive can be executed only by an adult who is of sound mind, and healthy state of mind and in a position to communicate, relate and comprehend the purpose and consequences of executing the documents.

ii) It must be voluntarily executed and without any coercion or inducement or compulsion and after having full knowledge or information.

iii) It should clearly indicate the decision relating to the circumstances in which withholding or withdrawal of medical treatment can be resorted to.

iv) It should disclose that the executor has understood the consequences of executing such a document.

v) The document should be signed by the executor in the presence of two attesting witnesses, preferably independent, and countersigned by jurisdictional judicial magistrate first class so designated by the concerned District Judge.

vi) In the event, the executor becomes terminally ill and is undergoing prolonged medical treatment with no hope of recovery and care of the ailment, the treating position, when made aware about the advance directive, shall ascertain the genuineness and authenticity thereof from the jurisdictional Judicial Magistrate First Class before acting upon the same.

vii) An Advance Directive shall not be applicable to the treatment in question if there are reasonable grounds for believing that circumstances exist which the person making the directive did not anticipate at the time of the Advance Directive and which would have affected his decision had he anticipated them.

If the Advance Directive is not clear and ambiguous, the concerned Medical Boards

42. AIR 2018 SC 172 (India).

shall not give effect to the same and, in that event, the guidelines meant for patients without Advance Directive shall be made applicable.

VII. CONCLUSION

Wills are legally recognised documents which enables ones property to be distributed according to his or her desires or wishes. In case where a person dies without making a will usually referred to as intestate situation, various issues may arise. Though writing of a will accrues various benefits, very little people do so. The most commonly types of will embraced by individuals are oral and handwritten wills. In cases where no will was written by the deceased person, the governing law automatically controls and regulates property distribution among the beneficiaries. The improvement in current law relating to wills in India is required to make the present status (framework) more effective like a will should be made video-graphed, the person who is making will should medically examined.

LEGAL PROTECTION TO REFUGEES IN INDIA: AN ANALYSIS

-Ms Indu Bala*

I. INTRODUCTION

One of the biggest political and human tragedies of the twentieth century has arisen in the shape of more than fifty million refugees and displaced persons in the world today. Century is referred to by many as the century of the up-rooted and the homeless persons. It has been marked by a seemingly unending number of mass flights of people fleeing their native lands, seeking a new life in foreign countries. Human rights violations are a major factor in causing the flight of refugees as well as an obstacle to their safe and voluntary return home.[1]

The impact of this problem is felt worldwide and its influence on international politics is increasingly becoming more pronounced. Coming to Indian scene, India is one of the few countries in the world which has experienced refugee situations on a gigantic scale during last century. It has given humanitarian assistance and protection to millions of refugees.[2] When India gained its independence from Britain on August 15, 1947, there followed a phase of armed conflict and enormous human suffering. With the creation of Pakistan, an estimated 5 million refugees arrived in India.[3] There was another steep rise in the number of refugees in 1965, this time from East Pakistan, as a result of the Indo-Pakistani war. People from minority communities fled East Pakistan for India due to fear of persecution by the Pakistani Army. During the period of 1964-1968, a large number of Chakmas migrated to India due to the ethnic disturbances in the Chittagong Hill Tracts area.[4] The largest wave of refugees, however, was admitted in 1971 when the liberation war in Bangladesh began. Another wave of refugees arrived from the Chittagong Hill Tracts in Tripura from Bangladesh in 1986, when the Government of Tripura arranged for rehabilitation packages for these people.[5] Minority population in Bangladesh continue to cross the international border to escape religious

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1. Manik Chakraborty, Human Rights And Refugees: Problems, Law And Practices xi (Deep and Deep Publications Pvt. Ltd., New Delhi, 2001).
2. *Ibid.*
3. Lakshmi Jambholkar And C. Jayaraj, ISIL Year Book Of International Humanitarian And Refugee Law 204 (The Indian Society of International Law (ISIL), Vol. III, Shivam Offset Press, New Delhi, 2003).
4. An Indigenous tribal community generally resides at the Chittagong Hill Tracts of Bangladesh.
5. Malabika Das Gupta, Refugee Influx, 2 Economic And Political Weekly, 39 (1980).

persecution, and the Government of India took several steps to regularise the entry, stay and citizenship process for these persecuted minorities.[6] More than 60,000 Afghan refugees came to India in the years following the 1979 to 1989 due to Soviet–Afghan war. There are more than 1,00,000 Sri Lankan Tamils in India, most of whom migrated during the rise of militancy in Sri Lanka. The Indian government does not officially recognise them as refugees, but has allowed the UNHCR India to operate a programme for them. Rohingya people are ethnic Muslims of Rakhine state, Burma. Rohingyas have been declared as the most persecuted ethnic group in the world by the UNHCR. India hosts a significant number of Rohingyas in Delhi, Hyderabad, J&K, West Bengal and Northeast India. The Indian government does not officially recognize them as refugees.[7]

Tibet is a mountainous State. Chinese interference in Tibet intensified the dispute over its legal status. The People's Republic of China (PRC) claims that Tibet is an integral part of China. The Tibetan government-in-exile maintains that Tibet is an independent State under unlawful occupation. It led to civil war in 1959, due to this 14th Dalai Lama and more than 1,50,000 Tibetan fled to India, took asylum and are residing here for the last 60 years.[8] Jawaharlal Nehru, then Prime Minister, agreed to provide all assistance to the Tibetan refugees to settle in India until their eventual return. 1,00,000 refugees remain in India today. Refugees are eligible to apply for long term visas (LTVs) / stay visas issued by the Government of India. The LTV / stay visa regularises their stay in India and reduces challenges in accessing public services and employment. UNHCR advocates that UNHCR documentation and LTVs are recognised by authorities and service providers to facilitate continued access to basic services and opportunities in asylum. The Tibetan diaspora maintains a government in exile in Himachal Pradesh, which coordinates political activities for Tibetans in India. The Tibetan government-in-exile functions from McLeod Ganj, a suburb of Dharamshala.[9]

II. MEANING AND DEFINITION OF REFUGEE

A refugee is a person who has fled across the physical borders of his homeland to seek refuge in another place and who, upon granting refugee status, receives certain rights not available to

6. Shuvro Prosun Sarker, Refugee Law In India xii (Springer Nature Singapore Pvt. Ltd., 2017).
7. Refugees in India, (July 2, 2019, 4:00 PM), https://www.livemint.com/Sundayapp/clQnX60MIR2LhCitpMmMWO/ Indias-refugee-saga-from-1947-to-2017.html.
8. Tibetan Diaspora, (July 25, 2019, 5:00 PM), https://www.jstor.org/stable/23005991.
9. Tibetan Government in exile, (June 2, 2019, 3:00 PM), https://unhcr.org.in/index.php?option=com_content&view=article&id=18&Itemid=103.

other international migrants.[10] Refugee means one who, owing to religious persecution or political trouble seeks refuge in a foreign country.[11] The Webster's Dictionary defines refugee as "one who flees to a refuge or one who flees from invasion, persecution or political danger."[12]

According to United Nations Convention Relating to the Status of Refugees, 1951 the term refugee shall apply to "any persons who, owing to a well founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country".[13]

The term 'persecution' comprises human rights abuses or other serious harm, often but not always with a systematic or repetitive element. While it is generally agreed that "mere" discrimination may not, in the normal course, amount to persecution in and of itself (though particularly egregious forms undoubtedly will be so considered), a persistent pattern of consistent discrimination will usually, on cumulative grounds, amount to persecution and warrant international protection.[14]

The 1969 Refugee Convention expanded the definition of refugee. It provided that term refugee shall also apply to every person who, owing to external aggression, occupation, foreign domination or events seriously disturbing public order in either part or the whole of his country of origin or nationality, is compelled to leave his place of habitual residence in order to seek refuge in another place outside his country of origin or nationality.[15]

The Cartagena Declaration determine that a refugee include persons who flee their countries because their lives, safety or freedom have been threatened by generalised violence, foreign aggression, internal conflicts, massive violation of human rights or other circumstances which have seriously disturbed public order.[16]

The definition of refugee in the 1951 Convention has been the principal tool for providing effective protection to millions of refugees since it was crafted sixty nine years ago. It has proven

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10. A. Natrajan, Human Rights In International Perspectives 2 (Aavishkar Publishers, Jaipur, 2006).
11. Oxford English Dictionary 493 (Second Edition, Volume-XIII, Clarendon Press, 1991).
12. The New International Webster's Comprehensive Dictionary 1060 (Trident Press Publication, 2004).
13. The United Nations Convention Relating to the Status of Refugees, 1951, article 1 (A) (2).
14. Interpreting Article 1 of the 1951 Convention Relating to the Status of Refugees, (July 2, 2019, 5:00 PM), https://www.refworld.org/pdfid/3b20a3914.pdf.
15. The Organisation of African Unity (OAU) Convention, 1969.
16. Cartagena Declaration on Refugees, Colloquium on the International Protection of Refugees in Central America, Mexico and Panama, 1984, article 1.

its resilience and adaptability over those years, demonstrating that a proper interpretation of article 1 respects and furthers the objects and purposes of the 1951 Convention. A principled approach to the inclusion elements and a careful application of the exclusion and cessation clauses are indispensable for the continuing efficacy of refugee protection, ensuring that refugee protection will neither be brought into disrepute by its abuse, nor weakened by its unwarranted restriction. In sum, a balanced and holistic application of the definition, incorporating human rights law principles, has the best chance of yielding the correct result.[17]

III. INTERNATIONAL EFFORTS FOR REFUGEE PROTECTION

The lack or denial of protection is a principal feature of refugee character, and it is for international law, in turn, to substitute its own protection for which the country of origin could not provide. Non-refoulement is the foundation-stone of international protection. [18] The office of the United Nations High Commissioner for Refugees was established on December 14, 1950.[19] The High Commissioner's work is entirely humanitarian and non political. The basic function of the United Nations High Commissioner for Refugees is to encompass providing international protection and seeking permanent solution to the problems of refugees by way of voluntary repatriation or assimilation in new national communities. Following are the main documents, Conventions and Protocols for the protection of refugees:

A. **Universal Declaration of Human Rights, 1948:** It showed their concern and played very effective role for the protection of refugees. It guarantees right to leave any country including his own and return to his own country.[20] The Declaration also lay down that everyone has the right to seek and to enjoy in other countries asylum from persecution, right to nationality.[21]

B. **Geneva Convention Relative to the Protection of Civilian Persons in Time of War, 1949:** It provides that the detaining power shall not treat as enemy aliens exclusively on the basis of their nationality *de jure* of an enemy State, refugees who do not, in fact, enjoy the protection of any government.[22]

C. **The Convention Relating to the Status of Refugees, 1951 and its Protocol, 1967:** It

17. Refugee Definition, (May 20, 2019, 5:00 PM), https://www.refworld.org/pdfid/3b20a3914.pdf.
18. S. Guy And Goodwin Gill, The Refugee In International Law 127 (Clarendon Press Oxford, 1983).
19. The United Nation High Commission for Refugees, (May 30, 2019, 11:00 AM), http://www.unhcr.org.
20. Universal Declaration of Human Rights, 1948, article 13.
21. *Id.,* article 14.
22. Geneva Convention Relative to the Protection of Civilian Persons in Time of War, 1949, article 44.

considered as an internationally agreed instrument and a milestone of refugee protection. It has given very important rights to refugees. Countries that have ratified the 1951 Convention are obliged to protect refugees that are on their territory, in accordance with its terms. Refugees shall abide by the national laws of the Contracting States.[23] The Member States shall provide free access to courts for refugees, identity papers for refugees, travel documents for refugees.[24] The State Parties shall not discriminate refugees, expel, forcibly return or refoul refugees to the country they have fled from.[25] Therefore, States are obligated under the Convention and under customary international law to respect the principle of non-refoulement. If and when this principle is threatened, UNHCR can respond by intervening with relevant authorities, and if it deems necessary, will inform the public.

Refugees shall be treated at least like nationals in relation to freedom to practice their religion, labour legislation and social security.[26] Refugees shall be treated at least like other non-nationals in relation to movable and immovable property, the right of association in unions or other associations, wage-earning employment,[27] education higher than elementary, the right to free movement and free choice of residence within the country.[28]

D. **Convention Relating to the Status of Stateless Persons, 1954:** This Convention provides that the Contracting States shall accord to stateless persons within their territories treatment at least as favourable as that accorded to their nationals with respect to freedom to practise their religion and freedom as regards the religious education of their children.[29] A stateless person shall have free access to the courts in the territory of all Contracting States.[30]

E. **International Covenant on Civil and Political Rights, 1966:** This Covenant deals with freedom of movement and to choose residence[31] and prohibition of expulsion of aliens except by due process of law.[32]

F. **The African Convention on Refugee, 1969:** This Convention[33] concerned with the

23. *Id.,* article 2.
24. *Id.,* article 16, 27 and 28.
25. *Id.,* article 3, 32 and 33.
26. *Id.,* article 4, 24.
27. *Id.,* article 13, 15 and 17.
28. *Id.,* article 22 and 26.
29. Convention Relating to the Status of Stateless Persons, 1954, article 4.
30. *Id.,* article 16.
31. The International Covenant on Civil and Political Rights, 1966, article 12.
32. *Id.,* article 13.
33. The OAU Convention governing the specific aspects of the refugee problem in Africa was adopted by the Assembly of Heads of State and government on September 10, 1969 and it came into force from June 20, 1974.

governance of specific aspects of the refugee problem in Africa. It provides that Member States shall use their best endeavours consistent with their respective legislations to receive refugees and to secure the settlement of those refugees who for well founded reasons are unable or unwilling to return to their country of origin or nationality.

G. **Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), 1979:** This Convention[34] stated that State Parties shall grant women equal rights with men to acquire, change or retain their nationality and equal rights with men in respect to nationality of their children.

H. **The Cartagena Declaration on Refugees, 1984:** This Declaration also reaffirms the importance of the right to asylum, the principle of non-refoulement and the importance of finding durable solutions. The Declaration also provides to adopt national laws and regulations to promote within the countries of the region facilitating the application of the Convention and the Protocol and, if necessary, establishing internal procedures and mechanisms for the protection of refugees.[35]

I. **Convention on the Rights of the Child, 1989:** It provides that States Parties shall take appropriate measures to ensure that a child who is seeking refugee status or who is considered a refugee in accordance with applicable international or domestic law and procedures shall, whether unaccompanied or accompanied by his or her parents or by any other person, receive appropriate protection and humanitarian assistance in the enjoyment of applicable rights set forth in the this Convention. For this purpose, States Parties shall provide, as they consider appropriate, co-operation in any efforts by the United Nations and other competent intergovernmental organisations or non-governmental organisations co-operating with the United Nations to protect and assist such a child and to trace the parents or other members of the family of any refugee child in order to obtain information necessary for reunification with his or her family. [36]

IV. NATIONAL LEGAL FRAMEWORK FOR PROTECTION OF REFUGEES

India has attempted to regulate the status and protection of refugees by administrative means as India is not signatory to 1951 Convention. In the absence of a legislative framework, the possibility of bias and discriminatory treatment of refugees cannot be ignored. Owing to the

34. Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), 1979, article 9.
35. The Cartagena Declaration on Refugees, 1984, (July 1, 2019, 2:00 PM), https://www.oas.org/dil/1984_cartagena_declaration_on_refugees.pdf.
36. Convention on the Rights of the Child, 1989, article 22.

absence of specific legislation, the laws relating to the regulation of foreigners are applied to refugees in India with no difference made between foreigners and refugees as a separate class. The primary Indian law relevant to foreigners is the Foreigners Act, 1946 which empowers the Central Government to regulate the entry, presence and departure of foreigners in India. As a result, refugees who have fled persecution are subject to the same rules and regulations as other foreigners entering India for any other purpose, and thus no legislative framework has been developed for identifying and determining refugee status.

The influx of refugees to India is not a recent phenomenon. Refugees started flowing into India during the partition in 1947. Though India is not a party to the 1951 Convention Relating to Status of Refugees and its 1967 Protocol, in the past the Indian Government has always tried to provide prompt relief and rehabilitation to refugees entering India. The relief and rehabilitation process for refugees during the partition of India was based on a very holistic approach and was organised at the highest levels of the Indian Government. Thereafter, refugees started coming to independent India from various neighboring countries as well as the Middle East and Africa. However, the assistance that was provided to refugees during partition, and the protection and rehabilitation extended to the first refugee group in India after independence (namely Tibetans), was not available to the refugees who came later, including those arriving today. It was expected that a country influenced by a rich religious and cultural tradition of hospitality (Atithi Devo Bhava), and governed by the rule of law, would be more proactive in ensuring the rights and protection of refugees in this evolving world of international human rights and protection of vulnerable people.[37]

The United Nations High Commissioner for Refugees (UNHCR) estimates the number of refugees currently present in India at around 2,05,764 of whom only 30,000 are registered with the UNCHR in New Delhi.[38] India chooses to deal with refugee protection through administrative measures coupled with strict laws dealing with the expulsion of foreigners. At the same time, there are several constitutional provisions which affirm the rights of non-citizens in the country, along with India's obligation to uphold international law through various Conventions, Protocols, Resolutions, Declarations, and so forth.[39]

In the absence of specialised statutory framework, India has to rely upon the Registration of

37. Sarker, *supra*, 14.
38. UNHCR Sub regional Operations Profile—South Asia (2015), (June 23, 2019, 2:00 PM), http://www.unhcr.org/pages/ 49e4876e6.html.
39. Sarker, *supra*, 14.

Foreigners Act, 1939, the Passport (Entry into India) Act, 1920 and the Foreigners Act, 1946, which govern the entry, stay and exit of foreigners in India. There are also some provisions of the Citizenship Act, 1955 which deal with granting of citizenship and expulsion of foreigners. The National Register of Citizens (NRC) is a register containing names of all genuine Indian citizens. The Illegal Migrants (Determination by Tribunal) Act, 1983 provides for the establishment of tribunals for the determination, whether a person is illegal migrant or not and to enable the Central Government to expel illegal migrants from India and for matters connected therein.

A. The Constitution of India, 1950

Refugees are entitled to some degree of Constitutional protection in India. These include the protection of the equality clause and the life, liberty and due process provisions of Indian Constitution. Equality before the law and the equal protection of law, classification of persons into separate and distinct classes based on intelligible differentia with a nexus to the object of the classification are allowed. Thus, the executive may distinguish between classes or descriptions of foreigners and deal with them differently.[40]

B. The Foreigners Act, 1946

In the absence of specific statutory framework in India, the chief legislation for the regulation of refugees is the Foreigners Act, 1946[41] which deals with the matter of entry of foreigners in India, their presence therein and their departure therefrom. Under this Act, wide range of powers has been granted to the Central Government. This Act was significant in the drafting of the Foreigners Order, 1948. This Order is an amalgamation of many of the provisions of the Passport (Entry into India) Act, 1920[42] and the Registration of the Foreigners Act, 1939.[43]

C. The Displaced Persons (Compensation and Rehabilitation) Act, 1954

The Displaced Persons (Compensation and Rehabilitation) Act, 1954[44] provides the payment of compensation and rehabilitation grant to displaced persons.

D. The Citizenship Act, 1955

This Act prohibits illegal migrants from acquiring Indian citizenship. To check the

40. The Constitution of India, 1950, art 14.
41. Act No. 31 of 1946.
42. Act No. 34 of 1920.
43. Act No. 16 of 1939.
44. Act No. 44 of 1954.

continuing influx of foreign nationals into Assam and fear about the adverse effect on political, social, cultural and economic life of the State, this Act was amended in 1985 which provide that every person of Indian origin who came on or after the January 1, 1966 but before the March 25, 1971 from territories presently included in Bangladesh and who has been ordinarily resident in Assam ever since and who has been detected in accordance with the provisions of the Foreigners Act, 1946 and the Foreigners (Tribunals) Order, 1964 shall, upon registration, be deemed to be a citizen for all purposes as from the date of expiry of a period of 10 years from the date of detection as a foreigner.[45]

E. The Extradition Act, 1962

This legislation provides some protection to refugees facing extradition by restricting the government's freedom to remove from its territory a particular category of foreigners. This restriction however is so narrowly relevant that it does not provide any real safeguards for the majority of refugees in India whose removal from the territory is most likely to face under the category of expulsion rather than extradition.[46]

F. The Refugee Relief Taxes (Abolition) Repeal Act, 2002

The Refugee Relief Taxes (Abolition) Act, 1973[47] was enacted to give relief to refugees from taxes but this Act was repeal by the Refugee Relief Taxes (Abolition) Repeal Act, 2002.[48]

G. The Asylum Bill, 2015

This Bill[49] was introduced for the establishment of an effective system to protect refugees and asylum seekers by means of an appropriate legal framework to determine claims for asylum and to provide for the rights and obligations flowing from such status and matters connected therewith. But the Bill has not been passed yet in the Parliament.

V. JUDICIAL RESPONSE TOWARDS REFUGEES

In India, the judiciary has played a very important role in protecting refugees. Court orders have filled legislative gaps and in many cases and has provided a humanitarian solution to the

45. Act No. 57 of 1955.
46. Act No. 34 of 1962.
47. Act No.13 of 1973.
48. Act No.70 of 2002.
49. The Asylum Bill, 2015, (June 2, 2019, 5:00 PM), http://164.100.47.4/billstexts/lsbilltexts/asintroduced/3088LS.pdf.

problems of refugees. Moreover, Indian courts have allowed refugees and intervening non-governmental organisations (NGOs) to file cases before them. Furthermore, the courts have interpreted provisions of the Indian Constitution, existing laws and, in the absence of municipal law, provisions of international law to offer protection to refugees and asylum seekers.

The Apex Court in ***National Human Rights Commission v. State of Arunachal Pradesh***,[50] pointed out that a large number of Chakmas from erstwhile East Pakistan (now Bangladesh) were displaced by the Kaptai Hydel Power Project in 1964. They took shelter in Assam and Tripura. Most of them were settled in these states and became Indian citizens in due course of time. Since a large number of refugees had taken shelter in Assam, the state government expressed its inability to rehabilitate all of them. However, about 4,012 Chakmas were settled in Arunachal Pradesh. They were also allotted some land in consultation with local tribals. The Government of India also sanctioned rehabilitation assistance of Rs. 4,200/- per family. The population of Chakmas in Arunachal Pradesh is estimated to be around 65,000. Later, relations between citizens of Arunachal Pradesh and the Chakmas deteriorated and the latter made a complaint that they are being subjected to repressive measures with a view of forcibly expelling them from Arunachal Pradesh. The Court stated, "we are a country governed by the rule of law. Our Constitution confers certain rights on every human being and certain other rights of citizens. Every person is entitled to equality before the law and equal protection of law (article 14). So also, no person can be deprived of his life or personal liberty except according to procedure established by law (article 21). Thus, the State is bound to protect the life and liberty of every human being, be he a citizen or otherwise, and it cannot permit anybody or group of persons to threaten the Chakmas to leave the state.

The Hon'ble Supreme Court in ***Louis de readt v. Union of India***[51] , held that article 21 of Constitution of India, which protects the life and liberty of Indian citizens is extended to all including aliens in Indian territory and they shall not be deprived of those rights except according to the procedure established by law.

In ***Chairperson, Railway Board v. Chandrimadas***[52] is a landmark judgment of the Supreme

50. (1996) 1 SCC 742 (India).
51. (1991) 3 SCC 554 (India).
52. AIR 2000 SC 998 (India).

Court on protection of human rights of refugees. Here Hanuffa Khatoon, a Bangladeshi national, was gang-raped in the rail yatri niwas of the Howrah railway station. A writ petition was filed and sum of Rs. 10 lakh was awarded as compensation against the Railway Department. The Supreme Court upholding this decision, held that offence of rape amounts to violation of fundamental right guaranteed to women under article 21 of the Constitution, and the victim, though a national of another country, was entitled to be treated with dignity.

In ***Tenzing Choden Sherpa v. Union of India,***[53] the Meghalya High Court held that on interpreting an unambiguous provision such as section 3 (1) (a) of the Citizenship Act, 1955, the petitioners (progeny of Tibetans) are Indian citizens in every respect and thus are entitled to all benefits and privileges available to the Indian citizens who born in India on/after January 26, 1950 and before July 1, 1987.

Dongh Lian Kham v. Union of India[54] is an important ruling by High Court of Delhi dealing with refugees. Two petitioners, Lian Kham and Zel Khan Mang, whose country of origin is Myanmar, have been staying in India under long term visa and mandate refugees since 2009 and 2011 respectively. The petitioners fled from Myanmar and entered India as they apprehended retaliatory attack by the military. Certificates were issued by the United Nations High Commission for Refugees recognising them to be refugees who are required to be protected from forcible return to their country. The High Court of Delhi held that since the petitioners apprehend danger to their lives on return to their countries, so the petitioners cannot be deported from India.

In ***Mohammad Salimullah v. Union of India***[55] , a petition has been filed before the Supreme Court, challenging the decision to deport Rohingya Muslims who have taken refuge in India to escape persecution in Myanmar. The petition has been filed by two Rohingya immigrants, Mohammad Salimullah and Mohammad Shaqir, who challenged the decision of the Central Government to deport 40,000 Rohingyas back to Myanmar, the country of their persecution. The petitioners have claimed that the proposed deportation violates the Constitutional protection of right to equality under article 14, right to life and personal liberty under article 21

53. WP (C) No. 206 of 2015 (India).
54. 2015 SCC Online Del. 14338 (India).
55. W.P. (C) No.793 of 2017 (India), (July 10, 2019, 5:00 PM), scobserver.in/court-case/rohingya-deportation-case.

and fostering respect for international law and treaty obligations under article 51 (c). The petitioners also claimed that the deportation would be in contradiction with the principle of non-refoulement, generally considered to be a part of customary international law. This petition is presently pending before the Apex Court, which will decide the fate of 40,000 Rohingyas in India will also clarify the extension of fundamental rights to the case of non-citizens like Rohingyas and the degree to which customary international norms are binding on municipal law.

VI. COMPARATIVE ANALYSIS OF SOUTH ASIAN REGION WITH NORTHERN REGION

Some of the important distinctions between the Northern Region and South Asian Region to the refugee problem would include the following. While the developed countries engage in individual determination by and large, the countries in South Asia engage in the group determination of refugees. In this process of determination, the developed countries have established a variety of administrative, quasi-judicial and appellate mechanisms while the countries in South Asia have not. The developed countries have enacted appropriate domestic legislation to give effect to the international obligations they have undertaken under the 1951 Refugee Convention and/or the 1967 Protocol, while there is no such legal framework in the South Asian countries. While the South Asian countries rely very heavily on the bilateral approach to resolve refugee crises, there is no such reliance placed on it by the developed countries. Again the South Asian countries have at tempted to resolve the problems of 'statelessness' by accommodating large numbers of people of their origin and by providing citizenship to them .[56]

The emergence of joint responsibility in this regard can also be seen in that process of resolving the issues arising out of population movements. The willingness on the part of India in according citizenship to 3,38,000 stateless persons from Sri Lanka and the efforts of the Sri Lankan Government to accommodate the rest of them is to be appreciated. The developed countries in resolving some of the refugee problems have also taken up such joint responsibility. Thousands of refugees from Burma, as indicated earlier, have also been assimilated in India without allowing them to create a refugee problem elsewhere. As far as the rights and liberties of the

56. Veerabhadran Vijayakumar, A Critical Analysis of Refugee Protection in South Asia, The Comparison, (July,26, 2020), file:///C:/Users/hp23/Downloads/22073-Article%20Text-22485-2-10-20180807%20(1).pdf.

refugee are concerned, there seems to be a wide gap between these two schemes. The developed countries have provided a number of rights and liberties as well as extended a number of welfare measures when compared to the countries in South Asia. When the systems present in these two groups of states, one can also identify certain similarities. Both the schemes permit the judiciary to resolve certain specific questions of law arising out of their determination, removal or in safeguarding their rights and liberties. There seems to be an active role placed by the human rights institutions, directly or indirectly, in both groups of countries. An increased number of NGOs are taking keen interest in the protection of refugees. Finally, there is an ever increasing awareness arising out of the 'Human Rights' concept that contribute to better protection of refugees through but the world today. The primary task for the developed countries would be to assist the developing countries to establish the appropriate legal framework in the protection of the refugees.[57]

To sustain this effort, an attempt must also be made to establish the necessary links at two different levels, with the academic institutions of higher learning in these countries for a constant and ongoing interaction with those institutions. Networking of educational institutions within these developing countries in the first place and then linking them with the institutions in the developed countries would certainly enhance the pace of establishing a human rights culture in the developing countries in South Asia. Reliance on a comparative analysis coupled with the perspective on human rights and refugee protection would certainly promote best practices in both the Northern and Southern countries in the years to come.

VII. CONCLUSION

Refugee problem is a tragic phenomenon which has always been a matter of concern at international, regional and national level. The tragedy lies with refugees is that they have to cross the borders of their nations and have to look with bare hands towards other states to let them give some space in their land. However, in the past decade, refugee concerns have moved to centre stage, probably because this period has seen some of the most serious cases of human rights violations and mass displacement. Though the basic human rights instruments have been

57. *Ibid.*

in existence since 1950, the contexts in which they are used today are very different. Compared to the post World War II era, refugee rights are being addressed with new concerns in mind.

India has so far dealt with situations of mass influx without a refugee law but with a continuously enlarging population of refugees and asylum seekers, a large section of who may not be repatriated in the near future, a uniform law would allow the government to maintain its huge non-citizen population with more accountability and order, apart from allowing them to enjoy uniform rights and privileges. A regional treaty can be beneficial in improving ties with its neighbours, but India will be better placed by having its own law owing to the large number of different communities that it hosts, and the unstable relations that it shares with several of its neighbours.

Thus, it is always to be remembered that no one becomes a refugee of his own free will rather when his own homeland becomes mouth of shark then one leaves his home and opts to become a refugee. It is the greatest tragedy of the current century that we are still witnessing the refugee crisis. Refugees are hungry for normalcy in their country so that they can go back and start their life afresh there. At present we need to develop a culture of peace so that the present and upcoming generation becomes symbol of peacemakers. Nations must join together to uphold the rule of law and must respect the basic rights of the individuals. The "Karuna Philosophy" propounded by Justice Krishna Iyer must always be kept in mind while

dealing with refugees. Thus the time at present is to join hands together to carve a new world where there shall be peace and where people are not forced to flee from their motherlands and become refugees.

Keeping into the consideration of national interest and measures needed to protect the rights of refugees in India, following are some suggestions:

- India must enact a specific national legislation for refugees. In order to make a good piece of legislation it is important if international law have a bearing on it.
- The definition given under the present 1951 Convention Relating to the Status of Refugees needs to be amended keeping into consideration the current scenario going on in various parts of the world.
- In the absence of Regional Convention in South Asia and also absence of national laws in countries of this region there is a need that refugee rights groups from South Asian Region must join hands and raise their voice on a regional platform.

- There must be need of some amendments in the Foreigners Act, 1946. Section 2(a) defines foreigner which only states that a foreigner is a person who is not a citizen of India.
- A coordinated effort should be made on the part of Central Government of India, UNHCR and various other non-governmental organizations for protecting the rights of refugees.
- Government can also think to establish a separate department that will deal with the issue of refugees in India. The procedural requirements can be simplified in context of providing them long terms visas etc.

MEN'S SEXUAL HARASSMENT AT WORKPLACE: AN EMPIRICAL STUDY

-Ms Amrita Rathi* & Mr Nishant Tiwari**

INTRODUCTION

Sexual harassment is a blasphemous act of encroaching into a person's private space and exploiting him/her in any manner possible, or embarrassing such person with lewd remarks so as to lead or result to forced sexual intercourse or any favors connected or incidental thereto.

It is not only a derogatory act, but also makes a person feel utterly violated and humiliated. Darkest of all shades, this act leaves a touch with the victim that doesn't go no matter how much rubbed, doesn't lessen no matter how much scratched, and doesn't revive no matter how much mollified it is a malpractice that slowly blemishes the day with the pall of gloom, just like the drop of ink stains *muslin*.

Violative of a hundred rights, as many as we can state, above all, it violates the dignity of a person. It is this when the victim would clench his fists and wish for it to revive. It would be this when he would beg the time to take recourse for once in the history, and sweep back the instant memories. It would be this when no matter how dark the night is, the mind is always darker. It is this when no matter how much vibrant the world is, a *Ravana* still comes into being.

It has been now since time immemorial that sexual harassment has been directly associated with ladies, and men are considered to be the aggressors. The concept of gender neutrality was introduced. Reservations for women were booked in the government institutions and the employment sector. Gender equality includes protection from sexual harassment and right to work with dignity, which is a universally recognized basic human right. The common minimum requirement of this right has received global acceptance.[1]

As Rick Bragg rightly quotes, *"every life deserves a certain amount of dignity, no matter how poor or damaged the shell that carries it is."*

But with the advancement of time, the protection meant for safety has begun to be misused. As the feminism took over the world, the essence of making laws for the defense of women started turning into laws for suppression of men. The idea of feminism spread like wildfire to the

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1. State of Vishaka v. Rajasthan, (1997) 6 SCC 241

farthest corners of the world, and the initiative of adulteration of its objective was enthusiastically taken up. Ignorance is bliss, they say. But too much knowledge is no less a fatal thing either.

"Beware of false knowledge; it is more dangerous than ignorance."

–George Bernard Shaw

With the rise of pseudo-feminists, the tables not only turned, but toppled upside down. The balance didn't only come at par, but broke with the shackles of misinterpretation and malicious demands. The justice took another turn. The itinerary of legal system changed. The slogan of "bringing women at par with men" was not the motto anymore, but *"bringing women at power"* was.

In the growing demand of empowerment of women, so that their security is not threatened in the workplace, the Sexual Harassment Act, 2013 was enacted that laid down penalties and safeguards to assure the well-being and welfare of women at their workstations. Apart from defining in black-and-white as to what 'sexual harassment' is, the Act also outlines what is tantamount to any such Act, also chalking down the proper meaning of the term 'workplace'. Now that Act, as the snubs of time corroded its shiny crust, revealed its rough scorching mantle, that if not covered anytime soon, would start flaring up the safety of men community of this nation. And so it happened, the judiciary got all the more burdened with the cases. Initially with the intent to seek aid from law, but later, to seek ulterior motives when men don't budge to the demands. Acts such as this, in the garb of protection to the women, practically in an implied manner defy others the basic right of being 'presumed innocent until proven guilty.'

It is the result of such developments that today in the eyes of law, only dignity of a woman amounts to chastity, dignity of a man means nothing. Not only as a form of sex discrimination, but as a weapon to avenge the mistakes of the past, sexual harassment of men has become one of the biggest unsaid tyrannies of the century.

Roberta Chinsky Matuson[2] has rightly so highlighted the problem, *"Many people mistakenly believe that harassment is limited to females only."*

The immutable statistics just hint at how gruesome the problem has gotten. The PEW Research

2. Human Resource Expert, Florida, United States

of 2014 shows that 25% of women and 13% of men have faced sexual harassment even when online.

By this paper, empowered by deep research and empirical studies, the writers aim to bring into light the urgency of a gender-neutral legislation to protect the dignity of even men from sexual harassment- a vindicatory, inhibitory, and heinous crime in the present era.

MEANING OF SEXUAL HARASSMENT

The definition of 'sexual harassment' has been stated in the Sexual Harassment Act 2013, in line with the Supreme Court's verdict in the Vishaka case, wherein it has been stipulated to be any unwelcome sexually determined behavior (expressed/implied) such as physical contact and advances, demand/request for sexual favors, sexually coloured remarks, exhibiting pornography, or any other unwelcome physical verbal or non-verbal conduct of sexual nature. [3]

CAUSES OF INACTION OF MEN:

Probing into the causes of abuse and the factors that coax the male community to stay silent about the constant blaring violation of their private space and dignity, some of the flagrant ones have been enumerated below:

1. Social Stigma:

Since time immemorial, men have been hailed to be the torchbearers of the traits of valor, power, domination and authority. These characteristics of a "true man" have instead started trampling their rights instead.

First, we progressed from a male dominant society to a comparatively moderate society on the principles of equity. Then we brought the males and females at par with each other. And then the privileges started transitioning into prejudice. In the Indian society, boys are taught not to cry, because a scientific act of releasing toxins is somehow equivalent to exhibit weaker nature of a man. The folkways have had it, a man was always capable enough of protecting his dignity by himself, while the women always needed a man's support to ensure her protection. This notion was aggravated to such an extent where all the possibilities of a man's security getting vulnerable ended. The tunnel was closed, and the "protector" was left susceptible to the unanticipated attacks in the dark.

That today has grown to be a misconception with its oxytocinic roots spread deep into the

3. Section 2(n), The Sexual Harassment of Women at Workplace (Prevention, Prohibition And Redressal) Act, 2013.

societal mentality, where now a man simply cannot be sexually abused. That's not an entrusted belief, that is, rather a pragmatic legacy that is not to be questioned.On the contrary, if a woman accuses a man of sexual harassment, even without any proof the world stands by her believing that this must be so. This is a practical example of the social labelling theory purported by the sociologists in the 1960s.

Just as similar case was of Swaroop Raj, a Genpact Executive who committed suicide over allegations of sexual harassment.[4] He was facing the charges of sexual harassment and without even anything being proven he was socially labelled as a man of corrupt demeanor. He was expelled from his office on the pretext of the case being investigated. The last line of his suicide note stated, *"I am going as everyone will look at me with that eye even if I come clean."*

2. Familial factor

More often than not, the generational gap is so potential amongst the two peer groups that genuine understanding is taken over by the societal pressure of fitting their kinsmen into the predefined brackets of "gender roles". On the contrary, at times this humiliating thing is taken sarcastically by the members of the family. The harassment naturally makes the victim feel humiliated. Then the lax remarks add onto the feeling of disappointment and frustration. This leaves the victim helpless and he keeps bearing all of it.

If the male is married it becomes all the more problematic for him to complain about the issue. The main reason being that there are already properly implemented laws for the sexual harassment of women but none for man. so in case a male does that and the woman accuses him of being sexually assaulting in return, it would not be him who would be at stake but his family. It would shatter into tiny pieces and he would be bitterly distances from his kids. The Hindu Minority and Guardianship Act, 1956, as it is presumes wives to be better custodian of the children, this complaint would add fuel to the fire by maligning his character.

Also, it is possible that the victim is being sexually harassed by the aggressor on the pretext of not harming his family. To save his family's disillusioned *prestige* and *image* in the society, the person decides to suffer through all of this alone. Or it is possible too that the aggressor threatens the victim to agree for sexual favors or else the family would suffer the consequences in terms of false criminal cases or fabricated allegations. All these cases successfully seal the conscience of

4. indiatoday.in/india/story/top-genpact-executive-commits-suicide-in-noida-over-accusations-of-sexual-harassment-1413409-2018-12-20 Accessed pn September 26, 2019

the victim and he decides to self-immolate his dignity for the well-being of his loved ones.

3. Legal hassle

In such a populated country such as India where there is an acute shortage of judges, despite the legal system working on its toes, the desired disposal rate of the cases is still an ideal situation to be achieved. A small case takes a couple of years to be finally decided.

On top of that, the right of judicial remedy (the right of appeal to the higher court) has been grossly misused and there is a grave possibility of the case being lingered on for a decade or so. Often being the sole bread-earner of the family, a man would never readily engross himself with such inscrutable legal proceedings, impliedly subscribing to the Court membership for a minimum of couple of years.

Where he tries to go ahead and file a suit, there most probably the first truck that he gets in his way is the police. There have been instances when the police have refused to lodge cases at once. They have even turned cold-shoulder to the most grievous of complaints, by asking such demeaning questions that would upset the sufferer in return, and to save such embarrassment he would not approach the protectors of justice' at all. They often turn despotic in tendencies.

Not only them, but the cross-questioning in the courts where instead of dispensation of justice, some advocates strengthen their case by taking off-guard the opponent's mental will of fighting and reducing his already-vulnerable personal life to shreds in front of public also makes the victim refrain from seeking legal help.

4. Financial favors

India is a developing nation and the first odd that it is tirelessly fighting against is the widespread poverty. Under the umbrella of unemployment, the more complications are faced by disguised labor and underpaid ones. Due to insecurity of job, or the scope of getting paid or promoted, a man is lured into enduring this mental torture with the semblance of searing grief but generous well-being of his family. He gets into believing that every cloud has a silver lining. And with the passage of time, reduces himself just to become a sex-object for someone at the workplace, while questioning his own self-worth.

5. Gender-biased laws

Talking specifically about the legislations in India, they are mainly connected or incidental to the time when the society was staunchly patriarchal and the women had no rights to safeguard their self-sufficiency. Right to the present 21st century, the laws are still based on that notion that

men always are the wrongdoers. This on the other hand gives blaring powers to the women counterparts, which have been so protected and sealed, that they have started suffocating men's rights in return.

For example, until the striking down of Section 497 of the Indian Penal Code, the offence of adultery was punishable only for the men. An adultery committed by the women wasn't legally guarded for, until and unless a bench led by the Former Chief Justice of India Dipak Misra struck it down. Personal laws although are always preferred to be left untouched and are not normally tampered with but they provide a completely different set of conundrums for the men to deal with.

To quote one, under the Hindu Adoption and Maintenance Act of 1956, the daughter is entitled to get maintenance until she gets married while the son is entitled to get maintenance only until he acquires the age of 18. Even under the Special Marriage Act, secular marriage legislation, only the wife can claim permanent maintenance and alimony, but not a man. Also, under the provisions of Section 375, only a male can be accused for the offence of rape. There is no provision for prosecuting a woman who blackmails a male into the practice until her satisfaction is sought.

For instance, in 2018, a married man committed suicide after finding himself helpless due to being constantly pestered for sex by his co-worker. She was constantly demanding him to enter into an illicit relationship, on the failure of which she would lodge a false criminal case against him.[5] His body was found hanging from his ceiling fan on Monday morning and the hand-written note that he left behind narrated the plight of that poor man.

With such gender-biased laws, the law, instead of appearing as a 'resorting' option, acts as a 'restrictive' option for the aggrieved. Instead of inspiring him to be an icon, rise against the injustice, it tacitly intimidates him to strangulate his right to life and survive in injustice.

'Savior' for one, 'Satan' for the other: The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013

Enacted in consonance with the Convention on Elimination of All Forms of Discrimination Against Women (CEDAW),[6] this act could be justifiably called the most potent propagator of tyranny of falsified cases by women on the men community. Taking into account the women

5. https://www.timesnownews.com/mirror-now/crime/article/married-man-commits-suicide-as-he-was-continuously-sexually-harassed-by-co-worker-in-maharashtra-metoo-stories-metoo-me-too-stories/299937 Accessed on September 26, 2019
6. Ratified by Government of India on 25-06-1993.

community in specific, the act in order to provide them a safe atmosphere of work provides such a pampered cushion that it doesn't leave a room for exercising of rights by their male counterparts.

First and the foremost, it defies the basic structure of the Indian Constitution enshrined under Article 14 wherein the suprema lex guarantees equality before law to all the people in the territory of India regardless of religion, race, caste, sex, or place of birth. Although under Article 15(3) the Constitution also states that special provisions maybe made for women and children by the Indian Parliament, but certainly by the clause the Constitution-makers meant not at the stake of someone else's rights. The law vouches for the principle of equality, but the doctrine of equity in itself has sprouted the concept of law and justice. Therefore, any principle against equity must be taken to be against the real motive of introduction of law in a state. This act, proving to be one such instrument of colorable legislation, is not at all gender-neutral, to start with. It provides security against sexual harassment only to the women, not the men. Anyway due to the societal barriers a lot of men hesitate to bring such malpractices against their will into light but this act totally wipes off the scope of any such complaints only.

Taking into consideration the Synovate Survey by the Economic Times, the staggering figures of sexual harassment serve as a blaring alarm of the dire need for men to be included in the ambit of laws against sexual harassment. Out of the 527 people who participated in the survey[7] , 19% people admitted to having been sexually assaulted at office. In Bangalore, 51% of the respondents agreed to have been harassed sexually, while in Delhi and Hyderabad the figures rose up to be 31% and 28% respectively. In totality, 38% of the respondents around these seven cities vehemently agreed upon the fact that 'men are just as vulnerable to sexual harassment just as women.'[8]

Further, the Internal Complaints Committee and Local Complaints Committee which find mention under Section 4 and 7 of the Act are blind towards the rule of *nemo in propria judex esse debet* i.e. the rule against bias. It is a doctrine of common law system that bars any party having any personal/pecuniary/proprietary/departmental interest/bias in the case from being a judge in that particular matter/case. As per Sections 4(2)(c) and 7(1)(c), it is mandatory to appoint in such

7. The survey was territorially limited to the seven metropolitan cities of Delhi, Chennai, Bangalore, Mumbai, Pune, Kolkata and Hyderabad.
8. <http://www.lawctopus.com/academike/sexual-harassment-workplace-prevention-prohibition-redressal-act-2013-critical-analysis/> Accessed on August 02,2016

committees the members from any such NGOs that are committed to the "cause of women".

No further detailed analysis of the qualifications has been provided as to what cause or what particular field of working. This would definitely be detrimental to the interest of the defendant party because any such member would be emotionally/professionally inclined towards the traditional notions, forever holding that it is always the man who is the aggressor. "If members of the committee of the adjudicatory committee are to be committed to an ideology, there mental frame will be such that it would give an opportunity for unwelcomed bias and their finding also will be in resonance of their personal commitment."[9]

There is no provision that maintains that there must be an appointment of a person who is 'expert in the field of law'. Only terming 'versed with the knowledge of law' opens up the situation to a plethora of interpretations. Further, roping in non-judicial bodies such as NGOs only aggravates the chances of breach of confidentiality, which is a fatal thing to happen in such sensitive issues involving the image of the man.

Therefore, to sum up, it can be concluded that this Act has marred the basic provisions of rule of law in the country by giving unreasonable power to one community over the other.

EMPIRICAL SURVEY- THE RESULTS[10]

Territorial Limits: India

Positive: 12/50 men face sexual abuse

There was an empirical survey conducted by the authors to verify the violating act of sexual harassment of men and reactions to such demeaning act. The authors sent a questionnaire consisting of 13 questions to 50 respondents (all males) within a stipulated time period. All people are from different occupations (in order to verify if sexual harassment prevails over all the major professions in India or not). The frightening results that were received have been stated below:

Question 1: Name (Optional):[11]

This question served dual purpose:

1. By not making it compulsory for the respondents to mention their name or email

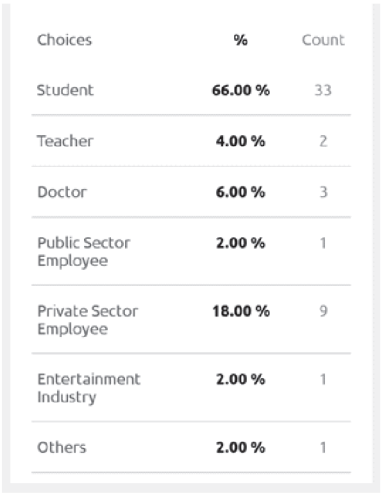
9. M. Pallavi Jane Periera, "Sexual harassment at Workplace in India, Medico Legal aspects", 36 Journal Indian Academic Forensic Medicine (2014).
10. Attached to the Annexure-I
11. *Ibid.*

addresses, the survey gave them a security blanket of their identity not being revealed anyhow.

2. It impliedly chalks out the current scenario regarding the acceptability and openness of the aforementioned heinous crime with respect to men, tacitly telling us the tolerability of such crime in the society and normality/stigma attached to it.

Question 2: Occupation (Required):

The people who participated in this survey belonged to the following fields:

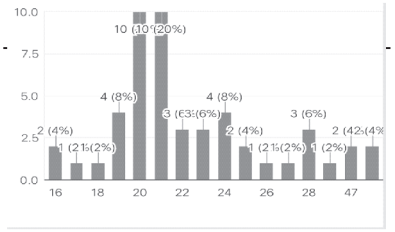


Choices	%	Count
Student	66.00 %	33
Teacher	4.00 %	2
Doctor	6.00 %	3
Public Sector Employee	2.00 %	1
Private Sector Employee	18.00 %	9
Entertainment Industry	2.00 %	1
Others	2.00 %	1

1. Scholars from different arenas of education
2. Academicians
3. Medical experts/practitioners
4. People employed in the public sector of India
5. People employed in the private sector in India
6. Entertainment industry
7. Miscellaneous

The authors assert that the respondents were wantonly not divided uniformly according to their professional background to minimize their intervention in the survey. It went unbridled to the most random people to get a fair idea of the prevalence of the malpractice. By keeping the respondents consistent in representation from different fields, the authors were afraid that would hint at curtailed contamination of the survey, which would negate the entire efforts of the study.

The authors acknowledge that maximum respondents belonged to the student's category and it is grief-stricken meeting with the fact that at this tender age of growing and maturing, nearly 40% of the students had to undergo the torment of facing sexual abuse in their lives. This is not only saddening, but also threatening for the upcoming generation as those who are today the victims, will vent out this frustration tomorrow. This ditches the society into a fatal vortex of anarchy and doom.



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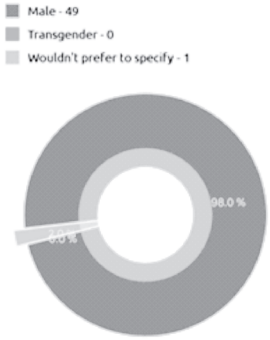

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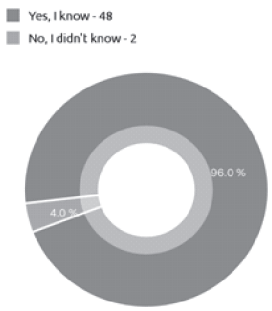

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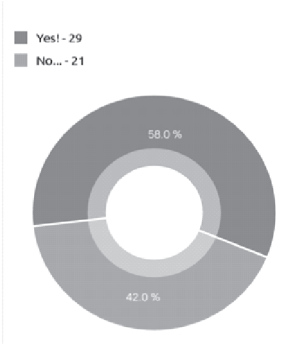
QUESTION 3: YOUR AGE? (OPTIONAL)

Peopleinvariably from a wide age group participated in the survey with no bar at all. Believing

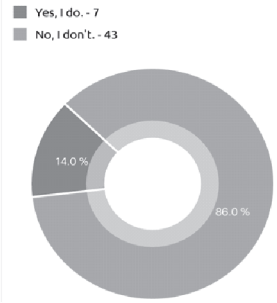
QUESTION 6: IS CASH (COMMITTEE AGAINST SEXUAL HARASSMENT) FUNCTIONAL AT YOUR WORKPLACE/CAMPUS? (REQUIRED)



As per the Sexual Harassment Act of 2013, the formation of committees against sexual harassment has been made necessary at every workplace for the utter protection of the females at their respective places of work. Even though no provision mentions taking the male counterparts into account, and the committee would lend their precious time of enquiry only for the females, it has failed even to keep them safe, let alone the males.

When asked about its existence and efficiency at their respective workplaces or campuses, the respondents got fairly divided into approximate proportion of 50% on each side, which means that every institution/workplace still doesn't have CASH.

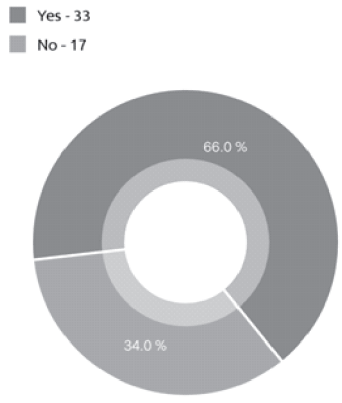
QUESTION 7: IF YES, ARE YOU AWARE OF ANY COMPLAINT THAT WAS INSTITUTED WITH THE CASH? (REQUIRED)



Providing an insight into its fructitiousness, we get an inkling of the productivity of such CASH.

As per the figures obtained, it can be fairly deduced that many people have no idea of any case solved by the CASH or any case instituted with it.

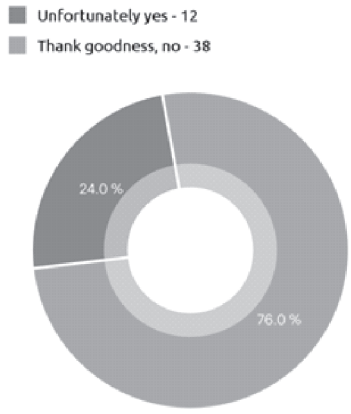
QUESTION 8: HAVE YOU EVER HEARD ABOUT SEXUAL HARASSMENT OF MALES AT WORKPLACE? (REQUIRED)



When asked about this pertinent unspoken issue that still lingers in shade today, the response highlighted the muffled shrieks of men community from underneath the societal pressure and worldly labels.

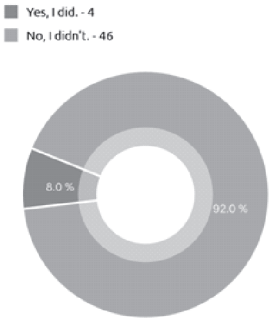
Out of 50 people, a staggering 33 number of males are acquainted with the existence of this problem but the law still chooses to ignore it.

QUESTION 9: AS A MALE, HAVE YOU EVER FACED ANY SEXUAL HARASSMENT BY A MALE/FEMALE HEAD/COLLEAGUE/MATE AT YOUR WORKPLACE/CAMPUS? (REQUIRED)



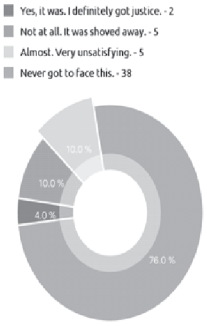
As per the survey, out of 50 men, 12 responded positive to having faced the blatant violation of self-possession. That is a defending percentage of 30 out of 100, and would definitely increase as the student body passes out and starts working in the corporate or the private sector, until the archaic laws change, the notions change, the tables come at equity, and along with the reservation at different levels, the women share the burden of liabilities that men do,

QUESTION 10: IF YES, HAVE YOU COMPLAINED ABOUT IT TO ANYBODY? (REQUIRED)



The gender barriers have always prevented men from telling about such horrendous experience to anyone else.

In previous times the reason was that no one would understand. Today, no one wants to understand. The times have changed, the reason hardly has. Out of 50 men, only 12.5% reported this infringement of rights to their peers or kinsmen, others just gulped down the worng done to them and moved on.

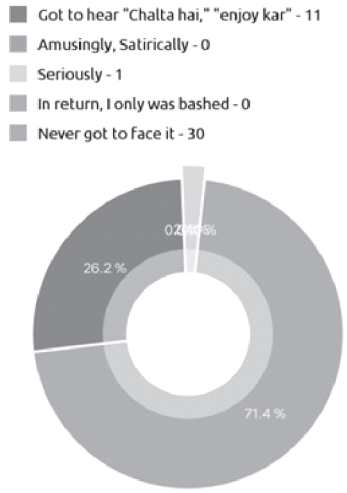


QUESTION 11: DID THAT COMPLAINT EVER GET REDRESSED? (REQUIRED)

For the people who stood up for their rights and merely demanded to be looked upon as a 'human', were rewarded by laughing upon and ignoring the complaints.

Is that what the society has reached to? Are we running in a vicious circle of exiting from the state of nature to protect the rights of man, and then shredding every right into finest fabric so as to return to the state of nature.

The massive figure stated alongside display the number of people who got justice out of the people who faced sexual harassment merely 2 out of 12, which means every 10 men go to bed with the guilt of having been touched inappropriately. Every day 10 out of every 50 men get their day ruined by the choking clouds of helplessness, but the thick dark clouds of lawlessness wouldn't tear apart.

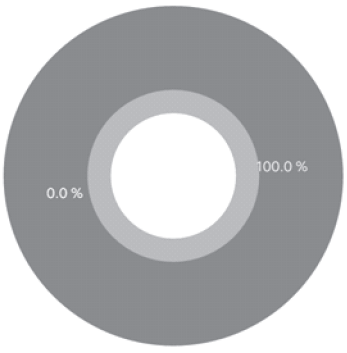


QUESTION 12: HOW DID THE PEERS AROUND TAKE THAT NEWS?

It was always in the theory that the complaints of men being sexually harassed was not taken seriously but the statistics prove the hypothesis so true. With remarks as cruel as *"enjoy"* or *"lucky guy"*, the victim feels all the more suicidal and depressed. Well, this is understood that with his/her dignity flung into air by someone else for some momentary pleasure, does make a person feel dishonored.

This brings into light the sad state of mentality that we have in our country today. A country where by the virtue of being a "man", "dignity" automatically gets eliminated from the itinerary. He also, by the virtue of being a "he", is not entitled to feel the pain or be sad, because he is a "he" and "he" must be therefore equivalent to a skeleton alive who doesn't feel anything.

Such thinking has to be changed and that can be done in the preliminary institutes and schools, wherein the teachers frame basic mindset of children. Compassion can't be bargained for. Inculcating mutual respect and empathy for everyone irrespective of genders and sexuality, will indeed make the circumstances better.



QUESTION 13: DO YOU THINK WE NEED GENDER-NEUTRAL LAWS FOR SEXUAL HARASSMENT NOW? (REQUIRED)

Finally, we had it asked out of *'Yes'* or *'No'* if the males feel a need for a gender-neutral law for men regarding sexual harassment in the 21st century now. Unsurprisingly, all the responses indicated one main thing: the vulnerability and insecurity the men face that makes the need of gender-neutral

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The Report of 172nd Law Commission, which recommended that laws such as that of rape shall be made gender-neutral (both for the victim and the offender) must be incorporated into law of the land. The report of Justice Verma Committee suggested neutralizing the law but only for the victim, not the offender, which the aimed to keep gender-specific. Even that wasn't adopted by the Indian Parliament.

The horrifying *Nirbhaya* gang-rape case opened doors to some significant amendments in the criminal law. The laws regarding acid attacks, disrobing a woman, sexual harassment, stalking, trafficking, and voyeurism[12] - all of these gender-specific except the laws related to acid attack.[13] This amendment, in the garb of progressing, is petrifying. It doesn't only presume that men are the only wrong-doers, but also that their safety doesn't need legal sanction. That they can't be attacked at and they can defend themselves. This is blasphemy to the sanctum sanctorum of the Indian Constitution- the fundamental rights of the citizens under Article 14 and 19 and and duties of the state, which dictate the State to take all the steps for development of its citizens and providing them means for them to achieve excellence in all spheres of life.

SUGGESTIONS

1. **Constitution of special courts to deal with sexual harassment of men and women as a whole:** Judiciary has customarily advised the formulation of special Courts, like Special Courts for women, youth, and SC/ST, wherever it so deemed necessary. Vide the power vested by the Indian constitution with the Indian Parliament under Article 323-B, new tribunals must be constituted for the adjudication of the disputes for men and women equally without any bias or prejudice.

Being a court of special nature, whose aim would be to deal with the intricacies of the matter dealing with the accused's character, reputation, custody of children, this court should be given the power to evolve its own rules of procedure. It must be advised to stick by the rules of Civil Procedure Court in the normal course of action, but be flexible enough so as to deal with peculiar matters in a different manner. This would allow a holistic inspection of the matter and would ensure proper disposal of the cases with no haste, parallely lightening the burden of the traditional courts.

2. **Increasing the legal fraternity in the courts:** In order to ensure speedy disposal of cases, not only an increased number of benches are necessary, but what is more important is an elevated cap on the limit of judicial fraternity. More division of labor would guarantee better facilitation of justice. But the irony is that we face an acute shortage of judges.

There are still a large number of vacancies in the subordinate judiciary, being 5,924 as on December 31st, 2017.[14] 24 High Courts have 406 posts vacant, whereas Supreme Court has 6

12. The Criminal Law Amendment Act , Section 354 (2013)
13. The Criminal Law Amendment Act , Section 326 (2013)
14. Ministry of Law and Justice, Government of India, Annual Report 2017-18, 109.

vacancies. The total vacancies, thus combined, are of 6,160 judges. Former CJI T.S. Thakur lamented about the "inaction of government on not increasing the number of judges present from 21,000 to 40,000" to handle the "avalanche in litigation. You cannot shift the entire burden on the judiciary," he complained to the Prime Minister. Increasing the number of judges from 10 per 10 lakh people to 50[15] is an urgent need, he reiterated.

Even the present Chief Justice of India, Mr. Ranjan Gogoi has written to Sir Prime Minister bringing into his attention the crippling effect the inadequacy of the workforce is resulting into. He advised raising the retirement age from current) 62 years to 65 years. Quoting that presently there remains a backlog of 58,669 unsolved pending cases with the judiciary, the Prime Minister must also consider tenure appointments of the retired Judges (of the Supreme Court and the High Courts) under Article 128 and 224A of the Indian Constitution to deal with the huge chunk of cases comparatively with ease. [16]

3. **Make the laws gender-neutral:** The society today has reached at the intersection of equal rights for men and the women. It is time to limit the excessive powers on both men's and women's parts and ensure a balanced state of affairs. This is the zenith of the equilibrium that the legal system and democracy were looking for. Now, after the communities have come at par, the laws must come at par too. If it gets late anymore, the society would steeply fall back into the state of nature. And the increasing number of suicides amongst males is a clue of the same awaiting calamity.

Male suicide at workplaces equates to 4 times more than that of women. Moreover, in 2015, as per data released by the National Crime Records Bureau, a whopping number of 1,33,623 suicides were reported across India, out of which 91,528 (68%) was solely constituted by men, while the women constituted only 32% of the entire record.

Approximately 77 countries, including the United Kingdom, Australia, Denmark, and the United States, have taken a step forward to safeguard human rights by turning all the laws into a gender-neutral state.

What is even more heart-wrenching is the plight of male inmates in the prisons. The People's Union of Civil Liberties states that way back in 1981 in the Tihar, as soon as there entered a young boy, the prisoners would bid up on him. The price was paid in terms of 'bidis,' 'soaps' or

15. Law Commission 1987.
16. June 23, 2019, Page 2, The Hindu

addiction such as 'charas'[17].

India, on one hand desiring to leave its mark at the United Nations and the Security Council, on the other hand is not ready to let go of the clutches of the Victorian laws.

The ambit of gender-specific laws should be broadened to turn them into gender-neutral laws. This would not only serve better the purpose of democracy, but would also warrant the rule of equity.

4. **Ensuring stricter guidelines for the media:** Media is often referred to as the fourth pillar of democracy, owing to the crucial role that it plays in mass-communication and bringing to life the spirit of democracy. But such a powerful source, when gets absolutely unbridled, in the absence of limits can lead to some serious irreversible damage. In the influenceof the air of westernization, media has often needlessly portrayed men as Casanova, easy-going beings who have no feelings and can be trodden as and when needed.

The Save Family Foundation revolted against the same idea of portrayal of men and sent a complaint to the Advertising Standards of India against the Kitply plywood commercial in which the wife slapped her husband because of the creaking bed. The foundation alleged that terming "violence" as "fun" was not justified.

Following the suit, *Indiya Kudumba Pathukappu Iyaakam,* a Chennai-based organization filed two similar complaints: one against a Pond's ad commercial where men were portrayed as terrible wife-beaters, another against the ICICI Prudential Insurance that insensitively displayed verbal and economical abuse against men.[18] From making trolls and memes out of every sensitive and grave situation, men are mocked at on the social media platforms and advertisement plates which makes them an easier target to violate the integrity of, without having to pay much in return.

The gravity of the situation can be better understood with the same ads but reversed roles. Such distorted social message when sent across, simultaneously also fits into the mentality of the people that men can be slapped or beaten up anytime anywhere as they are the only delinquents in the society. This sternly only petrifies men to raise questions about the objectionable touches

17. The Tribune Accessed on September 26, 2019 https://www.tribuneindia.com/news/comment/institutionalise-prisoners-conjugal-visits/790734.html.
18. September 16, 2008, DNA India, https://www.dnaindia.com/india/report-men-s-groups-want-offensive-ad-off-air-1190494 Accessed on September 26, 2019

they are subjected to. Therefore, strict and like guidelines must be maintained to keep media under control.

5. **Efficient hand-in-hand functioning of the judiciary and the legislature:** Lastly, in India we have independent branches of legislature, executive and judiciary, but on the contrary, serving as a purposeful benefit of the parliamentary system of democracy, these don't work separately as water-tight compartments unlike the machinery of the United States of America.

Therefore, in order to deal with the issues of gender-neutrality in a collaborative manner, not only the legislature needs to maintain a modern well- equipped approach of the emerging problems, but an effective judiciary exercising a fair right of judicial activism is just as important. This blend of neutral legislature and impartial judiciary will lead to upliftment of the present dull condition of men in the arena.

CONCLUSION

Sexual harassment is a harrowing crime that doesn't only affect the physical state of a human being but even his mental peace. It is just equivalent to mental torture if the circumstances are properly calculated. Dignity ain't defined by the gender or sexuality; it is defined by the character. And to uphold and safeguard a person's character is the state's foremost duty. Protection by laws is important, but above that is character, and that is an endeared constituent of a human life.

This is the need of the hour that men be included under the legislation prohibiting sexual harassment at workplace to fairly enjoy their right of protection under the state's legal system. And only changing legal provisions wouldn't be enough, but changing mentality would be the end of it. Opening our thoughts to the fact that 'it is not always the male who is the wrongdoer' and entertaining the truth that 'a woman can be the aggressor too' would help us not only grow as a community, but as a country as a whole.

As has been put by Nicole Kidman rightly into words, "imagine a bold plan for a world without discrimination, in which women and men are equal partners in shaping their societies and lives. Let's picture it!"

The acts such as this, whether done by a man or a woman, are as equally as heinous as they make an individual question his/her self-worth, which is quite demeaning in nature. It is high time that we look past the ascribed gender roles to us by the society, come together, share the grief, acknowledge that all of us are made from flesh and bones, we all have emotions and it is okay to cry, to vent it out. And when this happens, we would truly take the first step towards acceptability. Rest, as they say, death with dignity is better than life with humiliation.

MISSING DISCOURSE ON TRIPLE TALAQ AND DEBATE ON MUSLIM WOMEN (PROTECTION OF RIGHTS ON MARRIAGE) BILL, 2019

- Ms Meena Kumari*

"Men think themselves superior to the women, but they mingle that with the notion of equality between men and women. It's very odd".

Jean Paul Satre

INTRODUCTION

The Supreme Court in ***Shayara Bano v. Union of India***[1] declared the triple *talaq (talaq-a-biddat)* unconstitutional and void; further instructed the government to legislate a law with this respect. Thereafter the government had struggled to enact the law which ban and punishes the pronouncement of triple *talaq* in any form. For the first time on December 28, 2017, the then Law minister introduces the bill in Lower house of parliament, which was passed by it but remain pending in upper house of parliament. Later on three Ordinances were promulgated (on Sep. 2018, Jan. 2019 and Feb. 2019) to provide immediate relief to Muslim women.[2] On Jun. 21, 2019 bill was introduced in Lok Sabha, on Jul.25, 2019 bill was passed by Lok Sabha and on Jul. 30, 2019 bill was passed by Rajya Sabha; thus on July 30, 2019 Muslim Women (Protection of Rights on Marriage) Bill, 2019 was passed by both houses of parliamen[t3] after a wrangle debate.

On August 23, 2019 Supreme Court of India agreed to examine the bunch of petitions challenging the Muslim Women (Protection of Rights on Marriage) Act, 2019.[4] According to petitioners the Act is unconstitutional as it only criminalizes what is already declared unconstitutional and void and the objective of the Act is to protect the rights of the women but it not provide any provision with regarding maintenance. This acceptance of petition again reignites the debate on the Muslim personal laws and Muslim women rights.

Although there are arguments that triple *talaq,* polygamy, *nikah halaa* etc. are tools used for suppression and oppression of women but the debate on reformation of Muslim personal laws

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1. (2017) 9 SCC 1 (India).
2. Bills Parliament, (May 10, 2019), http://www.prsindia.orgbilltrack/muslim-women-protection-rights-marriage-bill.
3. Acts Parliament, (Sep. 21, 2019), http://www.prsindia.org/billtrack/muslim-women-protection-rights-marriage-bill.
4. Bhadra Sinha,Triple talaq law to come under Supreme Court lens, notice issued to center, HINDUSTAN TIMES (Sep. 21, 2019), http://www.hindustantimes.com>india-news>triple-talaq-law-to-be-review.

generally revolves around the interpretation of Quran, freedom to profess religion, secularism, Uniform Civil Code (UCC) etc without addressing the core issues of women rights, dignity, equality, feminism and patriarchy. The discourse bifurcate the term 'Muslim women'. In all legal discourse- in judgment of the Supreme Court[5] and even the debates in the Rajya Sabha and Lok Sabha the debate is more on 'Muslim' as a religious minority community in India, rather than 'Women'referred as gender and community oriented as the term 'women' involves the feminist approach, difference between sex and gender and dominance of patriarchy.

The research article outlines the brief overview of basic tenets involved in term 'Women' and examine and analyses the ***Shayara Bano*** judgment of Supreme Court and debates of members of parliament on the touchstone of those basic tenets with special reference to Convention on Elimination of All Forms of Discrimination against Women (CEDAW), which is called the Magna-Carta of women rights.

FEMINISM

In 19th century feminism was originated and developed as a women movement. Initially the women movement raised the demand of equality with men in public sphere mainly right to vote and political equality, called the first wave of feminism based on the liberal ideologies demanding equal rights as men had.[6] After achieving the equality at outer sphere still the women was not able to get the real gender-equality, still void was there. This was not sufficient, thus the women movement enter into the second wave of feminism, demanding the equality in inner sphere of family life. According to the second wave of the feminist equal rights are meaningless unless the women enjoy the social equality, which can be realized by the revolutionary process of social change, also referred as radical feminism, which moved beyond the equal rights and gave more emphasis on gender differences in the society- sex and gender; and concept of patriarchy is the main reason of oppression of women, deep rooted in the society and causes inequality.[7] Both concept of patriarchy and difference between sex and gender is provided hereinafter. Twenty-first century see the progression of third wave of feminism, which is not concerning about women in general but a particular category of women- poor women, black women, women of a particular religion or race or region.[8] According to the third wave of

5. *Supra* note 1.
6. ANDREW HEYWOOD, POLITICAL IDEOLOGIES: AN INTRODUCTION 227 (5th ed. 2014).
7. *Id.,* at 242.
8. ANDREW HEYWOOD, POLITICAL THEORY AN INTRODUCTION 264(4th ed. 2015).

feminism it is not that all the women in general suffers the discrimination but it can be a particular group of women, sometimes of particular race or region or color. To compensate the disadvantage and discrimination suffered by them, those women require special care and treatment.

A Muslim husband has a unilateral power t dissolve marriage by pronouncing *talaq,* sometimes without any reason. No such equal right or power was conferred on Muslim women. Triple *talaq* is the innovation of practice of *talaq* emerged during second century of origin of Islam; whereby a Muslim husband may pronounce three *talaqs* in one go, even in absence of wife, which becomes irrevocable and dissolve the marriage without any scope of reconciliation and reconsideration of consequence of the decision. Thus the practice of talaq causes inequality as well as injustice to Muslim women and such women require special treatment to uphold their dignity and equality.

(a) Patriarchy

The term patriarchy was originated from Medieval Latin and Greek term patriarkhias means 'ruling father'; a mass noun referring *'asystem of society or government in which father or eldest male is the head of the family and descent is recognized through the male line*'.[9]

Patriarchy is a social system where men havethe power, control and dominance over property, political leadership and social institutions.[10] Thus it illustrates the power relationship between men and women and refers to 'male dominance' and 'male supremacy' to describe the gender relations in society.[11] It also refers towards the unequal representation and participation of the women social-public life. It is a systematic, institutionalized and persistent form of power of men.

It was argued by traditionalists that practice of *talaq* upholds the principle of equality and fairness; however it was the notion affected by the concept of patriarchy. Practice of *talaq* was not something introduced by Prophet Muhammad but was already prevailed in pre-Islamic Arabia. It is evident that the attitude of people towards practice of *talaq* was affected by the cultural and social conditions of the society. Early Arabs were among the most violent peoples and such culture of violence affected both men and women; therefore generally men were the accused and the victims of murder, war and revenge but the burden of such violence was suffered

9. Meaning of patriarchy in English, (Sep. 22, 2019) https://www.lexico.com/en/definition/patriarchy.
10. Patriarchy, (Sep. 23, 2019)https://en.wikipedia.org/wiki/Patriarchy.
11. *Supra* note 6, at 231.

by women as transformed into the mean of entertainment for the surviving and privileged men and in such environment the ratio between men and women could be approximately three to one.[12] In pre-Islamic Arabia there is no restraint on the power of the husband to pronounce *talaq* for any number of times, after the advent of Islam these numbers were restricted to three with a procedure; although still it was the prerogative of the Muslim husband. Instead of *talaq* under Islamic law *ila, zihare*tc. are the other options given to them to dissolve the marriage; however it was said that *khoola* provides the right to the Muslim women to dissolve the marriage but in fact it is ultimately the decision of the husband to accept and agree to take compensation to pronounce the *talaq* on wife. Ultimately it is the husband who has to pronounce the *talaq.* No such equal rights were given to the Muslim women. It shows the male dominance and supremacy over the women. It is the systematic and institutionalized oppression of the Muslim women under the patriarchy system.

(b) Sex and Gender

On the basis of above arguments the simple question is why a Muslim woman not given the equal right to utter *talaq.* There is no provision in *Islamic* law enabling a married Muslim woman to obtain divorce, except *khoola* to some extent. In India under British rule in 1939, The Dissolution of Muslim Marriage Act, 1939 provides this right to Muslim married woman by filing an application for dissolution of marriage on certain grounds.

What is the difference between the Muslim men and women, whether she is not able to utter this word? The difference lies in the difference of gender and sex. Sex refers to the biological anatomy and has no social and political significance. Anatomically there is only one major difference between man and woman and that is the reproduction ability of woman. Except this the other differences refers the gender having social, political and economical significance. These gender differences are structured and constructed by society (male dominated),[13] it is right to refer this society a patriarchy society. According to patriarchs, gender division prevailing in society is natural[14]; but in fact it is constructed by them like what a woman should wear, eat and behave, pink refers to women blue to men, how many children and at what time etc. not refer to any natural difference but sociallyconstructed difference.

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12. AHMED E.SOUAIAIA, CONTESTING JUSTICE 50 (2008).
13. *Supra* note 6, at 231.
14. *Id.,* at 233.

(c) Approaches of gender justice

There are two main approaches of gender and inequality- sameness and difference approach.[15] According to sameness approach women are same as men, same standard should allotted to women and uphold that men and women are equal before law. Catherine criticized the approach as the standard of equality was the men, scale is men, women is compared with men- refers the male dominance in scaling.According to difference approach sex is the point of differentiation.[16] A woman requires special provision and treatment because of difference of biological anatomy of man and woman. Women should be treated differently (undercover perception may be because women are frail and weak require protection). Catherine criticized this approach as the women are measured at the standard of men. This approach involves a protectionist attitude rather than providing substantive equality.

A new approach of corrective treatment is adopted to provide equal and fair treatment to the women, where women are considered as historically deprived group.Before drafting any legislation or even judgment this approaches and concepts require attention to understand the basic problem from women's sensitivity.

EQUALITY

There are various forms of equality- legal, political and social equality. Conceptually there are two types of equality- Formal and Substantial equality.[17] Legal equality is the key expression of the formal equality i.e. equality before law and equal protection of law.[18] Law treats all equally irrespective of their caste, color, race, gender etc. Article 14 of the Constitution of India titled 'Equality before Law'[19]. Thus, it guarantees formal equality- equality before law. The Formal equality is about the nature of dealing rather than the result of dealing. The test is persons situated similarly should be treated similarly; thus the equal treatment should be given to those who similarly situated and not to persons who by reason of historic and systematic discrimination cannot recognize as similarly situated.[20] On the other hand substantive equality not concern with the equality before law but it considers the discrimination and inequality

15. CATHERINE A. MACKINNON, FEMINISM UNMODIFIED DISCOURSES ON LIFE AND LAW, 32 (1987).
16. *Id.,* at 33.
17. *Supra* note 8, at 270.
18. *Id.,* at 271.
19. INDIACONST. art. 14.Art. 14 provide that the State shall not deny to any person equality before the law or the equal protection of the laws within the territory of India.
20. RatnaKapur, Un-Veiling Equality: Discipling the 'Other' Woman, in ISLAMIC LAW AND INTERNATIONAL HUMAN RIGHTS LAW SEARCHING FOR COMMON GROUND 267 (Anver M. Menon et. al. ed., 2012).

suffered by particular person[21]; thus provide special treatment- equality of opportunity and equality of outcome. The idea is to remove the impediments in the way of the personal development by providing the special treatment. Article 16 clause (1) of the Constitution of India titled 'Equality of opportunity in matters of public employment'[22].

Further Article 15 clause (3)[23] of the Constitution of India empowers the State to make special provisions for women and children and thus provides an example of substantive equality to some extent.

The CEDAW also emphasis on State parties to incorporate the equality of outcome as a significant aspect of providing substantive equality to women.

The Muslim women in India thus de *jureentitled* to both legal and substantive equality under the framework of the Constitution but de *factounder* the disguise of personal laws cannot avail any of it. These personal laws are based on the notion of patriarchy and gender differences constructed by the male dominated society.

CONVENTION ON ELIMINATION OF ALL FORMS OF DISCRIMINATION AGAINST WOMEN (CEDAW)

United Nations General Assembly on Dec. 18, 1979 adopted Convention on Elimination of All Forms of Discrimination against Women (CEDAW)[24], which came into force in 1981 as an International treaty after ratified by the twentieth country. It is referred as milestone in women right movement.[25] It is instrumental in bringing to light all the areas in which women denied equality with men.The convention upholds the objectives of United Nation and faith in elementary human rights, dignity and equal rights of men-women. It laid down the meaning of equality, how to achieve it and agenda for action by State party to it. The preamble of the CEDAW provides that"That despite various instrument, extensive discrimination against women continues to exist, Recalling that discrimination against women violates the principles of equality of rights and respect for human dignity, is an obstacle to the participation of women, on equal terms with men, in the political, social, economic and cultural life of their countries, hampers the growth of the prosperity of society and the family and makes more difficult the full

21. *Id.,* at 268-269.
22. INDIA CONST. art.16 (1).Article 16(1) provides that there shall be equality of opportunity for all citizens in matters relating to employment or appointment to any office under the State.
23. INDIA CONST. art. 15, cl.3.
24. G.A. Res.34/184, Convention on Elimination of All Forms of Discrimination Against Women (Dec. 18, 1979).
25. SUSANNEZWINGLE, TRANSLATING INTERNATIONAL WOMEN'S RIGHT THECEDAW

development of the potentialities of women in the service of their countries and of humanity"[26].

CEDAW provides the meaning of the term 'discrimination against women' as"Any distinction, exclusion or restriction made on the basis of sex…which impairing or nullify the recognition…of human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field."[27]

It further requires the State parties to condemn all forms of discrimination against women and to take appropriate means by establishing legal protection of rights of women and by espousing legislative and other measures including sanction if necessary to prohibiting discrimination to provide effective protection.[28] It requires the State parties to modify or abolish any laws, customs and practices which constitute discrimination against women.[29] Article 4(1) provides that State parties should take up temporary special measure for accelerating de facto equality between men and women.[30] CEDAW compel the State parties to take all necessary measures to remove discrimination against women in all matters relating to marriage and family relations.[31]

Article 24 of CEDAW provides that"State parties undertake to adopt all necessary measures at the national level at achieving the full realization of the rights recognized in the present Convention"[32].

India had signed the CEDAW on July 30, 1980 and ratified it on July 9, 1993.[33] India ratified the CEDAW with two declarations and a reservation.[34] Reservation is with regarding Article 29(1) of the CEDAW, which not affect the core obligation of it.[35] The two declarations affected the basic purpose of the CEDAW as it is with regarding to Article 5(a), 16(1) and 16(2). India declares that it abide by and guarantee the conformity with the provisions of the CEDAW with the policy of non-interference in the personal affairs of any community without the consent of

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CONVENTION IN CONTEXT 35 (2016)

26. Convention on Elimination of All Forms of Discrimination against Women, Preamble, Fr. India, 13 U.N.T.S. 1249 Jul. 30, 1980 (Sep. 23, 2019)https://www.treaties.un.org/pages/ViewDetails.
27. Convention on Elimination of All Forms of Discrimination against Women, Id., Article1
28. *Id.,* Article 2(b) and (c).
29. *Id.,* Article 2(f).
30. *Id.,* Article 4(1).
31. *Id.,* Article 16(1).
32. *Id.,* Article 24.
33. Status of Ratification, Declaration and Reservation, Office of High Commissioner for Human Rights (Sep. 23, 2019) http://www.indicators.ohchr.org/.
34. Madhu Mehra, India's CEDAW Story, in WOMEN'S HUMAN RIGHTS: CEDAWIN INTERNATIONAL, REGIONAL ANDNATIONAL LAW 386 (Anne Hellum& Henriette Sinding Aasen ed., 2013).
35. *Ibid.*

the community. Declaration with regarding to Article 16(1) is that India supports the compulsory registration of marriage however it is not practicable in India because of hugeness, customs, religion and literacy.[36] The declaration reveals the rooted patriarchy and cultural identity, whereby the equal rights of the women are lost. Question here arises whether the term 'without the consent of the community' involves the consent of the women or whether community involves women or it refers to male-dominant community. India has signed and ratified the CEDAW, however upholds the policy of non-interference in personal affairs, which make the effect of ratification nugatory. Gender equality become irrelevant to the discourse of personal laws.

Committee on CEDAW time to time laid down the agenda and machinery to achieve its purpose in the form of General Recommendation.General Recommendation no.28 urges the State parties to fulfill the obligation by refraining from making laws which directly or indirectly resulted into the denial of equal enjoyment of civil, political, economic, social and cultural rights.[37] This requires the obligation of means, conduct and result. General recommendation no.29 provides that the inequality in family is the basis of discrimination against women which is warranted for the sake of religion, culture and ideology. It specifically provides that State parties should guarantee equality in economic aspect during the relationship and on the dissolution of marriage and should eliminate exemptions that serve the discrimination. These are the guiding light for all State parties to adopt and acted towards equal and non discriminatory rights of women. Article 51(c) of the Constitution also requires that State shall make efforts to comply and promote respect for international law and treaty obligations.[38]

Shayara Bano v. Union of India*[39] *: The Missing discourse

It is the judiciary who serve as a torch bearer on women right. Judicial pronouncement advances the women right and equality and raises concerns against discrimination. It is not the first time that judiciary declare triple *talaq* unreasonable, arbitrary and void. There were many judicial pronouncements which uphold the women equality and dignity. Guwhati high court in ***Jiauddin vs. Anwara Begum***[40] and ***Mst Rukia Khatoon vs Abdul KhaliqueLaskar***[41] , Kerla high court in

36. UnitedNationsTreatyCollection(Sep.23, 2019)https://www.treaties.un.org/.
37. General Recommendationof CEDAW, Office of High Commissioner for Human Rights(Sep. 23, 2019) https://www.ohchr.org/EN/HRBodies/CEDAW/Pages/Recommendations.aspx.
38. INDIA CONST. art. 51(c).
39. *Supra* note 1.
40. (1981) 1 GLR 358 (India).
41. (1981) 1 GLR.375 (India).

A. Yousuf Rawther vs Sowramma[42] and ***Mohammed Haneefa vs Puthummal Beevi***[43], Delhi high court in ***Massor Ahmed vs Delhi (NCT)***[44] and in ***Shamim Ara vs State of U.P.***[45] Supreme Court of India already held that that triple *talaq* is a revocable talaq and dissolution of marriage does not take place immediately at the time of pronouncement.

If we analyze the latest judgment of ***Shayara bano***[46] Supreme court analysis all necessary themes with respect to the term 'Muslim'- Prophet Muhammad, religion (Islam), religious book (Quran), traditions and customs *(Sunna and Hadith)* and changes or reforms takes place in other countries. However not consider the themes related to 'Women'- women right movement, feminism, patriarchy; although referred the CEDAW but not to the extent which was required.

Reason of this approach of Supreme Court in most of the family law cases is these laws called personal laws derived from the religion. While enormous codification has been taking place in Hindus and other religious communities but fewer efforts were make to codify the Islamic law because of lack of the political will and insensitivity towards right of the women. Instead of providing equal rights there were examples where judiciary tried to make efforts to eliminate discrimination but legislature overturned it. In ***Shah Bano vs Union of India***[47] Supreme Court uphold the right of the Muslim women to claim maintenance under section 125 Cr.P.C; however was back lashed by legislative action. In ***Daniel Latifi & another vs Union of India*** ultimately the court interpreted the provision in such manner that uphold the constitutionality of provisions as well as uphold the right of the women; although without reference to CEDAW.

Judiciary may uphold the equal rights of the women with the help of the basic themes of feminism, patriarchy, difference between sex and CEDAW in a better way.

Debate in Parliament of India on Muslim Women (Protection of Rights on Marriage) Bill, 2019: The Missing discourse

On June 21, 2019 the Muslim Women (Protection of Rights on Marriage) Bill was introduced by law minister Ravi Shankar Prasad for second time[48] in *LokSabha,* which was passed on July 25, 2019 and thereafter passed by *RajyaSabha* on July 30, 2019 after a wrangle debate.[49]

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42. A.I.R. 1971 Ker. 261(India).
43. (1972) ker. LT 512 (India).
44. (2008) 103 DRJ 137 (India).
45. (2002) Cri.LJ 4726 S.C. (India).
46. *Supra* note 1.
47. (1985) 2 SCC 556 (India).
48. Earlier bill had introduced in Dec. 28, 2019, which was passed by LokSabha but stuck in RajyaSabha.
49. *Supra* note 3.

For the first time 78 women members are elected in LokSabha ; although the number still nugatory as per the total numbers of seats of *LokSabha*[50] and as per the population of women. Likewise there are 26 women members in *RajyaSabha.* These represents the all the women of country in the parliament but less than ten shared their views on the sensitive matter. The main arguments against the bill in the debate in and *RajyaSabha*[51] and *LokSabha*[52] were as follows: that the bill conflated civil and criminal law by criminalizing the act of triple *talaq,* which is already declared null and void by the Supreme Court; thus framing a law for criminalizing Muslim husband for a void act.It is a class legislation, which is pointed at one community or class thus violated Article 14 of the Constitution.Bill does nothing to improve the status of Muslim women; thus not come under the purview of Article 15 the Constitution.It does not have procedural safeguards, can be easily misused; thus in violation of Article 21 of the Constitution.Bill is in violation of Article 13(2) of the Constitution as it violating the fundamental rights of the citizen under Article 25 of the Constitution. There are only 0.56 percent divorce incident in Muslims 0.56, which is negligible, so no need of any law. There are safeguards under section 498A I.P.C. 1860 and Protection of Woman from Domestic Violence, 2005, which are sufficient to deal with; thus no need of this. This bill is laid for political intention to harass the Muslim men.It provides punishment upto three years, how a husband in jail provides subsistence allowance to wife. Itarouses the communal passion and divides the country and not promotes marital harmony but hatred in relationship.

The arguments in favor of the bill were as follows[54]: that after the Supreme Court judgment in Aug. 17, 2019 345 incidents of triple *talaq* came into light till July 24, 2019; thus it is necessary to provide penal provision for deterrence. Because the Supreme Court urged that the government should legislate on it. Triple *talaq* causes injustice to Muslim women; thus for gender justice and justice to women, law is imperative. Penalization necessary as the idea of triple talaq still symbolize the one-sided end of the marriage. The practice of triple *talaq* is the matter of oppression, exploitation and injustice to Muslim women.

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50. Women Members in LokSabha, LokSabha(Sep. 24, 2019) http://164.100.47.194/loksabha/members/women.aspx.
51. Women Members in RajyaSabha (Sep. 24, 2019) https://rajyasabha.nic.in/rsnew/member_site/women.aspx.
52. Uncorrected Verbatim Debates RajyaSabha(Sep.21, 2019) http://rajyasabha.nic.in>home>debatesofficialdebate.aspx.
53. Uncorrected Verbatim Debates, LokSabha(Sep. 21, 2019 http://loksabha.nic.in/debates/uncorrecteddebate,aspx.
54. *Ibid.*

Above analysis of the debate shows the missing discourse of feminism; although some women member declares that they are feminist but not support the bill because it might be misused against Muslim husbands or it causes fear in community (not able to understand whether this community includes women or not). Some talking about equality of the Muslim women but compared with women of other community. Some calculated divorce rate and argued that it is negligible but forget that injustice to anyone is danger to justice everywhere. The basic themes of women movement, patriarchy, difference between sex and gender are missing there also.

CONCLUSION

Narrative of the women (of any religion, race, region, color etc.) is incomplete without the concept of patriarchy and the ages of discrimination suffered by her. We cannot understand her story until we discuss the difference between the sex and gender because all the rolls given her to perform were constructed by society (male dominant), having no relevancy to her biology. Irrespective of class, color, race all women shared the common narration; however the poor, black and a specific race or community suffers more therefore the concurrent third wave of feminism is related to their equality.

It is the duty of the Supreme Court as well as the government to uphold not only the legal equality but substantive notion of equality. Bare legal enactments are not sufficient until it also provides a mechanism of equality of outcome, whether women are able to assert and get their due or not. For that purpose CEDAW provides an elaborate action plan. In India, the judiciary played an active revolutionary role to uphold the dignity and worth of women; however without discussing the basic themes and their history of discrimination of centuries. The ***Shayara Bano*** judgment[55] referred the CEDAW but for the sake of reference. The court had the opportunity to elaborately discussed and emphasis on CEDAW as the India is signatory to it.It not only laid down the action plan for substantial equality of opportunity but of the outcome and to analyze the results of the corrective steps taken by the State parties. Without the reference of CEDAW no discussion on women right able to achieve its purpose.

The main argument of the government for introducing and passing Muslim Women (Protection

55. *Supra* note 1.

of Rights on Marriage) Bill, 2019 was for improving the position of Muslim Women and to cure the discrimination suffered by them but in debate in parliament while defending the bill nowhere referred CEDAW, even not a single parliamentarian referred it. On the other hand in debate the concept of patriarchy is also missing although equality (legal) to women was the dominant theme without any emphasis on substantive equality.

The two main branches of government might assert the rights of women forcefully with the help of these themes. The parliament also fails to touch upon these narratives so that they vigorously uphold the right of the women.

Again the Supreme Court has the opportunity (as the petition challenging the Muslim Women (Protection of Rights on Marriage) Act, 2019 is accepted) to decide and the women in hope, looking towards it that there real narrative should be put before.

The discussion on these themes will spread awareness not among the women but to the youths of these countries as a source of inspiration towards the sensitization of gender justice and equality.

NIKAH HALALA: A VIOLATION OF MUSLIM DIVORCED WOMAN'S RIGHT TO DIGNITY

- Dr Raghuvinder Singh* & Ms Arti Sharma**

INTRODUCTION

The concept of human dignity acquired universal importance in the year 1948, when the Universal Declaration of Human Rights came into force. Article 1 of the UDHR proclaims that, "All human beings are born free and equal in dignity and rights".[1] The preamble of the International Covenant on Civil and Political rights, 1966 while highlighting the importance of human dignity, states that the recognition of the inherent dignity and equal and inalienable rights of the human family is the foundation of freedom, justice and peace in the world.[2] Further, it says that the rights enshrined in the covenant derive from the inherent dignity of the human person. In India, right to dignity is neither defined nor specifically provided in the Constitution of India. It is only in the preamble where the word dignity appears. It says, 'WE THE PEOPLE OF INDIA, having solemnly resolved...to secure to all its citizens...FRATERNITY assuring the dignity of the individual...' For this pledge, the Indian Constitutional courts, post Maneka Gandhi case, have not only recognised that right to dignity is inherent and intrinsic in all individuals, irrespective of their status, caste, gender, religion etc., but also 'dealt with the task of assuring and preserving it whenever the occasion arises, for without the right to live with dignity, all other rights may not realise their complete meaning'[3].

In the early development of the jurisprudence relating to right to dignity, the courts have regarded it to be a facet of right to life enshrined in article 21 of the Constitution. As in, ***Maneka Gandhi v. Union of India,***[4] the Supreme Court observed that, "dignity of all, is a sacrosanct human right and sans dignity, human life loses its substantial meaning". But later, it has been considered to be closely connected with liberty, equality, and privacy as well. In ***Francis Coralic Mullin v. Administrator, Union territory of Delhi***,[5] the Supreme Court viewed liberty as closely linked to dignity.[6] Justice Bhagwati, in the instant case, observed that, "…right to life

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1. The Universal Declaration of Human Rights, 1948 adopted by Resolution A/RES/3/217A.
2. The International Covenant on Civil and Political Rights, 1966 adopted by Resolution 2200A (XXI).
3. (2018) 1 SCC 791.
4. AIR 1978 SC 597.
5. AIR 1980 SC 849.
6. (2017) 10 SCC 1.

includes right to live with dignity and all that goes along with it namely,…facilities for reading, writing, and expressing oneself in diverse forms, freely moving about and mixing and commingling with fellow human beings…". Also, in ***Navtej Singh & Ors. V. Union of India***,[7] the court has closely linked it to liberty. Recently, in ***K.S. Puttaswamy & Ors v. Union of India,***[8] the Supreme Court, has perceived privacy as closely connected with dignity and thus observed that, "privacy of the individual is an essential aspect of dignity…Dignity cannot exist without privacy. Both reside within the inalienable values of life, liberty and freedom which the constitution has recognized". In the instant case, the Supreme Courtwhile holding that the human dignity is an integral part of the Constitution observed that, "Reflections of dignity are found in the guarantee against arbitrariness (Arti.14), the lamps of freedom (Art.19), and in the right to life and personal liberty (Art.21)"[9]. And also, the Supreme Court, in ***Joseph Shine v. Union of India***,[10] observed that sexual autonomy constitutes an inviolable core of the dignity. At this juncture, it can be said that right to human dignity is an umbrella right encompassing and underpinning rights relating to life, liberty, equality and privacy. Violation of right to life, liberty, equality and privacy would result in the violation of right to dignity.

Divorce ends the marital tie and parties are once again free to marry a person of their choice. But, the practice of nikah halala puts an unwarranted restriction on the autonomy of Muslim divorced woman. It requires her to marry someone else in order to marry her former husband and consummate her marriage, while she is in love with her former husband. It gives unilateral power to the second husband to divorce her and secondly, it is only upon her divorce and actual consummation of her marriage with her second husband that she can remarry her former husband. The question here is, "whether such a situation is or is not derogatory to the dignity of the woman as enshrined in the preamble and part III which form the basic structure of the Constitution? Or is this situation not against the principles of equality, liberty and privacy and thus, should it not be considered a violation of her right to dignity?"

Against this background, the present paper will analyse the practice of nikah halala on the touchstone of right to dignity available to Muslim divorced woman and to find out, whether there is a violation of her right to dignity and if so, then this paper would attempt to provide some suggestions.

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7. *Supra* note 3.
8. *Supra* note 6.
9. *Ibid.*
10. 2018 SCC OnLine SC l676.

This research paper comprises of five parts. The first part is an introductory part which explains that right to dignity is an umbrella right encompassing and underpinning all other rights of life, Liberty, equality and privacy. The second part deals with the concept of nikah halala and its close relation with different modes of divorce in Islamic law. The third part of this paper examines the essential elements of nikah halala on the touchstone of right to dignity available to a Muslim divorced woman under the Constitution. The fourth part analyse the Muslim Woman (Protection of Rights on Marriage) Act, 2019 and the fifth and the last part of the paper attempts to provide suggestions for the violation of her right to dignity.

NIKAH HALALA

Nikah halala is made-up of two Arabic words i.e. 'Nikah' and 'Halala'. Nikah means marriage, and 'halala' in Arabic means 'halal' and in English it means 'to make something permissible or lawful'. Nikah halala is a practice by which a Muslim divorced woman is made permissible for her former husband, so that, they can remarry each other. To put it in another way, it is a practice by which a Muslim divorced woman repudiated by her husband is required by the Muslim law to undergo the necessary formalities of nikah halala. Fyzee, in his book has described the following formalities of nikah halala:

- firstly, she is required to observe iddat of divorce;
- Secondly, after observing iddat,she is required to marry someone else;
- Thirdly, the second marriage must be consummated;
- Fourthly, the later husband either must divorce her or had died;
- Lastly, the woman is required to observe iddat of this divorce; after the expiry of iddat the couple can lawfully remarry.[11]

And also, Mulla in §336 of chapter XIV says, where the husband has repudiated his wife by three pronouncements [§311(2)and §311(3)(i)] ,[12] it is not lawful for him to marry her again until she has married another man, and the latter has divorced her or died after actual consummation of the marriage.[13] Thus, the common ingredients of nikah halala as described by Islamic scholars can be reduced to:

11. Outlines Of Muhammadan Law, 81, (Oxford University Press, New Delhi, 5th edn – 2008).
12. Principles Of Mahomedan Law, 429(Lexis Nexi, New Delhi, 22nd edn-2017).
13. *Ibid.*

a) Muslim divorced woman is to marry someone else in order to marry her former husband;

b) The second marriage must be consummated;

c) The later husband either must divorce her or died.

Only upon the fulfillment of the above said conditions the marriage between former couple is considered as lawful and the consequences of lawful marriage flow from the union. Now, the question comes whether the concept of irrevocability of talaq necessitates that a wife must perform halala on any form of talaq becoming irrevocable? Before proceeding to answer this question, it is imperative here to understand the concept of divorce.

KINDS OF DIVORCE UNDER MUSLIM LAW

Under Muslim law, the marriage may be dissolved either; by the will of the husband, without intervention of the court called talaq; by the mutual consent of husband and wife, without the intervention of the court; by the decree of the court at the suit of either husband or wife. At this juncture, it is necessary to state that here we are concerned with the first two ways of dissolving the marriage tie, as the issue of nikah halala largely depends on the method the husband uses to divorce his wife.

I. Divorce by talaq

Talaq is when the divorce proceeds from the husband. It is of three kinds i.e. talaq-e-ahsan, talaq-e-hasan, and talaq-e-biddat. Talaq-e-ahsan is a single pronouncement of talaq during tuhr, by the husband, followed by a period of abstinence called iddat.[14] The duration of iddat is ninety days or three months in case the wife is subject to menstruation otherwise three lunar months. If the couple resumes cohabitation or intimacy within the said period the divorce is treated as having been revoked. Conversely, if there is no resumption of cohabitation, then the divorce is considered final and irrevocable, after the expiry of the iddat period.[15]

Talaq-e-hasan is pronouncing the formula of divorce thrice during three successive tuhrs. After the third pronouncement of talaq, if there is no resumption of cohabitation between the couple in any of the three months the talaq is considered final and irrevocable irrespective of iddat. To illustrate if upon first pronouncement of talaq, there is a resumption of cohabitation within a period of one month, the pronouncement of talaq is treated as having been revoked.[16] The same

14. Shayara Bano v. Union of India, (2017) 9 SCC 1.
15. *Ibid.*
16. *Ibid.*

procedure is adopted after the expiry of the first month if the marital ties have not been resumed. And the husband made the second pronouncement of talaq. The first and second pronouncement of talaq may be revoked by the husband either expressly or by resuming cohabitation and talaq pronounced by the husband becomes ineffective, as if no talaq had ever been expressed.[17] But, if first and second pronouncements have not been revoked and the husband pronounces the third talaq it becomes irrevocable and the marriage stands dissolved irrespective of the period of iddat. Where after, the wife has to observe the required iddat and the husband and wife cannot remarry.

Talaq-e-biddat is the third form of talaq pronounced by the husband. It is recognized by Hanafi sect of Sunni Muslims. In talaq-e-biddat one definitive pronouncement of talaq such as, I talaq you irrevocably or three simultaneous pronouncements like talaq, talaq, talaq is uttered at the same time, simultaneously.[18] Talaq-e-biddat becomes effective immediately as soon as it is pronounced without giving a chance to the husband to revoke it. Thus, there is no chance of reconciliation. It becomes irrevocable the very moment it is pronounced. Thereafter, the wife has to observe the period of iddat and the parties are barred to remarry unless the wife performs nikah halala. The practice of triple talaq has been set aside by the Supreme Court on August 22, 2017 by a majority of 3:2.[19]

II. Divorce by Mutual consent

Under this category, the Muslim law prescribes two kinds of divorce i.e., Khula and Mubara'at. Khula is a divorce with the consent and at the instance of the wife, in which, she offers to give or agrees to give consideration to the husband for her release from the marital tie. Once the offer is accepted it becomes talaq-i-bain.[20] Mubara'at is a divorce by mutual consent of both the parties. Herein, the offer may proceed from the wife or from the husband, but once it is accepted it becomes complete and operates as talaq-i-bain.[21]

Now, the present paper shall examine the question, whether the concept of irrevocability of talaq necessitates that a wife must perform halala on any form of talaq becoming irrevocable? The question was answered by the Bombay High court in Mrs. Sabah Adnan Sami Khan v. Adnan Sami Khan[22]. The facts of the instant case are, the appellant (Mrs. Sabah Adnan Sami Khan) and

17. *Ibid.*
18. *Supra n*ote 12 at 343.
19. *Supra n*ote14.
20. *Supra n*ote 12 at 414.
21. *Ibid.*
22. AIR 2010 Bom 109.

the respondent, Adnan Sami Khan were Mahomedans and they belonged to Sunni sect. Both, the respondent and the appellant got married on September 15, 2001 according to Islamic rites. Their marriage was dissolved under the agreement dated April 18, 2004 signed by them and the witnesses. The parties remarried on April 04, 2007 at Jama Masjid, Bandra, Mumbai and got their second marriage registered with the Sub Registrar of Marriage, Bandra, Mumbai on February 02, 2008. Disputes and differences arose between the parties sometime in June and July, 2008, which resulted in execution of reconciliation agreement dated January 01, 2009. The appellant on account of discord filed a complaint under Domestic Violence Act in February, 2009 in the Metropolitan Magistrate Court Andheri. The respondent filed a reply to her application under the Domestic Violence Act. On March 16, 2009, the appellant filed a petition under section 2(viii) the Dissolution of Muslim Marriage Act, 1939 seeking dissolution of the second marriage, along with misc. application for seeking relief under the Domestic Violation Act. The respondent filed reply to application under the Domestic Violation Act, so also, filed a written statement in which for the first time he brought the issue that the appellant did not perform halala formalities before the second marriage and therefore, the second marriage was a nullity. The family court observed that the first marriage was dissolved by mutual consent of the parties and thus, was a divorce by Mubara'at and not by talaq ahsan mode as contented by the appellant. Further, the court held that the appellant had not performed halala formalities before the second marriage thus, the said marriage was held not legal and valid. Thereby, this appeal was filed in the Bombay High court. The court held that merely because talaq in ahsan or khula mode becomes irrevocable does not mean that every irrevocable talaq creates a legal bar to remarriage, necessitating the wife to perform halala. It is only in the case where the husband has repudiated his wife by three pronouncements as provided for in the hasan mode of talaq and in talaq-ul-biddat by three pronouncements, it is not lawful for him to marry her again until she performs halala.

Consequences of re-marrying without performing nikah halala

In ***Saiyid Rashid Ahmed v. Anisa Khatun***,[23] the plaintiffs were the brother and sister of the Ghiyas-ud-din, who would have been the heirs, if respondent's no. 1 to 6 were unable to establish their claim to be widow and legitimate children. The dispute is related to the succession

23. AIR 1932 PC 25.

to the estate of Ghiyas-ud-din, a Muhammadan, who died on April 04, 1920. On September 13, 1905 he pronounced the triple talaq in the presence of the witnesses, though in the absence of his wife. Though, the later received Rs. 1000 as a payment of her dower on the same day for which a registered receipt was produced. There was also prepared a talaqnama, a deed of divorce on September 17, 1905. Anisa Khatun - respondent no.1, challenged the validity of divorce on two grounds that the divorce was pronounced in her absence and second that after divorce Giyas-ud-din and she lived as husband and wife for fifteen years and five children were born to the couple. Thus, Ghiyas-ud-din did not intend to divorce her. The Privy Council held that triple talaq pronounced in the absence of wife by Ghiyas-ud-din was valid and immediately effective. The validity and effectiveness of the talaq would not be affected by Ghiyas-ud-din's mental intention. Further, since the respondent had not undergone nikah halala after divorce, the Privy Council held that she was not legally married to Ghiyas-ud-din and the children born were held to be illegitimate, resulting in rejection of her claim for succession.

Nikah halala: A violation of Muslim divorced woman's right to Dignity

The dignity of the individual encompasses the right of the individual to develop his/ her personality to the fullest of his/her potential.[24] And this development is possible only if an individual has autonomy over fundamental personal choices.[25] Human desire to be intimate with a person of one's choice within marriage or outside comes within these fundamental choices. In ***Joseph Shine v. Union of India***,[26] the Supreme Court observed that human dignity both recognizes and protects the autonomy of the individual in making intimate personal choices as to partner and nature of relationship, and that these choices of an individual cannot obviously be imposed on society and are premised on voluntary acceptance by consenting parties. The court further observed that, "sharing of physical intimacies is a reflection of choice. In allowing individual tomake choices in a consensual sphere, the Constitution acknowledges that even in the most private of the zone, the individual must have the ability to make essential decisions…"

But, Muslim divorced woman is divested to make intimate personal choices as to partner and the nature of relationship as she wishes to pursue. Firstly, because the practice of nikah halala underMuslim personal law requires a Muslim divorced woman to marry someone else while she

24. *Supra* note 6.
25. *Ibid.*
26. *Supra* note 10.

is in very much love with her former husband who has divorced her whimsically, irrationally under zest and anger, without any fault of hers, it requires her to curtail her choice, and thus, it restricts her autonomy in making intimate personal choices guaranteed by the Constitution. She is forced by imposition of law to make choice of someone else over her love. She lives in the fear that if she does not choose to marry someone else before marrying her former husband, her marriage with former husband, if brought to question as in Rashid Ahmed case, would be declared null and void, her children, if born, would be declared illegitimate and she would not be entitled to the benefits of lawful marriage. To avoid such situation if she opts not to re-marry her former husband, it again works like an absolute restriction on her right to make choice of her partner and give free expression to her personality.

In ***Shakti Vahini v. Union of India***,[27] the Court has recognized that the right to choose a partner is a fundamental right under articles 19 and 21 of the Constitution. The court held that "…when two adults consensually choose each other as life partners, it is a manifestation of their choice which is recognized under articles 19 and 21 of the Constitution. Such a right has the sanction of the constitutional law and once that is recognized, the said right needs to be protected..." So also, in ***Shafin Jahan v. Asokan***,[28] the Supreme Court set aside, a Kerala High Court judgment which annulled the marriage of a twenty four years old woman with a man of her choice in a habeas corpus petition instituted by her father, on the ground of denying its citizens the right to intimacy. The court observed that the right to intimacy emanates from an individual's prerogative to engage in sexual relations on their own terms. It is an exercise of the individual's sexual agency, and includes the individual's right to the choice of partner as well as the freedom to decide on the nature of the relationship the individual wishes to pursue. As these rights are available to all individuals, so is also available to Muslim divorced woman, but the practice of nikah halala puts restriction not only on the right to make choice of her former husband as her life partner, but also puts restriction on her freedom to decide on the nature of the relationship she wishes to pursue. As in ***Saiyid Rashid Ahmed v. Anisa Khatun, Annisa Khatoon***[29] kept thinking herself to be the legally wedded wife of Ghiyas-ud-din because the later treated her that way for fifteen years, but after his death when her marriage was put to question in the court, her contention was rejected on the ground that she had not undergone the necessary

27. AIR 2018 SC 1601.
28. AIR 2018 SC 1933.
29. *Supra* note 23.

formality of halala. She wasbereft of her freedom to decide the nature of relationship she wanted to have with Ghiyas-ud-din, and she was also denied the right of inheritance to his property as his wife.

Secondly, the practice of nikah halala, requires a Muslim divorced woman to consummate her second marriage against her wishes, while she is in love with her former husband. Additionally, Radhika Iyengar citing Jurist Moulana Ashraf Ali Thanvi stated that, "if the second husband died or divorced her before sexual intercourse, then it will be of no account and she cannot marry the first husband in such condition."[30] This shows that the consummation of marriage with second husband is utmost necessary condition without fulfilling which she cannot marry her former husband. The Supreme Court in ***Navtez Singh& Ors. v. Union of India***,[31] observed that, "autonomy is individualistic. Under autonomy principle the individual has sovereignty over his/her body. He/she can surrender his/her autonomy willfully to another individual and their intimacy in privacy is a matter of their choice. The freedom of sexual autonomy is also available to a Muslim divorced woman. She has sovereignty over her body. She can surrender her body willfully to a person of her choice, even if her choice is her former husband. It is her prerogative; the law cannot dictate her with whom to engage or not to engage in sexual activity. But, the practice of nikah halala dictates that she cannot remarry her former husband unless she has consummated her second marriage with someone else. Thus, it denudes her of the freedom of sexual autonomy protected by the constitution. In ***Joseph Shine v. Union of India***,[32] the court observed that, "In protecting consensual intimacies, the Constitution adopts a simple principle that the state has no business to intrude into these personal matters. In so far as two individuals engage in acts based on consent, the law cannot intervene. Any intrusion in this private sphere would amount to deprivation of autonomy and sexual agency, which every individual is imbued with." So also, in ***Shafin Jahan v. Asokan K.M. & Ors***,[33] the court observed that, "the law [may] prescribe the conditions of a valid marriage. It [may] provide remedies when relationships run aground. [But] neither the state nor the law can dictate a choice of a partner or limit the free ability of any person to decide on these matters. They form the essence of personal liberty under

30. What Is Nikah Halala, How it was established and where it stands in Modern India, INDIAN EXPRESS (Sept. 09, 2019, 11:15 AM), https://indianexpress.com/article/what-is/what-is-nikah-halala-how-it-was-established-and-where-it-stands-in-modern-india-triple-talaq-4618415/.
31. *Supra* note 3.
32. *Supra* note 10.
33. SCC OnLine 2018 SC 343

the constitution."But, the practice of nikah halala intrudes in the private sphere of the Muslim woman and thus, denudes her from exercising her personal liberty.

Thirdly, the practice of nikah halala requires that Muslim woman can marry her former husband only if the second husband has divorced her or died. By providing so it subverts the equality of spouses. It treats Muslim woman as a possession of her second husband. The Supreme Court, in ***Joseph Shine v. Union of India***,[34] while holding that section 497 is manifestly arbitrary and thus, inconsistent with the ethos of the constitution, observed that, "Marriage in a constitutional regime is founded on the equality of and between the spouses. Each of them is entitled to take decisions in accordance with his or her conscience and each must have the ability to pursue the human desire for fulfillment." Further, in the instant case, the court observed that, "the ability to make choices within marriage and on every aspect concerning it is a facet of human liberty and dignity which the constitution protects."[35] In depriving the wife (Muslim woman) of the ability to divorce and recognizing it in the husband (man), alone, the practice of nikah halala fails to meet the essence of substantive equality, liberty and dignity in its application. Equality of rights and entitlement between parties to a marriage is crucial to preserve the values of the Constitution.[36] The practice of nikah halala offends that substantive equality and is violative of art. 14.

The Muslim Women (Protection of Rights on Marriage) Act, 2019- An Analysis

The Muslim Women (Protection of Rights on Marriage) Act, 2019 was passed; firstly, to abolish talaq-e-biddat by declaring it void and illegal; secondly, to punish its use by Muslim husbands to divorce their wives'; thirdly, to protect the rights of married Muslim women as to custody of children and subsistence allowance for herself and her children.; fourthly, to provide for matters connected therewith or incidental thereto. But, it has not expressly abolished the practice of nikah halala which is closely connected with talaq-e-biddat.

Conclusion and Suggestions

In the end, it can be concluded that, the practice of nikah halala involves the violation of, not just one but, several fundamental rights of Muslim divorced woman namely;

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34. *Supra* note 10.
35. *Supra* note 10.
36. *Ibid.*

- right to equality,as contained under article 14 and 15; as it offends the substantive equality by depriving the wife from divorcing her second husband;
- right to liberty, as contained under articles 19(a) and 21;as it denudes the Muslim divorced woman to express her choice of the life partner when that choice is her former husband who has divorced her by talaq-e-ahsan and talaq-e-biddat;
- right to privacy; as it is an interference by way of stipulation of law, which restricts her freedom to marry a person of her choice and exercise her sexual autonomy;
- right to live with human dignity; as the violation of her right to equality, liberty and privacy is ultimately a violation of her right to live with human dignity.

Thus, it is suggested that as regards the practice of nikah halala in case of talaq-e-biddat, the Parliament should make an amendment in the Muslim Women (Protection of Rights on Marriage) Act, 2019 to expressly abolish the practice of nikah halala. Since, the practice of talaq-e-biddat is declared void and illegal, consequently, the Muslim wife would not be required by law to undergo the practice of nikah halala even if her husband pronounces triple talaq upon her and latter retreats his step and starts living with her. Secondly, as regards the practice of nikah halala in case of talaq-e-hasan, the legislature should make a law to ameliorate the plight of Muslim divorced women as this practice takes away her right to live with human dignity.

PAID NEWS PANDEMIC: UNDERMINING CONSTITUTIONAL DEMOCRACY

-Dr Bharat*

"It needs little argument to hold that the heart of the Parliamentary system is free and fair elections periodically held, based on adult franchise, although social and economic democracy may demand much more." [1]

Constitutional democracy is the decisive underpin upon which the bravura edifice of India is conceived and construed. The sensitivity of this splendid conception lies in free and fair elections which are based on universal adult franchise.[2] On one hand, the free and fair elections strengthen the democratization of political philosophies & programs; and on the other hand it eggs-on the political liberalization. Mandated by the laudable sovereignty, through the Constitution of India, the Election Commission of India is progressively performing election after elections. With outstanding election management, the Election Commission of India strengthens the Constitutional democracy through its dynamic-direction, crackerjack-control and sterling-superintendence of elections in India to the Parliament and State Legislatures.

Prologue

The freedom of speech and expression not only occupies a 'preferred position in the ladder of the liberty' but it is also christened as 'the very life of liberty'. It is often characterized as the mother of all the other liberties. Moreover, the untrammeled flow of words is the first canon of the Constitutional democracy.

The freedom of press is nowhere recognized as a separate freedom under the Constitution of India in Part III dealing with the Fundamental Rights. Rather, the freedom of press is crinkled within the freedom of speech and expression.[3] Even the Supreme Court of India has described this freedom as the 'ark of the covenant of democracy'. [4]

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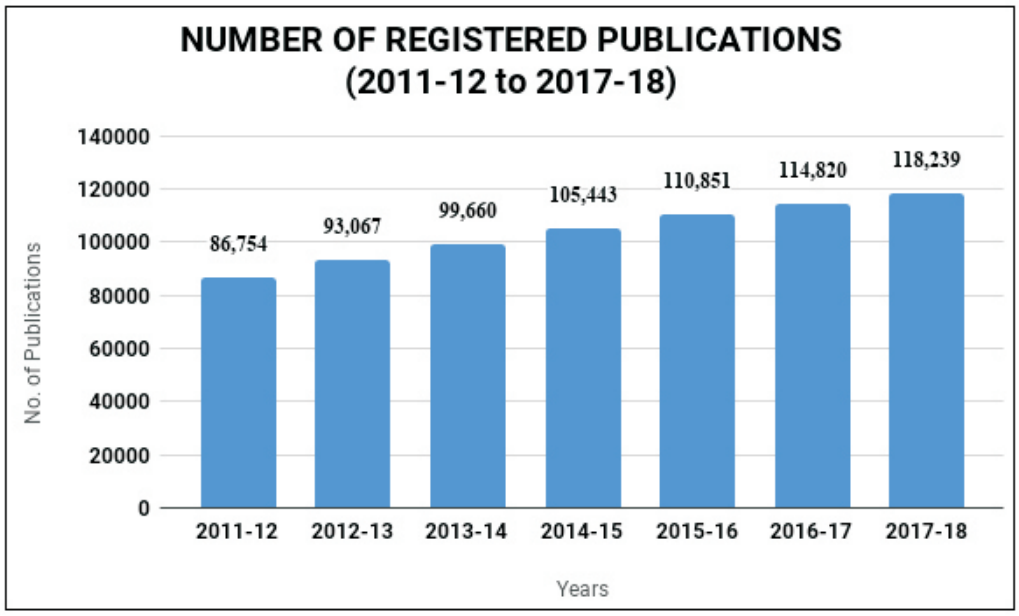
1. Mohinder Singh Gill v. Chief Election Commissioner, (1978) 1 SCC 405, 424, at para 23.
2. The word 'franchise' has its taproot in the French word 'franc' which means free. The phrase 'universal adult franchise' means that the 'right to vote' is available to all the adult citizens of India without any kind of discrimination on the basis of caste, class, colour, region, religion, gender etc.
3. Brij Bhushan and Another v. The State of Delhi, AIR 1950 SC 129; Sakal Papers (P) Ltd. v. Union of India, AIR 1962 SC 305.
4. Bennett Coleman & Co. v. Union of India, AIR 1973 SC 106.

The freedom of the press dishes-up the glory of the right to information between the electorate and the elected. Freedom of the press is undoubtedly indispensable for people to be informed and to participate in a democracy. Through press come beliefs and behavior, dictums and dogma, ideas and information; and hence it is decisive in sustaining the rule of law.

Law is said to be a voyage towards the truth. Being the fourth pillar in a democratic set-up, 'press' plays imperative character in exciting public opinion, revealing corrupt practices, discovering truth, shaping the demand for accountability and responsibility, and above all gearing up for governance.

Despite of the advent of advanced audio, visual, digital and social media; the following bar-chart reflects that there is ever increase in the number of 'registered publications' with the Office of Registrar of Newspapers for India under the Ministry of Information and Broadcasting, Government of India.[5]



5. For details, refer: http://rni.nic.in/all_page/press_india.aspx Last accessed on August 23, 2019.

As on March 31, 2018; 1,18,239 publications (out of which 17,573 falls in the newspaper category and 1,00,666 fall in the category of the periodicals) were registered as against 1,14,820 on March 31, 2017.[6] With this data at the backdrop, India is having every reason to celebrate. But as society advances, new concerns require fresh considerations. Although, technology is expanding our prospects, perspectives and possibilities but it has also brought some novel test along with it. Recent events relating to the news-media, including infringement of privacy, trial by media, fake sting operations, proliferation of social media, pandemic of paid news etc. pretense a set of foreboding.

As Lord Justice Leveson wrote in his path-breaking report on 'Culture, Practice and Ethics of the Press' in Great Britain:

> "With these rights (of press freedoms) come responsibilities to the public interest: to respect the truth, to obey the law and to uphold the rights and liberties of individuals."[7]

The scale and size of media in a democratic set-up becomes predominantly palpable when it comes to challenges confronting media and the elections. While considering the concerns related to electoral reforms, even the Law Commission of India felt the need to address media-related issues associated with free and fair elections, including the pandemic of paid news.[8]

PAID NEWS

As a fourth pillar, media is expected to play a role of building culture and character, society and nation. Free and fair election is not only about exercising the right to franchise in apposite state of affairs, but also about having adequate information about policies, parties, candidates and the election process in itself so that electorates can make a conversant choice. The narration of paid news is as old as the news itself. In the 19th century, US newspapers used to publish "reading notices", which were advertisements presented in the form and format of news.

As such in Indian context, it is easier said than done to pin-down the exact time when the pandemic of Paid News made its entry into the election arena. However, after the 2009 *Lok Sabha* elections, sensing the intense immoral smell from the electoral scene outsized number of

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6. *Ibid.*
7. Lord Justice Leveson, 'An Inquiry into the Culture, Practices and Ethics of the Press' (Leveson Inquiry Report, London: November 2012).
8. For details refer, Law Commission of India Report No. 255 (2015) on Electoral Reforms.

sensitized people expressed concerns about the need of ethical journalism for the overall vigor of the democracy. Thereafter, this anxiety aiming for preserving, protecting and promoting the constitutional democracy was timely conveyed to the Election Commission of India. There were discussions and deliberations in both the houses of the Parliament of India; debates and diverges poured from the Press Council of India, round of parlances happened within the Government and heated coverage in media circles calling for remedial measures to curb the pandemic of Paid News.

Constitutionally committed to the core for holding free and fair elections, the Election Commission of India initiated its first concrete step against Paid News in the 2010 General Elections so as not to allow any vitiation of level playing vote field and violation of election related laws. Since then, slowly but steadily, the Election Commission of India is trying its level best to fortify the measures and initiatives to keep all stakeholders well informed.

Paid news, defined by the Press Council of India as "any news or analysis appearing in any media (print and electronic) for a price in cash or kind as consideration" is now a common occurrence that poses a serious threat to democratic processes and financial markets. It misinforms audiences and undermines their freedom of choice.

The pandemic of paid news poses a direct threat to the freedom of speech and expression enshrined under Article 19 of the Constitution of India and also to the very fabric of constitutional democracy. News is meant to be fair and flaxen, neutral and non-aligned, independent and impartial. Media as the fourth pillar is one among the mainstay of democracy. But the blurring distinction between 'news' and 'paid news' is undermining the constitutional democracy in India by defeating the very spirit of free and fair elections.

Paid news is a pervasive in nature and bangs the sanctity of the electoral process. The ugly designs of the paid news operate on different principles and philosophy. It may be in the form of editorial write-up, biased opinion coverage, personality features, bewildering political promotion, statistically dubious opinion polls, soft interviews of candidates, obsequious political stories, publishing the press release word to word etc.

The deplorable fact about this pandemic is that neither the call of the Election Commission of India for self-regulation by political parties / media-houses nor the bid to criminalize the paid news in elections has gone well… jeopardize the very essence of constitutional democracy.

CHALLENGE OF PAID NEWS PANDEMIC

The pandemic of paid news in India and also in others parts of the world essentially springs from the verity that most of the media-houses are corporate conglomerates primarily engrossed in profit maximization. The 'fourth pillar' in the world's largest democracy i.e. India often emphasizes commercial considerations rather than exploration for the truth.

Paid news pandemic is prone, partial, partisan and predisposition. At election time, the concerns about the prejudice of the media are at the heart of debates, putting a big question-mark on its role and responsibilities. The open secret that the proprietors of the print and electronic media-houses have active political affiliations, ambitions and agendas which have (un)knowingly made their news-paper / news-channel preface of their respective associations and aspirations. And this interceded marriage accord between media and politics has lead to polarization of media-houses.

Uncalled incentive and undue influence to electorates pose challenge in the conduct of free and fair elections as it affects the level playing field in the political arena by deceiving the mind of the voter. The voter's right to correct and unbiased information needs protection. Another concern is that paid news deludes the ceiling of expenditure which is a key component in electioneering process.

Last but not the least; the desolate fact is that there can't be a fixed set of parameters to identify paid news as generally black-money is involved in this pandemic which is hard to tag, trace and track. For this and other reasons, the inherent deception involved in paid news as news entails a clandestine activity. Its occurrence, thus, can be reliably established by only its participants and that too by acknowledging that they are guilty of violating various election related laws, besides those relating to deception, fraud and non-payment of taxes.

GLIMPSES OF PAID NEWS PANDEMIC

The following table gives the glimpses of the year/election wise reporting of Paid News cases in India:

Year/Elections	No. of Paid News Cases Reported
2010 Bihar Assembly Elections	121
2011 Kerala Assembly Elections	65
2011 Assam Assembly Elections	42
2011 Tamil Nadu Assembly Elections	22
2012 Punjab Assembly Elections	523
2012 Uttar Pradesh Assembly Elections	97
2012 Uttarakhand Assembly Elections	30
2012 Gujarat Assembly Elections	414
2012 Himachal Pradesh Assembly Elections	104
2013 Madhya Pradesh Assembly Elections	165
2013 Karnataka Assembly Elections	93
2013 Delhi Assembly Elections	25
2013 Chhattisgarh Assembly Elections	32
2013 Rajasthan Assembly Elections	81
2014 General Elections	694
2014 Haryana Assembly Elections	212
2015 Delhi Assembly Elections	59
2016 Assam Assembly Elections	18
2016 Tamil Nadu Assembly Elections	17
2017 Uttar Pradesh Assembly Elections	56
2017 Punjab Assembly Elections	80
2017 Uttar Pradesh Assembly Elections	56
2017 Gujarat Assembly Elections	238
2017 Himachal Pradesh Assembly Elections	85
2018 Karnataka Assembly Elections	15
2019 General Elections	647

The year 2010 witnessed 121 cases of paid news in Bihar Assembly Elections. In 2011, 65 cases from Kerala, 42 cases from Assam were reported. The year 2012 recorded whopping cases of paid news as there were 523 confirmed cases in Punjab, 414 in Gujarat, 104 in Himachal Pradesh, and 97 in Uttar Pradesh. Elections to 2014 Haryana Assembly saw 212 cases and for 2017 Gujarat Assembly Elections the number was 238. General Elections are in no way far behind when it comes to pandemic of paid news, as 694 cases were reported in 2014 where as the number of cases in 2019 it was 647.[9]

In 2015, there were seven confirmed cases in Bihar, while in 2013, Madhya Pradesh saw 165 cases, Karnataka 93, and Rajasthan 81. The following table shows the data of the 2016 elections to the different legislative assemblies:[10]

State/UT	No. of Cases Recorded	No. of Notices Issued	No. of Cases Admitted by Candidate	No. of Cases found true by Media certification and Monitoring Committee (MCMC)
Assam	18	16	5	8
Kerala	5	5	0	0
Tamil Nadu	17	17	2	17
West Bengal	2	2	1	1
Puducherry	12	12	0	9

The most recent examples from the run-up to the 2017 assembly elections, Punjab recorded 80 and Uttar Pradesh recorded 56 cases whereas 2018 Karnataka Assembly Elections witnessed 15 cases. [11]

9. The data is compiled from the Election Commission of India.
10. *Ibid.*
11. *Ibid.*

Paid news is a serious electoral malpractice and the pandemic has continued to grow over the years. It leads to circumventing of the election expenditure limits and hampers the voter's right to reliable information.

So far, only few politicians have been barred by the Election Commission of India from contesting polls, on account of paid news. The most prominent among them are former Jharkhand Chief Minister Madhu Koda, and former Madhya Pradesh Minister Narottam Mishra.

The toughest challenge in these cases is to establish that the news is paid because media-houses do not maintain a distinction between news and paid news. Usually circumstantial evidence is there but with a very little proof. It is almost next to impossible to establish whether such transactions have taken place in cash or kind as usually, they are not carried out in black & white and promptly denied by both parties.

PAID NEWS UNDERMINING CONSTITUTIONAL DEMOCRACY

The counterbalancing influences of the doctrine of check and balance between various organs of the Government i.e. legislative, executive and judiciary is inevitable and the effective task of fourth pillar is imperative to achieve this balance in the very interest of free and fair elections. However, the rise of 'paid news' especially during election, has undermined the essence of a constitutional democracy.

> "Freedom of the press affords the public one of the best means of discovering and forming an opinion of the ideas and attitudes of their political leaders. In particular, it gives politicians the opportunity to reflect and comment on the preoccupations of public opinion; it thus enables everyone to participate in the free political debate which is at the very core of the concept of a democratic society." [12]

In contemporary times, media is a conscientious collaborator and the independence of the media endeavors to facilitate accountability and reduce corruption. It is not just the 'fourth pillar' but a 'significant pillar' which supports the Indian society in general and strengthens constitutional

12. Thorgeir Thorgeirson v. Iceland, (1992) 14 EHRR 843; 13778/88; [1992] ECHR 51.

democracy in particular through its sheer vigor and vitality. Media plays an imperative role in building the public opinion as it is an effervescent tool for the gamut of societal fabric.

The ability of the media to bring about precision in the system by playing an adversarial role is compromised because of breeding corruption by means of paid news pandemic. It is undermining the constitutional democracy at three levels. At the first level, the reader or viewer is betrayed by compelling him to believe paid news as news. Secondly, the expenditure incurred on paid news is veiled and it is not reflected as election expenditure violating the statutory provisions of the Representation of the People Act, 1951 and the Conduct of Election Rules, 1961. Lastly, the money received from political outfits is not accounted by the media-houses in their account books violating the provisions of the Companies Act, 2013 and the Income Tax Act, 1961 among other laws.

The news is expected to be independent and objective but the phenomenon of paid news projects a wrong picture and defrauds the electorate. This pandemic goes beyond the corruption of individual journalists and owes its existence to the egregious manifestation of the corporate media-houses. It has become highly planned, structured and organized subverting the fundamental ideal of sanctity of the right to vote. Whenever and wherever media adopts such unethical norms it is bound to abrogate its cloak of trust and faith. This section of corporatized media undoubtedly undermines the processes and structures that are meant to uphold and strengthen the constitutional democracy.

Now that there is a paradigm shift from the era of 'secrecy' to dawn of 'transparency', the pandemic of paid news is nothing less than an assault on the right to know true and correct credentials of those in the electoral fray thereby distorting the essence of whole process. If it is not addressed at this juncture, it will become overt as a normal course of the media's function. It is causing double jeopardy as it has put a big question on the very survival of ethical journalism on one side and on the sanctity of media democracy, electoral democracy and above all constitutional democracy on the other side.

CONCLUSION

Free and fair elections are as imperative as a free and independent press. The endurance of constitutional democracy in India owes a great deal to the freedom and vigor of press.

India's sheer scale and size, diversities and complexities are a big challenge in itself. The pandemic of 'paid news' mocks the electoral process and often reducing it to farce. It is pernicious for constitutional democracy and needs to be addressed holistically as it is a serious electoral malpractice which misleads public, influences voters, hampers the ability of electorates to form correct opinions, stalls the voter's right to trustworthy information and circumvents the election expenditure ceiling limits.

Constitutional democracy envisages protecting, promoting and preserving clean, caliber, capacity and character rather than cash, caste, community and criminality. Election Commission of India, the vanguard of Indian democracy, conducts elections as a matter of great pride & honour and strives every single day to ensure people's firm conviction in democracy sustains. It strongly believes in the concept of free and fair elections and continues to evolve itself time and again to support its stand.

Paid news pandemic had started out as an aberration, went on to become a disease and is now an epidemic. Without doubt, tackling of paid news in elections is still an evolving process and would require support of one and all. An alert citizenry can make a beginning in bringing the pandemic of paid news to an end by joining the hands with the Election Commission of India to break the symbiotic nexus between lawmakers and media-houses. What is at stake is not only the trust of public or role of media but the very foundation of our own Constitutional Democracy…!

RELEVANCY OF LEGITIMACY OF CHILDREN BORN OUT OF LIVE-IN-RELATIONSHIP: A SOCIO-LEGAL CONCERN

-Ms Wazida Rahman*

"Mankind owes to the child the best it has to give."

Preamble, UN Declaration on Child Rights (1959)

INTRODUCTION

"Live-in relationship" in straightforward terms, is a relationship in which both persons cohabit without marrying each other. Without marital responsibilities or accountabilities towards each other, it engrosses an established and undisturbed relationship (as cohabitants) between two partners. In such a situation, no law can make bound the two people who are living together, and they can move or separated at any time whenever they feel so; without any further legal consequences. There are an increasing number of couples entering into live - in relationships, not as a forerunner but rather an alternative of formal marriage institution. Such kind of long - term obligation often includes procreation of children. The live in "by circumstances", the cohabitants may procreate on believe that he/she will become legally married as of now they are 'de facto married' and after procreation they will be 'de jure married'. About the status and rights of such children born out of live in relationship, there are various legal issues arise, in comparison to those born out of marriages. Due to lack of proper legal definition of a live-in relationship, the status of such a relationship is unable to fix legally. So it is an ambiguous and uncertain legal issue to be solved in one go. The laws in India, does not provide suitable civil liberties or obligations to the parties who are in a live-in relationship. The children who are born as a result of such a relationship are not given a clear status that is why the courts have made available an explanation to the concept of live-in relationships through an assortment of judgments in the past few years. The courts have substantially stated that any heterosexual persons who are cohabiting for a long time will be presumed as legally married under the law unless contrary is proved.

In all early families in the society, it is very important in particular to have male progeny for the furtherance of the family as well as for the performance of interment rites and offerings. Thus the

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concept of *Aurasa* son was taking very essentially. An *Aurasa* or legitimate son is defined by Manu as one "whom a man begets on his own wedded wife"[1]. The procreation during continuation of a lawful wedlock was essential to represent the son as Aurasa son in the strict sense.[2]

The decision of Privy Council in ***Pedda Ammani v. Zaminder of Marungapuri***[3] that "Hindu law does not require procreation, as well as birth, after marriage to render a child legitimate is binding as law."

LEGITIMACY OF CHILDREN

It is the concept of the past, 'illegitimacy', having origin in Roman law termed as *"Nullius Filius"* and drift to the common law and well entrenched its roots there. However, Muslim law hold it very rigidly but concurrently adopted preventive course to see that all born legitimate child does not befall illegitimate. Thus it introduced the legal concept of *"Acknowledgement of Paternity"* and *"Iddat.*[4]

Under Section 16 the Hindu Marriage Act 1955, it is frequently argued that, the legitimacy of children out of void and voidable marriages, the interpretation and legislation assign a legal status as legitimate in law to children born out of live in relations and create it, a subject to debate regarding their property and maintenance rights. The interpreting analysis of section 16 (3) provides the rights of illegitimate children born from void or voidable marriages only. So it is not possible to legalize the status of children born from a live-in-relation in a reasonable period of time, under section 16 (3) of Hindu Marriage Act 1955. The gist of the provision as we can analyse that a void or voidable marriage is an attempt to enter into a marriage institution, although essential requirements for a valid the marriage could not be fulfilled under Section 5 of the Hindu Marriage Act 1955. However in recent inclination, live-in-relationship does not have any attempt to get married.[5]

The Indian Evidence Act under Section 112 also provides that "the legitimacy of a child is proved only if he/she was born during the continuance of a valid marriage between his/her mother and the father, if consequently they fail to prove the validity of marriage and children

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1. Manusmriti IX:166; Yajn. XI:2.
2. Misra Justice Ranganath & Dr. Kumar Vijender, Mayne's Hindu Law and Usage, 274, (Bharat Law House, 17th Ed., 2014).
3. (1874) I IA 282, 293.
4. Hari Dev Kohli, Law and Illegitimate Child From Sastrik Law to Statutory Law, 34, (Anmol Publication, Edition 1st, 2003).
5. Section 16 (3), Hindu Marriage Act 1955.

born out of such relationship"[6]. So in India, children from parents who are in live in relationship have been given the status of *"Legitimate in law, Illegitimate in fact".*

In ***S.P.S. Balasubramanyam v. Sruttayan***[7], the SC had said, "If a man and woman are living under the same roof and cohabiting for some years, there will be a presumption under *Section 114* of the Evidence Act that they live as husband and wife and the children born to them will not be illegitimate." This was one of landmark judgements wherein the apex court for the first time recognised live-in relationship and also preserved the legitimacy of the children from such relationship. The court's interpretation in the status of such a child is to be in accordance with the Constitution of India vide *Article 39(f)*, which imposes the State a responsibility of to provide "the children with adequate opportunity to develop in a normal manner and safeguard their interests."

Mohammedan law is a strict personal law relating to recognition of children. So according to it, legitimate children are those children who are the progeny between a man and his legally wedded wife as. Thus children born from a live - in relationship were "illegitimate" in the eye of existing Muslim personal law.

The Andhra High Court in ***S.A. Hussain v. Rajamma***[8], held that "where the paternity of a child cannot be proved by establishing a marriage between the parents, Islamic law recognises 'acknowledgement' as a method whereby such marriage and such legitimate descent can be established as a matter of substantive law for the purpose of inheritance."

The provision under Section16 (3) of the Hindu Marriage Act 1955 required to be amended to bring the social reform, by recognising the status of legitimacy on children born from live in relationship too. But the society always raising questions in live-in-relationship that it is never performed marriage between the cohabitants and further in those relationships which is not confirm to the established factor, the parties will not be recognised as husband and wife and their children will become illegitimate.[9]

The Supreme Court in ***Bharatha Matha & Anr. v. R. Vijaya Ranganathan & Ors.***[10] observed that "thus, it is evident that Section 16 of the (Hindu Marriage) Act intends to bring about social

6. Section 112, Indian Evidence Act 1972.
7. 1994 AIR 133, 1994 SCC (1) 460.
8. AIR 1977 AP 152.
9. *Supra* note 5.
10. AIR 2010 SC 2685.

reforms, conferment of social status of legitimacy on a group of children, otherwise treated as illegitimate, as its prime object. The Courts in India have continued to support this interpretation of law in a manner to ensure that no child is bastardized without a fault of his/her own, as it has been seen in the above case." In this case, the Supreme Court also had held that "a child born out of a live-in relationship may be allowed to succeed in the inheritance of the property of the parents and subsequently be given legitimacy in the eyes of the law."[11]

In ***Tulsa v. Durghatiya***[12] the Supreme Court held that "a child born from a marriage like relationship will no more be considered as an illegitimate child. The crucial pre-condition for a child born out of a live-in relationship to be not treated as illegitimate is that the parents must have lived under one roof and co-habited for a significantly long time for society to recognize them as husband and wife and it should not be a 'walk in and walk out' relationship." In the similar context, the Supreme Court has pointed out its judgment in ***Madan Mohan Singh and Ors vs. Rajni Kant & Anr***.[13]

The Supreme Court held in ***Vidhyadhari v. Sukhrana Bai***[14], that "even if a person had contracted into second marriage during the subsistence of his first marriage, children from the second marriage would still be legitimate though the second marriage would be void." the Privy Council in ***Mohd. Baukar v. Shurfoon Nissa Begum***[15] held that "legitimacy of children of Mohammadan parents may be inferred without any direct proof of marriage, if there is prolonged and continuous cohabitation. Thus in a case where a couple has lived together for a long term, there shall be presumption of marriage and a child born out of that relationship shall enjoy all the rights of a legitimate child."

In the case of ***Haneefa v. Pathummal Beevi***[16] court held that "where in certain circumstances give rise to the presumption of marriage, they also give rise to presumption of legitimacy of the child."[17]

Justice ***C. S. Karnan ruled in Aysha v. Ozir Hassan***[18] that "the petitioner was not entitled to

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11. Rebecca Furtado, Rights Of Child Born Out Of A Live-in Relationship, I-Pleaders blog, 2016, (21th September, 2019, 04.23 pm), https://blog.ipleaders.in/rights-child-born-live-relationship/.
12. (2008) 4 SCC 520.
13. AIR 2010 SC 631.
14. (2008) 2 SCC 238.
15. (1859) 8 MIA 136.
16. 1972 KLT, 512.
17. Fatima Tanzeem, Islamic Law and judiciary, 152, (Deep and Deep Publication, 2001).
18. 2013 (5) MLJ 31.

claim maintenance as the marriage between the petitioner and the respondent was not proved through documentary evidence but the respondent was the father of the two children and required him to pay them each Rs 500 per month."

MAINTENANCE RIGHTS OF CHILDREN

In civil matters it is always explained maintenance as the obligation to afford for another party. It is necessary to mention that it plays a very important rule for a child born out of a live-in relationship. ***The Hindu Adoptions and Maintenance Act 1956***,[19] states, "a legitimate son, son of predeceased son or the son of predeceased son of predeceased son, so long as he is minor, and even after attained majority if such child is by reason of any physical or mental abnormality or injury unable to maintain itself and a legitimate unmarried daughter or unmarried daughter of the predeceased son or the unmarried daughter of a predeceased son of predeceased son, so long as she remains unmarried, shall be maintained as dependants by his or her father or the estate of his or her deceased father." The "right to maintenance during the life time of his or her father or mother" is always the situation with children from live - in relationships. Under Section 125 of the Code of Criminal Procedure maintenance is provided to children irrespective of legitimacy or illegitimacy while they are minors and when they become major, but he/she unable to maintain himself by reason of any physical or mental aberration or injury.[20] In ***Dimple Gupta v. Rajiv Gupta***[21] the right to maintenance of children born from a live - in relationship was upheld. The Supreme Court in this case held that "even an illegitimate child born out of an illicit relationship is entitled for maintenance under Section 125 of the CrPC (Code of Criminal Procedure, 1973) which provides maintenance to children whether they are legitimate or illegitimate while they are minors and even after such a child has attained majority if he/she is unable to maintain himself/herself." Moreover there are handfuls of cases which have upheld the maintenance rights of live-in partners and the interpretation of the statutes are intriguing in a very broad manner to include female live- in partners regarded as "legally wedded wife". The Supreme Court of India in the case of ***Savitaben Somabhai Bhatiya v. State of Gujarat***[22] made an exception that "the live-in partner had assumed the role of a second wife and was not granted

19. Section 2, Hindu Adoptions and Maintenance Act 1956.
20. Dr. Vijender Kumar, Live-in-relationship: Impact on marriage and family institutions, 19, SCC J-19 , 2012 Vol.4.
21. (2007) 10 SCC 30 : (2008) 1 SCC (Cri) 567.
22. AIR 2005 SC 1809.

any maintenance, whereas the child born out of the said relationship was granted maintenance."[23]

Under Article 32 of the Constitution of India, the rejection to provide maintenance to a child born out of a live-in relationship can be challenged. This is amounting to a violation of the fundamental rights guarantees under Article 21 as Right to Life and Personal Liberty. Denial of such kind can deprive an individual of his right to live life with dignity. The Kerala High Court upheld the same by the in ***PV Susheela v. Komalavally.***[24] Under Article 14 the Equality before Law is the remedy to the unequal treatment of a child born out of a live-in relationship and a child born out of lawful wedding, though in both the cases are perceived as legitimate in the eyes of law[25]. It can be seen in the legal filtration as a very sensitive and a complex issue.[26]

GUARDIANSHIP AND CUSTODIAL RIGHTS

Custody of a child in live in relationship is very significantly legal obstacle as comparison to married one. When there is a child as a result from such live in relationship without a proper legislation, it is easy to get involved in such relationship, but it is tough decision to get out from it. There is no specific law in regarding to take custody of a child born out of a live-in relationship, so the existing law for children born out of married couple, is also applicable to child born out of a live-in relationship.

In the ***Hindu Minority and Guardianship Act, 1956***[27] clearly states that "the father is the natural guardian of his minor legitimate children and the mother becomes the natural guardian only in the absence of the father; which means when the father is not capable of acting as the child's guardian mother becomes guardian of the minor child." And same has been laid down in the case of ***Gita Hariharan v. Reserve Bank of India***.[28]

In Hindu law, after the marriage of a man to a girl who is a legal minor, the husband is the legal guardian of his wife as a minor and is entitled to her custody. The mere fact that she is a minor will not disentitle her from claiming such custody to the exclusion of her parents. Where the father and the mother are not married to each other and a child is born to such parents, the mother and not the father has the parental responsibility for the child. Section 6(a) of the Hindu Minority

23. *Supra* note 11.
24. (2000)DMC376.
25. Bharata Matha & Ors. Vs. Vijaya Renganathan & Ors (AIR 2010 SC 2685).
26. *Supra* note 23.
27. Section 6, Hindu Minority and Guardianship Act, 1956.
28. AIR 1999 2 SCC 228.

and Guardianship Act 1956 provides "the father as the natural guardian of his minor legitimate children and the mother becomes the natural guardian in his absence" i.e. where he is incapable of acting as the guardian. However, Section 6(b) of the Hindu Minority and Guardianship Act 1956 grants an indirect right to custody of a child born from live in relationship to the mother in the impression of illegitimate relation. While we interpret the law positively, it can reach in the conclusion that, if a break-up happens between the live-in the partners, then by being the natural guardian of a legitimate child, the father can be acquired the custodial rights naturally of the concerned child.

It is the ***Hindu Minority and Guardianship Act, 1956 under Section 13*** of talking about the "welfare of the concerned minor to be of paramount consideration and thereby to negate the effect of previous provisions if they are in contravention of the said section."[29]

In ***Shyam Rao Maroti Korwate v. Deepak Kisan Rao Tekam***[30], it was held that "the word, 'welfare' used in Section 13 of the Act has to be inferred literally and must be taken in its broad sense. Such an interpretation is in unanimity with the development of the child as a capable and independent individual."

The Muslim law always recognises the father, for the legitimate children as the natural guardian, but the mother even for a legitimate child, does not become the natural guardian even after death of the father. Only through case law, guardianship of illegitimate children is given to mother, because Muslim law does not provide guardianship of illegitimate children. Till a minor son attains age of 7 years and a daughter till she reaches puberty mother is the guardian according to the Hanafi school of Law. However under Shia School of Law, till he attains the age of 2 years in case of son and of till attains the age of 7 years in case of daughter; mother is the guardian.

It is the settled law that, deciding a matter on custody; age, sex, welfare of the child, his or her wish to stay with whom, the court takes into account. The welfare of the children must be the paramount consideration. This rule also applies in custody issues of the children from live - in relationships.

RIGHT TO INHERITANCE OF CHILDREN

"An illegitimate child inherits the property of his mother only and not putative father," whereas under Shia law, such a child cannot even inherit from his mother. If children from a live - in

29. Section 13, Hindu Minority and Guardianship Act, 1956.
30. 2010 (10) SCC 314.

relationship are still being considered "illegitimate", they will be barred to inherit from the father's estate. In fact, where the live - in relationship has not been continued for a reasonably long period of time, the courts would not consider a child from such relationship to be legitimate, thereby exclusion from inheritance as well.

The Supreme Court in ***Bharatha Matha & Anr. vs. R. Vijaya Renganathan & Ors***[31], held that "a child born out of a live-in relationship is not entitled to claim inheritance in Hindu ancestral coparcenary property (in the undivided joint Hindu family) and can only claim a share in the parents' self-acquired property."

Under the Hindu Succession Act, 1956, "a legitimate Child means both son and daughter from the Class-I heirs in the Joint Family Property" and "an illegitimate child means who can inherits the property of his/her mother only and not of the putative father."

To get the inheritance rights under personal laws, the precondition affair is legitimacy. Subsequently, the Courts have always made certain that a live-in relationship should be of a reasonable period and any child who is born from live-in relationship should not be deprived of the right to inheritance and this must be in conformity with ***Article 39(f)*** of the Constitution of India.[32] The Supreme Court in ***Vidyadhari v. Sukhrana Bai***[33] granted that "the right of inheritance to the children born from a live-in relationship and ascribed them with the status of 'legal heirs'."

Hindu Marriage Act 1955 under Section 16, sub clause (1) & (2) openly declare that "children born out of void or voidable marriage, should be deemed as legitimate children in the eyes of the law." However, live in relationship neither a void nor voidable marriage to be remedied under the above provision. Therefore, to sort out such conflict and to prevent discrimination against children born out of marriage like relationship, and this may lead to and legally entitled to all the rights in the property of their parents, both self-acquired and as coparcenaries, required an amendment in to this section. Subsequently, in ***Parayan Kandiyal Eravath Kanapravan Kalliani Amma and Ors vs. K. Devi and Ors***[34] Supreme Court held that ***"the Hindu Marriage Act 1955,*** a beneficial legislation, has to be interpreted in a manner which advances the objective of the law."

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31. AIR 2010 SC 2685.
32. *Supra* note 26.
33. AIR 2008 SC 1420.
34. (1996) 4 SCC.

If there will be a subsequent amendment of the ***Hindu Marriage Act Act 1955*** relating to Section 16, it will eliminate the dissimilarity between children born out of valid or void or voidable marriages, and children born from any kind of marriage like relationship. This will bring about social reforms and stable social status of legitimacy on innocent children, to whom some restrictions imposed on rights guaranteed under the Section 16.[35] The Supreme Court in ***Revanasiddappa v. Mallikarjun***[36] opined and granted that "the right to inherit the property of the biological father of the four children born from the woman with whom he was a live - in relationship by them 'his legal heirs'." Thus the Court has ensured through many precedents that no child be denied their inheritance right who is born from a live - in relationship of a reasonable period of time.

The Supreme Court had opined in ***SPS Balasubramanyam v. Sruttayan***[37] that "If a man and woman are living under the same roof and cohabiting for a number of years, there will be presumption that they live as husband and wife and the children born to them will not be illegitimate." In this landmark decision the apex court by interpreting the provision in according with Article 39(f) of the Constitution of India and upheld the legitimacy of the children born out of live in relationships and confirmed that "the responsibility on the state to provide children with opportunities to develop in a healthy manner and safeguard their interests." In the case of ***Uday Gupta v. Aysha and Anr***[38] it was held that "if a man and woman are living together for a long time as husband and wife, though never married, there would be a presumption of marriage and their children could not be called to be illegitimate."

STATUS OF CHILDREN BORN OUT OF NON-MARITAL COHABITATION IN OTHER COUNTRIES

Legitimacy is a status conferred by law which has created many issues globally. A child enjoying legitimate status is entitled to full recognition as a member of the family group in question and he or she has all the legal rights which such status involves. The child who does not enjoy such status is illegitimate and will suffer disadvantages as a consequence. In addition to legal disadvantages, there are social consequences which result from being classed as illegitimate, although the stigma attached is not as great as it formerly was. In recent years the general trend in most jurisdictions has been to reduce the consequences of illegitimacy, and some jurisdictions

35. *Supra* note 32.
36. (2011) 11 SCC 1 : (2011) 3 SCC (Civil) 581.
37. AIR 1992 SC 756.
38. SPECIAL LEAVE PETITION (Criminal.) No. 3390 OF 2014.

have even abolished the status of illegitimacy altogether.

UNITED STATES OF AMERICA

In United States of America, children born out of wedlock have not traditionally enjoyed the same legal protections as children born in wedlock. Such children were historically referred to as "bastards" in a legal context. However, many restrictions on illegitimate children have been repealed in most of the states now. State laws have traditionally prevented unmarried couples from adopting children. Though some states have begun permitting unmarried couples to adopt, these couples still must surmount prejudice and may face other difficulties. Married couples, on the other hand, are permitted to adopt and are usually preferred over unmarried individuals.[39]

In US substantial inroads have been made in abolishing the distinction between legitimate children and illegitimate children. The US Supreme Court has held that discrimination against the illegitimate child violates the equal protection clause in the constitution.[40] In ***Trimble v. Gordon***[41] in 1977 the court by 5:4 majorities held that an Illinois statute which provided that illegitimates could inherit from their mothers but not from their fathers was unconstitutional. Here the child's paternity had been established before death, the father was supporting the child and had acknowledged her as his child. The issue of unconstitutionality on the basis of discrimination against illegitimate child has also arisen in connection with the Social Security Act,[42] various support statutes[43] and immigration laws.[44]

UNITED KINGDOM

The couples living together without marriage in the United Kingdom does not enjoy the status of married couple. They do not have same legal rights and duties as assured to married couples. Though they are free to maintain each other separately, there exists no duty or obligation on anyone of them to maintain other. Though the partners do not have inheritance right over each other property but one is eligible to be maintained where a partner had specifically mentioned the name of other partner in the will. Thus couple in such a relationship is not plainly free from all legal consequences. The state pensions that are available to the wives and civil partners who have legalized their status are not similarly applicable to partners who live together unmarried.

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39. Cohabitation and the Rights Conferred under the Law, (July 29, 2020, 11:20 AM), https://www.stimmel-law.com/en/articles/cohabitation-and-rights-conferred-under-law.
40. Homer J. Clark, Constitutional Protection of Illegitimate Child? (1979), 12 U.C.D.L. Rev. 383.
41. (1977), 430U.S 762.
42. Richardson v. Devis (1972) 409 U.S. 1069.
43. Gomez v. Parez (1973) 409 U.S. 535.
44. Fiallo v. Bell (1977), 430 US 7787.

Bereavement allowance that is available to widowed person is also not available to surviving live-in partner if the other dies. However, the law seeks to protect the rights of a child born under such relationships and hence both parents have the responsibility of bringing up their children irrespective of the fact whether they are married or cohabiting'.[45]

FRANCE

Both French tradition and the French law consider the biological parents as the persons most naturally inclined to serve the interests of their children. The right to custody of one's children is included within the scope of parental authority.

A new Article in the Civil Code introduced the principle of equality between legitimate and illegitimate child. This reform allowed an illegitimate child to inherit its father. In case of unmarried parents, same rules apply to cohabiting and non-cohabiting parents regarding establishing filiations.[46] Although in earlier times natural born children inherit only three quarters of the entire estate of their parents, however, now in France a natural child inherits from his parents similarly as a legitimate child does, of course, the estate is divided into equal shares among them and their legitimate siblings, if they exists. More importantly, natural children are now integral parts of their parents' respective families and lineages. Better yet, reciprocal inheritance is now permitted between natural born children and their parents. The central point to grasp with French inheritance laws is that children are specifically protected from being disenfranchised from parent's estate. Parent cannot freely dispose of any part of la réserve, which must be held for children.[47]

The French Civil Code states that the breakdown of a marriage or a relationship does not affect the rules governing the exercise of parental responsibility. Therefore, separated parents continue to exercise joint parental responsibility over their children, which is the general principle provided for by Civil Code.[48]

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45. The English Law Commission, Family Law, Illegitimacy, Working Paper No 74, 1979.
46. Jean Marie Le Goff, Cohabiting unions in France and West Germany: Transitions to first birth and first marriage, 7(18) Demographic Research 602(2002), (July 24, 2020, 05:20 PM), http://www.demographic-research.org/volumes/vol7/18/7-18.pdf.
47. French Inheritance Laws, (July 24, 2020, 12:40 PM), https://www.french-property.com/guides/france/finance-taxation/inheritance/rights/surviving-spouse.
48. Civil Code (France), Article 372.

PHILIPPINES

In Philippines children born outside a marriage are illegitimate.[49] The Family Code of Philippines provides for the legitimization of illegitimate children, however, children of cohabitants having no impediments to marry each other can only be legitimated.[50] Legitimating takes place by a subsequent valid marriage between parents.[51] The effect of legitimating a child retroacts to the time of the child's birth[52] and a legitimated child enjoys the same rights as a legitimate child.[53]

The Philippine Family Code provides that illegitimate child shall use the surname of his/her mother. Such children shall be under the parental authority of their mother and shall be entitled to support in conformity with provisions provided in Family Code of Philippines.[54] The effect of legitimating a child retroacts to the time of the child's birth[55] and a legitimated child enjoys the same rights as a legitimate child.[56] Philippine Civil Code provides that an illegitimate child shall receive a share equivalent to half of the share that will be received by a legitimate child who in turn shall receive a share of half of the value of the whole legitimate.[57]

SCOTLAND

The Family Law (Scotland) Act of 2006 has abolished the discrimination between legitimate and illegitimate child. It provides that no person shall be illegitimate whose status is governed by Scots law; and accordingly, in determining the person's legal status the fact that a person's parents are not or have not been married to each other shall not be taken into consideration; and further, such fact shall be left out of account in establishing the legal relationship between the person and any other relations.[58] Thus it has been made statutorily clear in Scotland that the child born out of wedlock will be legitimate and no person's status shall be illegitimate.

Even if there is no Will, a child of unmarried parents has a legal right to inherit from both parents and the families of both parents like a child born within marriage can inherit automatically from

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49. Family Code of Philippines, 1987, Article 220.
50. Family Code of Philippines, 1987, Article 177.
51. Family Code of Philippines, 1987, Article 178.
52. Family Code of Philippines, 1987, Article 180.
53. Family Code of Philippines, 1987, Article 179.
54. Family Code of Philippines, 1987, Article 176.
55. *Supra* note 13.
56. *Supra* note 14.
57. Civil Code of Philippines, 1949, Article 895.
58. Family Law (Scotland) Act 2006, Section 21 & The Law Reform (Parent and Child) (Scotland) Act 1986, Section1.

both parents and the extended family of both parents.[59]

In China couples also sign a contract for live-in relationship. The child born through such relationships enjoys the same succession and inheritance rights as are enjoyed by children born through marriages.[60]

AUSTRALIA

In Australia only when children are involved, de-facto relationships come under the jurisdiction of the Family Law Act, 1975. Although a parliamentary review committee is considering whether the Act should be extended to cover all de-facto relationships, at present it stands that the legal system is inconsistent in the way it deals with these relationships; laws vary between states, between the states and even between government departments.[61] Law grants common-law partners the same fundamental rights as married couples after two years of cohabitation; it casts a light on how common-law couples are treated. The presence of children can significantly affect the way a common-law relationship is viewed in the eyes of law.[62]

ITALY

In Italy, cohabitation is not as common as in other countries of Europe, because of its Roman Catholicism had a historically strong presence. However cohabitation without marriage has increased in recent years. There are significant regional differences in non marital cohabitation can be found, as non-marital unions are more common in the Northern Italy than in Southern Italy.

A survey report was published in 2006, which said that "long term cohabitation was still novel to Italy, though more common among young people."[63] In 2015, the children born outside of marriage were total of 28.7% which was total of 27.6%, in 2014. But this statics was varied in different parts of Italy as follows- Central Italy from 32.8% to 33.8%, Northeast Italy from

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59. Living Together and Opposite Sex Marriage: Legal Differences, (July 24, 2020, 05:20 PM), https://www.citizensadvice.org.uk/scotland/family/living-together-marriage-and-civil-partnership-s/living-together-and-opposite-sex-marriage-legal-differences-s/.
60. Dr. Swarupa N. Dholam, Socio-legal dimensions of 'live-In relationship' in India, (July 24, 2020, 05:20 PM), http://mja.gov.in/Site/Upload/GR/final%20article%20in%20both%20lanuage%20%281%29.pdf,
See also: Sonali Abhang, Judicial Approach to 'Live- In-Relationship' In India- Its Impact on Other Related Statutes, 19(12) IOSR-JHSS, 34, (2014), (July 24, 2020, 05:20 PM), http://iosrjournals.org/iosr-jhss/papers/Vol19-issue12/Version-4/F0191242838.pdf.
61. Helen Glezer, Cohabitation, https://aifs.gov.au/publications/family-matters/issue-30/cohabitation.
62. Sonali Abhang, Judicial Approach to 'Live- In-Relationship' In India- Its Impact on Other Related Statutes, 19(12) IOSR-JHSS, 34, (2014), (July 24, 2020, 05:20 PM), http://iosrjournals.org/iosr-jhss/papers/Vol19-issue12/Version-4/F0191242838.pdf.
63. Schröder, Christin (2006). Cohabitation in Italy: do parents matter?.Genus. 62 (3/4):53 85. JSTOR 29789325.

31.8% to 33.1%, Northwest Italy from 30.1% to 31.3%, Insular Italy from 22.4% to 24.2%, and South Italy from 19.4% to 20.3%.[64] Urban versus rural living also plays a role in cohabitation arrangements, a 2001 study described cohabitation in Italy as "still rare outside of large cities"[65]. In general, couple's relationships in Italy were characterized by very long engagements.

In 1975, certain fundamental improvements were done in Italian family law. These amended provisions were providing the same right to maintenance to children born out of a valid marriage *(filiazione legittima)* as well as to those born outside marriage *(filiazione naturale)*. Previously, children born outside of a legal wedding had to suffer legal drawbacks. In principle, unmarried parents have the chance to accept parenthood officially. This acknowledgement ensures to the legal validity of rights and duties toward the child. So far, Italy has witnessed no real establishment of legal regulations that regard informal unions. Judgments are basically made on the basis of respective situations. As an independent field of law it has not developed yet.[66]

CONCLUSION

The concept of live-in-relationship is not a new concept in India, although the name "Live-in-relationship" is heard openly in recent times. Avarudh Stris, Maitri Karar, Nata Relationships, Visiting Husband, Polyandry, Dhuka marriage etc.; are the concepts developing in India from the ancient period to existing period of time. There is no legal barricade or need to prevent a man and a woman cohabiting together without entering into the formal marriage in the form of marriage like relationship i.e., "live - in-relationship". The traditional society of India, however, does not endorse such living arrangements as a whole. In the language of Leon R. Yankwich, "There are no illegitimate children – only illegitimate parents." Since there is no specific law that recognizes the status of the couples in live in relationship, hence the law as to the status of children born to the couples in live in relationship is also not very clear. The greatest importance in the protection of child rights parameter is to ascertain the status of such children in law as well as in society. The need of the hour is that it should be the primary agenda of the legislation to ensure the rights of the children born out of marriage like relationships, i.e. live in relationship. The decisions pronounced by the Supreme Court of India hold significant

64. Statistics Report 2015, NATALITÀ E FECONDITÀ DELLA POPOLAZIONE RESIDENTE, 28th Nov 2016, (July 24, 2020, 05:20 PM), https://translate.google.com/translate?hl=en&sl=it&u=https://www.istat.it/it/files/2016/11/Statistica-report-Nati.pdf&prev=search&pto=aue.
65. Christin Löffler, Non-Marital Cohabitation in Italy, (31 March 2009), (July 24, 2020, 05:20 PM), https://www.demogr.mpg.de/publications/files/3367_1248875633_1_Full%20Text.pdf.
66. *Supra* note 65.

assessment in dealing with the fact in issues arising to identify the position of the children born out of live in relationship in socio-legal arena. Now it is out of harm's way to conclude that the modern society while fixing the debated issue turns into the well being of the legal circumstances; as a result the child born from a marriage like relationship is bound to face requirement of clarity of legal status in life, the origin and subsequent rights etc. This can lead to instability and insecurity in the child's life both mentally and emotionally. Legalizing live in the relationship means that a totally new set of laws are required to govern the relationship including protection in case of desertion, cheating, maintenance, inheritance, etc. Even courts are also trying to take the live-in-relation under the presumption of marriage. It is not recognised in any judgment independently as live-in-relationship. The harm caused to a "legally wedded wife" and her children and promotion of bigamy is two main arguments opposed to wholly legalize the live-in-relationships in India. To avoid these circumstances, a set of clear laws should be legislated and amendments to the existing ambiguous terms in present laws must be granted clarity on the status and rights of children born in a live in relationship. This will ensure uniformity and security to establish emotional, mental and physical developments to such a child.

RESPONSE OF LEGISLATURE AND JUDICIARY TO CRYONIC LIFE EXTENSION IN CANADA AND INDIA: A COMPARATIVE STUDY

- Dr Supreet Gill*

1. INTRODUCTION

Regardless of dynamic and rapid development in the field of cryonics, with membership statistics showing growth spurt every year, it largely remains an unregulated activity in major jurisdictions across the globe. This can be attributed to the laziness, denial and callous attitude of governments towards its use and regulation. More often than not, the response of any legal system towards advancement in medical field is that of an unrealistic expectation that it will not cause any conflicts in the judicial arena. However, this expectation is far from reality as tragically, neither society nor cryonics advocates have been able to avoid the inevitable. Cryonic life extension has brought with itself a lot of litigation which could have been avoided if effective legal framework were in place to deal with it. However, the ongoing litigation is expected to spark further litigation as judicial officers dealing with these cases lack a sound legislation that they may rely upon when called to adjudicate upon matters related to cryonic life extension. Whatever little assistance they have is only through already decided cases which actually create more problems than they solve, as current case law falls in realm of varied jurisdictions where judges decide on the basis of sensibilities and perception towards cryonics in a given community, which may or may not be in consonance with other jurisdictions or community set up. Owing to absence of significant case law and authoritative inaction, people in general are left with no legislative assurance which will eventually lead to chaos.

2. CANADA

Canada is by far the only jurisdiction which has addressed the issue of cryonic life extension with a direct legislation. However, what would be disappointing for people interested in cryonic life extension is that, the Province of British Columbia has placed a blanket ban on the practice. The reasons as to why this happened can only be understood by searching deeper into the judicial system of the country in respect of presence of cryonic organisations. In Canada, the

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presence of cryonic organisations offering preservation facilities is not as wide spread as it is in the United States. There are only a handful of cryonic organisations which are actively involved in cryonic preservation or promotion of it. Two of the organisations involved in cryonic preservation are the Cryonics Society of Canada and the Lifespan Society of British Columbia. A brief description of both the organisations and their role in propelling the cryonics movement in Canada is mentioned as follows:

I. CRYONICS SOCIETY OF CANADA

The Cryonics Society of Canada and its publication titled, Canadian Cryonics News (hereinafter CCN) was founded in 1987 by a psychology student at McMaster University named Douglas Quinn as its President. Quinn was heavily influenced by the cryonics ideology owing to the time he spent in United States[1] and he eventually enrolled as a member at Alcor to be cryopreserved upon death. Quinn took responsibility of publicising cryonics in Canada upon himself and also contacted media for the same. Owing to wide scale publicity by Douglas Quinn, few people enrolled with Cryonics Society of Canada to be cryonically preserved. Over the years Cryonics Society of Canada's outreach became more widespread and more people joined in. When the province of British Columbia banned cryonic life extension in the year 1990, the Cryonics Society of Canada was instrumental in lobbying vigorously against the legislation and since then has been making efforts to get it revoked. The province of Alberta also made similar attempts but to the delight of cryonics supporters such regressive legislation could not succeed.

II. LIFESPAN SOCIETY OF BRITISH COLUMBIA

The Lifespan Society of British Columbia is an organisation dedicated to using scientific methods and technology to promote the quality of life and enhancing lifespans. It is their belief that access to medical technology for expansion of lifespans is a fundamental right of each citizen. They organise conferences and talks in order to educate people in Canada about various technologies presently under development that may be instrumental in expanding lifespans of humans in the near future.

A. LEGISLATIVE RESPONSE: BAN ON CRYONIC LIFE EXTENSION IN BRITISH COLUMBIA

The province of British Columbia is the one and only jurisdiction in the whole world which has enacted specific legislation to ban the practice of cryonic life extension. A lot of research has

1. Douglas Quinn had previously worked at Trans Time in 1987,therefore he knew most people in American Cryonics Society.

gone into tracing the real reason and events which led to the passage of this law. The President of Cryonics Society of Canada has published an extensive account of his conversations with various people who were on the committee which recommended this law, but none of them were ready to take individual responsibility for enactment of this law, neither did they divulge the name of the person who added cryonic life extension in that clause. They maintain that it is a result of collective effort of the ministry. However, there are some people who blame religious thinking behind the passage of this law as the idea of preserving a dead body in cold and waiting for its revival is in complete contrast with principles of Christianity.[2] There are two legislations which deal with ban on cryonic life extension.

1. THE CEMETERY AND FUNERAL SERVICES ACT, 1990.

The law which places this blanket ban on cryonic life extension is the Cemetery and Funeral Services Act, Part 5, Section 57talks about "Disposition of Human Remains." This Act is a result of fourteen years of deliberations and suggestions of Gosse Royal Commission of 1976, a study conducted by a former law professor named Richard Gosse. It was passed by the legislature in April 1990.

The language of the section is as follows,

Sale of cryonics, irradiation and other kinds of arrangements forbidden: No person shall offer for sale or sell any arrangement for the preservation or storage of human remains based on cryonics, irradiation or any other means of preservation or storage, by whatever name called, that is offered or sold on the expectation of the resuscitation of human remains at a future time.

The Cemetery and Funeral Services Act 1989, Part 5, Section 53. (Canada).

The section completely prohibits any commercial activity related to offering services to cryopreserve individuals upon death. Section 129 provides for punishment for contravention of provisions of the above section. The section states that if any corporation is found in violation of Section 57 then they shall be liable to pay fine not exceeding ten thousand Canadian dollars. Additionally, each of the directors and officers of the organisation or company who knew about the offence and permitted or acquiesced it, in addition to the company being convicted, shall be liable to fine of ten thousand Canadian dollars or imprisonment for not more than one year or both.

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2. Lincoln Cannon, Resuscitation, by Cryonics or Otherwise, Is a Religious Mandate, Institute for Ethics and Emerging Technologies (Jan. 26, 2019, 10:06 AM), https://ieet.org/index.php/IEET2/more/cannon20140811

The Act is very rigid in its wording as well as its penalties for offences related to contravention of its provisions. However, in the opinion of the researcher, the Act leaves a lot of questions unanswered. It is not clear whether there is a ban on cryonic life extension or just the advertisement of it. Also, nothing has been said about situations where citizens living in British Columbia make arrangements for cryonic preservation outside of their jurisdiction and need to apply for transport related procedure in order to be shipped out of the state. The drafters responsible for the legislation have issued some clarifications when questioned about the above. The Cryonics Society of Canada have been trying for long to seek clarification on the above issue and they quote several instances of written correspondence with the bureaucracy wherein different people have expressed different opinions.

In one such conversation, Bruce McCullen, Director of Policy and Planning, once suggested that such citizens will not face any opposition from law authorities if the facility was located outside of British Columbia[3]. He also stated that the reason behind the legislation was mainly based on consumer protection principles and the intention of the legislators was to protect potential clients from consumer fraud as the science behind cryonics has still not been proved in practice[4].

As more people became aware of the idea behind cryonic life extension, there was a lot of lobbying and support for changing the law. In August 1992 a proposal to amend the Cemetery and Funeral Services Act was made by the Directors of Cryonics Society of Canada. Unfortunately, the request was denied. In written correspondence, dated November 1992, Mr. Moe Sihota, Minister, Labour and Consumer Services wrote that, "commercial transactions concerning cryonic life extension are prohibited because the technologies involved in cryonics are as yet unproven."[5] Appeals to review Section 57 were also denied by Ms. Joan Smallwood who succeeded Mr. Sihota as the Minister of Labour and Consumer Services. By the year 1994 the appeal to amend Section 57 had gathered enough support that the ministry was forced to form a Consultation Group to review the provision, but yet again the group denied any change in law as cryonics was still an "unproven science". In a letter dated October 17, 1994, Joan Smallwood clarifies that the present language of the Act does not prevent preservation of

3. Doughlas Quinn, British Columbia's Anti-Cryonics Law: How Did British Columbia's Anti-Cryonics Law Come to Be?, The Cryonics Society of Canada (Jan. 26, 2019, 10.:06 AM) http://www.cryocdn.org/law57.html#howwhy
4. *Id.*
5. Letter by Moe Sitoha, Minister, Consumer Labour Services, to Mr. Douglas Quinn dated November, 24 1992. (Jan. 26, 2019, 10:06 AM),http://www.cryocdn.org/BC_Nov92.html

humans or organs but targets the sale or advertisement of a technology which is yet not proved scientifically. She writes that, "The present wording of the Act is intended to be representative of the present state of medical technology and to prevent the possible exploitation of individuals at a vulnerable period in their lives."[6]

However, she assures that as and when this technology is proven, the ministry will consider requests for review. Therefore, she basically implied that they will cross the bridge when they come it to and any speculation preceding to the working proof of this science is uncalled for. Further in a letter dated November 2, 1994 she clarifies that there is no ban on research in the field of cryonic life extension and the ministry in fact will be supportive of any life saving or lifespan enhancing scientific technologies if they are discovered in the future.[7]

History repeated itself two years later when in the year 1996 requests were denied to amend the provision yet again and thereafter no attempts were made to review the Act. However, post the revolution in media and technology after the turn of the century, a need was felt to issue some sort of clarification on cryonic life extension as now more and more people could access information about it and had expressed interest in it. So, in September 2002, Solicitor General R.T. (Rich) Coleman issued a letter[8] to Olaf Henry, (who sought the clarification)and Tayt Winnitoy (Registrar of Cemetery and Funeral Services) clarifying his stand on cryonic life extension. Solicitor General Coleman stated that,

Funeral providers are prohibited from offering cryonics arrangements on the expectation of future revival, but that cryonics businesses are not prohibited from operating and consumers are not prohibited from accessing cryonics services. Although a BC funeral director cannot sell cryonics arrangements, a BC funeral director is not prohibited from preparation and transport for cryonics purposes (to an organization outside of BC, presumably).[9]

In the aftermath of this move, Registrar Winnitoy, who was contacted by the Cryonics Institute situated in U.S., reiterated the fact that a funeral director in British Columbia will not be prohibited from assisting in the preparation of transportation of bodies for the purpose of cryonic preservation out of the state.[10]

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6. Letter by Joan Smallwood, Minister, Consumer Labour Services, to Douglas Skrecky, dated October 17, 1994. (Jan. 26, 2019, 10:06 AM),http://www.cryocdn.org/BC_Oct94.html.
7. Letter by Joan Smallwood, Minister, Consumer Labour Services to Yes Bozzonetti dated November 2, 1994. (Jan. 26, 2019, 10:06 AM),http://www.cryocdn.org/BC_Nov94.html.
8. Letter by R.T. (Rich) Coleman, Solicitor General, to Olaf Henry, Dated September 4, 2002. (Jan. 26, 2019, 10:06 AM),http://www.cryocdn.org/BC_Sep02.html.
9. *Id.*
10. Letter by Tayt Winnitoy, Director of Operations to Cryonics Institute, Dated July 7, 2005. (Jan. 26, 2019, 10:06 AM),http://www.cryocdn.org/BC_Jul05.html.

2. CREMATION, INTERMENT AND FUNERAL SERVICES ACT, 2004.

In addition to the above Act and the lack of clarity that surrounded it, the legislature of British Columbia enacted another legislation which once again laid down the same provision. Cremation, Interment and Funeral Services Act of 2004 expressly prohibits any sale of service related to cryonics. Section 14[11] prescribes the ban and Section 62[12] lays down the penalty for the same.

Furthermore, penalties provided for in case of contravention of this statute are more stringent than the previous legislation.

Even after this provision was enacted, the officers in bureaucracy, actually in charge of running day to day procedural formalities maintained that the practice of selling cryonic life extension is illegal, but not the act of buying it from outside. So the citizens of British Columbia are free to enter into such contracts with organisations situated outside of the province but, within the province, no cryonics organisation can be set up business. It is to be noted here that language of the section is quite evasive as any reasonable person reading the legislation would understand that the practice of cryonic life extension is completely prohibited.

A valuable suggestion here would be that the legislature should either add an explanation to that effect or add another provision in the statute which clarifies this stand. Since a lot of funeral directors were taking the language of legislation at face value and rebuffing persons interested in cryonic life extension, a fresh campaign to review and amend the Act was launched in the year 2006. Unfortunately, so far cryonics enthusiasts have not had any luck in getting the legislature to shift their stand.

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11. Section 14 of the Cremation, Interment and Funeral Services Act, 2004 states that,
Section 14: Prohibition on sales, and offers of sale, of arrangements relating to cryonics and irradiation: A person must not offer for sale, or sell, an arrangement for the preservation or storage of human remains that is based on
(a) cryonics,
(b) irradiation, or
(c) any other means of preservation or storage, by whatever name called,
and that is offered, or sold, on the expectation of the resuscitation of human remains at a future time.

12. Section 62 of the Cremation, Interment and Funeral Services Act, 2004 states that,
Section 62: Offence Penalties
(1) an individual who commits an offence under this act is liable to a fine of not more than $10 000 or to imprisonment for not more than 12 months or to both.
(2) a corporation that commits an offence under this act is liable, to a fine of not more than $100 000.
despite subsections (1) and (2), the court may increase a fine imposed under this section by an amount of up to 3 times the court's estimation of the amount of monetary benefit acquired or accrued as a result of the commission of the offence.

B. JUDICIAL RESPONSE

The amount of litigation that was seen in the United States is incomparable to litigation in any other country. This is mainly due to the fact that cryonics movement started and grew in the U.S. and most of cryonic organisations are situated within the United States of America. Canada comparatively has witnessed less need for judicial intervention as they are still struggling with legislative side of it.

There is a singular case which went to court and is still pending in courts. The details of the case are discussed as follows:

LIFESPAN SOCIETY OF BRITISH COLUMBIA

V.

HER MAJESTY THE QUEEN IN THE RIGHT OF THE PROVINCE OF BRITISH COLUMBIA[13]

Background: Canada's province of British Columbia had placed a blanket ban on selling or advertising any service related to cryonic life extension and there are several individuals within that jurisdiction who are interested in seeking cryonic preservation upon death.

Facts: Keegan Macintosh, a citizen of British Columbia signed a contract with the province's only cryonic organisation, Lifespan Society of British Columbia to preserve his body after death. However, owing to the The Cemetery and Funeral Services Act, 1990 and Cremation, Interment and Funeral Services Act, 2004, the sale of cryonics was banned and attracted penal provisions which included imprisonment as well as hefty fines. Nonetheless, Mr. Macintosh as well as members of Lifespan were very keen to go ahead with the agreement pursuant to which they signed a four-page contract. This contract was said to be one of a kind and possibly the first ever contract in British Columbia for such arrangement. Once the contract was signed the Lifespan Society moved the Supreme Court of British Columbia in a civil claim filed on July 14, 2015, with their client Keegan Macintosh as co-plaintiff challenging the constitutional validity of Section 14 of the Cremation, Interment and Funeral Services Act, 2004 (hereinafter CIFSA). The President of Society stated that they had to do so as they were left with no choice.[14]

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13. Lifespan Society of British Columbia v. Her Majesty, The Queen in The Right of The Province Of British Columbia, November 27, 2014. Case No. 36041.
14. Carrie Wong, Anti-Cryonics Law Challenged by The Lifespan Society of British Columbia, The Lifespan Society of British Columbia, (Jan. 26, 2019, 10:06 AM), https://www.lifespanbc.ca/home/m/5632614/article/3385410. "Lifespan Society has tried in vain for years to get a good explanation from the government of British Columbia for how this archaic restriction came into existence and to get the government to repeal it….We are left with no choice but to commence this lawsuit."

Issues: The Plaintiffs chose to argue this from the constitutional perspective stating that provisions of Section 14, 61 and 62 infringed the following rights under Section 7 of Charter of Rights and Freedoms:

a. Right to Life: As the restrictive nature of CIFSA deprived a person to possibly extend his lifespan by denying him cryonic preservation.

b. Right to Liberty: As individuals who are interested in cryonics can not dispose off their bodies as per their choice.

c. Right to Security: As organisations or persons who are involved in sale of cryonics technology are threatened to be imprisoned.

The Plaintiffs sought the following declarations in the present case:

a. That pursuant to the Constitution Act, 1982, Section 52, the Cremation, Interment and Funeral Services Act of 2004, Section 14 was of no effect or force.

b. Alternatively, Section 14 does not prohibit selling or offering for sale of cryonic services or an arrangement for cryonics services.

Decision: The final decision in this is case is still pending as of this day (October 19, 2018) and the last date of hearing was June 2018. Hon'ble Justice Stephen Kelleher has dismissed the application for striking down Section 14, however he has still not ruled on the constitutional validity of the provision. He has highlighted the absurdity of the case in following words,

> "This case has bizarre aspects. These questions are academic. The court is being asked to act like a law firm to provide advice about possible future business activities ".[15]

The final outcome of the case is going to be very imperative in paving the path for future of cryonic life extension in Canada as now more people than ever are interested in it and they have to make arrangements with U.S. firms for preserving their bodies.[16] A better approach would be to address both the cryonicists' and public's concerns through community discussions, and then use inclusive regulation to achieve regulation on this untamed field. While an absolute denial may ease any social or moral feelings of dread, this will be brief if cryonics is proceeded in any

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15. Jason Proctor, B.C. man signs first-of-its-kind Canadian cryonic contract, CBC News, Nov. 26, 2016. (Jan. 26, 2019, 10:06 AM), https://www.cbc.ca/news/canada/british-columbia/cryonic-macintosh-life-death-1.3864946

16. Brad Pritchard, Frozen in time: why an Ontario man chose cryonic suspension decision helped Brian Watson stop worrying about the end, Alliston Herald, June 4, 2017. (Jan. 26, 2019, 10:06 AM), https://www.simcoe.com/news-story/7236145-frozen-in-time-why-an-ontario-man-chose-cryonic-suspension.

case, or if the quantity of individuals for cryonic life extension becomes bigger, in which case a noteworthy piece of the populace may have their rights superfluously confined.

3. INDIA

In the year 2016, when this research was started, there were very few cases or people in the country which indicated any interest towards cryonic life extension as a science. The only information about an Indian citizen interested in cryonic life extension came from the Cryonics Institute website which states that so far two Indians have enrolled themselves for the program but due to confidentiality agreements, their identities were not made available to the researcher. In the year 2008, Alcor in its quarterly magazine titled, Cryonics, published an article[17] about an Indian citizen named, Kumar Krishnamsetty, who was a qualified software engineer but later moved to film direction. While working in the United States, he came in close contact with some of the members of Alcor and was fascinated by what the science of cryonics had to offer. Additionally, cryonet has made public, an email dated July 8, 1999 written to Alcor by an Indian citizen named Gurvinder (no Last name stated), who proposed to set up a cryonics facility on the moon given the possibility that Earth may be destroyed in the coming centuries.[18] The email also states that this person was personally in touch with Robert Ettinger before his death and inquired about the possibility of brain suspension. The case of fourteen-year-old JS and the impending judgment by Justice Peter Jackson attracted a lot of attention worldwide. Justice Bhanwar Singh is a former judge of Allahabad High Court who co-authored an article with Dr. N.K. Bahl, a former district judge, Uttar Pradesh, on *India Legal* about the legal predicaments that the judiciary will face in the years to come regarding the practice of cryonic life extension in India.[19] The authors suggested that India should equip itself with a legislation before the storm of cryonic life extension hits us. The authors suggested two possible ways to handle the legal problems arising out of cryonic life extension,

"(i) Prohibition on the use or prospective use of cryogenic preservation. Legislation can be drawn to define the scope of any such prohibition, domestically and internationally.

(ii) A formal acceptance of cryogenic preservation in the country with concomitant regulation of the process and actors involved."[20]

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17. Chana de Wolf, Member Profile: Kumar Krishnamsetty,CRYONICSFourth Quarter 2008 at 12-13.
18. Email from Diana Singh dated Thu, 8 Jul 1999 05:34:59 -0700 (PDT),(Jan. 26, 2019, 11:08 AM),http://www.cryonet.org/cgi-bin/dsp.cgi?msg=12089.
19. Justice Bhanwar Singh, Dr. N.K. Bahl, Dead Yet Alive, India Legal Live, (Jan. 26, 2019, 11:08 AM),http://www.indialegallive.com/special-story/cryogenic-preservation-dead-yet-alive-43878.
20. *Id.*

Additionally, there has been some evidence which supports that the Indian Institute of Science, Bangalore has been engaged in research in the science of cryonic life extension and they have even set up a Centre for Cryogenic Technology where they study the physics of life at very low temperature. The Indian Cryonics Society is another organisation, which is a one man show run by Mr. Lovepreet Singh who is engaged in fundraising for the cause of cryonic life extension.

The year 2018, cryonics saw some development and it would not be wrong to state that the year 2018 introduced metamorphic revolution in the country.

A. CRYONICS RESEARCH INSTITUTE PRIVATE LIMITED, KOLKATA:

In April 2018, India witnessed the establishment of its first cryonic life extension organisation titled, Cryonics Research Institute Private Limited, based in a three-bedroom apartment in Kolkata.[21] The company formally registered itself with the Registrar of Companies on March 15, 2018. There are three directors of Cryonics Research Institute Private Limited, namely Parag Chatterjee,[22] Pijush Kanti Chatterjee[23] and Saibal Mazumdar[24] who are very enthusiastic about establishing a full fledged project in India which is estimated to cost around twelve to fifteen crore Indian rupees. They have expressed their intention to buy land in Gwalior or Agra for the same and are presently engaged in fund raising from various governmental and non-governmental organisation as well as private individuals. Mr. Parag Chatterjee stated that they will not be setting up a facility in Kolkata itself because they cannot predict the span of time for which a body may be under cryonic preservation and therefore they cannot establish a facility in a city like Kolkata which may be prone to being submerged under sea in the coming years. From the above statements it is clear that this company is quite serious about establishing a fully functional cryonic organisation. Also, the directors have been quoted saying that in order to resolve any legal issues that may arise, they have written to the central government through the Medical Council of India for which response is awaited as of April 2019.

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21. Achintyarup Ray, Freeze-preserve firm, kms from Behala cold tomb, Times of India, Apr. 10, 2018. (Jan. 26, 2019, 10.:06 AM), http://timesofindia.indiatimes.com/articleshow/63673267.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.
22. Parag Chatterjee, 43, one of the three directors and the bra the brains behind the company, is an alumnus of Bengal Engineering College and head of the Department of Computer Science in Engineering at a well known tech-college near the city.
23. Parag Chatterjee's father is a retired government employee.
24. Siabal Majumdar is a schoolteacher in Amtala, South 24 Parganas, Kolkata.

B. INDIA FUTURE SOCIETY:

India Future Society (hereinafter IFS) has been one of the most vocal voices in spreading awareness about cryonics in India. IFS, is a non-profit organisation which campaigns to increase knowledge about the incipient forthcoming technologies for masses and use of technology to enlarge human capacities. Avinash K. Singh is the founder and president of the India Future Society and has played a key role in spreading awareness about cryonics in India. IFS in their mission state that their main focus is on emergent technologies and functional perspectives that can be derived out of it for the benefit of entire human race. They want to attract like minded people who can channel the debate on a number of issues under research namely, mind uploading, simulated/ virtual reality, genetics, nanotechnology, radical life extension and Artificial General Intelligence (hereinafter AGI) that would contribute to the prosperity of our species. IFS had also tried to collaborate with KrioRus but unfortunately nothing could materialise. IFS is also responsible for the establishment of the Transhumanist Association of India (hereinafter TAI) which is a closed group existing on social media[25] with a total of two hundred and forty two members as of February 2019. Transhumanists encourage the use of innovation and hereditary qualities to enlarge human abilities and life expectancies. The TAI also augment an educated and profoundly tolerant discussion on the outcomes of these future progressions, and also other rising innovations.

RIGHT TO BODILY AUTONOMY AND THE CASE OF PRESERVATION OF BODY OF DECEASED GODMAN ASHUTOSH MAHARAJ

In Indian context, the rights of dead bodies find an implied protection under the Constitution of India, under the word and expression 'person' in Article 21, which is interpreted to include a dead person in a limited sense. In the case of ***Mujeeb Bhai v. State of U.P. & Ors.,*** the Allahabad High Court observed that,

The law has not so far defined a person to include a dead person. It, however, has some rights, which cannot be detached from it, even if the body is denuded of the life, which together forms a human being. ….We thus find that the word and expression 'person' in Art.21, would include a dead person in a limited sense and that his rights to his life which includes his right to live with human dignity, to have an extended meaning to treat his dead body with respect, which he would have deserved, had he been alive subject to his tradition, culture and the religion, which he

25. (Jan. 26, 2019, 10.:06 AM) https://www.facebook.com/groups/tranhumanistindia.

professed.

Ramji Singh Mujeeb Bhai v. State of U.P. & Ors., Civil Misc. Writ Petition No.38985 of 2004.

The only case which comes close to cryonic preservation for life extension in India is the infamous case of Ashutosh Maharaj and the preservation of his body by his followers with the hope of his revival. Mahesh Kumar Jha, known as Ashutosh Maharaj, headed a religious sect called Divya Jyoti Jagriti Sansthan (hereinafter DJJS) in Nurmahal town of Jalandhar district who was pronounced clinically dead at Apollo Hospital Ludhiana on January 28, 2014. However, his followers declared that he was not dead but merely in 'samadhi' and will return to life when he wishes. Therefore, they preserved his body in an ice chamber. What followed was a highly publicised legal battle the events of which were no less than a movie plot.

In ***Dalip Kumar Jha & Another v. State Of Punjab & Others***[26] it was held that the right to life of an individual, which includes his right to live with human dignity, shall have an extended meaning, which will include the right to treat a dead body with respect, which a person would have deserved, had he been alive, subject to his tradition, culture and the religion, which he professed.[27] The timeline of events that lead to the first ever judgment being delivered on the issue of cryonic preservation are described as follows:

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26. Dalip Kumar Jha & Another v. State of Punjab & Others, Civil Misc. Writ Petition. No. 7345 of 2014 & C.R.M. M-9195 of 2014.
27. *Id.*

Date	Detail of Events
January 2014	The godman popularly known as Ashutosh Maharaj was declared dead after he suffered from a fatal heart attack. However, his devotees refuse to accept this fact and declare that their guru is not dead but has merely gone into samadhi and will eventually emerge from it one day and hence they preserve his body in sub zero temperatures similar to that of Himalayan conditions suitable for meditation.
December 2014	1. A person by the name of Pooran Singh files a writ of habeas corpus seeking the release of the godman's body. However, when this writ was rejected by the court he petitioned the court for a post-mortem examination of the corpse. 2. A person named as Dilip Kumar Jha, who claimed to be the son of Ashutosh, also appealed to court, demanding that the body be brought to his home town in Bihar for cremation according to local rituals. The Hon'ble Punjab and Haryana High Court ordered that the last rites for Ashutosh be performed in fifteen days.
February 2015	The above mentioned ruling was later suspended.
July 2017	The Hon'ble Punjab and Haryana High Court granted permission to the followers to preserve his body in a freezer, although it was unclear whether the court had agreed with the sect's argument that its founder was still alive.

As of December 2018, the body of the godman is still being preserved at the premises of the 'dera' and disciples still affirm their belief in his return.

It must be pointed out here that the disciples have merely frozen his body in an ice chamber and

no modern methods of cryonic preservation have been applied to the body. The understanding of the researcher from the medical context is that, since the body was preserved without infusing a cryoprotectant, it is likely that ice crystal formation would have damaged most of the cells in his body.

However, in the tussle between faith and science, things are not always black and white, so one never knows, may be the godman returns to life in the future, true to the faith of his followers.

4. CONCLUSION

Legal problems can never be solved in isolation as law and society are very intimately connected and entangled with one another. Laws cannot be made without weighing its possible consequences on society or the people they intend to govern. It is true that very few legislatures across the world have responded to the problem of cryonic preservation. But the question that needs to be asked before delving into law making is whether our society has progressed to a stage where it is ready for cryonic preservation as an alternative to death. Would it be fair to give some people a second chance at life at the cost of resources of future generations which are not even born yet. Conversely, would it be fair to deny cryonic enthusiasts their chance at second life. Will a blanket ban on cryonic life extension, like the one in Canada give rise to litigation related to curtailment of right to seek medical treatment and right to bodily autonomy? All these questions need to be addressed and fast as the trend of cryonic preservation is catching up in several countries across the globe and if eventually the right to cryonic preservation is granted, it would lead to serious violation of rights of the people who will miss out on it due to lack of regulation. Jurisdictions across the world at least need to make one thing clear; whether they are for or against cryonic preservation, which would practically solve half their problems

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RESTITUTION OF CONJUGAL RIGHTS: CRITICAL APPRAISAL

- Ms Jasleen Chahal* & Ms Sunidhi Singh**

INTRODUCTION

As the common belief goes, marital bonds are pure. It is a sacrosanct union of two souls; a union which continues for forth-coming seven lives. This is the traditional perception of marriage in a common household. We have traveled far from the old days when people looked down at marital breakdowns. Rather, people would not come out only to put up their grievances for the sake of their family's reputation. But gone are the days when marriage got associated to and used decided a person's status in society. Today, marriages do come to an end and relationships do die. Staying away from a person with whom you cannot live is only logical.

Restitution of conjugal rights means bringing together two spouses who have parted. Its etymological meaning is to restore matrimonial relationships. Is this practical, owing to the modern state of affairs? Forcing someone to live with a person whom he/she does not want to live with is not right. It is an infringement of our fundamental rights to freedom, liberty and equality.

Restitution of conjugal rights is a foreign concept adopted by India. British brought it to India with them. It was being used by them in ecclesiastical courts.[1] They had jurisdiction to decide over family and religious matters. British left but the concept of restitution of conjugal rights stayed. Before colonization, there was no such concept in India.

Restitution of conjugal rights has been contained in Section 9 of the Hindu Marriage Act, 1955 for Hindus, Section 22 of the Special Marriage Act, 1954 for couples married under the Special Marriage Act, Section 32 and 33 of the Indian Divorce Act, 1869 for the Indian Christians, Section 36 of Parsi Marriage and Divorce Act, 1936 for the Indian Parsis and in the general law for Muslims. The provisions of the essentials of conjugal rights are the same in all the above statutes. In this paper, we will be discussing restitution of conjugal rights concerning Section 9 of the Hindu Marriage Act, 1955.

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1. HarvinderKaur v. Harmander Singh, AIR 1984 Dell 66.

UNDERSTANDING THE CONCEPT

To begin with, it is of utmost importance that we understand the concept of Restitution of Conjugal Rights first.

Restitution of Conjugal rights means the restoration of marital rights. It is available only for valid marriages. Matrimonial rights are those rights people get after marriage. These marital rights can be of the following broad types:

Right to cohabitation: To cohabit means to live together. After getting married to each other, two people automatically gain the right of living with each other in consortium.

Right to live with dignity and liberty with each other's family: It comes as a part and parcel of a marriage that both the spouses have to live with each other, respect each other's family members and be compassionate towards them.

Right to consortium: Consortium means companionship. It a common belief that in a marital relationship, the felling of oneness is a must. Both the spouses are expected to support each other in all the ups and downs of life.

Restitution of conjugal rights is a remedy provided against desertion. Whenever the aggrieved party applies for this remedy, the court passes an order, when totally satisfied that the plaintiff has been deserted by the spouse, asking the deserting party to resume cohabitation and lead a normal married life. If the deserting spouse refuses to obey the orders of the court, this act amounts constructive desertion and if it continues for the period of one year, this becomes a ground for divorce. When the marriage is voidab initio, this remedy cannot be invoked.

When one of the spouses abandons the other without reasonable cause, the aggrieved party has a legal right to file a petition at the District Court or the Family Court of the appropriate jurisdiction. In this manner, the deserted spouse may actually compel the other person to fulfill his/her conjugal obligations.

Whenever one of the spouses has without any reasonable cause deserted the other spouse and no cohabitation takes place, then, in that case the aggrieved party can approach the court to order the other party start co habitation. It is important that no other remedy should be available with the petitioner and the court is satisfied with the truth of the statements. Essential elements for the filing of a restitution suit are contained in Section 9 of the Hindu Marriage Act 1955.

Following are the essentials for restitution of conjugal rights :[2]

1. Withdrawal from society: For withdrawal to take place, it is important that one of the spouses leaves the other in order to end all marital relations, rights, duties and obligations with them. When the husband deserted his wife and thereafter was totally unresponsive towards her. It was held sufficient to show his withdrawal of society from his wife and therefore, wife's petition for restitution of conjugal rights was allowed.[3]
2. Without any reasonable cause: For this essential to be fulfilled, it is necessary that the desertion should have taken place with no substantial reason supporting it. A reasonable excuse can be an act, omission or conduct on the part of the petitioner which makes it a practical impossibility to live with the person, a sufficiently weighty and grave matrimonial misconduct, cruelty, both physical and mental, failure to perform marital obligations, insanity of the other spouse, remarriage of either of the spouse, ill-treatment by in laws etc.
3. With no other legal remedy available: This essential means that this remedy can be availed against the other party only when the other remedies being like judicial separation and divorce are not available.
4. Court satisfied with the truth of the filed petition: A case can only move forward if the statement in the filed petition if found to be true by the court of law. If the petition is not maintainable, the suit cannot move forward.

While filing the case for restitution of conjugal rights, the petitioner has the capacity to ask for maintenance too. This provision comes in handy when the petitioner does not earn and has no means of livelihood but the deserting spouse does.

Burden of proof is always on the partner who withdrew from the society of the petitioner. But, at first, the petitioner has to prove the truth of his statement. The burden of proof shifts from the petitioner to the respondent during the course of the suit. In the beginning, it stays with the petitioner and then it moves on to the respondent.

The deserting party has to prove the following that there was some reasonable cause behind the party leaving the spouse completely, there was no fault on the deserting party's behalf and

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2. Paluck Sharma, Restitution of Conjugal Right: A Comparative Study Among Indian Personal Laws, Indian National Bar Association (September 25, 2019 4:00 pm), https://www.indianbarassociation.org/restitution-of-conjugal-right-a-comparative-study-among-indian-personal-laws/.
3. SushilaBai v. Prem, AIR 1986 MP 225.

circumstances had become such cohabitation and resumption of a marital relationship was next to impossible.

This is the basic concept of restitution of conjugal rights. But even after all this; the court has the authority to only order in favor of cohabitation. There are no harsh penalties as such as to the proper implementation of the order. Under Order 21 Rule 32 of CPC 1908, when a person fails to comply with the decree of restitution of conjugal rights, the court can attach his/her property and sell, it under rule 32(3). This penalty also gets ruled out when the parties own no properties as a vast majority of the population is poor. This defies the basic understanding of justice that justice should not only be done but should also be seen to be done. In this case, it cannot even be seen to be done.

There is one positive thing about restitution. Gender discrimination can be observed throughout the statutes of personal laws but the provisions relating to restitution of conjugal rights were meant to be gender neutral. But that fact alone cannot save it as it is against many provision of the Indian Constitution which is the regarded as the grundnorm and is the source of all authority and laws in India.

This concept was brought in India before the commencement of the Constitution, but afterwards it must have been repealed like it has been in major economies of the world owing to its illogical standing. This can also be confirmed from the fact the long debates were held before restitution of conjugal rights could be ratified in the Parliament.

Honorable High Court has held that the concept of restitution of conjugal rights "is a relic of ancient times when slavery and quasi slavery were seen as natural. This is particularly so after the Indian Constitution came in to force, which guarantees personal liberties and equality of status to men and women alike and further confers powers on the state to make special provisions for their protection and safeguard.."[4]

One cannot be forced to spend his/her whole life with a person with whom he/she cannot live even for a moment.

4. ShakilaBanu v. Gulam Mustafa, AIR 1971 Bom 166.

CONSTITUTIONAL VALIDITY OF RESTITUTION OF CONJUGAL RIGHTS

The constitutional validity of restitution of conjugal rights has been tested mainly in the following three landmark cases:

T. Sareetha v. VenkataSubbaiha[5]

In this case, the petitioner (husband) filed a case of restitution of conjugal rights against the respondent (wife), who was a celebrity. In response the wife gave the contention that right to privacy was guaranteed to her under Article 21 of the Constitution, which confers on a woman, a right to free choice as to whether where, when and how her body is to be used for the procreation of children and by whom her body parts are to be sensed. She contended that this freedom of choice is part of her right to privacy and is guaranteed by Article 21 as part of 'liberty'. By recognizing section 9 of Hindu Marriage Act, the State is violating the fundamental right of liberty. Further. It was also contended to be in violation of Article 14 as it was against the true concept of equality.

Justice P.A. Chaudhary struck down section 9 holding that it violates the right to privacy of wife by compelling her to have sexual intercourse against her will, which will be the ultimate consequence of cohabitation and consortium. He held that since section 9 was in violation of the fundamental rights to live with dignity and liberty, it is ultra vires the Constitution.It was held that decree of restitution of conjugal rights constitutes the grossest form of violation of an individual's right to privacy.State coercion of this nature can neither prolong nor preserve the voluntary union of husband and wife in matrimony.State coercion can neither soften the ruffled feelings nor clear the misunderstanding between the parties.Further, section 9 didn't promote any legitimate public purpose based on any concept of social good, and thus being arbitrary it is in violation of Article 14.

The husband's petition was accordingly dismissed.

HarvinderKaur v. Harmander Singh[6]

In this case the petitioner (husband) had filed a petition for restitution of conjugal rights against his wife (respondent). The Andhra Pradesh Court Judgment was cited in this case to support the invalidity of section 9.

Justice AvadhBihari dissented from the Andhra Pradesh judgment, stating that sexual

5. T. Sareetha v. V. Subbaiha, AIR 1983 AP356.
6. HarvinderKaur v. Harmander Singh, AIR 1984 Del 66.

intercource is only one of the elements of marriage. The Courts do not and cannot enforce sexual intercource. The remedy of restitution of conjugal rights aims at cohabitation and consortium and seeks to uphold the institution of marriage. It enforced not by imprisonment or detention of defaulter, but only by financial sanctions under civil procedure code. Further, it is only a step forward towards divorce. If the decree is not obeyed for one year, the remedy of divorce can be sought to under section 13 (1-A). So, to declare section 9 unconstitutional without giving any regard to section 13 (1-A) would be taking a very narrow view of things.

Validity of section 9 was upheld and the decree of restitution was granted in favor of the husband as the wife could not prove any reasonable cause behind her withdrawal from society. It was observed that the object of restitution decree is to bring about cohabitation between estranged parties so that they can live together in amity in their matrimonial home. Sexual intercourse is one of the elements to constitute consortium and is not the 'summumbonum' (highest good). It is a fallacy to hold that restitution of conjugal rights constitutes the starkest form of governmental invasion of marital privacy. The court further observed that introduction of constitutional law in home is like a bull in a China shop. Restitution was the introduction of the bull in the matrimonial home who will not resist from violation.

Thus, the remedy was held to be intra vires constitution.

Saroj rani v. Sudarshanchadha[7]

In this case, the decree in favor of restitution of conjugal rights was passed by the court. After that, when the wife came to live with the husband she was turned out after 2 months and the husband then filed a case of divorce under section 13 (1-A) of the Hindu Marriage Act, 1955. The wife contended that husband should not be allowed to take advantage of his own wrong.

The court had to decide on two matters, whether the suit of the husband was maintainable and should be allowed? The other question was regarding the Constitutional validity Section 9 of HMA, 1955. The Court discussed that mere non-compliance with a decree of restitution of conjugal rights does not constitute a wrong under section 23. Mere disinclination to agree to an offer of reunion is not serious enough a misconduct to justify denial of the relief to which husband or wife is otherwise entitled [8].It was also approved by the court that a consent decree in all cases could not be said to be collusive decree and where the parties had agreed to pass off a

7. Saroj rani v. Sudarshanchadha AIR 1984 SC 1562.
8. Dharmender Kumar v. Usha Kumar AIR 1977 SC 2298.

decree after attempts had been made to settle the matter[9] . Constitutional validity of restitution of conjugal rights was also discussed. The court held that after considering Section 23 of the HMA, 1955, the suit of the husband was maintainable and upheld section 9 of the Hindu Marriage Act to be constitutional.

CRITICALANALYSIS

1. **Purpose of Restitution of Conjugal Rights does not get fulfilled and there is insincerity of the petitioner in maximum cases:**[10] Even though it has been time and again quoted by the courts that restitution of conjugal rights is a remedy to save the institution of marriage, in reality it has only been used as a legal way of obtaining the decree of divorce. The very fact that the non-compliance of the decree of restitution for one year makes the deserted spouse eligible for filing a decree for divorce makes it a vulnerable rule which has been misused a lot of times. This rule was made in order to promote reconciliation between the spouses but most of such marriages end up in a breakdown. After all, relationships cannot be forced upon anyone.

   In the HarvinderKaur case, Justice Rohtagi has agreed to the fact that the remedy of restitution of conjugal right 'may be outmoded or out of tunes with the time. The restitution decree in the scheme of the Act is apreparation for divorce if the parties do not come together.'[11]

2. It defeats the purpose of fundamental rights guaranteed under the Indian Constitution: Article 21 of the Indian Constitution guarantees the right to life and personal liberty to all the citizens of India. Restitution of conjugal rights as a concept tries to indirectly curtail the rights of both the parties to a marriage by forcing to cohabit in consortium even when their relationship is such that they can't live together. As a consequence, they are forced to live in together, without giving them the option of exercising their right to privacy and right to choose which are vital for a developing society.

   Right to privacy has been held to be an integral part of right to life and personal liberty.[12] It was held that privacy is an essential part of dignity and *'dignity cannot exist without*

9. Joginder Singh v. Smt. Pushpa AIR 1967 P&H 397.
10. Mr. Prashanth S.J, Hindu Women And Restitution Of Conjugal Rights: Do We Need The Remedy?,Manupatra (September 23, 2019 3:34 pm), http://www.manupatrafast.com/articles/PopOpenArticle.aspx?ID=797c51f7-0615-4fa8-b92e-7d7d24d03689&txtsearch=Subject:%20Family%20Law.
11. HarvinderKaur v. Harmander Singh, AIR 1984 Del 66.
12. K.S. Puttaswamy v. Union of India, AIR 2017 SC 4161.

privacy. Both reside within the inalienable values of life, liberty and freedom which the constitution has recognized. Privacy is the ultimate expression of the sanctity of the individual. It is a constitutional value which straddles across the spectrum of fundamental rights and protects for the individual a zone of choice and self-determination.'[13] Forcing an individual to lead a life which is not of their choice defeats the purpose Article 21. When a decree for restitution of conjugal rights is enforced, the spouses are expected to live together in consortium[14] i.e. companionship which is a personal choice of an individual and cannot be forced upon them. It curtails our fundamental right to freedom under article 19 which gives us the freedom of expression and association.

3. **Right to make personal choices gets infringed and a disadvantageous situation for both men and women can be observed:** The word life in Article 21 denotes a life of dignity and not just animal life. It has been established by the Supreme Court of India that right to make choices regarding or privacy is an intrinsic part of the right to live a life of dignity. Whenever court orders in favor of restitution of conjugal rights, the right to self-determination indirectly gets curtailed as neither the husband nor the wife now has the choice of living a life of their choice.[15]

Let's face it that we live in a patriarchal society which has forever been functioning on the guiding principles of Manusmriti which has always looked down upon the weaker sections of the society and women. Women, of all, have had to face quite a lot and have been the victims of the worst of torture. Not stating that men have faced less of anything but women have always been portrayed and thought of as weak and fragile and have been abused to a greater extent. The continuance of this remedy is bound to lead to unwanted pregnancies, which is further an infringement of self-respect and self-fulfillment of women.

For their protection, it has been explicitly mentioned under Article 21 of the Indian Constitution that 'the woman's choice to make reproductive choices is also a dimension of "personal liberty"

13. K.S. Puttaswamy v. Union of India, AIR 2017 SC 4161.
14. Black's Law Dictionary, What is consortium?, Law Dictionary 2nd Ed. (September 26, 2019 3:24 pm) https://thelawdictionary.org/consortium/.
15. Paluck Sharma, Restitution of Conjugal Right: A Comparative Study Among Indian Personal Laws, Indian National Bar Association (September 25, 2019 4:00 pm), https://www.indianbarassociation.org/restitution-of-conjugal-right-a-comparative-study-among-indian-personal-laws/.

as understood under Article 21. It is important to recognize that reproductive choices can be exercised to procreate as well as to abstain from procreating. The crucial consideration is that a woman's right to privacy, dignity and bodily integrity should be respected. This means that there should be no restriction whatsoever on the exercise of reproduction choices such as a woman's right to refuse participation in sexual activity or alternatively the insistence on the use of contraceptive methods.' Agreed, that sexual intercourse is only an element of a marital relationship, but the fact that it is one of the most important elements cannot be denied because if keep the emotional bond at back-foot, the concept of marriage had initially emerged to give legality to the procreation of children who are a very important part of the evolution process, without whom the society cannot move forward and progress. The innocent men should also be allowed to use their right to choose and privacy to protect their dignity. Being men should not be used as a bias against our men. We live in the 21st century now and we know that women are not behind men in misusing legal provisions and gaining unnecessary sympathy. Take the example of the Dowry Act; no law has been more misused than this one in India for private gains.

Right to privacy is an integral part of life. This is a cherished constitutional value, and it is important that human beings be allowed domains of freedom that are free of public scrutiny unless they act in an unlawful manner. So if a spouse withdraws from the society of the other on being ill-treated, he/she should not be told to resume cohabitation despite their estranged relations [16]. They should be given the freedom of choice.

4. **Self-contradictory judgments:** In the Saroj Rani case, Justice SabyasachiMukherji referred to the case of T Sareetha and relying on the decision in HarvinderKaur, case held section 9 to be Constitutional. From Justice Rotagi's judgment, it can be clearly observed that he himself did not totally believe in the effectiveness of the concept of restitution of conjugal rights. Paragraph 78 of his judgment states that 'even the fervent and sincere hope of either of the spouses that there will be reconciliation cannot create a possibility of reconciliation where the other spouse is irreconcilable.

Whatever may be the cause of breakdown of marriage, if there is a withdrawal from matrimonial obligations with the intention of destroying the matrimonial consortium as well as physical separation, there is a clear sign that the marriage is at an end.[17]

On reading the judgments in HarvinderKaur and Saroj Rani case, it seems as if they have been

16. Ram Jethmalani v. Union of India, Writ Petition (C) No. 176 of 2009.
17. HarvinderKaur v. Harmander Singh, AIR 1984 Del 66.

given for the sake of giving since the statute mentioned the concept because in Para 85 and 87 of his judgment, Justice Rohtagi says that 'what has to be remembered is that it is not for the judges to rewrite the statute. It is for the legislature to amend and abrogate the law. As long as it does not change the law, we must learn to live with it.'[18]

5. **Constitution of India is the grundnorm and it has its full application in the private matters of an individual:** It was held in the Harvinder Kaur case that introduction of Constitutional law in home is like a bull in a china shop, but that is not the case. In India, all laws derive its powers from the Constitution and they become enforceable because of the existence of the Constitution. In Addition to that matters of our homes are deeply connected to our privacy and it has been held in the Puttaswamy judgment that 'the individual is the focal point of the Constitution because it is in the realization of individual rights that the collective well-being of the community is determined.

Privacy constitutes the foundation of all liberty because it is in privacy that the individual can decide how liberty is best exercised. Individual liberty and privacy are inextricably linked in a pattern woven out of a thread of diversity into the fabric of a plural culture. Privacy eminently qualifies as an inalienable natural right, intimately connected to two values whose protection is a matter of universal moral agreement: the innate dignity and autonomy of a man.'[19]

SUGGESTIONS:

In today's world, when literacy is growing fast it is impractical to think that any to people would want to consent to living together in cohabitation even after their relationship has worsened. Plus, most of the people now-a-days are not even dependent on each other for maintenance. They are either earning or have some inherited property to take them through the ups and downs of life.

In the poverty stricken sections of the society, restitution of conjugal rights is a far-fetched concept as they have more important problems to tackle first like hunger and thurst. Also, the large amount of money involved in the litigation process is not affordable by many and the awareness regarding State Legal Services Authorities is not yet widespread, let alone the

18. HarvinderKaur v. Harmander Singh, AIR 1984 Del 66.
19. K.S. Puttaswamy v. Union of India, AIR 2017 SC 4161.

awareness of the law.

Instead of forcing people to stay together against their wills, the following solutions can be sought to:

Out of Court Settlements:

People should be given an option of out of court settlements in the form of conciliation and mediation, where the atmosphere is less formal. For family matters it is necessary that things should be looked upon at with a sensitive mind.

Judges should be trained specially to deal with family matters. Even though there is already such provision but it has not been implemented properly. Family matters cannot be and should not be dealt with a firm approach. They constitute the basic unit of a society and a more practical approach should be made towards solving family disputes.

Repealing Old Laws and Formulating New Laws:

The provision of restitution of conjugal rights must be repealed from all the statutes as it is only worsening the marital ties instead of reconciling the fighting couples.

There is strong need for the formulation of pragmatic laws in India as the western influence on our society is growing by the hour which is making the people more prone to easier breakdown of marriages as marriage is a sacramental tie only in India.

Awareness Campaigns:

Awareness campaigning should be done once in a while by the administrative authorities to sensitize the people regarding the importance of marriage and issues revolving around it.

Government Intervention:

No matter how much we believe that no state intervention should happen in personal matters, there has to be some level of intervention because governments make laws and enforce legislations. Without their role, the society would become an uncontrollable crowd of unregulated people doing whatever they want to do.

CONCLUSION:

The concept of restitution of conjugal right is a foreign concept and made its way to India with the advent of the British administration when India was a colony under the crown rule. Somehow, even after the British left India, this concept managed to stay put. While the Hindu Marriage Act and its provisions were discussed before the enactment of the Act there were long

heated debates on whether the section should be included.

The funny thing here is that the countries which propounded the concept and took it further have now repealed all provisions relating to it calling restitution of conjugal rights to be an illogical and futile law. In today's world, when literacy is growing fast it is impractical to think that any to people would want to consent to living together in cohabitation even after their relationship has worsened. Plus, most of the people now-a-days are not even dependent on each other for maintenance. They are either earning or have some inherited property to take them through the ups and downs of life.

In the poverty stricken sections of the society, restitution of conjugal rights is a far-fetched concept as they have more important problems to tackle first like hunger and thirst. Also, the large amount of money involved in the litigation process is not affordable by many and the awareness regarding State Legal Services Authorities is not yet widespread, let alone the awareness of the law.

At the end, it can be concluded that the human society is still growing and so are the intricacies of their relations. Archaic laws must be repealed as soon as possible and new laws should be formulated which can handle all the new complexities with an open thought process and pragmatic view. If repealing is not the solution then at least, logical amendments should be done.

"If we desire respect for the law, we must first make the law respectable."

-Louis D. Brandeis

RIGHTS OF DIFFERENTLY-ABLED PERSON TO ACCESS HIGHER EDUCATION AND EMPLOYMENT: AN APPRAISAL

-Dr Sanjeeve Gowda G S*

1. INTRODUCTION

Every mother do have a confidence that her child would born, grow and lead a hale and healthy life and never fall prey to any kind of physiological or psychological disorder either at birth or thereafter. Many a time almighty do not belie her buoyancy. To our bad luck some children may bear with innate physiological or psychological 'barriers' either on birth or subsequently owing to accident, surgery, medicinal side effect etc., which would cripple him from, effectively and efficiently, participating in societal activities. This eternal disability is undermining their level of confidence as they are being looked down upon. Today it is, most fiery issue, drawing the attention of everyone with a hope of finding resolute means to resolve. An attempt is made herein to unravel gamut of it.

Today, there are millions of people living with one or multiple disabilities. In India, the population with disabilities is around 26.8 million, constituting 2.21% of India's total population, if one goes by the 2011 population census data.[1] There has been a marginal increase in the differently-abled population in India, with the figure rising from 21.9 million in 2001 to 26.8 million in 10 years. In an era where 'inclusive development' is being emphasised as the right path towards sustainable development, focussed initiatives for the welfare of disabled persons are essential.Despite constituting such a significant proportion of the total population, persons with disabilities live a very challenging life. Their 'disability' is often seen as their 'inability' by many and people in general have preconceived notions about their capabilities. There have been many cases where employers have denied a job to a candidate with a disability, citing the usual 'not found suitable'. The main problem lies in the psyche of a significant mass which considers persons with disabilities a liability, and this leads to discrimination and harassment against them and their isolation from the mainstream.

Persons with disabilities[2] face several forms of discrimination and have reduced access to

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1. Disabled Persons in India: A statistical profile 2016. A report by Ministry of Statistics and Programme Implementation, Govt. of India(Sept. 10, 2019, 10.00 AM), http://mospi.nic.in/sites/default/files/publication_reports/Disabled_persons_in_India_2016.pdf
2. Disabled is now addressed as Divyanginstead of Viklang.The Department of Empowerment of Persons with Disabilities will now be known as 'Divyangjan' SashaktikaranVibhag in Hindi, dropping the word 'viklangjan' from its previous nomenclature.

education, employment and other socio-economic opportunities. Dearth of infrastructural facilities to have access for the physically challenged-ramps, railings and accessible wash rooms – is just one of the reasons which prevent them from pursuing their studies. Trained staff and alternative teaching aides are seldom provided. This would impede differently-abled persons to compete with their peers.

The Constitutional mandate casts obligation on the State machineries to unveil legal measures for the protection and promotion of the interest of Differently-Abled Persons. The Convention on the Rights of Persons with Disabilities, 2006, aims to - empower persons with disabilities, -

a) respect for inherent dignity, individual autonomy including the freedom to make one's own choices, and independence of persons;
b) non-discrimination;
c) full and effective participation and inclusion in society;
d) respect for difference and acceptance of persons with disabilities as part of human diversity and humanity;
e) equality of opportunity;
f) accessibility;
g) equality between men and women;
h) respect for the evolving capacities of children with disabilities and respect for the right of children with disabilities to preserve their identities.

In furtherance of this Convention, being a party, the State promulgated, on 27th December, 2016, the Rights of Persons with Disabilities Act, 2016,[3] to facilitate the Differently-Abled Persons to lead 'barrierfree life[4]. United Nations General Assembly adopted it on the 13th day of December, 2006 and India ratified the said Convention on the 1st day of October, 2007.

2. CONCEPT OF DISABILITY

Disability is complex, dynamic, multidimensional, and contested. A disability is a result of the interaction between a person with a health condition and a particular environmental context. Individuals with similar health conditions may not be similarly disabled or share the same perception of their disability, depending on their environmental adaptations. Disabled people are the people with physical or mental incapacities, Disability generally varies in severity.

3. *Supra* note 1.
4. Right of Person with Disability Act 2016 §2(c).

Disability has been defined based on an evolving and dynamic concept, the nature of disabilities have been increased from existing 7 to 21[5] and the central government will have the power to add more types of disabilities.[6]

3. INTERNATIONAL INITIATIVES

A clamour for the rights of Differently Abled Persons hold its sway in, 1961, international arena with the adoption of Declaration on Social Progress and Development was adopted by the General Assembly of United Nations. A movement was initiated, in 1970s, to consider it as a human right issue. The concern for Differently Abled Persons made the UN General Assembly to proclaim the year '1981' as International Year of Disabled Persons in 1976. Thereafter, the UN declared 1983-1992 as Decade of Disabled Persons. The UN Convention on the Rights of Persons with Disabilities (UNCRPD), 2006 was a big leap towards viewing persons as "subjects with rights" and not "objects of charity".[7] Further, the 2030 Agenda for Sustainable Development pledges to "leave no one behind" urging that persons with disabilities must be both "beneficiaries and agents of change". However, the World Bank states that attitudinal, institutional, and infrastructural barriers remain with the 15% of the world's population who experiences some form of disability and that they "on average, as a group, are more likely to experience adverse socio-economic outcomes than persons without disabilities".

4. SCENARIO IN INDIA

The India society has been moving from charity to welfare and culminating in right based approach for persons with disabilities. Hitherto, thrust has been given to medical model of disability. Now the paradigm shift is made towards social model emphasizing the need to find attitudinal change bring Differently-Abled Persons to the mainstream and to provide them equal opportunities in order to have a perspective change viewing people with disabilities as subjects and not as objects.

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5. Blindness; Low-vision; Leprosy Cured persons; Hearing Impairment (deaf and hard of hearing); Locomotor Disability; Dwarfism; Intellectual Disability; Mental Illness; Autism Spectrum Disorder; Cerebral Palsy; Muscular Dystrophy; Chronic Neurological conditions; Specific Learning Disabilities; Multiple Sclerosis; Speech and Language disability; Thalassemia; Haemophilia; Sickle Cell disease; Multiple Disabilities including deaf blindness; Acid Attack Victim; Parkinson's disease.
6. The definition of disability as provided by UN Convention on Rights of Persons with Disabilities (UNCRPD) states that "Persons with disabilities include those who have longterm physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their fulland effective participation in society on an equal basis with others." But sometimes, disabled persons prove themselves to be "differently abled" by their intellectuality and positive outlook towards the life.
7. India is a signatory to the UNCRPD and ratified it in 2007.

On realizing the significance of Constitutional mandate[8] the Government accorded statutory status to the rights of differently-abled persons has and assured them with equal opportunities in education, health care, employment etc.[9] accordingly, several policies and schemes are unveiled in tune with the policies, of the Government, aiming at inclusive society.[10] National Policy for Persons with Disabilities, 2006, has termed Differently-Abled Persons as valuable human resource of the country and seeks to create an environment that provides equal opportunities, protection of their rights and full participation in society.

In this regard, it is felt that the Rights of Persons with Disabilities Act, 2016, would offer everlasting remedy to protect and to promote the rights of Differently-Abled Persons. This Act is offshoot of Constitutional mandate vis-a-vis United Nations Convention on the Rights of Persons with Disabilities, 2008 (UNCRPD). This has paved the way to attain legitimate expectations of Differently-Abled Persons.

4.1. THE RIGHT OF THE PERSON WITH DISABILITY ACT, 2016

The Rights of Persons with Disabilities Act, 2016, was promulgated on 27th December, 2016 by replacing the Persons with Disabilities (Equal Opportunity Protection of Rights and Full Participation) Act, 1995,[11] and in furtherance of United Nations Convention on the Rights of Persons with Disabilities,2006, and for matters connected therewith or incidental thereto. The object of the Act is to empower person with disability by providing equality in treatment and opportunities, accessibility to general services, non-discriminating behaviour and respect for inherent dignity, individual autonomy including the freedom to make one's own choices, and independence of persons. The Act made a move from 'concessional model' to a 'social one' by adopting 'inclusive policy'. Inclusion of acid-attack victims and people with learning disabilities, Parkinson's disease, blood disorders, speech and language disabilities amongst others. In the process of accomplishing the avowed objectives of the Act provisions are made for reasonable accommodation, accessibility, inclusive education, employment security, research and surveys, proactive measures to contain the issue of disability, protection against violence, legal guardianship, rights to appeal, etc.

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8. INDIA CONST. art. 14, 16, 21,38, 41, 42, 43, 46, 47, 48, 249 & 253.
9. The Mental Health Act, 1987, the Rehabilitation Council of India Act, 1992, the National Trust for Welfare of Persons with Autism, Cerebral Palsy, Mental Retardation and Multiple Disabilities act, 1999, Protection of Human Rights Act, 1993, Employees Compensation Act, 1923, the Employees State Insurance Act, 1948, and Public Liability Insurance Act, 1991, The Juvenile Justice (Care and Protection) Act, 2015.
10. Accessible Indian campaign or Sugamya Bharat Abhiyan, Deendayal Disabled Rehabilitation Scheme.
11. *Supra* note 1.

The Act was commended as it has increased the number of identified disabilities from seven to 21 and ordained to reserve not less than 4% in employment. Individual with at least 40 % of disability is entitled to get the benefits of Government schemes. It speaks about inclusive education and penalties for offences against Persons with Disabilities (PwDs). The Act also made provisions for the constitution of Special Courts (for speedy trial), national fund and a state fund for persons with disabilities.

PROHIBITION OF DISCRIMINATION

The Persons with Disabilities (Equal Opportunity Protection of Rights and Full Participation) Act, 1995, did not expressly prohibit discriminatory treatment to the persons with Disabilities. Whereas, the Act of 2016, aims to annihilate all forms of discrimination which may include any distinction, exclusion, restriction on the basis of disability with a purpose or effect of impairing or nullifying the recognition, enjoyment or exercise on an equal basis with others of all human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field and denial of reasonable accommodation[12]. However, the Act strangely makes the clauses on non-discrimination in employment mandatory only in government establishments. Persons with disability[13] have a right to get higher education and not making adequate provisions to facilitate their proper education would amount to "discrimination",

RIGHT TO EDUCATION

In the matter of higher education, the Act provides a strong set of measures to ensure that disabled students have access to Colleges and Universities

RESERVATION IN HIGHER EDUCATION

Education is an all pervasive right of an individual. It cannot be denied on the ground of disabilities. To ensure the rights of Persons with Disabilities to pursue Higher Education it is ordained that - Section 32 -

(1) All Government institutions of higher education and other higher education institutions receiving aid from the Government shall reserve not less than five per cent seats for persons with benchmark disabilities.[14]

(2) The persons with benchmark disabilities shall be given an upper age relaxation of five

12. Right of Person with Disability Act, 2016., § 2(h)
13. Person with Disability: means any person with long term physical, mental, intellectual or sensory impairments which on interacting with barriers hinders effective and equal growth in the society.
14. Persons with benchmark disabilities as those with at least 40% of any of the above-specified disabilities.

years for admission in institutions of higher education."

Albeit,at the outset afore mentioned provisions appears to be attractive in empowering Persons with Disabilities, in fact would give room for self-centric people to take deviation from the enjoined path and deny entitlement owing to lose knitted provisions e.g. recurring clauses like *'within the limit of their economic capacity and development', 'without imposing a disproportionate or undue burden', 'the extension of time depending on their state of preparedness and other related parameters', 'cannot be discriminated on the ground of disability.* Consequently, the goal of empowerment may well remain elusive and undermine the interest of Persons with Disabilities.

All the concerns of the people with disabilities haven't been addressed by the 2016 Act in entirety. Cushioning offered to private establishments is glaring. At first look, the private sector seems to be under the surveillance of the Act. However, it envelops a few areas leaving the rest at their disposition like - barrier-free access at private hospitals and among service-providers, or providing incentives in the case of employment, in which at least 5% of the workforce is made up of or reserved for persons with disabilities and an equal opportunity policy. Today, major players are private sector than public sector. Hence, this vacuum needs to be properly addressed. Trust, Disability Advisory Board would sit in the driving seat in this behalf.

All India Survey on Higher Education conducted by Ministry for Human Resource Development (MHRD) reveals that enrolment of Persons with Disability (PwDs) students in higher education has been increased. Thanks to the Government and University Grant Commission (UGC) has launched many schemes[15] and facilities to enhance the enrolment of the Differently-Abled Students in Higher Education. However, these schemes have not been fully implemented in all the higher educational institutions. The efficiency of the State machineries in providing equal educational opportunities to disabled/differently-able persons in higher education institutions still remains obscure. Thus, it warrants immediate attention to ease-out educational/pedagogical as well as infrastructural barriers that force exclusion of the differently-able persons in higher education.

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15. Upgradation of existing Polytechnics to integrate the Persons with Disabilities (PwD); Higher Education for Persons with Special Needs (HEPSN); Teacher preparation in Special Education Scheme (TEPSE); Financial Assistance to Visually Challenges Teachers (FAVCT); UGC also provide relaxations to PwDs in the National EligibilityTest; Saksham Scholarship Scheme; Reservation in admissions; Facilitating PwD students under Centrally Sponsored Scheme for Integrating PwDs in the mainstream of Technical and Vocational Education;Expert Committee constituted to identify the courses according to the categories of disabilities

Even institutions of higher education shall come forward on its own to satiate the needs of Differently-Abled Persons. But seldom respond to the call.

RIGHT TO EMPLOYMENT

Everyone is aspiring to, be self-reliant, have an employment to possess independent source of income. No one is bereft of it, whether he is rich or poor, haves or have nots, privileged or under-privileged, abled or disabled. Onus to generate employment is on the shoulder of the Government when an individual fails. Of course one has to imbibe employable traits. Employment is a key factor in the process of empowerment and inclusion of people with disabilities. It is an alarming reality that the disabled people are out of job not because their disability but for social and practical barrier that prevent them from joining the workforce. Resultantly, many disabled people live in poverty and their conditions are deplorable. In corollary, they find hard to make a useful contribution to their own wellbeing and the community.

According to the employment projection given in the Eleventh Plan, in the Chapter 'Employment Perspective and Labour Policy', "58 million job opportunities will be created in the Eleventh Plan period leading to a reduction in the unemployment rate to below 5%. Over the longer period up to 2016–17, spanning the Eleventh and Twelfth Plan periods, the additional employment opportunities created are estimated at 116 million. The unemployment rate at the end of the Twelfth Plan period is projected to fall to a little over 1%."

There is sea difference in, India, the ratio of employment between the people with and without disabilities. This variance cannot be scaled down unless the employment issues of people with disabilities, who constitute about 5-6% of the population, is properly addressed. Government and the Private Sector, in unison, shall go for proactive initiative to ensure berth for Persons with Disability in their establishments.

The appropriate Government owes a duty to constitute an expert committee to identify posts in the establishments suiting to persons with benchmark disabilities[16] to facilitate the Authorities concerned to reserve such posts to the Persons with Disabilities and the same shall be subjected

16. Person with Benchmark Disability:Persons with "benchmark disabilities" are defined as those certified to have at least 40 per cent of the disabilities in Blindness; Low-vision; Leprosy Cured persons; Hearing Impairment (deaf and hard of hearing); Locomotor Disability; Dwarfism; Intellectual Disability; Mental Illness; Autism Spectrum Disorder; Cerebral Palsy; Muscular Dystrophy; Chronic Neurological conditions; Specific Learning Disabilities; Multiple Sclerosis; Speech and Language disability; Thalassemia; Hemophilia; Sickle Cell disease; Multiple Disabilities including deaf blindness; Acid Attack Victim; Parkinson's disease.

to periodic review at an interval not exceeding three years, Section 33. The posts to be reserved shall be not less than *four per cent* of the total number of vacancies in the cadre strength in each group of posts, detailed hereunder, meant to be filled with persons with benchmark disabilities[17]

Sl.No	Particulars	Percent of reservation
(a)	Blindness and low vision	One percent
(b)	Deaf and hard of hearing	One percent
(c)	Locomotor disability including cerebral palsy, leprosy cured, dwarfism, acid attack victims and muscular dystrophy	One percent
(d)	Autism, intellectual disability, specific learning disability and mental illness	One percent
(e)	Multiple disabilities from amongst persons under clauses (a) to (d) including deaf-blindness in the posts identified for each disabilities	

The posts reserved may be carried forward to the succeeding recruitment year and it may be inter-changed too subject to the approval of the appropriate Government. However, an employer may appoint any other person without disability when no person with disability is available for the post in that year.The employers in private sector do get incentives if they employ, minimum of five per cent of their work force, persons with benchmark disability[18].

Private establishments too have statutory obligationstowards employees who are having benchmark disability i.e. setting out of job roles suitable for persons with benchmark disability if it is having 20 or more employees, recruitment process for such roles, trainings provided for these roles, preference in transfer and posting, special leave, assistive devices and measures taken to ensure barrier-free accessibility, appointment of liaison officer, maintenance of records detailing the number of PwDs employed, names, gender and addresses their date of joining, name, gender, addresses, nature of disabilities, nature of work assigned, facilities offered e.g. elevator, ramps, wheel chair, walkways etc. as per standard prescribed, registration of establishment with the Authorities designated and display of particulars/ policy on its official

17. Right of Person with Disability Act, 2016§34.
18. Right of Person with Disability Act, 2016§35.

website if feasible otherwise displaying the same at a conspicuous place of its premises. Failure to comply these statutory obligations enables the Authorities to impose fine, on the erring employers, up to INR 10,000 in the first instance and up to INR 500,000 for subsequent non-compliances.

5. CHALLENGES BEFORE DIFFERENTLY ABLED PERSONS

Differently abled persons, in India, are facing certain challenges owing to their disabilities which are catalogued as under -

a. Inaccessibility- Most of the government buildings or private offices and other infrastructure are inaccessible for disabling population.

b. Low Representation-The Disabled person has a very low representative in fields like government jobs, politics, economy etc.

c. Barriers to Health Care- The lack of appropriate services for people with disabilities is a significant barrier to health care. Affordability of health service and transportation are two main reasons why people with disabilities do not receive needed health care.

d. Attitudinal Barriers- Attitudinal barriers which help in stigmatisation and discrimination deny people with disabilities their dignity and potential and are one of the greatest obstacles to achieving equality of opportunity and social integration.

e. Inaccessible communication systems prevent access to information and knowledge and opportunities to participate. Lack of services or problems with service delivery also restricts the participation of people with disabilities.

f. Institutional Barriers- Institutional barriers include many laws, policies, strategies or practices that discriminate against people with disabilities. Discrimination may not be intended but systems can indirectly exclude people with disabilities by not taking their needs into account.

g. Inadequate Data & Statistics- The lack of rigorous and comparable Data and statics, combined with a lack of evidence on a programme that works, lack of planning, often delay in understanding and actions on disability inclusion.

h. Poor Implementation- Poor implementing policies and plans can prevent the inclusion of people with disabilities.

i. Major barriers identified in higher education and employment

• Environmental Barriers: That is assistive tools/computer software, institutions hesitate

to take up the financial support from UGC and other agencies for helping differently able, personal and interpersonal problems,

- Educational/Pedagogical Barriers: Disabled students face a lot of issues right from the application stage to admission to attending classes to examination and placement. Rigid curriculum frame and rigid methods of teaching.[19]
- Psycho-Social Barriers: lack of support from teachers or the lack of involvement in learning activities.
- Lack of Assistive Devices: Assistive devices are great enablers. They open up opportunities, improve efficiency and enable people with disabilities to work up to their potential. However, majority of disabled people in India have no access to assistive devices.

Physical access is the primary problem in almost all these places. Faculty apathy and under-preparedness to deal with the needs of the students with disabilities including peer insensitivity is a spiteful reality.

Thus, Differently-abled people face many physical and systemic barriers but cognitive and attitudinal barriers are the major concerns. Our society at large, teachers and employers do not expect much from differently-abled people, which hinders them to prove their excellence and worth as any ordinary citizen would normally have. These attitudes keep people away from appreciating and experiencing the full potential of differently-abled. The most pervasive negative attitude is focusing on a person's disability rather than on an individual's abilities.

We need to understand that differently-abled people do not need patronization and the drive to relegate them to low-skill jobs, setting different job standards; one should not expect a worker

19. No Sign language Interpreters in Colleges-"Adarsh College in Chamarajpet, Bangalore has over 10 deaf students and initially provided one interpreter for all of these - who ran from class to class - and then they added another but it did not increase the quality or quantity substantially. Now both have left, as a result of feeling frustrated about not being able to provide good services and the low pay, and so the students have no interpreters. What was especially egregious is that the parents were required to chip in Rs. 2000/- towards the interpreters' pay; Disabled girl refused hostel room in Pune law college-A 17 year-old disabled girl has bagged a seat in a prestigious law college, one among the very few disabled who go in for higher studies in India, but her hopes of becoming a lawyer may be dashed as the college has denied her 'suitable hostel accommodation'; Pooja Sharma, who is crippled below the waist, gained admission in Symbiosis Law College, Pune, one of the top colleges in India. She had scored 71 percent in the Class 12 board examinations. 'As a physically challenged girl, don't I have the right to study like a normal student? Can't I dream big? Can't I ever go out of my city to pursue higher education?' 'I want to become a reputed lawyer and serve my country,' Sharma told IANS. 'The college has backtracked from its promise of giving me a suitable accommodation – a single room in the hostel,' said Sharma, who is a resident of Meerut. She is now in Delhi to take the help of a disabled rights organisation.

with a disability to simply be content by appreciating the opportunity he or she gets to work instead of demanding equal pay, benefits, opportunity and access to workplace amenities.

Access to education and employment will remain a dream for the differently-abled population, even in our strongholds of higher learning, unless we work to break these cognitive and attitudinal barriers.

6. MEANS TO ACCORD HIGHER REPRESENTATION OF PERSONS WITH DISABILITY

Differently abled students have offered certain suggestion to scale down barriers in the institutions they are as under:

1. Mandate physically accessible premises at all public buildings[20]– to accommodate wheel chair users, visual and hearing impaired to use these facilities without impediments. Laws exist even today. What is required is courageous and empathetic implementation.

2. Barriers to accessing the curriculum need to be addressed.Design and implement new inclusive assessment processes. Most of current ones are archaic and obsolete any way.

3. Sensitization of faculty and students on inclusive growth – if they can provide a supportive environment, the students with disabilities will have the strength and courage to face the challenges with more confidence. NGOs can help in this.

4. Monitoring and evaluation of statistics and services for disabled -students also should be streamlined as it will end up purposeful discrimination to the disabled and pave clear pathways for further development.

5. Resource units or help desksare to be provided in the institutions as well as in the hostels

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20. In Disabled Rights Group v. Union of India, (2018)2 S.C.C. 397(India) The Disability Law Initiative has submitted similar arguments as outlined above. The case was prompted by the inability of a wheel chair bound girl to pursue her education in a law college because of inaccessible campus and classroom facilities.
The petition described the difficulties faced by the girl who was admitted to the law college of a reputed university. Requests for reasonable adjustments, such as modifications in the hostel bathroom and the availability of an assistant when required, were not agreed to by the university, whose position was that for such facilities, the girl would need to obtain accommodation off-campus. As a result, the girl and her family had to give up their aspirations and return to their hometown in frustration. The girl later had to pursue her higher education in a college located close to her town so that her family could provide her the necessary support.
When the matter had earlier come before the Court, DLI argued that the 1995 Disability Act mandated making campuses accessible. Also, the University Grants Commission had schemes to fund colleges for this purpose. The Court summoned the Bar Council of India, the apex body for legal education, which agreed that the concerned university and college had been remiss in fulfilling their obligations to the disabled students as required under the 1995 Act. Thereafter, BCI issued mandatory regulations to all law colleges to make their campuses and courses accessible. DLI further argued that the matter did not stop there, as the matter raised the larger issue of accessible higher education all over India. Following the submissions made by DLI, the scope of the petition has been expanded to include all law colleges and institutes of higher education in India.

for providing help and assistance to the students with disability. Self-help groups with involvement of NSS units can be an easy solution.

6. In many cases, in the case of students from poor social settings, the scholarship amounts are given for the family. Instead, a part of the scholarship of the assistance may be provided in the form of assistive devices which will inevitably help them to become more 'abled'.

7. Current provision for disabled students places too much emphasis on providing them with individual support to overcome institutional barriers, rather than on the more fundamental institutional change. In addition to this, more systematic sustainable changes to make the institutions disabled friendly should be made.

8. Employment in Government & Public Sector:Identification of Jobs- At present, the identification of appropriate jobs for disabled people is done in an ad hoc and arbitrary manner. Only 10% of the jobs are identified for disabled people. Eleventh Five Year Plan states that "There is a need to have this task performed by a professional group with the involvement of Disabled Peoples' Organisations". Government should constitute a task force immediately for revising the job list. The task force should analyse jobs in each department and not occupations or positions. There could be committees department wise, with representation of disabled people, particularly disabled employees of that Department to carry out the task. The concept of 'Identification of jobs' itself has been questioned by many people including the World Bank, which has recommended that it should be dropped. There is a need for developing a system / process which is non-discriminatory and inclusive. Campaign to fill Backlog Vacancies Only 0.44% of all the posts in the Government & public sector companies have been filled by disabled people. Eleventh Plan States, "The backlog of vacancies for persons with disability continues to be large. This backlog should be cleared in a time-bound manner and in a campaign mode." Government should immediately launch a campaign and set clear targets to fill the backlog vacancies for people with disability.

7. CONCLUSION

The Rights of Persons with Disabilities Act, 2016, is, a de-novo effort of the legislature, aiming to ameliorate the conditions of persons with disability and find avenues to enhance prospect of their employability. In furtherance of this object, the Act has underlined the significance of educating persons with disability with higher learning and training. In corollary, the Act enjoins that higher educational institutions shall reserve at least - 5% seats to differently abled students

and 4% of the total number of vacancies in the cadre strength in each group of posts in Government and private establishments. The public/ private institutions vis-à-vis employers owes obligation to offer facilities to Persons with Disability to have easy access. They need to submit compliance report to the Authorities designated. Any failure attracts fine up to INR 10,000 in the first instance and up to INR 500,000 for subsequent non-compliances.

The Legislature, indeed, anticipate untiring efforts from the citizenry to aid Persons with Disabilities to facilitate them to accept the challenges on par with the abled persons. Failing which intent of the Legislature remains only on paper.

ROLE OF ELECTION COMMISSION OF INDIA IN CURBING ELECTORAL OFFENCES UNDER THE REPRESENTATION OF PEOPLE ACT, 1951

-Dr Ajay Ranga & Mr Purushotam

"The Ballot is Stronger than the Bullet"

-Abraham Lincoln[1]

INTRODUCTION

The purity and freedom of elections can be ensured only if the supervisory arrangements for ensuring efficient and impartial functioning of the electoral machinery are done by an independent authority. For that purpose the Constitution[2] provides for an independent Election Commission.[3] The Election Commission (herein after EC) heads the entire election machinery in the country and wields plenary powers for taking appropriate steps to ensure free and fair elections. The Commission enjoys wide executive and quasi-judicial powers; it is described as a reservoir of power.[4] The EC plays a very important role in conducting free and fair elections. There are provisions provided both under Indian Penal Code, 1860 and Representation of People Act of 1951 for maintaining the purity and sanctity of the electoral process. Besides, various corrupt practices to maintain the purity of the election process and conduct of free and fair elections, certain undesirable activities have also been declared as punishable electoral offences. Some of such electoral offences had been introduced into the Indian Penal Code, 1860 in the year 1920, on before the passing of the Representation of the People Act, 1951 and the rest are traceable in the Act itself. Section 8[5] of the Act provides for disqualifications for membership of Parliament and State Legislative Assemblies on conviction for certain offences.

In addition to the corrupt practices at elections, various acts of commission and omission have been termed as 'electoral offences'. While the commission of a corrupt practice, if found proved, might cost the elected candidate his election, the commission of an electoral offence would expose a person who commits it for penal consequences. Further a person committing electoral

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1. https://www.news18.com/photogallery/politics/elections-2019-5-famous-quotes-on-voting-and-democracy-2098231-3.html (Sept. 21, 2019, 17:20 PM).
2. Const.of Ind. art. 324.
3. K.C.Sunny,Corrupt Practices in Election Law 241(Eastern Book Company, 2012).
4. Mohinder Singh v. Chief Election Commissioner, 1 SCC 405 (1978).
5. The Representation of the People Act, Section 8 (1951).

offence is liable to punishment irrespective of the fact whether such act was done by him with the consent of the candidate or not. Electoral offences are contained in Part-VII, Chapter-III in sections 125 to 136 of the Representation of People Act of 1951. The electoral offences under sections 125, 133 and 135-A, are also corrupt practices under section 123 of the Act. The following acts are regarded as electoral offences:[6]

PROMOTING ENMITY BETWEEN CLASSES IN CONNECTION WITH ELECTION:

Article 19of the Indian Constitution provides the freedom of speech and expression to the citizen of India as a Fundamental Right. But this right is provided subject to some restrictions. Apart from section 125 of the RP Act of 1951, section 153A of IPC penalizes 'promoting of enmity between different groups on the grounds of religion, race, place of birth, residence, language, etc, and doing acts prejudicial to maintenance of harmony.' Supreme Court of India in the case of ***Brij Bhushan v. State of Delhi***[7] held that "Public order was allied to the public safety and considered equivalent to security of the State.' The object of the provisions is to establish peace and harmony in the society. If any person is found guilty of the offence under section 125 of the Act, then the provisions provides the punishment for imprisonment which may extent to 3 years, or with fine or with both.

Filling False Affidavit:

Section 125A[8] provides for punishment for giving false information as directed under section 33A of the Act by furnishing an affidavit. This sub-section was inserted in 2002.In the case of ***Union of India v. Association for Democratic Reforms***,[9] the Supreme Court directed the Election Commission to call for an affidavit by issuing necessary order in exercise of its power under Article 324 from each candidate seeking election to Parliament or a State Legislature as a necessary part of his nomination paper, furnishing therein, certain information in relation to his/her candidature.[10]

After the issuance of directions by the Election Commission the President of India promulgated an Ordinance named Representation of the People (Amendment) Ordinance, 2002[11] by which sections 33A, 33B and 125A were inserted in the Act. Later the ordinance was replaced by

6. The Representation of the People Act, Section 125 to 136,(1951).
7. AIR 1951 SC 129.
8. The Representation of People Act, Section 125, (1951).
9. 5 SCC 294 (2002).
10. *Ibid.*
11. The Representation of the People (Amendment) Act, 2002.

Representation of the People (Third Amendment) Act, 2002.Section 33 of the Act provides for the presentation of nomination paper and requirements for a valid nomination and the newly inserted section 33A clarifies that along with the information required to furnish with the nomination paper the candidate has to furnish information about his past criminal record if any.[12] It is important that the section is an important one and rightly placed under the Act since the information furnished through an affidavit by a candidate about his past deeds is displayed for public at large and a voter may make up his mind about to whom he or she should vote for. The EC verifies the contents of the affidavit filed by the candidate and takes strict action in case of the information is not correct given.[13]

PROHIBITION REGARDING PUBLIC MEETINGS DURING THE SPECIFIED PERIOD:

The election propaganda in the form of public meetings in the polling area is to end 48 hours before the hour fixed for the conclusion of the poll for any election. It is not merely the convening or holding of a public meeting during this prohibited period which is barred; but attending to any such meeting is equally an offence. Any person who contravenes the above provisions of law is liable to be punished with fine which may extent to rupees two hundred and fifty. Section 126[14] of the Act prohibits the holding or attending any public meeting during period of forty-eight hours ending with hours fixed for conclusion of poll. If any candidate or the political party violates the provisions of section 126 of the Act, the EC can recommend registration of First Information Report against such candidate.[15]

BAN ON EXIT POLL:

Section 126A[16]prohibits regarding publication by means of print or electronic media any result of any exit poll without the permission of EC. The sub-section was inserted in the Act by 2009 Amendment as the electronic media has gained so much power to influence the voters when the election is in process. On 14 May 2019 the Election Commission of India (herein after ECI)issued notice to three media houses for displaying poll surveys predicting results of Lok Sabha elections.[17]

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12. The Representation of People Act, Section 33A, (1951).
13. M. Chandra v. M. Thangmuthu, AIR 2011 SC 146.
14. The Representation of People Act, Section 126, (1951).
15. *Ibid.*
16. The Representation of People Act,Section 126-A, (1951).
17. The Indian Express 3, 15 May 2019.

If the offence of section 126B[18] of the Act is committed by a company the person who is the in charge of and was responsible for the conduct of the business of the company and also the company shall be liable to proceed against and be punished accordingly. Predications by astrologers, tarot readers and political analysts on results cannot be published or broadcast by the media, bypassing the Representation of the People Act provision that bars exit polls during the conduct of elections, according to an EC advisory issued on 30/03/2017. The Election Commission observed that "despite its notification prohibiting exit polls from February 4 till March 9 evening, some T.V. channels aired programmes projecting the number of seats likely to be won by political parties in the recently concluded Assembly elections."[19]

DISTURBANCE AT ELECTION MEETINGS:

Disturbance at an election meeting is prohibited and it is an electoral offence to do so. Any person who at a public meeting of a political character acts, or incites others to act, in a disorderly manner for the purpose of preventing the transition of business for which a meeting has been called commits an electoral offence and is liable for punishment with fine which may extent to rupees two hundred and fifty. Public meetings which are held between the date of issue of notification calling the election and the date on which such election ends only are covered by the above prohibition.[20] The disturbance caused at election meetings during the other periods would be governed by the general law. If the Chairman of an election meeting reports to any police officer about any person acting in disorderly manner at the meeting, such police officer may require that person to declare to him immediately his name and address and if that person refuses or fails to declare his name and address or if the police officer reasonably suspects him of giving a false name or address the police officer may arrest such person without warrant.[21]

Section 127[22] of the Act cautions regarding disturbing at an election meeting. It prohibits any person who incites other and prevent the transaction of the business of the meeting shall be punished for imprisonment of six months and a fine of two thousand rupees or both. It is pertinent to note that the punishment was enhanced to the present limits by amending the section in the year 1996 and by the same amending Act sub-section 1-A was inserted to make the offence a cognizable one. If any candidate or his supporters violates the provisions of the section the EC

18. The Representation of People Act, Section 126-B, (1951).
19. The Hindu(Mohali), March 31, 2017, p.10.
21. S.L. Shakdher, The Law and Practice of Elections in India268 (National Publishing House, 1992).
21. *Ibid.*
22. The Representation of People Act, Section 127, (1951).

recommends the registration of FIR against such candidate or persons involved in such activities.

RESTRICTION ON PRINTING OF PAMPHLETS OR POSTERS:

The election law imposes certain restriction on the printing and publication of posters, pamphlets, etc. by any person. These restrictions have been imposed with a view to establishing the identity of publisher and printer of such documents so that if any such document contains any matter or material which is illegal or objectionable like appeal on ground of religion, race, caste, community or language or character assassination of any opponent etc, necessary punitive or preventive action nay be taken against the persons concerned. Therefore every election pamphlet or poster must bear on its format the name and address of its publisher as well as its printer. Election pamphlet or poster would cover any printed pamphlet, hand-bill or other documents distributed for the purpose of promoting or prejudicing the election of a candidate or group of candidates or any placard or poster having references to an election. However, any hand bill, placard merely announcing the date and time, place and other particulars of an election meeting or written instructions to election agents or workers does not come within the purview of the above restrictions. Any process of multiplying copies of a document, other than copying it by hand would be treated as printing.

The printer of any such document must obtain from the publisher a declaration (in duplicate) as to his identity signed by him and attested by two person to whom the publisher is personally known. Further the printer is also required to send, within a reasonable time of the printing of such documents, one copy of the declaration of the publisher together with one copy of the printed document to the Chief Election Officer where such printing is done in the capital of a State, or to the DM of the District in which it is printed in any other case. Any contravention of the aforesaid provisions is punishable with imprisonment for a term which may extent to six months, or with fine which may extent to rupees two thousands or with both.[23]

Section 127-A[24] of the Act lays down special requirements for printing any pamphlets or posters in connection with election and provides for punishment with imprisonment for six months or fine up to two thousand rupees or both for violation of the requirements. In the case of ***Amolak Chand v. Bhagwandas***,[25] it was held that the requirements for section 127-A, are as follows:

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23. *Ibid.*
24. *Id,* Section 127-A.
25. AIR 1977 SC 813.

(1) It must exhibit the names and addresses of the printer and the publisher,

(2) The publisher must deliver to printer a declaration in duplicate about his identity attested by two person to whom he is known personally,

(3) The printer must send within a reasonable time after printing, one copy of the declaration with a copy of the document printed, to the Chief Electoral Officer if the printing is done in the capital of the State and in any other case to the District Magistrate.[26]

The provisions of the section are attracted to any process of duplication. However, if, the document does not seek to promote or prejudice the prospects of election of a candidate, the provisions of the section are not applicable. One of the most common methods of carrying out the election propaganda is printing and distributing pamphlets, posters, handbills and leaflets among other forms of printed material. It is also common at election times to malign the image of the prospective rival candidates by using offending printed election propaganda materials. Therefore it becomes the bounden duty of law to protect the interest of all the parties chasing victory in elections, Section 127-A has been inserted by the Legislature to serve the same goal. In case of violation of the provisions of the section strict action is taken by the EC against such printer, publisher, political party or a candidate.

MAINTENANCE OF SECRECY OF VOTING:

Section 128[27] of the Act provides that any officer appointed by the Election Commission while performing his duty has to maintain the secrecy of the voting except in the case of election of seat of council of state. Any violation of the provision of the section shall attract the punishment of imprisonment three months as well as fine or both. The Supreme Court in the case of ***Sashi Bhushan v. Balraj Madhok*** [28] observed that:

A general inspection should not be permitted until there is satisfactory proof in support of those allegations. If the learned judge comes to the conclusion that the matter should be further probed into, he may take evidence on the points in issue including evidence of expert witnesses. Thereafter, it is open to him to direct or not to direct a general inspection of the ballot papers. But in doing so he will take care of maintain the secrecy of the ballot. In an election petition, the right

26. *Ibid.*
27. The Representation of People Act, Section 128, (1951).
28. AIR 1972 SC 1251.

of inspection of ballot paper is limited to rejected ballot papers and notes thereof. Unless a strong prima facie case is made out, the order for inspection cannot be granted.[29]

There is section 94[30] in the Act, which also provides for the secrecy of voting. The section says that no witness or other person shall be required to state for whom he has voted at an election. If fact section 94 covers a separate field. It gives the voter a free choice to disclose or not to disclose for whom he voted. There is no provision which would expose him to any penalty if a voter voluntarily chooses to disclose how he voted or for whom he voted. For maintenance of secrecy at the polling station the EC makes the necessary arrangements, so that the right to vote can be exercised in a free and fair manner.[31]

PROHIBITION ON OFFICERS TO ACT FOR CANDIDATE OR INFLUENCE THE VOTERS:

Section 129 castes a duty on officers etc, at elections not to act for candidate or to influence voting. Every officer or the member of police who is performing the election duty must be impartial and any type of favour to any candidate during the process of election is prohibited under the Act. In case of violation of the above stated provision the person shall attract the punishment of imprisonment of six months or fine or with both.[32]

In the case of ***P.R. Belagali v. B.D. Jatti*** [33]Supreme Court observed that:

> "Election must be freely and fairly conducted and the police and Government officers should not create even an impression that they are interfering for the benefit of one or the other candidate."[34]

PROHIBITS REGARDING CANVASSING IN OR NEAR POLLING STATIONS:

Section 130[35]of the Act provides the provisions regarding the prohibition on canvassing within hundred meters of the polling station on the date of poll. The Act further provides the punishment of fine of two hundred and fifty rupees in case of violation of the above stated provision.

In the case of ***G. Panneerselvam v. Narayanaswami***[36] it was held that;

"Wearing of a badge with the inscription of the name of the candidate would amount to

29. *Ibid*.
30. The Representation of People Act, Section 94, (1951).
31. Raghbir Singh Gill v. S. Gurcharan Singh Tohra, AIR 1980 SC 1362.
32. The Representation of People Act, Section 129, (1951).
33. AIR 1971 SC 1348.
34. *Ibid.*
35. The Representation of People Act, Section130, (1951).
36. 46 ELR 36.

canvassing of votes for the particular candidate and the wearing of any such badge within the polling station or within a radius of 100 meters thereof would be violation of section 130 of the Representation of People Act, 1951."[37]

DISORDERLY CONDUCT OR MISCONDUCT AT OR NEAR THE POLLING STATION:

On the date of poll, using or operating, within or at the entrance of the polling station or at any public or private place in the neighborhood of a polling station, any apparatus for amplifying or reproducing the human voice, such as a megaphone or a loudspeaker is prohibited. So that no annoyance is caused to any person visiting the polling station for the poll or that not interference is made with the work of the officers and other persons on duty at the polling station. Likewise shouting or otherwise acting in disorderly manner within or at the entrance of a polling station or in any public or private place in the neighborhood of a polling station is also prohibited. Any person who contravenes or willfully aids or abets the contravention of the above provisions of law is punishable with imprisonment extending to three months or with fine or with both. Section 131 provides the penalty for such conduct.[38]

Section 132[39] of the Act provides for the penalty for doing misconduct at the polling station. For the smooth conduct of poll at the polling station, it is necessary that no person should be allowed to misconduct himself at the polling station during the hours fixed for the poll and every person should be required to obey the lawful directions of the Presiding Officer. The Presiding Officer is empowered to see that if any person misconducts himself or fails to obey the lawful directions of the presiding officer such person may be removed from the polling station by the presiding officer or by any police officer on duty or by any person authorized in this behalf by the presiding officer.[40] The above power is, however, to be exercised by the Presiding Officer with restraint and should not be so exercised as to prevent any elector who is otherwise entitles to vote at the polling station from having an opportunity of voting at that polling station. The EC deploys police and forces to avoid any disturbance at the polling station.[41]

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37. S.K. Menditatta, All You Want to Know about Indian Elections 499 (Lexis Nexis,1sted. 2009).
38. The Representation of People Act,§ 131, (1951).
39. *Id,* Section 132.
40. *Id,* Section 132(1).
41. *Id,* Section 132(2).

FAILURE TO OBSERVE PROCEDURE FOR VOTING:

Section 132-A[42] of Act provides for penalty for failure to observe procedure for voting. This section was inserted by Act 4 of 1986. It says that if any elector, to whom a ballot paper has been issued, refuses to observe the procedure prescribed for voting the ballot paper issued to him shall be liable for cancellation. Here the clarification about the uses of voting machines is needed because such machines are being used at large scale in place of ballot papers. Explanation to section 61-A of the Act (Voting machines at elections) which says that for the purposes of section 61-A, "voting machines" means any machine or apparatus whether operated electronically or otherwise for giving or recording of votes and any reference to a ballot box or ballot paper in this Act, or the rules made there under shall, save as otherwise provided be construed as inculcating a reference to such voting machine wherever such voting machine is used at any election.

BREACH OF OFFICIAL DUTY IN CONNECTION WITH ELECTION:

If any person belonging to any of the specified categories is, without reasonable cause, guilty of any act of omission or commission in breach of his official duty in connection with elections, he commits Section 134[43] of the Act made the breach of official duty in connection with elections a punishable offence.[44]

PENALTY FOR GOVERNMENT SERVANT IN CASES HE/SHE ACTS AS AN ELECTION AGENT:

Section 134-A[45] makes it an offence for Government servants to act as election agents, polling agents or counting agents. It says that if any person in the service of the Government acts as an election agent or a polling agent5 or counting agent of a candidate at an election, he shall be punishable with imprisonment for a term which may extend to three months, or with fine, or with both.[46]

PROHIBITION OF GOING ARMED TO OR NEAR A POLLING STATION:

Section 134-B[47] prohibits going armed to or near a polling station other than polling officer or the returning officer on the polling day. It provides 2 years imprisonment or fine or both in case of

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42. Penalty for failure to observe procedure for voting – If any elector to whom a ballot paper has been issued, refused to observe the procedure prescribed for voting the ballot paper issued to him shall be liable for cancellation.
43. The Representation of People Act,Section134, (1951).
44. Ali Rehan, The Working of the Election Commission 44 (Jnanda Prakhashan, 2001).
45. The Representation of People Act,Section134-A,(1951).
46. *Ibid.*
47. *Id,* Section134-B.

violation or the provisions of the present section. The present section was inserted by Act of 1996 to carry out the electoral reforms proposed by the Election Commission and others considered by the committee on electoral reforms in 1990. Before every general election or bye election, the EC issues the directions and ensures that the licensed arms deposit in the concerned police station or with the arms dealer.

PENALTY FOR EMPLOYER IN CASE OF NOT PROVIDING PAID HOLIDAY ON THE DAY OF POLL:

Section 135-B[48] provides for penalty if any employer fails in granting paid holiday to employees on the day of poll. This section was inserted by Act 21 of 1996. It provides that the day of poll shall be granted as holiday and no deduction of his wages will be allowed. If employer contravenes the provisions than he shall be punished with a fine of five hundred rupees.

BAN ON SELLING OR DISTURBING OF LIQUOR ON THE DAY OF POLL:

Selling, giving or distributing liquor on polling day is a punishable offence under section 135-C[49] of the Act. This provision was inserted by Act 21 of 1996. This provides six months punishment of fine of two thousand rupees or both in case of violation of the provisions of the section. The step of curbing of evils produced out of consuming liquor has been taken in right direction since it is said that "the liquor is the root of many problem". Illiterate population does not think about the importance of voting and its process. The provision may prove helpful to some extent in controlling the activities of the persons having vested interests who disturbs the smooth sailing of the election process.Recently the police on the directions of the EC acting on a tip-off, the Dirba police raided a godown on the Kohriya road and seized illegal liquor worth Rs 9.5 lakh.[50]

CONCLUSION AND SUGGESTIONS:

Indian democracy is the world's largest democracy and it can continue its present status only through free and fair elections. The ECI from time to time issues necessary directions to the poll penal, political parties and candidates. The EC comes into action from the issuance of the election notification and remains in the picture till the announcement of the final results of the

48. *Id,* Section 135-B.
49. *Id,* Section 135-C.
50. The Tribune, January 30, 2017, p. 3.

elections. But sometimes allegations are made that EC is doing its work according to the directions of the government of the day and sometimes it is true. The biggest reason for the allegation of the discrimination is the appointment of the Chief Election Commissioner (herein after CEC) by the government of the day. The provisions relating to the appointment of the CEC need to be reconsidered. It should not be done only by the government of the day. It was the CEC (as he then was) T.N. Seshan, who showed the teeth to the political parties. Before him the EC was called 'toothless tiger'. The Election Commission of India is doing its duties according to the provisions provided for but sometimes it faces the difficulties. The implementation of Model Code of Conduct is the biggest challenge before the EC. The law relating to the use of religion for political benefit is not clear. Even the Supreme Court of India has also interpreted the law from time to time but till now there is no clarity. For example if the third person uses the religion for the political benefit of any candidate and without consent of such candidate, then against whom action can be taken. There should be clear and well defined law on the electoral offences. There is need of enhancement of punishment for the commission of electoral offences because in some cases the provided punishment is only a fine of five hundred rupees only. The punishment should be such which create a deterrent effect on the general public and the political parties.

ROLE OF EXPERT OPINION UNDER INDIAN CRIMINAL JUSTICE SYSTEM

-Ms Panchampreet Kaur*

INTRODUCTION

Crime has existed since the origin of civilization. Where there are conflicting minds there are bound to be conflicts and crimes. Crime occurs due to various factors including greed , poverty , need , enmity etc.

The existence of law is based upon the existence of crime. With the advancement in science and technology, the rate of crime has increased and its execution has changed in many ways. Technology is being used in committing crime as well as in solving the mystery behind it. The police and the courts can no longer rely on old methods of solving the crime. This is where forensic science and expert opinion come in. The development in forensic science has immensely helped the courts in detection of crime.

The word "Forensic" has been derived from the Latin word *Forensis,* meaning "belonging to the market place or forum." In ancient Rome the "forum" or public meeting place was where legal cases were tried & pleaded. The term Forensic Science means the application of the scientific methods for the purposes of law & justice.[1] Scientific method refers to the body of techniques for investigating phenomena, acquiring new knowledge, or correcting & integrating previous knowledge. It is based on gathering observable, empirical & measurable evidence subject to specific principles of reasoning.[2] The term includes the application of all sciences such as physics, chemistry, & biology. It may appear odd at the first instance, but almost all branches of science can help in the administration of justice.[3]

'Forensic science' can be defined more broadly as that 'scientific discipline which is directed to the recognition, identification, individualization, and evaluation of physical evidence by the application of the principles and methods of natural sciences for the purpose of administration of criminal justice'[4]. The term includes the application of all sciences such as physics, chemistry,

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1. What is Forensic Science, What is a Forensic Scientist, (Sep.2,2019,11:30AM), http://www.crimesceneinvestigatoredu.org.
2. ISAAC NEWTON (1687, 1713, 1726), "RULES FOR THE STUDY OF NATURAL PHILOSOPHY,"Philosophiae Naturalis Principia Mathematica.
3. What is forensic science? Forcon Forensic Consulting,(Aug28,2019,3:00PM) http://www.forcon.ca/learning/forensic_science.html.
4. B.S. NABAR, "FORENSIC SCIENCE IN CRIME INVESTIGATION",1(3ed. Asia Law House,2013)

& biology. It may appear odd at the first instance, but almost all branches of science can help in the administration of justice.[5] Forensic reports play a major role in both criminal and civil justice system. The important thing that is to be taken care of is that all important physical evidences must be procured in time, so that the experts can run tests on such physical evidences and furnish reports based on them.

HISTORICAL PERSPECTIVE

In India , the oldest evidence of use of science in law can be traced back to Kautilya's 'Arathshastra' where the investigation of murder was laid down.

The institution of forensic science in crime investigation in the contemporary sense can be traced in India in the middle of 20th century with the establishment of chemical examiner's laboratories created by Britishers at Madras , Calcutta , Agra and Bombay in the years 1849, 1853, 1864 and 1870 respectively. These laboratories worked upon general chemical analysis and toxicological work.

The operation of science & technology to the discovery & investigation of crime & administration of justice is not new to India.[6] Though not known to our ancestors in its present form, scientific methods in one way or the other seem to have been obeyed in the investigation of crime. Its particularised source is found in Kautilya's Arthashastra, which was written about 2300 years ago. Indians studied varied designs of the papillary lines, thousands of years ago. It is presumed that they knew about the continuity & individuality of fingerprints, which they used as signatures. Additionally , Chinese records have proved the use of fingerprints in an ancient kingdom of southern India. The Indians knew for long that the handprints, known as the 'Tarija', were matchless. The use of fingerprints as signatures by illiterate people in India, introduced centuries ago, was considered by some people as conventional only, till it was scientifically proved that identification from fingerprints was unerring [7].

MEANING AND CONCEPT OF AN EXPERT

An expert is a person who has a thorough command in a subject that can be relied upon. Opinion of an expert is considered valuable in various fields and it also holds significance in law. An

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5. *Supra* note 3.
6. B. B NANDA, FORENSIC SCIENCE IN INDIA: A VISION FOR THE TWENTY-FIRST CENTURY, Select Publishers,2001.
7. R.K. Tewari & K.V. Ravikumar, History & development of forensic science in India, Sep.2,2019,11:30AM),http://www.jpgmonline.com.

expert's opinion is admissible in many legal systems throughout the world. With time, the concept of expert opinion has evolved in Indian legal system. The need for an expert's opinion is no longer limited to the field of doctors or engineers, rather now the Courts seek expert opinion in every field.

In other words it can be inferred that an expert opinion is evidence given by experts i.e , the persons who has special skill and knowledge on a particular subject which does not come within the knowledge of the court.[8]

Lawson and Roger have made an attempt to define the term expert. Lawson[9] defines expert as a person who has a special knowledge and skill in the particular calling to which an enquiry relates. Roger gives special emphasis regarding the special knowledge as sciences, art and trade . Thus an expert is a person who dedicates his time and study to a special branch or learning and is especially skilled in those matters on which he is asked to state his opinion. So his evidence on such matters is admissible in the court of law to come into satisfactory conclusion.

The advancement in science and technology and the increase in the crime rate renders Courts helpless whenever a technical issue is in question. So, whenever such a technical issue arises that the Courts cannot contemplate on their own and is beyond their field of expertise and knowledge, opinion of a person who is an expert in that issue is sought.

The Indian Evidence Act, 1872 defines experts as, "When the court has to form an opinion upon a point of foreign law or of science or art, or as to identity of handwriting or finger impressions, the opinions upon that point of persons specially skilled in such foreign law, science or art, or in questions as to identity of handwriting or finger impressions are relevant facts. Such persons are called experts.[10]

APPLICATION OF FORENSIC SCIENCE IN LAW

The application of forensic science is required at various stages. The evidentiary value of forensic science is based on the following steps:

- Step-1 – Relevancy of Scientific Evidence

The first step covers the relevancy of scientific evidence. Evidence deduced with the help of scientific techniques must be relevant enough to be considered as evidence in the court of law.

8. From Wigmore statement.
9. Lawson , Evidence Rule 2 , Section 440.
10. The Indian Evidence Act, 1872 , S 45.

This is due to the fact that forensic science being new to the rules of evidence, may or may not be stringently in accordance with the provisions of the statutes. Thus, the first rule is to consider the relevancy of scientific evidence in the criminal justice court.

- Step-2 – Reliability of Scientific Evidence

The second step covers the reliability of the relevant scientific evidence. Various factors such as its authenticity, its use, its results are the base for the reliability of scientific evidence. Furthermore, it is based on the scientific technique. Certain tests and guidelines which are given by the courts and statutes helps in determining the reliability of scientific evidence.

- Step-3 – Admissibility of Scientific Evidence

The third step covers the admissibility of such relevant and reliable scientific evidence as provided by the law. What evidence has to be admitted is the discretion of a judge, what can be admissible or what cannot be is generally determined by long drawn tests and the provisions of the statutes.

- Step-4 – Credibility of Scientific Evidence

The fourth and the last step covers the credibility of the relevant, reliable and admissible evidence in the court of law. Basically the credibility of scientific evidence is laid down in the case laws where there are generally two types of evidences as scientific and conventional. It is the duty of the courts to take an equipoised view and seek that evidence whose credibility cannot be put to question.

RELEVANCE OF FORENSIC SCIENCE IN JUSTICE DELIVERY SYSTEM

The use of science in the field of law is called forensic science. It contains collection, preservation and analysis of physical as well as biological evidences. A Forensic Scientist is an expert in Biology (DNA expert),Chemistry (identification of explosives) and other fields of science . Various civil and criminal cases use forensic science for securing jutice. New techniques are being developed by the forensic scientists for the collection of evidences. Polygraph, brain fingerprinting and narco analysis are the techniques in this direction. In order to develop new techniques, the scientists should be afforded with sufficient funds and

excellently equipped laboratories. U.S. Federal Bureau of Investigation (F.B.I) has the largest laboratory in the world.[11]

The principle of the Criminal Justice System is to protect the innocent from wrong conviction and punishment and this can be done only by search of truth of the matter and justice. The following points based on scientific aspects help to follow the principle of Criminal Justice System:

1) Scientific evidence cannot lie and a decision arrived at by such an evidence is said to be justice through science.
2) To elicit truth from suspect scientific methods like narcoanalysis , brain mapping and lie detector tests used by law enforcement agencies are proving more authentic , accurate and reliable.
3) The principle based on advanced scientific technique, e.g. DNA testing says that every person of this world can be traced at a molecular level except of monozygotic twins.
4) Criminal behaviour of accused is determined by Forensic Psychology.
5) These days advanced science is boon for investigating agencies. These are powerful detective tool to detect crime and criminal.
6) It has also been seen that when there is no way for the court to reach at a point or to arrive to a correct decision, science helps the court to find out the truth and provides aid to the concerned justice .[12]

LEGAL FRAMEWOEK AND JUDICIAL INTERPRETATION RELATED TO EXPERT OPINION IN INDIA

Criminal trials in India are governed by the Criminal Procedure Code & Indian Evidence Act 1872, whereas the Criminal Procedure Code lays down the procedure from the point of taking cognizance of crime by appropriate judicial magistrates till the discharge of final order of conviction or acquittal or any appropriate order looking into the fact of the case. Indian Evidence

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(1) JAMES NORDBY, FORENSIC SCIENCE , (3ed.,CNC Press2009).
(2) B.S. NABAR, FORENSIC SCIENCE IN CRIMINAL INVESTIGATION , (3ed.,Asia Law House,2013).
(3) B.R. SHARMA, FORENSIC SCIENCE IN CRIMINAL INVESTIGATION AND TRIAL, (5ed.,Universal Law Publishing Co.,2014).
(4) YASHPAL SINGH &M.H. ZAIDI'S DNA TESTS IN CRIMINAL INVESTIGATION , TRIAL AND PATERNITY DISPUTES , 2006.

12. Sharique M .Rizvi , Science Meet Law,IIIT Alld.

Act is restricted in its scope of leading evidences in civil or criminal cases either by the prosecution or defendant, applicant or respondent. Act also deals with variety of evidences & relevancy of any fact which can be brought as evidence in any case.[13]

- **The Indian Constitution, 1950**

The constitution of India gives the rights of the accused under Articles 19, 20 and 21. It also provides for free legal aid under Article 39 A of the Constitution. The most debated amongst these is Article 20 (3) which is discussed below. The admissibility of forensic evidence in courts is based upon the manner of collection of evidence. India, follows a strict procedure while taking evidence as in it is the follower of adversarial system. Thus, destroying privacy or taking incriminatory evidence against the will of a person is violative of fundamental rights provided under the constitution.

In ***Nandani Satpathy v. P. L. Dani,***[14] the appellant, a former Chief Minister of Orissa, was given a direction to appear at the Vigilance police Station, Cuttack, for being examined in connection with a case which was registered against her under the Prevention Of Corruption Act, 1947 and under section 109, 161, 165 and 120-B of lndian Penal Code, 1860. 0n the strength of this first information report, investigation was commenced against her (only a suspect at that stage). The Supreme Court in this case held that section 160 (1) of Code of Criminal Procedure, 1973 which barred the calling of woman to a police station was violated in this case. Moreover, it was ruled that Article 20 (3) extended back to the stage of police investigation not commencing in court only, since such inquiry was of accusatory nature and could end in prosecution. It follows that the protection in Article 20 (3) is also available at the stage of police investigation. Further, it was stated that the right of silence guaranteed by Article 20 (3) is not limited to the case for which the person is examined but also extends to the other offences pending or imminent, which may deter him from voluntary disclosure of incriminatory matter. It was also held that the protection could be claimed by a suspect also.

The protection contained in Article 20 (3) is against compulsion “to be a witness". In **M.P.Sharma v. Satish Chandra**[15] a wide implication was given by the Supreme Court, to the expression “to be a witness" so as to include oral, documentary and testimonial evidence.

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13. Karan Ghelot, Forensic Crime Scene Investigation, 4(6), Indian Journal of Research (2005),(Sep.18,2019,9:00PM),http://worldwidejournals.com.
14. AIR 1978 SC 1025.
15. AIR1954 SC 300.

- **The Indian Evidence Act, 1872**

The provisions for relevancy and admissibility of evidence in courts are laid down in the Indian Evidence Act, 1872 . The evidence related to scientific techniques and electronic evidence are mentioned in the act. Where the evidence given by expert and related to handwriting already existed, the provisions related to admissibility of electronic evidence were incorporated in 2005. "When the court has to form an opinion upon a point of foreign law, or of science or art, or as to identity of handwriting (or finger impressions), the opinions upon that point of persons especially skilled in such foreign law, science or art, (or in questions as to identity of handwriting) (or finger impressions) are relevant facts. Such persons are called experts."[16]

The statutes of India do not provide any particular guidelines for the requirements of the expert testimony. The courts have taken distinct factors considering various facts, but, in ***Romesh Chandra Aggarwal v. Regency Hospital, 2010***[17] the Supreme Court detailed the requirements for allowing expert testimony. These are

1. Expert must be within a specialized field of expertise.
2. Evidence must be grounded on reliable principles
3. Expert must be competent in that discipline.

It also enumerated the following factors on which expert testimony maybe thrown out of court or which should become inadmissible.

1. Scientific finding in the question has no relevance with respect to issue in question.
2. Conclusions arrived by the expert are not based on scientific reasoning but speculation.
3. Scientific process was not reliable for want of accuracy or want of better method.
4. On the basis of tampering of expert report.

In ***Ram Narain V. State of UP***[18], the Supreme Court held that there is need of corroboration of expert opinion of finger impression if it is truthful. In this case, DVA J. himself compared the hand-writing in question with the person handwriting of the accused and satisfied himself and held that no corroboration is necessary .

In the case of ***M.S. Ushman Koya v. C.S. Santha***[19] , the Supreme Court rightly observed that an expert can certify only probability and not with 100% certainity. It should be corroborated either

16. *Supra* note 8.
17. Civil Appeal No. 5991 of 2002.
18. AIR 1973 SC 2200.
19. AIR 2003 SC Ker 191.

by direct evidence or by circumstantial evidence .It is the sole discretion of the court whether to admit the forensic report of an expert.

Reference may be given to the case of ***Krishan Chand v. Sita Ram,***[20] wherein in a conflict of expert opinion, it was held that it is the Court who is competent to form its own opinion with regard to signatures on a document. It entirely depends upon the facts & circumstances of the case, & the opinion of the courts, which varies consequently. Though there is no provision in the Indian Evidence Act, which expressly mandates corroboration of expert opinion, but in practical terms, it is the courts which consider it highly unsafe to convict a person on the basis of sole testimony of an expert.

- **The Criminal Procedure Code, 1973**

For collection of blood samples Section 53 of the CrPC is wanted which goes with the marginal heading "Examination of the accused by Medical Practitioner at the request of the Police." This section covers the examination of the accused by a medical practitioner at the request of the police officer, if there are reasonable grounds for accepting that an examination of a person will give evidence as to the commission of offence. So it shall be lawful for a registered medical practitioner at the call of the police officer not below the rank of sub-inspector & for any other person acting in bona fide in his assistance & under his direction, to make such an examination of the person arrested as is reasonably required in order to ascertain the facts which may give such evidence & to use such force as is reasonably necessary. It is nowhere mentioned in this section that the police officer shall be entitled to personally collect semen, blood, hair root, urine, vaginal swab etc. for the purpose of investigation.[21]

Sec. 54 of the Criminal Procedure Code, 1973 further deals with the examination of the arrested person by the registered medical practitioner at the request of the arrested person. The Law Commission of India in its 37th report stated that to facilitate efficient investigation, provision has been made which authorizes an examination of arrested person by a medical practitioner, if from the nature of the alleged offence or the circumstances under which it is alleged to have been committed, there are reasonable grounds for accepting that an examination of the person will give evidence either supporting the allegation or disproving it.[22]

Moreover, Section 293 of the CrPC exempts certain government scientific experts from

20. AIR 2005 P&H 156.
21. NAYAN JOSHI, ,MEDICAL JURISPRUDENCE & TOXICOLOGY, (3ed. Kamal Publishers2014).
22. Law Commission of India, Thirty Seventh Report, Ministry of Home Affairs (1967).

personal appearance before a court of law. The legislative importance behind this provision is to give some immunity to the higher officials in Forensic Scientific Departments. This immunity is given considering their qualifications, experience & work load in their respective fields. But this immunity is not given to the scientists occupied in Private Laboratories. By invoking Section 293, court can admit any report under the hand of

(a) any Chemical Examiner or Assistant Chemical Examiner to government;

(b) the Chief Inspector of Explosives;

(c) the Director of Fingerprint Bureau;

(d) the Director or Deputy Director or Assistant Director of a Central Forensic Science Laboratory or a State Forensic Science Laboratory;

(e) the Director of Haffkeine Institute, Bombay &; (f) the Serologist to the Government.[23]

- **The Identification of Prisoners Act, 1920**

In the Identification of prisoners Act it is provided that before a prisoner is admitted into the prison his measurements as to height, weight, color etc must be taken under sec 5 of the Act. 'Measurements' include fingerprints and footprints as well. The controversy regarding keeping the measurement of voice is still not resolved by the courts. The purpose for taking these measurements is to keep a record in case there is an escape or repeated offence. This helps in identification of the accused.[24] The sections 2, 3, 4, 5 & 6 of the Act deal with the expert evidence. They provide with the legal sanctions which are required for obtaining specimen evidence from the suspects or accused or convicts once they enter the jail.[25]

CONCLUSION

Forensic science has radically changed the process of criminal investigation and justice administration systems. Various techniques such DNA Profiling, Brain fingerprinting, Brain Mapping, Narco-Analysis, Polygraph test, Forensic photography and so on are being used by the investigating agencies and police organizations worldwide to detect and solve such crimes. Still, even the forensic science is not free from deficiencies & issues. The problems dealt with scientific evidence are investigative, scientific & legal in nature.

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23. Code of Criminal Procedure, 1973, S 293.
24. The Identification of Prisoner's Act,1920.
25. *Supra* Note 6.

Firstly, during the phase of investigation, authenticity of evidentiary clues is collected from the crime scene, the vehicle used, the home of victim or accused & other places, all these abovementioned should be proved beyond reasonable doubt by at least two independent witnesses. Lack of knowledge, dearth of time & corruption in police officers preferably means that much of the valuable evidence is lost or its integrity is tampered with.

Secondly, if regard is taken to scientific problems, forensic science is not a science in exact terms. The definite determination of criminality is not merely difficult but impossible to provide. Forensic science works on Law of Probability. Real lacunae in the presentation of forensic evidence are increasing and thus there is a need for standardizing tools & techniques, accreditation of institutions & demand for statistical data.

Lastly, the most essential legal issue relating to forensic evidence in the propagation of justice is a general belief that scientific evidence is weak evidence. Track evidence, though reliable as any other identification is still regarded as fundamental science. The difference must be drawn between charlatan & real expert.

So it is hereby suggested & recommended that the expert from the medical field should be inspired to undertake medico-legal work. The government should come up with more institutes which are particularly specialized in various fields of forensic science. According to the Malimath Committee,forensic science should be used exhaustively in the investigation of crime. The DNA experts should be considered & included in the list of experts as mentioned in the Code of CrP.C, 1973. The Malimath Committee Report has further suggested creation of a DNA database at national level to help in fighting terrorism. So, various efforts must be taken to create awareness among the prosecutors, the judges, the police machinery & the general public. The establishment of well-equipped laboratories are required to handle DNA samples & evidence. Also, an enactment of specific law in the light of framing & giving guidelines to the police machinery is required so as to set up uniform standards for obtaining genetic information and also the creation of adequate safeguards to prevent misuse of the same.

Criminal Judicial System in this country is at cross-roads, many a times, reliable, trustworthy, credible witnesses to the crime seldom come forward to depose before the court & even the hardened criminals get away from the clutches of law. Even the reliable witnesses for the prosecution turn hostile due to intimidation, fear & host of other reasons. Investigating agency has, therefore, to look for other ways & means to improve the quality of investigation, which can

only be through the collection of scientific evidence. In this age of science, we have to build legal foundations that are sound in science as well as in law. Practices & principles that served in the past, now people think, must give way to innovative & creative methods, if we want to save our criminal justice system. Emerging new types of crimes & their level of sophistication, the traditional methods & tools have become outdated, hence the necessity to strengthen the forensic science for crime detection. Oral evidence depends on several facts, like power of observation, humiliation, external influence, forgetfulness etc., whereas forensic evidence is free from those infirmities. Judiciary should also be equipped to understand & deal with such scientific materials. Constant interaction of Judges with scientists, engineers would promote & widen their knowledge to deal with such scientific evidence & to effectively deal with criminal cases based on scientific evidence. We are not advocating that, in all cases, the scientific evidence is the sure test, but only emphasizing the necessity of promoting scientific evidence also to detect & prove crimes over & above the other evidence.[26]

Forensic science indeed is a great help for the Indian legal system. Where the changing scenario has changed the notion of crime, there comes the forensic technology which has helped in investigating the toughest of these crimes where no eye-witnesses were found and it was only the scientific technology which comes to the rescue of investigating agencies and the judiciary. In India it is still growing at a rapid stage. Many statutory provisions have been interpreted in the light of scientific technology and evidence, many new provisions have also been added to the statutes but still, some problems remain unattended. The issues arising in the proper application of forensic science are as under.

26. Dharam Deo Yadav v. State of U.P,(2014) 5 SCC 509

ROLE OF LAW IN POVERTY ALLEVIATION: AN ANALYSIS

Mr Sajandeep Kinra*

INTRODUCTION

Poverty can be regarded as the single most universal phenomenon forming an unvarying and uniform thread that transcends all boundaries and nations. A whole gamut of complexities is encompassed by the single word 'poverty'. Poverty is the mother of many evils.[1] Poverty is the lack of basic human needs, such as clean water, nutrition, healthcare, education, clothing and shelter because of one's inability to afford them.[2] According to World Bank, India accounted for world's largest number of poor people in 2012 using revised methodology to measure poverty, reflecting its massive population. However, in terms of percentage, it scored fairly lower than other countries holding large poor populations. In July 2018, World Poverty Clock, a Vienna-based think tank, reported that a minimal of 5.3% or 70.6 million Indians living in extreme poverty compared to 44% or 87 million Nigerians. Till 2019, Nigeria and Congo surpassed India in terms of total population earning below $1.9 a day. Although India is expected to meet United Nation's Sustainable Development Goals on extreme poverty in due time, a very large share of its population lives on less than $3.2 a day, putting country safely into category of lower middle income economies. In contrast, the international poverty line as updated in October 2015 by the World Bank stands at US$1.90 per day. In 2011, 21.2% of the total population in India was estimated to be living below this poverty line, as per the World Bank data. India is home to over one-third of poor people in the world. If we add the poor of Pakistan and Bangladesh into it, we find that almost half of world.[3]

As per Tendulkar Committee methodology, the national poverty line (in Rs per capita per month) for the year 2011-12 was calculated at Rs 816 for rural areas and Rs 1000 for urban areas. Using this methodology, the National Sample Survey Organisation estimated poverty at 21.9% of the population (269 million) in 2011-12 was poor. That means in the category of poor fell the

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1. S.S. Sharma, Legal Aid To The Poorxi (Deep & Deep Publications, New Delhi, 1993).
2. Maj.Gen. Nilendra Kumar And Kush Chaturvedi, Textbook On Law, Poverty And Developmentvii (Lexis-Nexis, Gurgaon, 2nd Edition, 2016).
3. World Bank Data (July 3, 2019, 9:18 AM),https://www.worldbank.org/en/topic/poverty.

people whose daily income was less than Rs 27 a day in villages and Rs 33 a day in cities.[4] On the other hand, the subsequent Rangarajan Committee pegged the poverty line at Rs 32 in rural areas and Rs 47 in urban areas. On this basis, the number of poor living below the poverty line in India in 2011-2012 was revised to 29.5% of the population (363 million).[5]

MEANING AND DEFINITION OF POVERTY

Poverty is a major roadblock in the path of development of a nation. Development signifies reduction in poverty and law is the tool or mechanism which enables a State to frame policies for poverty reduction and towards development of society. In simplest terms, poverty can be described as the state of being poor. Poverty is an age-old social malaise and global problem.[6] There are various aspects and dimensions of poverty like absolute poverty, relative poverty, asset poverty, economic aspect and social aspect of poverty etc.[7] There are different causes of poverty in India—population explosion, illiteracy and unemployment, inadequate investment and low capital formation, major stress on farm sector and its output affected by floods and droughts, rampant corruption and leakages in delivery of public schemes and programs etc. According to Goddard, "Poverty is insufficient supply of those things which are requisites for an individual to maintain himself and those dependent upon him is his health and vigour."[8]

Schubert saw poverty as either absolute or relative or both. Absolute poverty being that which could be applied at all time in all societies, such as the level of income necessary for bare subsistence, while relative poverty relates to the living standard of the poor to the standards that prevail elsewhere in the society in which they live.[9]

According to the United Nations Committee on Economic, Social and Cultural Rights, "poverty is a human condition characterised by sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political and social rights."[10]

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4. India in Figures, 2018, (July 6, 2019, 7:22 AM),http://mospi.nic.in/sites/default/files/publication_reports/India_in_figures-2018_rev.pdf.
5. Planning Commission,(July 15, 2019, 3:00 PM), http://planningcommission.nic.in/reports/genrep/rep_pov.pdf.
6. Ekta Shukla, Singhal's Law, Poverty And Development3 (Singhal Law Publications, Delhi, 1st Edition, 2018).
7. Economics Discussion,(June 12, 2019, 4:00 PM), http://www.economicsdiscussion.net/essays/main-causes-of-poverty-in-india/2277.
8. Sharma, *supra,* 1.
9. A. Schubert, Poverty in Developing Countries: Its Definition, Extent and Implication,Economic, Vol. 49/50,17 (1994).
10. The International Covenant on Economic, Social and Cultural Rights, 1966(July 2, 2019, 2:00 PM), https://www.ohchr.org/EN/HRBodies/CESCR/Pages/CESCRIndex.aspx.

INTERNATIONAL EFFORTS FOR POVERTY ALLEVIATION

Through Resolution 47/196 adopted on December 22, 1992, the General Assembly declared 17thOctober as the International Day for the Eradication of Poverty. Various efforts have been made to reduce poverty at international level which are as follows:

A. Agenda 21 (Rio 1992) also deals with the issue of combating poverty. It promotes international cooperation to address the root causes of poverty. It provides that the governments with the assistance of and in cooperation with appropriate international, non-governmental and local community organizations should establish measures that will directly or indirectly generate remunerative employment and productive occupational opportunities.[11]

B. United Nation Commission on the Status of Woman, 1993 also plays role to achieve its objectives and action in the critical area of poverty. The Commission recommended that in formulating strategies to eradicate poverty, Member States take into account the specific requirements of women living in poverty, in both rural and urban areas, in order to enable them to fully exercise their social, economic, cultural, civil and political rights, as well as to maximize their resources and to increase their productivity.[12]

C. Fourth World Conference on Women, Beijing, 1995 is also concerned with women and poverty. This Conference states that more than 1 billion people in the world today, the great majority of whom are women, live in unacceptable conditions of poverty, mostly in the developing countries. The gender disparities in economic power-sharing are also an important contributing factor to the poverty of women. In order to eradicate poverty and achieve sustainable development, women and men must participate fully and equally in the formulation of macroeconomic and social policies and strategies for the eradication of poverty. The eradication of poverty cannot be accomplished through anti-poverty programmes alone but will require democratic participation and changes in economic structures in order to ensure access for all women to resources, opportunities and public services. [13]

D. United Nation Commission on Social Development was established in 1996 which deals with strategies and actions for eradication of poverty.The object of the Commission is to work in coordination with States and people for eradicating poverty in order to decrease the disparities in standards of living and better meet the needs of the majority of people of the world. The Commission also urges governments to formulate policies and programmes that ensure

11. Agenda 21 (The Rio Declaration on Environment and Development, 1992), chapter III.
12. United Nation Commission on the Status of Woman, 1993, chapter I (C).
13. Fourth World Conference on Women, Beijing, 1995, chapter 1 (IV) (A).

access to basic social services for all children and young people, in particular those living in poverty.[14]

E. Habitat II, Istanbul, 1996 is an international Convention deals with eradication of poverty. Governments at the appropriate levels, including local authorities, in partnership with all relevant interested parties, including workers' and employers' organizations should stimulate productive employment opportunities that generate income sufficient to achieve an adequate standard of living for all people, while ensuring equal employment opportunities and wage rates for women and encouraging the location of employment opportunities near and in the home, particularly for women living in poverty and people with disabilities. Also to ensure that people living in poverty have access to productive resources, including credit, land, education and training, technology, knowledge and information, as well as to public services, and that they have the opportunity to participate in decision-making in a policy and regulatory environment that would enable them to benefit from employment and economic opportunities.[15]

F. Earth Summit II (1997) provides for sector and issues relating to women, land and poverty. It states that governments, at their regional level, should frame policies to ensure universal access to basic social services, including basic education, health care, nutrition, clean water and sanitation. Efforts of individual governments and international cooperation and assistance should be brought together in a complementary way to eradicate poverty.[16]

G. The 2030 Agenda for sustainable development calls for an end to poverty by 2030. It seeks to ensure social protection for the poor and supporting people affected by climate-related extreme events. This agenda also ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services.[17]

NATIONAL LEGAL EFFORTS FOR POVERTY REDUCTION

India as a welfare State is committed to the development of its people. The Constitutional responsibility is reflected via legislations and development policies. It is realised that a collaborative measure of emphasis on accelerated growth and direct interventionist-safety net

14. United Nation Commission on Social Development, 1996, chapter III.
15. Habitat II, Istanbul,1996, chapter IV (C).
16. Earth Summit II, 1997, chapter 3(B).
17. A/RES/70/1- Transforming Our World: The 2030 Agenda for Sustainable Development, (June 20, 2019, 3:00 PM), https://sustainabledevelopment.un.org/topics/poverty/decisions.

procedure is the proper approach to optimise the control strategies. Furthermore, it needs to be ensured that the institutions executing these measures complement the policy stance.

A. The Constitution of India, 1950

The concern for the poor is reflected in the various provisions of the Constitution of India. The Preamble, Fundamental Rights, Directive Principles of State Policy and other provisions could be perused in this regard.[18] The Preamble of the Constitution of India resolved to secure to all its citizens justice; social, economic and political and equity of status and of opportunities. The Constitution provides that State shall not deny to any person right to equality before the law or the equal protection of the laws within the territory of India.[19] The Constitution also provides the fundamental rights including the protection of life and personal liberty.[20] The State shall secure that operation of legal system promotes justice, on a basis of equal opportunity and shall in particular provide free legal aid, by suitable legislation or schemes or in other way to ensure that opportunities for securing justice are not denied to any citizen by reason of economic or other disabilities.[21]

Recently in January, 2019, the benefit of reservation has also been extended to economically weaker sections of the society by amending articles 15 and 16 of the Constitution. It provides ten percent reservation in jobs and education to economically weaker sections. The economically weaker sections will be determined on the basis of value of assets and their annual income of the person. It is also an initiative for poverty alleviation.[22]

B. The Code of Civil Procedure, 1908

The Code of Civil Procedure[23] protects the bonafide claims of indigent persons. The Code exempt indigent person or his dependent to pay court fee for filing suit and assign a pleader, where he is not represented by a pleader.[24] The free legal aid will be provided in case of appeal by any indigent person.[25]

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18. Maj.Gen. Nilendra Kumar And Kush Chaturvedi, Textbook On Law, Poverty And Development14 (Lexis-Nexis, Gurgaon, 2nd Edition, 2016).
19. The Constitution of India, 1950, art 14.
20. *Id.,* art 21.
21. *Id.,* art 39 A.
22. The Constitution (103rd Amendment) Act, 2019.
23. Act No. 5 of 1908.
24. The Code of Civil Procedure, 1908, order XXXIII.
25. Id., order XLIV.

C. The Advocates Act, 1961

The Advocates Act[26] assigns functions to the Bar Council of India to provide legal aid or advice to the poor in accordance with the rules made in this behalf. This Act also assign State Bar Council to organize legal aid in the prescribed manner.[27]

D. The Code of Criminal Procedure, 1973

The punitive arm of the legal order is criminal law. It effects the life and liberty of human being. Therefore, special attention is to be given at the time of administration of criminal law. Justice Krishna Iyer rightly mentioned that to sensitize the criminal process to the wavelength of the poor is the strategy.[28] The legal process without legal aid to the poor may be a guarantee of anarchy and not of order. To hands and feet, we need are efficient means and method to carry out justice in every case in the shortest possible time and the lowest possible cost.[29] The Code of Criminal Procedure[30] provides a pleader to the accused who has not sufficient means for his defence at the expense of the State. The Code also empowered High Court to provide facilities to such pleader for the defence of such accused.[31]

E. The Legal Services Authorities Act, 1987

The main objective of this Act[32] is to constitute legal services authorities to provide free and competent legal services to the weaker sections of the society to ensure that opportunities for securing justice are not denied to any citizen by reason of economic or other disabilities. The authorities were constituted at national, state and district level i.e. National Legal Services Authority, State Legal Services Authority and District Legal Services Authority.[33]

F. The Mahatma Gandhi National Rural Employment Guarantee Act, 2005

This Act[34] was introduced with an aim of improving the purchasing power of the rural people, primarily semi or unskilled work to people living below poverty line in rural India.[35] This Act provides a guarantee for one hundred days of employment in every financial year to adult

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26. Act No. 25 of 1961.
27. The Advocate Act, 1961, section 7(1)(ib) and 6(1)(eee).
28. Krishna Iyer, Of Law And Life136 (Vikash Publishing House, Sahibabad, 1971).
29. Krishna Iyer, Social Mission Of Law104 (Orient Longman, New Delhi, 1976).
30. Act No. 2 of 1974.
31. The Code of Criminal Procedure, 1973, section 304.
32. Act No. 39 of 1987.
33. S.S. Sharma, Legal Aid To The Poor104 (Deep & Deep Publications, New Delhi, 1993).
34. Act No. 42 of 2005.
35. Sudhir Vaidya, National Rural Employment Guarantee Act (NREGA): With Schemes And Guidelines3 (Arise

members of any rural household willing to do public work-related unskilled manual work at the statutory minimum wage.[36]

G. The Right of Children to Free and Compulsory Education Act, 2009

This Act[37] was enacted to provide free and compulsory education to the all children of age of six to fourteen years. This Act is also an initiative for anti-poverty programme.

H. The National Food Security Act, 2013

This Act[38] introduced to provide food and nutritional security in human life cycle approach by ensuring access to adequate quantity of quality food at affordable prices to people to live life with dignity. This Act also provides every person belonging to priority households to receive five kilograms per person per month at subsidized prices.[39] The Act entitled pregnant woman and lactating mother to receive meal free of charge during pregnancy and six months after birth of child. The Act also ensured to entitle maternity benefit of Rs. 6,000 to pregnant woman.[40]

ANTI-POVERTY PROGRAMMES

Many poverty alleviation programmes have been started. The Integrated Rural Development Project was introduced in 1978-79 to provide assistance to rural poor in the form of subsidy and bank credit for productive employment opportunities.[41] National Rural Employment Programme (NREP) formulated district level or block level employment plan for skilled or unskilled work and prepared projects for each block.[42] Rural Landless Employment Guarantee Programme (RLEGP, 1983) aimed to eradicate poverty, unemployment and under employment among rural landless. It guaranteed employment to at least one member of every landless labourer household for 80 to 100 days.[43]

The NREP and RLEGP were merged in April, 1989 under Jawahar Rozgar Yojana (JRY). Jawahar RojgarYojna was meant to generate meaningful employment opportunities for the unemployed and underemployed in rural areas through the creation of economic infrastructure and community and social assets.[44] On April 1, 1999, the IRDP and allied programmes were

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Publishers & Distributors, New Delhi, 1st Edition, 2009).

36. The Mahatma Gandhi National Rural Employment Guarantee Act, 2005, section 3.
37. Act No. 35 of 2009.
38. Act No. 20 of 2013.
39. The National Food Security Act, 2013, section 3.
40. *Id.,* section 4.
41. The Integrated Rural Development Project (IRDP), 1978-79.
42. National Rural Employment Programme (NREP).
43. Rural Landless Employment Guarantee Programme (RLEGP, 1983).
44. Jawahar RojgarYojna, 1989.

merged into a single programme known as Swarnajayanti Gram Swarozgar Yojana (SGSY)[45] . The SGSY emphasises on organizing the rural poor into self-help groups, capacity-building, planning of activity clusters, infrastructure support, technology, credit and marketing linkages. The Indira Awaas Yojana (IAY) programme aims at providing free housing to below poverty line (BPL) families in rural areas and main targets would be the households of SC/STs.[46]

Sampoorna Gramin Rozgar Yojana (SGRY) Scheme,2001 was introduced with the objective that the scheme continues to be the generation of wage employment, creation of durable economic infrastructure in rural areas and provision of food and nutrition security for the poor. It is the skill and placement initiative of Ministry of Rural development.[47] It is a part of National Rural Livelihood Mission (NRLM)–the mission for poverty reduction is called Ajeevika, 2011. It evolves out the need to diversify the needs of the rural poor and provide them jobs with regular income on monthly basis. Self help groups are formed at the village level to help the needy.[48] The Pradhan Mantri Awas Yojana (PMAY) Scheme was launched by the Government of India to boost the affordability of houses against an inflated real estate sector. The scheme aims to achieve its objective of housing for all by March 31, 2022, the 150th birth anniversary year of Mahatma Gandhi, by constructing 20 million houses across the nation. The scheme will progress in three phases. In first phase, 100 cities were covered in select states and UTs between April 2015 and March 2017, in second phase, 200 additional cities covered between April 2017 and March 2019 and in third phase the remaining cities will be covered between April 2019 and March 2022.[49] Various scholarship schemes run by Central Government and State Government of Punjab like Post Matric Scholarship Scheme for Scheduled Caste students, Post Matric Scholarship Scheme for other backward classes, Post Matric Scholarship Scheme for Minority students and Central Sector Scheme of Rajiv Gandhi National Fellowship for providing Scholarships to Scheduled Caste students to pursue programmes in Higher Education such as M.Phil, Ph.D etc.[50] Central Sector Interest Subsidy Scheme by State Bank of India provides educational loan on subsidised interest rates for the benefit of all categories of students

45. Swarnajayanti Gram Swarozgar Yojana (SGSY), 1999.
46. The Indira Awaas Yojana (IAY), 1985.
47. SampoornaGraminRozgar Yojana (SGRY) Scheme, 2001.
48. National Rural Livelihood Mission, 2011(July 4, 2019, 6:00 AM),https://www.jagranjosh.com/general-knowledge/anti-poverty-employment-generation programmes-in-india-1448531927-1.
49. Pradhan Mantri Awas Yojana (PMAY) Scheme, 2016.
50. Scholarship Schemes, (Aug. 12, 2019, 4:00 PM), http://punjab.gov.in/documents/10191/51251/Various+scholarship+schemes+run+by+Govt.pdf/98358737-ed42-4375-a82b-401db49eaba0.

belonging to economically weaker sections of the society for pursuing professional or technical courses from accredited institutions in India.[51]

In Punjab, Mid Day Meal Scheme started for the students of first to eighth class. They are served with mid day meal in the school. The main objective of this scheme is to increase enrolment retention and to tone up the learning abilities of the beneficiaries, especially of the children belonging to poor and down trodden sections of the society.[52] The State Government of Punjab has also initiated Shagun Scheme for providing financial assistance of Rs.15,000 to Rs. 21,000 to the girl's marriage under the Department of Welfare of scheduled caste and backward class in the state. The Shagun Scheme is also named as Aashirwad Scheme by the government. This scheme is only for the girls of economically weaker families.[53] In 2011, Mai Bhago Scheme has also started by the State Government of Punjab in order to uplift the condition of women especially in women and the women who belong to the urban poor category.[54] Recently on August 20, 2019, Punjab Government has introduced Punjab Sarbat Sehat BimaYojna under Aushman Bharat Scheme which provides free medical treatment upto Rs. 5,00,000 to the people who have cards of below poverty line.[55]

NALSA (EFFECTIVE IMPLEMENTATION OF POVERTY ALLEVIATION SCHEMES) SCHEME, 2015

The National Legal Services Authority (NALSA) has been constituted under the Legal Services Authorities Act, 1987. This Authority has formulated a scheme for effective implementation of poverty alleviation schemes. The main objective of this Scheme is to ensure access to basic rights and benefits afforded to socially or economically weaker sections of the society and to strengthen the legal aid and support services at the national, state, district and taluka levels for persons belonging to socially or economically weaker sections in accessing poverty alleviation schemes.[56]

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51. Central Sector Interest Subsidy Scheme, 2019, (Aug. 24, 2019, 5:00 PM), https://www.sbi.co.in/portal/web/student-platform/interest-subsidy.
52. Mid Day Meal Scheme, (Aug. 15, 2019, 7:00 AM), http://www.ssapunjab.org/mdm/.
53. Aashirwad Scheme, (Aug. 12, 2019, 6:00 PM), https://www.indiafilings.com/learn/shagun-scheme-punjab/.
54. Mai Bhago Scheme, 2011, (Aug. 10, 2019, 5:00 PM), https://pmjandhanyojana.co.in/mai-bhago-scheme-punjab-cycle/.
55. Punjab SarbatSehatBimaYojna, 2019,(Aug. 20, 2019, 6:00 AM), https://www.shapunjab.in/home.
56. NALSA (Effective Implementation of Poverty Alleviation Schemes) Scheme, 2015.

NITI AAYOG

NITI Aayog recommended that the strategy for combating poverty must rest on two legs: sustained rapid growth that is also employment intensive and making anti-poverty programs effective. NITI Aayog further suggested that making anti-poverty programs such as the Public Distribution System (PDS), Midday Meal Scheme, MGNREGA and Housing for all more effective represents the second leg of the strategy to eliminate abject poverty.[57]

REPORTS OF COMMISSIONS AND COMMITTEES

Reports of Law Commission of India: Law Commission of India is an important body in the legal system of India. Its aim is to ensure law keeps up with the times the society live in so as to ensure and maximize justice. Law Commission has made efforts in respect of poverty alleviation. Following are the various reports on poverty alleviation:

The Law Commission of India in its Report suggested that legal aid will have to be first given to person accused of crime, particularly crimes of serious nature. Members of scheduled castes and scheduled tribes who generally are without means will have to receive preferential consideration. Legal aid will have next to be extended to really poor persons and then gradually made available to persons of moderate means who are unable to bear the cost of litigation.[58]

The Law Commission of India has also stated in its Report that every man and woman has the human right to a standard of living facility for health and well being, to food, clothing, housing, medical care and social services. These fundamental human rights are defined in our Constitution. The right to be free from poverty includes the human right to an adequate standard of living, right to live in adequate housing, right to be free from hunger, right to primary health care and medical attention in case of illness. Thus, poverty is a human rights violation.[59]

RANGARAJAN REPORT ON POVERTY, 2014

Expert Group under the chairmanship of Dr. C. Rangarajan to review the methodology for measurement of poverty in the country constituted by the Planning Commission in June 2012 has submitted its report on June 30, 2014. As per the report, poverty line is estimated as Monthly Per Capita Expenditure of Rs. 1407 in urban areas and Rs. 972 in rural areas. The Expert Group

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57. NITI Aayog, (June 29, 2019, 6:00 PM), https://www.niti.gov.in/sites/default/files/201901/Summary_eliminating_poverty.pdf.
58. Law Commission of India, 14th Report on Reforms of Judicial Administration- Vol. I, chapter 27, (September, 1958).
59. Law Commission of India, 223rd Report on Need for Ameliorating the lot of the Have-nots: Supreme Court's Judgments, (April, 2009).

(Rangarajan) has recommended that the poverty line should be based on certain normative levels of adequate nourishment, clothing, house rent, conveyance and education, and a behaviorally determined level of other non-food expenses.[60]

JUDICIAL ATTITUDE TOWARDS POVERTY IN INDIA

The judiciary has kept an intense scrutiny and ensured that Constitutional mandate is properly enforced and any friction between the legislature and the executive is eased. Building upon article 21, the judiciary has adopted an expansive interpretation bringing within its ambit almost all facets of poverty – direct or indirect.

Against the backdrop of the foregoing and in a scathing indictment on the denial of legal services to the poor and in a bold attempt to make courts accessible to the poor, the Supreme Court of India in ***People's Union for Democratic Rights v. Union of India,***[61] observed thatthe rule of law does not mean that the protection of law must be available only to a fortunate few or that the law should be allowed to be prostituted by the vested interests for protecting and upholding the status quo under the guise of enforcement of their civil and political rights. The poor too have civil and political rights and the rule of law is meant for them also, though today it exists only in paper and not in reality. The courts are praised for their boldness and courage and their independence and fearlessness are applauded and acclaimed. But if the fundamental right of the poor and helpless victims of injustice is sought to be enforced by public interest litigation, the so called champions of human rights frown upon it as a waste of time of the highest court in the land which according to them should not engage itself in such small and trifling matters.

The Indian Judiciary in ***Olga Tellisand Ors v. Bombay Municipal Corporation and Ors case,***[62] has also come forward in favour of poor people and the right to life was widened enough so as to bring the 'right to livelihood' within the purview of 'right to life' under article 21 of the Constitution. The Apex Court has justified eviction of slum dwellers that the respondents (Bombay Municipal Corporation) must provide with alternative shelter or accommodation to the slum dwellers before eviction from the pavements.

In an another case, ***People's Union for Civil Liberties v. Union of India,***[63] the Apex Court agitated over the issue of starvation deaths in Rajasthan despite excess grain being kept aside for famine. Various schemes for food distribution throughout India were also non-functional. The

60. Planning Commission, (July 14, 2019, 7:00 AM), http://planningcommission.nic.in/reports/genrep/pov_rep0707.pdf.
61. AIR 1982 SC 1473 (India).
62. 1985 SCC (3) 545 (India).
63. (2003) SCR 1136 (India).

Supreme Court, noting the right to life, stated "would the very existence of life of those families which are below poverty line not come under danger for want of appropriate schemes and implementation." The Court found failure on the part of government to implement various food schemes and the Court directed for more specific measures to be effected.

In ***M.R. Balaji v. State of Mysore,***[64] the Supreme Court held that two tests should be conjunctively applied in determining backward classes; firstly they should be comparable to the schedule castes and schedule tribes in the matter of their backwardness and secondly they should satisfy the means test i.e. the test of economic backwardness laid down by the state government in the context of the prevailing economic conditions.

The Apex Court in ***J. P. Parimoo v. State of Jammu & Kashmir***[65] said that if poverty is the exclusive test, a large population in our countrywould be socially and educationally backward class of citizens. Poverty is evident everywhere and perhaps more so in educationally advanced and socially affluent classes. A division between the population of our country on the ground of poverty that the people in the urban areas are not poor and that the people in the rural areas are poor is neither supported by facts nor by a division between the urban people on the one hand and the rural people on the other that the rural people are socially and educationally backward class.

The Hon'ble Supreme Court in ***Jarnail Singh v. Lachhmi Narain Gupta***[66] decided that reservation should be based on income. The Apex Court stated that reservation in promotions does not require the state to collect quantifiable data on the backwardness of the Scheduled Castes and the Scheduled Tribes, yet makes the creamy layer in either group ineligible for the benefits.

CONCLUDING REMARKS

The Government of India and the State Governments have been implementing several programmes (IRDP, JRY etc) for poverty alleviation in India. While the objectives of these programmes may be commendable,they are based on a belief that spending of money is in itself a necessary and sufficient condition for povertyalleviation. This belief under-plays the role of non-monetary policies and the impact they have on the lives ofthe people. It has been the

64. AIR 1963 SC 649 (India).
65. (1973) 3 S.C.R. 236 (India).
66. 2018 SCC Online SC 1641 (India).

experience of many grassroot workers that often certain government policiesharm the poor much more than any benefit that accrues to them through money-oriented schemes like theIRDP.Strong localgovernance such as expected from Panchayati Raj Institutions – responsive to the needsof beneficiaries, one which encourages mobilisation of the rural poor and is open tosocial audit -- promises better delivery system of the poverty alleviation programmes.It is now a recognised fact, that poverty is a multi-faceted phenomenon going beyond the realms of lack of adequate income; it must be viewed as a state of deprivation spanning the social, economic and political profile of the people that precludes their effective participation as equals in the development process. This recognition has resulted in restructuring and reorganization of various poverty reduction programmes. The formidable challenge faced by India at the time of independence was in the form of a large subgroup of its population being poor. This was an institutional outcome as well as the colonial legacy. During the last seven decades, India's tryst with poverty has met with chequered responses. It is quite obvious that the institutional interface dictated the performance. It would be incorrect to say that all poverty reduction programmes have failed. The growth of the middle class that was earlier virtually non-existent indicates that economic prosperity has indeed been promising in India, but the distribution of wealth has been extremely uneven. The responsibility of mitigating poverty cannot be that of the Government alone; it requires the cooperative efforts of the civil society. Optimization of the strategies should be such that the policies function in an atmosphere of both interdependence and independence simultaneously, thus creating a synergy for yielding better functional linkages and collaboration.

SEXUAL HARASSMENT OF WOMEN: A STUDY WITH REFERENCE TO EDUCATIONAL INSTITUTIONS IN CHANDIGARH

- Dr Babita Devi* & Mr Deepak Thakur**

INTRODUCTION

Man is born out of woman and the word 'Man' included in the word 'woman'. But this slice or part has assumed the proportion of the whole by reducing woman to an appendage of life, a parasite, a domestic pleasure, a pleasure of resort. This is the story of man- made civilization where lies the birth of tragedy of woman. Sexual harassment is an offence, which can destroy human dignity and freedom and confidence of the victim.[1] The term sexual harassment came to be used in the public media only from the year 1975 onwards. Till then no term existed to describe what is now universally called sexual harassment, though the phenomenon itself was well known to women. The term sexual harassment in a legal sense was first coined in the United States of America and subsequently exported from there to other industrialized countries in Western Europe. In India, the term sexual harassment was first defined in a formal legal sense in the year 1997 by the Supreme Court in ***Vishaka v. State of Rajasthan.***[2] Other terms used to describe this malady are 'unwanted intimacy' in the Netherlands, 'sexual molestation' in Italy, 'sexual blackmail' in France and 'sexual solicitation' in the state of Canada.[3]

Sexual harassment may be best conceptualized as one manifestation of the way in which sexual violence against women is committed in society. In the rape – prone culture, women are socialized to expect violence in their everyday lives, and such violence is treated as normal. Sexual violence is the most graphic and visceral tool of women's subordination and sexual harassment is a tool of oppression. Even those women who do not experience any direct form of sexual violence, experience fear which invade nearly all aspects of their public and private lives.[4] Sexual harassment must be understood to exist on the continuum of sexual violence against women.[5] Sexual violence is a violation of the rights of girls, threatening their right to

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1. Vijay Nagpal, Sexual Harassment of Women at Workplace: Legal Contours,P.U. L. Rev., Vol. 45 & 46, Part-II,93, 93 (2003-04, 2004-05).
2. Vishaka v. State of Rajasthan,AIR SC 3011, 3017 (1997).
3. Alok Bhasin, Law Relating to Sexual Harassment at Work 3 (1st ed. Eastern Book Company, 2002).
4. Suman Gupta, Sexual Harassment in Employment and Education: Causes, Consequences and Prevention, Del. L. Rev. Vol. XXVI 68, 68-69 (2004).
5. Vandana, Sexual Violence against Women: Penal Law and Human Rights Perspectives29 (1st ed. Lexis Nexis, 2008).

achieve an education, and injuring their psychological and physical well-being. Many countries do not use the term sexual harassment, but rather use other terms such as sexual bullying, gender-based violence, sexual abuse, and sexual violence among others.[6]

SEXUAL HARASSMENT AGAINST WOMEN IN CHANDIGARH

As per National Crime Records Bureau in Chandigarh under section 354 IPC i.e. assault on women with intent to outrage her modesty 21 incidents were reported in 2011, 45 incidents were reportedin 2012, 136 incidents were reportedin 2013, 87 incidents were reportedin 2014, 76 incidents were reportedin 2015,29 incidents were reportedin 2016, 102 incidents were reportedin 2017 and97 incidents were reported in 2018.[7]

As per National Crime Records Bureau in Chandigarh under section 509 IPC i.e. insult to the modesty of women, 12 incidents were reported2011, 25 incidents were reportedin 2012, 25 incidents were reportedin 2013,2 incidents were reportedin 2014, 10 incidents were reportedin 2015, 13 incidents were reportedin 2016, 12 incidents were reportedin 2017and 5 incidents were reportedin 2018.[8]

The above mentioned data has been reproduced in tabular form for brevity and clear understanding the number of incidents and percentage variation of crime under sections 354 and 509 IPC. Table A shows figures relating to crime against women under section 354 and 509 IPC from year 2011 to 2018 and percentage variation of crime rate from year 2017 to 2018.

Table A

Crime Head	2011	2012	2013	2014	2015	2016	2017	2018	% Variation between 2017 and 2018
Section 354, IPC	21	45	136	87	76	29	102	97	4.90%
Section 509, IPC	12	25	25	2	10	13	12	5	58.33%

MOLESTATION (SECTION 354 OF THE INDIAN PENAL CODE)

Adecrease of 4.90% has been observed in such cases as 97 cases were reported during the year 2018 as compared to 102 in the previous year (2017).

Eve-Teasing (Section 509 of the Indian Penal Code)

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6. Vol. I,Michele A. Paludi, Feminism and Women's Rights Worldwide, 187-88 (Praeger, 2010)
7. http://www.chandigarhpolice.gov.in/crimecht.html (Sept. 20, 2019, 17:30 PM)
8. *Ibid*

A decrease of 58.33% has been observed in such cases as 5 cases were reported during the year 2018 as compared to 12 in the previous year (2017).

After the Criminal Law (Amendment) Act, 2013, four new offences have been inserted in the Indian Penal Code from Section 354A to 354D dealing with sexual harassment, assault on women with intent to disrobe, voyeurism and stalking.In Chandigarh in the year 2014, 31 incidentsof sexual harassment were reported, 3 incidentsof assault on women with intent to disrobe were reported, 2 incidentsof voyeurism were reported and 10 incidentsof stalking were reported. In 2015, 22 incidentsof sexual harassment were reported, 2 incidentsof assault on women with intent to disrobe were reported, 1 incidentof voyeurism was reported and 13 incidentsof stalking were reported.In 2016, 26incidentsof sexual harassment were reported, 4incidentsof assault on women with intent to disrobe were reported, 2incidents of voyeurism were reported and 15 incidentsof stalking were reported. [9]

SEXUAL HARASSMENT AT EDUCATIONAL INSTITUTIONS IN CHANDIGARH

In executing the field work, the data was collected with the help of three sets of questionnaires including one set of females, one set for males and one set common for females and males which were distributed among females and males of different age groups at eight different educational institutions around Chandigarh viz. Panjab University, Sector 14, Panjab Engineering College (PEC) Sector 12, PGIMER Sector 12, Government College for Men (GCM) Sector 11, Government College for Girls (GCG) Sector 11, GGDSD College Sector 32, Dev Samaj College (DSC) Sector 45 and MCM DAV College Sector 36. The three sets of questionnaires had similar questions and were distributed among females and males respondents in the above mentioned educational institutions to the tune of 60 per institution.

The data reveals that generally males and females do take care of their behaviour in public especially in front of persons of opposite sex. This shows that in society males and females generally take care of their conduct. There is also similarity of opinion among the female and male respondents as to their outlook towards sexual harassment in our society and the majority has acknowledged that sexual harassment is prevalent in our society since long which satisfies the main objective of the research which is to measure the incidence and prevalence of sexual harassment among women. Thus, it can be seen that sexual harassment existed in our society since time immemorial and the same has been acknowledged by the respondents.

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9. http://www.data.gov.in/catalog/crime-committed-against-women (Sept. 20, 2019, 17:30 PM)

On being asked about the reasons for the sexual harassment of women in our society, 19% of female and 26% of malerespondents said patriarchal system is the reason; 16% of femaleand 20% of malerespondents said low status of women in the society is the reason; 13% of femaleand 12% of male respondents said women being an easy prey is the reason and 52% of female and 42% of malerespondents said women have been considered as an object of pleasure only which leads to sexual harassment of women in our society. This shows that majority of the female and male respondents are of the view that women have been sexually harassed in our society for reason being considered as an object of pleasure only, followed by the patriarchal system prevalent in the society which only leads to low status of women in the society. However, women being an easy prey has been least opined by both the female and male respondents for being sexually harassed in our society.

An important factor which is considered as a major reason behind sexual harassment is dressing of women. The data collected shows that 4% of female respondents and 24% of malerespondents think that dressing of women is a common cause to attract sexual harassment whereas 28% of femalerespondents and 8% of malerespondents do not think that dressing of women is a common cause to attract sexual harassment and 68% of female and male respondents think that it's the men's mentality that should be changed. The responses of the female and male respondents clearly shows a difference of opinion as very few percent of female said that dressing of women is a common cause to attract sexual harassment though quite high percent of male respondents are of the view that dressing of women does invite sexual harassment. Although majority of both female and male respondents are of view that there is a need to change the mentality of men which depicts that sexual harassment has nothing to do with the dressing of women rather the outlook of men is required to be changed.

The data collected shows that 90% of female respondents are of the view that the present condition of crimes against women is increasing while 10% of female respondents said that it's decreasing. On the other hand 74% of male respondents are of the view that the present condition of crimes against women is increasing while 26% of male respondentssaid that it's decreasing. It thus shows that though both female and male respondents are of opinion that crimes against women is increasing but this perception of female respondents is on the higher side as compared to the male respondents. On the other hand the perception of male respondents is on the higher

side as to the decreasing trend relating to crimes against women as compared to female respondents. Thus it can be said that the opinions of females and males differ as to the increasing or decreasing trend relating to crimes against women.

The data shows that 40% of the female respondents said that they have experienced non-verbal sexual harassment (e.g. looking someone up and down in a sexual way) whereas 56% of female respondents said that they have experienced oral sexual harassment (e.g. dirty jokes being sexual in nature, sexual comments etc.) and only 4% of female respondents said that they experienced physical sexual harassment (e.g. pulling someone's clothing, inappropriate touching, kissing etc.). The above data shows that females feel it difficult to reveal as to what type of sexual harassment they experienced.

The data collected shows that majority of victims of sexual harassment tends to talk about such incidents however most of them feel comfortable to discuss it with their peer groups followed by family members and most likely to the head of the institution if they want to seek redressal. The data collected also reveals that majority of persons have advised the female respondents to file a complaint against the harasser with the police. This reveals that if female becomes the victim of sexual harassment then society in general want to punish the culprit through legal process for such incidents are presumed to be normal by the other members of society.

On being asked as to what would they do in case sexually harassment, 8% female respondents said that they don't know what to do in such a situation whereas 4% of female respondents said that they would remain silent and would not speak about the incident and 88% of female respondents said that they would complain about sexual harassment. The data thus shows that the majority of women will come forward to report the matter to the police or to the institutional machinery in case of any incidence of sexual harassment and very minimal percent of women would remain silent or would not speak about such incident. This shows that women in the present day context are not afraid of any social taboo and will come forward to bring the culprit behind the bars for the offence of sexual harassment. This perception of females matches with that of society in general as gathered from the previous question observation wherein also maximum numbers of persons advised the victim to file a complaint against the harasser with the police.

The data collected shows that 82% of femalerespondentsare aware of laws protecting women from sexual harassmentwhile 18% of femalerespondentsare not aware of laws protecting

women from sexual harassment. On the other hand 81% of male respondents are aware of laws protecting women from sexual harassment while 19% of male respondents are not aware of laws protecting women from sexual harassment. The chart shows that there is similarity of opinion among female and male respondents as to the knowledge relating to laws protecting women from sexual harassment. This shows that female and male are proportionately aware or unaware respectively about the laws protecting women from sexual harassment, however, majority of both the respondents have shown their knowledge regarding such laws.

The data shows that 3% of female respondents and 9% of male respondents think that laws for the protection of women from sexual harassment are properly implemented whereas 32% of female respondents and 49% of male respondents think that such laws are not properly implemented. Further, 35% of female respondents and 36% of male respondents feel that such laws are rarely implemented whereas 30% of female respondents and 6% of male respondents are of view that rights/laws are there but none cares for such laws. Thus, general perception of respondents is that laws made for the protection of women from sexual harassment are either not properly implemented or rarely implemented. Marginal faction of respondents also thinks that no one cares about such laws even if they are enacted. The data thus reveals that there is lacking in the commitment of state agencies in enforcing or properly implementing the laws made for the protection of women from sexual harassment.

The data collected shows that 46% of femalerespondents see effective role of police in curbing crimes against women while 54% of femalerespondentsthink it's ineffective. Similarly,46% of male respondents see the role of police in curbing crimes against women as effective while 54% of malerespondentsthink it's not effective. The data shows that both the respondents see the role of police in curing crimes against women proportionately effective and in-effective respectively, however greater is the proportion of respondents with opinion that police's role is ineffective in curbing crime against women. This shows that role of protective agencies is not satisfactory while dealing with crimes against women.

The data collected shows that 43% of female respondents think that there are enough drives/campaigning by Chandigarh police regarding safety of women from sexual harassment whereas 57% of femalerespondents think that there are not enough drives/campaigning by Chandigarh police regarding safety of women from sexual harassment. On the other hand 37% of male respondents think that there are enough drives/campaigning by Chandigarh police

regarding safety of women from sexual harassment whereas and 63% of male respondentsthink that there are not enough drives/campaigning by Chandigarh police regarding safety of women from sexual harassment. Thus, the majority of female and male respondents are of the view that Chandigarh police's effort in curbing sexual harassment is lacking which in turn becomes one of the reasons in the increase of crime of sexual harassment which relates with the research hypothesis and shows that the role of protective agencies is lacking in dealing with such crimes.

On being asked if there are adequate number of women police personnel in Chandigarh, 47% of female respondents think that there are adequate numbers of women police personnel in Chandigarh while 53% of female respondents think that there are not adequate numbers of women police personnel in Chandigarh. The nature of crime against women requires reporting of incidents to women police personnel which if lacking will result in less number of complaints since it will be difficult for an aggrieved woman to reveal the information before a male police personnel.

The data collected shows that 82% of femalerespondentsthink that there is less deployment of women police personnel during night hours in Chandigarh whereas 18% of femalerespondents think that there is not less deployment of women police personnel during night hours in Chandigarh. Similarly, 82% of male respondentsthink that there is less deployment of women police personnel during night hours in Chandigarh whereas 18% of male respondents think that there is not less deployment of women police personnel during night hours in Chandigarh. The data thus suggests that majority of respondents are of the view that there is less deployment of women police personnel during night hours in Chandigarh which can be a major cause of insecurity among women because if sexually harassed woman victim may not feel comfortable to report the matter to male police personnel and that too during night hours fearing more harassment at the hands of male police personnel.

The data collected shows that 70% of female respondents said that they would avail late night dropping service started by Chandigarh police whereas 30% of female respondents said that they would not avail late night dropping service started by Chandigarh police. This shows that majority of female respondents have shown faith and trust on the Chandigarh police for dropping them during late night at their respective places rather than availing any other source of transportation. It reflects that females are afraid of using other modes of transportation during

night hours for fear of sexual harassment or other grave crimes. It is pertinent to mention here that recently in 2017 the Chandigarh police have also started late night picking and dropping of ladies.

The data collected shows that 90% of female respondents think that there should be notice board/banners prohibiting sexual harassment at educational institutions while 10% of femalerespondents think that there should not be notice board/banners prohibiting sexual harassment at educational institutions. On the other hand 93% of malerespondentsthink that there should be notice board/banners prohibiting sexual harassment at educational institutions while 7% of male respondents think that there should not be notice board/banners prohibiting sexual harassment at educational institutions. The chart shows that highlighting the prohibition of sexual harassment through notice board/banners will be a welcome step as a very high percentage of both the respondents were of this view. Since majority of people are unaware of laws prevalent in the country and sexual harassment has been taken up as a non-serious or casual incident without giving attention to the victims, such highlighting through notice/banners will regulate the behaviour of people and make them think before committing any such act.

The data collected shows that 58% of femalerespondents and 60% of malerespondents are of the view that imposing stringent punishment will help in the implementation of the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 whereas 42% of female respondents and 40% of malerespondents are of the view that sensitizing the society will help in the implementation of the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013. The data thus shows that the views of female respondents and that of male respondents are nearly proportionate for the implementation of the Sexual Harassment Act. However, imposing stringent punishment has been more opined than sensitizing the society for the implementation of the Act.

To see as if the provisions of the Act have been implemented by the educational institutionsinformation was sought under the provisions of Right to Information, Act from eight educational institutions which are the subject matter of the present research. As to the query regarding the number of complaints of sexual harassment dealt with by such institutions on yearly basis from 2006 to 2017, a total of 28 complaints during the period February, 2014 to May, 2017 in Panjab University, none in GGDSD College, in MCM DAV College there was one

complaint in 2016 and one complaint in 2017, in Dev Samaj College no such complaint has been received, in GCM there was one complaint during 2014-15, two complaints during 2015-16 and one compliant during 2016-17, in Government College for Girls no complaint has been received relating to sexual harassment, in PGIMER a total of 14 complaints, have been received.

As to the query,whether the complaintsrelating to sexual harassment were sorted out by the Committee itself or were referred to police under the provisions of Indian Penal Code, Panjab University replied that it depends upon the nature of the complaint, GGDSD College replied that in negative for reason that no documents are available, MCM DAV College replied that the matters were sorted out at the level of committee itself, Dev Samaj College and Government College for Girls replied in negative since no such compliant relating to sexual harassment has been received there, GCM College replied that all complaints were settled by the committee itself, PGIMER only revealed that no complaint has been referred to police.

It has been observed that bigger institutions like Panjab University and PGIMER have received more complaints of sexual harassment and all such complaints have been dealt with by the Complaints Committee only and no police case has been referred in such events. This tends to show that the problem of sexual harassment is more prevalent in bigger institutions as compared to smaller ones. However, these bigger institutions have not replied in spirit as to the query put to them that if the matter was sorted by the Committee then what punishment was given to the guilty person as Panjab University replied that the Committee recommended different punishments in different complaints keeping in view the nature of complaint andPGIMER replied that the findings of the Committee were sent to the concerned authorities for further action. Thus, what type of punishment was given to the harasser by the Committee or what were the findings of such Committee could not been unearthed. This could inadvertently imply that the provisions or procedures for dealing with sexual harassment complaints have not been properly implemented or applied by many educational institutions.

On the basis of information received through RTI from Chandigarh police, it has been observed that a total of 574 numbers of cases were registered under section 354 IPC during the period from 2006 to 2016 in Chandigarh, out of which 49% cases resulted in acquittal of the accused persons and only in 15% of cases the accused persons were convicted. Also, under section 509 IPC a total of 120 numbers of cases were registered during the period from 2006 to 2016 in Chandigarh, out of which 46% of cases resulted in acquittal of the accused persons and only in

18% of cases the accused persons were convicted. Rest 36% of the cases in both the categories are either pending in courts, or are untraced, or are pending investigation, or have been quashed. The above data thus shows that in cases involving sexual harassment of women, the rate of conviction is very less and the rate of acquittal is very high. This shows that there is some procedural lacuna with which the women victims of sexual harassment face a lot of hardship while dealing with their cases in the courts which results in acquittal of the culprits and ultimately in the failure of justice. Thus, the remedial mechanism lacks in providing appropriate relief to the victims of sexual harassment and defies the sufferings and humiliations of the victims.

CONCLUSION AND SUGGESTIONS

The Constitutional mandates as enshrined in the Preamble, Fundamental Rights and Directive Principles of State Policy aims at establishing an egalitarian society in which women can enjoy the same dignity as men. Although the Constitution of India guarantees to every citizen the equality before the law or the equal protection of law, the true equality has not been achieved even after so many years of independence. The Constitution of India assures for all freedom and right to dignity but has been systematically denied to women. In recent past, there has been so persistent and frequent commission of crimes in different shape and size violating their basic rights and outraging their dignity and modesty.

Article 29(2) of the Constitution of India provides that no citizen shall be denied admission into any educational institution maintained by the State. Education is the most effective tool for empowerment and human development. Negative parental attitudes toward educating daughters are a barrier to the girl's education since parents see their daughters' education as a waste of money because she will eventually live with her husband's family. As education helps a person grow cognitively, intellectually and emotionally and enables a person to take right decisions on the basis of logic and reasons. Women are empowered and their human rights are protected and promoted in India if our society concentrates on educating the girl children who are often discriminated against and whose rights are relegated to background in comparison to those of the male children. Hence, it is suggested that education being the most powerful weapon to bring about equality and to prevent the menace of sexual harassment, compulsory and free education should be given to girl children as fundamental right upto 12th standard. With better

education Indian women will try to get all the benefits and come forward to object any objectionable and uncomfortable behavior of men without caring any social taboos.

Students must learn about sexual violence, female equality, good communication skills, boundaries, and respect of gender differences. More female teachers and teacher's assistance should be hired for colleges, universities where most teachers are male. Curriculum development about gender equity, sexual harassment, and effective forms of discipline, among others, should be required in all college teacher education. Colleges should develop, disseminate, and publicize effective sexual violence policies and procedures, as well as monitor their effectiveness. Teachers who sexually abuse a student of any age should be fired and referred to the police.

Though plethora of legislation exists, due to ineffective enforcement, women are exploited by the male dominated society. Male dominated society has found ways to circumvent the provisions of the Act and act as a blockade against women empowerment. Due to the failure of the legislations to protect women, judiciary has come forward to protect women. In protecting the women, the Indian Judiciary has removed all the procedural shackles and has completely revolutionized constitutional litigations. The judiciary has encouraged widest possible coverage of the legislations by liberal interpretationof the terms. The Court has shown greater enthusiasm in granting the constitutional provisions for all women.

Women's cells/women police stations have been set up as special mechanisms to cope with violence against women. The number of women cells /women police stations should be increased and should be given adequate powers, funds and staff. There is also need ofreforms in the police department; often the police are unaware of the police safeguards for women and the amendments to laws relating to such safeguards. Thus, reforms in the police department for quick action, immediate disposal of the case, non-consideration of influence and helping hand to the women victim must be made available. There should be the movement of police control room vehicles within and around the workplaces which will create panic in the minds of doer of sexual harassment.

There is need of framing the National Media Policy and Mass Media like TV and films that do not simply reflect but subtly and indirectly help in shaping social reality. The indecent representation of women in the media is a social evil, which corrupts the young minds and encourages violence against women. Hence, the media should prevent the commoditization of

women. Channels, which spoil the minds of people, should be stopped immediately. Media must highlight the ideas and thoughts relating to human values which develop a social change. The media should give more coverage to sexual harassment issues and should follow up the cases and the public can be informed about the successful conviction of the perpetrators. So that, more women can come out to report sexual harassment incidents.

It is suggested that cases involving sexual harassment of women should be decided in a summarily manner and the courts should not follow the normal procedure of examining of victims/witnesses time and again in the court rooms rather the evidences be taken by way affidavits. This will reduce the time for deciding the cases and also the victims/witnesses will be saved from further mental and physical harassment arising out of the lengthy and cumbersome court's procedures.

Last but not least there is need of an effective implementation law to control and prevent the menace of sexual harassment.

THE SOUTH CHINA SEA DISPUTE: GENESIS, LEGAL ISSUES AND NEW DEVELOPMENTS

-Dr Ajaymeet Singh ?& Mr Ankit Malik ??

"National greatness is inextricably associated with the Sea; with its commercial usage in times of Peace and its control in times of War".

-Rear Admiral Alfred Thayer Mahan (United States Navy)[1]

INTRODUCTION

Rear Admiral Mahan highlighted the importance of sea in these words way back in the year 1890. However, his statement still holds immense significance even in the twenty first century. It is because of the reason that even after the invention of aircraft and aerial transport, 90% of the international trade is carried out via sea.[2] The South China Sea is a marginal sea near the Pacific Ocean, which is spread over an area of around 3.5 million square kilometers. It is a hotly contested maritime area between many countries because it is abundant in oil and natural gas reserves.[3] Apart from being rich in natural resources, the South China Sea is a very vital trade and maritime route as well. The South China Sea Dispute is a maritime conflict pertaining to sovereignty over Spratly and Paracel islands in the South China Sea and the surrounding sea territory. China, Taiwan and five ASEAN (Association of South East Asian Nations) countries, i.e., Vietnam, Philippines, Malaysia, Brunei and Indonesia are involved in this dispute. The exclusive economic zones of these countries also overlap in this area.[4] The dispute involves several complicated issues relating to the interpretation of the UN Convention on Law of the Sea, 1982.[5]

GENESIS AND BRIEF HISTORY OF THE DISPUTE

The South China Sea was very calm in the beginning of the 20th century because China and its neighboring States were focused on other global conflicts like World Wars I and II. In fact, at the end of the Second World War in 1945, no country possessed any island in the entire South China

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1. Alfred Thayer Mahan, Alfed Thayer Mahan Quotes, Goodreads (April 1, 2019, 4:15 PM), https://www.goodreads.com/author/quotes/4090051.Alfred_Thayer_Mahan.
2. In oceanography, a marginal sea is defined as a seapartially enclosed by islands, archipelagos, or peninsulas, adjacent to the open ocean at the surface, and/or bounded by submarine ridges on the sea floor.
3. Introduction to South China Sea, South China Sea (April 2, 2019, 5:30 PM), http://www.southchinasea.org/introduction/.
4. Zou Keyuan, Navigation in the South China Sea: Why Still an Issue?, 32(2) INTERNATIONAL JOURNAL OF MARINE AND COASTAL LAW 251 (2017).
5. Leszek Buszynski, The Development of the South China Sea Maritime Dispute, National Security College

Sea. It was in 1946 that China took possession of a few islands in the Spratly chain of islands. [6] The interest of various countries like China, Taiwan and Philippines in the South China Sea grew by leaps and bounds over the next 50 years. Between 1955 and 1956, China and Taiwan permanently occupied many islands in this area. But there was no dispute in this area for the next 15 years. However, by the early 1970's, the claimants became active again in order to wrest control of the disputed area because they came to know that there were significant crude oil reserves in the South China Sea. China and Philippines forcibly occupied several islands. The Battle of Paracel Islands was fought between the Naval forces of China and South Vietnam in January 1974. China emerged victorious in this battle and wrested control of several islands from South Vietnam. In this battle, several sailors and officers of the Vietnamese Navy were killed. After this battle, North and South Vietnam fortified their remaining positions in the South China Sea. They also took control of several unoccupied islands. Thereafter, tensions between these countries de-escalated for some years. However, disputes arose again in 1995 because Beijing built several underground bunkers in order to consolidate its position above the Mischief Reef.[7]

SOUTH CHINA SEA DISPUTE IN THE TWENTY FIRST CENTURY

In 2002, ASEAN (Association of South East Asian Nations) countries and China came together and held discussions to resolve the conflict in South China Sea. The discussions culminated in the Declaration on the Conduct of Parties in the South China Sea, 2002. The Declaration motivated the concerned countries to lay down a Code of Conduct for the use of resources of South China Sea. The parties promised not to use armed forces against each other in this

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Occasional Paper, 2013, National Security College (April 3, 2019, 5:45 PM),http://nsc.anu.edu.au/documents/occasional-5-brief-1.pdf. The UN Convention on Law of the Sea may contribute to a solution, but it has also contributed to the scramble for maritime territory and resources. UNCLOS allows each littoral state to claim an Exclusive Economic Zone of 200 nautical miles, and a Continental Shelf, and specifies that islands can generate their own EEZ's or continental shelves. However, what the claimants may be entitled to by asserting sovereignty over islands will be limited by UNCLOS, since not all islands can generate EEZ's or continental shelves. In Article 121(3), UNCLOS distinguishes between islands and rocks or reefs, which cannot generate EEZ's or continental shelves, but which are entitled to a 12 nautical mile territorial sea. Islands may not be entitled to full maritime zones in certain situations where they are close to continental land masses. Coastline length may be used to determine entitlement to the maritime zones of occupied islands, in which case the Philippines and Vietnam would benefit more than China. UNCLOS does not significantly benefit China in this matter, which has sought alternative ways of validating its claim to the area.

6. Sean Mirski, The South China Sea Dispute: A Brief History, Law Fare (April 4, 2019, 6:15 PM), https://www.lawfareblog.com/south-china-sea-dispute-brief-history.
7. David Anderson, Some Aspects of the Regime of Islands in the Law of the Sea, 32(2) INTERNATIONAL JOURNAL OF MAINE AND COASTAL LAW 320 (2017).

maritime area and agreed to solve their conflicts in an amicable manner. Over the next few years, the claimants refrained from provoking each other and did not occupy any other islands in the region. The concerned countries did not use force against each other. However, they started troubling each other by repeatedly sending demarches[8] and notes verbales.[9] Malaysia and Vietnam forwarded a joint memorandum to the Commission on the Limits of the Continental Shelf in May 2009, putting forth their claims in the South China Sea.[10]

China responded to the joint memorandum by submitting a map in which their notorious "nine dash line" was published. This line encompasses the entire South China Sea. China maintains that on the basis of its historical rights, it has unrestricted sovereignty over the islands in the South China Sea as well as the superjacent waters. Ever since the nine dash line was published, other countries interested in the South China Sea have been worried and intimidated by China's nefarious designs in the South China Sea. In 2012, Beijing snatched Scarborough Shoal away from the Philippines. Since then, Philippino boats have not dared to enter the waters of this shoal. [11]

Over the past 9 years, Chinese Navy has become very aggressive in the South China Sea. China has started an extensive land reclamation program in the entire South China Sea by constructing artificial islands. China has also prepared an airstrip on one of the large islands in this zone. Civilian as well as military aircraft are capable of landing on this airstrip. Till date, China has reclaimed over 2000 acres of land in the South China Sea. The other claimants in this region have vehemently condemned this land reclamation. In 2014, US President Barack Obama warned China and asked it to "stop throwing elbows and pushing people out of the way in pursuit of its interests."But unfortunately, China has not adhered to such warnings and requests till date.[12]

ISSUES INVOLVED IN THE DISPUTE

Both economic and strategic issues are involved in this maritime dispute. These issues are explained below:

1. Oil and Gas Reserves: Oil is the backbone of the economy of every country. Malaysian

8. Demarche is a formal diplomatic representation of the official position, views, or wishes on a given subject from one government to another government or intergovernmental organization.
9. Note Verbale is a diplomatic communication drafted in the third person and unsigned.
10. *Supra* note 6.
11. *Ibid.*
12. *Ibid.*

company Petronas is the major oil producer in this region. In 2011, it produced half a million barrels of crude oil per day. Apart from crude oil, it also produced 600 billion m3 of natural gas per year. Vietnamese company Petro Vietnam is also active in this area. With the passage of time the demand for crude oil has increased. As a result, the existing crude oil reserves have depleted. Therefore, both Petronas and Petro Vietnam are looking for new reserves in order to stay afloat in the market. This has irked China because it imports 55% of its crude oil and does not want any other country to explore the resources of the South China Sea.[13]

2. Fish Stocks: Fishing is the main source of earning livelihood for the people residing along the coastal areas. China has a very long coastline and the South China Sea is very rich in fish stock. But unfortunately, the fish stock of this region has been over exploited because of population explosion. As a result, both the quality and quantity of fish in this area has declined considerably. Some recent clashes which have taken place in this zone have been because of fisheries. Many countries have been sending naval and coast guard vessels in this zone for the purpose of supporting and protecting their fishermen. This has resulted in several tense incidents and close shaves.[14]

3. Strategic Value: The busiest sea lanes of the world pass through the South China Sea. It connects North East Asian countries like Japan, Philippines, Taiwan and South Korea with the South Asian countries like Malaysia, Sri Lanka and India. Most of the North East Asian countries import crude oil through the South China Sea because this trade route further extends to the Middle East countries which have abundant reserves of oil. Around 50 percent of the world's maritime trade and commerce is carried out through this area. Therefore, it holds immense strategic significance for North East Asian and South Asian countries. China can very easily hold these countries to ransom by blocking access to this vital trade route. Therefore, the major maritime powers like USA and Japan have always strived to maintain freedom of navigation through the area, which means preventing control over the South China Sea by one power, particularly a potentially hostile one.[15]

So far as China is concerned, it imports 80 percent of its crude oil through the South China Sea. In addition to it, 40 percent of China's entire trade and commerce is carried out through this zone. China is having an apprehension that in case the conflict in this zone aggravates, the US

13. *Supra* note 5.
14. *Ibid.*
15. *Ibid.*

Navy and the Indian Navy may join hands together in order to block China's oil imports and thus bring China down to its knees. Therefore, in order to protect its strategic interests, China has developed a very strong naval force which also includes an Aircraft Carrier and a few nuclear submarines capable of operating even in the Indian Ocean region. It is important to mention here that the US Navy has invited the Indian Navy many times for conducting joint patrolling in the South China Sea, but India has till date refrained from doing so, fearing Chinese aggression.



UNCLOS VERSUS CHINA'S HISTORICAL RIGHTS

China's claims to sovereignty over the South China Sea are based on 'historic rights' supported by imperial maps of the Ming dynasty, which date back to the 13th century.[16] The Chinese put forth the view that their historical notions of sovereignty predate and prevail over Western International Law and should be recognized as valid ab initio. China further argues that the United Nations Convention on Law of the Sea, 1982, is not applicable to the South China Sea because China had indisputable sovereignty over this area even before the coming into force of

16. Abhishek Pratap Singh, South China Sea Arbitration: An Analysis, Eurasia Review(April 5, 2019, 7:00 PM), http://www.eurasiareview.com/16052016-south-china-sea-arbitration-analysis/.

the UNCLOS, 1982. In the above mentioned image, the red line depicts the area claimed by China in the South China Sea. It is notoriously known as "The Nine Dash Line."

However, the Chinese claim of sovereignty over the entire South China Sea on the basis of historical records is not in consonance with modern International Law.[17] Justice Max Huber's test laid down in the ***Island of Palmas Case (United States of America vs. The Netherlands)***[18] *provides that "any rights obtained from history may be lost if they are not maintained in accordance with the changes brought about by the development of modern International Law."*[19]

Legally, most of the provisions of UNCLOS, 1982, are binding on all nations because it has codified pre-existing international customs related to maritime law. This is irrespective of the fact whether they have signed this Convention or not. As of December 2019, 167 countries and the European Union have ratified this Convention. USA is the only major maritime power which has not ratified the UNCLOS. In the ***Case concerning the Continental Shelf of Libyan Arab Jamahiriya/Malta,***[20] decided on 3rd June 1985, the International Court of Justice observed that: *"It cannot be denied that the 1982 Convention is of major importance, having been adopted by an overwhelming majority of states. Hence, it is the duty of this Court even independently of the reference made to the Convention by the parties, to consider that in what degree any of its relevant provisions are binding upon the parties as a rule of customary International Law."*[21]

THE PHILIPPINES VERSUS CHINA ARBITRATION CASE

International Court and Tribunals generally assume jurisdiction on the basis of mutual consent of the parties to the dispute. However, once a State has signed and ratified the UNCLOS, 1982, it has to settle all its disputes pertaining to the Convention by either one of the four methods mentioned in the Convention itself. Such disputes can be brought before the International Court of Justice (ICJ) or the International Tribunal for Law of the Sea (ITLOS). They can also be submitted for Arbitration under Annexes VII and VIII of the Convention. Thus, one of the disputant States can sue the other State or States in either of these forums for resolving a

17. *Supra* note 5.
18. Permanent Court of Arbitration, 1928.
19. Reports of International Arbitral Awards, UN Legal (April 8, 2019, 7:25 PM), http://legal.un.org/riaa/cases/vol_II/829-871.pdf.
20. 1985, ICJ Reports, at 13.
21. International Court of Justice, Continental Shelf Case (Libyan Arab Jamahiriya/Malta), ICJ (April 10, 2019, 8:00 PM), http://www.icj-cij.org/docket/index.php?sum=353&p1=3&p2=3&case=68&p3=5.

maritime dispute if the terms and conditions of the UNCLOS, 1982, are fulfilled.[22] Aggrieved by China's aggressive stance in the West Philippine Sea, which is overlapping with the South China Sea, Philippines brought forth arbitral proceedings against China at the Permanent Court of Arbitration, the Hague on 22nd January 2013, having recourse to Annexure VII of the UNCLOS, 1982.[23] ***In The Republic of Philippines vs. The People'sRepublic of China,***[24] the Philippines challenged the legality of the U shaped line (Nine Dash Line) claimed by China and the legal regime of several other features in the South China Sea. China refused to appear before the arbitral tribunal. It asserted that as per the treaties signed between China and Philippines, territorial disputes have to be settled by mutual negotiations only. The Chinese government further stated that as per the terms of "The Voluntary Declaration on the Conduct of Parties in the South China Sea," signed in 2002 between China and ASEAN (Association of South East Asian Nations) countries, border disputes have to be settled by bilateral or multilateral negotiations. China accused Philippines of violating this Declaration.[25]

China also challenged the jurisdiction of the arbitral tribunal to try the case, citing certain provisions of the UNCLOS, 1982.[26] China further claimed that the dispute settlement

22. Pham Lan Dung & Tran Huu Duy Minh, Some Legal Aspects of Current Developments in the South China Sea Dispute in Examining the South China Sea Disputes: Papers From the Fifth Annual CSIS South China Sea Conference, CSIS (April 11, 2019, 8:30 PM), http://csis.org/files/publication/151110_Hiebert_ExaminingSouthChinaSea_Web.pdf.
23. The South China Sea Arbitration (The Republic of Philippines vs. The People's Republic of China), Permanent Court of Arbitration, (April 11, 2019, 7:55 PM), http://www.pcacases.com/web/view/7.
24. Case No. 19/2013.
25. *Supra* note 22, at 74.
26. *Ibid.* UNCLOS, 1982, provides for optional exceptions for excluding the jurisdiction of dispute settlement forums provided in the Convention. As per Article 298, States may exclude several types of disputes by a declaration, among others, including disputes concerning maritime delimitation or historic title. China made such a declaration in 2006. Article 298(1) provides that when signing, ratifying or acceding to this Convention or at any time thereafter, a State may declare in writing that it does not accept any one or more of the procedures provided for in section 2 with respect to one or more of the following categories of disputes: (a) (i) disputes concerning the interpretation or application of articles 15, 74 and 83 relating to sea boundary delimitations, or those involving historic bays or titles, provided that a State having made such a declaration shall, when such a dispute arises subsequent to the entry into force of this Convention and where no agreement within a reasonable period of time is reached in negotiations between the parties, at the request of any party to the dispute, accept submission of the matter to conciliation under Annex V, section 2; and provided further that any dispute that necessarily involves the concurrent consideration of any unsettled dispute concerning sovereignty or other rights over continental or insular land territory shall be excluded from such submission; (ii) after the conciliation commission has presented its report, which shall state the reasons on which it is based, the parties shall negotiate an agreement on the basis of that report; if these negotiations do not result in an agreement, the parties shall, by mutual consent, submit the question to one of the procedures provided for in section 2, unless the parties otherwise agree; (iii) this subparagraph does not apply to any sea boundary dispute finally settled by an arrangement between the parties, or to any such dispute which is to be settled in accordance with a bilateral or multilateral agreement binding upon those parties; (b) disputes concerning military activities, including military activities by government vessels and aircraft engaged in non-commercial service, and disputes concerning law enforcement activities in regard to the

mechanism provided under the UNCLOS applies only to the Convention's application or interpretation. Therefore, the parties cannot avail its dispute settlement mechanism for settling their territorial sovereignty disputes. However, just one week before the deadline set by the arbitral tribunal for the submission of a counter memorial, China published a position paper highlighting its case on 7th December 2014.[27] It is important to mention here that China's decision of not participating in the arbitral proceedings cannot prevent the arbitral tribunal from proceeding with the case. Vietnam also submitted its position paper in the capacity of an interested third party, supporting the stand taken by the Philippines. In response to China's claim, Philippines clarified that all arguments put forth by it before the tribunal do not deal with territorial sovereignty only. It has only requested the arbitral tribunal to decide the legality of the U shaped line (Nine Dash Line) claimed by China and the legal status of several other islands in the South China Sea, notwithstanding the fact that who has sovereignty over them.[28]

The hearing of the case began on 7th July 2015. It was attended by observers from Indonesia, Malaysia, Japan, Thailand and Vietnam. The first issue before the Court was pertaining to jurisdiction. On 29th October 2015, the Court held that it has the jurisdiction to hear the case. However, it agreed to take up only 7 out of the 15 submissions put forth by Philippines. Two of these submissions related to the Scarborough Shoal and the Mischief Reef, which is a low tide zone. The issue was whether the shoal and the reef can be considered as islands.

In a landmark verdict delivered on 12th July 2016, the UN Arbitral Tribunal held that *"Philippines has exclusive sovereign rights over the West Philippine Sea (South China Sea). The Court also declared China's Nine Dash Line as invalid. The Court concluded that there is no legal basis for China to claim historic rights to resources in the sea areas falling within the nine dash line. It further observed that China has violated Philippine sovereign rights in the West Philippine Sea."*[29]

POST JUDGMENT DEVELOPMENTS

After the delivery of the judgment by the UN Arbitral Tribunal on 12th July 2016, China

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exercise of sovereign rights or jurisdiction excluded from the jurisdiction of a court or tribunal under article 297, paragraph 2 or 3; (c) disputes in respect of which the Security Council of the United Nations is exercising the functions assigned to it by the Charter of the United Nations, unless the Security Council decides to remove the matter from its agenda or calls upon the parties to settle it by the means provided for in this Convention.

27. *Supra* note 22, at 77.
28. *Ibid.*
29. Matikas Santos, Philippines Wins Arbitration Case vs China Over South China Sea, Global Nation (April 12, 2019, 8:30 PM), http://globalnation.inquirer.net/140358/philippines-arbitration-decision-maritime-dispute-south-china-sea-arbitral-tribunal-unclos-itlos.

declared that any decision by the UN Arbitral Tribunal which forces it to compromise with its territorial sovereignty is unacceptable to it. Chinese Foreign Ministry spokesperson Hua Chunying remarked that "on the issues of territorial sovereignty and maritime rights and interests, China will never accept any imposed solution."[30] On the very same day, China threatened to declare an "Air Defence Identification Zone (ADIZ)" over the disputed waters of the South China Sea. Liu Zhenmin, Chinese Vice Foreign Minister remarked that "if our security is being threatened, we have the right to demarcate an air defence identification zone."[31] If such an ADIZ is actually imposed, China would enjoy the right to require every aircraft entering the designated airspace to identify itself, failing which, it could be shot down. In November 2013, China declared an ADIZ over the disputed islands in the East China Sea and named it as "East China Air Defence Identification Zone." Both USA and Japan condemned this move by China. It resulted in the escalation of tensions between these three countries. USA immediately responded by sending two fully loaded B-52 Bombers of the US Air Force in this ADIZ and refused to identify them to China. However, the Chinese did not dare to shoot them down, fearing retaliation by the American forces. USA might respond in a similar manner if the Chinese declare an ADIZ over the South China Sea.[32] But till date, China has refrained from doing so.

On 28th July 2018, China for the first time sent a search and rescue ship to be permanently stationed at one of its manmade islands in the disputed Spratly chain of the South China Sea. China has also built several military outposts on the disputed islands of the South China Sea. It has always maintained that these facilities are for defensive purposes only. However, such moves could actually help to bolster China's claim of sovereignty over the disputed islands.[33]

On 5th July 2020, the US Navy deployed two aircraft carriers, i.e., "USS Nimitz" and "USS Ronald Reagan" in the South China Sea for conducting military exercises. This was done with

30. Matikas Santos, China: We are the Victims in Dispute; Won't Heed UN Decision, Global Nation (April 12, 2019, 9:00 PM), http://globalnation.inquirer.net/126097/china-we-are-the-victims-in-dispute-wont-heed-un-decision.
31. Neil Connor, China Threatens to Impose Air Defence Identification Zone on Disputed Area of South China Sea, The Telegraph (April 15, 2019, 8:00 PM), https://www.telegraph.co.uk/news/2016/07/13/china-declares-right-to-set-up-air-defence-zone-in-south-china-s/.
32. Ralph Jennings, What Happens if China Declares an Air Defence Identification Zone Over The Disputed South China Sea, Forbes (April 15, 2019, 8:30 PM), https://www.forbes.com/sites/ralphjennings/2016/07/27/what-you-do-if-beijing-declares-an-air-defense-zone-over-disputed-south-china-sea/#b07948e6fa55.
33. Jesse Johnson, In a First, China Permanently Stations Search and Rescue Vessel in South China Sea's Spratly Chain, The Japan Times (April 15, 2019, 7:15 PM), https://www.japantimes.co.jp/news/2018/07/29/asia-pacific/first-china-permanently-stations-search-rescue-vessel-south-china-seas-spratly-chain/#.W19BJNUzbIU.

the objective of mounting pressure on China to stop its expansionist activities.[34] In response, the Chinese Army conducted maritime attack drills and the Chinese Navy deployed warplanes in the South China Sea.[35]

INDIA AND SOUTH CHINA SEA

South China Sea holds vital significance for India because 55 percent of India's maritime trade and commerce is carried through the Malacca Strait, which is connected to the South China Sea. The aggressive posture of China in this maritime zone can be detrimental to India's economy as well as national security. If the South China Sea dispute takes a violent form and results in the outbreak of a War between the disputing States or between China and USA, the security of the entire Indian Ocean region would be jeopardized. Such a situation might disrupt India's trade with its South East Asian neighbours. Therefore, India needs to adopt a defensive strategy by entering into military alliances with its South East Asian neighbours in order to counter China's aggressive maneuvers in the South China Sea. Such a strategy has become imperative for India as the Chinese Navy has already established a foothold in a few critical Indian Ocean States like Myanmar and Cambodia.[36]

Although India is not a party to the ongoing conflict in the South China Sea, it needs to keep a keen eye on the dispute in order to maintain peace in the Indian Ocean region. China has poked India several times by stating that the Indian Ocean is not India's Ocean. But no one can deny the fact that India has the largest Navy in the South Asian region and is duty bound to maintain the Indian Ocean as a zone of tranquility. Therefore, India is interested in the South China Sea dispute primarily for three reasons, i.e.,

i) Firstly, to maintain and strengthen its maritime security,

ii) Secondly, to develop close ties with ASEAN countries to fulfill its 'Look East Policy' and

iii) Thirdly, to counter China in the Indian Ocean region.[37]

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34. Shishir Gupta, US Supercarriers in South China Sea: Ambitious Beijing Stretched on Multiple Fronts, Hindustan Times (July 22, 2020, 11:30 PM), https://www.hindustantimes.com/india-news/us-supercarriers-in-south-china-sea-ambitious-beijing-stretched-on-multiple-fronts/story-9TGe3YDqJgi6A304oVo7MM.html.
35. Liu Xuanzun, PLA conducts maritime drills, deploys warplanes in South China Sea amid US aggression, Global Times (July 22, 2020, 11:45 PM), https://www.globaltimes.cn/content/1195104.shtml.
36. Abhijit Singh, India and the South China Sea Dispute, The Diplomat (Sept. 22, 2019, 12:23 PM), https://thediplomat.com/2016/03/india-and-the-south-china-sea-dispute/.
37. *Ibid.*

However, till date, India has maintained a pragmatic position on the dispute. India has not favoured any particular country in the ongoing dispute. But it has always stressed upon the freedom of navigation for all countries. It has also advocated the peaceful resolution of all international disputes in accordance with the well settled principles of International Law.[38] So far as the decision of the arbitral tribunal on the South China Sea dispute, delivered in 2016 is concerned, India has urged all the disputing States to accept the verdict.

CONCLUSION

In the twenty first century, the South China Sea dispute is indeed a boiling point which could trigger a Nuclear War between USA and China in the hotly contested waters and beyond. The Chinese Navy and the US Navy often make aggressive overtures against each other in this sea. Although the South China Sea Dispute has its roots in history, it has assumed greater significance in the twenty first century. This is so because the South China Sea is a major shipping and trade route, it is rich in oil and gas reserves and fish stocks, and has a great strategic and military value. Apart from these factors, the advancement of science and technology has made it possible for China to reclaim land in the South China Sea by constructing artificial islands, which is a cause of concern for the other countries involved in the dispute. China's claim to the whole of the South China Sea on the basis of its nine dash line (U shaped line) cannot be justified by any stretch of imagination. The Chinese claim is in clear cut violation of the United Nations Convention on Law of the Sea, 1982, as well as customary international law. Such an extensive and usurping claim cannot be sustained on the basis of historical rights alone. No country should be allowed to usurp the exclusive economic zone of other countries on the basis of its historical rights. China is trying to aggressively dominate its small and weak maritime neighbors involved in the dispute as they cannot match the manpower and firepower of the mighty Chinese Navy. China is thus hell bent to prove that "might is right." The Chinese claim has been vehemently condemned and opposed by the other countries involved in the dispute as well as by neutral countries like India, Japan and USA.

SUGGESTIONS

In order to settle the South China Sea Dispute permanently, it is suggested that all countries involved in the dispute should whole heartedly accept the verdict of the Arbitral Tribunal

38. *Supra* note 33.

delivered in the case of ***Philippines vs. China.*** For the promotion and sustenance of international peace and security, it is imperative that the dispute should be settled at the earliest, once and for all, on the basis of a liberal and extended interpretation of the United Nations Convention on Law of the Sea, 1982, which is virtually a "Constitution for the Oceans."All countries bordering the South China Sea should bring their maritime claims in conformity with the provisions of the UNCLOS, 1982. This approach seems to be the best for dealing with the underlying sovereignty and maritime disputes in the South China Sea.[39] If China fails to abide by the UNCLOS, it would be a serious violation of International Law. Moreover, it will tarnish China's reputation and will become a hurdle in its quest to become a global leader. [40]

It is further suggested that China must be encouraged to resolve the issue of its claims in the South China Sea in a spirit of mutual cooperation, regional harmony and peace. Unnecessary belligerence and assertiveness will only vitiate the atmosphere and harm its own long term interests. Joint development of the region and sharing of natural resources will be for the common good of the region, as against an attempt to corner them for use by one country flexing its military muscle.[41]

It has been very aptly remarked that *"where the limits of the law are exhausted, it is for the diplomacy to mend friendly relations so that the desired results may be achieved."*[42]

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39. Robert Beckman, The UN Convention on the Law of the Sea and the Maritime Disputes in the South China Sea, 107 AMERICAN JOURNAL OF INTERNATIONAL LAW163 (2013).
40. Jill Goldenziel, International Law is the Real Threat to China's South China Sea Claims, The Diplomat (April 10, 2019, 8:15 PM), http://thediplomat.com/2015/11/international-law-is-the-real-threat-to-chinas-south-china-sea-claims/.
41. *Supra* note 33.
42. Manimuthu Gandhi, The Enrica Lexie Incident: Seeing Beyond the Grey Areas of International Law, 53 Indian Journal of International Law 26 (2013).

THE TRANSITIONAL SHIFT FROM THE HUMAN RIGHTS OF THE 'MENTALLY RETARDED' TO THE HUMAN RIGHTS OF THE PERSONS WITH INTELLECTUAL DISABILITIES- THE DISABILITY OFTEN IGNORED

-Nidhi Sharma*

"…The Disabled too are equal citizens of the country and have as much share in its resources as any other citizen. The denial of their rights would not only be unjust and unfair to them and their families but would create larger and grave problems for the society at large. What the law permits to them is no charity or largesse but their right as equal citizens of the country."[1]

Justice Aftab Alam.[2]

INTRODUCTION

Human Rights are considered as those natural rights which portray the existence of every human being in this society and also accord the right to lead a life of dignity and self-worth. These rights are considered to be inherent to the human survival and have been recognised as well as advocated since the last many centuries. Starting from the rights such as the right to life and right to self-preservation to providing the rights for every human which forms a part of this society, the concept of Human Rights has undergone a lot of evolution. At present, the movement of human rights has reached a point where they are not considered to be a choice but have been made mandatory for the well-being of the citizens of every country. All the national and domestic laws of the countries have these rights embedded within their Constitutions and there are proper remedies available for the violation of the same.

When we talk about the concept of Human Rights it must be seen that it is made up of two important words, Human and Right. The term 'right' which has its genesis in the Latin term 'rectus' i.e. rectify or correct, means something which is 'just.' It must be remembered that a 'Human' without 'Rights' is not a free man and is equivalent to a slave. Thus, all the doctrines and the ideologies as propounded by various writers and authors which talk about the protection of human freedom or upholding their dignity always presuppose the existence of the human

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1. Bhagwan Dass and another v. Punjab State Electricity Board (Supreme Court) Civil Appeal No. 8 of 2008, Judgment dated 4th January 2008.
2. *Id.*

rights. Harold Laski has rightly observed that, 'every state is known by the rights that it maintains'[3]. Even the writers and philosophers existing in the Vedic period were of the view that human rights are those essential rights without which we cannot be accorded with the true status of being a 'human'. According to them these essentials help us to grow and develop in the best possible manner. One of the other important things that they pointed out was that these rights are universal in nature and shall apply to one and all without any kind of discrimination.

Disability is regarded as that component of human existence which results due to the impairments that affect a person's social outlook. There is a lack of ability to take part in the societal affairs at an equal level with others. All human beings in this world are born free and are equal in terms of equal dignity and rights. 'Right' as we understand is nothing but an entitlement which a person may claim either on moral or legal grounds. The specially abled people whom we often regard as 'disabled' persons are considered to be a weaker section of the society and at times sub-human due to which they are at a risk of violence whether physical, mental or sexual in nature.

The concept of disability has been discussed by various thinkers and jurists who have not only tried to define the term but also accorded a viable interpretation to it over the years. When we use the term 'disability' we equate it with some form of incapability or deficiency to perform a physical or mental activity. In other words, disability can be expounded as the lack of ability and opportunities to compete with the world at large standing at the equal pedestal. Persons with disabilities have always been considered as the soft targets of abuse, inequality and charity in our society. For centuries they have been considered nothing but subjects of charity and pity which requires a change.

Even the texts of religious scriptures do not exempt the disabled from being regarded as the weaker and lower section of the society. The religion considers them incapable to perform the religious duties and ceremonies. The importance of rights for persons with disabilities is essential to their struggle for equality and social participation.[4] Before we discuss the shift in the terminology it would be imperative to first get an understanding of the terms 'disability' and 'intellectual disability'.

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3. Prof. S.N. Dhyani, Jurisprudence- Indian Legal Theory 224 (5thed, Central Law Agency., 2019).
4. Jayna Kothari,The Future of Disability Law in India: A Critical Analysis of the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 19952 (Oxford University Press, 2012).

DISABILITY- MEANING

Even though the concept and types of disabilities have been recognized around various cultures, the definition of the term disability is subjected to various socio-cultural considerations and the extent to which the persons with disabilities are acknowledged or discriminated varies from culture to culture.[5] Therefore, it would be correct to say that the notion and perception of disability varies according to the customs and culture which shape the attitudes of people living there. Disability is not just confined to the health condition rather covers a wide range of impairments. In order to attain a better clarity of the term disability, it would be imperative that we tend to focus on the various definitions and meanings attributed to it.

To frame a proper legal definition of disability is not exempted from debate itself. The definition of disability varies across the globe. A study which was conducted on the definitions of disability in various European Union countries depicted that the definitions vary not only from country to country but also in different cultures within a country.[6] To articulate and confine the word disability to a single definition is not an easy task since it contains within itself a number of impairments in the mind and the body. To sum it up the boundary between an abled and a disabled persons seems to be unclear.For example in the case of intellectual disability the ability to understand pictures but not words or numbers results in a disability regarded as dyslexia. Therefore, it is difficult to encompass the various impairments of conditions of mind in one single definition. Moreover, we often encounter a change in the definitions of disability with the developments in the field of science and medicine.

Nevertheless, there are some definitions mentioned in the legal instruments which speak about the rights of the disabled persons. The Preamble to the Convention on the Rights of Persons with Disabilities, 2006[7] not only acknowledge that disability is an evolving concept but also stresses that disability is the result of interaction that occurs between a person under an impairment and his environmental and attitudinal barriers. It also stresses that such barriers often hinder their active and full participation in the society. Therefore, to define disability as an interaction means that disability is not an attribute of a person.

Disability has often come to be understood as an existing difficulty in performing one or more

5. Dinesh Bhugra &Kamladeep Bhui, Textbook of Cultural Psychiatry 462 (Cambridge University Press, 2018).
6. Kothari, *supra,* 30.
7. United Nations Convention on the Rights of Persons with Disabilities, 2006GA Res 61/106, GAOR UN A/Res /106 (2006).

activities which in accordance with age, sex and other social factors are generally accepted as an essential basic component of daily living.[8] It is very essential that the meaning of disability is clarified at the very outset so that there persists no ambiguity in the future. Therefore, the terms such as impairment, disability and handicap are not be used synonymously as it will only lead to ambiguity. The World Health Organization has attempted to make a distinction between these three terms.[9] According to WHO impairment refers to the loss of physical or sensory working of any particular organ of the body, while disability means an inability or a limitation to cope up with the normal routine in an equal manner with the others. Handicap on the other hand is an entirely different concept which is nothing but a situation which results from the impairment or disability clubbed along with the response coming from the society.[10]

The definition of disability can be viewed from two perspectives, one being the medical definition and other being the social or legal definition. The legal definitions of disability vary according to the legal purposes that it attempts to fulfil. A law which talks about the social welfare of the disabled shall carry a definition which provides benefits in the society rather than an anti-discrimination law. This debate about the medical definition versus the social or legal definition has had a larger impact on disability studies, as it leads to a shift from the charity oriented understanding to a rights based understanding of the term disability.[11]

While the medical perspective only focuses to reintegrate the person with disability into the mainstream society, the social model defines disability with regard to the social, environmental and attitudinal barriers rather than the lack of ability. The concept of discrimination is the main attribute in the social definition, which focuses on the point that the disabled people do not face disadvantage because of their impairments but experience discrimination in the way a society is organised.

By placing emphasis on human dignity, respect and the right to equality, rather than the simple bio-medical condition the social approach recognises that the attitudes of society and its members often contribute to the idea or perception of a handicap and in fact a person may have limitations in everyday activities other than those reportedly created by prejudice and stereotypes. Since the research paper deals with one important aspect of disability i.e.

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8. Dr. Mohd. Ahmad, Disabled Persons and Human Rights,15(4) CMLJ463, 465 (2015).
9. World Report on Disability, Understanding Disability, World Health Organization (Sep. 12, 2017, 11:34 AM), http://www.who.int/disabilities/world_report/2011/report.pdf.
10. *Id.*
11. Kothari, *supra*,30.

Intellectual Disability, it is quite imperative that the term needs to be understood and subsequently the paradigm shift in the concept and terminology from'mental retardation'to 'intellectual disability'will be discussed.

INTELLECTUAL DISABILITY

The meaning and definition of the term intellectual disability has always remained a topic of debate since the times when classification of disorders relating to brain was being done.[12] Since the last decade, the term intellectual disability is more often used instead of the term mental retardation. Esquirol referred to intellectual deficits overall as conditions of incomplete mental development based on known or unknown biological or environmental issues.[13] The Convention on the Rights of the Persons with Disabilities, 2006 does not define the term disability per se, but rather talks about it as an outcome of the interaction between an impairment and the environment. Such a definition highlights the heterogeneity of experiences, life chances, choices and preferences of adults and children with disabilities shaped by a range of socio-economic, cultural and other factors rather than focusing on a condition. Therefore, in line with the Convention, the World Report on Disability[14] defines the term intellectual impairment as:

> "A state of arrested or incomplete development of mind which means that the person can have difficulties understanding, learning and remembering new things and in applying that learning to new conditions. Also known as intellectual disabilities, learning disabilities and formerly as mental retardation or mental handicap."[15]

The American Psychiatric Association[16] also defines Intellectual Disability as something which involves general mental abilities that affect the functioning in two areas i.e the intellectual functioning involving activities like learning or solving problems, etc. The Diagnostic and Statistical Manual[17] defines Intellectual Disability as an inability in the cognitive aspect of the brain and an intelligence quotient below 70. Apart from that the definition also covers the

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12. James C. Harris & Stephen Greenspan, Definition and Nature of Intellectual Disability, Springer (Sep. 15, 2016 21:45 PM), file:///C:/Users/jai%20mata%20di/Downloads/9783319265810-c1%20(1).pdf
13. *Id.*
14. Report of the ninth session of the Conference of States Parties to the Convention on the Rights of Persons with Disabilities, 2006,United Nations (Sep. 13, 2017, 09:50 AM), http://www.un.org/disabilities/documents/COP/9/cosp9_report_e.pdf.
15. *Id.*
16. Defining Intellectual Disability, American Psychiatric Association (Sep. 9, 2017, 22:13 PM), http://www.apa.org/pi/disability/resources/publications/newsletter/2016/09/intellectual-disability.aspx.
17. American Psychiatric Association, Diagnostic and Statistical Manual of Mental Disorders, (5th ed. Arlington: American Psychiatric Association, 2013).

inability to cope up in three areas i.e. conceptual (reading, writing, reasoning etc.), social and practical (taking up job responsibilities, take care of one's own self, etc).

At the national level, The Persons with the Disabilities Act, 2016[18] under its Schedule[19] clearly mentions that intellectual disability includes a disability in the intellectual functioning (reasoning, learning, problem solving) and in adaptive behaviour (every day, social and practical skills, including specific learning disabilities)[20] and autism spectrum disorder.[21] Specific Learning Disability means the condition where there is a deficit in processing language, or difficulty to comprehend, speak, read, write, spell or do mathematical calculations and also includes perceptual disabilities, while Autism Spectrum Disorder is a neuro-developmental condition that appears in the first three years of the life of a person. It affects a person's ability to communicate, understand relationships and relate to others.

Therefore, in the opinion of the researcher, intellectual disability may be defined as a significantly reduced ability to understand new or complex information, to learn new skills and a reduced ability to cope independently i.e. impaired social functioning. A person's mental capacity, the ability to make decisions can vary depending on the environmental or social factors; however, the legal capacity is "a universal attribute inherent in all the persons by virtue of their humanity and can therefore not be stripped of it."[22]

The Conceptual and Terminological shift from the Human Rights of the 'Mentally Retarded' to the Human Rights of the Persons with'Intellectual Disability'

As mentioned earlier, nowadays the term intellectual disability is used instead of mental retardation by the medical practitioners, psychiatrists, counsellors, lawyers and other sections of the society. The question that often arises in our mind is what necessitated or led to this change in the terminology of mental retardation. The laymen in our society often tend to use the term mental retardation whenever they meet any persons suffering from a disability connected to mind. There is a lack of awareness as well as knowledge whereby people fail to understand that a mere learning disability cannot be equated to a severe form of mental disorder. Organizations such as the American Association on Intellectual and Developmental Disabilities and the

18. The Rights of Persons with Disabilities Act, 2016, No. 49, Acts of Parliament, 2016 (India).
19. *Id*., at part 2 (a) of the Schedule.
20. *Id.*
21. Part 2(b) of the Schedule of the Rights of the Persons with Disabilities Act, 2016.
22. United Nations Committee on Rights of Persons with Disabilities, General Comment on Article 12: Equal Recognition before the LawCRPD/C/4/2 (2014).

International Association for the Scientific Study of Intellectual Disabilities have brought this change in the terminology.

The major question that has been addressed by the researcher is that as to why the term intellectual disability has been given preference as compared to mental retardation since the disability includes the same patients who were prior to this shift diagnosed with mental retardation. The only difference is that the ambit has been made wide and also includes the learning and developmental disabilities as well. Moreover, it has become the need of hour that the people have to be made aware that the illness resulting from psychological impairments also do not amount to intellectual disability.

Since time immemorial the society has equated the terms such as idiocy, mental illness, depression, bipolar disorders, epilepsy or simply a feeble mind with mental retardation. The people suffering from mental illness need mental health care and other therapies. In India, the Mental Healhcare Act, 2017[23] talks about the rights of the persons with psychological disorders which constitute 'mental illness' as a part of mental disorder, which also finds place in the Schedule attached to the 2016 Act.[24] The reason for doing so is that the disability that they are suffering from is not permanent in nature and they can live independently when the mental health is stable. On the other hand, in intellectual disability there is an actual impairment due to which it is difficult to cope up with the basic routine activities. If the disability is mild in nature they can live independently but not without support. But, if the disability is severe in nature the persons require a long term medical help and in most cases they remain specially abled for their entire life. Nevertheless, the fact remains that the persons suffering from both intellectual disability and mental disability are the victims of same prejudices and attitudes from the society.

In 1959 the American Association on Mental Retardation, at that time called the American Association on Mental Deficiency, published a definition of mental retardation according to which, mental retardation refers to subaverage general intellectual functioning which originates during the developmental period and is associated with impairment in adaptive behaviour. The definition was revised in 1961 which specified the meaning of the term subaverage general intellectual functioning in a manner that was to have considerable impact on the field of mental

23. The Mental Healthcare Act, 2017, No. 10, Acts of Parliament, 2017 (India).
24. Part 3 to the Schedule attached to the Rights of the Persons with Disabilities Act, 2016.

retardation. One standard deviation below the mean on an intelligence test was delineated as the point at which intellectual functioning should be considered subnormal. In 1992 the definition was again revised which said that mental retardation refers to a particular state of functioning that begins in the childhood in which the limitations in childhood coexist with related limitations in adaptive skills.[25]

Subsequently, with the emergence of intellectual and developmental disabilities, the name of the association was also changed to American Association on Intellectual and Developmental Disabilities (AAIDD). According to the definition given by the association, intellectual disability is a disability characterized by significant limitations in both intellectual functioning and in adaptive behaviour, which covers everyday social and practical skills. This disability originates before the age of 18.[26] But in defining and assessing intellectual disability, the AAIDD stresses that additional factors must be taken into account, such as the community environment typical of the individual's peers and culture. Professionals should also consider linguistic diversity and cultural differences in the way people communicate, move, and behave.[27] Thus, the term or name for condition we know today as intellectual disability has changed over the time; most recently the condition was primarily known as mental retardation. Although the name has changed, for more than 50 years the three essential elements for all US-based definitions for this condition limitations in intellectual functioning, behavioural limitations in adapting to environmental demands, and early age on onset have not substantially changed.The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders replaced the term mental retardation with intellectual disability and the same was done in consonance with the terminology which was used by the World Health Organization's International Classification of Diseases.[28]

In the earlier times, persons were identified as patients of mental retardation since they were not able to adapt in the environment and suffered various developmental and learning impairments. However, with the coming of medicine there came a shift in the approach whereby the symptoms were identified and later it was designated as a mild, moderate or severe type of

25. Michael L. Wehmeyer, Defining Mental Retardation and Ensuring Access to the General Curriculum,38(3) Edu. & Training in Developmental Disabilities 271, 276(2003).
26. *Supra* note 15.
27. *Id.*
28. DSM-5 Classification, American Psychiatric Association (Sep. 27, 2019, 5:45 pm) file:///C:/Users/jai%20mata%20di/Downloads/APA_DSM-5-Contents%20(1).pdf.

disability. For example dyslexia or dyscalculia is also included within the definition of intellectual disability and autism is also a part of the list. The causes, effects and consequences of both these categories are different but they have an impact on the social and cognitive functioning of an individual so they are referred to be a part of intellectual disability.

With the emerging trend of intelligence being regarded as an important aspect, the concept of IQ emerged and then the hidden forms of intellectual disability came to be recognised. This further led to the IQ-based statistical norms to define and classify the categories of intellectual disability. Moreover, the advocates for persons suffering from intellectual disability are of the view that the term mental retardation has somewhat a negative impact and tends to be degrading to people. Further, due to lack of understanding about the nature and type of disability people tend to confuse even a learning disability as mental retardation. Therefore, it would not be wrong to say that the term mental retardation is still in use in many settings, including by some clinicians, and is found in legal and public policies that determine eligibility for support; however, the use of the term intellectual disability as a direct substitute for mental retardation is increasing.

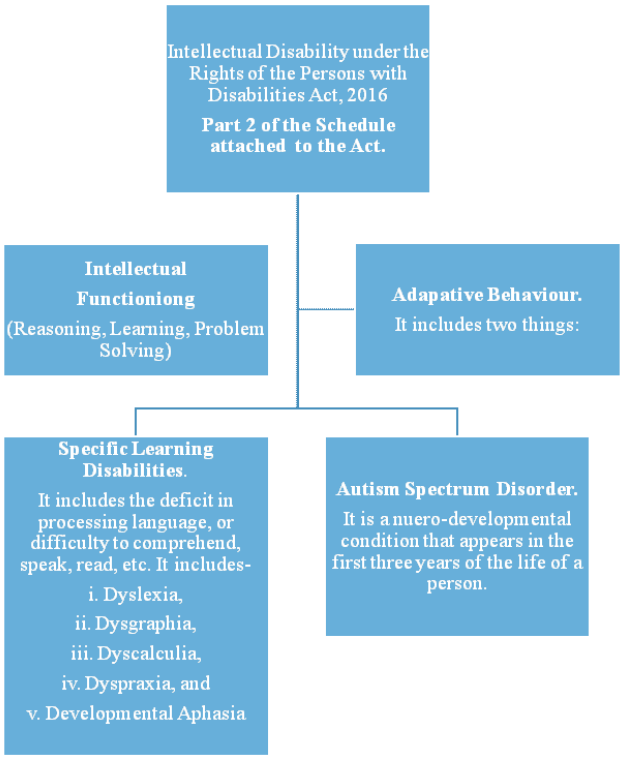
INTELLECTUAL DISABILITY – CHANGE IN TERMINOLOGY IN INDIA

In India like in most of the countries the concept of mental retardation has received a backseat and the term has been replaced by intellectual disability. The 1995 Act[29] on persons with disabilities used the term mental retardation and recognised it as a condition of arrested or incomplete development of mind usually identified by sub normality of intelligence.[30] However, after the coming of the new legislation for The Persons with Disabilities Act in 2016 the term intellectual disability has replaced mental retardation. The schedule attached to the Act as mentioned before refers to the specific disability i.e. the intellectual disability. This particular part gives us various form of disability which are included within the umbrella of intellectual impairments. It includes the limitation not only the intellectual functioning of a person but also the deficit in the adapting to the social environment. Apart from this learning disabilities which are specific in the sense that there is a difficulty in processing language or difficulty in

29. The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995, No. 1, Acts of Parliament, 1996.
30. Section 3(r) ofThe Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995.

understanding or reading and writing. The disabilities with regard to perception such as dyslexia, dysgraphia, dyscalculia and dyspraxia are also included in the terminology of intellectual disability. Lastly, the definition also includes autism spectrum disorder.

For a better clarity of the concept of intellectual disability, the researcher has prepared a flowchart (please refer to the next page) which depicts the various specific learning disabilities as enumerated under the national law. Thus, after a perusal of the legislation we get to know that at present nowhere the term mental retardation has been used. Therefore, the shift though late in time has successfully reached in our country as well through the legislation. The Act provides for various rights given to the persons suffering from intellectual disability in India. This particular aspect of disability therefore, contributes greatly to view various forms of human ability and the capability of the brain in conceptualizing this ability.



CONCLUSION

After a complete perusal of the concepts of 'mental retardation' and 'intellectual disability' it can be aptly concluded that this transition and terminological shift was the need of the hour since the application of the word 'mental retardation' for the specially abled persons was considered to be derogatory as well as against the principles and human worth. Moreover, the human rights should be made a prerogative and not a choice when it comes to the persons with intellectual disabilities. The discrimination and the wrath of the society as well as the ignorance of the government against them has never been a healthy scene to encounter. Apart from this, addressing them as 'mentally retarded' and casually using this term required a change and bringing this conceptual change was nothing but a necessity. The efforts that began in the Western and other European countries has also led to a fruitful result in India.

The transition and the journey from the definition of 'mental retardation' under the 1995 Act to now addressing it as 'intellectual disability' and a form of specific disability with its different realms has received a wider connotation in the field of Human Rights. Therefore, this shift has been a tremendous step taken up at the international as well the national levels and led to the recognition of the rights of the specially abled persons who have certain intellectual deficits.In the end the researcher would like to quote Albert Einstein while stressing the need to respect and provide proper dignity to the intellectually specially abled persons. In his words-

'Everyone is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid.'

TRANSGENDERS UNDER INDIAN LEGAL SYSTEM: AN ANALYSIS

- Dr Gurpreet Pannu*

I. INTRODUCTION

When a child is born, at the time of birth itself, sex is assigned to him/her. A child would be treated with that sex thereafter i.e. either a male or a female. Some persons may born with bodies which incorporate both or certain aspects of both male or female physiology. It may also happen that though a person is born as a male, because of some genital anatomy problems his innate perception may be that of a female and all his actions would be female oriented. The position may be exactly the opposite wherein a person born as female may be have like a male person.[1]

Etymologically the term transgender is derived from two words, namely 'trans' and 'gender'. 'Trans' is Latin word which means 'across' or 'beyond'. The grammatical meaning of transgender is across or beyond gender. The 'transgender' term is used for the persons whose identity, gender expression or behaviour does not match with the sex to which they were assigned at birth. Gender identity refers to a person's internal sense of being male, female or something else; gender expression refers to the way a person communicates gender identity to others through behaviour, clothing, hairstyles, voice or body characteristics.[2]

Transgender is a term referring to when one's gender and sex are not always or even equivalent. This is a broad term that includes transsexual (pre/non or post-operative), non-gender, bi(tri and multi) gender, androgynes, etc.[3] Transgender is defined by Oxford Dictionary as "denoting or relating to a person whose self-identity does not conform unambiguously to conventional notions of male or female gender."[4] The Transgender Persons (Protection of Rights) Bill, 2019 defines 'transgender' as a person, whose gender does not match with the gender assigned to that person at birth and includes trans-man or trans-woman (whether or not such person has undergone Sex Reassignment Surgery or hormone therapy or laser therapy or such other therapy), person with intersex variations, genderqueer and person having such socio-cultural identities as kinnar, hijras, aravanis and jogtas.[5]

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1. National Legal Service Authority v. Union of India, AIR 2014 SC 1863.
2. Answers to Your Questions About Transgender People, (January 4, 2015),www.apa.org/topics/transgender.
3. Urban Dictionary, (April 09, 2015),www.urbandictionary.com/define.php.
4. Oxford Advanced Learner's Dictionary (2001).
5. The Transgender Persons (Protection of Rights) Bill,2019, Section 2(k).

Justice Radhakrishnan defines transgender as "an umbrella term for person whose gender identity, gender expression or behaviour does not confirm to their biological sex."[6] Transgender may also take in persons who do not identify with their sex assigned at birth, which include hijras/eunuchs who, describe themselves as "third gender" and they do not identify as either male or female. Hijras are not men by virtue of anatomy, appearance and psychologically, they are also not women, though they are like women with no female reproductive organ and no menstruation. Since hijras do not have reproduction capacities as either men or women, they are neither men nor women and claim to be an institutional "third gender". Among them, there are emasculated (castrated, nirvana) men, non-emasculated men and inter-sexed persons (hermaphrodites). Transgender also includes persons who intend to undergo Sex Re-Assignment Surgery (SRS) or have undergone SRS to align their biological sex with their gender identity in order to become male or female. They are generally called transsexual persons. There are persons who like to cross-dress in clothing of opposite gender, i.e transvestites. Resultantly, the term "transgender", in contemporary usage, has become an umbrella term that is used to describe a wide range of identities and experiences, including but not limited to pre-operative, post-operative and non-operative transsexual people, who strongly identify with the gender opposite to their biological sex i.e. male and female.[7]

Transgender people are individuals of any age or sex whose appearance, personal characteristics or behaviours differ from stereotypes about how men and women are supposed to be. Transgender people have existed in every culture, race and class since the story of human life has been recorded. Only the term 'transgender' and the medical technology available to transsexual people are new. It is a wider term which encompasses anyone whose identity or behaviour falls outside of stereotypical gender norms. [8]

The contemporary term 'transgender' arose in mid 1990s from the grassroots community of gender different people. In the contemporary usage, transgender has become an umbrella term that is used to describe a wide range of identities and experiences, including but not limited to transsexual people; male and female cross dressers (sometimes referred as transvestites, drag queens or drag kings); intersexual individuals and men and women, regardless of sexual

6. *Supra* note 1.
7. *Supra* note 1, Para 11.
8. TransgenderPeople and their Problems, available at:socialjustice.nic.in/pdf/introduction.pdf (Visited on December 12, 2014),

orientation, whose appearance or characteristics are perceived to be gender typical. It includes people who do not self-identify as transgender, but who are perceived as such by others.[9]

II. CAUSES FOR TRANSSEXUALISM

In this regard there is no consensus even among medical, psychological, psychiatry, genetical and the other scientific communities. A cursory reading of the subject would reveal that there are a number of theories about the cause for transsexualism. Biologists claim that it is because of the chromosomal aberrations. It is well known that if an individual has XX chromosomes, she is a female and if an individual has got XY chromosomes, he is a male. However, there are also persons with XXY and XYX chromosomes. These are chromosomal aberrations. Some people by physical characteristics maybe females though they may have XY chromosomes indicating male characters. Similarly, there are people who are males by physical characteristics, but they have XX chromosomes indicating female characters. According to the medical community, these biological differences cause transsexualism. There are other theories which say that imbalances or fluctuations in hormones or use of certain medications during pregnancy may cause transsexualism. There are also theories to say that transsexualism is, pure and simple, a psychological disorder. The Brain Bank in Netherlands Studies say that there is a "brain sex" difference between men and women and transsexual people have the brain sex of the gender to which they identify themselves. Thus, it is manifest that there is no consensus among various theories as to how the transsexualism happens in human beings. Similarly, there is no recognised or universally accepted mode of drawing a line differentiating transsexuals from the other sexes.[10]

III. CLASSIFICATION OF TRANSGENDER

There is wide range of transgender related identities and cultures which are generally as follows:

a) Hijras

Hijras are biological males who reject their 'masculine' identity in due course of time to identify either as women, or 'not-men', or 'in-between man and woman', or 'neither man nor woman'. Hijras can be considered as the western equivalent of transgender/transsexual (male-to-female) persons but hijras have a long tradition/culture and have strong social ties formalised through a

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9. *Ibid.*
10. I.Jackuline Mary v. Superintendent of Police,available at:indiankanoon.org/doc/144523857 (Visited onMarch 1, 2015).

ritual called "reet" (becoming a member of hijra community). There are regional variations in the use of terms referred to Hijras.

b) Eunuch

Eunuch refers to an emasculated male and intersexed to a person whose genitals are ambiguously male-like at birth, but this is discovered that the child previously assigned to the male sex, would be recategorized as an intersexed as a hijra.[11]

c) Aravanis and Thirunangi

Hijras in Tamil Nadu identify as Aravani. Tamil Nadu Aravanigal Welfare Board, a state government's initiative under the Department of Social Welfare defines Aravanis as biological males who self-identify themselves as a woman trapped in a male's body. Some Aravani activists want the public and media to use the term 'Thirunangi' to refer to Aravanis.[12]

d) Kothi

Kothis are a heterogeneous group. Kothis can be described as biological males who show varying degrees of 'femininity' — which may be situational. Some proportion of Kothis have bisexual behaviour and get married to a woman. Kothis are generally of lower socio-economic status and some engage in sex work for survival. Some proportion of hijra-identified people may also identify themselves as Kothis. But not all Kothi people identify themselves as transgender or hijras.[13]

e) Jogtas/Jogappas

Jogtas or Jogappas are those persons who are dedicated to and serve as a servant of goddess Renukha Devi (Yellamma) whose temples are present in Maharashtra and Karnataka. Jogta refers to male servant of that Goddess and Jogti refers to female servant.[14] One can become a Jogta (or Jogti) if it is part of their family tradition or if one finds a Guru (or Pujari) who accepts him/her as a chela or shishya (disciple). This term is used to differentiate them from Jogtas who are heterosexuals and who may or may not dress in woman's attire when they worship the Goddess.

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11. *Ibid.*
12. *Ibid.*
13. *Ibid.*
14. Who is referred as Devdasi.

f) Shiv-Shakthis

Shiv-Shakthis are considered as males who are possessed by or particularly close to a goddess and who have feminine gender expression. Usually, Shiv Shakthis are inducted into the Shiv-Shakti community by senior gurus, who teach them the norms, customs, and rituals to be observed by them. In a ceremony, ShivShakthis are married to a sword that represents male power or Shiva. Shiv-Shakthis thus become the bride of the sword. Occasionally, Shiv-Shakthis cross- dress and use accessories and ornaments that are generally/socially meant for women. Most people in this community belong to lower socio-economic status and earn for their living as astrologers, soothsayers, and spiritual healers; some also seek alms.[15]

IV. PROBLEMS OF TRANSGENDER PERSONS

Indian law recognises binary genders, i.e. male and female based on the sex of a person assigned by birth. There is no mention of third gender or transgender under Indian legal system. Due to this they become victim of discrimination, abuse and exploitation. Despite constitutional guarantee of equality, the transgender people have to face discrimination in all spheres of society. They are extremely vulnerable to harassment, violence and sexual assault in public places, at home, in jail and in the custody of police. Sexual assault, including molestation, rape, forced and oral sex, gang rape and stripping is being committed with impunity. They have to face extreme discrimination especially in the field of employment, education, health care etc. They face humiliation in access to public spaces, the restaurants, cinemas, shops, malls etc. Access to public toilets is another serious problem they face quite often. As, there is no separate toilet facilities for these persons, they have to use male toilets where they are prone to sexual assault and harassment.[16]

Transgender people are deprived of social and cultural participation which results into eclipsing their access to education and health services. It is not even easy for such a person to take a decision to undergo SRS procedure which requires strong mental state of affairs. During hormone therapy these persons also suffer from depression, schizophrenia and transverses.[17]

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15. *Ibid.,* at 32.
16. *Supra* note 1.
17. Katherine M. Frank, The Central Mistake of Sex Determination Law: the Disaggregation of Sex from Gender89 (2010).

The other major problems that the transgender people face in their daily life are lack of education facilities, lack of medical facilities, homelessness, unemployment, depression, hormone pill abuse, tobacco and alcohol abuse and problems related to marriage and adoption. Transgender people are generally excluded from the society and people think transgender as a medical disease. Much like disability, it is considered as illness.

The transgender communities face several sexual health issues including HIV and they face barriers in accessing treatment services. HIV prevalence among male transgender was 7.4% against the overall adult HIV prevalence of 0.36%. The estimated size of men who have sex with male and male sex workers population in India (including hijras and transgenders) is 23, 52,133 and 2,35,213 respectively.[18] Rate of HIV infection among transgender female sex workers is 27.3% which is nine times higher than other such workers.[19]

V. LEGAL RIGHTS OF TRANSGENDERS IN OTHER COUNTRIES

Many countries have enacted laws for recognizing rights of transsexual persons, who have undergone either partial/complete SRS, including United Kingdom, Netherlands, Germany, Australia, Canada, Argentina, etc. Detail of these laws is given below:

a) United Kingdom

United Kingdom has passed the Gender Recognition Act, 2004. The Act is all encompassing as not only does it provide legal recognition to the acquired gender of a person, but it also lays down provisions highlighting the consequences of the newly acquired gender status on their legal rights and entitlements in various aspects such as marriage, parentage, succession, social security, pensions etc. One of the notable features of the Act is that it is not necessary that a person needs to have undergone or in the process of undergoing a SRS to apply under the Act. Reference in this connection may be made to the Equality Act, 2010 (UK) which has consolidated, repealed and replaced around nine different anti-discrimination legislations including the Sex Discrimination Act, 1986. The Act defines certain characteristics to be "protected characteristics" and no one shall be discriminated or treated less favourably on grounds that the person possesses one or more of the "protected characteristics". The Act also

18. *Supra* note 10.
19. *Ibid.*

imposes duties on Public Bodies to eliminate all kinds of discrimination, harassment and victimization. Gender reassignment has been declared as one of the protected characteristics under the Act, of course, only the transsexuals i.e. those who are proposing to undergo, is undergoing or has undergone the process of the gender reassignment are protected under the Act.

b) Australia

In Australia, there are two Acts dealing with the gender identity, (1) Sex Discrimination Act, 1984; and (ii) Sex Discrimination Amendment (Sexual Orientation, Gender Identity and Intersex Status) Act, 2013. Act of 2013 amends the Sex Discrimination Act, 1984. Act of 2013 defines gender identity as the appearance or mannerisms or other gender-related characteristics of a person (whether by way of medical intervention or not) with or without regard to the person's designated sex at birth.

It prohibits discrimination on the ground of sexual orientation,[20] Discrimination on the ground of gender identity[21] and discrimination on the ground of intersex status.[22]

c) United States of America

In United States of America some of the laws enacted by the states are inconsistent with each other. The Federal Law which provides protection to transgenders is the Hate Crimes Prevention Act, 2009, which expands the scope of the 1969 United States Federal Hate-Crime Law by including offences motivated by actual or perceived gender identity. The federal government recognises all same-sex marriages legally authorised under state law. Transgender people have all the legal rights e.g. rights to life, right to work, right to health, right to marry, right of equality, right to social security etc. Around 15 States and District of Colombia in the United State have legislations which prohibit discrimination on grounds of gender identity and expression. Few States have issued executive orders prohibiting discrimination.

d) South Africa

The Parliament of South Africa in the year 2003, enacted Alteration of Sex Description and Sex Status Act, 2003, which permits transgender persons who have undergone gender reassignment or people whose sexual characteristics have evolved naturally or an intersexed person to apply to the Director General of the National Department of Home Affairs for alteration of his/her sex description in the birth register, though the legislation does not contemplate a more inclusive

20. Sex Discrimination Amendment (Sexual Orientation, Gender Identity and Intersex Status) Act, 2013, Section 5A.
21. *Ibid.,* Section 5B.
22. *Ibid.,* Section 5C.

definition of transgenders. Same sex marriage is legal since Civil Union Act came into force in 2006. Discrimination on the basis of gender expression and identity against TGs in prohibited.

e) Argentina

The Senate of Argentina in the year 2012 passed a law on gender identity that recognizes right by all persons to the recognition of their gender identity as well as free development of their person according to their gender identity and can also request that their recorded sex be amended along with the changes in first name and image, whenever they do not agree with the self-perceived gender identity. It is not necessary that they seemed to prove that a surgical procedure for total or partial genital reassignment, hormonal therapies or anyother psychological or medical treatment had taken place. Article 12 deals with dignified treatment, respecting the gender identity adopted by the individual, even though the first name is different from the one recorded in their national identity documents. Further laws also provide that whenever requested by the individual, the adopted first name must be used for summoning, recording, filing, calling and any other procedure or service in public and private spaces.

f) Germany

In Germany, a new law has come into force on 5th November, 2013, which allows the parents to register the sex of the children as 'not specified' in the case of children with intersex variation. According to Article 22, Section 3 of the German Civil Statutes Act reads as follows:

"If a child can be assigned to neither the female nor the male sex then the child has to be named without a specification"

This law has also added a category of X, apart from "M" and "F" under the classification of gender in the passports. Transgenders have right to marry to a person of their choice. Registered life partnerships have been instituted since 2001 before the enforcement of this Act. Thus, transgenders enjoy freedom and State protect their legal rights. Transgenders have right to equality, right to work, right to health, right to security and other benefits etc.

g) Malta

The State of Maltaenacted the Gender Identity, Gender Expression and Sex Characteristics Act, 2015. The Act confers certain rights regarding gender identity, such as all the persons being citizens of Malta have right to the recognition of their gender identity; the free development of their person according to their gender identity; be treated according to their gender identity and

to be identified in that way as documents providing their identity and bodily integrity and physical autonomy etc.[23] such persons shall not be required to provide proof of a surgical procedure for total or partial genital reassignment, hormonal therapies or any other psychiatric, psychological or medical treatment to make use of the right to gender identity.[24]

h) Asia

There is no specific law in any of the Asian countries. Transgender have to face discrimination in their social and daily life, at school and at work place. In Asia, the society distinguishes between male and female, the lack of clear-cut gender puts great limitation on a person's social space. China, Nepal, Pakistan, India and other Asian countries have no specific law for the transgenders. China acknowledge the right of individuals to undergo gender reassignment surgery, but has never enacted formal laws to protect the rights of transgender people, it only allows gender alternation in documents like birth certification, student rolls or academic records etc. There is no law regarding the ability of transgender persons to marry, nor does it place any articulated restrictions on this right. These countries do not allow same sex marriage.[25] Transgenders have to live with heavy stigma directed against their person, their life style, often their chosen profession and their chosen identity. They are routinely marginalised and suffer from severe prejudice and violence at home and in society. Due to this many transgender people get themselves engage in sex-industry and they work as sex workers. Their vulnerabilities to HIV and other infections increases.[26]

VI. Historical Aspect and Position of Transgenders in India

Transgenders are a part of society from the very beginning. It comprises of hijras, eunuchs, kothis, aravanis, jogappas, shiv-shakthis etc. and they, as a group, have got a strong historical presence in our country in the Hindu mythology and other religious texts. The concept of tritiya prakrti or napunsaka has also been an integral part of vedic and puranic litratures. The word 'napunsaka' has been used to denote absence of procreative capability.[27] There are number of references of them in the religious books, which are as:

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23. The Gender Identity, Gender Expression and Sex Characteristics Act, 2015,Section 3(1).
24. The Gender Identity, Gender Expression and Sex Characteristics Act, 2015, Section 3(4).
25. "My Life is Too Dark to see the Light"- A Survey of Living Conditions of Transgenders Female Sex Workers in Beijing and Shanghai, 26. (January 2015)
26. *Id.,* at 45.
27. Sarena Nanda, Gender Diversity: Cross cultural Variations 42 (1999).

Lord Rama, in the epic Ramayana, was leaving for the forest upon being banished from the kingdom for fourteen years, turned around to his followers and asked all the 'men and women' to return to the city. Among his followers, the hijras alone did not feel bound by this direction and decided to stay with him. Impressed with their devotion, Rama sanctioned them the power to confer blessings on people on auspicious occasions like childbirth and marriage, and also at inaugural functions which, it is believed set the stage for the custom of badhai in which hijras sing, dance and confer blessings.[28]

Another reference is from the Epic Mahabharata, where Aravan, the son of Arjuna and Nagakanya, offers to be sacrificed to Goddess Kali to ensure the victory of the Pandavas in the Kurukshetra war, the only condition that he made was to spend the last night of his life in matrimony. Since no woman was willing to marry one who was going to be killed, Krishna assumes the form of a beautiful woman called Mohini and marries him. The Hijras of Tamil Nadu consider Aravan their progenitor and call themselves Aravanis.[29]

Jain Texts also make a detailed reference to transgenders which mentions the concept of 'psychological sex'. Hijras also played a prominent role in the royal courts of the Islamic world, especially in the Ottaman empires and the Mughal rule in the Medieval India.[30]

VII. TRANSGENDER PERSONS UNDER INDIAN LEGAL SYSTEM

Indian law only recognizes the paradigm of binary genders of male and female, based on a person's sex assigned by birth, which permits gender system, including the law relating to marriage, adoption, inheritance, succession, and welfare legislations. We have no legislation in our country dealing with the rights of transgender community. Due to absence of suitable legislation protecting the rights of the members of transgender community, they are facing discrimination in various areas.[31] Detailed analysis of historical aspect and legal treatment of transgenders is discussed below:

(i) During British Period

Though historically, hijras/transgender persons had played a prominent role, with the onset of colonial rule from the 18th century onwards, the situation had changed drastically. During the

28. *Supra* note 1, Para 13.
29. *Supra* note16 at 36.
30. Gayatri Reddy, With Respect to Sex: Negotiating Hijra Identity in South India 21 (2006).
31. *Supra* note 1, Para 49.

British rule, a legislation was enacted to supervise the deeds of hijras/TG community, called the Criminal Tribes Act, 1871,[32] which deemed the entire community of hijra persons as innately criminal and addicted to the systematic commission of non-bailable offences. The Act provided for the registration,[33] surveillance and control of certain criminal tribes and eunuchs and had penalised eunuchs, who were registered, and appeared to be dressed or ornamented like a woman, in a public street or place as well as those who danced or played music in a public place.[34] Such persons also could be arrested without warrant and sentenced to imprisonment up to two years or fine or both. Under the Act, the local government had to register the names and residence of all eunuchs residing in that area as well as of their properties, who were reasonably suspected of kidnapping or castrating children, or of committing offences under section 377 of the IPC, or of abetting the commission of any of the said offences.[35] Under the Act, any act of keeping a boy under 16 years in the charge of a registered eunuch was made an offence punishable with imprisonment up to two years or fine. The Act also denuded the registered eunuchs of their civil rights by prohibiting them from acting as guardians to minors, from making a gift deed or a will, or from adopting a son. The Act has, however, been repealed in August 1952.

(ii) Constitution of India

Article 14 provides that State shall not deny to "any person" equality before the law or the equal protection of the laws within the territory of India. Equality includes the full and equal enjoyment of all rights and freedom. Right to equality is declared as a basic feature of the Constitution and treatment of equals as unequal or unequal as equals will be volatile to basic structure of the Constitution. It is a positive obligation on the State to ensure equal protection of laws by bringing in necessary social and economic changes so that everyone including transgender may enjoy equal protection of laws and nobody is denied such protection. Article 14 does not restrict the word 'person' and its application only to male or female. Transgender, who are neither male nor female, fall within expression person and are entitled to legal protection of all the laws in the sphere of State activity.[36]

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32. Act no. XXXVII of 1871, passed by the Governor General of India in Council.
33. Criminal Tribes Act, Section 24 (1871).
34. *Id.,* Section 26.
35. *Id.,* Section 24 (a) & (b).
36. *Ibid.,* Para 54.

Articles 15 and 16 prohibit discrimination against any citizen on certain grounds including the ground of 'sex'. Both of the articles prohibit all forms of gender bias and gender-based discrimination. Article 15 states that the State shall not discriminate against any citizen on the ground of sex, with regard to (a) access to shops, public restaurants, hotels and places of public entertainment or (b) use of wells, tanks, bathing ghats, roads and places of public resort maintained wholly or partly out of State funds or dedicated to the use of the general public.[37]

The requirement of taking affirmative action for the advancement of any socially and educationally backward classes of citizens is also provided in this Article.

Article 16 states that there shall be equality of opportunities for all the citizens in matters relating to employment or appointment to any office. No person shall on grounds only of religion, race, caste, sex, descent, place of birth, residence or any of them, be ineligible for, or discriminated against in respect or, any employment or office under the State.[38]

Sex discrimination in public employment is prohibited under Indian Constitution. Article 19 assures the right of freedom of speech and expression.[39] This right also includes one's right to expression of his self-identified gender which can be expressed through dress, words, action or behaviour or any other form. A transgender personality can be expressed by transgender's behaviour, presentation, mannerism or clothing.[40]

Protection of life and personal liberty is available to everyone under article 21 of the Constitution. Right to life is one of the basic fundamental right and not even the State has authority to violate or take away that right. It protects the dignity of human life, one's personal autonomy, has been recognized to be an essential part of the right to life and access to all persons on account of being humans.[41]

In ***Francis Coralie Mullin v. Administrator, Union Territory of Delhi***[42] , the Apex Court held that the right to dignity forms an essential part of our constitutional culture which seeks to ensure the full development and evolution of persons and includes "expressing oneself in diverse forms, freely moving about and mixing and commingling with fellow human beings". Similarly, recognition of one's gender identity lies at the heart of the fundamental right to dignity. Gender

37. Constitution of India, Article 15(2).
38. *Id.,* Article16 (1) and (2).
39. *Id.,* Article 19(1) (a).
40. *Supra note* 1 Para 66.
41. *Id.,* Para 67.
42. (1981) 1 SCC 608 (Para 78).

constitutes the core of one's sense being as well as integral part of a person's identity. Legal recognition of gender identity is part of right to dignity and freedom which is guaranteed under our Constitution. Thus articles 14, 16, 19 and 21 of Constitution do not exclude transgender community from its ambit, but Indian law on the whole recognise the parading of binary genders of male and female, based on one's biological sex. Binary notion of gender reflects in Penal Code e.g. sections 8, 10 etc. and also in the laws relating to marriage, adoption, divorce, inheritance, successionand other social welfare legislations like MGNAREGA, 2005 etc. Non recognition of identity of third gender in various legislations denies them equal protection of law and thus they face wide spread discrimination.[43]

(iii) The Transgender Persons (Protection of Rights) Bill, 2019

The demand for a specific legislation was being raised by number of social activists since long. Supreme Court of India dealt with this issue in detail by its historical verdict[44] and declared number of rights of transgender. Then a Private Member Bill was introduced by a DMK Member of Parliament, Shiva Triuchi regarding the issues relating to certain basic rights of the third gender in India. On April 24, 2015 the Rights of Transgender Persons Bill, 2014 was passed by the Rajya Sabha. A new Bill, the Transgender Persons (Protection of Rights) Bill, 2016 was introduced to protect the rights of transgenders, but it was not passed by the Parliament and it lapsed. The Transgender Persons (Protection of Rights) Bill, 2019 was introduced in the Lower House during Monsoon Session and was passed on July 19, 2019.

This Bill prohibits the discrimination against transgender persons, including denial of service or unfair treatment in relation to education; employment; healthcare; access to or enjoyment or use of any goods, facilities, opportunities available to the public; right to movement; right to reside, rent or otherwise occupy property; opportunities to hold public or private office; access to a governmental or private establishment in whose care or custody a transgender person is.[45] Chapter III of the Bill deals with recognition of identity of transgender persons. A transgender person may make an application to the District Magistrate for a certificate of identity, indicating the gender as 'transgender'. A revised certificate may be obtained only if the individual undergoes surgeries to change his/her gender either a male or a female.[46] The Bill also ensures

43. *Supra* note 1, Para 75.
44. National Legal Service Authority v. Union of India, AIR 2014 SC 1863.
45. *Id.*, Section 3.
46. *Id.,* Chapter III, Sections 4 to 7.

that the government will take measures to ensure the full inclusion and participation of transgender persons in society. The appropriate government must also take steps for their rescue and rehabilitation, vocational training and self-employment, to formulate welfare schemes and programmes that are transgender sensitive, non stigmatising and non-discriminatory.[47]

Right of residence has been assured under section 12 of the Bill. It provides that no child shall be separated from parents on the ground of being transgender. If the immediate family is unable to care for the transgender person, the person may be placed in a rehabilitation centre, on the orders of a competent court. The government is duty bound to take steps to provide health facilities to transgender persons including separate HIV surveillance centers and sex reassignment surgeries. The government shall review medical curriculum to address health issues of transgender persons and provide comprehensive medical insurance schemes for them.[48] This Bill imposes duty on educational institutions, funded or recognized by the appropriate government, to provide inclusive education, sports and recreational facilities for transgender persons, without discrimination.[49]

The Bill recognizes certain offences against transgenders like: forced labour (excluding compulsory government service for public purpose), denial of use of public places, removal from household and village, physical, sexual, verbal, emotional or economic abuse. Penalties for these offences vary between six months to two years and fine.[50]

The Bill also proposes for the constitution of National Council for Transgender Persons to advise the Central Government as well as to monitor the impact of policies, legislation and projects with respect to transgender persons. It will also redress the grievances of transgender people.

VIII. ROLE OF INDIAN JUDICIARY IN PROTECTING THE RIGHTS OF TRANSGENDER PERSONS

There is no specific enactment to protect the rights of transgender persons in India. Indian judiciary has protected the rights of transgenders from time to time.

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47. *Id.,* Section 8.
48. *Id.,* Section 15.
49. *Id.,* Section 13.
50. *Id.,*Section 18.

In the case of I. ***Jackuline Mary v. Superintendent of Police***,[51] the petitioner, who identified herself as a, transgender was terminated from service by labeling her as a transgender. The petitioner was recorded as a female child in her birth certificate. She passed her graduation and applied for a job in police department. She cleared all the tests and recruited in Tamil Nadu police. When she was undergoing training, she appeared for medical test. On examination, the medical officer made a mark in the Out Patient slip of petitioner as transgender and medical officer opined that petitioner should go for the tests of biological determination. Then she was declared as transgender by birth. She had to appear for various tests, due to which she was on medical leave and could not complete her training. Ultimately, she was terminated. Then she filed this petition in Madras High Court. The Court observed that, "By compelling an individual to undergo medical examination to declare her as transsexual is violation of right to life. There is no social recognition of transgender. Even many of the parents do not treat such children well. They are thrown out of the families. The agonies suffered by them are unimaginable."

The Court held and declared:

(i). Petitioner is declared as a female for all purposes to retain such identity.

(ii). Petitioner has liberty to choose a different sexual/gender identity as third gender.

(iii). The impugned order of termination from service issued by Superintendent of Police is hereby set aside.

The judiciary again protected the rights of a transgender as an ordinary citizen in Aslam Pasha urf Chandini v. State of Karnataka,[52] the petitioner, who is a transgender field this petition requesting the Court to issue a direction to the respondents to provide reservation of posts to transgender class of persons by the issue of a writ of Mandamus. Court held that the Apex Court has already issued several directions for taking steps by the Central and State Governments to safeguard the interests of transgender under Part III of Constitution of India and laws made by Parliament and State Legislature. So, it is duty of the Government to protect the rights of transgender in the society.

The Apex Court of India gave landmark, judgement ***National Legal Service Authority v. Union of India,***[53] and thus came forward to protect the rights of transgender people. C.K.S. Radhakrishnan, J. observed about the condition of transgender as, "Seldom, our society realises

51. Indianknoon.org/doc/144523857.
52. Judgmenthck.kar.nic.in.
53. AIR 2014 SC 1863.

or cares to realise the trauma, agony and pain which the members of transgender community undergo nor appreciates the innate feelings of the members of the transgender community, especially of those whose mind and body disown their biological sex. Our society often ridicules and abuses the transgender community and in public places like railway stations, bus stands, schools, workplaces, malls, theaters, hospitals, they are sidelined and treated as untouchables, forgetting the fact that the moral failure lies in the society's unwillingness to contain or embrace different gender identities and expressions, a mindset which we have to change."[54]

The Court ordered to treat transgender as third gender for the purposes of safeguarding and enforcing their rights guaranteed under the Constitution and gave following directions:[55]

1. Hijras, Eunuchs, apart from binary gender, be treated as "third gender" for the purpose of safeguarding their rights under Part III of our Constitution and the laws made by the Parliament and the State Legislature.
2. Transgender persons' right to decide their self-identified gender is also upheld and Centre and State Governments are directed to grant legal recognition of their gender identity such as male, female or as third gender.
3. Centre and State Governments to take steps to treat them as socially and educationally backward classes of citizens and to extend all kinds of reservation in cases of admission in educational institutions and for public appointments.
4. Centre and State Government to operate separate HIV surveillance centers since Hijras/Transgenders face several sexual health issues.
5. Centre and State Governments should seriously address the problems being faced by Hijras/Transgender such as fear, shame, gender dysphoria, social stigma, etc. and any insistence for SRS for declaring one's gender is immoral and illegal.
6. Centre and State Government should take proper measures to provide medical care to TGs in the hospitals and also provide them separate public toilets and other facilities.
7. Centre and State Governments should also take steps for framing various social welfare schemes for their betterment.

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54. *Id.,* Para 1.
55. *Id.,* Para 129.

8. Centre and State Government should take steps to create public awareness so that TGs will feel that they are also part and parcel of the social life and be not treated as untouchables.
9. Centre and State Governments should also take measures to regain their respect and place in the society which once they enjoyed in our cultural and social life.

In ***Arun Kumar v. The Inspector General of Registration and Others***[56] , the Madurai Bench of Madras High Court came forward to declare the marriage solemnised between a male and a trans woman as valid under section 5 of the Hindu Marriage Act, 1955. The Court held that he registrar of marriage is bound to register a marriage of a male and a trans woman.

IX. CONCLUSION

Transgenders people have to face various types of problems at home, in the society, at schools, at workplace etc. They are discriminated at various stages of life. They are humiliated socially and publically. They usually become victim of molestation, rape, forced oral and anal sex, gang rape etc. They have to face humiliation at public places e.g. bus stands, restaurants, cinemas, shops etc. There are no separate public toilets for them. They are deprived of education, employment and health care. Following are the suggestions to improve the position of transgender people:

- Transgender persons must be properly documented in census. There is need for statutory reservation in education, elections and employment in both public and private sectors.
- They need to be empowered and uplifted by facilities for higher education and vocational training to upgrade their earnings and status in the society and to promote their acceptability in the society.
- As transgender people are prone to health risks and infections, they need to be provided proper medical facilities, including health insurance and clinics, where free or subsidised treatment should be made available.
- The word 'rape' in section 375 IPC should include all sexual crimes against women, men, children and transsexual/eunuchs, as eunuchs are often the targets of some of

56. WP (MD)No.4125 of 2019, available at:http://www.judis.nic.in (Visited on July 16, 2019).

worst sex crimes.

- There is need to change the mindset of the society. Government should take appropriate and effective steps to regain their respect and place in the society.
- Government should provide special social welfare schemes for the upliftment and betterment of transgender people.
- Problems of transgender people must be tackled properly. Counselling centers should be established at every level to give psychological therapy to transgenders.
- Government and non-governmental organisations should create awareness among the masses that transgender people are also human beings like us and have right to lead their life with dignity and respect.
- There is urgent need for legal and constitutional safeguards to prevent human rights violations of transgender community as well as institutional mechanisms that can address the specific concerns of transgender people.
- There should be an amended column of gender in every type of forms for admission or employment with a new entry of third gender along with male or female.
- Government should develop mechanisms for the facility of loans at concessional rates for transgenders for self-employment. Government and local authorities should initiate programmes of rehabilitation particularly in the area of health, education, employment etc.
- Government must sponsor and encourage regular information campaigns and sensitization programmes to ensure that rights of transgenders recognised by existing statutes must be protected and respected.
- There must be amendments in the existing laws relating to marriage, adoption, inheritance, etc. to avail equal rights to transgenders in India.

The paper would end with a note of hope:

"We need a world where our families no longer disown us, where society treats us as equal, and where governments guarantee our rights; a world that understands the transgender identity."

WOMEN ENTREPRENEURSHIP: A MEANS OF ACHIEVING GENDER JUSTICE

-Dr Jai Mala* & Shivanshi Thakur**

"The idea of perfect womanhood is perfect independence"

~Swami Vivekananda

1.1 INTRODUCTION

The above mentioned quote was given by swami Vivekananda, a true Indian intellectualist, spiritualist and scholar. He considered the downfall of Indian society as the result of neglect of masses and women subjected to subjugation from centuries. Relying on his theory, we consider the education, liberation and empowerment of women as the only key to achieve gender justice.[1] Independence of women consist not only the social liberation but also her financial freedom, and for its accomplishment women entrepreneurship can be a suitable path. Then only women can be fully independent, subject to no dominance and exploitation. In last few decades, the notion of entrepreneurship has evolved as a significant focus of attention.

Entrepreneurship being synonymous with Innovation and creativity is claimed as an economic panacea for some serious problems like lopsided development and unemployment. It is basically a dynamic process which is created and managed by a person called the entrepreneur, who strives to utilize the economic innovation for the creation of a new value in the market for accomplishing a definite goal.[2] As a vital tool for social transformation, entrepreneurship needs to be balanced between both the genders of the society for better economic growth. For achieving gender justice in the society, men and women need to be placed at equal footings, the essence of which lies in the economic empowerment of women.

The relationship between gender impartiality, growth and progress outcomes is multifaceted and there is no automatic 'win-win' among them.[3] Achieving gender equality involves measures to reimburse for existing disadvantages that avert equal opportunities from being offered to both men and women.[4] India being a developing Nation needs entrepreneurs. Our country needs to

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1. Swami Vivekananda, Complete Works of Swami Vivekananda (1st ed. 1947).
2. Poornima M Charantimath, Entrepreneurship Development Small Business Enterprises (3rd ed.2012).
3. N. Kabeer & L. Natali, Gender equality and economic growth: Is there a win win?, 417 I.D.S. Work. Pap. 1, 3 (2013).
4. UNECE, Promoting Gender Equality And Women's Economic Empowerment On The Road To Sustainable Development, Policy Seminar On Women's Entrepreneurship Development, 19 September 2011, Geneva.

utilize and mobilize fully all its resources which include human resources as well.[5] But the Indian women have usually been assumed as home-makers with slight to do with financial system or trade. They have not been vigorously involved in the conventional development, even though they symbolize equal proportion of the populace and labor force. Principally women are the resources of survival of their families, although are generally unrecognized and underestimated, being placed underneath the pile. It may be noted, that in a country like India, majority of females take entrepreneurship not as a career opportunity but because of economic compulsions or otherwise. Financial viability is the basis of social, political and psychological supremacy in the society. Entrepreneurship can help women's economic freedom and perk up their social status. Automatically, the women get empowered once they accomplish economic independence.[6]

Entrepreneurship has been considered as a male-dominated phenomenon from the very early age, but time has changed the circumstances and brought women as today's most unforgettable and inspiring entrepreneurs.[7] Despite this fact, there are numerous areas where women are still lacking such as: right to use resources, impartiality at the workplace, entrepreneurship development, executive powers, and the settlement of work and family responsibilities.[8] The constitution of India has the provision to provide gender equality, which can be seen in the five year plans having the socio-economic as well as legal empowerment of women as the main goal.Women's financial empowerment is a transformational process, where by women gainaccess and power over economic assets &decisions, which results in economic empowerment of women, which is a step towards gender justice.

1.2 CONCEPT AND DEFINITIONS OF ENTREPRENEURSHIP

1.2.1 Defining An Entrepreneur: In its most simplest sense "an entrepreneur" is defined as a person, who is the creator of an enterprise. And the process of creation and action taken by an entrepreneur for the establishment of his Enterprise is known as "entrepreneurship". The term entrepreneur is derived from a French word "enterprendre" which means "to undertake". Some eminent definitions of an entrepreneur are given below :

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5. Charantimath, *supra*, 55.
6. Dr Shefali Raizada, Women's Entrepreneurship Development and Gender Equality, (Sept. 19, 2019, 3:45 PM),http://www.internationalseminar.org/XV_AIS/TS%203/2.%20Dr.%20SHEFALI%20RAIZADA.pdf.
7. S. Saidapur, Women Candle Entrepreneurs in Gulbarg District: A Micro analysis, 4 Spect. J. Multi. R. 7, 17 (2012).
8. UNECE, *supra*, 5.

The word entrepreneur is derived from a Sanskrit word called "Antaraprerana" stated by Poornima charantimath.

"Entrepreneurs are people who have the ability to see and evaluate business opportunities, together with the necessary resources to take advantage of them and to intimate appropriate action to ensure success" by International Labour Organisation (ILO).[9]

The word entrepreneur was taken from the French verb "enterprendre" which means 'to Undertake'. In the earlier part of 16th century, the French men who organised and led military expeditions were referred to as entrepreneurs. The French tradition regarded an entrepreneur as a person who changes a profitable Idea into a productive activity. Also, the Architects and contractors of public works, back in 1700, were called entrepreneurs. Quensnay recognised a rich farmer as an entrepreneur, who manages and makes his trade profitable by his Intelligence and capital. In early 16th century, the entrepreneurs were signified as dealers who bought an article at a certain price & sold it at uncertain price, building profit.[10] By this we understood that although the word entrepreneur is not of Indian Origin but if we look into the history we can surely form an idea that the process of entrepreneurship has not emerged in this century but is of late origin.

Entrepreneurship is a catalyst of trade and fiscal development. The social and financial forces of entrepreneurial activity subsistedprior to the new millennium. In fact, as noted, the entrepreneurial spirit is linked with humanity's achievements. Eventually all this proposes the role of entrepreneur as the "driving force of change," the force that instigates and implements material development. Today, we identify that the agent of revolution in mankind has been and possibly will persist to be the entrepreneur.[11]

Pandit Jawaharlal Nehru rightly said that "when a woman moves forward, the family Moves, the village moves and the nation moves". The socio-economic status of women is perceived as an indication of the budding stage of a society. A considerable amount of academic attention has been gathered by the concept women entrepreneurs in recent years. It is becoming a primary focus for practitioners, policymakers, and even Scholars worldwide who are interested in entrepreneurship as well as small business management.[12] "Women Entrepreneurship" means

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9. Charantimath, *supra,* 99.
10. *id* At 51, 52.
11. Calvin A. Kent, Donald L. Sexton & Karl H. Vesper, Encyclopedia of Entrepreneurship, (1982).
12. Dr. S. Narasimha Chary, Savvasi Sreenivas, Micro Finance In India – Policy Issues And Strategies, 5 O. J. L. S. Sc. 101, 102 (2011).

an act of trade ownership and business creation that empowers women economically increases their economic strength as well as position in society. A female who accepts the demanding role in society, to meet her personal desires by becoming economically independent is known as a "Women Entrepreneur". A powerful desire to do something impressive in a positive manner is an inbuilt feature of entrepreneurial women, who is competent of contributing values in her family and social life as well.[13]

Women became more occupied in the business world simply when the idea of females in business became pleasant to the general public; nevertheless, this doesn't show that there were no female entrepreneurs until that period. Dutch colonists, who came to nowadays New York City in the 17th century, functioned under a matriarchal culture. In this society, loads of women inherited wealth and lands, and through this heritage, became business proprietors. Margaret Hardenbrook Philipsewas one of the most victorious women of this time, who is believed to be a ship owner, a merchant and was also occupied with the trading of commodities. Evidences show that during the middle of 18th century, it was common for women to be the owner of certain businesses like shops, taverns, brothels, and alehouses. The majority of these businesses were not alleged to have good reputations, because, they were measured as shameful acts for women engaging in these occupations. During the 1900s, because of more progressive means of thinking & the augment of feminism, female entrepreneurs commenced to be a widely established term. Although, these entrepreneurs served mostly female consumers.

With the easy accessibility of technology and constant support from different institutions, there is a constant expansion in popularity of business women. Still, female entrepreneurs today are struggling and are confronting a number of challenges and barriers. One such major challenge for women entrepreneurs is to cope up with traditional gender-roles which are structurally internalized by our society. Entrepreneurship is still regarded as a field dominated by males, and it might be difficult to outshine these conventional views, except if women entrepreneurship is boosted by government to achieve real gender justice in the society.[14]

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13. Ranbir Singh, Dr. Nisha Raghuvanshi, Women Entrepreneurship Issues, Challenges And Empowerment Through Self Help Groups: An Overview Of Himachal Pradesh, 2 I. J. M. R. Rev. 81, 82 (2012).
14. Female Entrepreneurs, Entrepreneurship (Sept. 19, 2019, 12:05 PM), https://en.wikipedia.org/wiki/Female_entrepreneurs.

There are certain factors influencing women entrepreneurs such as-

- equivalent status in the social order
- More mobility & freedom
- financial viability
- Motivation
- set up their own creativity and individuality
- Achievement of distinction
- Enhancing risk taking ability
- Building self-reliance and confidence[15]

1.3 ENTREPRENEURSHIP AND GENDER JUSTICE

Since the enactment of our law of the land, the gender equality principle is enshrined in the Constitution of India, in its Preamble[16], Fundamental Rights[17] , Fundamental Duties[18] and Directive Principles[19] . The Indian Constitution not only grants impartiality to women, but also authorizes the State to adopt actions of positive discrimination in women's favour.[20] Apart from these provisions, The Constitution gives every citizen, including women free right to trade and commerce in India[21], but subject to certain reasonable restrictions[22]. All these provisions empowers sate to boost female empowerment, which can be best achieved through entrepreneurship because an entrepreneur is a master of his own and when there will be more females in entrepreneurial field, then there will be economic, social and political empowerment of women in true sense.

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15. Charantimath, *supra*,105.
16. Indian Const. Preamble.
17. *id* At art. 14,15,16. See Article 14 of Indian Constitution, "the State shall not deny to any person the equality before the law and equal protection of laws with in the territory of India", Whereas, Article 15(1) "prohibits the State to discriminate against any citizen on the grounds only of religion, race, caste, sex, place of birth or any of them".Also, Article 15(3) authorizes "the State to make special provisions for women and children", Article 16 states that "there shall be equality of opportunity for all citizens and they shall not be discriminated on the base of religion, race, caste and sex".
18. *id* At art. 51. See Article 51(A)(e) of Indian Constitution, "it will be the duty of every citizen to relinquish practices which are derogatory to the dignity of women
19. *id* At 39. See Article 39(a) of Indian Constitution, "the state in particular direct its policy towards securing that citizen, men and women equally, have the right to sufficient means of livelihood". Article 39(e) of the Constitution of India provides that "the health and strength of workers, men and women, and the tender age of children shall not be abused and that citizens are not forced by economic necessity to enter avocations unsuited to their age or strength"
20. *id* At art. 14, 15, 16, 39, 51.
21. *id* At art. 301. See Article 301,"subject to the other provisions of this part, trade, commerce and intercourse throughout the territory of India shall be free".
22. *id* At art. 302, 304, 305.

The enforcement and protection of intellectual property rights has also received greater attention these days because they also play an important part affecting victorious female entrepreneurship. The intention of IP rights is to promote and expand innovation and creativity, which in return helps perk up the value of our lives. In general views, IPR is associated with inventions in scientific, engineering, technological or mathematical fields but IP exits beyond patented innovation and also includes other exclusive rights like, trademarks, geographical indications, copyrights, industrial designs, so-called traditional knowledge, are few to mention. To enhance entrepreneur spirit, patents provide protection to novel inventions for 20 years[23] , whereas in terms of literary and artistic sector, copy rights protect the work for the entire life of author and additional 60 years.[24] Similarly, trademarks protect the distinguished ability of brands[25], further promoting entrepreneurial development.[26]

We consider women's entrepreneurship development to be a significant channel of women's economic empowerment and also a pillar on the path to sustainable development. By setting up their own ventures, women can transform their prospects to gain economic independence, defeat poverty, and improve their wellbeing. Throughout this process women can become riders of change and obtain a long-term perception accounting for the consequences of actions for our generations in order to safeguard better future. The question, why are actions needed may arise in the minds of many. Women entrepreneurs encounter a range of obstacles in locating up and then running their own establishments due to lack of/restrictions concerning access to resources, which tied together with gender-neutral policies, may put women at a inconvenience in this field. An allowing and supportive environment is fundamental to remove the obstacles & barriers to equal involvement across the different stages within entrepreneurship development.

Within the structure of a democratic republic, our policies for development, various laws, programs and planning processes have always aimed at women's progress in different spheres. The central issue in shaping the status of women is acknowledged as the empowerment of women in recent years. Starting from the 5th 5 Year Plan (1974-1978) there has been a noticeable shift in addressing women's issues from wellbeing to development. It put emphasis on training of women, who needed income and protection and also coincided with International

23. The Patents Act (1970).
24. The Copyright Act (1957).
25. The Trade Marks Act (1999).
26. UNECE, *supra,* 25.

Women's Decade &the preparation as well as submission of report explaining status of women in India. Under this plan only, Women's Welfare &Development Bureau was set up in 1976, under the Social Welfare Ministry. The 7th 5Year Plan (1985-1990) laid the emphasis on gender equality and need for empowerment. During this period, stress was upon qualitative aspects, like generation of awareness with respect to rights, skill training and inculcation of self-confidence for better employment[27]. After these remarkable steps taken by the Government, The National Commission for Women set up by a statute of Indian Parliament in 1990, was established to safeguard the rights along with lawful entitlements of women.[28] The 10th 5 Year Plan (2002-2007) aimed at empowering women through interpreting the newly adopted National Policy for Empowerment of Women. This policy was launched in the year 2001 by Indian govt., with following specific objectives:

Further, The National Policy for Empowerment of Women In order to make women develop & realize their potentials, creating an environment full of positive socio-economic policies.

- Establishment of an atmosphere for enjoyment of all the fundamental freedoms and human rights by women alike with men in all spheres like civil, political, social, economic, and cultural.
- Giving equal access to contribution and decision making power of females in the polity, society and economy of India.
- Providing equal right to health care of women, career and vocational guidance, quality education at all stages, equal remuneration and employment, occupational safety and health, civic life and social security as well.
- Strengthening legal arrangements aimed at eradication of all kinds of discrimination against women.
- Altering societal attitudes and the public practices by active involvement of both the genders.
- Mainstreaming a gender viewpoint in the transformation process.
- Abolition of discrimination &violence (physical, mental, social) against females and

27. Ranbir Singh, Women Entrepreneurs: A Study of Current Status, Challenges and Future Perspective in the State of Himachal Pradesh,Ph.D. Thesis, Shoolini University of Biotechnology and Management Sciences 1, 19(2015).
28. The National Commission for Women Act (1990).

the girl child.

- Constructing and amplifying partnerships with communal societies, principally women's organizations.[29]

One such women oriented organization or agency is The Ministry of Women and Child Development which functions as the nodal agency for every matter pertaining to benefit, growth and emancipation of women, which means that its one hidden objective is to establish gender justice through over all women development. It has developed a lot of schemes and programmes for women's assistance. These plans extend to a very wide spectrum like as women's call for food, shelter, safety, justice, physical, mental and maternal health, nutrition, legal aid, information, etc, along with their need for economic nourishment through education, skill development and access to finance and marketing.

1.3.1 ADDITIONAL SUPPORT TO WOMEN ENTREPRENEURS THROUGH VARIOUS INSTITUTIONS:

- **National Research Development Corporation of India:** This is a government of India enterprise (a non-profit organization) constituted under sec. 8 of the companies Act, 2103and established in the year 1953. Specifically designed for the development and full exploitation of indigenous know-how, patents, processes and inventions originating from all research and development institutions of India.
- **Central Social Welfare Board:** Established in 1953, the board runs vocational training courses for needful and poor women of rural areas in order to provide better employment prospects and acquire leadership qualities.
- **Small Scale Industries Board:** It was constituted in 1954 to advice on improvement of small scale industries in India. Now it's the apex advisory body to make advice on all matters concerning development of small scale industries.
- **Small Industry Development Organisation:** It was also set up in 1954, for the development of all the small scale units in various areas. This nodal agency works for identifying needs and promotion of small scale industries by way of entrepreneurship development, training and consultancy etc. It also provides comprehensive common facilities, marketing assistance and technological support to emerging entrepreneurs.

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29. National Policy for The Empowerment of Women (2001), Ministry of Women and Child Development (Sept. 16, 2019, 10:01 AM), https://wcd.nic.in/womendevelopment/national-policy-women-empowerment.

- **National Small Industries Corporation:** Constituted in 1955, this public sector undertaking provides financial assistance for purchasing raw materials by small scale industries and also helps in providing various other inputs.
- **Khadi and Village Industries Commission:** It is a statutory body established in 1957 and works for the sake of rural development. It engages in preparation, promotion, organisation and execution of programmes for the khadi and various other village industries.
- **National Alliance of Young Entrepreneurs:** It was specially established in 1975 for encouraging women entrepreneurship. Having its wings in 5 states, and in other states by affiliating women through it, it has become most representative association of women entrepreneurs in India.[30]
- **Federation of Indian women entrepreneurs:** This oraganisation was instituted in 1993 and is India's leading institution for entrepreneurship development. Having branches in different states, it aims at providing networking platform, industrial research, skill trainings to women entrepreneurs of the country.[31]
- **National Bank for Agriculture and Rural Development:** NABARD came into existence in 1982, and being an Autonomous financial institution offers liberal credit to women entrepreneurs, especially of rural areas.
- **International Centre for Entrepreneurship and Career Development:** It works as a registered trust founded in 1986, and is involved in training of women entrepreneurs for MSME development at large scale and has also extended its operations internationally to support women entrepreneurs.[31]

On the event of International Women's Day, Women Entrepreneurship Platform was launched on 8th March 2018, by Hon'ble Prime Minister Shri Narendra Modi. Although, the idea of WEP came at the annual Global Entrepreneurship Summit 2017, in Hyderabad combinely by the NITI Aayog and government of USA. This is the first platform which will work with public and private sector to enable the sharing of best practices of entrepreneurship and promote evidence based policy makings by compliance support, Incubation and Acceleration of Entrepreneurship

30. Singh, *supra.* 22.
31. Hina Shah,Creating An Enabling Environment for Women's Entrepreneurship in India, 1309 Dev. Pap. 1, 14 (2013).

Skilling, funding assistance etc.[32]

1.3.2 STEPS TAKEN FOR WOMEN ENTREPRENEURS AT INTERNATIONAL LEVEL

On the occasion of World Youth Skills Day in 2016 ie.15th July, in an event held at UN, New York, "Global Coalition of Young Women Entrepreneurs" was launched in order to promote young women's entrepreneurship and innovation. Many experiences and recommendations were shared by prominent young entrepreneurs and leaders from all over the world. The panel stated that economic empowerment and skills development are the main pillars of United Nation's Youth and Gender Equality Strategy.[33] International Labour Organisation initiated a programme in 2002 on Women's Entrepreneurship Development and Gender Equality (WEDGE) which is a project funded by Ireland and North American Aerospace Defense Command. In furtherance of which a strategy was adopted by ILO in 2008 in Geneva which identifies hurdles that women entrepreneurs face in initiating and rising their business. By means of economic empowerment, it aspires to contribute to enhanced gender equality and more employment opportunities for women.[34]

All the above mentioned laws, institutions, policies and programmes contribute towards achieving the goal of gender justice by making women stand on equal footing as like men. Similarly, various schemes of the Ministry like Swayamsidha, Swawlamban, Swashakti and STEP enable economic empowerment of women in India. Where Working Women Hostels & Creches offer support services, the Short Stay Homes and Swadhar provide safety and rehabilitation to women in hard circumstances. The Ministry also aids autonomous bodies like Central Social Welfare Board, National Commissionand Rashtriya Mahila Kosh whodo continuous efforts for the welfare and improvement of women. Areas upon which Ministry has special focus include financial sustenance of women through skill enhancement, education as

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32. Women Entrepreneurship Platform (WEP), Niti Aayog, (Sept. 22, 2019, 5:20PM),https://niti.gov.in/women-entrepreneurship-platform-wep.
33. Promoting Innovation, Skills and Young Women's Entrepreneurship, Office of the Secretary-General's Envoy on Youth (Sept. 25, 2019, 12:00 PM),https://www.un.org/youthenvoy/2016/07/promoting-innovation-skills-young-womens-entrepreneurship/.
34. Women's Entrepreneurship Development (WED) Programme, International Labour Organization (Sept. 25, 2019 12:00 PM), https://www.ilo.org/empent/areas/womens-entrepreneurship-development-wed/lang--en/index.htm.

well as access to marketing & credit.[35]

1.4 CHANGING SOCIO-ECONOMIC STATUS OF WOMEN

The status of Indian women has been changing due to growth in urbanization, industrialization, spatial mobility and social legislations. Since the century turn, most of the women are going for higher education in manners of professional and Technical Education. Even their proportion in labour force has also seen increasing. With the changing scenario women is shifting from kitchen, handicrafts and some traditional cottage industries to the non-traditional in the higher level of economic activities. The decade of international Women's year (1970's), efforts were made to promote the self employment of women which gathered greater attention from various Government and Non governmental agencies, as discussed above. Indian government new industrial policy has laid emphasis on the need to organise special entrepreneurial programs for training of women for enabling them to start their own Ventures.[36] The following data helps in analyzing the present status of women entrepreneurs in India.

- **Proportional allocation of Enterprises in rural and urban areas :**

Sector	Male	Female	All
Rural	77.76%	22.24%	100%
Urban	81.58%	18.42%	100%
All	79.63%	20.37%	100%

- **Proportional distribution of Enterprises by Male/Female :**

Category	Male	Female	All
Micro	79.56%	20.44%	100%
Small	94.74%	5.26%	100%
Medium	97.33%	2.67%	100%
All	79.63%	20.37%	100%

35. Namit k Srivastava, Women Empowerment in India, Women Empowerment (Sept. 14, 2019, 2:40 PM), https://www.indiacelebrating.com/social-issues/women-empowerment/.
36. Charantimath, *supra*, 105.

From the above extracted data, we find that male dominance in ownership has been more pronounced for Small and Medium enterprises being owned by them, as compared to Micro enterprises owned by males.[37] We also find that the southern States of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu, along with West Bengal, have the highest number of women entrepreneurs in the country with a majority in small- and medium-sized businesses, according to a study. The report on the State of Women Entrepreneurship in India by she at work, a knowledge hub for women entrepreneurs, attributes this to the high literacy rate, along with overall women's empowerment in these States. However, in terms of offering the maximum number of schemes for women entrepreneurs, Goa, Jammu & Kashmir, Karnataka, Rajasthan and West Bengal have emerged as the top five States in the country. The focus of schemes for women entrepreneurs is primarily on financial aid followed by training and skill building of such entrepreneurs. The education sector sees the maximum number of women entrepreneurs followed by financial services, insurance, livestock, forestry and lodging. Further, almost 80% of women entrepreneurs opt to self-finance their businesses with little utilisation of various government schemes that provide financial aid to women entrepreneurs. Incidentally, the north eastern states of Arunachal Pradesh, Meghalaya and Nagaland have lesser number of women entrepreneurs though the ratio of male to female entrepreneurs strongly favours women.[38]

According to the female entrepreneurship and development index of 2015, our country ranks below the 20th percentile in female entrepreneurship index. It is a matter of great worry not only because this rank is below the developed economies like US and UK but also below the developing Nations like Nigeria and Brazil. The Google and Bain &company also reported that the women enterprises in India consist of 20% of all the enterprises in the nation. In the last decade it was 14 %, and despite this growth, we find several constraints restricting women from reaching heights. It is also to be noted that the maximum women oriented business in India is owned by the females only on documents. A Report published during 2019, states that funding raised by a female team in 2018 was an abysmal 0.63 % of the total 13 billion dollars raised by entrepreneurship in the ecosystem. Women also faced constraints in terms of investment where they experienced sexist comments, intrusive questions and lot of investor bias. Such kind of

37. Annual Report, Micro, Small and Medium Enterprise, (2018-19).
38. Business women score high in south : Study, The hindu (Sept. 26, 10:00 AM), https://www.thehindu.com/business/businesswomen-score-high-in-south-study/article20627605.ece.

instances proves it right that women face a tough time getting funding than their male counterparts.[39]

Historical evidences indicate that the women entrepreneurship has evolved from the push factors to the pull factors turning women towards entrepreneurship for fulfilling their aspirations both socially and economically. The number of women entrepreneurs increased especially during 1990's.Their emergence as entrepreneurs and the emergence of women owned firms have significant contribution, which is very much visible in India. However, in future it would be possible for Women entrepreneurs to work from home and also manage work and home with flexible timings. It is crucial to formulate Strategies and policies to support, invigorate and sustain women's efforts in the right direction as they are capable of contributing much more and their business possesses great potential.[40] In developing countries like India, earlier marriage was the only career for most women. Women were restricted to selected professions such as teaching, nursing and office work. Over the years, more and more women are going in for higher, technical and professional education.[41] Empirical evidences demonstrate that the primary entrepreneurial activity of women is mainly focused on small and medium enterprises sector. They widely work in sectors ranging from trade and services to beauty parlors, printing, tailoring, catering etc for which they require small amount of financial assistance. So, in the views of researcher, this may be considered as a root step for their financial independence, but with changing need of time they need more support to establish big ventures so that they could stand on the same place as that of men and thus, establish a just society where men and women are treated equally. If women entrepreneurship is accelerated with all the possible efforts, it can lead to creation of more than 30 million women owned enterprises. This will potentially transform the employment sector in the country with new jobs and economic growth. International labour organisation, provides with a data which showed that 77% of women in India who are of working age are not out of the labour market resulting in a tragic waste of human talent and resources. As stated by IMF, by making these women participate in the national workforce, our biggest democracy would be 27% Richer.[42]

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39. Nirandhi Gowthaman & Tenzin Norzom, Women's entrepreneurship can lead to creation of 30 million women-owned enterprises in India, HerStory (July 23, 2020, 12:20 PM), https://yourstory.com/herstory/2020/03/womens-entrepreneurship-30-million-women-enterprises india#:~:text=Women's%20entrepreneurship%2C%20if%20accelerated%20to,jobs%2C%20according%20to %20the%20study.
40. Charantimath, *supra,* 101.
41. A. Mathur, Women as Change Agents in the Diversified Global Economy, 1(3) J. A. R. Consrt. (2011).
42. Gowthaman & Norzom, *supra.*

1.4.1 MOST INFLUENTIAL WOMEN ENTREPRENEURS OF INDIA

Starting with one of the most widely recognized female entrepreneur of India, Indra Nooyi CEO of the Pepsi Co. India, was awarded "Padma Bhushan" in the field of business and leadership. Indu jain is the chairperson of Bennet, Coleman and Co. Ltd, which is one of the largest media group in the country. She was also awarded "Padma Bhushan" in the year 2016. Kiran Mazumdar Shawwho is the Managing Director of Biocon Ltd., which is India's one of the leading pharmaceutical company, was also awarded with Padma Shri in 1989 and Padma Bhushan in 2005 by the Government of India. Chanda Kochchar, Managing Director and CEO, ICICI Bank Ltd., has been awarded with prestigious Padma Bhushan in the year 2011 and has been over and over again ranked in the record of 'The most powerful women in the World' by the Forbes magazine. Ekta Kapoor the creative head of Balaji Telefilms and the daughter of veteran Actor Jeetendra is also an influential entrepreneur of the Tele industry. She bagged the Hall of Fame award in the Indian Tele awards 2006. [43] The founder of VLCC, Health Care Ltd., Vandana Luthra, was also facilitated with "Padma Shri" in 2013 for her outstanding contributions in the field of business. Falguni Nayar is a well-known and flourishing women entrepreneur who started a multi-product beauty store called "Nykaa". It is an e-commerce store which deals in wellness and beauty products from leading brands like Lakmé, L'Oreal Paris, Kaya Skin Clinic etc.[44] Women entrepreneurs engaging in small foundries and workshops in Maharashtra, manufacturing solar cookers in Gujarat, and T.V. capacitors in Orissa have already proved beyond suspicion that given the chance, they can surpass their male counterparts. Smt. Yumutai Kirloskar (Mahila Udyog Limited), Smt. Sumati Morarji (Shipping Corporation), Smt. Neena Malhotra (Exports) and Smt. Shahnaz Hussain (Beauty Clinic) are only few exemplary names of talented, flourishing and successful women entrepreneurs in our country.[45]

These females may be considered as exemplary figures by Government in order to achieve gender justice in each section of the society. Entrepreneurship as discussed in the paper, results not only in financial but also in over all development of women at large scale. By promoting women entrepreneurship, gender justice can be achieved easily and speedily, which is one of the foremost needs of the country.

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43. Singh & Dr. Raghuvanshi,*supra,* 81.
44. Swati Mittal,10 Most Successful Female Entrepreneurs in India,Jagran Josh (Sept. 28, 2019, 9:00 AM),https://www.jagranjosh.com/articles/10-most-successful-female-entrepreneurs-in-india-1520423806-1.
45. Ranbir Singh & O.P. Monga, Changing Status of Women Entrepreneurs in Himachal Pradesh, 2 Eu. Acae. R. 5723 (2014).

1.5 CONCLUSION

It may be concluded in the end that a women is the reflection of a society but in India she is still considered to be a part of weaker section. Many statutes have been enacted so far to uplift the status of women in the patriarchal society of India and also at a global level. But only the economic independence of women can lead to their overall development. We know that the population of women is almost equal to men, yet their active participation in economic development did not seem to be significant till 1990. Indian women did not enjoy social freedom so that they could mingle freely with the nation building activity by realizing their full potentials. That is why a drastic change is required in the mindset of men folk towards general women and working women in particular. So finding remedies for the problems of women entrepreneurs becomes a great necessity for the society as well as government. Many steps have been taken to solve the problems of women entrepreneurship by the central and state governments and the non-governmental organizations but some special incentives and subsidies are yet to be provided.[46]

Earlier, woman used to work out of compulsion and to fulfill the basic needs of her family, but as the time is changing this mind set is also changing. Now they are ready to compete with men in every field, be it politics, business, home-making, fashion, television, sports or agriculture, females are seen everywhere. This is how gender justice is being done to women by promoting their financial stability. Most people will believe that women as compared to men have innate capacities and tactics to utilize resources to maximum and make surplus profits, with huge savings. In the Oriental societies it can be observed that the women are born risk seekers. They intended to grow up with the feeling of risk management and adaptation with the environment change. This talent in women makes her superior to men up to some extent. More the women entrepreneurs, more the human resources contributing in economic growth of the nation, further resulting in empowering the better half of the population. Now is the time that a little effort is made to boost the economic participation of women through entrepreneurship, so that appropriate justice is done to this gender of the society and it no longer remains a weaker section.

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46. Dr. G. Jaya Lakshmi, Problems of Women Entrepreneurship in India 5 O. J. L. S. Sc. 78, 83 (2011).

ARTIFICIAL INTELLIGENCE IN HEALTHCARE- A BOON OR BANE

- Ms Aishwarya Jagga*

"Everything we love about civilization is a product of intelligence, so amplifying our human intelligence with artificial intelligence has the potential of helping civilization flourish like never before – as long as we manage to keep the technology beneficial."

- Max Tegmark, President of the Future of Life Institute[1]

INTRODUCTION

The contemporary world is growing at such a rate of knots that with every passing hour the entire world witnesses a technology which is smarter than the former prevailing technology. Artificial intelligence and machine-learning algorithms are the focal-point of many exciting technologies currently in development. From self-driving Tesla's to in-home assistants such as Amazon's Alexa or Google Home, artificial intelligence is swiftly becoming the hot new focus of the technology industry[2].

NITI Aayog has given five sectors that are envisioned to benefit the most from artificial intelligence in solving societal needs :[3]

a) Healthcare: increased access and affordability of quality healthcare,

b) Agriculture: enhanced income for farmers, increased productivity of farms and declining wastage,

c) Education: education with improved access and quality,

d) Smart Cities and Infrastructure: efficient and connectivity for the mushrooming urban population, and

e) Smart Mobility and Transportation: transportation which is smarter and safer

There is no definition of artificial intelligence which has been collectively agreed upon . It was in the mid-1950s that McCarthy, recognized as the father of Artificial Intelligence coined the term

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1. https://futureoflife.org/background/benefits-risks-of-artificial-intelligence/?cn-reloaded=1 (Retrieved on 10 March 2020 7:54 p.m.)
2. Shailin Thomas, Artificial Intelligence, Medical Malpractice, and the End of Defensive Medicine, Bill of Health , Jan 2017 (March, 14 2020 12:48 p.m.) https://blog.petrieflom.law.harvard.edu/2017/01/26/artificial-intelligence-medical-malpractice-and-the-end-of-defensive-medicine/
3. National Strategy for Artificial Intelligence, Niti Aayog, June 2018 (March 14, 2020 11:24 p.m.) https://niti.gov.in/writereaddata/files/document_publication/NationalStrategy-for-AI-Discussion-Paper.pdf

"Artificial Intelligence" which he defined as "the science and engineering of making intelligent machines"[4]. Artificial intelligence generally refers to computing technologies that are analogous to processes associated with human intelligence, such as reasoning, learning and adaptation, sensory understanding, and interaction. A formal definition of Artificial Intelligence would read as "a field of science concerned with the computational understanding of what is commonly called intelligent behavior, and with the creation of intelligent agents that exhibit such behavior"[5]. Artificial intelligence in healthcare and research artificial intelligence is not new, but there have been rapid advances in the field in recent years.

ARTIFICIAL INTELLIGENCE VIS-À-VIS HEALTHCARE

Though artificial intelligence like robots and computers have sneaked into all walks of life but they will never be able to completely substitute the work of doctors, nurses, and other hospital staff members, but there are no two ways about the fact that artificial intelligence is changing the healthcare industry. From productivity at workplaces to treating patients, high tech technology has the potential to improve diagnosis, predicting patient outcomes and creating a more bespoke patient care experience. Artificial intelligence in medicine can be dichotomized into two subtypes[6]:

a) VIRTUAL - virtual part ranges from applications such as electronic health record systems to neural network-based guidance in treatment decisions and

b) PHYSICAL - physical part deals with robots assisting in performing surgeries, intelligent prostheses for handicapped people, and elderly care.

The latest example of artificial intelligence in the healthcare industry is of IBM's Watson which has received substantial attention in the media for its spotlight on precision medicine, particularly cancer diagnosis and its treatment. Watson employs a combination of machine learning and natural language process (NLP) capabilities. However, the early enthusiasm for application of this technology took a back seat as customers realised the difficulty of teaching Watson how to concentrate on particular types of cancer and of integrating Watson into care

4. And Peart, Homage to John McCarthy, the Father of Artificial Intelligence, Industry Insight, Jun 2017, (March 14, 2020 1:24 p.m) https://www.artificial-solutions.com/blog/homage-to-john-mccarthy-the-father-of-artificial-intelligence
5. Sandeep Reddy, Use of Artificial Intelligence in Healthcare Delivery, eHealth- Making Health Care Smarter, Thomas F. Heston, IntechOpen, (March 14, 2020. 1:52 p.m.) https://www.intechopen.com/books/ehealth-making-health-care-smarter/use-of-artificial-intelligence-in-healthcare-delivery
6. Amisha, Paras Malik, Monika Pathanian and Vyas Kumar Rathur, Overview of Artificial Intelligence in Medicine, J Family Med Prim Care. Jul 2019 (March 14, 2020. 1:00 p.m.) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6691444/1

processes and systems. Watson is not a single product but a set of 'cognitive services' provided through application programming interfaces (APIs), including speech and language, vision, and machine learning-based data-analysis programs.[7]

HISTORY OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE

The use of artificial intelligence in the field of healthcare and medicine is a natural corollary to the advent of artificial intelligence in the contemporary world. The same has no element of surprise as the system of artificial intelligence clearly intends to replicate the functioning of the human brain.

In the year 1970, William B Schwartz, a physician interested in the use of computing science in medicine, published that computing science will probably exert its major effect by augmenting and, in some cases; it will replace the intellectual functions of the physician.[8] It was realized by the 1970's that the conservative computing techniques were not appropriate for solution of the complex medical phenomenon. A better computational model that stimulated human cognitive processes, known as Artificial Intelligence was required for solving the clinical problems.

The earliest use of Artificial intelligence in medicine was comprised of setting up of the rule-based systems to help with medical reasoning. However the serious clinical problems were too complex to be dealt with simple rule based problem solving techniques. Problem solving was then sought by computer programs based on models of diseases[9].

In 1976, Gunn a Scottish surgeon used computational analysis to diagnose acute pain in abdominal region. This was achieved through clinical audits of structured case notes through computers, whereby diagnosis through this route proved to be 10% more accurate that the conventional route[10].

By 1980, artificial intelligence was well established all over the globe but especially in learning centers in the United States where, there was use of novel and innovative artificial intelligence approach to medical diagnoses which was majorly based on the expert system methodologies.

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7. Thomas Davenport and Ravi Kalakota, The potential for artificial intelligence in healthcare, Future Healthc J. 2019 Jun (March.14, 2020, 5:30 p.m.) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/#CIT000
8. William B. Schwartz, Medicine and the Computer- the Promise and Problems of Change, New England Journal of Medicine (March.15, 2020, 1:06 p.m.) https://www.nejm.org/doi/full/10.1056/NEJM197012032832305
9. Sandeep Reddy, Use of Artificial Intelligence in Healthcare Delivery, eHealth - Making Health Care Smarter, Thomas F. Heston, IntechOpen, (March.15, 2020, 1:00 p.m) https://www.intechopen.com/books/ehealth-making-health-care-smarter/use-of-artificial-intelligence-in-healthcare-delivery
10. *Id.*

By the end of the 1990's, research in the field of medical artificial intelligence had started to use novel techniques like machine learning and artificial neutral networks to support clinical decision-making.

APPLICATION OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE

Artificial intelligence today is being employed for the three classical medical tasks: diagnosis, prognosis and therapy but most importantly in the area of diagnosis.

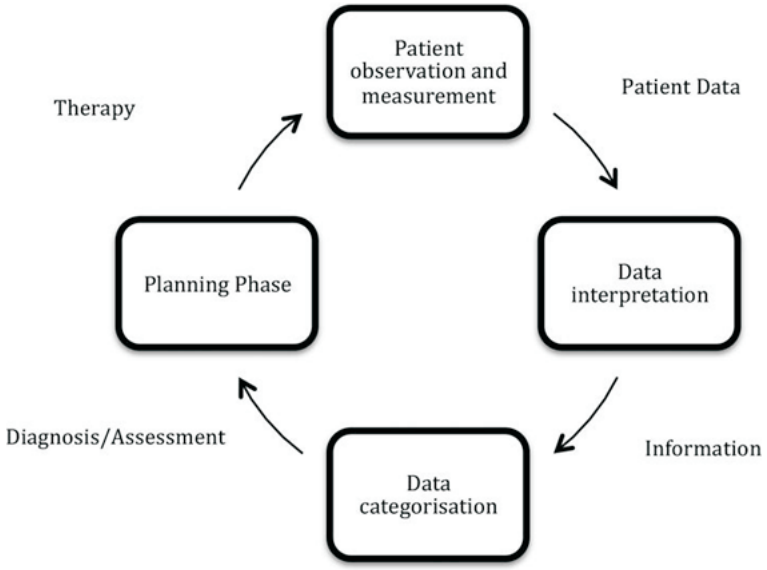

Figure 1

Figure 1 depicts the medical diagnosis cycle which involves observation and examination of the patient, collection of patient data, interpretation of data using the clinician's knowledge and experience and then formulation of a diagnosis and a therapeutic plan by the physician. This concept in the realm of artificial intelligence is replicated by the physician being the intelligent agent, the patient data being the input and the diagnosis being the output.[11]

Artificial intelligence is not a single technology, but rather a compilation of them each of which have inevitable and immediate relevance to the healthcare field. Some particular artificial intelligence technologies of high importance to healthcare are below-

11. Sandeep Reddy, Use of Artificial Intelligence in Healthcare Delivery, eHealth- Making Health Care Smarter, Thomas F. Heston, IntechOpen, (March 14, 2020. 5:52 p.m.) https://www.intechopen.com/books/ehealth-making-health-care-smarter/use-of-artificial-intelligence-in-healthcare-delivery

1. MACHINE LEARNING

Machine learning is a statistical technique for fitting models to data and to 'learn' by training models with data. There are following versions of machine learning in healthcare-

a) Precision Medicine- This is the most common application of traditional machine learning which predicts the best suited treatment for the patient.[12]

b) Neural Network – This is a more complex technology used for categorization applications like determining whether a patient will acquire a particular disease. It resembles to the way neurons process signals, but the analogy to the brain's function is relatively weak.

c) Deep Learning/ Neural Network Models - This is the most complex forms of machine learning with many levels of features or variables that predict outcomes. A widespread application of deep learning in healthcare is recognizing potentially cancerous lesions in radiology images. Deep learning is being applied to radiomics more and more, or for the detection of clinically relevant features in imaging data beyond what can be perceived by the human eye.

2. NATURAL LANGUAGE PROCESSING

Natural Language Process includes applications like speech recognition, text analysis, translation and other such objectives related to language. In healthcare, the dominant applications of NLP involve the creation, understanding and classification of clinical documentation and published research. NLP systems can analyze unstructured clinical notes on patients, prepare reports (for instance- on radiology examinations), transcribe patient interactions and conduct conversational artificial intelligence.[13]

3. RULE-BASED EXPERT SYSTEMS

Expert systems are based on collections of 'if-then' rules. In healthcare, they are being widely engaged for 'clinical decision support' purposes.[14] Expert systems require human experts and knowledge engineers to build a series of rules in a particular knowledge domain. However, when the number of rules is large (usually over several thousand) and the rules begin to conflict

12. Su-In Lee, Safiye Celik, B A Logsdon, et al. A machine learning approach to integrate big data for precision medicine in acute myeloid ¬leukemia. Nat Commun 2018 (March.15, 2020, 2:14 p.m.) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5752671/
13. Thomas Davenport and Ravi Kalakota, The potential for artificial intelligence in healthcare, Future Healthc J. 2019 Jun (March.15, 2020, 2:30 p.m.) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/#CIT000
14. *Id.*

with each other, they tend to break down. Moreover, if there is change in the knowledge domain, bringing about a change in the rules can be difficult and time-consuming. They are slowly being replaced in healthcare by more approaches based on data and machine learning algorithms.

4. PHYSICAL ROBOTS

Physical robots are well known to perform pre-defined tasks like lifting, repositioning, welding or assembling objects in places like factories and warehouses, and delivering supplies in hospitals. They are also becoming extra intelligent, as other artificial intelligence capabilities are being implanted in their 'brains' (that is, their operating systems). Surgical robots, originally approved in the United States of America in the year 2000, endow 'superpowers' to surgeons, advancing their skill to see, craft clear-cut and minimally invasive incisions, stitching wounds and so forth.[15] Crucial and significant decisions are forwarded only by human surgeons, however. Common surgical procedures using robotic surgery include gynecologic surgery, prostate surgery and head and neck surgery.[16]

5. ROBOTIC PROCESS AUTOMATION

Robotic process automation (RPA) doesn't in actual fact involve robots as the name suggests but includes only computer programs on servers. It relies on an amalgamation of workflow, business rules and 'presentation layer' integration along with information systems to operate like a semi-intelligent user of the systems. In healthcare, they are applied for recurring tasks like prior authorization, updating patient records or billing. When combined with other technologies like image recognition, they can be materialized to dig out data from, for example, faxed images so as to input it into transactional systems.

These technologies are mostly individual ones, but increasingly they are being pooled and integrated; robots are getting artificial intelligence supported 'brains', image recognition is being integrated with Robot Process Automation . Perhaps in the upcoming years these technologies will be so intermingled that composite solutions will be more likely or feasible.

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15. Davenport TH, Glaser J. Just-in-time delivery comes to knowledge management. Harvard Business Review 2002. (March.15, 2020, 3;10 p.m.) https://hbr.org/2002/07/just-in-time-delivery-comes-to-knowledge-management.
16. Su-In Lee, Safiye Celik, B A Logsdon, et al. A machine learning approach to integrate big data for precision medicine in acute myeloid ¬leukemia. Nat Commun 2018 (March 15, 2020, 3:00 p.m.) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5752671/

ARTIFICIAL INTELLIGENCE IN HELTHCARE – A BOON

"What all of us have to do is to make sure we are using artificial intelligence ina a way that is for the benefit of humanity, not to the detriment of humanity."

- Tim Cook, CEO of Apple[17]

Artificial intelligence in healthcare today is gaining more and more importance for the following reasons-

1. ARTIFICIAL INTELLIGENCE EXCELS AT WELL-DEFINED TASKS

Research has focused on tasks where artificial intelligence is able to effectively demonstrate its performance in relation to a human doctor. By and large, these tasks have evidently helped define inputs and a binary output which is easily validated.

2. ARTIFICIAL INTELLIGENCE IS SUPPORTING DOCTORS, NOT REPLACING THEM

Machines invariably lack human qualities such as sympathy, empathy and compassion, so it becomes necessary that patients perceive that consultations are being led by human doctors. Furthermore, patients cannot be expected to immediately trust artificial intelligence a technology shrouded by mistrust.[18] Therefore, artificial intelligence commonly handles tasks that are essential, but narrowed down in their scope so as to leave the primary and key responsibility of patient management with a human doctor. There is an ongoing clinical trial using artificial intelligence to calculate target zones for head and neck radiotherapy more accurately and way more quickly than by a human being. An interventional radiologist is still ultimately responsible for delivering the therapy but artificial intelligence has a significant background role in protecting the patient from harmful radiation.[19]

3. ARTIFICIAL INTELLIGENCE SUPPORTS POORLY RESOURCED SERVICES

A single artificial intelligence system is capable of supporting an enormous population and

17. https://www.forbes.com/sites/nicolemartin1/2019/06/27/13-greatest-quotes-about-the-future-of-artificial-intelligence/#637512e63bdf (Retrieved on March 14, 2020 7:46 p.m.)
18. Oppenheim M. Stephen Hawking: artificial intelligence could be the greatest disaster in human history. Independent. Oct,2016 (March 14,2020 6:03 p.m.), http://www.independent.co.uk/news/people/stephen-hawking-artificial-intelligence-diaster-human-history-leverhulme-centre-cambridge-a7371106.html
19. Varun H Buch, Irfan Ahmed, Mahiben Maruthappu, Artificial intelligence in medicine: current trends and future possibilities, Br J Gen Pract. 2018 Mar (March 14, 2020 6:06 p.m.) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5819974/

therefore it is ideally suited to situations where human expertise is a scarce resource, such as in the developing nations. In many Tuberculosis prevalent countries there is a shortage of radiological expertise at remote centers. By means of artificial intelligence, radiographs uploaded via these centers could be understood by a single central system; one of the recent study shows that artificial intelligence precisely diagnoses pulmonary Tuberculosis with a sensitivity of 95% and specificity of 100%. Furthermore, under-resourced tasks where patients are experiencing unsatisfactory waiting times are also attractive to artificial intelligence in the form of triage systems.[20]

Thus, tele-medicine has proved to be a boon in the contemporary world.

ARTIFICIAL INTELLIGENCE IN HEALTHCARE- A BANE

"Success in creating artificial intelligence would be the biggest event in human history. Unfortunately it might also be the last, unless we learn how to avoid the risks."

-Stephen Hawking, Theoretical Physicist [21]

As the use of artificial intelligence in the healthcare sector rises and advances, the legal front will also face issues, particularly with the blooming attention and unique application of customary regulatory principles which are not as of now attuned and accustomed to artificial intelligence. Though there is potential and scope for artificial intelligence to transform healthcare ethical, legal, and cultural factors need to be considered by developers, practitioners, and policy makers when designing, using, and regulating artificial intelligence-

1. DATA PRIVACY AND SECURITY –

Artificial Intelligence applications in healthcare make use of data that many would consider to be sensitive and private[22]. These are subject to legal controls. Patient privacy is a key concern affecting how artificial intelligence is developed and tested.[23] The data of patients should only be used in compliance with patient's expectations as to their usage and requirement. Artificial intelligence could be materialized to detect cyber-attacks and protect healthcare computer systems. However, there is the potential for Artificial Intelligence systems to be hacked to gain

20. *Id.*
21. https://www.forbes.com/sites/nicolemartin1/2019/06/27/13-greatest-quotes-about-the-future-of-artificial-intelligence/#637512e63bdf (retrieved on 14 March, 2020 7:42 p.m.)
22. https://www.nuffieldbioethics.org/assets/pdfs/Artificial-Intelligence-AI-in-healthcare-and-research.pdf (Retrieved on March 15, 2020. 6:34 p.m.)

access to sensitive data, or spammed with fake or biased data in such ways that might not easily be detectable and will jeopardize the security and safety of vital information of the patients.

In 2016, there was hacking of a Mumbai-based diagnostic laboratory database which led to the leaking of medical records (including HIV reports) of over 35,000 patients. This database was holding the records of patients throughout Indian Territory, and many were oblivious that their details and particulars have been exposed. This database had been victim of multiple hacks sometimes even up to three times in a week. However, no action was taken by the laboratory to secure the data.[24]

2. RELIABILITY AND SAFETY

Reliability and safety are primary and principal issues where artificial intelligence is used to control equipment, deliver treatment, or make decisions in healthcare sector. Artificial intelligence could make errors and, if an error is difficult to detect or has knock-on effects, this could have serious implications.[25] The reason for the fallacy can be because patients may react differently to injuries and secondly, an underlying problem in one artificial system might result in injuries to thousands of patients in sharp contrast to the physical presence of a professional. For example, in a clinical trial in 2015, an artificial intelligence application was exercised to predict which patients were expected to develop complications subsequent to pneumonia, and henceforth should be hospitalized. This application erroneously directed doctors to send home patients with asthma due to its failure to take contextual information into account.

3. EFFECTS ON HEALTHCARE PROFESSIONALS

The ethical obligations of healthcare professionals towards individual patients might be affected by the use of artificial intelligence decision support systems, given these might be guided by other priorities or interests, for instance cost efficiency or widespread public health apprehensions. As with many new technologies, the introduction of artificial intelligence is likely to denote that the skills and expertise required of healthcare professionals will change. This could ease up health professionals to splurge more time engaging directly with the patients.

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23. Mary H. Stanfill and David T. Marc, Health Information Management:Implications of Artificial Intelligence on Healthcare Data and Information. Yearb Med Info 2019, (March 15, 2020. 6:10 p.m.) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6697524/
24. ENS (2016, December 3), Maharashtra website hacked: Diagnostic lab details of 35,000 patients leaked, (March 15, 2020. 5:55 p.m.) http://indianexpress.com/article/india/diagnostic-lab-detailsof-35000-patients-leaked-hiv-reports-4407762/
25. https://web.stanford.edu/class/cs240/old/sp2014/readings/therac-25.pdf (Retrieved on March 15, 2020. 6:34 p.m.)

However, there are concerns that the introduction of artificial intelligence systems might be used to justify the engaging of less skilled staff. This could be problematic if the technology is unsuccessful and staff is not able to recognize faults or carry out necessary tasks without computer guidance. A related concern is that artificial intelligence could make healthcare professionals complacent, and less likely to check results and challenge errors.[26]

4. LEGAL LIABILITY:

In case of error in diagnosis, malfunction of a technology or applying inaccurate or inappropriate data the question crops up as to on whom should the liability fall upon – the doctor or the software developer(artificial intelligence). In cases of medical negligence in India, medical professional are held liable, and can further be prosecuted under civil and criminal law of the country. Since software and codes is not technology agnostic, many believe that the creator of the software should be an agent that can be regulated.

Additionally, how does one settle the level of accountability and liability of the doctor in a scenario where he provides the erroneous treatment or diagnosis on account of a glitch in the system or a mistake in data entry? Even though he may not be at fault, liability will fall on him instead of the technology that he relied upon. As a result of such issues of trust and liability and the current capability of artificial intelligence, completely replacing medical professionals with artificial intelligence (that is active assistance by artificial intelligence) is unfeasible at present.[27]

Consequently in light of these disadvantages artificial intelligence should be used cautiously.

POSSIBLE SOLUTIONS

There is a need of responsible and ethical artificial intelligence to make sure that patients are the utmost priority. To combat the problems in the arena of artificial intelligence in healthcare following solutions can be helpful-

1. DATA GENERATION AND AVAILABILITY -

Several risks in Artificial intelligence healthcare exist as to the assembling high quality data in line with the protection of privacy. One set of solutions is provision by government for infrastructural resources for data, varying from setting standards for electronic health records to

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26. https://towardsdatascience.com/the-dangers-of-ai-in-health-care-risk-homeostasis-and-automation-bias-148477a9080f?gi=c7ad6d3ac013 (retrieved on March 15, 2020. 6:24 p.m.)
27. Yesha Paul, Elonnai Hickok, Amber Sinha , Udbhav Tiwari. Artificial intelligence in the healthcare industry in India, the Centre for internet and society, India (March 15, 2020 6:52 p.m.) https://cis-india.org/internet-governance/files/ai-and-healtchare-report

directly providing technical support for high-quality data gathering efforts in the healthcare system that otherwise are not available. Another option is direct investment in the creation of high quality data-sets. Reflecting in this direction, both the United States of America's initiative and the United Kingdom's BioBank aim to assemble comprehensive health-care data on enormous numbers of individuals. Ensuring these effective privacy safeguards for large-scale data-sets is essential to ensure patient trust and participation.[28]

2. QUALITY OVERSIGHT-

Oversight of artificial intelligence system will assist addressing the risk of patient injury. Increased oversights efforts by health systems and hospitals, professional organizations like the American College of Radiology and the American Medical Association, or insurers may be necessary to ensure quality of systems that fall outside the Food and Drug Administration's regulatory authority[29].

3. PROVIDER ENGAGEMENT AND EDUCATION -

The integration of artificial intelligence into health system will undoubtedly change the role of the healthcare professionals. On one side the professionals will be enabled to provide more-personalized and better care, more time to interact with their patients on the other hand the professionals would struggle uninterruptable predictions and recommendations from completing algorithms. In either case medical education would be required to evaluate and interpret the artificial intelligence systems in healthcare.

4. PRIORITY TO PATIENT-

Parallel to the traditional clinical activity, patient safety must remain paramount and artificial intelligence ought to be developed in a regulated way in partnership between clinicians and computer scientists. However, regulation cannot be permitted to asphyxiate innovation.

5. TRANSPARENCY

External critical evaluation and transparency of technology companies is indispensable for clinicians to be in no doubt that the tools they are providing are not dangerous to use. In many respects, artificial intelligence developers in healthcare are not poles apart from pharmaceutical

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28. W.Nicholson Price II, Riska and remedies for Artificial Intelligence in Health Care, The Brookings Institution's Artificial Intelligence and Emerging Technology (AIET) Initiative (March 15, 2020. 11:30 p.m.) https://www.brookings.edu/research/risks-and-remedies-for-artificial-intelligence-in-health-care/
29. *Id.*

companies who comprise of a similar arms-length relationship with care providers. This is a practical parallel and could serve as a guide. As with the pharmaceutical industry, providing license and post-market surveillance are vital and such methods should be advanced that ensure full-proof safety.

Thus for better functioning the above solutions can prove to be a step towards better use of artificial intelligence in the healthcare industry.

ARTIFICIAL INTELLIGENCE IN HEALTHCARE- INDIAN PERSPECTIVE

India presently is in a unique position to be a driver in the artificial intelligence and healthcare space for national and international companies. With large amounts of data and a burgeoning startup community, India has the opportunity to address many health care related problems through the use of artificial intelligence. In its quest for India to join the artificial intelligence revolution, the government has also undertaken a number of initiatives to drive the adoption of artificial intelligence across the country. Yet, many obstacle still stand in the approach to widespread adoption and implementation, arising out of a lack of regulatory clarity on issues of data, design and certification and lack of reliable and ethical collection of data and the processing systems. A robust open data policy, a comprehensive privacy legislation, greater investment in artificial intelligence research and development, robust national infrastructure, equipping labour forces with the necessary skills to adopt artificial intelligence and to be prepared for the changes that artificial intelligence could bring, and a regulatory framework that ensures transparency and accountability but does not hinder innovation, are some of the measures required for the establishment of a flourishing artificial intelligence healthcare ecosystem in India[30]

CONCLUSION

Artificial Intelligence will become the stethoscope of the 21st Century provided there is a high level of co-operation between the law, technology and the medical community. Legal systems around the world will soon be faced with fundamental decisions regarding artificial intelligence systems. These systems will be prone to encountering liability for their decisions in relation to the treatment of patients; in the way similar to doctors who treat their patients.

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30. Yesha Paul, Elonnai Hickok, Amber Sinha , Udbhav Tiwari. Artificial intelligence in the healthcare industry in India, the Centre for internet and society, India (March 14, 2020 8:52 p.m.) https://cis-india.org/internet-governance/files/ai-and-healtchare-report

Watson and other similar artificial intelligence systems are already so well entrenched in, and relied upon by medical practitioners, that the option of imposing an outright ban on such systems has already passed. The only alternative at hand is that the legislators all over the globe enforce a prudent form of regulation of such systems to safeguard the rights of thousands of patients who will be exposed to the diagnosis and therapies put forward by their artificial intelligence systems.

Therefore, it is submitted that to encourage the safe and sound use of the skills these systems undoubtedly have, a new legal action which is based on enterprise liability. Regulations and laws need to be created, which shall also encompass all relevant aspects of medical malpractice, products liability and vicarious liability. Certainty, stability and accountability through far sighted and appropriate legislation will stimulate and entrench this vital new asset within the medical profession.

ARTIFICIAL INTELLIGENCE: LEGAL PERSONALITY AND LIABILITY

-Mr Mayank Sharma*

"It is the year 2023, and for the first time, a self-driving car navigating city streets strikes and kills a pedestrian. A lawsuit is sure to follow. But exactly which laws will apply? No-one knows." [1]

INTRODUCTION

Such legal conundrum is no more theoretical. Technological advancement has led to the rise of intelligent machines, capable of imitating human like intelligence, referred to as Artificial Intelligence (AI). The term Artificial *Intelligence* was coined by John McCarthy in 1956 to describe computer programs which seemingly exhibit intelligence, that is, computers perform tasks which when performed by humans require them to be intelligent.[2] Simply put, AI is a collection of technologies that combine data, algorithms and computing power to perform tasks that would require human intelligence, such as learning, reasoning, analysing, socialising etc. A distinction is made between Artificial Narrow Intelligence (ANI) which is designed to accomplish a specific task and Artificial General Intelligence (AGI) capable of all sorts of general intelligent actions. All the AI systems available today are 'narrow'. Nevertheless such intelligent machines are ubiquitous and exists in various forms such as computers, chat-bots, digital assistants, robots, autonomous vehicles etc.Over the past few years, the availability of big data, cloud computing and the associated computational and storage capacity and breakthroughs in an AI technology called "machine learning" (ML), have dramatically increased the power, availability, growth and impact of AI.[3] All this is transforming communication, businesses, healthcare, medicine, safety, transport, finance, banking, and every other aspect of human life for better. However there must be some safeguards in place to prevent the harm that these machines may cause. For example, autonomous vehicles[4] would be freely

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1. J. Kingston, Artificial Intelligence and Legal Liability(2016), in M. BRAME, & M. PETRIDIS (Eds.), RESEARCH AND DEVELOPMENT IN INTELLIGENT SYSTEMS XXXIII: INCORPORATING APPLICATIONS AND INNOVATIONS IN INTELLIGENT SYSTEMS XXIV (p. 269-279).
2. V. Rajaraman,JohnMcCarthy — Father of Artificial Intelligence, 19 Reson, 198–207 (2014).
3. OECD, ARTIFICIAL INTELLIGENCE IN SOCIETY, (2019) available at: https://doi.org/10.1787/eedfee77-en.
4. Google's driver-less cars have been test-driven on public roads for several years and have logged hundreds of thousands of miles under the brand name WAYMO.

running on roads without human aids in a few years, the trials for which are already underway and robot assisted diagnosis and surgeries are already being performed in hospitals. Today, mankind stands on the threshold of an era where AI is set to unleash a new industrial revolution, which will pervade every aspect of human life and therefore it has become imperative for the legislatures to consider its legal validity, implications and effects, without suffocating research and development.

Intelligence makes humans special among other species because it gives them the ability to think and perform various action. Each individual is responsible for their own actions because their each action is intelligently calculated and they can foresee the consequence of their actions and they are recognised in the eyes of law as persons capable of possessing rights and liabilities. For example, if a person commits a murder, he himself will be liable for his act. However, law makes an exception in case of minors and lunatics who are unable to utilise this intelligence. When it comes to machines operated by humans, liability arising out of any damage or harm caused by machines, is imposed on operator or the manufacturer depending upon the cause. This is essentially the case in, for example, car accident. But what happens in case of machines which operates with their own intelligence without any human aid. Who bears the liability in case damage is caused due to operation of such a machine? This is the case, for example, where an autonomous vehicle[5] causes an accident. Who shall be held responsible: the driver, the car owner, the manufacturer, the programmer or the AI itself? A similar problem arises in case a robot assisted surgery goes wrong. Who shall be held liable: the doctor, the hospital, the manufacturer, the programmer or the robot itself? Therefore, the Author shall, in absence of any specific law on AI, investigate the position of AI in eyes of law by comparing it with that of legal personality of corporation, ship, idol and animals and then explore the contours of liability arising out of any wrongful act or omission by AI.

LEGAL PERSONALITY: A FICTION OF LAW

The foundational principle of a legal system is that it must recognise the subjects it seeks to govern. This is done by the law recognising distinct legal units or "legal persons"[6]. The concept of legal personality constitutes an important subject matter in law, for there cannot be rights and duties without a person. To be a legal person is to be recognised by the law as a subject which

5. Autonomous vehicle refers to the vehicle being driven with the use of an AI without or minimum human interference. Such cars are commercially available such as the Tesla and Google's Waymo.
6. M. Siddiq (Ram Janmabhumi Temple) v. Suresh Das, (2020) 1 SCC.

embodies rights, entitlements, liabilities and duties.

The word "person" is derived from the Latin word *"persona"*. Literally it meant a mask worn by actors in a play to personify God, however later on it was extended to refer to the role played by humans in legal proceedings concerned with rights and liabilities. However human beings and legal person have never been synonymous. Neither all humans were legal persons nor were all legal persons humans. What or who is a legal person has changed with changing time and place. Legal person and legal personality are artificial creations of law with their own distinct features. Salmond has defined a *"person"* as, *"Any being to whom the law regards as capable of rights or duties. Any being that is so capable, is a person whether human being or not and nothing that is no so capable is a person even though he be a man."*[7]

A person in the eyes of law may be a 'natural person' or a 'legal person'. A natural person is a living human being who is a subject matter of rights and liabilities. On other hand, legal persons are 'artificial or juristic person', real or imaginary, who are treated as humans in greater or lesser degree and in whom law vests rights and duties and thus attributes personality by way of fiction. The very words "juristic person" connote recognition of an entity to be in law a person which otherwise it is not. When a legal system confers legal rights and obligations on an entity, it has determined to treat that entity as though it were a person in fact. It is a kind of pretence in which legal systems can decide to engage, regardless of whether an entity really is a person.[8] What law recognises as a legal person depends upon the prevailing social and political conditions. Roscoe Pound has rightly observed, *"In civilised lands even in the modern world it has happened that all human beings were not legal persons. In Roman law down to the constitution of Antonius Pius the slave was not a person. He enjoyed neither rights of family nor rights of patrimony. He was a thing, and as such like animals, could be the object of rights of property."*[9] On the other hand, ancient animals were regarded as subject of legal duty. Under Ancient Jewish Law, if an ox gored a human being to death, it was to be stoned and by way of further punishment its flesh was not to be eaten. Modern system of law, however give no countenance to the theory that animals can be subject to legal duties."[10] The development and advancement of societies demanded the

7. SIR JOHN W SALMON, JURISPRUDENCE OR THE THEORY OF LAW, (12th ed. 2004).
8. J.J. Brynson &M.E. Diamantis, Of, For, and By the People: The Legal Lacuna of Synthetic Persons, 25 Artificial Intelligence and Law, 273–291 (2017).
9. ROSCOE POUND, JURISPRUDENCE, (6th ed. 2008).
10. G. C. V. SUBBARAO, JURISPRUDENCE AND LEGAL THEORY, (9th ed. 2009).

need to recognise other entities as juristic person. In this regard Supreme Court observes, *"Where an individual's interaction fell short of cooperation, a larger circle of individuals was necessitated and therefore institutions like corporations and companies were created, to help the society in achieving the desired result.*[11]*"* Under the Indian law corporations [12], deities[13], idols[14] , mutt[15], mosque[16] and animals[17] are recognised as legal persons.

NECESSITY AND CONVENIENCE AS THE BASIS FOR LEGAL PERSONALITY.

The concept of legal person is an innovation of law that has expanded beyond natural persons due to historical circumstances, legal necessity or adjudicatory convenience. Conferring legal personality is an artifice, a pretence, a trick of speech or a cloak draped around entities for them to be recognised in eyes of law. For the purposes of recognising a legal person, the relevant inquiry is the purpose to be achieved by such recognition. To subject an entity to legal personality is to make it a subject of rights and liabilities. However such rights and liabilities are neither unlimited nor equivalent to those of natural purpose. Since legal personality is a creation of law to fulfil some person therefore law confers only limited rights and liabilities to such fictitious person relevant to the said purpose. The author shall enquire and analyse this purpose for conferring legal personality to corporation, ships, idols and animals and then juxtapose it with that of an AI and make a case as to why conferring legal personality would not serve any purpose.

CORPORATIONS AS A LEGAL PERSONALITY.

Corporation is a classic example of artificial legal person that gives us a great understanding of how legal recognition of an artificial person is useful for the society and a convenience for law. A corporation is a group of individuals which is treated in law, for the purpose of identification, as a single unit.[18] A corporation is a legal person having separate identity apart from its members, capable of rights and liabilities of its own and endowed with the potential of perpetual succession.[19] It can sue or be sued and can sell or buy property in its name. But a corporation is

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11. Shriomani Gurudwara Prabandhak Committee, Amritsar v.Shri Som NathDass&Ors. AIR 2000 SC 1421.
12. Solomon v. Solomon& Co. Ltd.,[1897] AC 22.
13. Moorti Shree Behari Ji v. Prem Dass and Oths.AIR 1972 All 287.
14. Pramatha Nath Mullic v. Pradvumna Kumar Mullick (1925) L.R. 52 Ind. App. 245.
15. Sarangadeva Periya Matam v. Ramaswami Goundar, AIR 1966 SC 1603.
16. Masjid Shahid Ganj v. Shromani Gurdwara Parbandhak Committee, AIR 1938 Lah 369 (FB).
17. Karnail Singh v. State of Haryana &Othrs. (2019) SCC OnLine P&H 704.
18. *Id.*at 6.
19. HAHLO & TREBILCOCK, CASEBOOK ON COMPANY LAW, 42 (2nd ed. 2000).

not merely an institution recognise by law, but a legal device for the attainment of social, political or economic ends.[20] An association in form of a corporation helps individuals to achieve what they can't by themselves. For example, a new business venture through a corporation helps in raising capital and mitigating the risks and liability. Legal personality enables corporation to enter into almost all legal relations with other persons. This has simplified the legal proceedings. In a dispute with a corporation a person proceeds against corporation only and not the number of individuals who are the members. However such immunity is not unlimited as the courts lifts the corporate veil to fasten the liability on human agents such as directors and managers when legal personality of corporation presents obstructions in protection and enforcement of public and private rights. This is because the corporation has no will of its own, will of its human agents is the will of the corporation. Corporations also help in continuous operation of trade and commerce since transfer, resignation or death of a member does not affect the functioning of the corporation. There is also a clear distinction between the assets of the Corporation and that of its members. As a result it can shield its own assets from the intervention of its owners or their personal creditors, because company's creditors are given priority over investors, this is called 'entity shielding' and it helps in ensuring investments which promotes growth.[21] Thus, legal personality of corporation serves a great utility.

This discussion leads us to the question that, what benefits could be derived by conferring AI with legal personality. The significance and utility of AI in present and the near future can hardly be disputed. AI will completely revolutionize human life providing them with better standard of living. Thus it can be argued that separate legal personality of AI, similar to that of a corporation, will limit the liability of human agency operating behind AI in form of its owner, manufacturer or programmer. This would promote research and development and application of AI in varied fields, which will provide enormous utility to humans. Once conferred with such a status of a legal person similar to the extent of a corporation, AI can be sued for its actions and the liability arising thereof just as in case of a corporation. However such a suit would not help secure any relief to the plaintiff since civil liability will requires AI to hold assets and thus the claims would fail. In case of corporate liability the court lifts the corporate veil to determine will of the human

20. E.S. MASON,CORPORATION IN MODERN SOCIETY, (2nd ed. 1967).
21. Henry Hansmann et al.,Law and Rise of Firm, 119 Harv. L. Rev. 1335 (2005-2006).

agents behind it. But such piercing of immunity would not be possible in case of AI because its actions are based on intelligent calculation and its decision is its own and not that of a manufacturer or the programmer. Moreover, the manufacturers or the programmers would often escape from their liability by blaming it on the AI. And therefore a personality similar to that of a corporation would not serve any purpose for AI to be conferred with legal personality.

SHIP AS A LEGAL PERSON

A more relatable example is that of conferment of legal personality on a Ship. Under Admiralty Law, jurisdiction can be exercised either in *persona* i.e. against the individual or the corporation responsible or in *rem* i.e. by proceeding against the ship as a legal person directly in case of any damage. Having been regarded as entirely independent from the action in persona, the action in *rem* is the action against the ship, or, more appropriately against other properties such as cargo and freight but most significantly not against its owner.[22] Jessel M.R. has aptly described the action in rem as, *"You may in England and in most countries proceed against the ship. The writ may be issued against the owner, and the owner may never appear and you get your judgment against the ship without a single person being named from the beginning to end. This is an action in rem, and it is perfectly well understood that the judgment is against the ship."*[23]

The law confers legal personality to ship for adjudicatory convenience. Conferring the ship with a legal personality allows for actions to be taken independent of the presence of ship's owner who may be in another part of the world.[24] Moreover, since most of the admiralty litigation involves international trade, the ship and the accompanying cargo and freight are highly mobile and an action against the ship serves as a security for the claim. After proceedings are initiated against the ship it is arrested, so that it does not move outside the court's jurisdiction. If no person appears in court to defend, the proceeding will continue against the ship and eventually, the ship may be sold by court order to satisfy the claim.[25] In this way conferring legal personality ensures convenience to law and effective adjudication of disputes.

Similar purpose for conferring personality on AI does not seems to provide similar convenience. A ship or its cargo are valuable assets and therefore they can be easily sold out and claims can be

22. CHRISTOPHER HILL, GUIDE TO MARITIME LAW 100 (6th ed.2003).
23. VERONICA RUIZ ABOU-NIGM, THE ARREST OF SHIP IN PRIVATE INTERNATIONAL LAW, (1st ed. 2011).
24. *Id.* at 6.
25. THOMAS J. SCHOENBAUM, ADMIRALITY AND MARITIME LAW506-507 (5thed. 2012).

satisfied. AI would lose its utility as well as its value in case of any act or an omission resulting in an injury. It would lose out on the trust of people and subsequently its goodwill and it will find no buyers and claims would remain unfulfilled. Thus, the purpose which serves basis of legal personality of a ship finds no use in case of AI.

IDOL AS LEGAL PERSONS

An idol refers to a statue created and worshipped by humans. In India, legal personality has been conferred upon Hindu idol. Legal personality vests in the idol however it does not personify the divinity behind the idol which is indefinite, limitless and omnipresent in Hinduism. Legal personality exists for the underlying pious purpose and moving or destroying the idol has no effect on its legal personality.[26] It is a result of historical process whereby the rulers and emperors donated property to Hindu shrines and as a result such shrines came to hold large area of land owned, managed and cultivated by *shebaits* and *mohunts* who were not the owner of this property. This situation presented a problem to colonial rulers and British courts and for this reason the legal concept of the Hindu idol as a juristic entity owning land evolved.[27] The legal personality of idols provided the courts with a conceptual framework within which to practically adjudicate disputes involving competing claims over disputed property endowed to or appurtenant to Hindu idols. However this purpose can't support the claim for legal personality of AI since it would not hold any property, instead it will itself be a property. Property is donated to Hindu shrines for religious and spiritual gains but there is no reason as to why someone will donate property in the name of AI. And therefore the purpose which serves as basis of legal personality of idols cannot provide similar basis for legal personality of AI.

ANIMALS AS LEGAL PERSONS

In the recent judgment in ***Karnail Singh v State of Haryana***[28] the Punjab & Haryana High Court held that the entire animal kingdom including avian and aquatic as legal entities having corresponding rights, duties and liabilities of a living person. All the citizens throughout the State of Haryana were held to be persons in *loco parentis* as the human face who could approach for the welfare of the animals. The reason for conferring legal personality is promotion of general welfare of animals, protection of threatened species of animals and their habitat. The

26. Ram Jankijee Deities v. State of Bihar,(1999) 5 SCC 50.
27. Gautam Patel, Idols in Law, 45 E&P W, 49 (2010).
28 2019 SCC OnLine P&H 704.

court held that, *"Article 21 of constitution protects 'life' which means something more than mere survival or existence or instrumental value for human beings, but to lead a life with some intrinsic worth, honour or dignity. All the animals have honour and dignity. Every species has an inherent right to live and is required to be protected by law. The rights and privacy of animals are to be respected and protected from unlawful attacks. Their Lordships have evolved the term 'species best interest'."*

Animals are an integral part of our environment. There is an increasing need to protect wildlife and ecology as more and more species are becoming threatened due to deteriorating environment. Animals share common qualities like intelligence, emotion and self-awareness, language, memory, culture, cooperation and altruism with humans.[29] Animals also play a significant role in different cultures and religions and thus are part of common heritage of humans which needs protection. Thus conferring animals with legal personality has made them subject of right rather that as objects. Animals can be directly represented in court through humans and can be a party to legal action. This would help their conservation and protection and prevent their abuse.

Similar arguments however, finds no relevance in conferring legal personality on AI. Though AI possesses intelligence however it does not share other qualities such as emotions, culture, language or altruism. It can neither experience pain nor pleasure. It is often argued that development in technology will lead to machines being self-aware, however as of present it is only a theory and remains a distant possibility. Moreover, neither AI faces any threat from humans nor it can be abused as in case of animals. Thus arguments based on human like qualities or conservation find no relevance in case of AI.

LIABILITY FOR AI

Conferring legal personality to AI seems no way out and therefore we shall explore the liability of AI under present civil liability laws. The contours of civil liability arising out of act or omission by an AI under present legal framework can be explore in two ways – firstly when AI is used as a product and secondly when AI is used as a service.

AI AS A PRODUCT

Product liability is the main basis of manufacturer's liability. A manufacturer of goods may be

29. DAVID R. BOYD, THE RIGHTS OF NATURE: A REVOLUTION THAT COULD SAVE THE WORLD,(1st ed.2017).

held liable to the person injured due to his product either on violation of a statute imposing duty on the manufacturer or under broader principles of law such as negligence and strict liability. In the absence of any statute imposing duty on manufacturer of AI, manufacturer's liability can be explored under the principle of strict liability and negligence.

Strict Liability of manufacturer

Under the theory of strict liability it is the wrongful act alone which makes a person liable, guilty mind, innocent mind or a negligent mind is immaterial. The wrong may have resulted in spite of all the care and caution exercised yet the person is held liable. Any fault or imperfection in the quantity, quality, purity, potency or standard required under law in force amounts to defect.[30] Manufacturing defects arises when a given product does not meet the standards and specifications laid down by the manufacturer.[31] For plaintiff to impose liability on manufacturer it must be proved that the product does not conform to specifications irrespective of any negligence.[32] In case of autonomous vehicles, plaintiff can proceed by proving that the product did not worked as specified by the manufacturer. For example, if an autonomous vehicle fails to detect nearby vehicles and collides then the plaintiff should be able to recover from manufacturer. Under the malfunction doctrine, a variation of the manufacturing defect doctrine, a plaintiff can show a manufacturing defect without specifically proving how it was defective.[33] A plaintiff must prove that:

(1) the product malfunctioned,

(2) the malfunction occurred during proper use, and

(3) the product was not altered or misused in such a manner so as to cause a malfunction.[34]

This can be proved by circumstantial evidence which makes manufacturer strictly liable for the defects in the products.

Negligence

A person who sustains injury to his person or property by the use, storage or consumption of a product may recover damages from the manufacturer under the principle of negligence.[35] Negligence is absence of care. A claim of negligence against the manufacture arises because

30. Consumer Protection Act, 1986.
31. David G. Owen, Manufacturing Defects, 53 S.C. L. REV. 851, 871–72 (2002).
32. *Id.*
33. Victor E. Schwartz, The Restatement (Third) of Torts: Products Liability-The American Law Institute 's Process of Democracy and Deliberation, Haftra L.R. (1998).
34. *Id.*
35. *Id.*

there is duty of care. The theory of negligence is not to be found in the state of mind but in the conduct of person which is to be derived from his external behaviour. The plaintiff in a products liability case may recover damages if he can establish the three essential elements of negligence liability:

(1) there was a duty on the manufacturer,

(2) manufacturer failed to the discharge that duty; and

(3) resulting injury or damage had proximate connection with the breach of duty.[36]

The plaintiff may bring an action against manufacturer for failure to carefully design, manufacture, process, inspect, test, disclose known defects, warn of known dangers, or adequately instruct in the use of the product.[37] Therefore, the manufacturer can be proceeded against in case of damaged caused due to manufacturing defects in AI, under the law of negligence. The manufacturer owes duty of care not only to the consumers but also third parties since privity of contract does not holds good and manufacturer is liable to every person injured as a natural and probable cause of its use.[38] At the same time operators will also have to discharge a range of duties of carerelate to the choice of technology, in particular in light of the tasks to be performed and the operator's own skills and abilities, the organisational framework provided, in particular with regard to proper monitoring and maintenance, including any safety checks and repair.[39] Failure to comply with such duty would trigger liability against operator similar to the liability of operator in case of traditional machines.

AI AS A SERVICE

Vicarious Liability of Master

Under the principle of vicarious liability, for the wrongful acts on one person, another can be held liable. Based on this principle masters are liable for the acts of their servants done in the course of their employment. The legal basis is that a servant carries on the business of master with his express or implied authority and agrees to abide by the lawful orders and direction of the master in respect of certain work to be done.[40] Therefore what follows is that if someone can be

36. Donald M. Jenkins, The Product Liability of Manufacturers: An Understanding And Exploration, Akron Law Review 4 (1971).
37. *Id.*
38. Donoghue v Stevenson, [1932] UKHL 100.
39. European Commission's Expert Group on Liability and New Technologies, Liability for Artificial Intelligence and other Emerging Digital Technologies, available at: https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupMeetingDoc&docid=36608.
40. Dr. VEENA MADHAV TONAPI, TEXTBOOK ON JURISPRUDENCE, (2nd ed. 2010).

held liable for the wrongdoing of some human helper, why should the beneficiary of such support not be equally liable if they outsource their duties to a non-human helper instead, considering that they equally benefit from such delegation?[41] Thus when an AI is employed by the employer to do certain task any liability arising out of the wrongful act shall fall upon the employer who derives benefits from the servant. For example, a company employing autonomous vehicles for cab services shall be held liable for any accidents that may happen during course of employment. The basis of such a liability lies in the following principles:

(1) *Qui facit per alium facit per se:* it means that the one who does an act through others is said to have done it himself. A servant is engaged by the master and it is the master who decides what to be done and how it is to be done.

(2) *Public Policy:* Master's liability rests on public policy which demands that there ought to be some remedy for the injury caused and since the master is in a better position, the liability falls on him.

Therefore it seems reasonable that in case the AI is provided as a service than any liability arising out of any wrongful act to the consumer or any third party shall fall upon the master under the principle of vicarious liability for he derives the benefit from the work of such servant and is in better position to pay the damages.

CONCLUSION

AI has the potential to change our societies and economies for better. It will completely revolutionize the way we interact with machines. This will lead to a number of legal, moral and ethical dilemmas. And therefore we must prepare for the challenges that we will be faced with in the near future. Our legal systems were designed to regulate human conduct but now we need laws to regulate the conduct of intelligent machines. These machines cannot be a subject of rights and duties and cannot be recognised as a legal person because neither can damages be recovered from them nor can they be prisoned. Thus we will need to broaden our principles of liability to make the human agents behind machines liable. Strict liability of manufacturer under the product liability regime should provide plaintiff with damages for the defects in the AI. Once

41. *Ibid.*

harm is proved by the plaintiff the burden of proof falls upon the manufacturer to show that required level of safety standards were maintained. Similarly under the law of negligence the operator should be held liable for failure of duty of care in terms of maintenance, safety checks and repairs and the manufacturer should be held liable for failure to carefully design, manufacture, process, test, disclose known defects, or adequately instruct in the use of the product. Consider an autopilot system for airplanes manufactured by X and sold to Y. The autopilot system will lead to crash if not turned off in certain circumstances. Here X has the duty to inform Y of risk and the design and will be held liable for any injury caused. At the same time Y has the duty to carefully operate the system and arrange for proper training for pilots and in case of failure of this duty it shall be strictly liable. If harm is caused by AI when used in a way similar to that of human help, the liability for making use of the AI should fall upon beneficiary similar to existing vicarious liability regime of master and servant. The standards to assess the performance of AI should be same as that in case of a human servant however once AI outgrows human intelligence then the standard should be determined by comparing it to similar available AI. Consider a hospital performing surgery using an AI driven robot. Even if hospital fulfils the reasonable duty of care, for any harm caused by the robot which many not have been foreseeable, the hospital should be liable as per the principle discussed.

Both Civil and Criminal legal system will be faced with a number of challenges with the further development of technology. We will have to redefine our legal principles so as to accommodate for machines of the future or will have to come up with new principles. Whichever is the case, the law and the legal system is sure to undergo drastic changes.

LAWS VS. LAWS: MAPPING AUTONOMY OF KILLER ROBOTS*

- Mr Omvir Singh*

INTRODUCTION

"Change is the law of life, those who look only to the past or the present are certain to lose the future."

- John F. Kennedy

Human history has been a witness, time and again, to the deftness of the iron-clad combat fighter sitting confidently on a horse driving the army with armed subordinates into the battleground. Though, with the passage of time, the interminable and catastrophic annals of war operations acclimated themselves to the progressively advancing nature of the battle, which led to gradual increments in the mechanization along with increased effectiveness attributable to elevated mechanization. In the long run, the scrabble of combat supremacy was lost by the horse warrior anddeftly surpassed by ranged weapons which could inflict perilous injuries over larger distances in comparison to the hand-to-hand confrontations. These projectile instruments of assault changed over period from out-dated spears and bows and arrows to the new-age firearms that came into existence after the invention of gunpowder.[1] Consequentially, war at distancebecame a reality with the arrival of these ranged weapons.

In recent times, the world has in reality been experiencing a weapon revolution wherein combatis becoming increasingly covert, atleast in the method of its operational command, if not with respect to its visibility on the battle front. This continuum phase of mechanical and technological advancement in the weapons has fomented several imperativeethical, political, social, and legal debates. For quite a while, the discussion on military technologies was transcendently centred on armed drones which seem to operate regularly all around the air spaces of Afghanistan, Yemen, and other countries irrespective of the host State's consent.[2] With the increasing investments in the innovation of weapons, the genesis of the next phase of unmanned warfare—lethal autonomous weapon systems (LAWS)—has become certain, unless an embargo can be placed on their developmentor they can be controlled in the very least

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1. JOHN KEEGAN, A HISTORY OF WARFARE 04-05 (Penguin Books 1993).
2. Ashley S. Deeks, Consent to the Use of Force and International Law Supremacy, 54 HARV. INT'L L.J. 1, 21 (2013).

through global measures in the near future. The self-determination characteristic of LAWS' in the vital functions of choosing and striking targets collaborated with concordant machine learning helps in distinguishing them from armed drones. Furthermore, the manifestation of unpredictable circumstances in battle zones makes upfor a possibilityfor LAWS to act in a manner which cannot be anticipated, thereby making themthe weapons of extreme contention.While debates on defining LAWS are augmenting, they still cannot seem tobe limned by a universal definition.[3]

DEFINTION OF AUTONOMOUS WEAPON SYSTEMS

An attempt was made by U.S. Department of Defence in its 2012 mandate to define Autonomous Weapon System (AWS), wherein AWS was defined as "a weapon system that, once activated, can select and engage targets without further intervention by a human operator. This includes human-supervised autonomous weapon systems that are designed to allow human operators to override operation of the weapon system, but can select and engage targets without further human input after activation."[4] They are otherwise called 'Robotic Weapons or Killer Robots.[5]' Basically, in order for the weapons to be classified as LAWS they must correspondto the two-fold criteria of being autonomous and de-facto out-of-the-loop in their vital functions,after they have been actuated through human interference regardless of whether humans actually remain on-the-loop in the master plan.[6] Therefore, a weapon can be categorized as autonomous, if the depiction of its tasks is expansive and estimatedand it has the capability of using its computerized artificial intelligence (AI) while deciding on independent courses of action which include a weapon's vital functions after gathering and processing information from its operational environment.[7] Interestingly, technology used in LAWS resembles with the technology that is being currentlyused for the development of autonomous cars using AI.[8]

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3. Michael Horowitz, Why Words Matter: The Real World Consequences of Defining Autonomous Weapons Systems, 30 TEMP. INT'L & COMP. L.J. 85, 92 (2016).
4. U.S. Department of Defense Directive No. 3000.09 on Autonomy in Weapon Systems (2012).
5. HRW, "Losing Humanity: The Case against Killer Robots" (Human Rights Watch, 2012), https://www.hrw.org/report/2012/11/19/losing-humanity/case-againstkiller-robots.
6. ICRC, Convention on Certain Conventional Weapons (CCW) Meeting of Experts on Lethal Autonomous Weapons Systems (LAWS) 11-15 April 2016, Geneva.
7. VINCENT BOULANIN&MAAIKEVERBRUGGEN, MAPPING THE DEVELOPMENT OF AUTONOMY IN WEAPON SYSTEMS 90, 92 (Sipri 2017).
8. Adrianne Jeffries, Only Five Countries Actually Want to Ban Killer Robots, VERGE, May 16, 2014 at 06.

TECHNOLOGICAL SHIFT TOWARDS 'LAWS'

"Technology is always a two-edged sword. It will bring in many benefits, but also many disasters."

- Alan Moore

With the technological advancement towards LAWS, the countries are moving from near-autonomous defensive systems to offensive systems. Autonomous Defensive Systems do not effectively seek out targets but rather respond to preordained dangers, whereas, weapon systems which are Offensive in nature, conversely, can be deployed and used anywhere and do not necessarily shield an object or target. Offensive weapons systems can "hunt, recognize and detect a target without human intervention"[9]. It is a belief of the policymaker that LAWS as Artificial Super Intelligence (ASI) empowered machines are going to affect all aspects of the human experience 'from medicine to driving automobiles.[10]' This march towards greater autonomy therefore seems to be irreversible. This introduction of advanced AI has led to the increasing likelihood that winning the AI race might end up being incompatible with using any safety method which causes a deferral or limits performance.[11]

IMPACT AND CHALLENGES OF 'LAWS'

The debate with respect to LAWS generally revolves around a few propositions: ethical and legal issues bolstered by NGO's; military debate in relation to keep up prevalence in the battle front by countering the enemy's autonomous weapons; political debate relating to the abatement of losses during an armed conflict; and debate encompassingtechnological restrictions as AI is not completely developed at this point;[12] and following all these,there is another important issue of cost.

ETHICAL AND LEGAL ASPECTS

The debate on ethical and legal terms about weapons is not in reality any new. There is discourse going on about these within the international community from the period of Spartan Army's objectionof long-range weapons to the usage of submarines and chemical weapons in recent times. The international community either acknowledges or wants to prohibit yet another new

9. John Markoff, Fearing Bombs That Can Pick Whom to Kill, N.Y. TIMES, Nov. 11, 2014 at 09.
10. Alex Davies, IBM's Watson Lets you Talk to your Self-Driving Car, WIRED, June 16, 2016 at 05.
11. Nick Bostrom, Strategic Implications of Openness in AI Development, 1 OXFORD L.J. 733 (2016).
12. Rodney Brooks, Artificial Intelligence is a Tool, Not a Threat, RETHINK READNESS BLOG (Nov. 10, 2014, 10:04 AM), http://www.rethinkrobotics.com/blog/artificial-intelligence-toolthreat/123323158.html.

technology depending on the assertions mentioned underneath. The argument for restricting LAWS is based on the main concern thatethical and legal principles cannot be developed by a machine or machine programme. The subsequent concernis that if humans will be excluded from the system, then in that case it will turn next to impossible to hold anyone accountable, which is ethically wrong. In simpler terms, a machine can never be trusted entirely owing to its inability to comprehend the value of human life. Another hugeconcern is that the possibility of loss of lives of fewer soldiers might actually bring about more wars or clashes. The expansive usage of drone strikes in Afghanistan by the United States is a valid example. In April 2013, a United Nations (UN) special report affirmed that there is a need for the member states to step up to the occasion in prohibiting these weapons,[13] and that they should not get involved in the development or deployment of these weapons since the weapons are violative of the 'Principle of Distinction' (jus in bello) and 'Principle of Proportionality' *(jus ad bellum)*.[14] Further, it is contented that LAWS should notbe usedirrespective of their ability to meet the requirements of International Humanitarian Law (IHL). The principles of distinction, proportionality and military necessity are used by IHL while governing armed conflict, which have already laid human judgement as a prerequisite through an obligation on states to not designate the capacity to initiate the usage of lethal force to unaided machines or automated processes.

Article 35 of the Additional Protocol to the Geneva Conventions (hereinafter, Additional Protocol I) aims at prohibiting the usage of weapons that 'are of a nature to spawn widespread injury or unnecessary suffering.'[15] Likewise, it bans weapons which are planned, or might be anticipated to cause sweeping, long-term and serious damage to the environment. Therefore, this rule prohibits weapons that owing to their character might cause wide-spread,unpredictable and unclassified harm or through their 'expected' use might have long-haul aftermath.

Further, the deployment of a weapon generally determines its legitimacy as well. In regards to this, Article 36 of the Additional Protocol I to the Geneva Convention of August 12, 1949 provides the legal framework for assessing a new weapon, which is largelysubject to two rules. The first one is to analyse if the weapons are indiscriminate or not. The next assessment will be to determine whether they would inflict unnecessary pain or not.[16] Basically, the primary

13. Winson Campbell, Security Council Adopts First-Ever Resolution Dedicated to Question of Small Arms, Light Weapons, N.Y.TIMES (Sep. 26, 2013), https://www.un.org/press/en/2013/sc11131.doc.html.
14. *Supra* note 11.
15. Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), Art.35 (1949).
16. *Id.*

alludes to the prerequisite that the general population and military targets must be recognized and distinguished during the onset of an armed battle. Whereas the subsequent one is pertaining to the limits which a military can be allowed to cross in order to achieve its aims –though, civilian loss is ought not to transcend the military gains. Moreover, the weapon systems and their usage are required to meet the 'dictates of public conscience', in accordance with a provision in the First Protocol, known as the Martens Clause.[17] Accordingly, numerous scholarscontend that in warfare, an embargo should be put on LAWS permanently and their deployment ought to be limited since machines can never build up the degree of empathy which human beings have as machines intrinsically lack with the capacity of having such emotions.

Many countries cite Ottawa Treaty which is a Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti- Personal Mines and on their Destruction, otherwise called the Mine Ban Treaty as the precedent for pre-emptive limitation on LAWS. Moreover, many NGO's working on the legal aspects of AWS lobby for the total prohibition on these weapons.[18] EvenInternational Committee of Red Cross (ICRC) has indicated that these systems come under the IHL's legal umbrella; even though, some LAWS-specific regulations are still required.

POLITICALASPECT

LAWS can be hacked just like all other computer systems, which would further make it immeasurably difficult to quantify or decide with respect to who ought to be held liable for the harm inflicted since it would not be evident who was verily or effectively handling the machine. Additionally, the world would not become peaceful after the possibility of a 'riskless' war. The other difficulty with LAWS lies in the steps to taken up by the policy development. After taking into consideration the time required for consultations and accord building, it might be safe to presume that it might take a couple of years by the policy makers, before materialising and coming into effect with any regulatory instrument. This implies that AI revolution which will promote the proliferation of LAWS is most probably not going to happen at a rate that policymaking might be able to keep up a pace with. Contrarily, people backing LAWS set forward numerous assertions with regards to giving reasons which makes their development

17.Rupert Ticehurst, The Martens Clause and the Laws of Armed Conflict, INT. REV. OF RED CROSS 317 (1997).
18. ROBIN GEISS, THE INTERNATIONAL LAW DIMENSION OF AUTONOMOUS WEAPONS SYSTEMS06 (Cambridge, 2015).

inevitable. Deployment of drones in Afghanistan by the USA is the most cited example. With the general publicgetting more careful about conflicts, states are becoming hesitant on a constant basis to send their people to strife zones for harmony building and other objectives. Besides, soldiers are regularly getting accused of carrying out atrocities such as war crimes, specifically rape and sexual assault[19]- the LAWS would not commit these unlawful acts. Hence, such autonomous systems are constantly being viewed as a mature innovation, hanging tight for their final-stage development in AI.

SECURITY ASPECTS

The most usually referred security concerns find theirbase in the argument that these autonomous weapons come with the added prospect to augment the acceleration of warfare and the possibility ofpatronizing the war, largely because of the guarantee of considerably decreased military casualties in the war. The weaponsmight ignite and promote races for arms development. Moreover, these weapon systems can be attained and operated by non-state armed groups, including terrorist organisations or rogue states. Additionally, existing laws on warfare, controls, guidelines and regulations are been sabotaged by these systems. No particular hard-to-create materials are required by LAWS, unlike the nuclear and atomic weapons, which makes their monitoring even more strenuous. There are predications that owing to their easy accessibility, 'autonomous weapons of today will turn into the Kalashnikovs of tomorrow.' We have already seen an example of this in the war on the Islamic State of Iraq and Syria (ISIS), where Russia, Iraq, US, Turkey, and Syria used semi-autonomous weapons like drones.[20] Consequentially, the evolution of LAWS would ultimately prompt advancements in unsymmetrical warfare attributable to clear-cut benefits to the user. A report on 'LAWS under International Law', made by the Geneva Academy focuses on the necessity for leaders to consider the balance between advantages and disadvantages of using LAWS for a given operation. Potential advantages involve "the absence of emotions like fear, vengeance, or self-interest which may prompt results that are generally less harmful." However, lack of emotions may be detrimental in certain circumstances since "autonomous weapon systems lack positive

19. Elizabeth F. Defeis, U.N. Peacekeepers and Sexual Abuse and Exploitation: An End to Impunity, 7 WASHINGTON UNIVERSITY GLOBAL STUDIES LAW REVIEW 02 (2008).
20. Michael C. Haas & Sophie-Charlotte Fischer, The Evolution of Targeted Killing Practices: Autonomous Weapons, Future Conflict, and the International Order, 38 CONTEMP. SECURITY POL'Y 281, 283 (2017).

human emotions, such as compassion or mercy."[21]

ECONOMIC ASPECTS

Contrasting aggregate costs of armed force troops to LAWS is hard. For this, we can take the case of United States of America wherein multiple general patterns exist, like that of 2012, when the Under Secretary of Pentagon, Robert Hale shared that a regular soldier in Afghanistan costs nearly USD 850,000 per year.[22] In 2012, the Military Retirement Fund paid a total of USD 51.7 billion a year to a soldier.[23] It is estimated that if any armed force replaces individuals with robots, then the expense might be reduced.Back in 2002, the expense incurred in selecting and preparing a Marine trooper was USD 44,877[24]. This expense addresses the value point for acquiring LAWS that will go on to specially replace individuals in the armed forces. Additionally, military workforce has enrolment, training, pay, rewards, housing, and clinical costs which are collected on a yearly base. Moreover, when a soldier leaves the military, there is an expected expense of handicap along with retirement pay. In case if a soldier loses his life, there are internment, security, and stipend instalments to be paid as well. The primary expenses that are traded over in the case of induction of LAWS into the military would involve basic preparation or production, feeding (gas or electric power), and clinical (support). Further, robots have addedhigh costs ofinventive work for upgrades that are not required in case of a human soldier. The real-time opportunity cost for exchanging robots with human beings could be better comprehended with the help of an intensive research about the expenditures. Though, in this regard it can be concluded that an exhaustive report taking a gander at the costs comparisons between a robot and individualmight highly tilt the discussion in favour of LAWS.

RECOMMENDATIONS & SUGGESTIONS

A varied set of complex issues have been identified particularly with the developmental, operational, legal, and ethical aspects of LAWS. A significant number of these issues are already

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21. Charles Christian, Autonomous Weapon Systems under International Law, GENEVA ACADEMY L.J. 04, 05 (2015).
22. Larry Shaughnessy, One Soldier, One Year: $850,000 and Rising, CNN SECURITY CLEARANCE BLOG, (Feb. 28, 2012, 11:13 PM), http://security.blogs.cnn.com/2012/02/28/one-soldier-one-year-850000-and-rising/1445227.html.
23. George Reich, Costs of Military Pay and Benefits in the Defense Budget, CBOBLOG (Apr. 12, 2012, 02:46 PM), https://www.cbo.gov/sites/default/files/112th-congress-2011-2012/reports/43574militarycompensationone-col.html.
24. Diana Olick, An Army of One Carries a High Price, NBC NEWS, (Oct. 21, 2002, 10:31 AM), http://www.nbcnews.com/id/3072945/t/army-one-carries-highprice/#.WkTVSNKWYs4.html.

on the plates of competent government, industrial organizations and several NGO's. This segment offers recommendations to facilitate the evolutionary way for the future of certainkey issues influencing the usage of LAWS.

POLICY REQUIREMENT

UN and the ICRC should work towards making a LAWS policy which shouldaim at the inclusion of all unarmed and unmanned platforms capable of causing damage to people or property in case they happen tobreakdown or malfunction or on the off chance, their command and control interface-link is lost. Further, the policy should forsake discrete definitions which pigeonhole systems into classes of autonomy and should rather define the characterization of autonomy. Accordingly, a framework should be laid which considers the autonomous elements of a system and how they may change over the time-span of a given mission. Hence, it is increasingly important to clearly distinguish when autonomous functioning of the unmanned system is planned to occur (intentionally autonomous) along with as to how and when it can occur unintentionally or accidentally (either through normal malfunction, obstruction, or attack by the enemy on the system or its links).

The policy should continue to require measures which permit the exercise of human judgment and control in the operations and tasks of LAWS. This requirement should be further expanded to incorporate greater accentuation for commanders and planners to consider the manner in which the extent of such human control may differ during a given operationalong with the possible strategic implications of any fully autonomous mission segments. Additionally, the development community of LAWS should likewise underline how there is scope for autonomy and human control to differ during operations and design systems that are fault-tolerant incorporating 'fail safe' or 'safeguard' modes for all mission segments, and not only for those which are designated as'intentionally autonomous'. An ethical code of conduct for work on LAWS comparable in nature to that proposed by NGO's such as Human Rights Watch and International Human Rights Council (IHRC) should be developed and promulgated by the development community. All parties who are involved with the development and operation of LAWS should be required to guaranteethat the human dimension is unequivocally emphasized and observed in doctrine, organizations, and procedures. Leaders and planners ought to be

careful enough to guard against any kind of the 'Jupiter Complex' (similar to World War II) which may arise at the strategic level. Preparations should be made by the developers and operators in order to guard against any unfortunate disengagement at the strategic and operational levels.[25]

STATE RESPONSIBILITY

The policy recommendation was in regards to risk management and harm prevention; another important recommendation which needs to be considered is what will happen if something goes wrong on the battle front. According to the general principles on state responsibility,[26] only the liability for all such violations of IHL can be imposed on a state which can be attributed to it. Basically, state liability is imposed based on two essential elements, namely, the attribution of conduct and a violation of international law.

a. Attribution of conduct

There are no specific legal challenges which exist regarding the attribution of acts which are committed by LAWS. Liability can be decided based on the clearly established rules of attribution, till the time the decision pertaining to their deployment has been made by the individuals.[27] It is an age-old and widely-accepted rule in the customary international law (CIL), which was laid down under Article 3 of the 1907 Hague Convention (IV) and reiterated again in Article 91 of the Additional Protocol I of the Geneva Convention which enunciates that states are liable for their state organs, including the liability for "all acts committed by persons forming part of its military". This rule applies by lieu of CIL as affirmed in the ICRC Customary Law Study,which has indicated that "a State is liable for violations of IHL attributable to it, includingviolation(s) committed by the state organs, including its armed forces.[28]" Hence, supposedly if a member from the military, which is a state organ, of state X takes a decision to deploy an AWS for a combat mission, all the activities which will be carried out by that system are going to be attributed to the State X. The mere fact that the system is working under its autonomous capacities does not have any effect on this evaluation.

b. The commission of an internationally wrongful act

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25. Thomas K. Adams, Future Warfare and the Decline of Human Decision-making, 35 PARA L.J. 57, 71 (2002).
26. Articles on Responsibility of States for Internationally Wrongful Acts, Report of the International Law Commission, 53rd Session, UN Doc. A/56/10 (2001), 43–59 (noted in GA Res. 56/83, 12 December 2001, UN Doc.A/RES/56/83 (2001)).
27. *Id.*
28. ICRC Customary Law Study, Rule 149.

Rules of IHL are considered to be violated when their objective prerequisites are met with. According to the Commentary of theInternational Law Commission (ILC), whenever any particular prerequisite of a mental element with respect to the primary obligation is absent, then in that case, it is only the act of the State which matters, entirely independent of anymens rea.[29] In such instance, no specificissues emerge. This can foster a conclusion that whenever an AWS violates such a rule and the act can be attributed to a state, the state liability sets in. In this way, establishing state liability for the improper conduct of AWS will turn out to be a moderately simple and clear exercise,irrespective of one's opinion that all or most of the prohibitionsprovided in IHL do not comprise of such an 'intent' or 'fault' element. For instance, in relation to Additional Protocol II of the Geneva Convention, it was as of late held that: "there is no 'intent' requirement in relation to the restriction under APII, implying that State responsibility is to be evaluated 'objectively' instead of 'subjectively': the intent or advertence of pertinent State authorities or agents is not relevant to an appraisal of whether a violation of APII has taken place."[30]

Though, an element of 'fault' (negligence, recklessness, or intent) is required as a prerequisite by some primary rules of IHL in order to be considered violated. In such an event that the rule in question happens to be a rule which mandates an element of 'fault', it might in reality become extremely troublesome to establish the state liability for the robotic activity 'violating' that rule. Even these scenarios will not pose any form of hardships in certain specific situations, such as in a case wherein the military commander has acted with the definite *mens rea* to break a rule established by the IHL.Hence, if during an armed combat a military commander deliberately programs the AWS to assault civilians, it is more than obvious that the commander shall be held individually liable for perpetrating a war crime.Similarly, the State for which the commander was acting as a State-organ shalllikewisebe held liable for the violation of the laws of armed conflict.[31] Basically, no distinction should be made between a member of the military shooting a civilian or an individual soldier programming an AWS to shoot at civilian or non-military personnel.

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29. ILC Commentaries, Art.2, para. 10.
30. P. Sands et al., The Lawfulness of the Authorization by the United Kingdom of Weapons and Related Items for Export to Saudi Arabia in the Context of Saudi Arabia's Military Intervention in Yemen, SAFERWORLD, (Dec. 11, 2015, 06:22 PM), http://www.saferworld.org.uk/resources/view-resource/1023-the-lawfulness-of-the-authorisation-by-the-united-kingdom-of-weapons-and-related-items-for -export-to-saudiarabia-in-the-context-of-saudi-arabias-military-intervention-in-yemen.
31. *supra* note 26.

STRICT LIABILITY REGIME

A liability regime which does not need any proof of 'fault' ('strict liability') or which does not alter the burden of proof('presumed liability') should conceivably be designed effectively for LAWS. Strict liability would basically withdraw that the element of 'fault' (intent, negligence, orrecklessness) from consideration. As soon as the risks integral in unpredictable system behaviour are realised, the responsibility is triggered consequently. The 'thought' of programmer, operator, and officer in chargeor state behind the operation or their 'expectation' of what the system may actually do becomes immaterial, under such a strict liability regime. Only the action of the LAWS matters in such situations. It becomes entirely irrelevant whether this was due to technical glitches of its sensors, unexpected or external impedance, ever-changing ecological conditions, programming faults, any other flaws, or the autonomously determined outcome of the system's algorithms.

It is very common to find strict liabilityregimes whilehandling processes involving high intricacies andhazardous activity which makes it intrinsically hard to distinguish and prove what precisely went wrong. Product liability regimes mostly include strict liability on the domestic levels. The relevant examples are regulations such as the ILC Draft Principles on the Allocation of Loss in the Case of Trans-boundary Harm Arising out of Hazardous Activities,[32] the Outer Space Treaty, 1967 and the Space Liability Convention,1972. Article VII of the Outer Space Treaty imposes a liability on each State Party that dispatches an object into outer space for damage that is caused to other State Parties. The contemplations which prompted for this liability regime to be adoptedwith regards to Outer Space Treatyare in lot many mannerslike the contemplations with respect to LAWS. During the 1960's, when the Outer Space Treaty was been drafted and adopted, the outer space technology was viewed as incompletely understood and was considered to be a high-risk and highly complex undertaking with possibly unpredictable results. It is argued that the very same case applies to LAWS at the present time. Further, the civil usages of Autonomous Technologies are presently being examined under the strict liability regimes domestically. One of the recent examples is that of the Swedish

32. ILC Draft Principles on the Allocation of Loss in the Case of Trans-boundary Harm Arising out of Hazardous Activities, Principle 4 (2004).

automaker Volvo which has vowed to be 'entirely responsible' for any mishaps which will be brought about by its self-driving innovation.

A strict international liability regime would not only help with overcoming particular accountability challenges in relation to the high-risk, uncertain and profoundly complicated activity, but would also create strong incentives to deploy LAWS warily. Additionally, it would open up opportunities for them to take weapons surveys and strides towards risk minimisation and damage prevention more seriously. Further, it would also help in programming LAWS 'conservatively', and in domestic implementation of strict product liability regimes.

LAWS would require a more nuanced liability regime than Outer Space Treaty explicitly customized for the setting of a military conflict. Eventually, the causation of specific damages, for instance a military target's annihilation, is unmistakably permissible amidstwarfare and fails to fosterstate liability of any kind. One could hence imagine an increased liability regime wherein presumed or strict liability can be imposed in some specific situations or with regards to some specificprinciples. Though, this cannot be done in all situations and not in terms of the general causation of harm and destruction, or comparable to the whole assemblage of rules containing the laws of warfare. Such an increased liability regime which consolidates strict liability with different types of liability might be most appropriate in order to give response to the variousrisks and unpredictability's ingrained in LAWS that may be deployed in immeasurably various contexts.

CONCLUSION

Even though machines are already used in the military operations of the present day, still it is extremely hard to conceptualise the dangerous effect of these LAWS.It is almost certain that after the up-gradation of present day's 'war machines' to entirely autonomous ones, leaders may get increasingly inclined towards the usage of lethal force. Henceforth, it is important to get answers to the critical, legal, moral and ethicalquestions pertaining to fully autonomous weapon systems before letting anyone develop them. These questions should also review the possibilities of changes which might be required to be made in the military conventions in accordance with the development and advancement of LAWS. In addition, leaders shouldactually request more research into theconceivablerepercussions that might arise owing to the deployment of LAWS. Armies should also think about the effect of deploying LAWS on the battlefront, particularly, with regards to civilians.

There is undoubtedly huge potential in innovation to make conflicts more secureand reduce blood-shed, which can altogether change the nature of weapons which are used in armed conflicts. Notwithstanding, this potential must becapitalized on only for such duration for which a pledge can be made on our part to adequately regulate new weapons. LAWS must be used to only serve humanitarian purposes and assurances should be made that these machines would not be moved to be used for military purposes. A comprehensive global consensus is required for the same. It has become a common practice for states to pursue their self-interest only in matters of international affairs. Regardless of international law, countries keep on developing nuclear weapons to achieve their various objectives such as security, political and military goals. Likewise, LAWS also grant major states a high ground in conflict, which will make the countries to continue with their development. Therefore, their materialization may in reality cause an application and responsibility gap as discussed above in the paper, but it is indeed bridgeable with the innovative application of the laws that we have now alongsidethe emergence of new, progressively refined and the pertinent ones.

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'Promoting Good Practices and Standards'

The Indian Police Journal

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October-December 2020

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IPJ

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EDITORIAL MESSAGE

2020 has been a year of revisiting our priorities. The Corona pandemic has brought health, hygiene and environmental issues back to the fore. As we usher in 2021, with the rolling out of the vaccines, we also realise that hope will surmount darkness and despair, no matter what the odds are.

For the Indian police it has been a year of realising again that public service is its raison de etre. As corona warriors, our police forces have shown that they are committed to the public. I pay homage to the Police officers who made the supreme sacrifice of laying down their lives in the service of the nation. I am proud of the name earned by police in winning the hearts of the public while fighting the pandemic together. The BPR&D has published a compendium of good police work during the corona pandemic.

As always, it is a pleasure to introduce the latest edition of the IPJ. Our eminent contributors have authored several well research articles on various subjects and I am happy to introduce them.

The article on "Effects of covid-19 lockdown on psychological health", touches upon many aspects of policing as frontline corona warriors in khaki. It elaborates upon how a number of health care and clinical institutions have opened online to provide services for affected people to battle the deadly virus.

In the article "Ways of coping and mental health among male and female police constables", Dr. Rinki and Dr. Nitesh Kumar Jha focus on how the constabulary is struggling with mental health issues and challenges.

The article "Changing forms of cyber violence against women and girls", explains how cybercrimes are continuing in changed forms and the required police response to contain them.

The article, "Online radicalization: Threats, challenges and proactive measures", provides deep insights into the factors of poverty, disadvantage, social exclusion, extremist influences and access to online resources, which lead to vulnerability and conversion to extreme views and radicalisation.

Arul Verma expounds the important role of police in curbing the drug menace among children utilizing provisions of Juvenile Justice Act.

In a well-researched article, DG NCRB, Shri Ramphal Pawar & his colleague Sanjay Mathur, and Dr. Prasoon Gupta explain the "Crime Multi-Agency Centre", a platform to share information on crime and criminals on a real-time basis.

I hope that you will find these articles useful and would also continue contributing your valuable suggestions for further raising the standards of the IPJ.

I wish the readers, a very Happy New Year and hope that the year 2021 brings joy, success and good health.

Happy Reading!

(Editor-in-Chief)

Crime-Multi Agency Centre (Cri-MAC)

A Platform to Share Information on Crime & Criminals on Real-Time Basis

Ram Phal Pawar, IPS[1]
Sanjay Mathur, IPS[2]
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ABSTRACT

The Cri-MAC application is designed and developed by an in-house team of NCRB to enable smooth online sharing of crime and criminal data in the form of real-time alerts among various disjointed police units across the country, keeping in mind the ease of use.

KEYWORDS

Cri-MAC, crime alert, real-time alerts, crime prevention, Hue and Cry Notices, jail breaks, broadcast crime information, high alert, police communication

INTRODUCTION

Detection of crime is one of the important functions of the police. Criminals adopt new technology and techniques of committing crimes. Gathering clues from the scene of crime without any delay and dissemination of relevant information to the neighboring police stations plays a very important role in detection and apprehension of criminals. Conveying information to other states in case of a possible involvement of an interstate gang is also extremely important. Crime and Criminal Network & Systems (CCTNS) is a key e-governance project of Government of India. It facilitates entry of data related to crime reported at police stations in CCTNS including details of scene of crime, accused involved, property seized, and final report filed in the court. Under CCTNS project, search facility for searching person of interest and property of interest has been provided at the state level as well as the national level. NCRB has played a very important role in the implementation of this project. As on 31st May 2020, out of 16050 Police stations, CCTNS has been implemented in 15214 Police stations in the country. CCTNS has created a backbone for sharing Crime and Criminal related information across the country.

Taking one step forward, NCRB has recently launched Cri-MAC application for flashing alerts on important matters of crime and for inter-unit communication among disjointed police units across the country. The concept

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of Cri-MAC was coined during the DGsP/IGsP Conference held at Tekanpur (MP) in January, 2018 on the lines of Multi Agency Centre (MAC) of the Intelligence Bureau. It has been integrated with the CCTNS application at the backend so that related FIR details can be fetched directly from the system on click of a button. The application can be accessed securely through a link provided in the national Digital Police Portal (https://digitalpolice.gov.in) by Police and Prison officials by using ICJS user credentials already existing with them.

There are seven scrolling windows for sharing information on important and critical crime events such as jail breaks, major heinous crimes, important seizure and recoveries, jail releases of notorious criminals, major human trafficking cases, information on wanted/arrested notorious criminals and High Alerts like Hue and Cry Notices (Screenshot1). Police officers can upload information by selecting a crime category (window), simply by entering relevant information (gist) available with them (Screenshot2). They can also upload attachments such as photographs and other documents.

There is a provision to make searches - FIR-based (Screenshot3) and text-based (Screenshot4) – in different windows over legacy data. Further, for operational or logistic communication needs, the application offers two modes of communication: E-mails (Screenshot6) can be sent to any Police Station along with attachments after selecting state, district and police station names from the drop-down menu; and SMSs (Screenshot7) can be sent to any police personnel after selecting state, district and police station names from the drop-down menu.

SALIENT FEATURES

Using the Cri-MAC application, a user can view alerts, generate new alerts, search for an alert and communicate with others through e-mail and SMS.

a) The application can be accessed by using ICJS user credentials already existing with the Police and Prison officers.

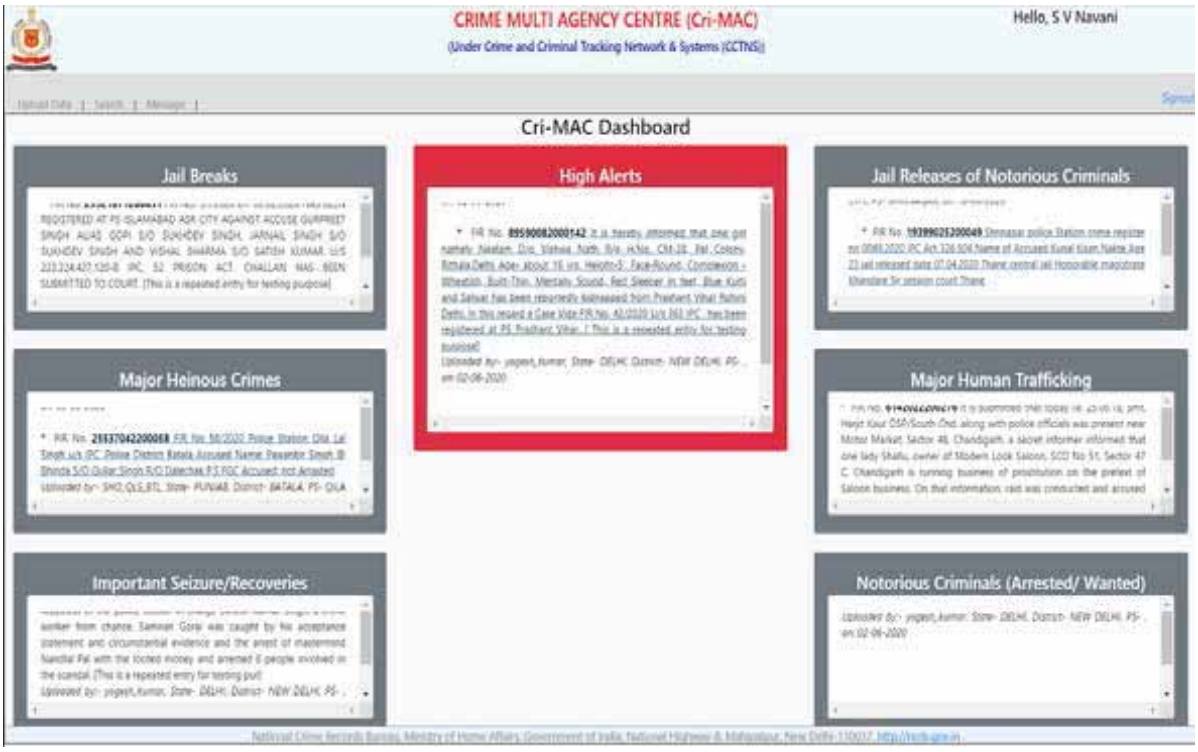
   Police Stations are able to directly export and broadcast important information under various identified crime heads. The exported information is displayed on the application's dashboard (Screenshot1).

   Alerts can be generated about a particular crime category, simply by entering relevant information in the application's upload data module (Screenshot2).

b) Two types of searches can be performed on legacy data under any/all the windows:

   Search based on FIR number (Screenshot3)

   Search based on crime category or any keyword (Screenshot4)



Screenshot1. The Cri-MAC Dashboard



Screenshot2. Generating Alerts (uploading data)

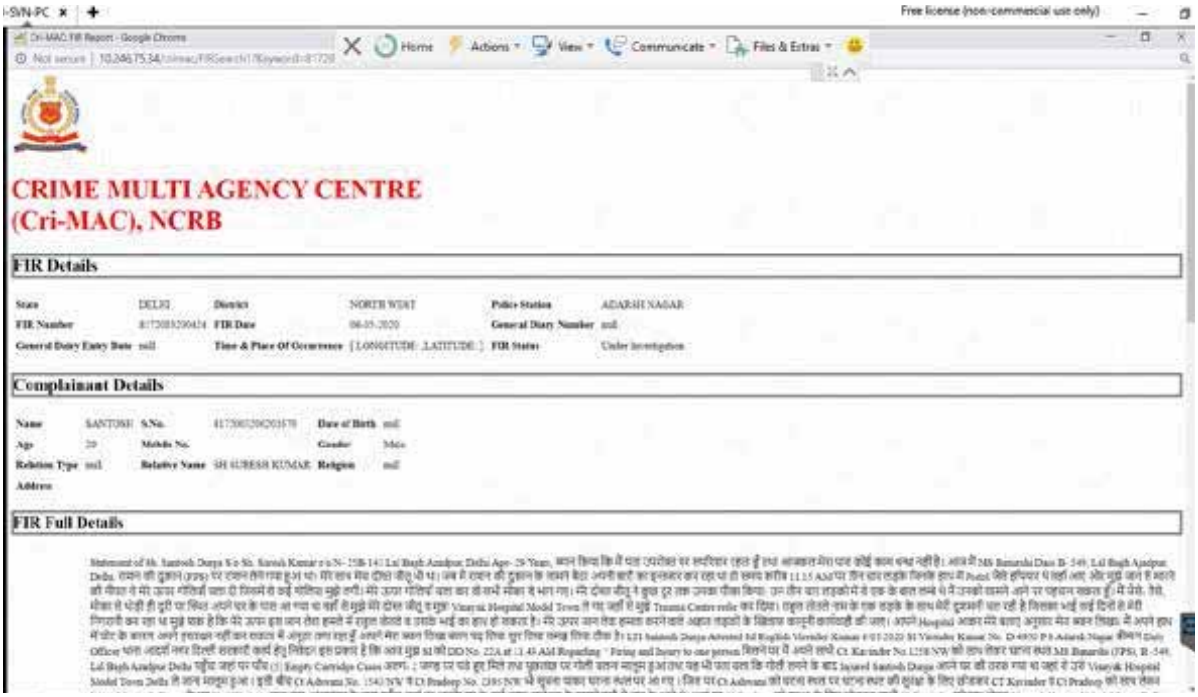


Screenshot3. FIR number based search



Screenshot4. Crime category/keyword based search

In each alert, a link to the case details is given, clicking on which will fetch the related FIR details from the CCTNS/ICJS database (Screenshot5).



Screenshot5. FIR Details

c) Police officers can communicate with each other using any of the two modes of communication provided in the application:

E-mails can be sent to any Police Station along with attachments after selecting state, district and police station names from the drop-down menu (Screenshot6).



Screenshot6. Communicating through E-mail

SMS: SMSs can be sent to any police personnel after selecting state, district and police station names from the drop-down menu (Screenshot7).



Screenshot7. Communicating through SMS

TECHNOLOGIES USED

NCRB has developed the Cri-MAC application as a web-application using the following technologies/ tools:

i. Programming language: Java (Springboot Framework)

ii. Database: My SQL

iii. Other technologies/tools used: HTML, jQuery, Javascript, CSS, Bootstrap

iv. The application runs on browsers such as Google Chrome, Internet Explorer, Safari, Firefox, etc.

It has backend integration with CCTNS for the purpose of fetching FIR data.

SECURE APPLICATION

Being a software application, thorough IT Security Audit for Vulnerability Testing and Certification was performed by CERT-In empanelled vendor and a certificate was obtained therein. A built-in counter keeps track of the footfalls into the application, emails/SMSs originated through the App and number of searches made as well as FIR button clicked for seeing the corresponding FIRs.

BENEFITS TO POLICE

a) The Cri-MAC is a user friendly application

which requires very little training for use.

b) The application utilizes the existing CCTNS network at police stations, without any extra infrastructural demands.

c) Being a web-based computer application, it puts minimal strain on logistics and finance.

d) Security of application and data remains a priority. Police Stations, Prison offices and other higher offices can securely access this portal by using already existing ICJS user credentials with them.

e) Using the alert generation feature for incidents like Jail Breaks and for Hue and Cry Notices, the sensitive and urgent information can be disseminated quickly.

f) Using the built-in communication module and pre-existing email IDs and Mobile Nos. of PSs in the application, the time required for operational and logistic communication would be minimized.

g) The application can also be used to refer to previous incidents of a particular type through search from the legacy data earlier uploaded on Cri-MAC portal.

ADOPTABILITY AND SCALABILITY

a) The Cri-MAC application is adopted and currently being used by 28 States/UTs.

b) Currently, the application is accessible to nearly 12000 police stations across the country.

c) At present, the application can be used for following types of crimes:

   i. Major Heinous Crime
   ii. Major Human Trafficking
   iii. Jail Breaks
   iv. Jail Releases
   v. Important Seizures and Recoveries
   vi. Notorious Criminals (Arrested / Wanted)
   vii. Hue & Cry Notices (PAN India)

GOING FORWARD

NCRB is open to suggestions and improvements and the same would be reviewed and incorporated in subsequent versions. The following features are being incorporated in the next version:

a. A user will see data, by default, related to his district alone. There will however, be an option to click the State or Country level filter as well. High Alert (Red Window) will however, show the entire country's data at all times without any filter in order to show national high alerts.

b. There would be a facility with the state to upload/update email addresses and phone numbers for the users, to reflect changes, if any, from time to time.

c. The application response time will be further reduced for enhanced user experience.

d. Report on the usage of application will be developed.

EXPECTATIONS FROM THE STATES|UTs

a. Submission of updated email-ids and mobile numbers of police stations for communication

b. Opening access of Cri-MAC application to its police stations. As of now, 29 States|UTs

have provided access. Arunachal Pradesh, Bihar, DD&DNH, Manipur, Nagaland, Sikkim and Uttar Pradesh have to facilitate the Cri-MAC access to their police stations.

c. Enhance the usage experience of Cri-MAC application by sharing and viewing the alerts as well as communicate over e-mail and SMS.

CONCLUSION

Earlier, there was no formal system of sharing of alerts on crime and criminals in real-time basis across various disjointed police/jails units across the country. It used to be shared through unsecure channels like PSTN lines, police wireless, or personal emails etc. Using Cri-MAC Application features now, generation of alerts and online sharing of information can be efficiently done. This would help in better and faster coordination leading to early detection and prevention of crime across the country.

The Politics of Punishment

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ABSTRACT

This paper examines the politics of how penal laws get framed. The retributive as well as reductive consequences of punishment are discussed. It is shown how sometimes the optics of lawmaking takes precedence over extant social realities and the capabilities of the State for enforcement of the said laws. To illustrate the anomaly, the morality and the utility of corporal punishment are examined by juxtaposing it with the death penalty. The paper suggests that reform in the Penal system is essentially a political question and needs a suitable political discourse along with building of a social discourse and capability of the State before a proper Penal reform can happen.

Key words: Reductivism, Retributivism, Corporal Punishment, Death Penalty

INTRODUCTION

Lant Pritchett (2009) has called India a flailing State[1]. A flailing state is what happens when the principal cannot control its agents. The flailing state cannot implement its own plans and may have its plans actively subverted when its agents work at cross-purposes. To explain the mismatch between the Indian state's ambitions and its abilities, some economists blame premature demands by Indian elite for policies more appropriate to a developed country. Some of them state that in order to satisfy external actors, the Indian state and other recipients of foreign funding often take on tasks that overwhelm state capacity, leading to premature load bearing[2].

On the other hand, some of these writers feel that the cause for inappropriate imitation is that the Indian intelligentsia—the top people involved in politics, the bureaucracy, universities, think tanks, foundations, and so forth—are closely connected with Anglo-American elites, sometimes even more closely than they are to the Indian populace. As a result, the Indian elite initiates and supports policies that appear to be normal even though such policies may have little relevance to the Indian population as a whole and may be

1 Pritchett, Lant. 2009, Is India a Flailing State: HKS Faculty Research Working Paper Series RWP09-013, John F. Kennedy School of Government, Harvard University

2 Andrews, Matt, Lant Pritchett, and Michael Woolcock. 2017. Building State Capability: Evidence, Analysis, Action. 1st ed. Oxford: Oxford University Press

Author's Intro:

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wildly at odds with Indian state capacity[3]. Incidentally, these writers do not assert that this kind of mimicry of what appear to be the best Western policies and practices is necessarily ill intentioned. It is simply one by-product of the background within which the Indian intellectual class operates.

This paper will attempt to show that a similar dynamic appears to be operating in the process of enactment of penal law as well. It will do so by examining in detail the paradoxical way in which corporal punishment is viewed in our country today, at least officially, and compare it with the largely accepted public discourse on Capital punishment- in the larger perspective of the purpose for which punishment is imposed on the individual. It will also argue that building up of a proper social discourse and State capacity are necessary precursors to penal reform.

THE TRIGGER

The premature release of Manu Sharma on June 1, 2020 has once again highlighted the deeply ambivalent nature of the society's outlook towards the Penal System (for which, incidentally, the presently correct terminology is the Correctional System). Manu Sharma had shot dead Jessica Lal, a model working as a barmaid for the evening, in the early hours of April 30, 1999, in a posh party in Delhi, for refusing to serve him alcohol. The trial court acquitted him in February 2006, causing an outrage which manifested itself in widespread condemnation, candle vigils and protest marches. During the trial, the accused was granted bail quite a few times. It was only in November 2003 that the Delhi High Court put an end to this, and the Supreme Court (SC) too dismissed his special leave petition.

The High Court took the case on 'fast track' and delivered the judgement in December 2006, convicting him and awarding him life imprisonment, besides terming the trial court judgement "an immature assessment of material on record." The SC upheld both the conviction and life sentence in 2010. The sentence review board (SRB) rejected his plea six times for premature release, against which he went to the High Court, which ordered that detailed reasons may be recorded for rejecting his plea and that it should be heard on the next date. Now, the SRB, headed by the state home minister, recommended the release of the prisoner on grounds of "good conduct" after having served a term of 16 years, 11 months and 24 days.

During the prison term, he was on parole and furlough a number of times. This was a topic of much coverage in the media during Mrs. Sheila Dikshit's tenure as the Delhi CM. During parole, his fight with a police officer's son in a pub was also well-publicised, as well as his visits to a hotel in Janakpuri. For the last two years, he was awarded open jail facilities implying he was out the whole day working with an NGO and then back to his cell at night. As expected, questions were raised as to whether such facilities are given to other prisoners too or only to those who have the resources to apply so many times for paroles, remissions and other facilities. Civil society strongly protested the release, specially the women activists asking that in a country which witnesses so many heinous crimes

3 Shruti Rajagopalan and Alexander Tabarrok, Premature Imitation and India's flailing State, The Independent Review, v. 24, n. 2, Fall 2019, ISSN 1086– 1653

against women at regular intervals, what kind of message is sent by such premature releases.

The SC in 2012, noticing the trend of the state governments pardoning prisoners on important occasions or granting remissions en masse, had observed that life imprisonment means prison term for life. The state governments can reduce sentence under Section 432 CrPC but not less than 14 years as stipulated under Section 433A CrPC. Premature release of a lifer amounts to commutation of sentence u/s 433 CrPC for which the opinion of the trial judge is not required. For remission of sentence u/s 432 CrPC, opinion of the trial court may be taken as prescribed in section 432(2) CrPC.

In the legalistic and moralistic debate, one loses sight of the fact that the real questions should be about the fundamental assumptions about that how a society punishes crime. It is about what that society considers right and what it considers wrong- it is about Ethics- it is about the norms of human conduct- it is about priorities- and therefore it is essentially a political question!

THE MORAL JUSTIFICATIONS FOR PUNISHMENT

Human societies have always sought to reduce the frequency and severity of crime and all societies evolved different techniques for dealing with crime. The first technique is to ensure that the potential criminal understands that he has far more to lose than to gain from committing the crime. This is basically disincentivising the act of crime which may also be called as *deterrence*. The second method would be to *incapacitate* the criminals by sending them to jail, executing them, sending them away from the places they commit a crime in (externment) or otherwise make it impossible for them to commit a crime. The third method would be to *persuade* the criminal not to take action by rehabilitation, re-education or shaming him and convincing him that his action is wrong.

All these methods have different overlaps. Punishment, per se, may have features of incapacitation or deterrence or even reform but if one was to cite a moral justification for punishment, it can be broadly classified into two categories: *Retribution* justifies punishment on the ground that it is deserved by the offender whereas *Reductivism* justifies punishment on the ground that it helps to reduce the incidence of crime.

Reductivism is a forward looking or consequentialist theory. It seeks to justify punishment by the so called future consequences. It is hoped that with punishment the incidence of crime will be less than what it would be if there was no punishment. These ideas are also utilitarian in the sense that those actions which produce the greatest happiness of the greatest number of people have moral worth. But does punishment really reduce crime? If *individual deterrence* did work and if we had a new kind of harsh punishment, the offenders who underwent the new harsh punishment would be less likely to reoffend than similar offenders who underwent more lenient penalty. This was the logic behind the introduction of the concept of 'Short Sharp Shock Detention System' for young offenders by the UK Government in the early 1980s[4].

4 https://thatchercrisisyears.com/2013/01/14/short-sharp-shock-

However, these centres with the new harsher penalties were no more successful than detention centres with unmodified regimes in terms of recidivism rates of their ex-inmates. In fact, some other research suggests that offenders who suffer more serious penalties are more and not less likely to reoffend.

This may appear to be contrary to intuition but it is not difficult to understand. Overall, punishment has other effects which cancel out the effects of deterrence. These are known as labelling effects. Catching and punishing offenders labels and stigmatizes them as criminals and very often this acts as a self-fulfilling prophecy which makes it more difficult for them to conform to law abiding life in future. Our jails are notoriously known as schools for crime where offenders meet each other, learn criminal techniques and enter into a criminal subculture. Harsher penalties in particular, could foster a tough macho self-image in young men who predominate in criminal statistics.

The other deterrent effect is known as general deterrence. This is the idea that once the criminal is punished it may send a signal to the rest of the society that it does not pay to commit the crime. There is some evidence that general deterrence can be improved if potential criminals' perceived likelihood of punishment is increased. But there is little evidence that more serious punishments can deter any better than more lenient ones. Hence, general deterrence might well form the basis of a plausible general justification for having a system of punishment. But there is no justification to argue that the amount of punishment is justifiable by only deterrent considerations.

Consistent finding in research is that increases in the certainty of arrest and punishment demonstrate a significant deterrent effect. Perception about the certainty of arrest, for example, may counter the 'present bias'[5] and reinforce the potential cost of committing a crime.[6] Certainty and not the severity of punishment is the chief deterrent for most crimes. However, homicide is influenced by severity, possibly reflecting the differences between homicide and other crimes.[7]

The next reductive purpose of punishment could be *reform* or rehabilitation. The idea that punishment can reduce the incidence of crime by improving the individual offender's character or behaviour and make him/her less likely to reoffend in future is still highly popular in India. Many proponents of reform including the heavily influential positivistic theorists of crime favour this ideal called the 'treatment' model. This views criminal behaviour not as 'freely willed' action but as a symptom of some kind of mental illness that should not be punished but be treated like an illness. However, modern research has suggested that penal measures intending to reform offenders are no more effective in preventing recidivism than sheer punitive methods.

The present wisdom about reform in many quarters is that 'nothing works'[8] and that

thatcher-takes-on-the-wayward-youth/

5 The 'present bias' refers to the tendency of people to give stronger weight to payoffs that are closer to the present time when considering trade-offs between two future moments

6 Donald Ritchie, April 2011, Does Imprisonment Deter? A Review of the Evidence, Sentencing Advisory Council, www.sentencingcouncil.vic.gov.au

7 Bailey, William C. and J. David Martin (1974). Crime and Deterrence: A Correlation Analysis. Journal of Research and Crime and Delinquency, 11, 124-143

8 Lipton, Douglas, R. Martinson, and J. Wilks, The Effectiveness of

whatever you do to offenders makes no difference. However, this might be an exaggeration as there are examples of reformative programmes which seem to work with certain groups of offenders[9]. The ambivalence of society, especially about young criminals, also shows itself in pendulum swings between retribution and reform. The retributive social outrages after Nirbhaya[10], Shakti Mills Rape case[11] [12] or the Ryan school murder[13] also got countered by sentimentality over 'children in trouble'[14].

The next reductive purpose is incapacitation which simply means that the offender is usually physically prevented from reoffending by the punishment imposed either temporarily or permanently. The practice in some societies of chopping off the hands of thieves has this kind of incapacitatory effect! Similarly, one of the few obviously valid arguments in favour of capital punishment is that executed offender can never reoffend afterwards. Lesser penalties can also have some incapacitatory effects. Disqualification from driving does something to prevent motoring offenders from repeating their crimes! It is therefore, certainly a plausible claim that incapacitation could be a justification for certain kinds of punishments.

The *retributivist* principle that wrong doers should be punished because they deserve it is in many ways the complete antithesis of reductivism. Where reductivism is forward looking, retributivism looks backwards in time- to the offence. It is the fact that the offender has committed a wrongful act which deserves punishment, not the future consequences of the punishment, which is important to the retributivist. Retributivism therefore advocates a 'tariff' of punishments of varying severity matched to crimes of varying seriousness: punishment should fit the crime in the sense of being in proportion to the moral culpability shown by the offender in committing the crime. It should be noted that our Penal Code is retributive, in this sense.

Retributivism also has consonance with the fundamental principle of justice that like cases should be treated alike and that offenders have rights. Reductivist theory has always found it difficult to encompass the notions of rights even when it comes to providing

Correctional Treatment: A Survey of Treatment valuation Studies, Praeger Press, New York.

9 Miceli, Victoria, Analyzing the Effectiveness of Rehabilitation Programs (2009). Senior Honors Projects. Paper 158. http://digitalcommons.uri.edu/srhonorsprog/158

10 In July 2014, Minister of Women and Child Development said that the Govt. was preparing a new law which will allow 16-year-olds to be tried as adults. She said that 50% of juvenile crimes were committed by teens who thought that they get away with it. She added that changing the law, which will allow them to be tried for murder and rape as adults, would scare them. This culminated in the JJ Act 2015.

11 The Shakti Mills gang rape refers to the incident in which a 22-year-old photojournalist was gang-raped by five people, including a juvenile. The incident occurred on 22 August 2013, when she had gone to the deserted Shakti Mills compound, in South Mumbai, with a male colleague on an assignment. Later, an eighteen year old call centre employee reported that she too had been gang-raped, on 31 July 2013 inside the mills complex. On 20 March 2014, a Mumbai sessions court convicted all five adult accused in both cases on 13 counts. On 4 April 2014, the court awarded the death penalty to the three repeat offenders. For the other two accused, one was awarded life imprisonment while the other accused turned approver in the case. Two minors, one in each case, were tried by the Juvenile Justice Board separately. They were convicted on 15 July 2015, and sentenced to three years (including time in custody) in a Nasik reform school.

12 After being sent to a correction home in Nasik for three years for the gang-rape Akash Jadhav, then 17 years old, by 2018, had formed an underworld gang and was arrested in 3 offences subsequently. His repeat offences put paid to expectations that he would emerge a reformed man from the Nasik home.

13 Pradyuman Thakur was a student at Ryan International School, who was found murdered inside a washroom on 8 September 2017 in Gurgaon. On 8 November 2017, the CBI arrested a class XI student aged 16 from the same school for the murder.

14 Child Rights Activists and Women Rights Activists called the JJ Act 2015 a regressive step. Many experts and activists viewed post 'Nirbhaya' responses as creation of media sensationalisation of the issue, and cautioned against any 'regressive' move to disturb the 'momentum of Juvenile Justice Legislation' in the Country which was so far purely rehabilitative and reformative.

entirely innocent people with a right not to be punished. For example, if you could achieve the desired reductive consequences by punishing an innocent person and if these effects are all that is needed to justify punishment, there should be nothing wrong with punishing the innocent! Retributivism has no such problem as it follows automatically that it is wrong to punish non-offenders, nor do we need to punish criminals to a greater extent than their crimes deserve. This is the reason why retributivism fits well with our common sense intuitions and this has been the most resilient idea when dealing with crime and punishment. Hence, often when people talk of 'justice', what they really mean is 'retribution'.

TYPES OF PUNISHMENT

Section 53 of the Indian Penal Code of 1860 provides for five forms of punishment-death; imprisonment for life; simple and rigorous imprisonment for a period; forfeiture of property and fine - there is nothing intervening between imprisonment and fine. The Indian Penal Code (Amendment) Bill, 1972 had provided for sentencing alternatives. With the restrictive use of the death penalty ('in the rarest of the rare cases', as the Supreme Court has prescribed) and a limited infrastructure for probation-sentencing, imprisonment was the only punishment available in a wide variety of cases. This created problems of resource, and it led the Executive to look for noncustodial alternatives.

The Indian Penal Code Amendment Bill of 1972 suggested three new forms of punishment: externment, compensation to victims and public censure. The Bill was sent to a select committee of Parliament, and in 1978 the committee rejected the proposal for externment as a form of punishment, having regard to its constitutional ramifications. The subsequent Indian Penal Code Amendment Bill of 1978 proposed four forms of punishment: community service, compensation to victims, public censure and disqualification from holding offices in certain types of cases, for example, white-collar crimes. But the 1978 Bill never saw the light of day. (W.r.t. compensation, Section 357 A inserted into Cr.P.C. with effect from December 31, 2009, provides for "victim compensation scheme". Similar provisions have also been made under Section 5 of the Probation of Offenders Act, 1958).

The sentence of forfeiture of property was abolished for certain offences *(e.g.* Sections 121 and 122) by Act XVI of 1921 but can be imposed for certain other offences *(e.g.* Sections 126 and 127). The sentence of penal servitude which could be awarded against Europeans and Americans in lieu of transportation was abolished by Act XVII of 1949. Act 26 of 1955 abolished the sentence of transportation and Act 44 of 1955 which repealed the Whipping Act, 1909, abolished the sentence of whipping which could be imposed in lieu of or in addition to other punishments. The Reformatory Schools Act, 1897, provided for "youthful offenders" *(i.e.,* offenders below the age of 15 years) sentenced to imprisonment being detained in a Reformatory School instead of being sent to Jail.

Imprisonment is comparatively a modern method of dealing with offenders. Although there had been a practice of imprisoning the

wrong doers for a particular period of time, those places were not the concrete structures meant for keeping the offenders. Such places could be part of a palace, a church or any other place declared as prison by the rulers at that time. Prison was initially regarded as temporary holding den rather than a primary institution of punishment and rehabilitation. Imprisonment was used to compel the offender to pay the fine imposed on him, or to spend the period between arrest and trial or between the conviction and its execution.

Penal philosophies usually undergo a development from retaliation to brutality, to restraint, to deterrence, to treatment and to rehabilitation. Penal philosophies also differed widely between East and West. This difference was primarily attributable to the fundamental differences between the two cultures in social values. In Eastern societies, the cause of crime was linked to the neglect of the natural order. Man's action was regarded as part of the complex network of causal filaments within the Universe. Any social violation was interpreted as an ominous disturbance of the natural order, and thus subject to punishment by heaven through designated agencies such as the family, clan or state. In India as well, traditional penal philosophies were more retributive than reductive. As our present Criminal Justice System is derived from the English, it would be instructive to examine the trajectory of the penal philosophy in our country, since the English, by looking at the trajectory of Corporal Punishment.

THE POLITICS OF CORPORAL PUNISHMENT

As already stated supra, in Indian law today, there is nothing intervening between imprisonment and fine. However, this wasn't always so. The Abolition of Whipping Act, 1955 repealed the Whipping Act, 1909; and omitted 'whipping' from sections 32 & 396 & deleted sections 390-395 of Cr.P.C. of 1898. It would be instructive to have a look at the discussions in the Rajya Sabha on 24th August 1955[15] when the then Union Home Minister Sri Govind Vallabh Pant introduced the Act. The UHM had said, "…Our entire outlook towards crime and criminals has undergone a far-reaching and almost categorical change. The age when punishment was inflicted out of a spirit of vindictiveness is gone. No longer do we think of an eye for an eye or a tooth for a tooth. On the other hand, punishment is inflicted more with a view to reforming and rehabilitating the person who is subjected to some sort of penalty by the State. The State is interested in the reform and rehabilitation of the so-called criminal, and also in the protection of society. The triumph of a penal system lies in converting a criminal into a useful and clean citizen. The sentence of whipping does not conduce towards that end. It, in fact, aggravates the tendency towards desperation. It embitters one and makes him all the more callous. So, from whatever angle one may look at it, it serves no wholesome purpose, and no remedy short of its complete eradication and elimination can suffice."

In reply Prof A.R. Wadia had said, "…It seems to me that after all whipping is not resorted

15 http://164.100.47.5/Official_Debate_Nhindi/Floor/10/F24.08.1955.pdf

to normally by our magistrates. It is there. No magistrate is compelled to impose whipping as a form of punishment. Along with two other forms of punishment it is there. And it should be there, because human nature is very complex, and although I fully share the enthusiasm of the Home Minister that criminal law should be used as an instrument for reforming a criminal, I am afraid, there are certain types of criminals who cannot be reformed... It is impossible for any person to enter a prison and to leave it without being coarsened- exactly the expression that the Home Minister used. Well, perhaps it is so. But that is hardly an argument for abolishing imprisonment altogether. If human beings choose to do a wrong, they must face the consequences…I think even whipping would be useful in connection with those people who are really bullies at heart, absolutely depraved individuals who deserve very little sympathy from respectable citizens, and in the case of such people, a timely whipping would do a lot of good and would serve to reform them really much more effectively than perhaps a long term of imprisonment, or even a very heavy fine…I think the fear of whipping would be a useful deterrent in several cases. And, if it is there, it is the business of the magistrates to make use of it or not. If a magistrate feels that in a particular case whipping would be the right type of punishment, I think, his hands should not be fettered, and he should be given the liberty of imposing that type of punishment."

Dr. P.V. Kane had added, "…If you want to abolish entirely this punishment of whipping, why don't you abolish the death sentence? I know as a lawyer that there have been miscarriage of justice and the wrong man being sentenced to death and the right man being found out afterwards. You inflict the death sentence and there is no question of reforming the man. You simply hang him. Unless you reform the whole system, such piecemeal legislation is bad in the first place…"

The discussions had fascinating contributions from Sri Rajendra Pratap Sinha, Smt. Mona Hensman, Sri H.P. Saksena, Sri Akbar Ali Khan & Sri Devakinandan and the rich debate shows that the members were well aware of the retributive as well as reductivist ideas of penology. However, the winds of change and the desire to align with 'modern' understanding of penology carried the day.

THE TRAJECTORY OF CORPORAL PUNISHMENT

The formal application of flogging, caning, birching, whipping, strapping or spanking as an official sentence by order of a court, as laid down for specified offences under the law of the country concerned is called the Judicial Corporal Punishment (JCP). Earlier it used to be common in many countries, but it has now been abolished in nearly all the Western world. It still remains a standard penalty in some Asian, African and Middle Eastern countries. Many countries, which were not under the British colonial rule or are Islamic, use whipping as a punishment. Other countries that were neither British nor Islamic that have used JCP in the past include the USA (it was last used in 1952 in Delaware), China, Germany, Korea, Sweden and Vietnam. Flogging as a punishment, of both men and women, used to take place in public in

England. This seems to have had its origin in the Common Law coming from the medieval times. However, there were no laid down rules about the offences for which whipping was to be administered, the number of strokes or the modus operandi of whipping. The public whipping of women was abolished in 1817. Public floggings were discontinued altogether in the 1830s.

One of the aims during the Industrial Revolution was to do things more efficiently and cheaply and the solution was to make a machine for everything. During this period, the use of whipping was so widespread in England that Jeremy Bentham gave a detailed suggestion on how to make a machine which could perform the task of whipping several persons simultaneously and more efficiently and thereby cutting down the cost of whipping per person and saving time and energy[16]! Between 1861 and 1863, under various legislations, provision for JCP was restricted and regularised by statute law. Ordinary local courts lost their common-law right to order whippings. Thereafter only the higher courts in England and Wales were empowered to order corporal punishment for adults, and these too for a narrowly defined range of offences - mostly robbery with violence, treason and certain vice-related crimes[17]. Corporal punishment as a judicial penalty was abolished in England, Wales and Scotland in 1948. However, the 1948 abolition did not affect the ability of a prison's visiting justices to order flogging for prisoners committing serious assaults on prison staff. This power was abolished in 1967.

Singaporean law even today allows caning for over 30 offences, including robbery, gang robbery with murder, drug use, vandalism, and rioting. The maximum number of strokes that can be awarded in Singapore is 24. Caning is also a mandatory punishment for certain offences such as rape and drug trafficking, and for visiting foreigners who overstay their visa by more than 90 days, a measure designed to deter illegal immigrant workers. Judicial caning is clearly intended to be a humiliating experience. Former Prime Minister Lee Kuan Yew, founding father of modern Singapore, introducing mandatory caning for vandalism in 1966, told Parliament :"If the offender knows he is going to get three of the best, I think he will lose a great deal of enthusiasm, because there is little glory attracted to the rather humiliating experience of having to be caned[18]. The Singapore's official punishment of caning was widely discussed when an American teenager Michael P. Fay was sentenced to six strokes of the cane for vandalism in 1994. Subsequently, the sentence was reduced from six lashes to four in an attempt to "accommodate" a personal appeal for clemency from the then President Bill Clinton of the USA. However, in a speech to an international conference of lawyers in Singapore, Shunmugam Jayakumar, Singapore's Minister of Law and Foreign Affairs, defended the decision to carry out the caning: "If today we are told that we are not entitled to cane, then tomorrow we will be told that we cannot enforce the death penalty and some other day, that we cannot enforce some other law," he said[19].

16 "The Rationale of Punishment" by Jeremy Bentham, Published by Robert Heward, Wellington Street, Strand, London, MDCCCXXX.

17 http://www.corpun.com/counukj.htm#prisoncp

18 http://www.malaysianbar.org.my/criminal_law/the_current_form_of_sentencing_is_outdated_time_for_ reform_by_v._sithambaram.html

19 http://www.nytimes.com/1994/05/05/news/05iht-cane_0.html

THE ANOMALY

Interestingly, in India whipping continues on the statute for prisoners in most states! There are two Central Acts on Prisons in India - The Prisons Act, 1894 and the Prisoners Act 1900. The former, deals with prisons in India and rules for their regulation. The latter deals with the law relating to prisoners confined by order of a court. "Prisons" is a State subject under List II of the Seventh Schedule to the Constitution and Prison Administration is the responsibility of the State Governments. The provisions of the Prisons Act, 1894 and the Jail Manuals framed by State Governments provide a framework for the prison administration. Chapter XI of the Prisons Act 1894 deals with prison offences and their punishments. Section 45 gives a long list of 16 acts which are prison offences. Section 46(12) prescribes punishments for jail offences and states that whipping will be one of the punishments provided that the number of stripes shall not exceed 30. Only the following 7 States have, by amendments, omitted this section in so far as their respective States are concerned - Andhra Pradesh, Assam, Bihar, Gujarat, Madhya Pradesh, Maharashtra and West Bengal. The Punjab Jail Manual 1996 has omitted whipping as one of the punishments for prison offences.

Article 5 of the Universal Declaration of Human Rights states that, "No one shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment." Article 7 of International Covenant on Civil and Political Rights, which was adopted and opened for signature, ratification and accession by General Assembly resolution 2200A (XXI) of 16 December 1966 lays down that "No one shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment." India ratified the Covenant in 1979. "Standard Minimum Rules For The Treatment Of Prisoners" were adopted by the First United Nations Congress on the Prevention of Crime and the Treatment of Offenders, held at Geneva in 1955, and approved by the Economic and Social Council by its resolutions 663 C (XXIV) of 31 July 1957 and 2076 (LXII) of 13 May 1977. Rule 31 states that 'corporal punishment, punishment by placing in a dark cell, and all cruel, inhuman or degrading punishments shall be completely prohibited as punishments for disciplinary offences.' Hence, it is evident that despite being party to these international covenants, India has not amended its law regarding punishment applicable to prisoners, enough!

It should also be noted that the Prevention of Torture Bill, 2018 which was brought before the Lok Sabha on 9th February 2018 (The Prevention of Torture Bill, 2010 was introduced in the Lok Sabha to give effect to the provisions of the UN Convention against Torture. The Bill was passed by the Lok Sabha on May 6, 2010. Rajya Sabha referred the Bill to a Select Committee which had proposed amendments to the Bill. However, the Bill lapsed with dissolution of the 15th Lok Sabha. Again in 2017, the Bill was introduced as a private member bill in Rajya Sabha and then again in 2018, in the same form in Lok Sabha. The latter has lapsed due to dissolution of the 16th Lok Sabha) dealt with the unauthorised use of violence by public servants against an individual whereas both the Whipping Act and the Prisons Act deal with punishments as authorized by law. This anti-Torture Bill was

not considered seriously, it is said, because it was felt that the western standards of human rights did not apply to India. Thus, it is clear that when it comes to treatment of prisoners or of people in custody, there appears to be insufficient moral imperative in our country to ensure that corporal punishment is not imposed, whereas JCP itself appears to beyond the pale.

THE MORAL IMPERATIVE

JCP is called out in our discourse as 'unusual' or 'inhuman' punishment. However, if Corporal Punishment is termed as 'inhuman' or 'unusual', what about the death penalty? Death penalty is a subject of great debate not only in India but in the world over. There are two Constitution Bench judgments on the death penalty rendered by the Supreme Court. The first case relates to Jagmohan Singh. It was held that capital punishment was not 'unusual' or 'inhuman' as it had been followed since ancient times.

Earlier, when a person was convicted for murder under Section 302 IPC, the punishment was either death or imprisonment for life. Section 367 (5) of CrPC provided that normal punishment for murder was death, while a lesser punishment of life imprisonment was to be given after giving special reasons. When Jagmohan's case came up, Section 367 (5) was deleted by an amendment in 1955. It was left to the courts to hang or give life imprisonment. CrPC was amended, yet again, after the judgment and Section 354(3) was inserted. It stated that when a man was convicted for murder, special reasons should be given for imposing the death penalty. This was a shift from the earlier stand when death penalty was the norm. In the case of Bachan Singh, the constitutionality of the death penalty was again upheld, though death was to be awarded in the 'rarest of the rare' case.

Another important case which led to the evolution of the death penalty jurisprudence in India is that of Machchi Singh. Justice Thakkar, delivering the judgment, said persons like Machchi Singh should be hanged. The court, while upholding the penalty of death, laid down certain guidelines. A person was to be hanged only when murder was grotesque, diabolical and shocked the community. There was a sort of moratorium on the death penalty till the Supreme Court decided to hang Dhananjoy Chatterjee. The rape of a 14-year-old innocent and defenceless girl by a security guard fell within the ambit of the 'rarest of the rare', said the court. There was widespread protest when he was ultimately hanged. Human rights organizations claimed that the death penalty was too harsh in India's imperfect judicial system where the poor were hanged and the rich got away.

This view was supported in Santosh Kumar Bariyar's case wherein it was observed, "What is sorely lacking in most capital sentencing cases is information in relation to socio-economic background of the offender. This issue was also raised in the 48th report of the Law Commission." The court observed further, "The truth of the matter is that the question of death penalty is not free from subjective element and the commutation by this Court depends a good deal on the personal predilection of the judges constituting the Bench." This view was also taken in the case of Sangeet and Another vs. State of Haryana wherein it was observed, "It appears to us

that even though Bachan Singh intended "principled sentencing," sentencing has now become "judge centric" as highlighted in Swamy Shraddananda and Bariyar."

Hence, it is clear that the SC hasn't found the death penalty to be either 'inhuman' or 'unusual'; what the concern has been is the judicial vagary. The absence of statutory sentencing guidelines to assist judges in discharging this duty has left a vacuum in the machinery of justice dispensation in India. Often, in cases that capture the public imagination and create a groundswell of opinion, even the trial can get affected[20]. The Malimath Committee Report on Criminal Law Reform (2003) had recommended an incorporation of sentencing guidelines for aiding the judiciary in deciding an appropriate sentence. The Law Commission of India in its 262nd report on Death Penalty had recorded this disparity in sentencing on account of personal leanings of judges, as one of the factors amongst others to recommend abolition of death penalty in all crimes except terrorism related offences.

We need to bend our heads around the fact that if judicially ordered death is not 'inhuman' or 'unusual', it should logically follow that JCP too is not! Dr. P.V. Kane's advice in the 1955 Rajya Sabha debate about the futility of piecemeal legislation now appears prescient.

ISSUE OF IMPRISONMENT

The National Policy on Prison Reforms & Correctional Administration[21] of 2007 had accepted that "the main problem of prison administration has been related to prison overcrowding. Prisons in most countries, including India, face dearth of resources to provide for proper accommodation, health care and constructive activities for prisoners, leading to overcrowding and neglect of schemes for reformation and offender rehabilitation. Prison overcrowding adversely affects the justice system and has repercussions on the safety and health of society. Even construction of new prisons to accommodate the increasing prison population is an unsustainable solution, as there is a limit to provision of public funds for this purpose. However, imprisonment is costly in terms of not just financial expenditure, it also has social costs. It damages people socially and psychologically making the process of reintegration difficult and challenging."

The same policy had suggested alternatives to imprisonment at all the three stages: pre-trial, sentencing and post sentencing. The Pre-Trial alternatives suggested were liberal Bail, Imposing time limits on Pre-Trial Detention, Plea Bargaining, Free Legal Aid, Compounding of Offences, Decriminalization of Offences, Diversion from criminal justice process and redirection to community support service and Administrative fines / non penal fines. The suggestions at the Sentencing stage were for Fines and other monetary penalties, Admonition/Absolute discharge/Conditional discharge, Compensation, Probation and community-based sentencing. Suggestions for the post-sentencing stage included liberal use of Parole, Pardon, Remission of Sentence, Temporary Release Mechanisms and Open Prisons.

20 Howell-Collins, Marti Cecilia, "Court Of Public Opinion: How the Convicted Perceive Mass Media Have Affected Their Criminal Trials and Personal Lives" (2012).Mass Communications - Dissertations. Paper 90.

21 https://bprd.nic.in/content/196_1_NPPRCA.aspx

The point to be noted here is that the above policy did not even discuss JCP. All the above suggestions were made towards reducing the load on Imprisonment- showing an implicit assumption that Imprisonment is the only possible method of Punishment and Penal reform implies reform in Imprisonment. The possible utility of JCP diverting the penal load away from Imprisonment did not even figure as a possibility. Failure of this piecemeal approach towards reform based on Western experience is exemplified, for instance, in the fate of 'plea bargaining'[22]. The public disquiet over Manu Sharma's pre-mature release is at odds with the correctional ideologies behind the same. This tension between the public mood and lofty legal ideals in our country comes into sharper focus every time in cause célèbre cases. The Rule of Law, that our polity is based on, is what our legislature- as the voice of the people- decides or is it something more?

VOX POPULI, VOX DEI?

Does the concept of Rule of Law find its fulfilment by the mere enactment of a law, or is it also concerned with the content and quality of the law? There is a certain core component without which a government cannot really be said to be based on the Rule of Law. That core component is respect for the basic human rights of the people and for human dignity. Otherwise commission of atrocities and gross violation of human rights could be justified by pointing to the mere existence of a law. Most of the actions of the Nazi State were carried out under laws made by law makers. Therefore, law should satisfy at least the prerequisite that it guarantees basic human rights and ensures their implementation by due process through an independent judiciary exercising power of judicial review. But what is the right way to generate Law? Is it the voice of the people as expressed through the Legislature? If so, how do we prevent creation of unjust Law, as described supra? Is Judicial Review a sufficient bulwark against this? But we have seen how even Judicial Review may suffer from Sectoral myopia. Or is the right way by an elitist rule making- by the 'enlightened'? Then how to prevent 'Rule by Law' instead of 'Rule of Law'?

Law requires the Police to enforce all criminal laws all the time. Police discretion to enforce a criminal law or not to enforce it is not envisaged in law. Yet, full enforcement of many laws will never be tolerated. Selective enforcement of *mala prohibita* laws relating to social vices or bad practices like child marriage, dowry etc. is well known but what about neglect of laws enacted for maintenance of public order? Say, for instance, 'The Religious Institutions (Prevention of Misuse) Act of 1988'?

In conclusion, therefore, we need to see that many of the problems in our Criminal Justice System flow from the fact that as a society we did not develop enough self-confidence so far to determine what are the basic human rights, which we will uphold- without reference to western paradigms. As pointed out earlier, we failed to develop our own system of Ethics- our own ideas of Justice, because we failed to do this. We see this permanent tension between the public mood and the Law. We have therefore adopted the 'way of the hypocrite' where the law enforcement agencies are allowed to operate beyond the pale of law

22 Sharraf, Umesh, The Chimera of Plea Bargaining, Indian Police Journal, January-March 2017

to meet public expectations, while the State pretends that such action is without sanction. If at all genuine reform in the Correctional/ Penal System is desired, then a reform of the entire Criminal Justice System is required. A build up of a proper social discourse and a concomitant build up of the capacity of the state to administer the law without fear or favour is therefore a necessary precursor to penal reform. And that - is a Political question!

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The Doctrine of Approver: A Complex Evidentiary Process

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"Discovering witnesses is just as important as catching criminals". -Simon Wiesenthal

ABSTRACT

Heinous offences warrant extraordinary evidentiary tools to punish offenders especially in the modern era of advanced technologies helping criminals to escape from the cusp of law. The archaic battery of evidence sometimes fails to provide cogent proof to complete the chain of conspiracy in order to establish guilt beyond reasonable doubt. In common law jurisdictions, the doctrine of tender of pardon provides an extraordinary evidentiary provision to fill the void in the chain of crime events by disclosing uncharted mystery and role of main culprits behind a crime by an accomplice. However, the approver testimony per se may be a slippery slope and have the potential to frustrate the purpose of justice. The judiciary must use this tool with utmost diligence only in exceptional and extraordinary cases to facilitate justice. In the recent past, the doctrine of approver has extensively been used in criminal cases of significance; but this legal precept is least explored by the academia, which ignited the quest to deliberate the subject in this article.

KEY WORDS

Approver, accomplice, tender of pardon, investigation, trial, revocation of pardon, criminal justice system.

INTRODUCTION

Justice is the quintessence of the right to life with dignity. In criminal justice administration across the globe, proving culpability beyond a reasonable doubt by the prosecution is an essential prerequisite for punishing guilty and for securing a conviction. In the modern era of 'smart criminals' equipped with the latest technology, proving the infallible chain of events in commission of crime becomes a daunting task. It further necessitates additional evidentiary tools to strengthen the judicial system ensuring that criminals may not slip from the clutches of the legal process.

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The doctrine of approver, as additional testimonial evidence, permits an accomplice[1] to realise and timely disclose his guilt to facilitate and assist the investigation and judicial process to ensure justice. In the Code of Criminal Procedure, the term 'approver' is neither defined nor used, however, sections 306 to 308 of the Code deal with tender of pardon to an accomplice. In this article, attempts have been made to deliberate upon legal requirements for making an approver, its reliability and efficacy; and to delve into the global perspective of this extraordinary evidence in criminal administration. The apex court in Ravinder Singh vs State of Haryana[2] has succinctly described the nature and scope of an approver in the criminal justice process:

An approver is a most unworthy friend if at all and he having bargained for his immunity, must prove his worthiness for credibility in court. This test is fulfilled, firstly, if the story he relates involves him in the crime and appears intrinsically to be a natural and probable catalogue of events that had taken place. The story if given of minute details according to reality is likely to save it from being rejected brevi manu. Secondly, once that hurdle is crossed, the story given by an approver so far as the accused on trial is concerned, must implicate him in such a manner as to give rise to a conclusion of guilt beyond reasonable doubt. In a rare case taking into consideration all the factors, circumstances and situations governing a particular case, conviction based on the uncorroborated evidence of an approver confidently held to be true and reliable by the court may be permissible. Ordinarily, however, an approver's statement has to be corroborated in material particular bridging closely the distance between the crime and the criminal. Certain clinching features of involvement disclosed by an approver pertaining directly to an accused, it reliable by the touchstone of other independent credible evidence, would give the needed assurance for acceptance of his testimony on which a conviction may be based.

Sections 306, 307 and 308 under Chapter XXIV of the Code of Criminal Procedure, 1973(hereafter 'the Code') deal with granting and revocation of pardon to an accomplice. The corresponding provisions for tender of pardon to accomplice were enshrined under section 337 to 339 of the Code of Criminal Procedure, 1898.[3] A comparative account of the provisions for tender of pardon under the Code, 1898 and the Code, 1973 reveals that they are, in all germane respects, in *parimatetria*, and the provisions for granting pardon under the Code, 1898 would also apply, *mutalis mutandis*, to sections 306 to 309 of the Code, 1973.[4] The Prevention of Corruption Act, 1988 has enabling provisions under section 5 for tender of pardon to facilitate justice in graft cases.[5] In the recent past, the issue of approver has been in the limelight in some significant cases like the INX Media graft case[6] and the August Westland case[7] warranting in-depth discussion on this procedural legal dogma.

AN ACCOMPLICE

An accomplice, after a tender of pardon becomes approver, however, term approver nowhere defined under the Indian laws. In ancient English law, an approver may also be called as probator, an accomplice in felony,

who to save himself confesses to the fact and charged or accused any other person as principal or accessory, against whom he is aware of the secrets behind a crime. Every approver may be called an accomplice, but all accomplices cannot be termed as the approver. The apex court in *R.K. Dalmia* v. *Delhi Administration*8has succinctly explained an accomplice as under:

An accomplice is a person who participates in the commission of the actual crime charged against an accused. He is to be a particleboard. There are two cases, however, in which a person has been held to be an accomplice even if he is not a *particepscriminis*. Receivers of stolen property are taken to be accomplices of the thieves from whom they receive goods, on a trial for theft. Accomplices in previous similar offences committed by the accused on trial are deemed accomplices in the offence for which the accused is on trial, when evidence of the accused having committed crimes of identical types on other occasions be admissible to prove the system and intent of the accused in committing the offence charged.

PURPOSE OF TENDER OF PARDON

It is essential to understand the purpose of granting pardon to an accused enshrined the procedure code before entering into nature and scope of the canon of law. Public policy and public interest are the baseline for sanctioning tender of pardon.[9] In general, investigative agency necessitates the course of tendering pardon for making an approver, firstly, when the perpetrators of a felony are more than one and they have committed a crime in pursuance of criminal conspiracy but chain of evidence with regard to establishing conspiracy is not in sequence; secondly when investigating agency feels that without taking an accused as an approver, it is difficult to prove guilt beyond reasonable doubt against all other accused or the mastermind or main accused. The Kerala High Court in *Asokan* v. *State of Kerala10* has succinctly observed that "the object of the provision for tendering pardon to an accomplice is to get evidence in cases involving grave offences alleged to have been committed by several persons under circumstances making it difficult to get any evidence otherwise. Sometimes, expert offenders leave no clue or trace of the offence or there may be vital gaps in the chain of crime events to connect crime with the perpetrators. The dominant purpose of pardon is that the culprits behind such heinous crimes do not go unpunished if a co-participant of the crime comes forward offering to make a clean breast of his complicity as also the complicity of other offenders."*In re ArusamiGoundan*,11 the Madras High Court has observed:

Let us examine the reason of the matter. Occasionally when grave offences are committed the law finds it necessary to enlist the assistance of some of the offenders in order that the rest may be brought to justice. This happens when one of several persons who have committed a crime makes a confession which is believed to be true and which is considered would help to secure a conviction of the rest.

The Procedure Code now insists that accomplices who have been tendered a pardon must be examined both in the Committing Court and in the Court of Session. This provision is inserted in the interests of justice and is not intended for the benefit of

the approver. Its purpose is to ensure that all the evidence obtained from the accomplice is placed before the court so that justice may be done as between the State and the persons placed in their trial. It is not an ordeal through which an approver has to pass before he can win to safety.

So far as the approver is concerned, he is given a pardon on condition of his making a full and true disclosure of the whole of the circumstances within his knowledge relative to the offence and to every other person concerned, whether as principal or abettor, in the commission thereof. The condition of the pardon is that he must make a full and true disclosure, and, if, he wilfully conceals anything essential or gives false evidence, he would have failed to comply with the conditions on which the pardon was granted to him.

Thus, the inherent objective of tendering pardon is to serve the larger interest of justice, since it additionally helps to cogently stitch a crime with the criminals.

INGREDIENTS OF SECTION 306 OF THE CODE

The procedural laws in India empowers the court to ensure justice despite having adversaries and otherwise deficit of cogent evidence. Section 306 of the Code empowers the Magistrate for tender of pardon to an accused. The main ingredients of these legal provisions include:

- The application for seeking pardon must be filed before Magistrate of the First Class by the investigating officer (IO) or by the accomplice [s. 306(1) CrPC].
- Tender of pardon may be considered by the Magistrate at any stage of investigation or enquiry; or the trial of the offence [s. 306(1) CrPC].
- The person must have been directly or indirectly concerned in or privy to the offence in question [s. 306(1) CrPC].
- This legal provision applies to any offence triable exclusively by the Court of Session or by the Court of Special Judge [s. 306(2)(a) CrPC], or the offence punishable with imprisonment which may extend to seven years or with a more severe sentence [s. 306(2)(b) CrPC].
- The Magistrate shall record his reason on application for tendering a pardon [s. 306(3) CrPC].
- In case a tender of pardon is accepted, the accomplice shall be examined as a witness [s. 306(4)a) CrPC]; and he shall, unless already on bail, be detained in custody until the termination of the trial [s. 306(4)(b) CrPC].
- Where a person has accepted a tender of pardon made under section 306(1) and has been examined under section 306(4), the Magistrate shall, without making any further inquiry, commit it for trial either to the Court of Session [s. 306(5)(a)(i) Cr.PC], or to a Court of Special Judge [s. 306(5)(a)(ii) Cr.PC], or in other case make to the Chief Judicial Magistrate [s. 306(5)(b) Cr.PC].

Authority of the court to grant a pardon is a judicial function, but cannot be exercised *suo motu.*12 It is conditioned upon the request

of either prosecution or the accused person because the court can have no interest whatsoever with any party or in the final decision of the case.The apex court held that while proceeding and considering of granting pardon, co-accused has no right to be heard.13

PROCEDURE FOR A TENDER OF PARDON

The inculpatory statement of an approver is voluntary admission of guilt in addition to disclosure of the role of the co-accused in commission of the crime. Sections 306 and 307 of the Code empower the court to tender pardon under different circumstances. The powers conferred for granting pardon can be exercised at any stage after the case is received for trial and before its conclusion. There is nothing in the language of the section to show that an application must be moved by the prosecution. The court may consider a request by the prosecution and also from an accused. The Supreme in *CBI* v. *NK Amin*,14 has referred the *Lt. Commander Pascal Fernandes* case15 to explain procedure and nature for granting pardon:16

To determine whether the accused's testimony as an approver is likely to advance the interest of justice, the Special Judge must have material before him to show what the nature of that testimony will be. Ordinarily it is for the prosecution to ask that a particular accused, out of several, may be tendered pardon. But even where the accused directly applies to the Special Judges he must first refer the request to the prosecuting agency. It is not for the Special Judge to enter the ring, as a veritable director of prosecution. The power which the Special Judge exercises is not on his own behalf but on behalf of the prosecuting agency, and must, therefore, be exercised only when the prosecution joins in the request. The State may not desire that any accused be tendered pardon because it does not need approver's testimony. It may also not like the tender of pardon to the particular accused because he may be the brain behind the crime or the worst offender. The proper course for the Special Judge is to ask for a statement from the prosecution on the request of the prisoner. If the prosecution thinks that the tender of pardon will be in the interests of a successful prosecution of the other offenders whose conviction is not easy without the approver's testimony, it will indubitably agree to the tendering of pardon. The Special Judge (or the Magistrate) must not take on himself the task of determining the propriety of tendering pardon in the circumstances of the case.

An accused can approach the court with a request for the recording of his confessional statement as an approver, however in that situation, the magistrate has to ensure his identity as the accused and also the fact that investigation in that offence is currently underway, otherwise such statement shall not amount to a statement 'in the course of investigation' and therefore not a valid statement within the meaning of Section 164 of the Code.[17] Procedures are different for tendering pardon under section 306 and section 307 of the Code.[18] Section 306 is invokable at the pre-committal stage whereas section 307 is applicable at the post-committal stage. The person granted a pardon under section 306 may have to be examined twice; such a contingency may not arise

under section 307. First stage proceedings under section 306 held in the Magistrate Court in the absence of suspect at any stage of the investigation or inquiry into or at the stage of taking cognizance; whereas in the second stage the court is also empowered to tender a pardon during the trial.

The examination of the approver, as per the scheme under section 306(4) of the Code is ex-facie, mandatory. Thereafter, the proceeding may follow one of two paths; the trial of main offence continues, in the absence of any infraction, and the approver is liable to be arraigned therein as a prosecution witness. On the other hand, if the public prosecutor certifies that the approver is breaching any condition of tender of pardon, by concealing material facts or tendering false evidence, the approver is arraigned as accused liable to be tried separately under section 308.

On the other hand, the power to grant pardon under section 307 is exercised after the commitment of case under section 209 of the Code usually to the Court of Session, but before the judgment, intending to obtain evidence from a person supposed to have been directly or indirectly concerned in, or privy to, any such offence. Thus, after the commitment of a case for trial, the Session Court or the court trying the case also equipped with the power to examine the approver at the first instance after expressing intention and qualifying the object under section 307, without any limitation of section 306(4)(b) of the Code, since after commitment an accused has the right to participate in all the proceedings conducted in open court. Thus, by invoking section 307, the court may exercise power to grant a pardon as a trying court in the original jurisdiction

The multiplicity of proceedings in granting pardon as well as a dual examination of intended approver is also curbed under section 307 of the Code to avoid possibilities for elimination or influencing the intended approver. However, the drawback of section 307 is that prosecution also loses its right to claim the privilege under section 173(6) of the Code[19] in a case section 307 has opted during open proceedings after the committal of a case. This legal conundrum of procedural duality was challenged before the apex court in *M. Chhagganlal* v. *Greater Bombay Municipality*[20] on the strength of violation of Article 14 of the Indian Constitution. The apex court turned down the contentions by observing:[21]

It is, therefore, clear from these decisions that where there are two procedures for determination and enforcement of a liability, be it civil or criminal or revenue, one of which is substantially more drastic and prejudicial than the other, and they operate in the same field, without any guiding policy or principle available from the legislation as to when one or the other procedure shall be followed, the law providing for the more drastic and prejudicial procedure would be liable to be condemned as discriminatory and void. This principle has held that field for over twenty years and it is logically sound and unexceptionable. The arbitrary choice of two alternative procedure is, therefore, not given to the same authority and there is accordingly no violation of Article 14. This contention of the respondents is in our opinion, having regard to the substance of the guarantee of equality, untenable and cannot be accepted.

It proceeds on a misconception of the true principle on which this Court has struck down laws providing for special procedure which is substantially more drastic and prejudicial than the ordinary procedure.

There is another provision under section 5(2) of the Prevention of Corruption Act, 1988, which empowers the Special Judge to tender pardon to obtain evidence of any person who directly or indirectly concerned in an offence for the purpose of sub-sections (1) to (5) of section 308 of the Codedeemed to have been tendered pardon under section 307 of that Code. However, Section 5(2) of the Act, 1988 does not affect invoking provisions of section 306 of the Code by the court. Consequently, the Special Judge of PC Act enjoys dual power as the warrant trial magistrate and the Session Judge. Thus, the powers under sections 306 and 307 of the Code are vested in the court notwithstanding the provision of section 5(2) of the Act, 1988.[22]

RECORDING THE STATEMENT OF PROPOSED APPROVER UNDER SECTION 164 OF THE CODE

It is pertinent to understand the need to record the statement under section 164 of the Code. The object of the recording of such statement before the Magistrate is twofold; firstly, to deter a witness from changing his version subsequently;and secondly, to get over the immunity from the prosecution concerning information given by the witness under section161 read with section 162 of the Code. The other reason of recording statement of a witness by the Magistrate is to minimize the chances of turning volte-face by a witness during the trial due to fear of being found involved in perjury, or under duress or intimidation by the perpetrators. The statement recorded under section 164 is the public document according to section 74 of the Evidence Act and does not require any formal proof. Such a statement is admissible in evidence under section 80 of the Evidence Act. Hence, summoning of the Magistrate by the Sessions Court to prove the contents of the said statement is improper.[23]

The statement recorded by the Magistrate under section 164 of the Code is not a substantive piece of evidence, however, it may be used only for contradiction or corroboration made in the Court in the manner provided under sections 157 and 145 of the Indian Evidence Act. A confession is a substantive evidence against its maker, provided it has been duly recorded and suffers from no legal infirmity, it would suffice to convict the accused who has confessed. Further, as a matter of prudence, the Court may expect some corroboration for establishing the guilt of other accused beyond a reasonable doubt, in addition to a disclosure made by an approver.

The confessional statement of an accused under section 164 of the Codefor considering him as an approver is not mandatory to be recorded,[24] but it is a prevalent prudent convention for getting recorded his confessional version by the Magistrate to arrive at a logical conclusion before considering to grant tender of pardon.[25] It is suggested that the Magistrate must emphasize corroboration of facts disclosed by the proposed approver and advanced digital technology like videography must be used for examination of approver to take judicial

notice of gestures and body language of the witness, which is relevant under sections 8, 14 and 119 of the Evidence Act.1872 of the Evidence Act. It becomes more relevant in case the approver is deaf or dumb or not in a state to tender oral statement.[26]

EXAMINATION OF THE APPROVER

Section 306(4)(a) of the Code entails that the person accepting a tender of pardon made under sub-section (1) shall be examined as a witness in the court of Magistrate taking cognizance and during the subsequent trial. As such, there are two occasions to be examined the approver once by the magistrate while taking cognizance, and before the trial court. The question arises whether the approver is to be cross-examined while examining pre-cognizance by the Magistrate and the defence has the right to cross- examine twice on both stages. The examination of the approver by the Magistrate taking cognizance is similar to the examination of a witness under section 202(2) of the Code. It is a settled law upheld by the apex court during the course of an enquiry under section 202, the accused neither has right to cross-examine the accused, nor has a claim to participate in such proceedings; even the Magistrate has not to put any question to the witnesses at the instance of the accused.[27] Earlier, different views on this legal issue have been expressed by the High Courts.

The High Court of Andhra Pradesh in *Uravakonda Vijayaraj Paul* v. *Stateof Andhra Pradesh*[28] held that mere recording of the statement of an approver does not amount to examination as a witness unless the accused are allowed to cross-examine the approver and that the provision of section 306(4) of the Code is mandatory. Kerala High Court in *In ReChief Judicial Magistrate* v. *Unknown29*has observed that examination under section 306(4) would be even before issuing process, and at that stage no inquiry is involved and accused will be nowhere in the picture, therefore, there is no question of the accused being permitted to cross-examine the approver at that stage and he has no right to participate in the examination. The apex court in a plethora of judgments has illuminated this legal riddle by not permitting the accused, at this stage, to cross-examine a proposed approver.30

An analytical examination of law safely deduced that examination of the approver by the Magistrate taking cognizance is a mandatory requirement but his cross-examination by the accused is not the statutory obligation, and the accused would get an opportunity to cross-examine the approver only during trial proceedings. Nevertheless, the offences under the Prevention of Corruption Act are to be tried before the Special Judge who has got original jurisdiction on a par with the Magistrate and if pardon tendered by the Special Judge, the approver is to be examined only during the trial and not before taking cognizance.

JUDICIAL CUSTODY OF THE APPROVER

Section 306(4)(b) of the Code necessitates that after accepting a tender of pardon under section 306(1) he shall, unless he is already on bail, be retained under judicial custody till termination of the trial. Illuminating the constitutional validity of section 306(4)(b), the apex court in *Suresh Chandra Bahri*v. *State*

*of Bihar*31has observed that there is no doubt that Clause (b) of section 306(4) directs that the approver shall not be set at liberty till the termination of the trial, and the provision is based on the principle of public policy and public interest, and violation of the statutory provision would invite stringent action against hostile approver under section 308. Sections 437 and 439 of the Code may not be applicable to the case of approver since after granting a pardon his status is as a witness of the prosecution and these sections deal with granting of bail to the accused lodged under judicial custody. It is a well settled principle of law that general provisions shall give way and bow before the special provisions.[32]

However, a question was raised before various High Courts, whether notwithstanding section 306(4)(b), provisions under section 482 of the Code may be invoked within the ambit of the inherent power of the High Court to grant the bail to the approver. Various high courts of India have observed that there is nothing to fetter the power of the High Court under section 482 and in exceptional and reasonable matters a High Court is empowered to enlarge an approver on bail; or if proven circumstances to suggest that his detention is longer.[33] In these judgments of high courts, the observations of the apex court in *Sunil Batra* v. *Delhi Administration*[34] and *Hussainara Khatoon* v. *State of Bihar*[35] have been referred, wherein section 482 of the Code has been made applicable to the approver for releasing him on bail for preserving the spirit cherished under Article 21 of the Indian Constitution. It appears befitting that in case an approver being in jail has complied all conditions of a tender of pardon to the satisfaction of the court and the public prosecutor has no objection to the disclosure of all facts of crime, then there must be a provision in law enabling the trial court to release the approver immediately.

EVIDENTIARY VALUE: 'DOUBLE TEST' FOR DETERMINING THE RELIABILITY OF AN APPROVER

In *Mahla* v. *Crown*[36] the High Court of Lahore observed that "The fact, however, that an approver appears to the court to be an untrustworthy witness does not absolve the court from complying with the statutory provisions." The apex court of India, in *Sarwan Singh* v. *State of Punjab*,[37] held that "The appreciation of an approver's evidence has to satisfy a double test. It must show that he is a reliable witnessand that his evidence receives sufficient corroboration".[38] The Magistrate, while recording the statement of proposed accomplish under section 164 of the Code for considering as approver, must ensure that "the mind of the accused person should be completely free from any possible influence of the police and he must be sent to jail custody and given adequate time to consider whether he should confess at all. Ordinarily, he must be given at least 24 hours to decide."[39] The court must evaluate two interconnected and inseparable aspects, firstly considering the evidence of the approver with the corroborated piece of testimony, and secondly, reject it if appears to be untrustworthy. The court must ascertain that confession is purely voluntarily and discloses true facts of commission of the crime. It is essential to compare the disclosure with the rest of evidence and probabilities of chain of incidence.

In *R* v. *Baskerville*,[40] the King Bench held that "It has been a rule of practice at common law for the judge at the trial of a person for a criminal offence to warn the jury of the danger of convicting the prisoner on the uncorroborated evidence of an accomplice." It is not necessary that the accomplice provides every detail of the crime with direct evidence, it is sufficient if the evidence is merely circumstantial in nature. The United Kingdom Courts in *R.* v. *Atwood and Robbins*,[41] and *R.* v. *Jones*[42] held that an accomplice is a competent witness, and, if the jury found testimony worthy of credit, the verdict fulfil requirements of law.[43] Lord Ellenborough, in *R* v. *Jones*[44] held that "Judges in their discretion will advise a jury not to believe an accomplice unless he is confirmed, or only in as far as he is confirmed, but, if he is believed, his testimony is unquestionably sufficient to establish the facts to which he deposes. It is allowed that he is a competent witness, and the consequence is inevitable that if credit is given to his evidence it requires no confirmation from another witness." In *Ram Narain* v. *State of Rajasthan*,[45] Dua, J. while speaking for the apex court on the nature of approver has observed:

An approver who is admittedly guilty of the crime is an accomplice who has betrayed his associates and has apparently sought pardon for saving his own skin. In other words, he has purchased complete immunity for his prosecution at the expense of his associates by agreeing to give evidence against them for the prosecution. He is, therefore, presumed not to be a man of high character or a fair witness. His pardon being conditional, to please the prosecution he may well weave some false detail into the true details of the prosecution story and may also falsely involve some innocent person. There is thus a real danger of his telling a story true in general outline but containing some untruth which he can easily work into the story. It is for this reason that the courts as a matter of prudence and caution anxiously look for some corroboration to satisfy their conscience that the approver's testimony which is clearly admissible is also worthy of belief credit. One can of course visualise an accomplice who is genuinely repentant for the commission of his crime and truly desires to make a clean breast of the whole affair by way of penitence. But even in such cases the court has to judicially determine the extent to which his uncorroborated can be considered as trustworthy by looking to the other relevant material and the attending circumstances on the basis of which the accused can be safely convicted. The rule which seems to emerge from the foregoing discussion and judicial decisions is that the necessity of corroboration as a matter of prudence except when it is safe to dispense with such corroboration must be clearly present to the mind of the judge.

In *Narayan Chetanram Chaudhary* v. *State of Maharashtra,*[46] the apex court held that a conviction based on the uncorroborated testimony of an approver is not illegal since no distinction can be made between an accomplice who is an approver and who is not. However, courts as a matter of prudence and practice do not usually accept the testimony of an approver without corroboration in material particulars.In reference to evidential value of approver,

provision under section 133 and illustration (b) of section 114 of the Indian Evidence Act, 1872 need to be analysed. Section 133 contemplates that an accomplice shall be a competent witness, and a conviction is not illegal merely because it proceeds upon the uncorroborated testimony of an accomplice. However, as per illustration (b) of section 114, an accomplice is unworthy of credit unless he is corroborated in material particulars. These provisions seemingly appear contrary, but in a true sense, these are complementary to each other. The constitutional courts have deliberated and approved the legal issue of conviction based on the uncorroboratedsole testimony of the approver.[47] Section 134 of the Indian Evidence Act contemplates that no particular number of witnesses shall, in any case, be required for proving an act, and an approver is akin to a witness. Hence, it would be befitting to deduce that a conviction cannot be illegal merely due to non-corroboration; however, his evidence is examined and evaluated with due care and copious caution.

NON-COMPLIANCE OF CONDITIONS OF A TENDER OF PARDON

Once an accused is granted a pardon under the provision of the Code and is made approver, his status changes from the accused to a prosecution witness, and he is duty- bound to speak 'truth' to facilitate the process of justice. Violation of conditions of tender of pardon by an approver, irrespective of the pardon granted under sections 306 or 307 of the Code, meets the same fate as envisaged under section 308 of the Code. Section 308(1), enables the judge to conduct the trial of a person not complying with the conditions of pardon, if the Public Prosecutor certifies that in his considered opinion such person has, either by wilfully concealing anything essential or by giving false evidence, not complied with the condition on which the tender was granted, or for any other offence in which he appears to have been guilty in connection with the same manner, and also for the offence of giving false evidence.[48]

After the public prosecutor filed such certificate under section 308(1), the inexorable and inevitable consequence would be that the approver would cease to be an approver, and would become an accused. Consequently, the approver-turned-accused could never be regarded as a witness for the prosecution during the core trial. The apex court has observed that in case the Public Prosecutor has not taken any step to proceed against the approver, the High Court itself has inherent powers to proceed against the approver in case he is wilfully suppressing material facts or is giving false evidence.[49]

In *State (Delhi Administration)* v. *Jagjit Singh*,50 the apex court held that grant of pardon has nature of a contract between the State and the accused in exchange for full disclosure of facts on the part of accused and granting pardon by the State. The court further observed that". It is because of this mandate, the State cannot withdraw the pardon from the approver nor the approver can cast away the pardon granted to him till he is examined as a witness by the prosecution both in the Committing Court as well as in the trial court. The approver may have resiled from the statement made before the Magistrate in the Committing Court and may not have complied with the condition on

which a pardon was granted to him, still the prosecution has to examine him as a witness in the trial court".[51] Commenting on the role of the Public Prosecutor in criminal proceedings and the provisions under section 308 of the Code, the High Court of Delhi has observed:[52]

I do not deem it necessary to examine the authority, of the Public Prosecutor, to "peep into" the investigation, and the evidence garnered therein. It is obviously not possible to hold that the Public Prosecutor should remain a stranger to the investigative process, which constitutes the terminus a quo, wherefrom the entire proceeding emanates. Suffice it, therefore, to state that the certificate, under Section 308 (1) of the Cr PC, to be issued by the Public Prosecutor, is required to be based on the examination, of the approver, under Section 306 (4), or any other evidence adduced by the approver during trial, whether prior to committal or thereafter.

The approver is entitled to plead that he had complied with the condition on which tender of pardon was made. The approver shall not be tried for the offence of giving false evidence except with the permission of the Hon'ble High Court. Section 308(2) also contemplates that any statement of such person accepting the tender of pardon, recorded by Magistrate under section 164 or by a court under section 306(4) may be used as a piece of evidence against him during the trial.53 In case, during separate trial of the approver-turned-accused, the trial court observed that he has complied the conditions of pardon, judgment of acquittal shall be passed under section 308(5) of the Code.

REVOCATION OF A TENDER OF PARDON DURING INVESTIGATION: A LEGAL CONUNDRUM

Recently Delhi High Court has deliberated upon the interplay between section 306 and section 308 of the Code of Criminal Procedure, 1973.[54] The petitioner law enforcement agency, in this case, had moved an application before the Special Judge to revoke the tender of the pardon granted to the approver on the ground that he has wilfully concealed true facts and essential information during the ongoing investigation and had deleted relevant data from his laptop. The special court held that the application is not maintainable being premature and implying contention of the approver that pardon granted to an accomplice can be invoked at any stage is untenable; consequently, the application was dismissed. The legal conundrum arose before the high court whether the concept of 'revocation of pardon' does exist under the Indian legal lexicon. The issue was also raised before the court as to whether pardon once granted be revoked, cancelled or withdrawn at the stage of investigation and before recording the statement of an approver under section 306(4) of the Code.

The "concealment" of something "essential", or the tendering of "false evidence" has to be relatable to the statement of the approver, recorded under section 306(4), and not independent thereof. Delhi High Court dismissed the petition by observing that an inclusive and conjoint reading of sections 306 and 308 reveals an "inexorable sequence", whereby the most obligatory step is the examination, of the approver, as a witness, mandated under section 306(4). The high

court further held that issuance of a certificate under section 308(1) had to be necessarily preceded by recording of the statement of the approver as enshrined under section 306(4). However, the court refrained from entering into a debate as to whether "revocation of pardon" exists as a concept in law or not. 55 This remained a vital legal challenge, which needs to be deliberated by the constitutional courts of India. In view of the authors, the legislature or the apex court may consider to introduce legal provisions for revocation of a tender of pardon, if approver is wilfully not disclosing true facts, which may likely to help other accused. This amendment may compel the approver to abide by the conditions of pardon and to cooperate during the process of evidence collection, which is the baseline for fair trial.

CONCLUSION

The approver is an extraordinary legal dogma to punish the heinous criminals, otherwise they may have escaped from the clutches of the legal process. However, it is a slippery slope especially when the prosecution builds a case predominately on an edifice of sole testimony of the approver, without credible corroboration. The judge must be extra cautious about holding guilty, since in Indian social milieu false allegations due to extraneous factors like personal enmity cannot be ruled out. This legal provision may be considered for extraordinary cases like terrorism, big-ticket corruption and economic offences, or diabolic and gruesome bodily crimes. Further, admission of guilt by a proposed approver may be corroborated in terms of recovery of vital items related to crime such as case property or documents or weapon etc. under section 27 of the Evidence Act, 1872 or any significant disclosure which otherwise remained unknown during investigation or trial. Indeed, an approver is a double-edged sword, which must be used by the court with due attention and utmost caution.

(Endnotes)

1 References

Section 133 of the Indian Evidence Act, 1972 deals with 'Accomplice", but the term is nowhere defined in the law. However, an accomplice means "a partner in crime" or "a guilty associate". Section 133 laid down that an accomplice shall be a competent witness against an accused and conviction is not illegal merely because uncorroborated testimony of the accomplice against the accused. Also see: RK Dalmia v. Delhi Administration 1962 AIR 1821: 1963 SCR (1) 253:1962 (32) CC 699.

2 1975 AIR 856 : 1975 SCR (3) 453.

3 Bipin Bihari Sarkar v. State of West Bengal AIR 1959 SC 13 : 1959 SCR 1324:

4 Id. at para 7. Also see: Bipin Bihari Sarkar v. State of West Bengal Also see: Emperor v. Imamshah AIR 1944 Sindh 184; In re.ArusamiGoudan v. Unknown AIR 1959 Mad 274.

5 State through CBI, Chennai v. Arul Kumar (2016) 11 SCC 733 : (2017) 1 SCC (Cri) 381 : (2016) 2 SCC (L&S) 715 : 2016 SCC OnLine SC 582.

6 IndiraniMukerjea (Sheena Bora murder

case accused) turns approver in INX media case. Available at:

https://www.business-standard.com/article/pti-stories/delhi-court-allows-indrani-mukerjea-to-turn-approver-in-inx-media-case-119070400953_1.html (last visited on July 21, 2020).

7 Available at:

https://www.google.com/search?q=Approver+latest+case&rlz=1C1CHBD_enIN863IN864&oq=Approver+latest+case&aqs=chrome..69i57.6987j0j8&sourceid=chrome&ie=UTF-8 (last visited on July 21, 2020).

8 .AIR 1962 SC 1821 : 1963 SCR (1) 253. Also see: Suresh Chand Bahri v. State of Bihar AIR 1994 SC 2420.

9 Holmon v. Johnson [(1775) 1 Cowp 341, 343;98 E.R. 1120, 1121]. Lord Mansfield explained the percept of public policy by saying, "ex dolomalo non oritur action" meaning means "no action arises from deceit". Also see: KaruppaServaiv. KundaruAIR 1952 Mad 833; Rajkumar Sangaiah Pandiyan v. State of Gujarat2010 SCC OnLineGuj 12540 : (2011) 98 AIC (Sum 13) 6 : (2010) 3 GCD 2594 (DB) : (2011) 2 CCR 412 (DB).

10 2005 SCC OnLine Ker 377 : 2005 CriLJ 3848 : 2005 (3) KLT 770 : (2005) 3 KLT 770 (FB) : (2005) 35 AIC 198 (FB) : (2005) 4 CCR 372 (FB).

11 AIR 1959 Mad 274.

12 Santosh Kumar Satish Bhushan Bariyarv. State of Maharashtra (2009) 6 SCC 498. Also see: BawaFaquir Singh v. Emperor AIR 1938 PC 266.

13 CBI v. Ashok Kumar Aggarwal (2014) 14 SCC 295.

14 .CBI v. NK Amin 2010 SCC OnLineGuj 10104.

15 Lt. Commander Pascal Fernandes v. State of Maharashtra (1968) 1 SCR 695 : 1968 AIR 594.

16 .Id. at p. 9.

17 Mahavir Singh v. State of Haryana AIR 2001 SC 2503

18 State of Maharashtra v. Yuvraj 2014 SCC OnLine Bom 1978 : 2015 Cri LJ (NOC 255) 79. The Bombay High Court held that: "… section 306 is applicable where in a case the order of commitment has not been passed and section 307 would be applicable after commitment of the case but before the judgment is pronounced."

19 Section 173 (6) Cr.PC If the police officer is of opinion that any part of any such statement is not relevant to the subject-matter of the proceedings or that its disclosure to the accused is not essential in the interests of justice and is inexpedient in the public interest, he shall indicate that part of the statement and append a note requesting the Magistrate to exclude that part from the copies to be granted to the accused and stating his reasons for making such request

20 AIR 1974 SC 2009.

21 Id. at para 33.

22 Supra note 5.

23 Guruvindapalli Anna Rao v. State of A.P. 2003 CRI.L.J. 3253

24 K. Anil Kumar v. State of Kerala 1996 CrlJ 1942, Hon'ble Kerala High Court has observed that recording a statement U/s 164 is not a "condition for grating pardon".

25 Inderpreet Singh Kahlonv. State of Punjab 2006 (6) SCJ 107 : 2006 (5) JT 252 : (2006) 11 SCC 356; Gurvinder Singh Bhatia v. CBI 2015 SCC OnLine Del 13078; Bangaru Laxman v. State through CBI (2012) 1 SCC 500; CBI v. Ashok Kumar Aggarwal (2014) 14 SCC 295 : (2015) 1 SCC (Cri) 344 : (2015) 3 SCC (L&S) 475 : 2013 SCC Online SC 1030; Harshad S. Mehta v. CBI 1998 (5) BomCR 783 : 1998 2 MOBLR 114; and State through CBI, Chennai v. Arul Kumar (2016) 11 SCC 733 : (2017) 1 SCC (Cri) 381 : (2016) 2 SCC (L&S) 715 : 2016 SCC OnLine SC 582.

26 State of Rajasthan v. Darshan Singh @ Darshan Lal (2012) 5 SCC at p. 789; and Chander Singh v State (NCT of Delhi) (2016) 3 DLT (Cri) 793 : 2016 SCC OnLine Del 3574 : (2016) 167 AIC 697 : (2016) 232 DLT 517 : (2016) 5 RCR (Cri) 890.

27 ChandraDeo Singh v.Prokash Chandra Base @ Chabi1963 AIR 1430; andSashi Jena v.Khadal Swain (2004) 4 SCC 236 : AIR 2004 SC 1492.

28 1986 Cri. L.J. 2104 : LQ 1986 HC 1705.

29 1988 CriLJ 812. Also see: Ashokan v. State of Kerala 2005 Cri.LJ 3848 : 2005 (3) KLT 770.

30 Sanjay Gandhi v. Union of India 1978 AIR 514 : 1978 SCR (2) 861;RanadhirBasuv. State of West BengalAIR 2000 SC 908 : (2000) 3 CALLT 74 SC : 2000 Cri.LJ 1417 : JT 2000 (1) SC 618 : 2000 (1) SCALE 483 : (2000) 3 SCC 161 : 2000 1 SCR 646 : 2000 (1) UJ 446 SC;and Suresh Chandra Bahriv. State of Bihar1995 Suppl. (1) SCC 80.

31 1995 Supp (1) SCC 80. Also see: A. L. Mehrav. State. 1958 Cri LJ 413; Bhawani Singh v. State1956 Cri LJ 44; and KaruppaServaiv. Kundaru alias Muniandi1953 Cri LJ 45.

32 Kunj Bihari Lal and Jagdish v. State of Rajasthan 1984 RCC 42; Bhimsen v. State of Rajasthan 1991 RCC 412; Gurcharan Singh v. State of Rajasthan 2001 (3) WLC 575 : 2002 (1) WLN 338.

33 Prem Chand v. State 1985 Cri.L.J 1534; Noor Taki Alias Mammuv. State of Rajasthan 1986 Cri.L.J 1488; and Subramanian @ Ravi Subramanian v. State of Tamil Nadu 2013 SCC OnLine Mad 3760 : (2014) 1 LW (Cri) 122.

34 1980 Cri LJ 1099 : AIR 1980 SC 1579.

35 AIR 1979 SC 1360 : 1979 Cri LJ 1036.

36 AIR 1930 Lah 95.

37 1957 Cri LJ 1014 : 1957 AIR 637 : 1957 SCR 953.

38 Id. at para 7.

39 Id. at para 10.

40 [2016] 2 KB 658 : [1916-1917] All ER Rep 38 : 86 LJKB 28 : 25 Cox CC 524 : 60 Sol Jo 696 : 115 LT 453 : 12 Cr App Rep 81.

41 (1788) 1 Leach 464 : 14 Digest (Repl) 534,

5132.

42 14 Digest (Repl) 535, 5184 : (1809) 2 Camp 131 : 31 State Tr 251.

43 R. v. Everest 2 Cr App Rep at p. 132. The court observed that "The rule has long been established that the judge should tell the jury to acquit the prisoner if the only evidence against him is that of an accomplice, unless that evidence is corroborated in some particular which goes to implicate the accused."

44 14 Digest (Repl) 535, 5184 : (1809) 2 Camp 131 : 31 State Tr 251.

45 (1973) 3 SCC 805 : AIR 1973 SC 1188 : 1973 3 SCR 463 : 1973 CriLJ 914 : 1973 (5) UJ 598 SC : 1973 WLN 98.

46 (2000) 8 SCC 457.

47 BhivaDoulu Patil v. State of Maharashtra 1963 AIR 599; Ravinder Singh v. State of Haryana 1975 AIR 856, CBI v. Ashok Kumar Aggarwal (2014) 14 SCC 295;Narayan Chetanram Chaudhary v. State of Maharashtra (2000) 8 SCC 457 : AIR 2000 SC 3352; and K. Hashim v. State of Tamil Nadu (2005) 1 SCC 237 : AIR 2005 SC 128.

48 Emperor v. ShandinoDhaniparto AIR 1940 (Sind) 114.

49 Renuka Bai alias Rinku alias Ratan v. State of Maharashtra (2006) 7 SCC 442.

50 AIR 1989 SC 598 : 1989 (2) SCALE 1578 : 1989 CriLJ 1986 : 1989 (1) Crimes 343 SC : 1989 Supp (2) SCC 770.

51 Id. at para 8.

52 Directorate of Enforcement v. Rajiv Saxena 2020 SCC OnLine Del 719, at para 47.

53 The State of Rajasthan v.BhooraAIR 1961 Raj 274 : 1961 CriLJ 798; The State v.HiralalGirdharilal Kothari AIR 1960 SC 360 : 1960 CriLJ 524 : 1960 2 SCR 355; and State of Maharashtra v. Abu Salem Abdul Kayyum Ansari (2010) 10 SCC 179.

54 Supra note 52.Also see: In re:ArusamiGoundan AIR 1959 (Madras) 274; and Emperor v. ShandinoDhaniparto AIR 1940 (Sind) 114.

55 Id. at para 54.

Role of Police in Curbing the Drug Menace among Children using the Juvenile Justice (Care & Protection of Children) Act, 2015

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Thou shalt not be a victim, thou shalt not be a perpetrator, but, above all, thou shalt not be a bystander."

- Yehuda Bauer

ABSTRACT

A pivotal duty is discharged by the police in combating the drug menace, as it has the mandate, and requisite machinery to implement supply reduction techniques. Supply reduction techniques essentially involve taking preventive measures, identification of source of drugs, containing drug peddlers, taking steps to initiate legal action by registering FIRs against the drug peddlers, and conducting effective investigation with a focus to secure convictions. To equip the police in this endeavour, the Parliament in its wisdom introduced Juvenile Justice (Care & Protection of Children) Act, 2015 (JJ Act) which also contains provisions for tackling drug peddlers. Section 77[1] is a formidable tool, a '*Ram Baan*', which prohibits and penalizes the supply of various categories of drugs and psychotropic substances to children. The intent of the legislature is that if drug pushers are kept at bay and the sale of drugs and intoxicating fluids is regulated, the proclivity of children to fall prey to addiction would reduce drastically. The extirpation of the source of these drugs and fluids is a sustainable solution to stop the malaise of addiction, and the path to ameliorate the condition of these hapless children of India. This paper seeks to guide the police in this direction. The experiences shared in this paper are chiefly from Delhi but can be replicated with equal force across the country.

I. Introduction

It is trite that addiction to drugs and other substances induce children to commit crimes to purchase fluid/drugs in order to satiate their cravings. Significantly,

1 77. Penalty for giving intoxicating liquor or narcotic drug or psychotropic substance to a child.—Whoever gives, or causes to be given, to any child any intoxicating liquor or any narcotic drug or tobacco products or psychotropic substance, except on the order of a duly qualified medical practitioner, shall be punishable with rigorous imprisonment for a term which may extend to seven years and shall also be liable to a fine which may extend up to one lakh rupees

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there is a direct relationship between consumption of intoxicating substances and increase in crime rate. In a study titled **'Substance Use and Criminality among Juveniles-under-enquiry in New Delhi'** published in Indian J Psychiatry, 2016 AprJun:58(2): 178-182 it was concluded that 'Out of 487 juveniles-under-enquiry booked under different crimes, 86.44% of the sample had a history of substance use.' The study and statistics essentially bring to the fore the deleterious effect such substances have on children. This is the age where their susceptibility to start consuming drugs is also at the peak, and thus intervention by the police must be made on a war footing.

II. Section 77, Juvenile Justice (Care & Protection of Children) Act, 2015 and other relevant provisions

Albeit least invoked, this provision is the most potent weapon in the arsenal of law enforcement authorities. To combat the burgeoning issue of drug proliferation amongst children, this stringent provision i.e. Section 77 penalizes the offering of (i) narcotic drugs, (ii) psychotropic substances, (iii)tobacco product or (iv) intoxicating liquor to a child below the age of eighteen years. The section makes the offence punishable with rigorous imprisonment upto seven years, and a fine extendable up to as high as rupees one lakh. Section 78[2] is equally effective, and it penalises whosoever uses a child, for vending, peddling, carrying, supplying or smuggling the above four categories of substances. Both the sections are cognizable, and non-bailable. Further, Rules 56[3] & 57[4] of the Juvenile Justice (Care & Protection of Children) Model Rules, 2016 (JJ Rules) provide for the procedural

2 78. Using a child for vending, peddling, carrying, supplying or smuggling any intoxicating liquor, narcotic drug or psychotropic substance.—Whoever uses a child, for vending, peddling, carrying, supplying or smuggling any intoxicating liquor, narcotic drug or psychotropic substance, shall be liable for rigorous imprisonment for a term which may extend to seven years and shall also be liable to a fine up to one lakh rupees

3 56. Procedure in case of offence under section 77 of the Act.- (1) Whenever a child is found to be under the influence of, or in possession of intoxicating liquor or narcotic drugs or psychotropic substances or tobacco products, including for the purpose of sale, the police shall enquire as to how the child came under the influence of, or possession of such intoxicating liquor or narcotic drugs or psychotropic substances or tobacco products and shall register an FIR forthwith. (2) The child who has been administered narcotic drugs or psychotropic substances or is found under the influence of the same may be produced either before the Board or the Committee as the case may be, and the Board or the Committee shall pass appropriate orders regarding rehabilitation and de-addiction of the child. (3) In case of a child found to be addicted to intoxicating liquor or tobacco products, the child shall be produced before the Committee which shall pass directions for rehabilitation including de-addiction of the child and transfer the child to a fit facility identified for the purpose. (4) In case any child is found to have been administered intoxicating liquor or narcotic drugs or psychotropic substances or tobacco products in a Child Care Institution, the child shall be produced immediately before the Board or the Committee, except in such cases where the child is not in a position to be produced before the Board or the Committee and requires immediate medical attention. (5) The Board, shall on its own or on complaint received from the Committee, issue directions to the police to register an FIR immediately. (6) The Board or the Committee shall also issue appropriate directions for inquiry as to the circumstances in which such product entered the Child Care Institution and reached the child and shall recommend appropriate action against the erring officials and the Child Care Institution. (7) The Board or the Committee may also issue directions for transfer of the child to another Child Care Institution as the case may be. (8) Any shop selling intoxicating liquor, tobacco products, must display a message at a prominent place on their shop that giving or selling intoxicating liquor or tobacco products to a child is a punishable crime with up to seven years of rigorous imprisonment and a fine of up to one lakh rupees. (9) All tobacco products and intoxicating liquor must display a message that giving or selling intoxicating liquor or tobacco products to a child is a punishable crime with up to seven years of rigorous imprisonment and a fine of up to one lakh rupees. (10) Giving or selling of intoxicating liquor, narcotic drugs or psychotropic substances or tobacco products within 200 meters of a Child Care Institution or any other home registered or recognized under the Act, or the office of a Committee or a Board shall be deemed to be an offence under section 77 of the Act.

4 57. Procedure in case of offence under section 78 of the Act.- (1) Whenever a child is found to be vending, carrying, supplying or smuggling an intoxicating liquor, narcotic drug, or psychotropic substance, the police shall enquire how and from whom the child came into possession of the intoxicating liquor, narcotic drug, or psychotropic substance and shall register an FIR forthwith.(2) A child who is alleged to have committed an offence under section 78 of the Act shall be produced before the Board, which may transfer the child to the Committee, if the child is also in need of care and protection.

mechanism to give teeth to the above sections.

A perusal of the individual childcare plans or social investigation reports of any of the children lodged in drug de-addiction centers reveal that many children have dependency inter alia on inhalants. As narrated by their parents, these children regularly consume whiteners, diluters, thinners and solution/sulochan. It is writ large by observing the plight of such children that consumption of the aforementioned addictive substances has played havoc with their physical and mental health. It would be further revealed that addiction of the child is due to the nefarious activities of drug peddlers, and even unscrupulous chemists, who are operating in the area and who are responsible for proliferation of such substances.

III. Interpretation of Section 77 JJ Act, 2015

Four categories of substances have been explicitly mentioned in the section. However, what was not mentioned, was a seemingly innocuous but potentially deadly substance, sale of which was essentially unregulated, and its ease of availability ensured sustained doses of addiction. The said substances are different species of inhalants or volatile solvents viz. correction fluids, whiteners, thinners etc. As per the **Report on Magnitude of Substance Abuse in India, 2019**, issued by the Ministry of Social Justice and Empowerment, GOI 'at the national level, an estimated 4.58 lakh children and 18 lakh adults need help for their problematic inhalant use'. The Juvenile Justice Board, Delhi, was grappling with the issue of children taking inhalants and committing crimes, and was bestowed with an occasion to meaningfully interpret this provision to include inhalants within its ambit, under the category of ' intoxicating liquor' It is pertinent to note that according to the **25th Report of the Standing Committee on Social Justice and Empowerment, December 2015** titled "Persons Affected By Alcoholism & Substance (Drug) Abuse, Their Treatment/Rehabilitation And Role Of Voluntary Organizations", the Committee observed that early prevention and early intervention are an integral part of the treatment and rehabilitation programme for drug addicts. Early prevention necessitates keeping children away from drugs and other psychotropic substances. Prohibiting the sale of such substances that are easily available would be a positive step towards attaining this objective.

Duty of the State

It is the duty of the State as enshrined in Article 47, Part IV of the Constitution of India to raise the level of nutrition and the standard of living and to improve public health. It is mandated that the state shall regard the raising of the level of nutrition and the standard of living of its people and the improvement of public health as among its primary duties. Further, the State shall endeavour to bring about prohibition of the consumption, except for medicinal purposes of intoxicating drinks and of drugs which are injurious to health. At the time when the process of framing of our country's Holy Document was underway, one of the members Sh A.V Thakkar had remarked during the debate on the aforementioned Article held on 24.11.1948 :

"There is another matter. All Adivasis do not want to drink: they want prohibition.

I am talking of the Bhils in Gujarat, in Maharashtra, in West Khandesh and in the Central Provinces. I am talking of the Gonds also of the Central Provinces. I have asked hundreds and thousands of them whether they want drink or whether they want prohibition. Their decided answer to me has been: ''Thakkar, you are talking of prohibition; you are talking of doing away with drinks. **You are placing these enticements in our path and you are still asking for our opinion. For God's sake have the liquor shops closed and then ask us. We are enticed to go to drink; otherwise we will not.**"

Thus, the focus has to be on removal of supply chain.

Order of the JJB

The JJB surmised that the meaning of the term 'intoxicating liquor' in Section 77 cannot be confined to mean only beer, wine, etc., as understood in common parlance. It's meaning would be expanded to inhalants too. These inhalants contain inter alia solvents like toulene, methylbenzene, trichloroethylene, etc. which are alcoholic, and produce the same effects on the body as an alcohol does. Inhalants are highly addictive, like alcohol and are often the first drug children experiment with because of their widespread and easy accessibility. To mitigate the menace caused by inhalants, the quest that the Board embarked upon was to ascertain whether inhalants like correction fluids/whiteners, thinners and vulcanising solutions/sulochans can be covered within the ambit of the term 'intoxicating liquor' as mentioned in section 77 of the JJ Act,2015. The answer was held to be in the affirmative.

Govt Notification

Pursuant to the Order of the JJB, the Delhi govt issued a notification, having far reaching ramifications, which would eventually be for the benefit of lacs of children of Delhi This notification will serve as an efficacious tool to curb the menace of drugs, as it is inhalants that are 'stepping stones' into the world of drugs. The prohibition vide the above said notification, on the sale of inhalants to minors, would eventually reduce their usage and dependency by minors: It would be a stupendous strategic and tactical move in the war against drugs.

High Court verdicts

The above interpretation of Section 77 JJ Act was referred to, and upheld in *Aasha vs State*[5], *Akshay Chadha vs State*[6], two verdicts of seminal importance in this field. Both the judgments held that inhalants fall in the category of intoxicating liquor, and thus their sale to minors is punishable under Section 77 JJ Act. Taking a cue from Delhi High Court, The Uttarakhand High Court in Shweta *Mashiwal Vs State of Uttarakhand*[7] *relied on Aasha's* judgment and also banned the sale of inhalants in Uttarakhand, punishable under Section 77 JJ Act.

IV. Prevention

Surveillance

Criminal history is replete with examples where persons with previous convictions or involvements are unable to extricate themselves out of the vicious cycle of crime, and pursue it as an avocation. The experience in Delhi reflects that a lot of drug peddlers had a prior involvement especially with NDPS cases, but they unabashedly continued with their

5 WP (Crl) No 2401 of 2017 (Delhi High Court)

6 Bail Application No. 334/2018 (Delhi High Court)

7 2018 SCC OnLineUtt 736

nefarious activities while they were out on bail. It is this lot which needs to be monitored. In *Asha's* case (supra), the High Court instructed the Delhi Police to mount a constant vigil and surveillance on such persons. Further, externment proceedings ought to be initiated against bad characters (BC) against whom NDPS and Excise cases have already been registered, as they, more often than not, indulge in drug peddling to children

Awareness & distancing

Next, steps should be taken for removal of sources of allurement. As per Rule 56(8) of the JJ Rules, any shop selling intoxicating liquor, tobacco products, must display a message at a prominent place on their shop that giving or selling intoxicating liquor or tobacco products to a child is a punishable crime with up to seven years of rigorous imprisonment and a fine of up to one lakh rupees. This alone would deter the owner of the shop. Further, as per Rule 56(10) giving or selling of intoxicating liquor, narcotic drugs or psychotropic substances or tobacco products within 200 meters of a Child Care Institution or even the office of a Child Welfare Committee or a Juvenile Justice Board shall be deemed to be an offence under section 77 of the Act. Carrying out a survey to ensure that there is no violation of Rule 56(8) and 56(10) of the JJ Rules would be a constructive step toward reducing the supply of these contraband items. Further, invoking powers vested under Section 144 CrPC, senior police officers may get directions issued for putting such display boards in all betel shops.

Action against unauthorized shops

Further, a lot of these stalls operate without licenses. Their removal may entail loss of livelihood, and it may be a law and order problem. However, when such unscrupulous elements sell tobacco products and alcohol to children without any compunction, then steps must be initiated for their closure under Section 268 or 283 IPC. Similarly, it is a known phenomenon that stolen items are usually sold to goldsmiths, scrap dealers, many of them which are unauthorized. Removal of unauthorized *kabadi* shops which do not have licenses is another step that needs to be taken along with invoking Sec 411 IPC i.e. the charge of receiving or retaining stolen property must be invoked against such elements.

Special Units

Setting up of Task Forces or Special Units, as mandated by the NALSA (Legal Services to the Victims of Drug Abuse and Eradication of Drug Menace) Scheme, 2015. The Special Units, apart from coordination and spreading awareness, can also help in destruction of illicit opium and cannabis cultivation[8].Cue can be taken from Delhi where, vide a Govt. Notification[9], setting up of District Task Force comprising the

8 9. Destruction of illicit cultivation: The SLSAs shall coordinate with the State Governments for the destruction of illicit cultivation of cannabis and opium as well as any other plant used to derive Narcotic and Psychotropic Substances. The SLSAs may also urge the State Government to include such destruction as admissible work under MNREGA Scheme. This will pave the way for the destruction of illicit plants on a large scale besides, encouraging community involvement in the entire campaign.

9 Government Notification F.No.7(15)/2012/Misc/DHS/SHS/Pt.file-III/1229-1239 dated 28.07.2017 issued by the Department of Health and Family Welfare,Govt of NCT of Delhi

Deputy Commissioner (Revenue) and the Deputy Commissioner of Police has been envisaged for monthly monitoring of sale of inhalants.

V. Taking the Initiative

Identification of source and registration of FIRs under Section 77 & 78 JJ Act

Experience suggests that most of the FIRs under Section 77 & 78 JJ Act came to be registered pursuant to the orders of Juvenile Justice Boards(JJBs). The JJBs take a proactive approach, inquire from the children as to the source of drugs, and by exercising powers under Sec 8(3)(k) of the JJ Act, direct the police to register FIRs against drug peddlers. However, the need of the hour is *suo moto* registration of FIRs under section 77 and 78 JJ Act by the police. It is imperative for the police to develop credible intelligence network for the said purpose. The most reliable sources for tapping information are Children's Homes, Observation Homes and Drug De-addiction Centers. There are Narcotics Anonymous Centers too.[10] Senior Police Officers should make regular visits to these centers and interact with children. Do not begin by asking *whether* the child takes drugs, as invariably the child will be in denial. Instead, ask from him *where* does he buy his stuff, from *whom* does he buy and at what price. Show that you know. The presence of staff of these centers, including counsellors, who have already established a rapport with these children, would be imperative. Once the trust of a child is earned, he or she will easily divulge all the necessary information.

Eliciting information through persuasion

The above information can, and ought to be elicited by the Child Welfare Police Officers (CWPO)[11] too. Rule 2(xvi) of the Juvenile Justice (Care & Protection of Children) Model Rules, 2016 mandates the preparation of Social Background Report (SBR) of the child. The most vital utility of preparation of a Social Investigation Report has been laid down in the Rules, wherein it has been elaborated that Social Investigation Report should provide for risk assessment, including aggravating and mitigating factors highlighting the circumstances which induced vulnerability such as traffickers or abusers being in the neighbourhood, adult gangs, drug users, accessibility to weapons and drugs, exposure to age inappropriate behaviours, information and material. The report prepared by CWPOs can give a description of drug peddlers in the following format, and the police can initiate action suo motu thereafter.

10 https://naindia.in/na-meetings-in-india/delhi-area-meetings/

11 107. Child Welfare Police Officer and Special Juvenile Police Unit.—(1) In every police station, at least one officer, not below the rank of assistant sub-inspector, with aptitude, appropriate training and orientation may be designated as the child welfare police officer to exclusively deal with children either as victims or perpetrators, in co-ordination with the police, voluntary and non-governmental organisations. (2) To co-ordinate all functions of police related to children, the State Government shall constitute Special Juvenile Police Units in each district and city, headed by a police officer not below the rank of a 42 Deputy Superintendent of Police or above and consisting of all police officers designated under subsection (1) and two social workers having experience of working in the field of child welfare, of whom one shall be a woman. (3) All police officers of the Special Juvenile Police Units shall be provided special training, especially at induction as child welfare police officer, to enable them to perform their functions more effectively. (4) Special Juvenile Police Unit also includes Railway police dealing with children

Name & Description of suspected drug peddler	Other details viz. address, family members etc.	Area of operation	Time of operation	Type & price of drugs sold

Protocols

It would be vital to formulate a Standard Operating Procedure (SOP) qua investigation of cases under section 77 and 78 JJ Act. In Delhi, the police have been so mandated vide orders passed in *Akshay Chaddha's* case. This progressive order makes it incumbent upon CWPOs to prepare the above chart while preparing SBRs.

Anti-Narcotic Squads

The necessity of specialized task forces, of law enforcement agencies, to curb street peddling was recognized by the High Court of Delhi in *Aasha's* judgment. The Commissioner of Police, Delhi has approved to constitute a Anti-Narcotics Squad in each district, which shall be supervised by an Inspector rank Officer, who in turn shall work under the supervision of ACP Operations. Each Squad shall have manpower of two Upper (S.I/ASI) and eight subordinates (HCt./ Ct.). Another step that ought to be taken is immediate operationalization of Anti-Narcotics Squads. Further, these Squads should have sufficient women officers, so as to allay the apprehension of counter allegations of sexual harassment on male police officers, as many drug peddlers are women.

Ending illegal community practices

It has been a trend that certain sections of society/communities indulge in bootlegging, of carrying trade in illicit liquor. They brazenly carry out this 'trade' with total impunity, on the pretext that it is their 'family' or 'community' business. By involving children in these activities, they jettison the future of children of their own community. This cannot give them a *carte blanche* to violate the law, and the police must step in, and not baulk at invoking Section 78 of the JJ Act, along with the provisions of relevant Excise laws.

Ban on sale of loose cigarettes

Another major area of concern is the easy availability of loose cigarettes in the hands of children. An overwhelming 70% of the cigarettes sold in India are loose. Banning sale of loose cigarettes would be an important step: The ban on loose cigarette sale would be in consonance with the WHO Framework Convention on Tobacco Control (FCTC), which India signed and ratified in February 2005. Article 16(3) of FCTC states: *"Each Party shall endeavour to prohibit the sale of cigarettes individually or in small packets which increases the affordability of such products to minors.* Further, interpretation of Rule 3 & 4 of the Cigarettes and Tobacco Products (Packaging & Labelling) Rules, 2008 would make it explicit that selling loose cigarettes would defeat the purpose of Rule 3, and is a violation of Rule 4

Crime Review Meetings

Include Section 77 JJ Act in Crime Review

meetings /Statistics along with the *de rigueur* theft, murder etc statistics to keep a check on nefarious activities.

Helpline number

Having a helpline number/ WhatsApp Number like NCB has (for uploading images of illicit cultivated areas of opium[12].Further, State Police website and Facebook page should have a mechanism for reporting sale of illicit drugs and intoxicants.(with an assurance to the informer that the user will not be prosecuted). There should be Reward Policy like NCB has- rewards to be paid to informants as well as officers.

VI. Investigation

Mindset

There is a mindset to take action only when a 'big' recovery would be effected. Quantity should not be a factor to be taken into consideration. A drug peddler sells small 'purias/piece/packet' at one point in time, but at the end of the day, it is a 'big' quantity that has been ultimately sold.

Effective Investigation

All pending investigations should be immediately transferred to specialized task forces or the Anti-Narcotics Squad in each District. Uttarakhand has emulated Delhi by setting up Anti-Narcotics Squad, and other States can follow suit too. Further, it must be ensured that surveillance and trap technique is adhered to, as straightaway arrests, without recovery, botch up the cases. Further, to ensure videography during raids, smart body worn cameras can be put on the body of decoy or stock witnesses. Further, directions should be given under Section 144 CrPC for installing CCTVs at liquor vends and betel stalls, to keep a vigil and prevent sale to minors.

Bringing unscrupulous chemists to book

In case of sale of medicines without prescription to children, bills and registers of chemists should be seized so that investigation can be done qua stock actually received and items disposed off. In case of sale of habit forming drugs (Alprazolam, diazepam etc which are Schedule H 1 drugs) to children without prescription, action should be taken not only under the Drugs & Cosmetics Act but also under the NDPS Act as these substances fall under the category of psychotropic substances too. This will effectively deter unscrupulous chemists. Focus should be on registration of FIRs u/s 18(1) read with Section 27(b)(2) of the Drugs & Cosmetics Act, 1940 instead of merely cancelling/revoking licenses under Rule 65&66 of the Drugs and Cosmetics Rules, 1945.

Safeguards whilst recording statement of child victim

It must be borne in mind that a child in conflict with law who is a substance abuser, is also a child in need of care & protection[13]. Since the child is a victim, recording of Statement under section 164 CrPC of the child witness must be scrupulously in adherence to Rule 54 of the JJ Rules. Thus, the child shall be produced before a Magistrate to get the statement recorded as expeditiously as

12 WhatsApp No : 9868505002 for uploading of images of illicit cultivated area of opium and poppy by general public

13 Section 2(14) "child in need of care and protection" means a child— (viii) who has been or is being or is likely to be abused, tortured or exploited for the purpose of sexual abuse or illegal acts; or (ix) who is found vulnerable and is likely to be inducted into drug abuse or trafficking;

possible, the child should be accompanied by a support person, the child should be examined in the Vulnerable Witness Deposition Rooms and must not be brought face to face with the accused. With the safeguards, truthful testimonies would be elicited, which will go a long way towards securing convictions.

VII. Prosecution

Witness Protection

We have always lamented the rate of low convictions. To secure a higher conviction rate, especially under Section 77 JJ Act cases, it is of vital importance to protect our vulnerable witnesses. Identity of child witnesses needs to be concealed and they need to be protected in terms of the Witness Protection Scheme, 2018 and directions laid down in *Mahender Chawla vs Union of India*[14]**.**If child witnesses are threatened, appropriate action u/s 195A IPC be initiated

Opposing bails

Bails need to be opposed vociferously by the IOs through the Prosecutor, along with previous NCRB or SCRB dossiers of the accused, if any. The Courts also grant bail wherever investigation is slipshod. There is a need to invoke Section 41(1)(b)(ii) of the CrPC at the time of making arrests and in opposing bail applications so as to meaningfully adhere to the mandate of *Arnesh Kumar vs State of Bihar*[15]. Threats to child witness, commission of offence again by the accused are reasons that can be put forth, as per the said section.

Challenging bail orders

Bail cannot denigrate into a passport for commission of crimes. To go a step further, the bail orders granted should be challenged wherever warranted, through the office of the Chief Prosecutor, especially in cases where the accused, who has previous involvements, comes out and commits an offence during his bail term. Also, grant of anticipatory bail does not *ipso facto* entail in grant of a regular bail, as laid down in *Sat Pal Singh vs State of Punjab*[16], wherein the Apex court highlighted the difference between section 438 and 439 CrPC.

Thorough chargesheets

Prosecutors need to be trained or Special Public Prosecutors may be appointed in the Courts of Metropolitan Magistrates where cases under Section 77 and 78 will be tried. Checklists/Standard points qua objections to being raised at the time of scrutiny need to be developed by the Directorate of Prosecution and the same be disseminated amongst all prosecutors, and then only charge-sheets be filed in courts. Forwarding authority i.e. ACsP be directed to strictly comply with objections raised during scrutiny, and to get lacunae in investigations rectified

The Bait

Section 64 A NDPS Act should be invoked by Prosecutors to grant immunity from prosecution. This provision can be used as a bargaining chip to elicit information on main suppliers/ traffickers. Further, Courts can be persuaded to invoke Section 39 NDPS Act, for accused persons cooperating with the investigation. This avant garde measure needs to be explored and implemented.

14 (2019) 14 SCC 614

15 (2014) 8 SCC 273

16 (2018) 13 SCC 813

VIII. Coordination

With Drug Inspectors

The State Police cannot work in isolation to tackle this menace. In Delhi, Standing Order No. 435/2018 of the Delhi Police ensures that the police liaisons with the Drug Inspectors/office of the Drug Controller. Drug Inspectors must make complaints, requesting the Delhi Police to register FIRs under the NDPS Act too. The police should keep a check on chemists whose licences have been suspended / cancelled by office of the Drug Controller. For this, it is imperative that the data should be shared by both agencies.

With NCB

Deputation of one officer from NCB for a period of time to the Anti Narcotic Squad. Distribution of Drug Detection/Precursor Testing kits by NCB to these Squads.

SIMS & SIEN

Giving access to the State Police to SIMS(Seizure Information management System) as information needs to be shared. Further, police need to be added to SIEN- Secure Information Exchange Network- a platform for an online exchange of intel and info.

With CEIB

The CEIB(Central Economic Intelligence Bureau) has data of illicit cultivation of cannabis and opium, which they obtain by using satellite images. For effective identification, steps should be taken towards procuring latest digital maps of affected areas in each State, so that steps can be taken to destroy illicit crops. It must be noted that the Special Units set up under NALSA Scheme, 2015 have also the mandate to take steps to destroy illicit cultivation[17].

IX. Training

The theme for International Day against Drug Abuse and Illicit Trafficking 2020 is *'Better Knowledge for Better Care'*. The title is apt, for it is only sharing of knowledge and best practices of police forces across the country that can lead to concerted efforts to contain this menace.

Manual

It is imperative that local police get training in drug law enforcement by the officers of Narcotics Control Bureau, as it as an area of their expertise. NCB can help the State Police to make a booklet of Dos and Don'ts, similar to their own The National Academy of Customs, Excise & Narcotics (NAECN), Faridabad can also play a vital role in disseminating information. The COVID pandemic has forced us to adopt technology, and we can make use of this opportunity to prepare online modules and impart classes online.

Sensitization Courses

The course content should focus on imparting knowledge about the JJ Act and the Rules. Further, police personnel should also be taught how to deal with peddlers who themselves are addicts. It is important for the police to regularly have meetings with the judiciary and

17 Supra Note 4

the prosecution department. As per directions of Supreme Court in *Sampurna Behrua vs Union Of India*[18], *the District Legal Services Authority conduct sensitization programmes for police officers.*

X. Monitoring & Evaluation

The efforts of all agencies need to be continuously monitored and reviewed by one Nodal organization or Steering Committee. In Delhi, a suggestion was mooted to make the Juvenile Justice Committee as the Steering Committee, as it routinely holds meetings comprising stakeholders including the police. Further, in Delhi there is an Intersectoral Coordination Committee which discusses and attempts to resolve issues pertaining to drug addiction. It would be in the fitness of things to have 'District Task Forces' or 'Special Units' working and reporting to the above. The work done can be encapsulated in the form of a **Quarterly Reporting Format** given at the end of the paper.

XI. Conclusion

It is common knowledge that inhalants and psychotropic substances pharmaceutical combinations (like alprazolam diazepam etc.) are widely and easily available. Focus and priority of law enforcement agencies need a paradigm shift. It is inevitable that there would be diversion of manpower & resources, which are insufficient. However, a concerted effort for a relatively short period of time, a '*blitzkrieg*' so as to say, might help in the elimination of these anti-social elements and would ensure a drastic reduction in the overall crime rate. It would be an act of supererogation to highlight the nexus between drug proliferation among children on the one hand, and the rising spate of crimes on the other. Children are increasingly being lured and used by unscrupulous adults. The bait is drugs, be it in the form of inhalants, narcotic drugs such as ganja, psychotropic substances such as smack, pharmaceutical products like Nitrovite (10 number) etc. We need to urgently tackle the core issue and take the bull by the horns, to be able to break the vicious cycle of crime, perpetrated using youngsters, by adults pursuing their nefarious designs.

It is with a sense of urgency that we need to understand that children need to be insulated from the scourge of substance abuse, which has proliferated deep in our societal structure. The UN Secretary General Kofi Annan had once remarked *"there is no trust more sacred than the one the world holds with children. There is no duty more important than ensuring that their rights are respected, that their welfare is protected, that their lives are free from fear and want and that they can grow up in peace"*. It is upto us to zealously safeguard their rights. We need to act on a war footing.

18 (2011) 9 SCC 801

EVALUATION FORMAT (QUARTERLY)

S. NO.	ACTION TO BE TAKEN	DEPARTMENT	DETAILS OF WORK DONE	SHORTFALL, IF ANY & REASONS THEREOF
1.	No. of cases registered u/s 18 read with Sec 27 Drugs & Cosmetics Act, 1940 qua unauthorized sale to minors	Drug Controller		
2.	No. of licenses suspended or cancelled under Rule 66 Drugs & Cosmetics Rules,1945.	Drug Controller		
3.	No. of personnel in Anti-Narcotics Squad	Police		
4.	No. of women personnel in Anti-Narcotics Squad	Police		
5.	No. of Bad Characters externed	Police		
6.	No. of FIRs registered u/s 77 JJ Act,2015	Police		
7.	No. of FIRs registered u/s 78 JJ Act,2015	Police		
8.	No. of unauthorized kabadi shops challaned u/s 283 IPC	Police		
9.	No. of authorized/unauthorized kabadi shops challaned u/s 411 IPC	Police		
10.	No. of betel stalls/khokas and liquor vends in the area.	Police		
11.	No. of betel stalls/khokas and liquor vends in the area complying with Rule 56(8) JJ Rules,2016	Police		
12.	No. of areas where exercise to conduct mapping of distance has been conducted under Rule 56(10) JJ Rules,2016	Police		
13.	No. of areas where exercise to conduct mapping of distance has been conducted under Section 6 COTPA	Police		
14.	No. of areas where exercise to conduct mapping of distance has been conducted under Rule 51, Delhi Excise Rules,2009	Police		

S. NO.	ACTION TO BE TAKEN	DEPARTMENT	DETAILS OF WORK DONE	SHORTFALL, IF ANY & REASONS THEREOF
15.	No. of illegal liquor vends removed, including ones running in houses.			
16.	No. of cases where statement of child was recorded under Section 164 CrPC as per Rule 54(13) JJ Rules,2016. (include number of days within registration of FIR within which statement was so recorded)	Police		
17.	No. of cases where TIP applications were moved immediately after arrest of drug peddler, include number of days within registration of FIR within which statement was so recorded)	Police		
18.	No. of CCTVs installed u/s 144 CrPC in vulnerable areas viz. betel shops, liquor vends etc.	Police		
19.	No. of hot spots in the area	Police		
20.	No. of hot spots removed and declared to be 'Drug-free' Zones.	Police		
21.	No. of visits made by DCP/SP to Drug-de addiction centers and to NAs (Source)	Police		
22.	No. of cases investigated where videography was not used, and reasons thereof.	Police, NCB & Drug Controller		
23.	No. of cases investigated where recovery was not effected, and reasons thereof.	Police, NCB & Drug Controller		
24.	No. of cases qua sale of habit-forming drugs, where in addition to Drugs & Cosmetics Act, the NDPS Act is also invoked	Police NCB & Drug Controller		
25.	No. of cases where SBRs (Social Background Reports) prepared by CWPOs give a description of drug peddlers (as per chart)	Police		

S. NO.	ACTION TO BE TAKEN	DEPARTMENT	DETAILS OF WORK DONE	SHORTFALL, IF ANY & REASONS THEREOF
26.	No. of meetings of Drug Disposal Committee and details of contraband incinerated/destroyed.	Police		
27.	No. of meetings of Drug Disposal Committee and details of contraband incinerated/destroyed.	NCB &Police		
28.	No of WhatsApp messages received on 9868505002 (for uploading of images of illicit cultivated area of opium and poppy) by general public	CEIB & CBN		
29.	Details of illicit opium etc. destroyed	CBN		
30.	No. of cases where destruction of illicit crops has been carried out after receiving intel from Delhi Police and NCB	CBN		
31.	No. of cases where steps have been taken under Chapter V & V-A, NDPS Act for confiscation and forfeiture of property derived from, or used in illicit traffic	NCB &Police		
32.	No. of Field Testing Kit(standard sized ND detection kit, Precursors chemical detection kit, Ketamine Detection kits) and Electronic Weighing machine at every PS	NCB &Police		
33.	No. of recipients, and details of rewards given as per reward policy	NCB &Police		
34.	No. of cases in which police sent intimation to the MCD so that unauthorized structures/illegal encroachments of drug peddlers can be demolished or removed	Police		
35.	No. of officers against whom action taken for failure to comply, as per addendum dated 22.03.2018 to S.O 453/2018 issued by the Delhi Police.	Police		

Forensic Examination of Unaccustomed Handwriting in Hindi Script: A Case Study

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ABSTRACT

Disguise may be accomplished by writing with opposite hand from that habitually used for writing i.e. unaccustomed hand writing. Many anonymous communications such as extortion letter, threatening letter, obscene missive, defamation letter etc. are sent by post and usually disguised using unaccustomed hand to avoid identity. The detection of writing characteristics of unaccustomed hand writing is a challenging task for Forensic Document Examiners. One of such cases in Hindi writing produced by unaccustomed hand was successfully reported in the laboratory. The present case study lays emphasis on the extraction of characteristic features of the writing in a threatening letter executed with unaccustomed hand and its comparison with sample writing written with both accustomed and unaccustomed hand are discussed here along with the silent points leading to the identification of the writer.

Keywords: Disguised Writing, Unaccustomed Handprinting, Accustomed Handwriting, Anonymous Communication, Forensic Document Examiner.

INTRODUCTION:

In India, Hindi language is country's official language [1]. Hindi language is an effective medium of communication in India and generally used for committing crimes. The modus operandi [2] has the potential of attracting criminals using Hindi language for committing crimes by writing threatening letter, extortion letter and anonymous letter causing social and mental harassment. Criminals while engaging in criminal activities have the mind-set of hiding his or her identity and thereby execute disguise writings. In disguise writings the writer intends to impart an appearance of writing which is unlike his own habitual writing and yet maintain a significant level of legibility of the disguised writing [3, 4, 5, 6].

A case was reported and opined successfully related to an anonymous handprinted letter (threatening letter) that was written by the

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unaccustomed hand in Hindi Language. There are a few materials available related to work on examination of unaccustomed handprinting in Hindi language. The available materials are facilitating the points related to examination in English Language but none is available in Hindi language.

James VP Convey, discussed in his book "Evidential Documents" [7] regarding the left and right hand writing which states that the naturally right-handed writer who resorts to his left hand under abnormal writing condition, may adopt awkward counter-clockwise ovals and circles and clumsy left hand uncertainty may be apparent at the turns and upstrokes of the upper and lower loop letters in various English letters.

The essential resemblance between the writing of the two hands is not surprising when it is realised that developed handwriting is substantially the unconscious product of the mind; it is only reasonable to conclude that if a man is blessed with an artistic ability which is expressed in the adoption of a well-proportioned hand-writing, it is unlikely that this quality will be suppressed merely by changing the hand which has acted as the servant of the brain [8].

G.A. Dawson [9] presented a case study on unaccustomed left handprinting in English script. Jannine Zimmerman [10] presented his paper in 1991, ASQDE meeting in Orlando, Florida, titled "Handwriting Identification Based on An Unaccustomed Hand Standard". Several Document Examiners have worked in this context using English as the language and have generated similar results [11,12]. Team could not locate any research paper in reference to Hindi Script.

DETAILS OF CASE

The present case forwarded by the authority to the laboratory was comprised of disputed writings marked as Q1 (Figure 1) and specimen writings marked as S1, S2, S3 & S4. The disputed handwriting was legible. The specimen writings marked S1 & S2 were written by accustomed or practiced hand which shows smooth line quality and the letters are formed smoothly and shows directness in strokes, gradation of pressure, flying commencing and terminating strokes. These were indication of free natural writing and full control on the writing instrument (Figure 2). The specimen writings marked S3 & S4 were executed by unpractised or unaccustomed hand as shown by the irregular movement of the strokes, sudden change in the direction of strokes which affects the skill level of the writing (Figure 3). These effects were due to the unfamiliarity of the writing hand to execute the letters.

Figure 1: A view of questioned document (Threatening letter) marked as Q1.

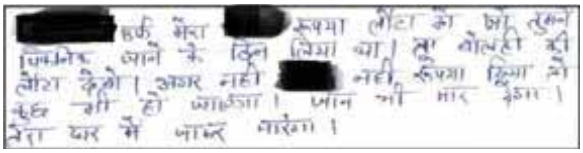


Figure 2: A view of Accustomed Handwriting Sample

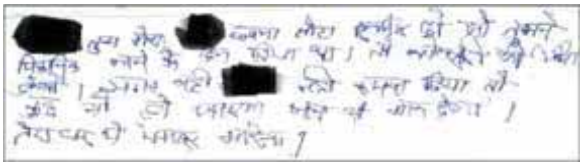


Figure 3: A view of Unaccustomed Handprinting Sample

EXAMINATION OF THE CASE

It was observed that the disputed writings were executed which show painful and laborious strokes. Some important noticeable features of the disputed writings were as follows:

A) Slow in writing speed, movement (finger movement), show poor line quality, tremulous, irregular size of ovals, change in curvatures of the strokes, abrupt change in pen pressure, erratic motion, lack of coordination and rhythm, disconnections of letters and more spacing between the letters in the words.

B) A noticeable loss of pen or muscular control that was evident in execution of curves and loops of letters viz. 'v', 'अ', 'घ', 'ज', 'त', 'ल, 'ब, 'भ', 'द', 'ह' etc., erratic turns, abrupt directional changes, wavy nature of overhead stroke in words.

C) The inability to maintain consistency and quality of letters forms, letters sizes, alignments, terminations and movements (finger).

D) The inability to maintain consistency in the slope of the particular letters in writing.

E) More consciousness in execution of punctuation marks and vowel signs.

F) Some simplifications of complex letters, hesitations and pen stops, uncertainty in succeeding movements of next character.

All these characteristics indicate that the disputed writings were written by unaccustomed hands [13].

The supplied specimens were written by both unaccustomed and accustomed hands. Similar texts of standard writings were supplied. The letters and words were repeated in both accustomed and unaccustomed writings make a suitable standard for detecting the inconspicuous details of the characters for comparison. The specimen written by an unaccustomed hand shows a laborious effort in the construction of letters as they were executed with an untrained hand. The writings were written by slow speed that affects the line quality, movement, pen pressure, rhythm, alignment and slant with a noticeable loss of pen control that dramatically changes the pictorial appearance of the texts. The specimen writings written with both hands show inter-se consistency among themselves (Table 1).

3.1 Comparison of characteristics similarities between Handwriting of both Left and Right Hand in specimen writings

The handwriting of both accustomed and unaccustomed hands shows similarity between each other. The letters executed by the unaccustomed hand are larger with zig-zag movements, hesitation, lack of directness of strokes but they show inconspicuous characteristic similarities with accustomed handwriting in execution of letters, nature of commencement and termination of strokes, their movements, relative size and proportion of letters as well as spacing in writing as shown in Table 1.

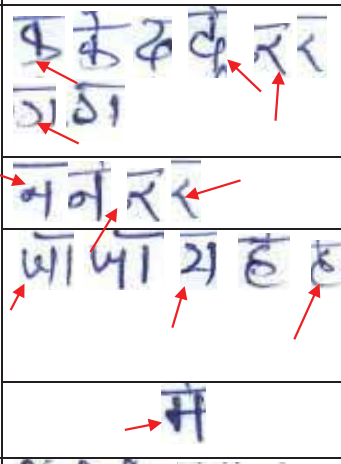
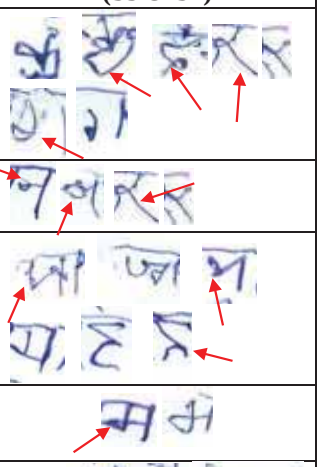
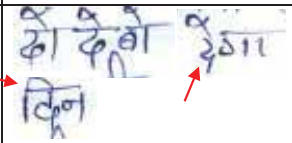
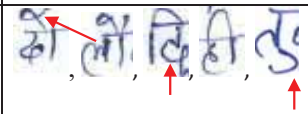
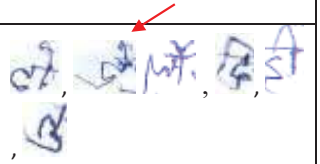
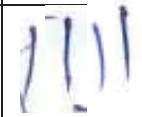
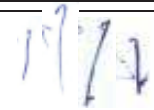
S. No.	Characteristic Similarities	Accustomed Handwriting Sample (S1 & S2)	Unaccustomed Handprinting Sample (S3 & S4)
1.	The basic pattern and execution of various strokes in Hindi letters viz क,ग, ज, द,न,म,य,र,ह etc a) Termination of strokes of letters 'क', 'द', 'र' and loop of letter 'ग'. b) the location of commencement of letters 'न' and 'र'. c) Curvature of curved body parts of letters 'ज', 'य'and 'ह'. d) execution of letter 'म'.		
2.	The shape of body curve of letter 'द' in words'दो', 'देबो'and'देगा'.		
3.	The manner of execution of u-kar "ु" and degree of curvature in body curve of 'त' in 'तुम'.		
4.	Similar manner of execution of vowel signs viz. o-kar "ो", ou-kar, e-kar "ि",ee-kar "ी ", u-kar "ु".		
5.	Manner of execution of full stop "।" (Purnaviram in Hindi script).		

Table 1: The comparison of characteristic similarities in between Unaccustomed and Accustomed handprinting.

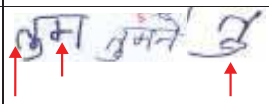
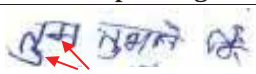
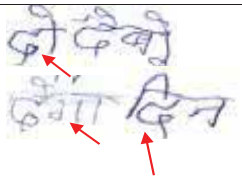
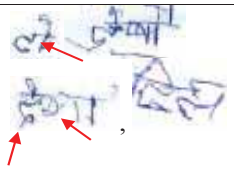
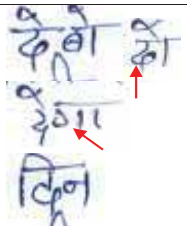
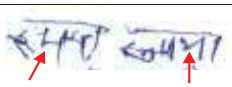
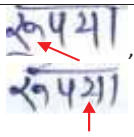
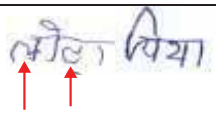
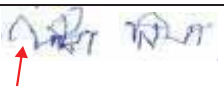
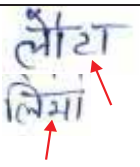
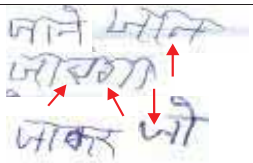
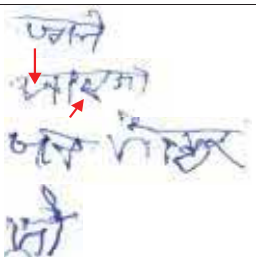
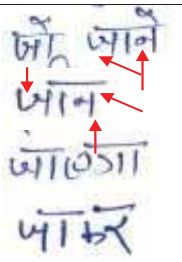
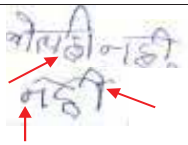
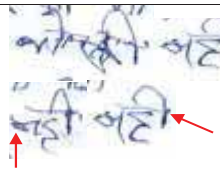
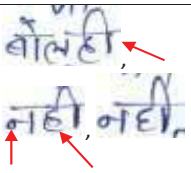
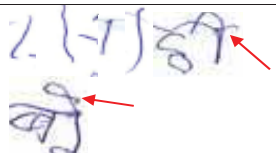
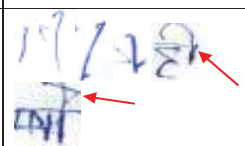
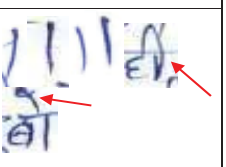
S. No.	Characteristics	Disputed Writing	Known Samples	
			Unaccustomed Handprintings	Accustomed Handwritings
1.	The manner of execution of u-kar "ु" and degree of curvature in the body curve of 'त' in 'तुम'.			
2.	Shape of body curve and termination of letter 'द' in words 'दो', 'देबो'and'देगा', etc.			
3.	Manner of execution of letter 'रू'; angularity in body curve of letter 'य'; shape of bowl of letter 'प ; upper curvature and termination of 'र'.			
4.	Nature of body curve and termination of letter 'ल'; connecting stroke with the curved body part in 'त'; retrace in commencing stroke of vowel sign e-kar "ि" in word 'लिया'.			
5.	Shape of bowl of letter 'ज' and wavy nature of upper head strokes in words 'जो','जाने', 'जान'and'जाएगा', etc.			
6.	Shape of body curve of letters 'ह'; relative location of commencement of loop in letter 'न'.			
7.	Manner of execution of full stop "।" (Purnaviram in Hindi script). Manner of execution of vowel signs viz. o-kar "ो" and ee-kar "ी ".			

Table 2: Showing characteristic similarities between disputed and known Specimen Handwritings (unaccustomed and accustomed hand).

The letters produced by an unaccustomed hand are generally larger in size than accustomed handwritings counterparts and show the difference in shift of slope (leftward). The vertical strokes are curved, wavy and generally written in haphazardly manner. The writer could not alter the writing habits on the change of hand except uncoordinated and erratic movement of strokes.

CONCLUSION

Although writings executed by unaccustomed hand appears awkward and clumsy but due to graphical maturity of writer the basic patterns of the letters remain the same. Above case study shows that it is possible to express opinion on an unaccustomed hand writing, if collected samplers are suitable and sufficient in quality. In criminal investigation, steps should be taken to obtain request writings of suspects(s) executed with both hands. Once the graphical maturity is achieved by the writer, it is extremely difficult to adapt to new letter formation. The developed writing is the product of unconscious mind and it is unlikely that this quality will be merely suppressed by changing the hand. Writing habits are neurologically fixed and it is difficult to change these to maintain the disguise thus making it possible for the Forensic Document Examiner to conduct examination and arrive at conclusion

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Online Radicalization- Threats, Challenges and Proactive Measures

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ABSTRACT:

The paper discusses the challenge of radicalization in context of internet and possible solution which might be helpful in keeping control on spreading of radicalization through internet. The radicals and political extremists have chosen internet as their favorite tool for spreading their propaganda and recruitment purposes. The internet sans the national and international boundaries has started to affect even the developed nations in continents like Europe and Asia. There is a need to have an international solution in form of international regulatory framework for identification and prosecution of such perpetrators who originates such radical content on internet. Counter narrative is an important factor in de-radicalization, it is also suggested that whenever identified radical content is searched then it can be made possible that counter narrative will be consequently uploaded for the search contents. International organizations, NGOs and corporations may also make collaborative efforts in checking menace of online radicalization.

Keywords: Internet, Radicalization, Counter narrative, Transnational, Online, Website.

We've only begun to think about the strategic implications of how a connected world changes the balance of power among states and we need to put a lot more thought into how to manage that, just as we did after the invention of chemical weapons, nuclear weapons, and drones.

DAVID SANGER, NEW YORK TIMES JOURNALIST.

In the last decade the internet has become an integral part of our life, nearly every group or social entity which forms any important ingredient of our life is now represented online. This will not come as a surprise that political and religious radicals and terrorists also have used the internet in reaching out to people across different geographical regions. Extremists and radicals are using the internet tools for radicalization and recruitment purposes. "The Internet provides a great opportunity for terror groups to radicalize youth as it is an inexpensive way to connect, communicate, validate by finding out that the thoughts are widely shared and create a collective identity

Author's Intro:

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transcending national culture and ethos". [1]

Many federal agencies are focusing their efforts on removing and blocking radicalizing data from the internet, but the efforts require multidisciplinary efforts involving various stakeholders which include the Internet Service Provider (ISP) companies, government institutions, NGOs and the users therewith.

There has been various versions what 'on line radicalization stands for',"Online radicalization to violence is the process by which an individual is introduced to an ideological message and belief system that encourages movement from mainstream beliefs toward extreme views, primarily through the use of online media, including social networks such as Facebook, Twitter, and YouTube". [2] "On the other hand, online radicalization may be defined as the set of strategies that are being jointly applied by radical violent groups to consolidate and maintain a transnational audience of supporters. From this perspective, online radicalization is to be understood as a paradigmatic shift likely to explain how individuals become exposed to radicalization in the digital age". [3]

Generally, as individuals immerse themselves in online extremist content, they begin to develop a skewed sense of reality in which their views no longer seem radical. Online interactions with like-minded individuals can substitute for an individual's physical community and create an online social environment similar to that of a gang in which deviant behavior and violence are the norms. Consumers of online extremist content can also develop or increase feelings of superiority, moral outrage, and desensitization to violence, and willingness to commit acts of violence in furtherance of a particular cause. [4]

While the Islamic State conducts most of its operations in the physical realm, hacking networks like 'Anonymous' rely predominantly on digital capabilities. Despite 'Anonymous' having little, if any, centralized command structure, the group (or individuals claiming to be affiliated with the group) has successfully attacked government agencies, major international corporations, and political figures. Anonymous and the Islamic State both demonstrate a central feature of the digital age: Even decentralized non-state actors can wield considerable power through the acquisition and deployment of cyber capacity. We should expect this trend to intensify quickly. [5]

INTERNET ROLE IN RADICALIZATION

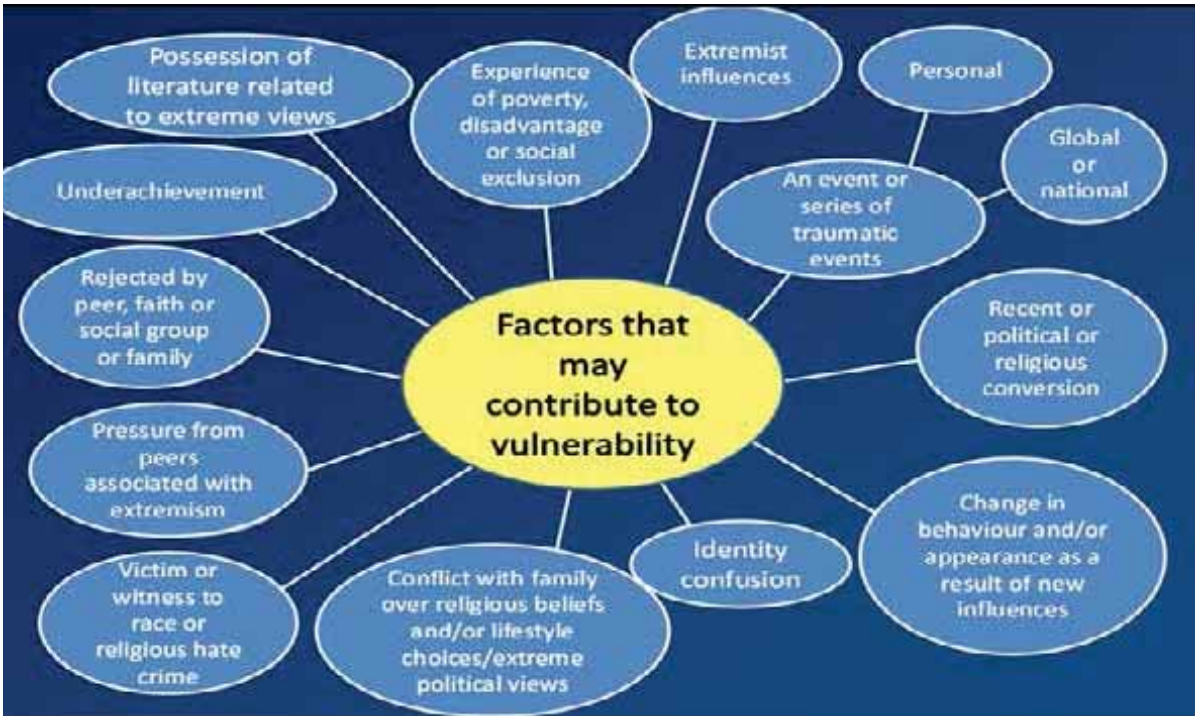
The reason for use of internet by radicals and extremists is the same as the importance is for a normal citizen, the overarching reach of internet with minimum efforts which sans the geographical barriers makes it the favourite tool of radicals. A comprehensive inventory of online activities, therefore, can be said to be relevant and beneficial to extremist/ radical organizations.

Based on the analysis of benefits of internet over conventional methods of radicalization, there are three aspects of the internet which can be thought of as particularly problematic in the context of radicalization and recruitment described in policy report by International Centre for the Study of Radicalization and Political Violence (ICSR): [6]

- The internet can be used by extremists to illustrate and reinforce ideological messages and/or narratives. Through the internet, potential recruits can gain near-instantaneous access to visually powerful video and imagery which appear to substantiate the extremists' political claims.
- The internet makes it easier to join and integrate into more formal organizations. It provides a comparatively risk-free way for potential recruits to find like-minded individuals and network amongst them, enabling them to reach beyond an isolated core group of conspirators.
- It creates a new social environment in which otherwise unacceptable views and behavior are normalized. Surrounded by other radicals, the internet becomes a virtual 'echo chamber' in which the most extreme ideas and suggestions receive the great encouragement and support.

Having described the comparative benefits of internet over the other conventional methods of radicalization and subsequent recruitment for the purpose of extremist and violent activities, the following diagram describes the individual vulnerability factors which make susceptible to availability of radical literature on the internet. The diagram identifies the factors of individual in the sociological context and best described as distortions in social harmony at the level of family and society. These factors may even lead to social withdrawal symptoms and crisis of identity, for which a person will long for association and identification with something worthwhile.

Figure: 1



Source: https://www.sheffield.ac.uk/ssd/safeguarding/prevent/radicalisation

In European context the digital radicalization is the context of identity crisis and the search for identity politics. The 'online radicalization' is a symptom of 'internal threat' for most of the European States since the governments are witnessing evidence of radicalization from within and they have started to apply self-criticism and reflect on some local, regional and national issues. "In Europe, recruitment of foreign fighters has raised particular concerns with regard to the way second- or third-generation immigrants within local Muslim communities, as well as young individuals recently converted to Islam, are facing a form of identity crisis. As a result, the issue of radicalization in Europe often relies—explicitly and implicitly—on a broad range of debates relating to immigration, cultural integration, and the relationship between secularism and democracy. Over the last two to three years, commentators have ironically faced with a more challenging task when evaluating these parameters, as the debate on radicalization has introduced a trend towards identity politics from which many parties and political leaders have considerably benefited. The European case shows that anticipating radicalization cannot only be achieved by acknowledging existing identity concerns, but also by preventing all political actors from capitalizing on a resultant identity crisis". [7] "The root of radicalization lies in the sociopolitical alienation of a vulnerable individual and according to available literature goes through four stages: what is happening is not right; it is not fair; laying the blame on or demonizing the perceived enemy". [8]

The radicals are offering to target audiences a 'counter culture' and claim to offer an alternative to Western model of democracy with the option of political theological system. These subjects are mainly vulnerable and are target top online radicalization. The role of 'human interaction' in first person has been replaced by online material with target audiences, though this is also true that at times internet fails to provide the answers to many questions which arise in the minds of target audiences. "The reason for the absence of self-radicalization and self-recruitment online is that real-world social relationships continue to be pivotal. Many experts who have studied the problem have concluded that the internet can support and facilitate but never completely replace direct human contact and the ties of friendship and kinship through which intense personal loyalties form". [9]

METHODS TO CHECK INTERNET BASED RADICALIZATION

Network-Level Filtering

"Filters are specialized software programmes that can restrict access to entire websites, types of online services, specific pages or content within websites, or web pages containing specified keywords". [10] State-mandated filtering is usually carried out by ISPs and can be required as one of the conditions of a company's operating license in a jurisdiction. The state may also install centralized filtering mechanisms through internet exchange points that serve as gateways for internet traffic between different jurisdictions and to - and from - the networks operated by different ISPs. Private or local institutions such as schools and libraries can deploy filters on their own local networks to

block access to certain content. Filters can also be installed at the household level – most commonly by parents seeking to control what content their children can access. [11]

When content or a URL within a specific website it is filtered at the level of network, then only will the users reach the unfiltered part of the website. But when an entire website is filtered at the level of network, the user cannot reach any part of that particular website. Under the second exercise, it is strongly possible that even legal content is also rendered inaccessible to the user. "Depending on the legal context, ISPs can receive requests, recommendations, and orders for filtering from the government, private third parties, and/or regulatory organizations. Such orders can be communicated on a case-by-case basis directly to the ISP, or in the form of a general 'blacklist'. ISPs can also offer individual users the option of applying filters to their home and office networks. Freedom of expression can be affected by the reasons for filtering, the practical implementation of the filtering, and the transparency by government and companies about how and why the filtering occurs". [12]

Figure: 2; represents various methods of preventing objectionable contents on internet.

MEASURE	METHOD	ASSESSMENT
	Removing	
Takedowns	Government tells hosting company to 'take down' content of website.	Hosting company needs to be located in same jurisdiction.
Domain name deregistration	Government tells domain name provider to deregister domain name.	Top-level domain (e.g. '.uk') needs to be operated by national registry.
Denial of service attack	Overloading servers or networks with communication requests.	Illegal and, at best, a temporary means of disruption.
	Filtering	
Internet protocol (IP) filtering	Requests for blacklisted IP addresses are intentionally dropped.	Cheap, but blocks all services hosted by a web host ('overblocking').
Content filtering (dynamic filtering)	Filtering software 'sniffs' all information packets for blacklisted keywords.	Expensive. Also requires 'white listing' of permitted websites.
Domain name tampering	During IP 'look-up', requests for banned domain names are dropped.	Cheap, but problems with overblocking. Also, easy to circumvent.
Proxy filtering	Proxy filters decide whether to allow requests for individual webpages.	Expensive. May slow down traffic unless substantial investments are made.
Hybrid IP and proxy filtering	Combines IP and proxy filtering: proxy filtering only for blacklisted IP addresses.	Technically effective. But, like other methods, relies on blacklisting and fails to capture dynamic content.
	Hiding	
Search engine filtering	Search engines drop requests for certain webpages and keywords.	Requires active collaboration of search engine provider.
'Black hat' search engine optimisation (SEO)	Manipulating search engines to boost or reduce websites' page rank.	Widely frowned upon. Utility may be limited.

Source: Countering Online Radicalization: A Strategy for Action (ICSR), p.22

NARRATIVES AND COUNTER NARRATIVES ON INTERNET

Extremist narratives and online radicalization; the Internet is a convenient propaganda tool for extremists for the following reasons. First, online media ranging from video web to interactive forums and social media could cater to different kinds of personality and cultural background. IS propaganda, for instance, consists of varying mixtures of humanitarian and violent elements, depending on the targeted audience. Messages that stress the humanitarian element of the Syrian conflict appeared to be more successful when targeting Western audience as opposed to the Arab one that could relate more to the violence dimension. Second, extremists have managed to establish resilient, multi-lingual online networks by combining various online and social media platforms. "A certain Indonesian Twitter user who translates and re-tweets IS' Arabic and English tweets in Bahasa Indonesia has over 11,000 followers. These networks enable uninterrupted campaigns and constant reproduction of materials to a wider audience. Consequently removing online extremist materials would be a pointless exercise. While many studies have been done on extremist narratives and how they are being propagated, the influence of such propaganda on the audience is often less understood. For example some people who consumed extremist materials online became radicalized but not others". [13] The mechanism and tipping point for violent extremism could vary among different individuals. In fact, individuals actively try to understand the information they receive, and the way they interpret extremist narratives is largely influenced by their context. For instance, the extremist master narrative that emphasizes injustices on Muslims and the need for revenge might resonate more with someone who has personally experienced discrimination or had difficulties integrating within Western society. Therefore, it is instructive to understand the contextual factors and social milieu that could allow extremist narratives to find resonance.

The study based on role and use of internet by extremists which was undertaken jointly by Digitalis and the Centre on Religion and Geopolitics, explains the function of the search engine has been a blind spot that has been remained neglected for those seeking to measure and counter extremist messages on the internet.

'The findings came in the wake of a spate of attacks in Germany and France, some undertaken by young people radicalized on the internet. The study was entitled "A War of Keywords: How extremists are exploiting the internet and what to do about it," says the most popular search words used were crusader, martyr, kafir (non-believer), khilafa (a pan-Islamic state) or apostate'. [14]

'The study also discovered that from the extremist content accessible through the specific keyword searches, 44% was overtly violent, 36% was non-violent and 20% was political Islamist in context, the last being non-violent but circulated by known Islamist groups with political aims. The study is one of the first to expose the role of the search engine rather than social media in drawing people to extremist jihadi material on the web. It argues the role of the search engine

– a field dominated by Google – has been a blind spot that has been missed by those seeking to measure and counter extremist messages on the internet'. [15]

While the Internet posed new challenges to counter-terrorism, it could also provide some of the solutions. Available analytics tools such as big data and profiling techniques could help gather a large amount of data from social media and extremist online forums that are essential to support any theory on online radicalisation. Long-term solution to online extremism, however, requires more preventive measures through a concerted online and offline efforts. To this end, the role of civil society is indispensable given the significant influence of social context on individual radicalisation. Grassroots initiatives such as youth engagement programmes through sport and arts might be more effective to reach out to young people. Ultimately, education is vital in preventing the spread of extremist ideology. The education system in many countries does not prioritise critical thinking skills. The role of educators, family and civil society organisations in promoting critical thinking is needed to encourage youth to question and challenge assumptions, especially in the current information age.

Finally, counter-narrative remains the key to confronting online extremism. This could be improved through three elements: the message, messaging and messenger. The message promoted in counter-narratives should be positive and not just reactive, such as by promoting the ideology of peace. Counter-strategists could learn from extremist online campaigns to come up with creative messaging methods that appeal more to the audience. A positive message and appealing campaign strategy would not work well without a credible messenger. Local religious and community leaders have a considerable role in this regard. To move forward, there is a need to bring out more terrorism victims' voices in order to show the harm inflicted by terrorists to the lives of common people. [16]

In a condemnation of government efforts it finds very little of this content is challenged online. Analysing 47 relevant keywords, the search-engine analysis found counter-narrative content outperformed extremist content in only 11% of the results generated. For the search term khilafah, which has 10,000 global monthly searches, the ratio of extremist content to counter-narrative is nine to one. [17]

Developing, communicating, and publicizing an inclusive counter-narrative to violent extremism is a crucial and tough assignment. It demands international cooperation between the United Nations, governmental bodies, and dedicated expertise. It further requires comprehensiveness, credibility, and extensive accessibility. An inclusive counter-narrative must be able to cover the major aspect of the violent extremist context in question, like the political, historical, socio-psychological, and theological dimensions. It needs to be communicated, promoted, and purported by reliable messengers. For making counter narrative more appealing governments can also involve people who themselves once used violent or extremist means against state authorities. "The current moment is unique; for the first time in the history of Jihadism we are provided with a "critical mass" of former

militants who rebelled, not only against the current jihadists' behaviour but also against the ideology that motivated them. Their message to the younger generations of potential sympathizers and recruits is quite powerful: we were the pioneers of Jihadism and the authors of a large part of its literature. Here are our experiences and here is what went wrong."[18] "In addition, due to the behavior of violent extremists, multiple other independent, credible messengers have emerged to speak out against the violent behavior and the ideologies promoting it. Those messengers include respectable and independent religious clerics, academic scholars, former officials, and civil society organizations". [19] "The challenge for the United National and for governments worldwide will be how to capitalize on that unique moment and how to employ the messages, the messengers, and the proper media outlets to create and promote a comprehensive, credible counter-narrative to violent extremism. This article sketches a broad framework for a counter-narrative strategy". [20]

The role of media in counter narrative is still underutilized. The internet which has taken shape of mass media can be exploited for disseminating the counter narrative versions. The media dimension of the counter-narrative strategy will require multiple tasks: [21]

1. The first task is to analyse the counter-narratives available and highlight their sources of strength, appropriateness for the audience in question, and evaluate the potential impact.
2. The second task is to translate (if required), summarize, and sometimes simplify the existing and, hopefully, the forthcoming counter-narrative(s). In addition to texts, multi-media forms (for example online videos and audios) should be utilized as propagating tools.
3. The third task is introducing the messengers, their background, and their experiences.

SEARCH ENGINES ADAPTATIONS

Google also tested on a pilot programme that would divert British users searching for words linked to religious extremism to material prepared to counter radicalization. In 2016 Anthony House, Google's senior manager for public policy and communications, told British lawmakers in a parliamentary committee hearing about the pilot initiative, which is targeted at reducing the online influence of groups like ISIS. "We should get the bad stuff down, but it's also extremely important that people are able to find good information, that when people are feeling isolated that when they go online, they find a community of hope, not a community of harm," House said. [22]

"What was referenced is a pilot Google AdWords Grants program that's in the works right now with a handful of eligible nonprofit organizations," spokesman William Fitzgerald stated in an interview. "The program will enable NGOs to place counter-radicalization ads against search queries of their choosing." [23] Hence such adaptations may also be experimented and subsequently launched for worldwide usage.

EMPOWERING REGULATORY FRAMEWORK IN CYBERSPACE

Whenever users send complaints to the service provider about the content which is not suitable or breaches the internal policies, national or international laws, the user has to depend upon the prudence and discretion of ISP. "Most file-sharing and social networking sites have internal reporting mechanisms which allow community members to flag offensive or potentially illegal content as well as material which contravenes the sites' own community guidelines". [24] Although the Code of Practice adopted by the Internet Services Providers Association (ISPA) addresses issues such as legality and decency – including the hosting of 'material inciting violence, cruelty or racial hatred'. [25] Considering the factors mentioned there is need of International body of regulators having intercontinental jurisdiction for such to redress private and national complains in context of objectionable material present on internet.

HOW PREPARED INDIA IS TO TACKLE THIS MENACE?

There have been instances in India where young people are getting radicalized through internet sources and this event is not only evident in people who are technically aware but also there are people who were having basic knowledge of use of internet. Shutting down of internet for some time is the best method used by security agencies for the past few years but it is proving to be counterproductive as it affects the other activities like banking, education, communication etc., so this method typically targets all and affects all adversely.

One main problem is the location of search engines due to which tracking of source is very difficult and security agencies have to depend upon Internet Service Provider (ISP) or the source country where servers are located. The most challenging problem has been posed by use of WhatsApp which used end to end encryption where the chats and other material exchanged among individual is difficult to track and decipher, although after incidents of lynching where the main provocation was spread through this media only Indian government has successfully persuaded to modify the appliance to restrict the number of options for forwarding of messages but the service provider is still not ready to compromise on encryption issue. There is no more problem of tracking of source of messages and photographs sent through WhatsApp for reason that every time any message is forwarded it changes the digital characteristics. So apart from YouTube these appliances which are freely available on internet with strong encryption features are facing stiff challenges to security forces.

India does have some good research and academic institutions like Gujarat Forensic Science University and National Institute of Criminology and Forensic Science where practitioners and researchers are there who are constantly working on such kind of issues but what is expected from such exemplary institutions is collaborate with international institutions of updating and advancement of digital forensics. The knowledge from such institutions is to be disseminated further to the level of district police.

There have been isolated cases of de-radicalization programmes that are being

run by police officers at some jails but these kind of programmes need to be expanded horizontally in society also by taking help of NGOs, counselors, academic institutions etc,. India still has to learn from best practices of de-radicalization programmes that are being run in countries like Germany and some South-East Asian countries. It is also important that there has been some kind of social taboo has also attached with de-radicalization programme which needs to be reformed and parents of such targeted young people may be motivated to send their wards voluntarily for such programmes.

CONCLUSION

Any effective strategic effort to counter the online radicalization where the production, launch and reception of such kind of material is made more difficult technically and psychologically less convincing, which includes the following process to be followed;

The production of such online material to be made more difficult, the prosecution of those who are involved to be made more effective by international cooperation and creation of such international investigative organizations having transnational jurisdiction.

Framing code of conduct for Internet Service Providers corporations and devising software for their servers which can block the identified programmes responsible for online radicalization.

The counter narratives are to be made more appealing, like discussed earlier in the paper the counter narratives may be made to get uploaded whenever any website for radicalization is searched also the counter narratives are to be authored and produced by empirical evidence of persons like theologians, radicals and extremists themselves.

Empowering the users plays a very important role in de-radicalization, in today's world socially connected through internet can be termed as 'internet social and academic community' in which the content audit, deletion and corrections is done by either ISP corporations or web site managers. Like the example of Wikipedia, "Nowhere is this more obvious than in the case of Wikipedia, the online encyclopedia, whose 12 million entries have all been written by volunteers from across the world and can be edited by any registered user. Wikipedia has been criticized for inconsistencies and for being susceptible to acts of online vandalism, though academic studies have shown that such aberrations are usually corrected within minutes". [26]

Indeed, the power of the user-driven model lies precisely in its ability to detect anomalies, self-correct and, over time, build collective institutional memory.[27] In addition to it the reporting mechanism to the service provider and the prompt action therewith in identification of objectionable content and the accountability identification can help the internet communities for bringing down the radical content online. "Most file-sharing and social networking sites have internal reporting mechanisms which allow community members to flag offensive or potentially illegal content as well as material which contravenes the sites' own community guidelines". [28] also the , " Code of Practice adopted by the Internet Services Providers Association (ISPA) addresses issues such as

legality and decency – including the hosting of 'material inciting violence, cruelty or racial hatred". [29] But with these provisions strong international mutually agreeable legal framework is required for cyber domain.

The internet transcends the national and geographical boundaries and the online radicalization content are now meant for transnational communities, in addition to technical solutions like censorship, blocking and surveillance we require international regulatory body for policing and prosecuting the offenders. The international organizations like United Nations, and Non-Governmental Organizations and foundations should also be involved in keeping a check on contents available on the internet to check spread of radicalization.

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CERTIFICATE

Certified that above mentioned paper content are original in nature and this paper has not been published in any form or appeared in any publication therewith.

Forensic Evidence Archiving in Crime Scene Investigation

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ABSTRACT

Representation of photograph tells the story behind the mysterious layers of crime scene. Forensic photography is the most imperative feature of any crime scene investigation as it encloses the power to secure the crime scene in the form of pixels. This could help the prosecution and defense to refresh and reinvestigate the crime scene over and over again.

Forensic photography is the amalgamation of both science and art. The prospective of depiction of crime scene and the technology which could visualize latent evidence secures a very important place in crime scene investigation. The advancements in image editing software's and digital photography have explored various applications in the field of forensic sciences.

The use of UV, IR and oblique lighting in the questioned document examination had been described in many studies. The development of latent pattern with non-destructive photographic methods using excitation filters has given a new dimension to latent evidence development science. Moreover, different types of image processing softwares and instruments can help in better understanding of the crime scene. Therefore, recognition and knowledge of recent advancements in the field of forensic photography is the need of the hour. The present review has been conducted to explain technical aspects utilized to capture multivariate attributes present at the scene of crime.

Keywords: Forensic science, Crime scene photography, Forensic Photography, Crime scene investigation, Criminalistics.

Introduction: Crime rate is increasing day by day, as a result new methodologies and techniques of investigation are also developing to exonerate the innocent and to provide justice to the victim. Modern Forensic photography for the very first time was reported in 1851 in Belgium and had been further utilized to secure crime scene permanently since 1870s. In 1859, united state supreme court gave ruling for the very first time to use photograph for forensic purposes and the images will be admissible

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in court trials. Afterwards, the advancements in the technology has given more power to photography as forensic tool to secure and stretch its wings in the science of criminal identification as well [1] Smith in 1970 said the photographer is expected to produce "something which will convey to the eye of the viewer an accurate reproduction of the scene as it would appear if the viewer actually saw the scene" [2]. By using modern technology, the investigator could attain photographs by means of different range of wavelengths that are in general obscured from normal human vision. These have been used to reproduce arson, accidental crime scene with the help of lens [3]. The use of Alternative light sources, Ultraviolet, Visible and Infrared light source photography for the examination, processing of latent fingerprinting, detection of seminal stains, bloodstains, wound detection, and bite mark analysis had provided new vision to forensic scientist with non-destructive technology[4,5]. The present review highlights the use of necessary equipment used to archive a crime scene and the advancements in the field to produce high definition evidence photographs. The following table represents the items required in a photography kit to study a crime scene:

ITEMS	USE
Camera	35mm digital camera with ten megapixel image sensor for crime scene & evidence photography.
Wide angle lens	28 mm wide angle lens for 35 mm camera . For photographing in space -constricted areas such as in small rooms.
Normal lens	50 mm lens for 35mm camera for most of the photographs.
Close-up accessories	For photography of small items. It includes 1:1 adapters, extension tubes, close-up filters.
Tripod	Used in still & motion photography to prevent camera movement & gives stability.
Filters	For photographing through glass & water. Color filters for photographing with black & white film.
Electronic flash	For lightning evidence & for indoor, outdoor photography at night.
Scale & tape measure	6 to 36 inches scales for photographing of various evidence. Long tape measures for large items.
ABFO#2 scale	For photography of injuries.
Angle finder	For positioning of camera.
Color charts	In injury photography.
18% gray card	As an aid for getting accurate exposures.
Flash light	Helps to see in dark areas.
Photo log , notebook & pen	For recording information of the photographs taken on a crime scene.
Film speed (ISO)	Medium speed film is mostly used i.e. 400 ISO.
Devices for positioning evidence and Scales	Blocks of woods, clamps for positioning evidence 7 in close-up photography.

Techniques used in Forensic Photography

1. **Alternate light sources (ALS):** Photography ALS involves lasers, blue or green lights and colored filters that detect processed latent fingerprints

or other hidden and unnoticeable evidence. In forensic investigation, there is an enormous growth in the use of alternate light imaging for both locating and photographing the latent evidence. Serological fluids such as blood, semen, saliva, different types of ink that used to counterfeit documents, bruises or other pattern injuries left on the human body throughout the crime scene could be detected without difficulty with the help of utilization of ALS. A tunable multi wavelength emitter is used to emit a specific wavelength of light. The light of specific wavelength selected should be able to result in peak fluorescence of the background of the image to be captured whereas the suitable filters are placed in front of the lens to filter the light emitted, so that the area of focus will be enhanced by emission of lower frequency of light. ALS light sources are used in the analysis and identification of bite marks, fingerprints, serological fluids and identification of white restorative materials such as composites [4]

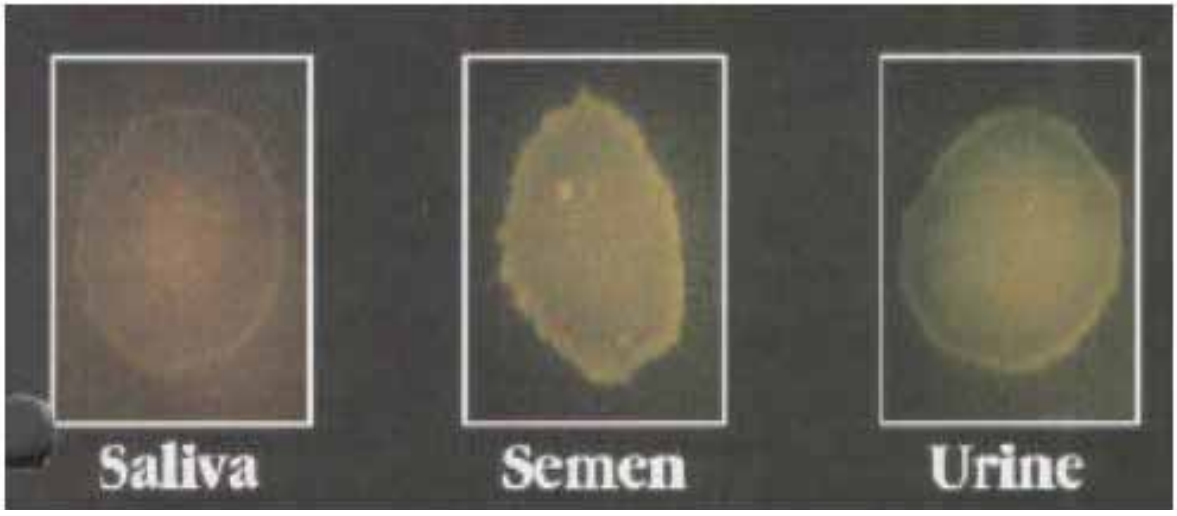

Fig 1 showing latent biological fluids visualized with the help of alternate light sources. After non-destructive visualization, the evidence can be collected from forensic science laboratories for further analysis. Image is cited from https://dps.mn.gov/divisions/bca/bca-divisions/forensic-science/Pages/forensic-programs-crime-scene-alt-light.aspx

2. **Oblique light technique:** This technique utilizes one or more lights that are positioned at different angles. If there is only use of one light then a white or silver reflector can be placed on the opposite side of the evidence in order to reflect some of the light back toward the evidence. It helps in reducing the shadows. The main objective of oblique lighting is to clearly demonstrate the 3 dimensional features of the evidence with high contrast to showcase relevant depth[6]

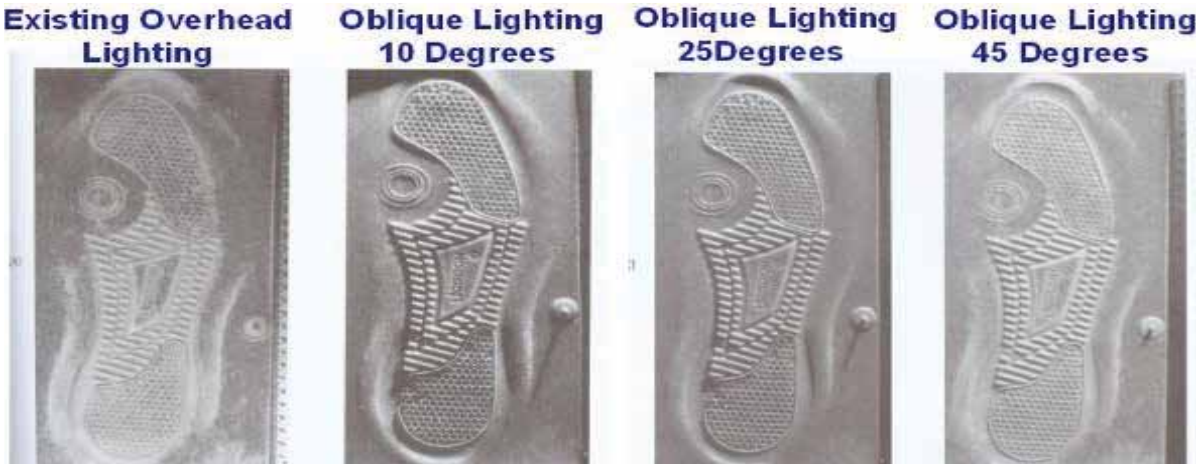

Fig 2 showing the contrast of footprint evidence photographed using oblique light technique overhead, 10°, 25° and 45° angles. Image is cited from https://tinyurl.com/sl5hv35

3. **Diffused lighting:** Diffused lighting is generally used for photographing evidence with shiny or reflective surfaces. In diffused lighting, an opaque material is placed between the light source and the subject to soften the light. It results in even lighting with reduced reflections and hot spots. The opaque material used can be as simple as a section of a white bed sheet or an empty water bottle, or it can be a commercial device which is designed for laboratory photography[7]

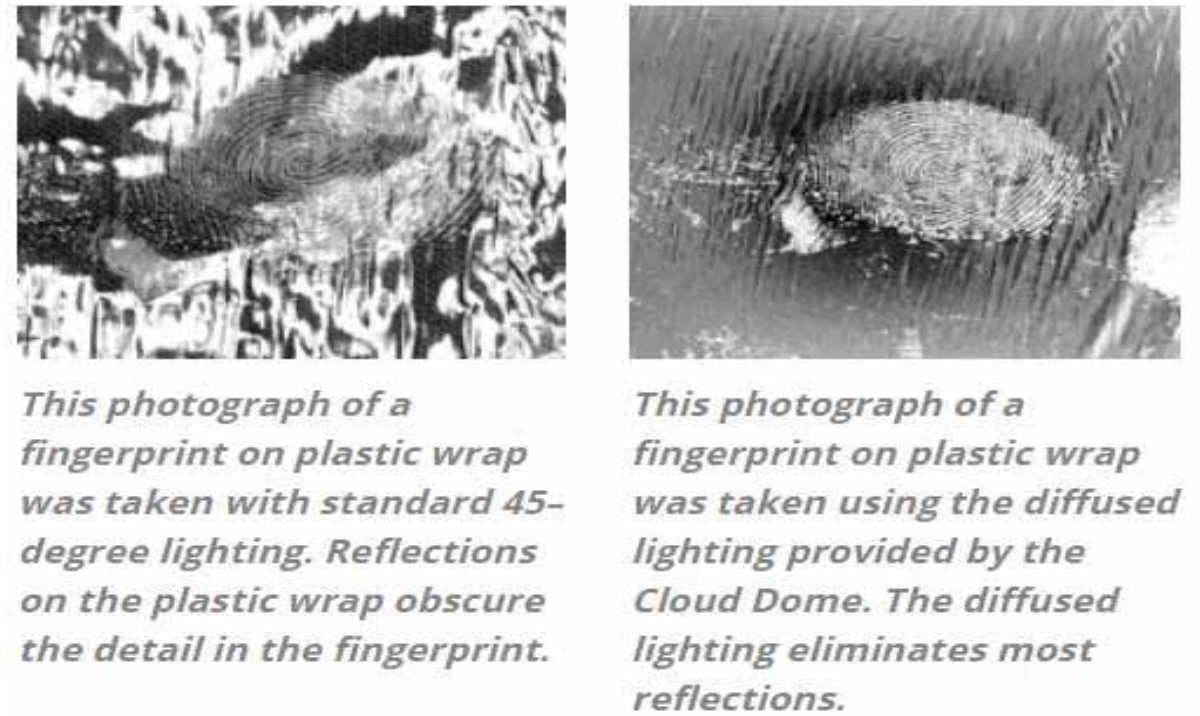

Fig 3 showing diffused light photography in comparison to oblique light photography. The diffused light photography (right) was able to procure the details better as compared to oblique lighting (left). Image cited from https://www.crime-scene-investigator.net/closeup.html

4. **Ultraviolet photography** is used to capture fingerprints and body fluids such as blood, semen, sweat etc on multicolored surfaces. The ultraviolet photography is usually carried out in three regions i.e UVA (315-400), UVB (280-315) and UVC (100-280). There are some materials that absorb ultraviolet, while others reflect these radiations. A source of ultraviolet is directed at the subject which then reflects this radiation back into the camera. With this technique, it is important to fit an ultraviolet transmission filter over the lens to prevent any visible radiation from impinging on the standard black-and-white film. In this, a filter is used that absorbs all visible light but allows to pass ultraviolet light [4].

5. **Infrared photography** is used to reveal the contents of documents such as charred documents, obliterated writings and biological evidence could be captured more effectively with IR photography. This photography is also beneficial to detect health problems like breast tumors, acute abdomen, early diagnosis of severity of burns etc. Photography of gunshot residues on clothing is also done by IR [14, 15]. For, Infrared photography, infrared light is used for image sensors or film. The image sensor is sensitive to infrared light. In infrared photography, wavelength ranges from about 700 nm to about 900 nm. Infrared photography is used to take the photographs of evidence that are invisible to the naked eye. The infrared is longer therefore, it penetrates up to 3 mm below the surface of the skin. Infrared (IR) Light Sources involves Flash Units, Tungsten Lamps, Quartz-halogen lamps[8]

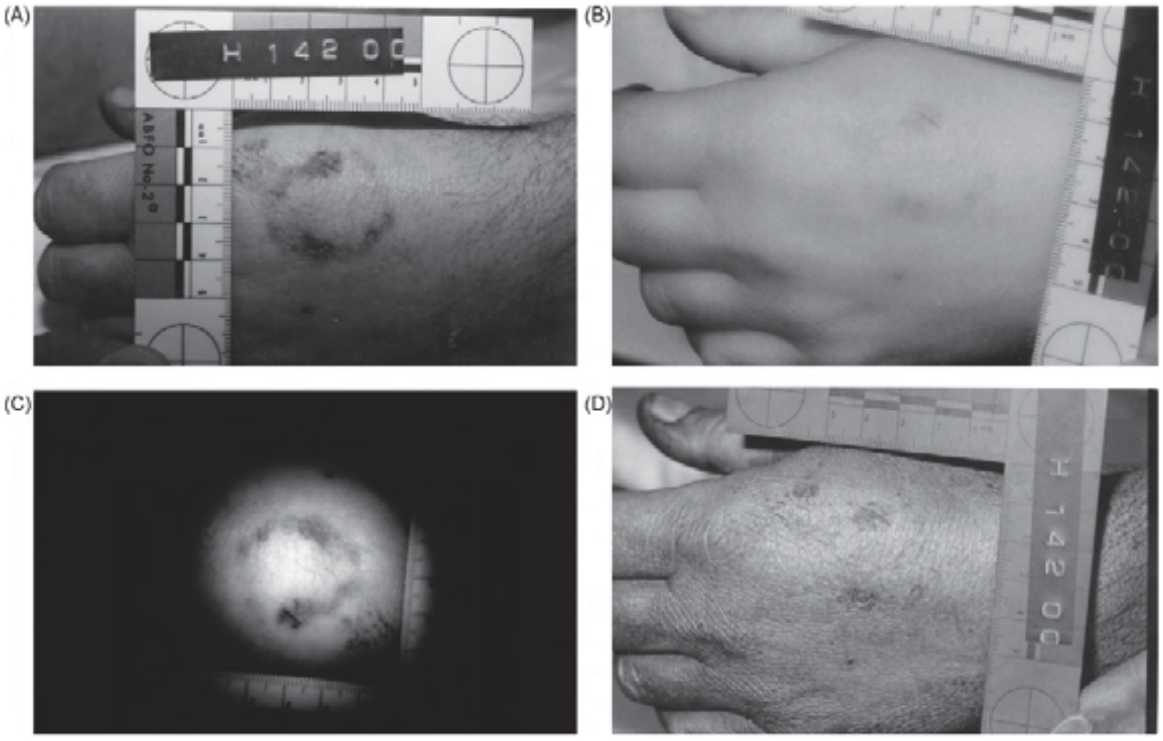

Fig 4 showing (A) Black and White image of bite mark (B) Infrared light photography of same bite mark (c) All images of the same bite mark (D) Uv photograph of bite mark[16]

RECENT ADVANCEMENTS IN FORENSIC PHOTOGRAPHY

The technical names given to drones are unmanned aerial vehicles (UAV), unmanned aerial systemM̂ (UAS), remotely piloted vehicle (RPV), etc. They are developed in a wide variety of size, shape and functions. They are radio controlled planes or multi-rotor copters. Their programming may be managed either by remote or control systems from the ground. A drone is a sophisticated and an advanced tool in the field of robotics, aeronautics and electronics. The technical names given to drones are unmanned aerial vehicles (UAV), unmanned aerial system (UAS).

1. **DRONES:** In drones, LIDAR (Light Illumination Detection and Ranging) technology is embedded which could be utilized to digitally map the whole crime scene by emitting highly coherent laser light that hits the surface of evidence and crime scene. The programming of drones can be managed either by remote or control systems from the ground. Investigator has to face so many problems while doing the crime scene investigation due to the complicated nature of crime scene such as crime scene on hilly areas, secondary crime scenes & evidence may be on lower hilly areas. So, in such cases, drones are used for doing photography. The technical names of drone are unmanned aerial vehicles (UAV), unmanned aerial systems (UAS), remotely piloted vehicles (RPV) etc. Evidence are photographed without disturbance such as in lakes, mountains, ponds, slopes etc. It can be flown to a considerable height in rural areas, forest region or over the water bodies. The programming of drones can be managed either by remotes or by the control systems from the ground[9].

2. **CAD** programme could be useful for forensic scientists in the crime scene documentation to produce 2-D drawings of crime scene to scale sketching in digital format. CAD can help to reconstruct path of bullets and can also be used to construct a 3D-image of an object [10].

3. **Amped software**: This software is used for the analysis, enhancement and the authentication of images and video for forensic security, investigative and military applications. The application is used for the purpose of authentication and detection of any kind of alteration. It basically helps in examining whether the image is unaltered or in an altered stage. Depending upon the state, whether the photograph can be used in court of law or not [11].

4. **Forensically:** is a kind of magnifying glass that involves the free set of tools for digital image forensics. It is useful to see the hidden information and details. It involves clone detector that detects whether manipulation has been done with the photograph, the picture or not. It detects and highlights copied regions within an image, noise analysis that included the utilization of a super simple separable median filter to separate the noise. It is beneficial to examine certain types of manipulations for example airbrushing, deformation, warping and perspective corrected cloning[12].

5. **JPEG Snoop** is a window application which is utilized to examine the source of an image to check its authenticity. It examines and decodes the internal particulars of JPEG and photoshop files. A digital photo contains some hidden information and JPEG Snoop used to expose those details[13].

6. **Ghiro** is a software used for digital photo and image forensics .The forensic analysis is a fully automated, report data that can be searched in different perspective. It involves an error level analysis that is to detect an image if edited or not[14].

7. **Izitru**- It is basic photo forensic software that gives out true or false answer. It verifies the digital photo authenticity. Whenever an image is uploaded to izitru, standard tests determine whether it is an unmodified original from a digital camera[14].

8. **Fotoforensics** tool utilizes an error level analysis to identify areas of different compression level within an image. It performs the evaluation process. It helps to understand whether the picture has been edited or not. It highlights the artifacts and details that may not be able to identify by human eye[14].

9. **Adobe Photoshop:** The software can be used as work station to analyze fingerprints in juxtaposition for easy comparison without manual loops. Various tools available in the software can help in counting, measuring distances and forming presentable evidence for court room trials [15].

CONCLUSIONS:

The primary standard of crime scene recording is to give visual and permanent record of an accident or crime scene. Forensic photography helps to know the bit and pieces of a scene of crime with exact measurement of sites and evidence. In Forensic photography helps to link the suspect with the scene of crime by analyzing the captured images of evidence and it aids in demonstrating the corpus delicti and modus operandi in certain cases. Forensic photography helps to establish the whole story of any case and to exonerate the innocent. Utilization of forensic photography to its full potential while maintaining a chain of custody can help Indian judiciary system to understand and resolve cases rapidly and more accurately.

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- https://tinyurl.com/sl5hv35

Public Interest Litigation and Social Change in Society - An Overview

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ABSTRACT

Public Interest Litigation is the need of the hour and a weapon in the hands of public to protect their rights whether fundamental or human. And through PIL, courts can also improve their image because everyone is reluctant to approach courts due to its lengthy procedure according to a famous saying that ' Justice delayed is justice denied and justice hurried is justice buried.' So it is a benevolent piece of justice but it should be used in right perspective only because some persons abuse it for achieving their own missions under the veil of social purpose.

KEYWORDS

Public Interest Litigation, Constitution, Writs, Legal rights, Fundamental rights, administration, Habeas Corpus, Mandamus, Quo-Warranto, Certiorari, Prohibition, Judicial system, Social change, Society.

PRELUDE-

Public interest litigation broadly defined as 'Litigation for the protection of public interest'. Its unambiguous purpose is to pull apart the suffering of all those who have borne the brunt of insensible dealing at the hands of follow human being. Eloquence in public life is a fair judicial action is the right answer to check increasing risk of infringement of legal rights. It develops a new jurisprudence of the responsibility of the state for Constitutional and legal violations adversely upsetting the interest of the weaker elements in society. The courts in India, in a series of creative steps, responded to the clarion call for justice to be done. They relied on the wide power in the constitution and other sources such as the Directive principles, in India to develop a proper method to advance and protect fundamental rights and use this power to promote a public interest litigation system to fulfil the constitutional promise of social and economic orders based on equality. Energetic and intellectual members of the judiciary exercised their insight into rebalancing the distribution of legal resources, increase access to justice for the disadvantaged and permeate formal legal guarantees with a substantive and positive content. This trend shows austere difference between the

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traditional justice delivery system and the modern informal justice system where the judiciary is performing administrative judicial role[1].

The marvellous efforts of justice P.N Bagwati and Justice V.R. Krishna Iyer were instrumental in justice revolution of the eighties as a result any citizen of India or any consumer groups or social action groups can approach the apex court of the country for seeking legal remedies in all cases where the interests of general public or a section of public are at stake. Public interest cases could be filed without the investment of heavy court fees as required in private civil litigation.

The charter in its preamble has solemnly resolved to secure to all of us social justice and in its Article 38 has commanded the state to service to promote the welfare of the people by securing and protecting a social order in which social justice reform all institutions of our national life. The main and only focus of such litigation is only 'Public Interest'.[2] Public interest litigation can be filed when the following conditions are fulfilled there must be a public injury and public wrongful act or omission of the state or public authority.[3]

MEANING OF PIL

The term Public Interest litigation is made from two words Public Interest and litigation the word Public Interest an expression which indicates something in which the general public or the community at large has some pecuniary interest or some interest by which their legal rights or liabilities are affected. The world litigation on the other hand means a legal action including all legal proceedings initiated in a court of law with the purpose of enforcing a right or seeking a remedy'.4 'Public interest' means an act beneficial to public in general. It connotes action necessarily taken for public interest.5

Simply, Public Interest litigation means any public spirited citizen can approach the court under Article 32 of the constitution or the High court under Article 226 of the Constitution or before the court of magistrate under Section 133 of the code of criminal procedure 1973.[6] Public Interest law does not define a body of law or a legal field the term was adopted to define whom the public Interest lawyers were expressive rather than what matters they would work on. A significant current in public interest lawering has always emphasized the need to provide legal services to those living in poverty. A large community of lawyers practices public interest law in the form of providing legal assistance free of charge to those who cannot afford to pay for it.[7] As per Ramanatha Iyer's, Law Lexicon *pro bono* is defined as litigation for the public good for the benefit of the community as a whole. (*Pro bono* public) constitutes a significant place in dispensation of justice in the present judicial system.[8]

Public Interest Litigation has been playing a vital role in safeguarding the rights of

1 DR. Mrs. Saroj Bohra Manuputra Article Public interest litigation.

2 Available at: https;//www.laywersclubindia.com/Article-constitutional-law (Last visited on 20-7-2017).

3 Available at: https://www.kamayog.org/pil/article/11839.html (Last visited on 23-7-2017).

4 Available at: https://www.lawctopus.com/academeke/public-interest-litigation-2711 (Last visited on 15/1/2018).

5 Id. at 15.

6 Pritam Kumar Ghose, 1(1) Galgotia's Journal of Legal Studies GJLS IISN 2321-1997 (2013) Available at: law.galgotiauniversity.edu.in/pdf/issue6.Pdf. (Last visited on 2/2/2018).

7 Supra note 3.

8 Ramanatha Iyer's Law Lexicon. Available at: https:/www.legalblog.com/definitions (Last visited on 12/2/2018).

a common man, especially women and children. The other matters relating to PIL are normally against pollution, disturbance of ecological balance, drugs, abuse of food adulteration act, against maintenance of heritage and safeguarding culture, forest and wild life and other matters of public importance. Public Interest Litigation is an important mechanism of social variation. It is working for the welfare of the needy living in society. In the traditional adversarial system, the poor, indigent or illiterate person could not enforce the rights given to them by law because of poverty or ignorance nor could they afford to move the court particularly against the living in society rich, mighty or resourceful adversaries. It was so because prior to the herald of PIL in India during 1980 only the aggrieved party could move the court and seek redress for his grievance. In other words, any other person not personally affected could not knock the doors of justice excepting the victim or the aggrieved party himself because only the affected party had the *Locus standi* and persons not affected had no *Locus standi* to do so.[9]

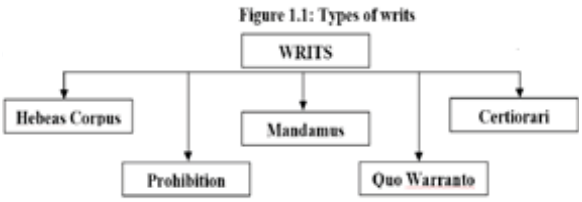
TREATING LETTER AS A WRIT PETITION

In the early stages of liberalization of *locus standi* the court often has said that the procedure being a handmaiden of justice cannot stand in the way of access to justice to the weaker sections of society. Court would not insist on a regular Writ petition. The letter has been converted into Writ petitions on the logic that Article 32(1) of the constitution does not say as to 'Who' shall have the right to move the Supreme Court nor does it say by 'What' proceedings. The word 'appropriate proceedings is too wide and so moving the court through a letter can be an appropriate proceeding because it would not be right to except a person substitute *pro bono publico* to acquire expenses for having a regular writ petition arranged by a lawyer. It has to be appropriate not in terms of any particular form, but appropriate with reference to the purpose of the proceeding.[10] In ***Sunil Batra vs. Delhi Administration,***[11] The court accepted a letter written to the court by Sunil Batra, a prisoner from Tihar jail, Delhi complaining of inhuman treatment meted out to fellow prisoners. Court treated the writ petition, allowed the petition and issued directions to the authorities concerned.

There are mainly five types of writs.[12]

- Habeas Corpus.
- Mandamus.
- Quo-Warranto.
- Certiorari.
- Prohibition.

Figure 1.1: Types of writs



Summary- Above figure 1.1 shows the five types of writs. The writ jurisdiction of the Supreme Court and High Court under Articles 32 and 226 respectively has played an important role in development of Public Interest Litigation in India. The writ jurisdiction of higher courts is invariable

9 Supra note 4.

10 Ibid.

11 AIR 1980 SC 1579.

12 Dr. J.N Pandey 'The Constitution Law of India' (2009) 691.

invoked requesting the court to issue necessary orders directing the executive or the Legislative authorities to desist from continuing its unconstitutional act or perform its Constitutional obligation which it has omitted or neglected to do.

1. **Habeas Corpus–** literally means "you may have the body". The writ is issued in the form of an order issued by the High Court calling upon a person, by whom another person is detained, to bring the detenu earlier the court and to let the court know by what ability he has detained that person. The object of the writ is to give a quick and immediate remedy to a person for his release from an unlawful detention. In ***Kanu Sanyal* vs. *District Magistrate, Darjeeling,***[13] the court ruled that in writ of habeas corpus under Article 32, the production of the body of the detenue before the court was not compulsory for hearing besides disposing of the writ petition by the court.

   The General rule is that an application for the writ of habeas corpus can be made by a person who is legally detained. However, a friend or a relative or an advocate of the detenue may also file an application for Habeas corpus.

2. **Mandamus**– The term mandamus means "the order". The writ of mandamus is thus a command issued by the court, asking a public authority, to perform a public duty belonging to its office. It is an order issued by a court commanding a public authority to do some particular act which appertains to its office and is in the nature of a public duty. In the case S.M. Borkar vs. State of Karnataka,14 Mandamus is issued only when a legal duty is imposed on a public authority in the performance of which the petitioner has a legal right. The writ cannot be issued just like that. The petitioner must have a judicially enforceable right as well as legally protected right. In Union of India vs. Kishan K. Sharma,15 the Apex Court ruled the High Court could not issue a writ of mandamus directing the central Government to grant a scale of pay in favour of the respondents.

3. **Quo warranto–** means "What is your authority" or "Warrant your authority". The writ of Quo warranto is issued against the holder of a public office calling upon him to show with what authority he holds that office. The writ is issued to oust a person from an office to which he is not entitled. It is issued against the usurper of an office. The object to confer jurisdiction upon the judiciary to control the executive action in making the appointment to public offices and also to protect the public from usurpers of public offices. In ***J.D. Karkare* vs. *T.L. Shavade,***[16] the court issued the writ of Quo Warranto against the Advocate General of the State, who was found not qualified to hold that office. In ***P.L. Lakhanpal* vs. *Justice A.N. Ray,***[17] the petitioner challenge the appointment of Justice A.N. Ray, who was junior to three judges of the Supreme Court, as the Chief Justice of India. Earlier, the court could decide the writ, the persons senior to him had resigned from office; as a result, the respondent became the senior most judge of the Supreme Court. The writ was refused as it had become futile.

4. **Prohibition–** The term prohibition means "to prohibit". The writ is issued primarily

13 AIR 1973 SC 2684.

14 AIR 2007 (NOC) 1382 (Kar.).

15 AIR 2004 (1) 59.

16 AIR 1952 Nag 330.

17 AIR 1975 Del. 66.

to prevent an inferior court or tribunal from exceeding its jurisdiction or acting contrary to the rules of natural justice, and to keep them, within the limits of their jurisdiction. The writ commands the court or tribunals to whom it is issued to refrain from doing something which it is about to do, which is not within its jurisdiction or power. The writ of prohibition is a jurisdictional writ and is issued in both cases, i.e., where there are excess of jurisdiction and where there is want of jurisdiction. In the case ***Sewpujanrai I. Ltd.*** **vs.** ***Collector of Customs,***[18] it might happen that the proceedings of an inferior court to tribunal are partly within and without jurisdiction. In that case, prohibition will lie against doing what is an excess of jurisdiction.

5. **Certiorari–** means "to certify" The writ of certiorari is an order issued to an inferior court or tribunal to transmit to it the record of proceedings pending with them for scrutiny and it is necessary, for quashing the same. The writ of certiorari may be issued whenever anybody of persons having legal authority to determine question affecting the right of subjects, acts in excess of their authority. In ***State of Bihar*** **vs.** ***Ganguly,***[19] the writ of Certiorari lies against Judicial or quasi-judicial authorities. It is issued only if the act done by the inferior body or authority is a "judicial" act which term includes the concept of "quasi-judicial" act.

SOCIAL ISSUES AND PUBLIC INTEREST LITIGATION

There are some social issues in society. Some issues are major problems in society. These problems are protected through the PIL.

1 Child Labour and PIL
2 Environment and PIL
3 Corruption and PIL
4 Public health and PIL

PIL MUST PROMOTE GOOD FAITH AND MAINTENANCE OF SOCIAL BALANCE

So the courts must do justice by promoting good faith, and stop law from crafty invasions. Courts must sustain the social stability by prying where obligatory for the sake of justice and reject to restrict where it is beside the social interest and public good.[20] The PIL proceedings of superior courts not only assure enforcement of fundamental rights of the citizens but also make sure that the government and its officials or authorities discharge their constitutional functions. The non-governmental organizations and social activists, through PIL petitions bring to the notice of the court the matters which are of vital public importance with a view to ensuring socio-economic justice to all sections of society irrespective of their social or economic status thereby re-affirming people's faith in the rule of law.[21]

IMPORTANCE OF PIL IN A WELFARE STATE

India being a welfare state, there are several provisions in the Constitution which have led to the origin and development of the concept of public interest action in India. The preamble of the Constitution seeks to secure all its citizens to socio-economic justice, liberty of thought, expression, belief, faith and worship; fraternity and dignity of the individual and unity and integrity of the nation. Article 38[22] of the Constitution directs the states to

18 AIR 1958 SC 845.

19 AIR 1958 SC 1018.

20 Ibid.

21 Ibid.

22 State to secure a social order for the promotion of welfare of the people (1) The State shall strive to promote the welfare of the people by securing and protecting as effectively as it may a social order in which justice, social, economic and political, shall inform all the institutions of the national life. (2) The State shall, in particular, strive to minimize the inequalities in income, and endeavour to eliminate inequalities in status, facilities and

ensure every citizen socio-economic and political justice. Similarly Article 39[23] provides for distributive justice so that citizens may enjoy their natural rights and live with dignity. Article 39-A[24] further directs the state to provide free legal aid to poor and indigent persons so that they are not deprived of their right to seek justice through a court of law. Public Interest Litigation cover approaches a novel command of human rights by giving a broader elucidation to the right to equality, life and personal liberty guaranteed under part III[25]of the Indian Constitution[26].

Some of the human rights developed as a result of public interest litigation are; Right to education, Right to live with dignity, Right to clean environment, Right to free legal aid and speedy trial, protection against sexual harassment at work place etc. Public interest litigation has announced new categories of remedies or reliefs under Writ jurisdiction such as Interim compensation to the victim. Public interest litigation also purposes as a device for social change in a developing country like India PIL functions as an effective device for the social welfare.[27]

DYNAMIC APPROACH- PIL

The Traditional rule of *locus standi* that a petition under Article 32[28] can only be filed by a person whose fundamental right is infringed has now been considerably relaxed by the Supreme Court in its recent rulings. The Court now permits Public Interest Litigations or Social Interest Litigations at the instance of 'Public Spirited Citizens' for the enforcement of Constitutional and other legal rights of any person who because of their poverty or socially or economically disadvantaged position are unable to approach the Court itself.[29]

SOCIAL CHANGE AND PUBLIC INTEREST LITIGATION

Professor Upendra Baxi, former Vice-Chancellor of Delhi University and a well-known legal academician as also a social activist prefers to call 'public interest litigation' as 'social action litigation' because these cases are generally brought to the notice of the court by social activists or organizations who are working for the welfare of society. It must be stated that public interest litigation involves cases relating to welfare of the poor and marginalized sections of society by protecting social, legal and Constitutional rights and interests. Thus the Public Interest Litigation has played an important role in bringing courts nearer to the people and therefore, earned sufficient validity and credibility over the years. The decisions of the courts in PIL cases have been highly praised by one and all being in the interest of the public welfare and socio-economic development of the nation. For example, the dispute between the state of Tamil Nadu and Karnataka over the Cauvery river water was

opportunities, not only amongst individuals but also amongst groups of people residing in different areas or engaged in different vocations.

23 Article 39 of Constitutional law provides. Certain principles of policy to be followed by the State: The State shall, in particular, direct its policy towards securing; (a) that the citizens, men and women equally, have the right to an adequate means to livelihood; (b) that the ownership and control of the material resources of the community are so distributed as best to subserve the common good; (c) that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment; (d) that there is equal pay for equal work for both men and women; (e) that the health and strength of workers, men and women, and the tender age of children are not abused and that citizens are not forced by economic necessity to enter avocations unsuited to their age or strength; (f) that children are given opportunities and facilities to develop in a healthy manner and in conditions of freedom and dignity and that childhood and youth are protected against exploitation and against moral and material abandonment.

24 39A. Equal justice and free legal aid-The State shall secure that the operation of the legal system promotes justice, on a basis of equal opportunity, and shall, in particular, provide free legal aid, by suitable legislation or schemes or in any other way, to ensure that opportunities for securing justice are not denied to any citizen by reason of economic or other disabilities.

25 Part III of the Costitution contains long list of fundamental rights.

26 Available at: www.learninglaw.in/2016/07/nature-and-importance-of-public-Interest-litigation.html (Last visited on 9/9/17).

27 Ibid.

28 Supra note 4.

29 Supra note 13 at 355

settled by Public Interest Litigation wherein the mighty and powerful chief Minister of the state of Tamil Nadu Miss Jai Lalitha had to ask the court for an unconditional pardon for raising this prolonged dispute with the neighbouring state of Karnataka.[30]

Social change is the necessity of any society. In India it is complete through Public Interest Litigation. The Jurisprudence of PIL is essential to appreciate the nature of PIL in India. PIL is working as an Instrument of social change. It is working for the safety of each unit of society. It's the sword of every one used only for seeking justice. The modernisation of this legitimate gadget proved beneficial for the developing country like India. PIL has been used as an approach to combating the atrocities prevailing in society.[31] PIL puts emphasis on law as influential and purposive– a site and vehicle for assessing and matching official prerogatives and limits to state policy. The idea of the rule of law/ legal system as an agent of social change and development is contested terrain.[32] The rule of law to the extent that it guarantees human freedoms, has an intrinsic valve independent of its effect on various other measures of development. By interpreting parts III[33] and IV[34] of the constitution together it has created a normative foundation for establishing a linkage between law and social change.

The court has also evolved new remedies to induce an affirmative action on the part of the state, better enforce constitutional or statutory guarantees that specifically promote developmental goals, and to set the direction for change and monitor its implementation.[35] The Court now permits Public Interest Litigations or Social Interest litigations at the instance of 'Public spirited citizens' for the enforcement of their poverty or socially or economically disadvantaged position are unable to approach the court for relief. Under the Indian scenario, this is an effective remedy available to an ordinary person, to seek redressal for the harm suffered. As an effect of this broad view of *locus standi* permitting Public Interest Litigation or social action Litigation.[36]

30 Ibid.

31 Available at: www.ngosIndia.com/article8/3/2015 (Last visited on 16/3/2018).

32 In one view, Ghai (1991) sees law as a dependent and not an independent variable, a reflection of underlying socio- economic realities and legal change is not viewed as a fruitful way of effectuating social change. In another view, Brenner (1990) argues that economic problems emanate from a weak tradition of law generally and the rule of law specifically and that the legal system should be accorded a high development priority. He assumes that the legal system can play a transformatory role, despite the pervasiveness of social/economic /cultural forces antithetical to such a role. An intermediate position is taken by Cooter (1994, 1995, 1996) states that developing countries should rely less on "top-down" statutory and regulatory law and more on judicial and statutory codification of selective existing social norms that are conducive to efficient forms of cooperation rather than appropriation. (Trebilcock, "What makes poor countries poor?". Tamanaha holds that modern law is necessary, though not sufficient for economic development. Legal reform was important because the world market system was gradually resulting in a global homogenization of commercial laws. To partake in this system required a minimum infrastructure of the laws and institutions necessary to enforce them. He also feels that the quality of life of developing countries will improve if they develop their own variant of the minimum content of the rule of law– such as ensuring that the government acts according to the rules produced in the political arena and respects the civil rights of citizens, and that there is a judicial body to resort to that embodies the ethic of treating all cases before it neutrally and fairly. (Brian Tamanaha, "The lessons of law and development Studies") Carothers finds that rather than mere enactment of laws, considerable investment in changing the conditions for implementation and enforcement of laws and government compliance with laws are necessary. (Thomas Carothers, "The rule of law revival"). Trebilcock concludes that incremental reform in the interstices of institutional structures/subsystems of developing countries is likely to be more effective than promoting changes in entire regime types. He asserts along with Tamanaha and Carothers, that a minimalist, procedurally oriented rule of law is a necessary, albeit not sufficient, condition for a just legal system. He finds that there are important connections between legal institutional reform and political reform since the effectiveness of legal institutions are contingent upon the effectiveness of a number of other institutions. (Trebilcock, "What makes poor countries poor?").

33 Supra note 26.

34 Part IV of the Constitutional law of India-Directive principles of state policy (Article 36-51).

35 Kerry Rittich, "The future of law and development: second generation reforms and the incorporation of the social" in David, M. Trubeck & Alvaro Santos, eds., 'The new law and economic development: a critical appraisal' (Cambridge University Press, Cambridge, 2006).

36 Sammaiah Mundrathi, Law on Compensation to Victims of Crime and Abuse of Power 135 (Deep & Deep Publications, New Delhi, 2007).

Table 1.1: Changes under the society by writs pre-position through the PIL

S. no.	Name of cases	Citation	Pre-position	After position
1	Sunil Batra vs. Delhi Administration	AIR 1980 SC 1579	Inhuman treatment meted out to fellow prisoners	The court observed prisoners are persons not animal as such their fundamental right to do not cease to exist, however certain reasonable restrictions may be imposed on them. Court issued direction, allowed the petition and issued direction to the authorities concerned.
2	Bandhua Mukti Morcha vs. Union of India	AIR 1984 SC 802	Inhuman, intolerable, Miserable conditions of Labourers, unfortunately the workers who are emplaced as bonded labourers at as distant place deprive of their fundamental rights.	The Letter was written by a dedicated organization and was that the worker in the petition, Bandhua Mukti Morcha, is an organization dedicated to the cause of release bounded labourers. The petitioner conducted a survey of some of the quarries in Faridabad district near the city of Delhi. Proper implementation of Bonded Labour System (Abolition) Act, 1976
3	Vishakha vs. State of Rajasthan	AIR1997SC3011	Sexual harassment of women at workplaces. Gang rape of Social Worker in village of Rajasthan.	Guidelines issued by Supreme Court in all work places for the Preservation and enforcement of the right to gender equality of the working women.

S. no.	Name of cases	Citation	Pre-position	After position
4	M.C, Mehta vs. State of Tamil Nadu	AIR1997SC669	Child working in match factories	The Apex Court held that children cannot be employed in match factories. Article 39(f) of the Constitution provides that the state should direct its policy towards securing that children are given opportunities and facilities to develop in a health manner and in conditions of freedom and dignity and that childhood and youth are protected against exploitation and against moral and material abandonment. Article 45 meant to be subjected to free and compulsory education until they complete the age of 14 years.
5	Mukesh Advani vs. State of Madhya Pradesh	AIR1985 SC 1363	Children work in hazardous places like mines construction.	The Apex court held that children cannot be employed within the meaning of Child Labour Act 1986.
6	Sheela Barse vs. State of Maharashtra	AIR 1983 SC 1213	Custodial violence against women prisoners	`The court issue guidelines for the safety and security of women suspect or prisoners. The term life in Article 21 covers the living conditions of the prisoners prevailing in jails. The prisoners are also entitled to the benefit of the guarantees provided in the Article 21 subject to reasonable restriction.

S. no.	Name of cases	Citation	Pre-position	After position
7	M.C. Mehta vs. Union of India	AIR1988 SC 2963	IT Involved in violation of the right of the citizens to pollution free water and air for enjoyment of life.	The court observed that despite comprehensive law on prevention of water pollution and protection of environment. There are water pollution controls Act 1986 for the protection of environment. The Supreme Court ordered immediate closure of those tanneries of Jajamhow, near Kanpur which had filed to treat their dirty water before discharging it into the river of Ganga.
8	Hussainara Khatoon vs. State of Bihar	AIR1979 SC 1360	In this case, the attention of the court on the Incredible situation of undertrial in Bihar. The court expressed grave concern at the distressing conditions of under trials in jails of Bihar and observed that incarceration of under trials that had virtually spent their whole period of sentence was clearly illegal and a blatant violation of their fundamental right guaranteed under Article 21 of the Constitution.	The court not only proceeded to make the right to a speedy trial and passed the order of general release of close to 40,000 under-trials who had undergone detention beyond such maximum period. The court held that Speedy trial is a constitutional mandate and the state cannot avoid its constitutional obligation by pleading financial or administrative inability.

S. no.	Name of cases	Citation	Pre-position	After position
9	Parmanand Katara vs. Union of India	AIR1995SC2039	Newspaper report concerning the death of a scooterist after an accident with a speeding car	Supreme Court held that preservation of human life is a paramount importance. Every doctor at a government hospital or otherwise has the professional obligations to extend his/her services to protect life.
10	ADM vs. Shivekant Sukla	AIR 1976 SC	Fundamental right case	Supreme Court held that the right of citizens to move the court for violation of Article 14, 21 and 22 would remain suspended during Emergency.
11	Laksmi Pandey vs. Union of India	AIR 1984 2 SCC 244	Adoption of Indian children they were subject to harassment and abuse in that country	Supreme Court issued the directions to government and various social- service agencies dealing with the matter to follow these guidelines as it was their constitutional obligation under Article 15 (3) and Article 39 (c) and (f) to ensure the welfare of children who were being adopted by foreign parents in order to protect them against any possible exploitation.

S. no.	Name of cases	Citation	Pre-position	After position
12	Delhi Democratic Working Women Forum vs. Union of India	AIR 1995 1 SCC 14	Realising the psychology and mental torture of victims of Sexual exploitation	Supreme Court issue the guidelines. The court observed that the National Commission for women should frame scheme for compensation and rehabilitation in order to ensure justice to rape victims. Thereafter, the Union Government should implement the scheme drawn by the national commission for women.
13	D.K. Basu v. State of W.B.	AIR 1997 SC 610	PIL filed against custodial torture or inhuman treatment by the police.	Supreme Court issued the guidelines for preventing the custodial violence and not to deprive the prisoners of human rights.
14	People Union for Civil Liberties vs. Union of India	AIR 1997 SC 1203	Fake encounter by the police is violation of Article 21 of the Constitution	Court held state may be directed to pay compensation and the state shall not be allowed the plea of sovereign immunity
15	Indian Council for Environment Legal Action vs. Union of India	AIR 1999 SC 1502	Pollution case	Supreme court gave directions for the prevention of Industrial pollution
16	M.C. Mehta v. Union of India	AIR 1998 SC 2963	Vehicle pollution case	Supreme Court issued direction for checking vehicle pollution
17	Mohan Lal Sharma vs. State of UP	AIR 1989 2 SCC 609	Petitioner sent a letter to Supreme Court alleging that his son was murdered by the police in the lock-up and the police were trying to hush–up the case.	Supreme court treated this telegram as a writ petition and ordered a CBI Investigation in the case.

S. no.	Name of cases	Citation	Pre-position	After position
18	Sushila Gothala vs. State of Rajasthan	AIR 1995 RAJ.90	Child marriage case	The High court of Rajasthan held that there is no point in issuing fresh directions to government to prevent such marriages. The court noted that child marriage is a social evil. There is already existence of child marriage Restraint Act, 1929. There is need to implement properly.
19	Bharatlar Kumar vs. State of Odisha	AIR 1989 SC 1793	Case of sexual exploitation of a girl student	The court gave the suitable directions for rescue and rehabilitation of the prosecutes and children of fallen women
20	Gaurav Jain v. Union of India	AIR 1997 SC 3048	Case of women and children rights	The court issued directions for rescue and rehabilitation of 2 prosecutes and children of fallen women.

Source; Supreme Court cases

The table no. 1.1 exhibits the social change in society through PIL. This table is based on only 20 landmark case laws which are taken on a random basis. Further, it is divided into two major heads i.e. pre-position and post position of society after filing PIL. There are number of cases through which power of PIL can be noticed such as Bandhua Mukti Morcha, Sexual Harassment of women in the workplace, D. K. Basu Case, M.C. Mehta Case (related to pollution). In these cases, mostly the Supreme Court had issued the guidelines for the protection of human rights and had appealed for humane behaviour of them irrespective of their class whether they belong to labour class, women, prisoners, children etc.

SUGGESTIONS

Thus, the introduction of Public Interest Litigation in India in the late seventies was indeed a new technique, but later on the pit-falls and shortcomings of the PIL system came to be noticed. As everything has its pros and cons. The courts found that it was being misused by the so called social service organizations and publicity minded social workers. So it has some flaws but can be cured by following precautionary measures as 'Prevention is better than cure.' Some suggestions are as follows:

1. Need of Government Corporation check on filling of false and frivolous PIL Petitions.

2. There being no codified Law on Writ jurisdiction of Higher Courts, the field of PIL particular, has remained wholly unregulated.
3. To expand the sphere of old rights rather than creating new rights according to the need of social change.
4. Established NGOs to provide knowledge about fundamental rights.
5. To make stringent laws which prevent and punish the persons who wasted the courts by misusing these benevolent provisions.
6. To impose heavy fine on the person who files a frivolous PIL.

CONCLUSION

Thus, it may be stated that the PIL proceeding of superior courts not only give surety enforcement of fundamental rights of the citizens but also make sure that the government and its official or authorities release their constitutional functions properly. The non- government organisation and social activists, through PIL petitions bring to the notice of the court the matters which are of vital public importance with a view to ensuring socio-economic justice to all society irrespective of their social or economic status thereby re- affirming people's faith in the rule of Law. Social changes play a vital role in development of growth of Public Interest Litigation.

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Effects of COVID-19 Lockdown on Psychological Health (Implications on Police Personnel)

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ABSTRACT

Worldwide the COVID-19 pandemic has posed a very serious challenge to humanity with the virus infecting and causing the death of millions across 215 countries and damaging the economy to inconceivable levels. In India, the virus has caused havoc as the number of infected and causality cases continue to increase with every passing day. A nationwide lockdown with strict preventive measures are imposed by the Indian government. Within this backdrop, the present study was planned to examine the efficacy of precautionary measures and psychological health related consequences on respondents who are confined in their dwelling environment during this emergency lockdown. Furthermore, how male and female respondents of different age groups, marital status, education level, employment status respond to the lockdown and what are its social and psychological health related consequences are also investigated. The data was retrieved from the questionnaire prepared using Google Forms. Of the total sample of 489 respondents, 196 males and 293 females located in 70 cities covering 19 states of India volunteered to participate in the survey. The data collected on these participants was subjected to descriptive and inferential statistical analyses. The results revealed that an overwhelmingly large percentage of respondents have understood and have strictly abided by the precautionary and preventive guidelines issued by the government. Most of the respondents have reported that they are facing problems during the lockdown while a sizeable percentage of respondents were moderately involved in various educational, social and household activities in their residential environment. Finally, approximately fifty percentage respondents reported that they have never and rarely experienced any psychological health problems. In contrast, twenty percentage respondents have often and very often reported psychological health related problems. Implication of the results with special reference to police personnel is highlighted.

Keywords: COVID-19, Pandemic, Lockdown, Quarantine, Preventive measures, Residential Activities, Psychological Health.

Introduction:

A pandemic is an epidemic overstretching its reach across nations and continents. The world has witnessed a number of pandemic cases such as smallpox and tuberculosis. Before COVID 19,the most devastating pandemic was the Black Death or Plague which killed an estimated 75–200 million people in the 14th century. Other notable

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pandemics that appeared were Influenza (1918), H1N1 (2009) and HIV/AIDS. In the past, pandemics have adversely affected the physical and psychological health and caused death and causalities to a large number of people. However, for the first time in hundred years, humanity has witnessed a very strange and an invisible enemy; the novel COVID-19 (coronavirus) which got noticed at the end of 2019 from the sea food market of the Wuhan province of China (WHO, 2020). It is currently spreading at a fast pace around the world, eliminating hundreds and thousands of humans besides continuously threatening, the psychological well-being of millions. This highly contagious virus, which has the potential to cause severe respiratory disease, has quickly impacted governments and public health systems. The WHO declared COVID-19 as a pandemic in March 2020. Across the world different countries have initiated various measures to prevent the contagion and limit its outbreak.

To deal with the pandemic, a large number of health care, clinical, academic and social service institutions have opened online platforms to provide services for affected people. However, it seems very likely that both the physical and mental health of COVID-19 patients (including confirmed patients, patients with suspected infection, quarantined family members, and health care workers) has been adversely affected. From the social and psychological perspective, millions of lives across the world have been significantly altered. Professional counseling, positive health and well-being enhancing protective measures are needed to combat this ongoing crisis.

Visualizing this threat, the Government of India has adopted extraordinary measures to prevent its transmission and minimize casualties. Addressing the nation, Prime Minister Modi urged the citizens to initiate a disciplined fight against an invisible enemy by locking themselves inside their residential settings and abiding by social distancing norms. To start this comprehensive fight,the PM in his address asked all people across India to follow "Janta Curfew" on March 22 from 7 A.M to 9 P.M. Subsequently, on March 23, an unprecedented lockdown of 21 days was imposed. The PM stressed "Samyanam and Sankalp" or restraint and resolve to deal with this global crisis. Proactive measures like travel restrictions, community surveillance, contact tracing, social distancing, rapid clinical care and self- quarantine were planned and implemented. The central government, statutory bodies and subsequently the state governments have issued comprehensive advisories and emphasized the precautions to be taken like social distancing, washing hands at periodic intervals, wearing a mask while going out, sanitizing all items purchased and so forth to flatten the exponential growth curve of infection. To educate the masses, awareness campaigns were launched by the Ministry of Home, Health, Police departments, educational institutions, NGOs and all the public and private sector institutions which got comprehensive coverage by media.

This pandemic has posed a challenge globally. The WHO in its dashboard reported on May 11, 2020 that the virus had infected (confirmed cases) 4013728 people and caused the death of 2,78,993 in more than 215 countries. The real damage, both in terms

of loss of lives and economic loss, is expected to be much more than what is being observed at present (who.int/emergencies/disease/novel-Coronavirus-2019). In India, almost all states and Union territories have faced the brunt of the problem to varying degrees. On May 12, Indian COVID-19 dashboard had reported approximately 46008 confirmed cases of which approximately 22454 people have recovered and 2293 died. (mygov.in/Covid-19, 2020)

REVIEW OF LITERATURE:

The recent Lancet review, conducted by Brooks, Webster, Smith et.al (2020) based on the 24 most quoted studies, has broadly concluded negative psychological effects of quarantine. Some of the major adverse effects include post-traumatic stress symptoms, confusion and anger. Furthermore, a few common symptoms found in the people during quarantine include fear, sadness, numbness, insomnia, anger, depressive symptoms, low mood, irritability, emotional disturbance and exhaustion. Some other studies have reported that quarantine has contributed to the increase in feeling of loneliness, social isolation, alcohol and substance abuse, entrapment and relationship breakdown. (O'Connor & Kirtley, 2018)Psychological researches conducted during the outbreak of SARS indicated that quarantined individuals experienced immediate and short term psychological consequences (Hawryluck et. al. 2004). The result of one study reveals that social isolation was found to increase the feeling of isolation and depression. The study conducted by Hawryluck et al (2004) found that 29% of the people felt that other people avoided them after they had been in quarantine which indicates attachment of social stigma which further contributed to the increase in mental distress following quarantine.

A large number of empirical studies have unequivocally reported the negative effects of stress on health (Schwarzer, R., & Gutierrez-Dono, B, 2000). However, to reduce the adverse effects of stress on health, social support, coping strategies and perceived feeling of control are found to be helpful (Lazarus &Folkman, 1984). If people are provided some control to terminate the stressor, the adverse effects on psychological health are very likely to reduce. (Dalal, &Ray., 2005., Nagar, 2006). To reduce or overcome the adverse effects of stressors supportive relationship with friends, family and acquaintances is beneficial (Baron & Kerr, 2003) and has been linked to different aspects of health and wellness. Research has also shown the correlation between high social support and reduction in consequences of trauma induced disorders. The effect of social support has been linked to boosting the immune system which further decreases the stress experienced by people or reduce the amount of health risks involved (Uchino, et a;, 2012). The findings of relatively similar studies indicate that social support is connected to favorable health outcomes due to beneficial physiological effects produced by it and adhering to the possibility of better health behavior (Uchino,2009).

The COVID-19 pandemic has dramatically changed the way we live and is causing major interruptions and disruption in our routine life style. This interference coupled with the threat of contracting the potentially deadly virus is leading many people to experience

stress, anxiety, depression and other mental health challenges. Against this backdrop, the major objectives of this research is to examine the social, psychological and health related consequences of respondents who are confined in their dwelling environment during this emergency lockdown. Furthermore, how male and female respondents of different age groups, marital status, education level, employment status respond and cope with it and what are its consequences on psychological health have also been investigated.

METHODOLOGY

The final draft of the present survey, entitled as "Novel COVID 19: A Psychological Survey on Lockdown" was designed after analysing the results of the pilot study conducted on ten participants. Based on the results, some items were revised or deleted. Minor changes were made in the instructions to enhance the clarity and eliminate errors. The data collection of the survey started during the remaining last few days of the first lockdown declared by the government of India. An online platform was used and the survey was sent to various WhatsApp groups three days before the first lockdown period was over. During the remaining days of the end of the first lockdown, an overwhelming number of 489 responses were received. A brief discussion of the methodology is given below:

Sample and Design: The sample comprised 489 respondents. Of the total sample, 196 males and 293 females located in 70 cities covering 19 states of India participated in this survey. Furthermore, the sample consisted of 207 married and 282 unmarried respondents.

Measures: A brief four page questionnaire involving five sections was designed by the investigators using Google forms. Through this survey, personal and demographical information about the respondents was collected. Information about the respondent involvement in various activities in their dwelling environment, precautions for protecting one from infection, problems faced and assessment of psychological health during the lockdown period was noted. A brief description of the measures is given below:

Demographical information: In the first section, personal details of the respondents like age, gender, educational qualification, marital status, employment status, number of occupants residing under one roof and information about any existing medical illness were obtained.

Assessments of preventive measures: The third section constitutes eight items based on the major precautions that had to be followed by the people during lockdown. The items were focused on measuring the degree to which the respondents washing their hands with soap, sanitizing the goods which are delivered from outside, covering their mouth and nose while sneezing or coughing and throwing the tissue or mask in a closed bin immediately after using. Some of the items also dealt with restricting oneself to their residences, maintaining more than 1 meter distance from others while moving outside for needful purchases and washing the hands properly after returning from outside. The score on this scale ranged from

8 to 40 with the high score indicative of high level of compliance on precautions taken by the respondents during lockdown.

Assessment of Problems Encountered: The fourth section encompasses 12 items depicting problems faced by the people during the lockdown period. This section attempts to assess the respondents financial loss, adverse effects on regular studies, health facilities and unhealthy lifestyle. The items also dealt with increase in the urge to consume alcohol. Finally, other items were related to the perceived fear of administrative action if norms pertaining to lockdown were broken, fear of isolation from society and fear of judgement by society in case they contact the virus. The section also deals with likelihood of respondents to warn the neighbours if someone arrives from outside the city and seek medical help for them. The total score on this scale ranged from 12 to 60 with the high score indicative of more problems faced by respondents during lockdown.

Assessment of Residential Activities: The second section comprised 20 items which tapped a range of major activities being performed by individuals in their home environment. The respondents were required to rate their involvement in these activities on a 5 point Likert type rating scale ranging from never to very often. The high score is indicative of the respondent's high involvement in activities at home during the lockdown. The score on this scale ranged from 20 to 100 where high score is indicative of more involvement of respondents in various major activities in their home setting.

To reduce the number of items exploratory Factor analysis with varimax rotation was performed. The item loadings with a minimum cut-off of 0.50 were used to retain the items for the formation of subscales. Results of factor analysis indicated presence of seven distinct factors labelled as online entertainment, watching news and spiritual TV shows, working online, household activities, chatting with friends, engaging in hobbies and physical activity. Two items which showed low loadings were dropped from the final analysis. The seven subscales together explained 69.28 percentage of variance. A brief description of these subscales is given below:

Online Entertainment: The scores on four items which showed high factor loadings were summed up to form the subscale. The items included in this scale dealt with watching web series and movies through online streaming, playing indoor and online games. The scores on this scale ranged from 4 to 20 where high score is indicative of more entertainment.

News and Serials: The three items which showed high loading for the formation of subscale were related to watching news and serials and reading newspapers. The scores on this subscale ranged from 3 to 15 where high score is indicative of more involvement in watching and reading news and light entertainment.

Working Online: The two items which formed this subscale were focused on working from home and attending online classes. The score on this scale ranged from 2 to 10 where high score is indicative of more involvement with working online.

Household activities: The two items which formed this subscale were focused on cleaning up the uncluttered places and investing time in doing household activities. The score on this scale ranged from 2 to 10 where high score is indicative of more engagement in doing household activities.

Chatting with friends: The two items which formed this subscale were focused on having a heartfelt conversation and chatting with friends on the mobile phone. The score on this scale ranged from 2 to 10 where high score is indicative of more involvement in interacting with friends on mobile.

Hobbies The two items which formed this subscale were focused on pursuing hobbies and learning to cook new dishes. The score on this scale ranged from 2 to 10 where high score is indicative of more investment in pursuing hobbies and interest.

Fitness activities: The two items which formed this subscale were focused on doing yoga/meditation and investing time in physical activity. The score on this scale ranged from 2 to 10 where high score is indicative of more involvement mental and physical activities.

Assessment of Psychological Health: The fifth section composes 20 items related to assess the health of the participants currently put under lockdown. The respondents were required to rate the items on a five point Likert type rating scale. The score on this scale ranged from 20 to 100 where low score indicates good psychological health.

All the twenty items belonging to psychological health were subjected to exploratory factor analysis with varimax rotation. For the formation of subscales the item loadings with a minimum cut-off of 0.50 were used to retain the items. The results of factor analysis indicated evidence of three subscales which were labelled as emotional health, social health and cognitive health. Only one item which showed low loadings was dropped from the final analysis. The subscales together explained approximately 70% variance. Brief descriptions of these subscales are given below:

Emotional Health: The thirteen items which formed this subscale dealt with anxiety, unable to control worry, sleep disturbance, irritation, aggression, hopelessness, depressive thoughts and so forth. The score on this scale ranged from 13 to 65 where low score is indicative of good emotional health.

Cognitive Health: The three items which formed this subscale were focused on checking news updates about virus, believing unforeseen circumstances will be tackled and overwhelmed by watching news. The score on this scale ranged from 3 to 15 where high score is indicative of good cognitive health.

Social Health: The three items which formed this subscale were focused on measuring connectivity with family, enjoying with family and feeling energetic and rejuvenated. The score on this scale ranged from 3 to 15 where high score is indicative of good social health.

Procedure: The survey instrument designed was transferred in the google form format. A general instruction was written to appraise the respondents about the objective and purpose of the survey. The confidentiality of

the responses given by the participants and their identity was assured. The respondents were asked for their consent to participate in the survey. For each section, separate instructions were written which focused on the major theme covered while describing the procedure to record the response. The investigators used their contact list and forwarded the survey to various individuals and WhatsApp groups and other online forums to participate in the survey. The responses submitted by the participants were copies in Excel and subsequently after cleaning the data was transferred to SPSS for analysis. The participants were thanked for their cooperation.

RESULTS AND DISCUSSION:

To analyse the results on major demographical and outcome measures for the total sample descriptive statistics including means and percentages was used. However, to examine the means differences of major predictor variables like age, gender, marital status, education and employment status on outcome measures pertaining to precautions taken to deal with the possibility of infection, activities performed by respondents at their residence and psychological health, analysis of variance was used. Major results are systematically presented below:

Demographical Findings: The demographical information revealed that 51% of respondents were pursuing their graduation and were below the age of 25 while 49% of respondents belonged to the remaining three age groups with only 3.8% respondents were above 56 years. With regard to gender, sixty percentage of female and forty percentage of male participated in the present survey. A slightly more than eighty percentage of respondents were either pursuing their under graduation or were holding the UG degree with only 6.4% were pursuing their PhD degrees. Of the total sample, 41% of the respondents were unemployed while 34% of the respondents were employed. House makers and businessmen shared a very small percentage of 8.2% and 7.5% respectively. During the period of lockdown 65% of the respondents were residing with 2 to 5 members, 10% of respondents were residing alone while the remaining 25% respondents were living with more than 5 family members in their dwelling environment. With regard to pre-existing disease, 81% of respondents were physically healthy while 19% had a history of major diseases including diabetes and health. The major demographical information reveal that a very high percentage of respondents were young, educated, physically healthy with no prior history of major disease. More than 90% respondents were residing with their family members during the period of lockdown.

Involvement in Residential Activities: The descriptive analysis of the activities performed by the respondents in their home environment during lockdown period indicated that 34.7% of the respondents often watched news but 1.3% never watched the news which indicates that most people are aware and updated about the happenings around the world. TV Serials like Ramayana and Mahabharata are viewed by 54. 8% while 22.4% of the respondents avoid watching these serials. Online streaming platforms like Netfilx, Hotstar, Amazon Prime, etc

has been quite in demand with 58% of the respondents viewing it while 22.4% reported never using these platforms. The results further illustrate that a large percentage of respondents reported watching more comedy and positive content based serials on the media. The results reveal that 55.2% of the respondents are reading newspapers, magazines or books as a way to spend their time. Around 32% of the people went through their old photos and albums and a large number of 38.4% of respondents de-cluttered their houses. The period of lockdown has definitely given more time for the people to pursue their hobbies and around 50% spend their time in kitchen learning to cook new dishes. During prolonged lockdown 69% respondents spend their time chatting with their friends. The results further indicate that 38.2% respondents are attending online classes. In contrast, 50.2% of respondents are devoting their time to self-study. During lockdown domestic help in not available thus 67.9% of the respondents are helping their family members in the household chores. Interestingly, while respondents are spending time at home yet 35.6% are not often playing online games. In contrast 37% respondents are playing indoor games. Finally, 30.1% and 31% of the respondents are doing yoga and meditation.

The major results on home activities clearly suggest that more than fifty five percentages of respondents spend their time watching spiritual serials, news and were using online streaming platforms like Netfilx, Hotstar, Amazon Prime. Furthermore, the results indicate that during lockdown overwhelmingly high percentage of respondents were spending their substantial amount of time interacting with friends and helping their family in household chores. Finally, around fifty percentage respondents have reported spending their time in pursuing their hobbies and involving themselves in self-study.

Assessment of Precautions: The results of the survey based on guidelines and precautions are comprehensively presented in table 1. The result reveals that of the total respondents 54.4% very often,38.5 often, 6.5%sometimes and 1% rarely washed their hands with soap at regular intervals. More or less the same trends of results are seen on other seven items on precautions. For instance, 58.5% of the people are vigilant and sanitize all the products they get from outside while only 2% of the respondents declared that they never sanitized the products being purchased. The results further reveal that over 60% of the people are frequently following the orders and guidelines provided during the lock down period. Even after strict instructions by the administration, there are 14% of the respondents who are going outside their homes without any urgent purpose. Physical distancing norms prescribed by the government are clearly maintained by respondents as over 75% of the participants stated that they maintained more than 1 metre distance norm while stepping out of their houses. Finally, 91.3% of the respondents reported that very often, 7.3% often and 1% sometimes wash their hands after returning home from outside. Thus, the results clearly indicate that the massive awareness campaigns initiated nationwide relentlessly particularly by the

health, police and education departments have proven to be very effective with regard to spreading awareness to the masses about the precautions to be taken to protect themselves from viral infection. Most of the respondents have overwhelmingly abided by the precautions and guidelines issued by the government. In other words the results clearly indicate that the awareness campaign launched by the Government was highly successful.

Table1: Percentages depicting respondents adhering to precautionary measures for protection against Covid -19 infection.

Precautionary measures taken by	Never	Rarely	Sometimes	Often	Very Often
Washing hands with soap regularly	0	1%	6.5%	38.1%	54.2%
Sanitizing all items	2%	2.6%	8.7%	28.4%	58.2%
Covering mouth & nose while coughing or sneezing	1%	3.2%	6.1%	24.9%	64.7%
Discarding tissue immediately after coughing	4.3%	4.3%	5.5%	25.8%	60.2%
Avoiding eyes, ears & nose touch	0.6%	6.9%	19.7%	34.1%	38.7%
Avoiding outside movement during lockdown	3.2%	3.4%	4.3%	14.4%	74.6%
Maintaining 1 meter distance	0	1%	3.7%	20.1%	75.1%
Washing hands after getting back from outside	0	0	1%	7.3%	91.5%

Problems encountered: The major results on problems encountered by respondents reveal that during the complete lockdown, only 7.4% of the respondents suffered financial losses and 29.6% stated that they did not suffer any loss at all. However, 39% of the respondents stated that they paid more money for essential goods. The result clearly indicates that 40.6% of the respondents reported that their own studies or their children's studies have suffered. Furthermore, 37% of the respondents feel that regular health facilities have been affected due to the lockdown. While during lockdown the alcohol supply was shut down completely but only a very small percentage of respondents reported any urge to consume alcohol. The results show a positive outlook on the lifestyle of the respondents as 34.9% state that there has been no increase in an unhealthy lifestyle even after the lockdown. Fear of administrative action and public harassment is not felt by 32.1% of the respondents and most of the respondents did not fear being isolated from society during quarantine. The results indicate that 42.1% of the respondents are very much likely to warn the neighbours if someone arrive their house from outside the city and 50.8% claimed that they would seek medical help for the same. The analysis of the responses also indicate that 11.1% of the participants were worried about being negatively judged by society if they get infected by the virus which is more than the

fear of administrative action taken against them and remaining in isolation. The overall results seem to suggest that on average more respondents have reported about the various problems they have faced during the lockdown.

Psychological Health: Inspection of table 2 reveals psychological health of the respondents on all the nineteen items individually and on the three subscales dealing with emotional, cognitive and social health. The results reveal that 29.62, 21.83 and 29.21 percentage of respondents never, rarely and sometimes perceived emotional health related problems. Furthermore, 11.44 and 7.9 percentage respondents often and very often perceived emotional heath related problems during lockdown. The results further reveal that on average approximately 9.7, 11.8, and 33.3percentages of respondents never, rarely and sometimes perceived cognitive health related problems. Furthermore, 26.6 and 18.47 percentage respondents often and very often perceived cognitive health problems. Finally, the results reveal that approximately 10.8, 11.5, and 25 percentages of respondents never, rarely and sometimes perceived cognitive health related problems. Furthermore, 28 and 25 percentage respondents often and very often perceived cognitive health related problems.

Table 2: Percentages depicting respondents Perceived Psychological health during lockdown

Factors	Never	Rarely	Sometimes	Often	Very Often
Emotional Health					
Nervous & Anxious	26.4%	21.1%	37.1%	9.5%	5.9%
Unable to control worrying	30%	21.1%	33.9%	10.8%	4.3%
Trouble Relaxing	30.8%	22.3%	32.3%	9.3%	5.3%
Difficulty in Sleeping	37.1%	17.4%	27.4%	9.1%	8.9%
Afraid of something bad might happen	27.4%	25.4%	33.1%	8.5%	5.7%
Irritated	21.7%	24.5%	33.1%	11.6%	9.1%
Lonely	38.1%	20.5%	22.5%	8.9%	9.9%
Angry	25.8%	27.2%	27.6%	10.1%	9.3%
Hopeless	46.2%	19.5%	21.1%	6.9%	6.3%
Depressive thoughts	35.2%	23.3%	29.2%	6.3%	5.9%
Difficulty adjusting indoor	10.1%	13%	25.8%	33.9%	17.2%
Unable to concentrate	27.2%	23.1%	29.6%	12.6%	7.5%
Stressed	29%	25.4%	27%	11.2	7.5%
Average Emotional Health	29.62%	21.83%	29.21%	11.44%	7.9%
Cognitive health					

Factors	Never	Rarely	Sometimes	Often	Very Often
Check updates related to Covid – 19	4.5%	7.3%	24.3%	29.4%	34.5%
Feeling unforeseen circumstances could be tackled	8.3%	6.1%	37.7%	34.7%	13.2%
Overwhelmed by watching news & media	16.4%	22.1%	37.9%	15.8%	7.7%
Average Cognitive health	9.7%	11.8%	33.3%	26.6%	18.47%
Social Health					
High connectivity with family	4.5%	9.3%	22.5%	38.3%	25.4%
Enjoying family time	2.4%	7.1%	19.7%	31.6%	39.1%
Feeling energetic and rejuvenated at home	25.4%	18.1%	32.9%	13.4%	10.3%
Average Social Health	10.8%	11.5%	25%	28%	25%

The major descriptive results on demographical characteristics reveal that during lockdown all the precautionary measures were taken by the respondents to protect themselves from infection. The awareness campaign aggressively initiated by various implementing agencies of the government was very successful in changing the attitude and behaviour of respondents. A large number of respondents have taken the lockdown in a very positive manner and have invested their time engaging themselves in various activities ranging from investing time meaningfully with family members, interacting with friends, utilizing their time in household activities and so forth. All these factors have probably contributed to a reasonable good psychological health for a reasonably big number of respondents. However, over one-fifth of respondents did report problems pertaining to psychological health.

The analyses of variance results of major predictor variables pertaining to age, gender, marital status education, occupation on major outcome measures are presented.

Main effect of Age Groups on Major Outcome Measures: Mean difference on outcome variables with regard to five age groups are presented in table 3. Inspection of the table reveals that respondents of all age groups were taking all precautions to keep themselves away from infection. However, the results do suggest that respondents who were from the age group of 36 to 45 were taken slightly more precautions than their counterparts. The respondents who were youngest were found to be spending significantly more time in online activities and were spending more time playing games than their counterparts who were in the senior age brackets. Furthermore, very modest but significant difference was found on work related activities with respondents who were under 25 and those who were aged in between 36 and 45 exhibited spending significantly more time in work related activities related to their counterparts

particularly those who were from the senior age groups. No significant difference was found on the remaining components of social activities. Finally, respondents belonging to higher age groups reported better emotional health. In contrast, the young respondents reported better cognitive and social health.

Table 3: ANOVA results depicting Mean differences on outcome measures and health as a function of age groups

Outcome measures	Age Groups					
	Under 25	26 to 35	36 to 45	46 to 55	Above 55	F(4,484)
Precaution taken	35.71	35.84	37.02	35.63	33.76	3.41*
Problem encountered	23.68	23.56	23.84	23.52	21.0	1.09
Residential Activities						
Online entertainment	13.14	10.87	10.26	9.58	7.95	37.12**
News and Serials	10.46	9.87	10.36	10.43	10.85	.90
Working Online	6.61	5.68	6.21	5.62	4.05	6.25*
Household activities	4.60	4.00	4.27	4.25	4.66	1.35
Chatting with friends	10.76	10.59	10.91	10.34	10.24	.35
Hobbies	7.38	7.22	7.40	6.64	6.80	1.35
Fitness activities	2.15	2.50	3.45	2.70	2.15	5.10*
Psychological Health						
Emotional health	33.73	31.56	28.18	27.47	28.0	7.03**
Cognitive health	9.56	8.92	8.69	8.93	8.90	4.57*
Social health	7.17	6.74	5.90	6.49	7.23	5.70**

Main effects of Gender and Marital Status on Major Outcome Measures: Mean difference on outcome variables with regard to Gender and Marital status are presented in table 4. Inspection of the table reveals that female respondents were taking significantly more precautions to keep themselves away from infection than their male counterparts. The results further reveal that female respondents reported significantly more involvement in work related activities, online chatting with friends and interaction with family members relative to their male counterparts. In contrast the males reported significantly more engagement in yoga and physical exercise than females. No significant difference across gender was found on other major activities like watching news, online games, performing household work. Finally, males reported significantly better emotional and social health than females. However, no difference was found across gender on cognitive health.

No significant difference between married and unmarried respondents was found on precautions taken to deal with infection and problems encountered by respondents during lockdown. However, as compared to married, the unmarried respondents significantly reported playing more online games and reported spending more time

in doing yoga and physical activities. No significant differences was found on remaining five activities been performed by respondents in their dwelling environment during lockdown between married and unmarried respondents. Finally, significantly better emotional, cognitive and social health was reported by unmarried respondents relative to their married counterparts.

Main effects of Education on Major Outcome Measures: A close inspection of table 5 reveals that post graduate respondents reported taking slightly better precautions than their counterparts. Respondents pursuing graduation are significantly more involved in various online activities and games. Furthermore, very small but significant differences were seen in other activities being carried out by respondents with students pursuing graduation reporting more involvement in work related activities, chatting with friends, interacting with family members and doing physical exercises and yoga relative to their counterparts. Finally, post graduate and Ph.D. respondents reported significantly better emotional health whereas those pursuing graduation reported better cognitive health and social health than their counterparts.

Table 4: ANOVA result depicting Mean differences on outcome measures and psychological health as a function of gender and marital status

Outcome measures	Gender		F (1,487)	Marital Status		
	Male	Female		Married	Unmarried	F (1,487)
Precautions taken	34.90	36.43	19.69**	35.95	35.72	.44
Problem encountered	23.76	23.39	.46	23.40	23.65	.22
Residential Activities						
Online entertainment	11.52	11.61	.08	9.93	12.79	98.12**
News and serials	10.18	10.51	1.89	10.35	10.40	.03
Working online	5.71	6.46	9.17**	5.60	5.55	.86
Household activities	4.37	4.42	.08	4.32	4.48	.81
Chatting with friends	6.84	7.51	15.69**	7.17	7.30	.51
Hobbies	10.12	11.01	17.83**	10.56	10.72	.56
Fitness activities	2.30	2.10	3.29*	2.00	2.55	8.33**
Psychological Health						
Emotional Health	29.72	32.37	6.14**	28.85	33.12	16.65**
Cognitive health	9.11	9.27	.86	8.99	9.37	5.07*
Social health	7.16	6.58	5.58**	6.36	7.15	10.69**

Table 5: ANOVA result depicting Mean differences on outcome measures and health as a function of Education

Outcome measures	Education				
	Pursuing	Graduation	Post Graduation	Ph.d	F(4,484)
Precautions taken	Graduation				3.41*
Problem encountered	23.68	23.56	23.84	23.52	1.09
In Dwelling Activities					
Online entertainment	13.92	12.62	10.52	8.70	30.16**
News and serials	10.95	10.26	10.44	10	1.07
Working online	7.32	6.23	5.90	5.86	3.48*
Household activities	4.36	4.52	4.38	3.90	1.07
Chatting with friends	8.05	7.12	7.27	6.86	3.24*
Hobbies	11.50	10.42	10.74	10.46	2.68*
Fitness activities	2.54	2.20	2.04	2.00	3.05*
Psychological Health					
Emotional health	35.25	33.92	28.54	27.46	10.73**
Cognitive health	9.95	9.44	8.91	8.73	5.50*
Social health	6.77	7.38	6.26	6.86	6.30*

Main effects of Employment Status on Major Outcome Measures: The mean difference across five types of occupational status on outcome variables is presented in table 6. No significant difference was noticed on precautions taken to deal with viral infection and problems encountered during lockdown among respondents differing on occupational status. The students and housewives were significantly more involved in online activities and games than their counterparts. The students and unemployed were significantly more involved in work related activities while respondents doing business reported more involvement in physical activities and yoga relative to their respective counterparts. Finally, respondents who were doing business reported significantly better emotional health than their counterparts. In contrast, students who were pursuing their graduation reported better cognitive and social health relative to other group members.

Table 6: ANOVA result depicting Mean differences on outcome measure and health as a function of employment status

Outcome measures	Employment Status					
	Student	unemployed	Employed	Business	Homemaker	F(4,484)
Precautions taken	35.81	36.10	34.05	36.70	36.46	2.99
Problem encountered	23.93	23.07	25	22.12	23.65	1.69
In Dwelling Activities						
Online entertainment	12.42	10.85	10.73	10.56	12.27	6.95**
News and serials	10.52	10.18	10.34	10.70	10.31	.52
Working online	6.46	6.75	4.51	3.78	5.82	14.73**
Household activities	4.50	4.30	4.63	4.23	4.45	.46
Chatting with friends	7.27	7.19	7.36	7.27	7.24	.15
Hobbies	10.67	10.13	10.50	10.48	10.57	.16
Fitness activities	2.62	2.98	2.34	3.42	2.55	3.52*
Psychological Health						
Emotional health	34.52	29.0	30.0	27.5	30.68	6.94**
Cognitive health	9.65	8.96	8.73	9.02	9.45	2.93*
Social health	7.49	6.40	7.10	5.26	6.74	7.93**

Implications of the Study for Police Personnel

Police personnel are required to coordinate their duties with doctors, paramedical staff and health officials who are all at the front line while dealing with this unprecedented and strenuous exigency. While undertaking these formidable responsibilities, they find themselves at a greater risk of exposure and infection. Police officials are tasked with explaining and enforcing preventive measures such as social distancing, isolation, quarantine, travel restrictions, contact tracing so as to protect the masses, contain the spread of infection and maintain public order.

Police officials are required to continuously do patrolling in "containment zones" and hot spots to ascertain that the citizens abide by the safety norms to reduce the spread of the viral infection. Given the person-to-person spread of COVID-19 through respiratory droplets, law enforcement officers are at heightened risks of exposure due to their close contact with members of the public. Thus, the police personnel are likely to be over-exposed to the infection and are likely to be stressed. Evidence exists that during the pandemic a large number of police personnel were not only being infected but also losing their lives while discharging their duties. In addition to this, because of an acute shortage of police personnel, the existing staff has to work beyond their duty hours even without any weekly break in highly risky conditions to maintain law and order. There have been several instances when the crowd defying lockdown attacked, pelted stones and injured the police personnel in many Indian states including Maharashtra, Punjab, Madhya Pradesh and Delhi. All these factors are very likely to generate stress which subsequently may adversely affect the mental health of police personnel. A large number of studies

conducted before the ongoing pandemic have consistently reported that occupational stress have contributed to mental health problems in police personnel (Nagar, 2007). Thus, it is very likely that during heightened stress conditions emanating from COVID-19 mental health problems are very likely to increase.

The nation was not professionally equipped and prepared for the vast effects of COVID-19. After being exposed to the pandemic for several months, the leadership and executive authorities have gained a lot of experience to deal with medical emergencies and handling of law and order situations. To protect the police officials from infection, personal standard protective equipment (PPE), masks etc. are also not always available in adequate numbers. The overburden of work accompanied with the fear of infection might result in poor psychological health. To overcome this burden, a few crucial steps need to be taken. Provision of proper PPE and psychological aid in the form of counseling or workshops to help the stressed personnel cope better with these stressful conditions can lead to the betterment of the physical and mental health of these policemen. Online capsule training.

SUMMING-UP

The distinctive feature of the sample is its representativeness across nineteen states of India with a large percentage of respondents being young, educated and sharing their home with more than one family member during the nationwide lockdown. The result revealed that during lockdown almost all the respondents have taken adequate precautions to minimize the possibility of the infection. Thus, it can be concluded that the forceful, emotional and emphatic appeal of the Honorable Prime Minister Modi during the start of Janta Curfew and lockdown and subsequently the Government of India's awareness campaign for educating and convincing the masses to adopt preventive and precautionary measures to minimize the possibility of viral infection has proven to be very successful.

The results further indicate that the respondents have explicitly stated the problems which they have faced. However, they moderately engaged themselves in a wide range of activities like watching news and spiritual episodes, working online, playing online games, doing household chores, interacting with friends and family members and revisiting their hobbies in their residential settings. Finally, approximately half of the total respondents reported that they never or rarely faced any psychological health related problems. In contrast, thirty percent reported that they had sometimes while the remaining twenty percentage respondents felt that they often and very often faced psychological health related problems during lockdown. The respondents who belonged to the younger age group reported relatively more emotional health problems than their older counterparts. In contrast, the young respondents perceived better social and cognitive health relative to the ones in the older age groups. The result on psychological health seems very understandable. The young respondents are mostly students who are under the age group of twenty five and usually spend

considerable amount of time attending their universities/ colleges besides many students also attend prolonged hours of coaching largely because they are on the threshold of building their career. The students might have perceived the sudden lockdown of prolonged duration as an impediment to their career. Further, the educational institutions were also not professionally prepared to deal with the challenge of delivering the educational inputs effectively online through e-learning platforms. While a large number of educational resources are available free of charge online but the educational atmosphere of the classroom setting is missing and cannot be substituted by monotonous online lectures. All these factors might have contributed to emotional health related problems for students. However, the availability and accessibility of laptops and mobiles have made the communication easy and that students are connected to their friends. Even the feeling that everyone in the same boat might has provided social and cognitive health related relief to the students. Currently, the number of infected cases is on the increase both in India and across many countries of the world. It is very plausible that people have to change their life styles and have to take all precautions to minimize the possibility of infection till some permanent medical solution is achieved. Educational institutions should now prepare themselves professionally to create online learning platforms so that the teaching and learning process is made more students centric, lively and interesting. A proper mix of online education and classroom driven lectures may be worked out to reduce the presence of number of students at one point in time. In a similar vein both government and private sectors work may be shifted from off line to online to reduce the density of people in service centered organizations. Online marketing and shopping is gradually picking up. People have to restrict themselves more and more to their residential settings and will have to take extra precautions while leaving their premises at least till a concrete and permanent method for the eradication of this virus is devised.

The programmes of short duration on stress management, counselling and emotional intelligence with special reference to enhancing their adversity quotient may equip the police personnel to enhance their wellness indicators.

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Changing forms of Cyber Violence against Women and Girls

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Abstract: The problem of violence against women is pervasive, ubiquitous and widespread, It is assuming new dimensions with the changing forms of society globally. The new forms of violence against women are equally alarming as the old ones, with an exponential rise in the former. Cybercrime is the new age crime of knowledge and information society which is taking hideous proportions. Women and children both are the most vulnerable group due to the high chances of anonymity in cybercrimes. It is a myth that online crimes are a problem of the developed world and the rest of the world is immune to it. The present paper is an attempt to understand the changing forms of cyber violence against women prevalent in society and the vulnerability of women to this form of crime. This paper digs deep into the menace of cyber violence against women and girls by exploring the magnitude and types of cybercrime against women. It moves on to discussing the existing legal provisions in India to combat cybercrime against women and girls and then concludes with suggestions to counter and prevent cyber violence.

Keywords: Cyber violence, Online violence, Violence against women, Crime against women, Changing forms of crimes, Legal provisions, Cyber Stalking, Cyber Bullying, Hate Speech, Doxxing.

Online crimes were believed to be a problem of the First world only, but penetration of the Internet has driven it to third world countries as well. In the early days of the emergence and development of the Internet, it was believed that away from the social discriminatory inequalities of society it would be a platform to provide equal opportunities for all sections. But over time, the nature of the Internet is also becoming unequal, offensive and scandalous like real-world. Most women face multiple forms of misconduct from their infancy to death in the physical world which is reflected in the cyberspace as well. Along with technological progress, the nature of violence and crime has further evolved. In the era of the social internet, when the mobile phone is a medium to make instant contacts, it is difficult to stay away from online communication and network, making

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women easy prey for online criminals.

Many incidents that have surfaced recently, such as making objectionable comments in social media, broadcasting obscene pictures, using threatening words and/or threatening to intimidate women all have been designated in the category of cyber violence against women and girls by the United Nations. Cyber Violence against Women and Girls includes hate speech (publishing a blasphemous libel), hacking (intercepting private communications), identity theft, online stalking (criminal harassment) and uttering threats. It can entail convincing a target to end their lives (counselling suicide or advocating genocide). The Internet also facilitates other forms of violence against women and girls including trafficking and sex trade[1]. According to United Nations Declaration on the elimination of violence against women, violence against women is, any act of gender-based violence that results in, or is likely to result in, physical, sexual, or mental harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or private life."[2] Giving the extension of this definition, cyber violence has also been included, which encompasses acts like trolling, hacking, spamming and harassment [3]. According to a report of the United Nations "Combating Online Violence against Women & Girls: A Worldwide Wake-up Call"[4], the Internet is being used for violent behaviour and harassment against women and girls. Due to this, the physical and emotional health of women is at stake. This report has been broadcast in the context of Wake up Call. As per data, every third woman in the world faces violence in her life [5], but this report takes this fact a step further, reveals that approximately 73% of women aged 18 - 24 years have faced online violence and crime.

Cyber violence is as harmful as physical violence to life and health of women and girls. Under-Secretary-General (UN Women) Phumzile Mlambo-Ngcuka had equated death due to cyber violence with death by physical violence. Incidents of suicides committed by teenagers due to provocation by "Blue-Whale" an online game or cyber bullying, trolling supports her view.

According to an estimate, only 1 per cent of the population of the world was connected to the Internet in 1995, this number has increased to 40% now out of which 25% of users are women [6]. In India, it is reported that a total of 143 million women use the internet which is 30% of the total user base in India, with rural areas witnessing a growth of 14.11% [7]. It highlights the importance to understand the vulnerability of women towards cyber crimes in India.

To cause direct or indirect harm to the people using telecommunication and electronic devices such as computers, mobile, internet etc. comes under the category of cybercrime. According to the National Crime Record Bureau 2016 figures a total of 7.7% of cases of cybercrimes in India, including the cases of cyber violence against women and girls were registered [8]. The number of cybercrimes increased dramatically in 2017 as compared to 2016, and nearly every fifth cybercrime in 2017 was committed against a woman, as shown by official data for that year released

by the National Crime Records Bureau (NCRB). A total 21,796 instances of cybercrime were recorded in 2017, an increase of 77% over the previous year's number of 12,317[9]. The total number of cybercrime in India has reached to 27248 in 2018 with more than 22% (6030) cyber crimes directed towards women. During 2018, 55.2% of all cyber-crime cases registered were for the motive of fraud (15,051 out of 27,248 cases) followed by sexual exploitation with 7.5% (2,030 cases) and causing disrepute with 4.4% (1,212 cases). Figure1 illustrates the rise in the cases of cybercrime in India during the last five year. From 9,622 cases in 2014, it has risen to 27248 cases in 2018 with a rise of more than 180% in less than a decade[10]. This is only a tip of the iceberg, as most of the cases still go unreported. This rise is also due to the increased awareness of citizens toward reporting them.

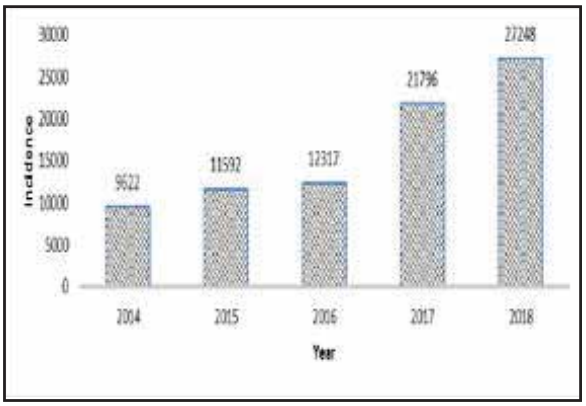
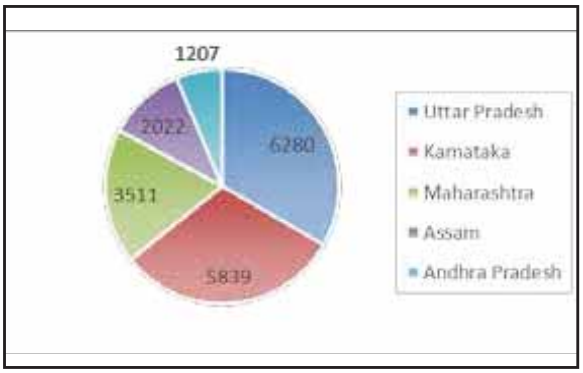


Figure 3: Rise of cyber crime in India



Uttar Pradesh tops the chart with 6280 cases of cyber crimes reported followed by Karnataka (5839) and Maharashtra (3511) as shown in figure 2. Among the metropolitan cities having a population of more than two million, the highest number of cybercrimes are reported in Bengaluru (5253) followed by Mumbai(1482) in 2018 [11].

If we consider the specific cyber crimes against women the picture is no better. Table 1presents data reported in Crime in India in 2017 and 2018 under various categories of blackmailing, pornography, stalking/bullying, fake profile and other crimes. These categories are together reported as online crimes against women. A comparative analysis reveals that there is a sharp escalation in the number of cases as reported from 2017 to 2018. Maharashtra reports the highest number of cyber crimes against women in both 2017 and 2018, with majority crimes under "Other crimes" subheads. A large number of cases are also reported in the category of "Stalking and bullying" which are constantly on a rise, clearly showing the vulnerability of woman and girls to online stalking.

It can be seen in table no.1 that cases of pornography (172) and Fake profile (94) were reported in a big number in Assam during the year 2018. Both these categories had reported only 76 and 21 cases in 2017, respectively. All the data discussed until now clearly reveals that cybercrime against women in India has already taken monstrous dimensions.

	Blackmailing		Pornography		Stalking/Bullying		Fake Profile		Other crimes		Total	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Maharashtra	8	5	15	31	304	398	9	13	809	815	1146	1262
Assam	70	29	76	172	12	18	21	94	199	357	380	670
Telangana	12	10	24	42	27	18	3	12	130	254	196	336
Uttar Pradesh	5	2	18	11	6	24	6	6	233	217	268	340
Andhra Pradesh	11	12	1	5	48	82	3	16	110	96	173	217

Table 2: Online crimes against women and children in top 5 states of India

The cases of cyber stalking and bullying are also witnessing a steady rise in almost all the states in the country led by Maharashtra, followed by Andhra Pradesh and others.

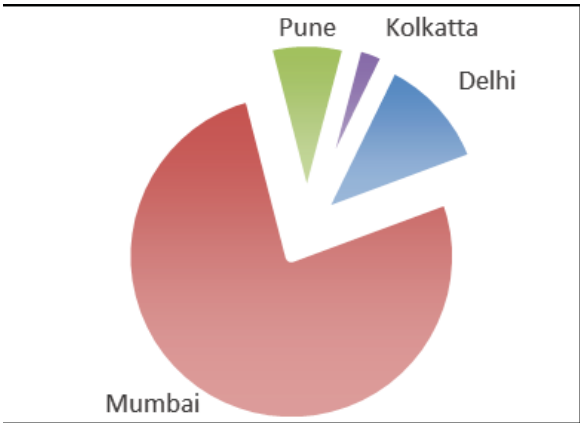


Figure 3: Reported cyber stalking and bullying cases against women & children in four major cities (2018).

When the individual categories of Cyber stalking and bullying against women are considered in Metropolitan cities, Mumbai can be seen to top the charts with 171 cases followed by Delhi with 27, Pune with 18 and Kolkata with 7 cases as reported in 2018[11].

As far as cyber crimes against women and children are considered, data show Mumbai topping the charts in the majority of categories. The data discussed herewith leads us to the finding that there is an exponential rise in cyber crimes in India over the past decade and it has led to an equal escalation in cyber crimes against women.

Types of cybercrime against women: Many types of cybercrimes can be marked in India, including crime against an individual, the crime against an organization and the crime against society. While the abusers use different tactics and means, the goal remains the same: embarrassing, humiliating, scaring, threatening and silencing women. Following are types of cybercrime against women, which are required to be discussed for assessing the gravity of the situation:

Sexist hate speech: Council of Europe defines it as "expressions which spread, incite, promote or justify hatred based on sex"[12]. These are typically the threats of rape, death and torture that women and girls can receive because they carry the stereotypes enforced by the culture of rape and patriarchy

Tactics: Attacks women who assert their opinions online.

Habitat: Offline public places, Comments section, Reddit, dedicated websites, social networks.

Cyber bullying: Cyber bullying is the use of technology to bully a person or group with the intent to hurt them socially,

psychologically or even physically [13]. Cyber bullying is defined by Smith et al. as an "aggressive, intentional act carried out by a group or individual, using electronic forms of contact, repeatedly and overtime against a victim who cannot easily defend himself or herself"[13]. It takes place over digital devices like cell phones, computers, and tablets. Cyber bullying can occur through SMS, Text, and apps, or online in social media, forums, or gaming where people can view, participate in, or share content. Cyber bullying includes sending, posting, or sharing negative, harmful, false, or mean content about someone else. The Global Youth Online Behaviour Survey conducted by Microsoft ranked India third in cyber bullying, with 53% of the respondents, mainly children admitting to having experienced online bullying, falling behind only China and Singapore[14]. Suicide cases related to cyber bullying have increased significantly in the last decade. The seriousness of cyber bullying came to the forefront after Amanda Todd, a 15-year-old schoolgirl from Canada committed suicide because of being continuously cyber bullied and posted a video of her story. Freedom House and Feminism in its report "Violence Online In India: Cyber Crime Against Women and Minority on Social Media 2015"[16] has reported that about 58% of respondents in India face cyberbullying, trolling and other forms of harassment online.

Tactics: Repeatedly sends hurtful messages and start rumors to shame and humiliate.

Habitat: Social networks, communication applications.

Cyber Harassment*:* It is harassment by means of email, text (or online) messages or the internet. It can take many forms, including but not limited to: unwanted sexually explicit online messages; inappropriate or offensive advances on social networking websites or internet chat rooms; threats of physical and/or sexual violence by online messages; Hate speech, de-meaning language that denigrates, insults, threatens or targets an individual based on her identity (gender) and other traits (such as sexual orientation or disability).

Tactics: Targets women who assert their opinions online.

Habitat: Comments sections, forums, chat rooms.

Cyber stalking is the act of online spying, fixing or compiling somebody's information and communicate with them against their will. This is one of the most popular crimes in the online world.

Tactics: Spies, fixates on and compiles information about women online to scare them and sometime blackmail them.

Habitat: Social network

Doxing refers to the online researching and publishing of private information on the internet to publicly expose and shame the person targeted.

Tactics: Researches and publishes private information online as to publicly expose, out, and shame victims.

Habitat: Victim's social networks profiles, google searches

Digital voyeurism or Creep shots: "Creep

shots consist of perpetrators surreptitiously taking photos or videos of women's private areas for the purpose of sexual gratification. In some cases, the act of taking the image without the victim's knowledge, and the subsequent violation of their privacy and agency, is what provides the sexual gratification". Creep shots are then posted on the web, sometimes with hash tags such as #up skirting.

Tactics: Photographs women and girls without their consent and publishes their photos online

Habitat: Offline public places, Reddit, dedicated websites, social networks

Revenge porn: Revenge porn has been defined by the government as "the sharing of private, sexual materials, either photos or videos, of another person without their consent and to cause embarrassment or distress"[17]. Additional personal information will often be included with the published images or videos. This combination may leave a person vulnerable and may endanger them. It is psychologically harmful to the victim at least. The numbers speak for themselves: in January 2017 alone, Face book had to evaluate 54.000 potential cases of revenge porn and close more than 14.000 accounts [17].

Tactics: Posts private pictures or videos of a sexual nature to shame and humiliate the victim. Extension of intimate partner violence.

Habitat: Social networks

Online impersonation is the use of someone else's name or identity with the intention of harming, defrauding, intimidating or threatening anyone. The impersonation can be used to discredit targeted women with their social and professional peers or for criminal purposes similar to theft of offline identity.

Tactics: Uses new technologies and a propaganda tool to steal online identities

Habitat: Social networks

Legal provisions to combat cyber crimes against women and girls

Most cybercrimes are not covered by existing laws in the country. The perpetrators are booked under various sections as understood to be appropriate by the police personnel. Table 2 presents various legal provisions for combating cyber crimes against women in India[19, 20, 21].

Cyber crime type	Legal provisions applicable
Sexist Hate Speech	• The Indian Penal Code, 1860: Section 124A; Section 153A, Section 153B, Section153 C, Section 295A, Section 298, Section 505(1) and (2) (penalizes promotion of enmity between different groups and people on grounds of race religion, place of birth, residence, language and disturbing harmony) • The Representation of the People Act, 1951: Section 8; Section 324; Section 123(3); 123(3A) and Section 12 (Prohibits promotion of enmity between different groups and people on grounds of race, religion, place of birth, residence, and language in relation to elections) • The Protection of Civil Rights Act, 1955: Section (penalizes un touchability through the word; spoken written, symbols or otherwise)
Cyber bullying	• IT act 2000: Section 67, 70 and 72 (publishing or transmitting obscene/sexually explicit material against women and children) • The 2013 Criminal Law Amendment Act: 354, 354 A, 354 B, 354 C & 354 D (Criminal force against woman outraging her modesty)
Cyber Harassment	• IT act amendment 2008: 67A to C (publishing or transmitting of material containing sexually explicit act and child pornography in electronic form.) • IPC: Section 292A (printing or publishing grossly indecent or scurrilous matter or matter intended to blackmail), Section 509 (uttering any word or making any gesture intended to insult the modesty of a woman)
Cyber Stalking	• IT act 2000: Section 72 (remotely for breach of confidentiality and privacy) • IPC: Section 441(Criminal trespass) and • Section 509(Outraging the modesty of women)
Doxing	• IPC Section 354C(Voyeurism) and D(Stalking), • Section 292(Obscene content) • Section 499(Defamation) and IT act amendment 2008

Cyber crime type	Legal provisions applicable
Digital Voyeurism	• IT act amendment 2008: Section 66E (Capturing, Publishing or transmitting the image of the private area without a person's consent or Knowledge) • IPC Section 292 (sale, hire, distribution of obscene content)
Revenge Porn	• 67 A of IT act 2000 (publishing or transmitting obscene/sexually explicit material against women), • Section 354C, IPC (Voyeurism), Section 66E, IT Act (violation of privacy) and Section 509, IPC (harming the modesty of women).
Online Impersonation	• IPC Section 464 (forgery), Section 465 (making false documents), Section 468 (forgery for purpose of cheating), Section 469 (reputation), Section 471 (using as genuine a forged document), and Section 474 (possession of a document known to be forged and intending to use it as genuine) • IT act 2000, Section 43(damage to computer systems without permission of the owner) Section 66 (sending offensive messages through the electronic device), 66B-D (dishonestly receiving stolen computer resources, cheating by personating by using computer etc.)

Suggestions to counter Cyber Violence and Cyber Crime

Crime on the Internet can be financially, physically, and emotionally harmful to any person. To avoid this, the following measures should be taken while using the Internet[22].

The user must keep her security settings in an active state. A friend request from an unknown person should not be accepted.

User should not share personal information on the Internet. If necessary, keep the setting private.

Keep privacy settings for your photos, personal information, locations, on your online account, so that only user's friends can see them.

User should never respond to messages by an unknown person and avoid flirting and arguing with an unknown person.

Avoid using provocative screen names or email addresses.

Protect online information using a password. The password should always be a combination of digits and special symbols, such as # &%, with upper and lower case letters. Change

the password from time to time and do not share this password on unknown websites.

Avoid using the same password in many places.

Use computer and laptop safely. Be cautious about using a cyber cafe etc. Always close the website by signing out or log out.

Do not open an anonymous email as far as possible.

Do not click on the attached attachments and do not try to delete it by the removal link provided in it.

If a user faces any kind of cyber violence even after the above caution, then family members must be involved and informed. User should contact the police in case of any online threat listed earlier. One can also approach various institutional mechanisms set up by the government to deal with such crimes. These institutional mechanisms may be helplines, one-stop centres or cyber cells of police, or any website established to counter cyber violence.

In sum, it can be said that according to the United Nations report there are 3 ways to prevent and prevent cyber violence. First, Sensitize: giving information about cyber violence to society, there is a need to be sensitization to prevent such behaviour. Second, Safeguard: To make all sections of women and society aware of cyber violence and ways to prevent and protect them. And last, Sanctions, violence cannot be allowed in civil societies, so the laws which prohibit cyber violence are required to be constituted and be strictly adhered.

Conclusion

The cyber-violence abnormity can be controlled only by ensuring the participation of the individuals, society and government. Thus, it can be concluded that the magnitude of cyber violence against women and girls is rising at an alarming pace. A closer look at this augmentation can lead us to state that it is expected to grow further in future with the advent and progress of latest technological devices. In this paper it was attempted to illustrate the forms of violence against women and girls are evolving in form of cyber stalking, cyber bullying, trolling, hate speech and online sexual solicitation. The physical forms of violence against women and girls are increasingly combined with cyber violence against women and girls giving birth to hybrid violence. As far as the existing legal provisions for online violence are concerned, there is a great deal which needs to be done at the level of not only social media platforms but also police and the individual user as well. It is worth mentioning here that the National Crime Records Bureau of India has recently started segregating gender based data on cyber violence and further categorization still to be done for specifics. It is need of the hour to recognize the severity of cyber violence against women and girls and treat it with the same intensity as any physical form of violence is done.

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India ups the ante on Money Laundering: Consequences and Countermeasures

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ABSTRACT

Money laundering is the process by which criminal proceeds earned from illegal sources are laundered and disguised by making it appear as it has been derived from a legitimate source. Globalisation has made it into a menace which is not confined to any specific country and India is no exception to it. Money laundering is not only against our country's economic growth but also undermines the rule of law. This article focuses on the far reaching impact money laundering has on our economy and recent countermeasures taken against the crime in India with special focus on 2019 amendment to Prevention of Money Laundering Act.

KEYWORDS: Money laundering; Economy; Anti Money laundering regime; KYC Guidelines; Proceeds of Crime;

INTRODUCTION

Money laundering is the process by which criminal proceeds earned from illegal sources are laundered and disguised by making it appear as it has been derived from a legitimate source (The United Nations Office on Drugs and Crime, n.d.). The term "money laundering" has originated from the United States, Where the mafias and criminals laundered their illegally earned money into lawfully earned money. With globalisation and developments in technologies money laundering has become a global menace (Mehanathan, 2017, p.3) which is no longer confined to any specific country. And our country is no exception to it rather India serves as a lucrative destination for launderers (Retharekar, n.d.). The plain meaning of launder is to wash or clean dirty clothes and the term Money Laundering is used for cleaning the illegally earned dirty money by disguising or concealing its origin and presenting it as rightfully earned legal money. The extent, magnitude and intricacies of money laundering have evolved significantly. The modes and methods of operation keep changing with changes in technological development, techniques and policy approaches (Mehanathan, 2017, p.3).

Money laundering let the criminals encash the profits of their crimes and illegal activities, and bestow them with power, influence and

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stature in society. (Mehanathan, 2017,p.2). These crimes not only threaten the economic stability but also hamper government's role of delivering basic facilities and services for the public (Brown, 2018). Money Laundering is a crime not against a specific individual, but against countries, their governments and rule of law (The Associated Chambers of Commerce and Industry of India, n.d., p.7). Though in recent years India has intensified the fight against money laundering to ensure financial stability of the country but the battle is far from over. India needs to be consistent and more vigilant in its commitment to combating money laundering.

HOW MONEY LAUNDERING WORKS

Although Money laundering is a single process but it is divided into three stages named Placement; Layering and Integration, which are explained below:

1. **Placement**- In this stage illegally earned money is positioned in to the financial system. This stage is the riskiest as placing huge amounts of cash into the system may attract suspicion of the authorities and they might get caught. So it is mostly done by placing smaller amounts to evade unnecessary attention from the law keepers (Mehanathan, 2017, p.21).

2. **Layering**- This stage disguises the true origin of the illegally earned money. Layering cuts off the link of unlawful money from its illegal source. It involves multiple financial transactions to baffle authorities. During this stage, the money may be transferred through different accounts within the country or to different countries or money may be converted into financial instruments like money orders, insurances, stocks, bonds etc, Electronic Funds Transfer (EFT) is also very popular and many other modes are used to disguise the trail of money (Mehanathan, 2017, p.23).

3. **Integration**- The last and final stage of money laundering is integration. In this stage the money arrives back to the criminal from a legitimate looking source. For example money is received from any business, trade etc bought with the laundered money and is following all rules and regulations and carrying on a legitimate lawful purpose. So, technically the money coming from a lawful business or source following all laws and regulations is lawful money. This way money can be used by criminals for any purpose and can be integrated into the economy without violating any laws (The United Nations Office on Drugs and Crime, n.d.).

CONSEQUENCES OF MONEY LAUNDERING IN INDIA

Money laundering strikes at the very foundation of a society and deeply impacts so many aspects of economic development as well as law and order in a country deteriorating the social fabric and values of nation. The so called cleaned or laundered money gives criminals that needed power and stature in a society making them even stronger. They use this laundered money to further expand their criminal activities (Mehanathan, 2017, p.1,2) not only which jeopardizes not only security but also national interests, as the illicit proceeds of laundering are invested in

criminal activities like drug trafficking, arms dealing, supporting terrorist groups and funding them, human trafficking (Jamal, 2018) smuggling etc. Money laundering also impacts the government revenues and fills up loss of revenue because of untaxed money, the tax rates go up, which has direct bearing on honest taxpayers, increasing their burden (McDowel,2001,p.7,8). Money laundering assists the rise in crime and corrupt practices, which hampers the economic sustainability and depresses the growth, discourages foreign direct investment (Bartlett, 2002, p.22,24), also causes instability of inflows and outflows of capital, damages the reputation of financial institutions and the country associated (The International Monetary Fund,2019, p.6). Money laundering harms the private sector by offering products at low prices as their aim is not profit but laundering the money making the competition difficult and negatively impacting the legitimate businesses. Instability of exchange rates, unstable financial markets leads to financial crisis in the country. This way the economic power shifts from government and economy to criminal masterminds, which can be devastating for any country. Hence the smooth functioning of financial sector of a country is crucial for its prospering economy (Financial Intelligence Unit -Republic of Mauritius, n.d.). The impacts of money laundering are manifold and are summed up into following:

- Loss in Government Revenue
    - Weakens economy
    - Increase in crimes like terrorism, drug trafficking etc
    - Discourages foreign direct investment
    - Unfair competition in private sector
    - Instability of financial markets
    - Financial crisis owing to unstable economy
    - Damages reputation of a country internationally

COUNTER MEASURES: ANTI MONEY LAUNDERING (AML) REGIME IN INDIA

The Prevention of Money Laundering Act, 2002 (PMLA), together with the rules, is the primary legislation dealing with money laundering in India. Act criminalises money laundering with imprisonment up to 10 years and provides for confiscation of tainted properties acquired from proceeds of money-laundering. It defines Money laundering as the process of cleaning criminal proceeds earned from illegal criminal activities and making it appear as it has been gained from a legitimate source. The PMLA mandates banking companies, financial institutions and intermediaries to keep account of transactions, verify details of all its clients and report all doubtful transactions or transactions above a specified value to Financial Intelligence Unit-India (FIU-IND). Financial Intelligence Unit-India has power to impose fines on all reporting entities .i.e. banking company, financial institution, intermediary for not complying with provisions of the act. It also empowers Enforcement Directorate (ED) to investigate the offence, arrest an accused and attach tainted property involved in money laundering without seeking any permission from court or government (The Prevention of Money Laundering Act, 2002).

With increase in the number of financial crimes and scandals the Central Government amended the Prevention of Money Laundering Act, 2002 through Finance Act, 2019 by inserting explanations to sections and cleared the ambiguities existing in the act and made the provisions stricter to contain money laundering in India. By these amendments the scope of the "*proceeds of crime*" has been expanded and now (a) Concealment (b) possession (c) acquisition (d) using (e) projecting /claiming tainted property as untainted property in any manner shall be guilty for the offence of money-laundering under section 3. It has also been made a continuing offence by the amendment as the offence will continue till the time the person enjoys the benefits of laundered money in any way.

The 2019 Act deletes the proviso of Sections 17 (1) and 18 (1) and gives power to the ED to conduct search and seizure without pre existing FIR or permission from court. *Proviso* inserted under Section 44(1)(b) of the PMLA for submitting Closure Report to the Special Court when upon investigation no offence is determined. Amended Section 45(2) also clarifies that offences under the Act are cognizable and non-bailable offences, independent of anything contained in The Code of Criminal Procedure, 1973 (CrPC). Hence, the accused can be arrested by authorised officers without a warrant, subject to the fulfillment of conditions under Section 19. Section 12AA, which compels every Reporting Entity to increase monitoring and due diligence for any doubtful transactions and take all necessary due steps mentioned under the act (Amendment in PMLA by The Finance Act, 2019). The amendments to the PMLA gives clarity on various ambiguous aspects of money laundering and brings in more reporting obligations for the reporting entities for detecting and foiling suspicious money laundering attempts (Kumar,2019). Apart from Prevention of Money Laundering Act the RBI KYC Master Directions, the SEBI AML Guidelines, IRDAI AML Guidelines based on Anti-Money Laundering standards (Anti-Money Laundering Forum, n.d.) and recommended by the Financial Action Task Force (FATF) are instrumental in fighting money laundering in India and are updated from time to time. This way making the anti-money laundering regulations in India stricter and updated for the current scenario.

FEW MAJOR RECENT MONEY LAUNDERING CASES IN INDIA

INX Media Money laundering case

The 2019 amendments to Prevention of Money Laundering Act, 2002 will bring more troubles to former finance Minister P Chidambaram. He was arrested in the INX Media money-laundering case on charges of irregularities in a Foreign Investment Promotion Board approval to the INX Media group for receiving ₹305 crore in 2007 as overseas funds during Chidambaram's tenure as finance minister. Currently CBI has filed a chargesheet against former Union minister P Chidambaram, his son. With new amendments now scope of section 3 has been expanded and other explanations added to existing sections in the act will strengthen position of Enforcement Directorate and CBI in the case against Chidambaram.

Vijay Mallya Money laundering case

Vijay Mallya is wanted in India over alleged ₹ 9,000 crore frauds and money laundering charges. He was the first person declared a fugitive economic offender under the Fugitive Economic Offenders Act 2018 after he fled India avoiding prosecution. Currently he is set to be extradited to India soon after losing appeal against India's extradition demand in UK Supreme Court in 2020.

Nirav Modi fraud and Money laundering case

Nirav Modi is involved in biggest fraud in banking history of India. He defrauded Punjab National Bank of ₹11,400 crore by fraudulently acquiring letters of bank guarantees and laundered the proceeds of the funds using his fake companies. Nirav Modi and his relatives fled from India to United Kingdom in early 2018 and is the second person declared a fugitive economic offender under the Fugitive Economic Offenders Act, 2018. In the ongoing extradition case, he is contesting his extradition to India. The Indian government submitted further evidence in the London court in May 2020.

Apart from the Prevention of Money Laundering Act, 2002 the main bodies responsible for enforcing and regulating anti-money laundering framework in various other sectors in India are:

Financial Intelligence Unit - India (FIU-IND)**:** at https://fiuindia.gov.in/. Financial Intelligence Unit – India is an independent body, set up on November, 2004 by the Government of India. It is responsible for collecting, analyzing, processing and sharing the information regarding suspicious financial transactions. FIU-IND reports directly to the Economic Intelligence Council of India headed by the Finance Minister and work towards strengthening efforts, intelligence and measures to combat money laundering in India.

Enforcement Directorate (ED): Enforcement Directorate at http://www.enforcementdirectorate.gov.in/index_home.html?p1. can exercise special powers regarding investigation, prosecution of cases and also attachment of the property under the Prevention of Money Laundering Act 2002.

Reserve Bank of India (RBI): at https://www.rbi.org.in/. RBI, the central bank of India regulates financial institutions like banks and various financial markets and sets anti-money laundering guidelines and policies and has regulatory powers to combat money laundering in India.RBI also updates KYC rules from time to time as per recommendations made by the Financial Action Task Force (FATF) and directions by government of India.

Securities and Exchange Board of India (SEBI): at https://www.sebi.gov.in/. SEBI regulates intermediaries and investors in the securities market to curb money laundering.

Insurance Regulatory & Development Authority of India (IRDAI): at **http://www.irdaonline.org/.** The IRDA regulates the insurance sector and ensures compliance with Anti-Money Laundering guidelines applicable to certain insurers.

CONCLUSION AND SUGGESTIONS

Money laundering has become a matter

of grave concern not only for India but for the world as well. It not only dampens the productivity of an economy but also spoils the image of the nation which adversely affects the economic growth .For an effective implementation of Anti-Money laundering regime, the government should make sure that all concerned institutions comply with anti money laundering rules and laws, follow the KYC Policy .i.e. "Know Your Customer", immediately report doubtful transactions (Sarigul,2012, P.299), strict Customer Due Diligence must be applied which includes proper identification and verification of clients and keeping proper records of them (The International Monetary Fund, n.d.). The stern enforcement of laws and stronger penalty for non compliance are the most effective measures to fight money laundering (Bartlett, 2002, p.33). Clearly, money laundering cannot be contained and controlled by a single country but collective efforts and cooperation in technologies, information sharing and strategies among countries is the need of the hour (Shah et al., 2006, p.1127). Mere enactment of Anti-Money Laundering Laws and regulations are not suffice, keeping pace with new technologies, techniques and ways is imperative (The Associated Chambers of Commerce and Industry of India,2013), as money launderers keep on finding new modes and methods to launder money and bluff authorities.

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Dermatoglyphics of Criminals and Effects of Social Environment: A Study

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ABSTRACT

Intro —Dermatoglyphics start developing in the human fetus from third month of pregnancy and are formed fully by the sixth month and are genetic in nature. Mental retardation, schizophrenia, leprosy were observed on the basis of dermatoglyphics. It can act as a predictor tool of criminal tendency as the youth displaying the tendency were found to have low IQ. It is opined by researchers that criminal behavior is influenced both genetically and environmentally. Aim: The present study's objective was to determine the role of dermatoglyphics in detection of the genetic criminal tendency. Method & materials: 100 hand prints of criminal and control were obtained and digital parameters and palmar dermatoglyphics were studied. Result: PII, Furuhatta's indexes were low and Whorl patterns were more prominent in criminals than control group, and palmar creases and ABRC, Mean at dangle were found statistically significant.

Keywords—Criminal tendency; Dermatoglyphics; genetics; Low IQ; Social Environment; Delinquency

INTRODUCTION TO DERMATOGLYPHICS

The analysis of epidermal lines on the palmar and plantar surface is termed dermatoglyphics. The term Dermatoglyphics, a Greek word, was coined by Cummins which meant skin carvings. Historically, fingerprints in ancient culture were used for adornment or as a signature on documents. Fingerprints were also found on clay seals, clay tablets and pottery in Babylon. Malphigi observed presence of spirals, ridges in fingerprints. J.C. Meyer was the primary to ascertain the distinctiveness of fingerprints. Later the work was taken up many researchers like J.E.Purkinje, Sir William Herschel, Dr. Henry Faulds, Sir Francis Galton, Cummins, Henry and others. Two Indians pioneers, Azizul Haque and Hem chandra Bose worked with Henry to arrive at the present classification system.[1]

Faces change with time but dermatoglyphics never change as they are formed within the intrauterine life of a foetus and are permanent

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and individualistic. They are epidermal friction lines fused with sweat pores. The ridged skin is found on all primates and also the main function of it is creating traction and forming an interface between the object and the hand. Now, it is being used by investigators to ascertain the identity of an individual, especially at the scene of crime.

Dermatoglyphics has always interested scientists as having link to syndromes and diseases. Researchers studied medical disorders as down syndrome, mental retardation, Schizophrenia, epilepsy, diabetes, Leprosy, TB and many others. [2]-[8] Student counsellors with observation and experience found that talent of a student can be explored by the study of dermatoglyphics.[9].

Bali and chaube [10] applied dermatoglyphics to study criminal tendency and it was found that Palmar flexion creases, ATD angle on palm and patterns on hypothenar showed variation in experimental group to control group. With the advancement of technology, the character of crimes and therefore the number of criminals are increasing. New methods are required to predict criminals in the early stages and stop growth of criminal tendency. Large numbers of studies were conducted in various fields linking dermatoglyphics but not much research has been done in the detection of criminal tendency using dermatoglyphics as a predictor tool. Researchers derived that dermatoglyphics are inheritable and genetic in nature [11]-[12], so the possibility of inheriting criminal behavior exists.

The aim of the present study was to investigate qualitatively and quantitatively, dermatoglyphics as predictor tool of criminal tendency, by applying various digital and palmar parameters. The obtained information can often be employed in forming an information database. The delinquent children, who are at a risk and are prone to anti-social behavior and violence, can be detected from the database and taken care of by providing suitable and safe environment.

DIGITAL DERMATOGLYPHICS

A fingerprint is the reproduction of the ridges of the first phalange portion of a digit. It comprises elevations and depressions, as in a crop field. The elevations and the depressions, termed ridges and furrows respectively, tend to create a pattern. The central part of a pattern is named 'core' and the external edge is termed the 'delta'. There are different patterns formed but the only three are most important and they are Arch, Loop, and Whorl. [13].

Arches: The ridges run from end of the finger to the other end and called a plain arch. Sometimes, a tent like formation is found in the centre and is named as tented arch.

Loops: The ridges recurve and exit from the same side of entrance. There are two types. Radial and Ulnar loops, depending on the point of origin and exit of the hand. If the exit is from Ulnar bone side, they are called Ulnar loop and if the exit is from radial bone side, they are called Radial loop.

Whorl: In this pattern, the ridges appear either in concentric circles, spiral formation, combination of two loops or a mixture of two patterns within the central area. The variations are termed i) concentric whorls, ii) spiral whorls, iii) Double loop whorls, iv)

central pocket whorls v) Accidental whorls. Figure 1 exhibits common patterns.

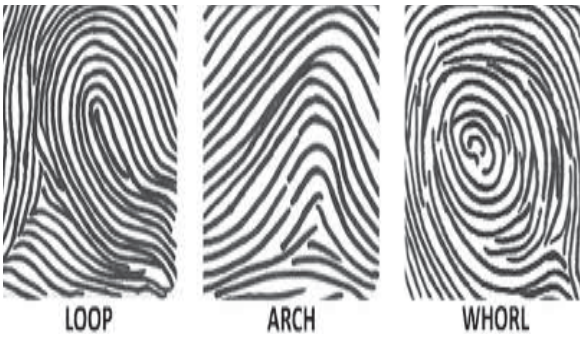


Fig:1. Common Fingerprint patterns (courtesy Research gate)

PALMAR DERMATOGLYPHICS

The palm is larger in area than a finger and has more characteristics. It is divided into three areas: Hypothenar, Thenar and Triradiate / Inter digital area. The palm has triradii, Palmar flexion creases, atd angle, a-b ridge count(ABRC) as some parameters for study. A triraidus is a meeting of three ridges stepping into three different directions, mostly at 120^0 to each other. The triradil occur below the index finger, middle finger, ring finger, and the little finger and are marked as 'a","b","c' and 'd'. One more triradius is found at the base of the palm and is called axial triraidus 't'.

ABRC: The number of ridges between the triradii 'a & b' are counted by drawing an imaginary straight line from a-b points.

ATD angle: It is obtained by drawing a line from the digital 'd' triradius to axial 't' triradius and from there to 'a' triradius in the ID area. The angle so formed is measured by keeping centre of protractor at T. The position of 't' changes and accordingly it is given values as (t', t").

Palmar Flexion Creases: The palmar lines are folds of the epidermis. They are called Heartline, Headline and Life line. They are again classified into SRBC, DRBC, TRBC based on the point of origin on the Radial side of the palm: Single Radial Base Crease (SRBC), Double Radial Base Crease (DRBC); and Triple Radial Base Crease (TRBC). Figure 2 exhibits palmar parameters.

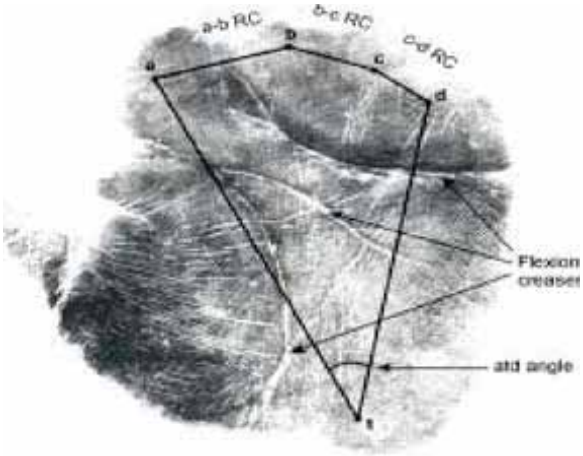


Fig:2 Palmer parameters..ATD, AB,Creases *(courtesy Research gate)*

Fig:2 Palmar Parameters

Abbreviations
ABRC: a-b ridge count
RH; Right hand
LH: Left hand
DTC: Distal Transverse crease
PTC: Proximal Transverse crease
RLC: Radial Longitudinal crease
ATD: atd angle
PII: Pattern Intensity index
F I: Faruhatta's index
DI : Dankmeijer's Index

METHODS AND MATERIALS:

For the study, a convenient sample study of 100 criminal and control group was selected. 100 clear hand print slips of RH & LH of criminals were obtained from fingerprint department, National Crime Records Bureau, India. The prints so obtained were sought

for clarity of details through light source and magnifier. Hand prints of control group were obtained from willing normal individuals known to author in the age group of 18-70. The materials used were finger and palm inking system, Standard black printers ink, roller, LCD magnifier, sheets of paper and cleaning solution.[14]

INCLUSION CRITERIA: REGISTERED CASES OF CRIMINALS WITH THE BUREAU

Exclusion criteria:

1. Deformed fingers and palm
2. scars and burns on palms
3. Partial and incomplete handprints

Procedure: Dermatoglyphics were taken by manual method suggested by Cummins. To get hand prints, the subjects were asked to scrub their hands well with soap and water. Little amount of ink was taken and spread evenly on the plate. The subjects then placed their palms facing down on the plate and inked their palms and fingers by pressing them hard. The inked hand was then placed on fingerprint sheets and hand prints were recorded. The names and sex details were noted down.[15]

Data handling: The information of criminals and control was entered within the excel sheets. The criminal group hand prints were given a separate serial number and the control group was given a separate serial number. Employing a 5 X magnifier and a light source, the hand prints were analyzed and the data found was entered against their allotted number.

Statistical analysis: The digital and palmar parameters were analyzed and tabulated. Calculations were done to find observed values as well as expected values. Statistical tools as arithmetic mean, Chi square were applied wherever necessary.

QUALITATIVE ANALYSIS:

i) Fingertip patterns: Arches(A), Loops(L), Whorls(W) frequency was studied

ii) Palmar analysis: Presence of triradii a,b,c,d & t was observed. Similarly the nature of origin of palmar lines was noted.

QUANTITATIVE ANALYSIS:

i) Pattern Intensity Index=
2x whorls+ loops
N(where n= total number of samples)

ii) Furuhatta's Index= $\frac{\text{Whorls X100}}{\text{Loops}}$

iii) Dankmeijer's Index = $\frac{\text{Arches X100}}{\text{Whorls}}$

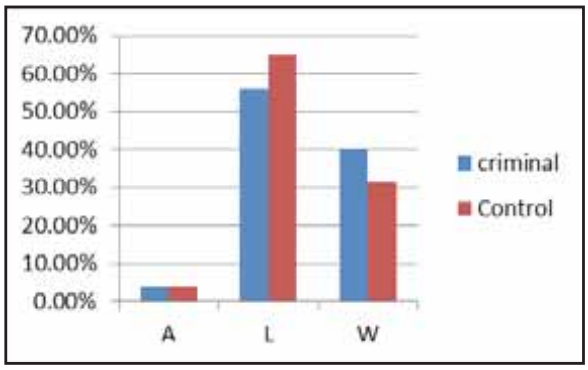
iv) ATD angle: Values obtained through geometric measurements

v) ABRC: Values obtained by counting ridges between a-b triradii

RESULTS & DISCUSSION

Digital parameters:

a) FP Patterns: Whorls were found more in criminals and less in controls (40.29% : 31.22%). Loops and arches were more frequent in control groups than study group (loops 65%: 56.05% & arches 3.77%: 3.66%). Chi square values were statistically significant @0.05 level of significance. Detailed distribution of Fingerprint patterns is shown in Graph.1 below.



Graph1. Distribution of Fingerprint patterns in both the groups

b) Pattern Intensity Index: The mean PII values of criminal group (13.67) were found to be higher than Control group(12.74).

c) Furuhatta's Index: The mean values of whorl-loop index for criminal (72.02) were found to be more than control group (48.03).

d) Dankmeijer's Index: The values of arch-whorl index for criminal (9.09) were found to be less than control group (12.09). Table.1.shows values of digital Dermatoglyphic indices.

Table:1 Digital Dermatoglyphic indices

Index	Criminal group	Control Group
PII	13.67	12.74
F I	72.02	48.03
D I	9.09	12.09

PALMAR PARAMETERS:

a) **ABRC:** It had been observed that the mean values for ABRC in criminal group (36.40 with SD 5.4)were higher than control RH (35.27 with SD of 5.6) and mean AB-RC on left hand of control group (37.21 with SD 6.42) was marginally beyond LH criminal group (37.07 with SD 5.01). The chi square values for both hands were found to be statistically significant @0.05 level of significance.

b) **Creases:** Single radial base creases were found more in criminals than non-criminals groups. SRBC shows higher values in criminals (8.34%) as compared to the Control group (0%) whereas Double Radial Base Crease (DRBC) & Triple Radial Base Crease (TRBC) show greater values in control (86.1%) & (13.9%) than criminals group (78.33%) &(13.3%). The Chi-square values are significant for both right and left hand @ 0.001 and support crease association with criminality.

c) **ATD angle:** It was observed that ATD angle was in right hand was @ 41.56 with SD 7.37 and left hand @ 41.90 with SD 7.53 in criminal group whereas RH of control was @39.63 with SD 5.40 and LH @ 39.90 with SD 5.34. The value of chi square. was statistically significant @0.01 level of significance. All the palmar dermatoglyphic values are displayed in Table 2.

Table:2. Different Dermatoglyphic Parameters						
S. no.	Parameter	Control		Criminal		X2 Value
		RH	LH	RH	LH	
1	FP Pattern (Whorl only)	31.98%	30.46%	44.62%	35.96%	Significant @0.05
2	ATD angle	39.63 with SD 5.40	39.90 with SD 5.34	41.56 with SD 7.37	41.90 with SD 7.53	significant @0.01
3	A-B RC	35.27 with SD of 5.6	37.21 with SD 6.42	36.40 with SD 5.4	37.07 with SD 5.01	Significant @0.05
4	Flexion Crease	SRBC -0% DRBC-86.1% TRBC-13.9%		SRBC- 8.34% DRBC-78.33% TRBC-13.3%		significant @0.001

DISCUSSION

In the present study, whorl pattern was found as the more frequently occurring pattern among criminals. It had been observed by Madhumitha et al, [16] that the whorl patterns of finger prints were found more in low intelligence quotient group. The results of our study were in accordance to the studies conducted by some researchers who found whorls more common than loops and arches. [17] -[19]

Pattern intensity index (PII) indicates presence of triradii in the sample group. Arch doesn't possess triradii, so it had not been considered. Increased value of PII indicates higher number of triradii, which occur more in whorl patterns. Within the present study, criminal group exhibited higher values of triradii than control group.

Higher values of Furuhatta's Index (whorl-loop index) in criminal group indicated more number of whorl patterns and fewer numbers of loops within the study group. Lower values of Dankmeijer's Index in criminal group indicated less number of arches and higher number of whorls in study group than control group. The current study is in accordance with the study done by Biswas, [17] Banik et al.[18]

The mean values for ABRC were found to be were higher in RH of criminal group than control. Madhumitha et al observed that intelligence inversely varies with ABRC and reduces with increase in values of ABRC. [16]. Palmar flexion creases when studied, showed that single radial base creases were more prevalent in criminals than Double Radial Base Creases & Triple Radial Base Creases. Bali & Chaube observed the same in their study [10].

Table:3 ATD Values for Criminal and control group				
ATD	Criminal	Criminal	Control	
	RH	LH	RH	LH
<30	1	2	1	0
51-55	4	5	2	2
56-60	1	2	0	1
61-65	2	2	0	0
66-70	2	1	0	0

It had been found [3] that standard values of ATD are between 30^0-60^0 and ATD values <30^0 and >60^0 revealed mental retardation and also that if the value of ATD is smaller and in the range of 30^0-60^0, brain responded faster. In the present study it was observed that in criminals the atd values exhibited <30 and >60 were more in number than in the control group, as shown in Table.3. It was observed by Madhumitha et al that ATD angle was highest in low IQ group [16].

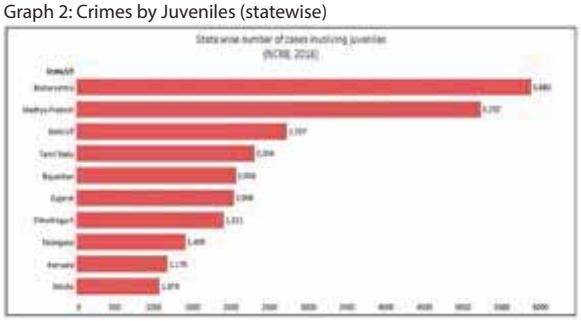
It can be corroborated by the above results that IQ and criminal tendency are related. Karestan C. Koenen et al [20]observed in his study that low IQ results in anti social behavior. The anti social behavior becomes a criminal act when it harms others.

SOCIAL ENVIRONMENT AND EFFECTS ON CRIMINAL BEHAVIOUR

Most violent behavior shown by juveniles is behavior witnessed either at home or school. As per statistics of 'Crime in India 2018'

published by NCRB, 31,591 crimes were committed by juveniles and Maharashtra & Madhya Pradesh topped the list as shown in Graph.2.[21] and also that 99.3% of the juveniles were boys within the age group of 16 to 18. Early childhood exposure to violence increases the danger of violent behavior by an adolescent. It had been observed that about 1% of the juveniles, as per statistics, were below 12 years. Majority of the crimes by juveniles were offences affecting human body and property.

Graph 2: Crimes by Juveniles (statewise)



REASONS FOR JUVENILE CRIME:

1) **Home environment**: Family has a stabilizing or disturbing influence on an individual. It either teaches children to care for others, respect their needs and rights or teach to be aggressive, anti-social and not caring. Children who grow up in homes, with conflicting parents, poor family management, excessive discipline by parents, high family mobility, mal-nourishment, no emotional attachment towards any parent or maltreatment, the child develops negative behavior as a way of life. A child who has grown up in happy family surroundings learns to develop positivity as a way to unravel problems. Positive parenting helps and acts as a buffer to forestall development of delinquent behavior. A child of law abiding parents has greater likelihood of becoming a law abiding citizen than a child with criminal parents.[22]

2) **School environment:** School is sort of a second home for the child. He comes to school to flee the monotony of the house and also to sharpen his skills. But because of high student/teacher ratio, excessive syllabus and other work pressures, teachers tend to ignore children who are underachievers. As a result, the child is on his own to deal with bullying, harassment

by peer group and hence, stays less attached to the school. [23]

3) **Poverty**: A powerful association had been found between poverty and crime. Children grown up in poor atmosphere find disharmony within the family, a daily feature. Parents lack time to bond with children and are inattentive to their emotional and physical needs. Income inequality is alleged to be the mother of crime. [24]

4) **Neighborhood / Community**: High levels of crime within the neighborhood, easy availability of arms and ammunition, poor housing, lack of mentors are a number of the factors contributing enhancement of deviant behavior. Limited education, lack of coaching/ training, less job opportunities pushes the youth towards violent behavior to survive.[23]

CONCLUSION

With the assistance of dermatoglyphics, the criminal behavior can often be predicted within the early stages of life of an individual. The growth of the criminal tendency is related to the available environment. Emotional and behavioral disorders (EBD) coupled with learning disabilities, poor problem-solving skills, poor social skills were enhancers of criminal behavior. The cumulative effect of the social environment and the higher the risks to which a child is exposed, the greater is the influence on the criminal behavior.

Prevention is the most plausible strategy to curb delinquency of children.[25]-[26] Children, who are at-risk for delinquency may be detected with the assistance of the predictor tool .In the present study, though absolute proof could not be obtained because of small sample size but results do support the hypothesis that dermatoglyphics plays a role in detecting criminal tendency. Dermatoglyphics could be a preventive, non-invasive tool to explain, compare and contrast, and predict events. Conducting additional studies involving larger samples of dermatoglyphics can give the required outcome.

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Lying and Lie spotting: Can brain waves detect lying and whether the use of EEG for theta band analysis is proficient in catching liars?

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ABSTRACT

Some people can lie confidently and never get caught, but a few are gifted with abilities to catch such people. The exciting question, asking how people are even capable of doing such things is explored in this research. In experiment-1 of the study, 40 students participated in an experiment where their skills to lie and catch liars was explored; an effort was made to relate them to their personalities. In experiment-2, 10 students were asked to lie while they were equipped with an EEG apparatus. Results confirmed that it is not necessary for a liar to be a lie spotter in all the cases and that the presence of a video teaching how to catch a liar could not affect the natural abilities of a person. An idea of relating a human's short term memory to the theta brain waves was highlighted and then the results were compared to verify the presence of the same particular band while lying.

Keywords: Deception, Personality, lie spotting, Brain signaling, Electroencephalography

INTRODUCTION

We have several decades worth of studies and theories on lie detection and related fields. Listening and analyzing speech, observing behavioral cues are widely used to try and detect lying and deception. But from the score of knowledge present, we can come to a conclusion that these tests are not reliable and do not form the basis for irrefutable conclusions. Do lies often remain undetected because people never even attempt to uncover it? Do they even know what to look for if they do try? An aptly named phenomenon, the *ostrich effect* (Vrij, 2008a) by Paul Ekman (1985/2001), suggests much the same. It is again emphasized that certain so-called wizards have extraordinary lie spotting skills but others don't (O'Sullivan and Ekman,2004). The objective of this present work is an attempt to know whether people can be trained to do so and even more importantly if they can relate this to extraversion or similar common personality traits?

Author's Intro:

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According to Gonza et al.(2001) people are expected to be good actors if they are likely to lie every day and be successful in doing it. They made a reasonably justifiable hypothesis that the personality constructs of *Acting, Manipulativeness, Anxiousness, Impression Management and Sociability* could have an effect on how people may lie, and was supported to a certain extent. The correlation between personality and deceptive ability is proven by well-documented works which go back up to the late 80s (Riggio et al., 1988) by a simple 16 personality test. The stratification of personalities and their relationship with deception can be observed with ease if one has more scales (16 in this case) to point them out. It was conclusive on correlating guilt (O scale) and self-control (Q3 scale) but failed to comment on the more common *extraversion* and reserved scales. An old research relating to '*extraversion and detection of deception*' (Bradley and Janisse, 1980) concluded that extroverts were more likely to be identified whether they are innocent or guilty as compared to introverts who were equally sensitive to past and present crime related events, unlike extroverts.

A videotape experiment carried by Johnson et al. (2005) was done on premature actors throws some interesting light on the *theory of mind,* concluding that individuals with high self-awareness were more effective in deceiving others. This particular finding verifies the results of Riggio et al. (1988), but had the same drawback, one of relating deception to a more common trait (like extraversion or neuroticism) as pointed out by Gudjonsson (1982) on the findings of Bradley and Janisse (1980). Vrij et al. (2010) suggested that pitfalls and opportunities in nonverbal and verbal lie detection were more than a guide on deception and more over they excellently bridged the gap that had come between the present generation and Paul Ekman's study with a pervasive domain. Much earlier the same researcher in (2007), tried to explain the facilitation of cognitive load using the techniques of recalling an event in reverse order and explored it adequately.

Gudjonsson (2011) reasonably argues that the personality traits like suggestibility, compliance and acquiescence have an observable amount of correlation with deception, irrespective of whether it is done by you or to you. This is interesting as his traits were more general, but their capabilities to catch a liar was untouched. Explored in Ein-Dor et al. (2017) with the help of two experiments, the "*Bullshit*" game and a study which checked whether a partner catching an extramarital affair had any affair before, is the age old cliché "*it takes a thief to know a thief*". This begs the question whether it is really so, in a general sense?

Discovery of brain waves shook the conventional lie detecting and it has been argued that one could detect deception by studying brain activity. As of now, revolutionary and conclusive literature findings are not eminent on deception and brain activity in a more suggestive and definite way. A very recent article (Khadelwal et al., 2016), which points out various different existing and upcoming deception detection techniques and technologies. These include the famous *Polygraph testing, Functional magnetic resonance imaging, Heart rate variability, Radar based lie detection and*

*finally EEG (electroencephalogram)***.** Out of all these techniques, only a few like EEG do not depend on non-specific physiological vectors (e.g., heart rate) and the doubt is certain that people having *Dark Triad* personalities would challenge the accuracy of existing Polygraph or any other techniques that have come to rely on non-specific physiological vectors for detection of deception though studies like Lykken, (1978) beg to differ.

Hence, there is a need to understand a simpler and reliable cue in brain activity when a person is deceiving, similar to the way a person sneezes during a cold. Just from the idea that lying demands more of our cognitive attention than does truth telling (Vrij et al., 2008), it would be reasonable to hypothesize that the formulated lie is dealt by the short-term memory in the liar's mind. This assumption of short-term memory related to lying may lead to more scope of future research if proven, as there are at least a few articles which talk about the relationship between *theta* waveband and short term memory like (Vosskuhl et al., 2015). An exciting work had been already shown by Kubo & Nittono (2009), where using EEG and P300 it was shown how the intention to conceal has a huge impact on deception detection.

The first experiment of this study focuses on relating both the lying and lie-spotting abilities of a person to his personality using the more common and famous test, the *Big Five Personality* questionnaire. As one can see many findings illuminate on the abilities to lie or deceive but the findings do not say much on the lie-spotting skills of a person. Hence, further relation to their personality and lie-spotting ability is out of the question. Whereas, the second experiment of this work tries to explore the presence of *theta waveband* in the EEG tests done on a lying subject.

METHOD

Experiment 1

In Experiment 1, we tried to analyze and understand a pattern between the personality of a person and deception using more common traits like extraversion. The ability of a person to lie and catch liars was equally explored using the experiment which aptly designed to achieve the aim. The early studies by Riggio et al. (1987) and Gudjonsson (1981) discuss this aspect, but later many other studies like the videotape experiment by Johnson et al. (2005), facilitation of cognitive load using the techniques explained in the literature review by Vrij et al. (2007) and the experiments of Ein-Dor et al. (2017) all of these point to the fact that there indeed exists a certain pattern, a correlation between the personality of a person and deception. The experiment design also challenges the findings of the study (Ein-Dor et al., 2017), whether it is true that it takes an insecure liar to catch another liar. For that, we took a subject pool, randomly divided them into two groups, control and experimental, verified how well they could lie or catch a lie in the presence and absence of a helping agent.

Participants

The participants were 40 students from the Indian Institute of Technology located in Kharagpur, West Bengal, India. They were the undergraduate and post graduate students

who belonged to the age group of 19-28, (M = 19.54, SD = 1.324). They volunteered to participate in the study with proper consent.

Materials and procedure

The students were at first given a *Big Five Personality* questionnaire for personality assessment. We have selected *Big Five* not just because it is widely used. It also directly concludes the scores of the required personality traits (i.e., *extraversion, agreeableness, neuroticism, openness and conscientiousness)* as we aimed.

Students from both the control and experimental groups were given serial numbers and were paired with each other after completing the questionnaire. Instructions were given to the students about how to proceed with the experiment. They were given a set of 8 questions each and were clearly instructed that they needed to ask and answer the same. The condition present was that odd serial numbered students would lie for the odd numbered questions and even serial numbered students to the even questions. It was made sure that all the participating students were not aware of this control condition. The experimental and control groups were separated; the control group was taken to a separate room where they continued the experiment, whereas the experimental group was shown a video (10 min) that instructed them on how to spot liars and were paired to complete the experiment.

RESULTS AND DISCUSSION (EXPERIMENT 1)

The scores from the *Big Five personality test* are calculated and the means and standard deviation for all the personality traits are estimated as follows: *Extraversion* (M = 18.70, SD = 7.154) , *Agreeableness* (M = 26.12, SD = 6.734) , *Neuroticism* (M = 22.12, SD = 4.675) , *Openness* (M = 16.52, SD = 5.67) *and Conscientiousness* (M = 24.7, SD = 6.454).

Later on, these scores and the number of uncaught lies told and lies caught were correlated to arrive at various inferences. From **Table 1** it can be seen that there was a significant negative correlation between lies told and lies caught. It implies that more is the ability to lie, less is the ability to catch lies. This is totally in contrast with previous studies (Ein-Dor et al. 2017). Secondly, the lies caught and uncaught lies told by each person is observed and noted. Briefly speaking, in a nut shell, we know which person was asked to lie for which particular question and if he was successful doing that he is a better liar and if he wasn't there the other person was a better lie spotter. The individuals who were able to lie or catch liars at least 75% of the time were separated and analyzed.

Table 1

Correlation among Personality traits, Lies uncaught and Lies caught (N=40) (Experiment 1)

Correlation	Uncaught Lies	Lies caught
Extraversion	-0.222	0.049
Agreeableness	-0.207	0.019
Conscientiousness	0.020	0.058
Neuroticism	-0.003	-0.275
Openness	0.020	-0.002
Uncaught Lies Told	1	-0.475**
Lies caught	-0.475**	1

**p <0.01

A minute increase of 1% was seen in the

experimental group as a whole while lying when compared with the control group. Whereas in lie spotting, surprisingly control group showed an increase of 1% than the experimental group. The peculiar result which was seen among the people who succeed in lying for at least 75% of the question is that few subjects (59 % among the class of 40) in the experimental group have used the video for better lying than lie spotting.

To test the significance of the difference between the two groups in terms of the effect of priming by the video on the ability to lie as well as spot lies, Mann-Whitney U test was performed. The results clearly showed that there was no significant effect of the video on the ability to either lie well or to catch a lie well, as there was no difference between the two groups.

The entire results of experiment 1 were as follows: Out of 11 participants who did lie perfectly 75% of the time, only 2 had very low scores on the scale of Extraversion (below 15 from a maximum of 40). Out of 9 participants who caught lies 75% of the time, only 1 had a low score on Extraversion scale while 3 of them scored very high (above 30). It might be an indication that extroverts are better liars and lie-spotters than introverts.

An interesting observation made was that 7 out of 20 students of the experimental group (30% approximately) were better at lying than spotting a lie (they lied 75% of the time), whereas there were only 4 in the other group who did better lying than spotting a lie. The video, in this case, might have acted as an agent to increase the ability to deceive well. Does this show the importance of one's self-concern about hiding their facts well more than to check the same in others?

EXPERIMENT 2

The second experiment of this article tries to explore the presence of *theta waveband* in the *EEG (electroencephalogram)* tests performed on a lying subject. Though lie detection using EEG is not a novel idea but the study of *theta waves* for the same is not as familiar compared to the former. The experiment was aimed to search for any possible and new observational methods for lie detection. The possible connection between *theta* wavebands and short-term memory was also explored by many others like Vosskuhl et al. (2015). An exciting work had been shown by Kubo and Nittono (2009), where using EEG and P300 it was shown how Intention to conceal has a huge impact on deception detection. The recent work by Khandelwal et al. (2016), also points out that in upcoming techniques on deception detection an EEG will be very useful.

PARTICIPANTS

The sample comprised 10 participants (5 men and 5 women), who were the undergraduate and post graduate students between the age group of 20 and 25 years, (M = 25.45, SD = 2.477). They volunteered with proper knowledge of the experiment and consent.

INSTRUMENTS

An electroencephalogram (EEG) was used to find the electrical activity of the brain and data were collected from 64 scalp sites. The sampling rate was 256 Hz. The data from each participant was recorded with the help of a computer.

MATERIALS AND PROCEDURE

The experiment was designed to mimic the present day's polygraph test, but was never aimed at catching liars. As the study of how *theta waveband* is directly related to short term memory of a person is not yet quite strong, none can say that the presence of *theta waves* can be fully indicative as to whether the person is only using his short term memory or lying as a matter of fact.

The participants were equipped with the EEG apparatus and they were provided with two sets of questions. Utmost care was taken in keeping the participant unaware of the questions until the apparatus was installed. The experiment was quite simple, in that the first set of questions they were asked were simple questions. For example, " do you believe that the earth is flat? ", " do you believe in God? ". The second set consisted of more personal questions like "No offense!, Are you a virgin?"," would you hit your children in future?" and so on.

The only instruction given to them was to lie in every alternate question starting from the first one in the first set and select any four questions which they preferred in the second set. As there were 8 questions in each set the total number of truths and lies told were equal in each and every case. Sufficient gap was given between set one and set two, and participants were requested to restrict their movement. The questions were answered in only Yes and No, so that later it could be easy to analyze the data without significant noises or artifacts.

The sample rate was 256Hz and as *theta band* exists only within 4-7 Hz, the current results were evaluated for the presence of the same. For the first set, it was known that for which questions the participant was lying and the choices were ticked on the paper by the participant for the second set. As declared earlier, we were only interested in observing the presence on the assumed band when the person was lying so the result for the rest of the questions was ignored.

RESULTS AND DISCUSSION (EXPERIMENT 2)

The experiment roughly took 2-3 minutes for each participant. We had at least 30,000 data points to analyze and so Wavelet Analysis was used given the sampling rate of (256 Hz). The purpose of this Wavelet analysis was to analyze and compress a signal. In this process, the signals were first analyzed and representations of simplified versions were produced in MATLAB. The data were reconstructed with approximations at given levels and the data were clustered for comparing with each question. As removal of the noises was unavoidable, it was done much before the entire analysis for accuracy.

Once the *theta band* was separated, the data was approximated with higher order polynomial fitting and partitioned into two sets of 8 questions each and then compared to the choices made by the participant.

The probability of congruence of the choices made and the presence of the *theta waveband* was at least 50% in all the cases and 75% for 8 out of 10 participants with (mean= 2.9, SD= 0.567). But the possibility of occurrences of false positives was inevitable and was at least 1 in each case and went up to 3 for one subject whose (mean= 1.5 and SD= 0.707). A sample data and analysis are shown in **fig 1**

for a brief idea.



Fig 1: Comparision of the results from the choices given by the individuals.

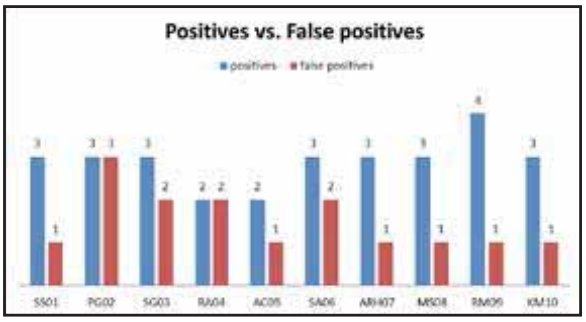

Fig. 2: Plot showing Positives and False positives observed among the subjects (N=10) (Experiment 2)

The idea of the experiment was never to read EEG for clues of deceit rather understand why the participant was anxious or in this case using his short term memory. If at all the answer to the question was decided well in advance it should be in his long term memory. Though this particular experiment was built on the basis of some infant findings we believe that there would be a huge scope of future study along this perspective. From **Fig. 2,** one can see that just the idea of why the false-positives present in the first place itself are definitely fascinating and thought-provoking.

Discussion

No appropriate connection was found between a liar and a lie spotter which was repudiating the discoveries of Ein-Dor et al, (2017), as his research was more on a concise topic, where people either know each other or the game very well. Our first experiment gave equal chance to each and every individual to show whether the participant got skills to lie well or catch a liar. The act of using the lie-spotting tips for better lying rather than catching suggests that one's self-awareness comes way earlier than any motivation to understand or suspect others.

The article on *Dark Triad and deception* by Azizli et al. (2016) helped reasonably to gain a perspective but was relatively incongruent with our study as we were not specific on personality standouts. Individuals who used their instincts performed equally well compared to those who were educated before at lie-spotting. Concluding that both lying and lie-spotting are mostly based on natural instincts and cannot be easily taught, would be as presumptuous as commenting that the nature of a person is more prominent than nurture in the above context.

As expressed earlier, the desire of the investigation in experiment 2, was never to peruse EEG for pieces of information of double dealing rather comprehend why the member was on edge or for this situation utilizing his short-term memory. On the off chance that at all the response to the inquiry was chosen well ahead of time it ought to be in his long term memory and simply, why the false-positives exhibited in any case are certainly entrancing and interesting.

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FOOTNOTES

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ILO Convention on the Elimination of Violence and Harassment in the World of Work: A Much Awaited Step

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ABSTRACT

The Convention on the Elimination of Violence and Harassment in the World of Work was adopted on 21 June 2019 with non-binding guidelines to make the "world of work free from violence and harassment". The Convention has been drafted in a comprehensive manner in terms of the meaning of violence and harassment, worker, world of work, etc. A workplace which is free from violence and harassment ensures equality, respect, dignity, non-discrimination, etc. A robust system regarding workplace at a national level will help States to fulfil their human rights obligations under human rights treaties.

KEY WORDS

Violence and harassment, victims, world of work, domestic violence, vulnerable groups, ILO, workers, Convention, Recommendation, workplace policy, awareness

INTRODUCTION

"What we have adopted today is a roadmap, a compass to take us forward in the future of this Organization, because the future of work is the future of our Organization".

-Guy Ryder
ILO Director-General

The increasing reaction from international community against "violence and harassment in the world of work" made it clear that international action in the form of a legally binding instrument was imminently required as a safe workplace ensures equality and dignity among other things. According to an estimate, women are not protected from sexual harassment in the workplace in 59 countries. Further, legal protection is lacking for them in 70% of economies in the "Middle East and North Africa, half in East Asia and the Pacific, and one-third in Latin America and the Caribbean". About 500 million women have been potentially affected around the world.[1]According to another estimate, 35%

1 Paula Tavares and Quentin Wodon, "Sexual Harassment – Where do we Stand on Legal Protection for Women?" available at https://

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of women over the age of 15 years have experienced "sexual or physical violence at home, in their communities or in the workplace."[2] It was realized that higher level of protection was needed to women workers than what has been provided under various treaties on human rights more particularly the International Covenant on Economic, Social and Cultural Rights (ICESCR) and the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW).

With an objective to make the workplace "free from violence and harassment", the ILO took a concrete step in 2009 by publishing its special report on "Gender Equality at the Heart of Decent Work". The Report called for the prohibition of violence and harassment at workplace. Subsequently, many reports were adopted at ILO to end violence and harassment for all the workers. It was decided by the Governing Body of ILO in October 2015 to bring on the agenda of the 107th Session of its Conference the item "Violence against women and men in the world of work". The Conference was scheduled to be held in the month of June 2018.

The ILO published a *Brown Paper* report on "Ending Violence and Harassment in the World of Work" in August 2018. The report included the "proposed texts of the Convention and its complementing Recommendation". Comment and feedback were invited on the report by the ILO member States. After receiving comments and feedback, the second discussion on Convention took place in June 2019 and the Convention on the Elimination of Violence and Harassment in the World of Work was adopted on June 21, 2019.[3]

At the same General Conference of ILO, it was decided to adopt certain proposals in the form of Recommendation. The provisions of "Violence and Harassment Recommendation, 2019" so adopted was to supplement the Convention. In other words, the Recommendation "*should be* considered in conjunction" with the Convention. It is however to be noted that Convention is *legally binding* instrument that may or may not be ratified by States, whereas Recommendation serves as *non-binding guidelines*.[4] In other words, Violence and Harassment Recommendation which is non-binding in nature and accompanies the Convention provides guidance only on the Convention's obligations.[5]

The Preamble to Convention recognizes the "right of everyone to a world of work free from violence and harassment, including gender-based violence and harassment". It also recognizes that such violence and harassment which can "constitute a human rights violation or abuse" and is also a "threat to equal opportunities", is "unacceptable and incompatible with decent work".

blogs.worldbank.org/voices/sexual-harassment-where-do-we-stand-legal-protection-women last visited on 18 June 2020.

2 https://www.ituc-csi.org/GBV

3 See Yuliia Ostrovskaya, "ILO Convention on Combating Violence and Harassment at Work: History and Significance" available at https://legal-dialogue.org/ilo-convention-on-combating-violence-and-harassment-at-work-history-and-significance last visited on 12 June 2020.

4 See also https://www.ilo.org/ilc/ILCSessions/108/media-centre/news/WCMS_711366/lang--en/index.htm last visited on 15 June 2020.

5 See Human Rights Watch, "ILO: New Treaty to Protect Workers from Violence, Harassment" available at https://www.hrw.org/news/2019/06/21/ilo-new-treaty-protect-workers-violence-harassment, last visited on 15 June 2020; See also "We did it! New ILO Convention on Violence and Harassment at Work" available at http://www.industriall-union.org/we-did-it-new-ilo-convention-on-violence-and-harassment-at-work last visited on 12 June 2020.

Members are responsible "to promote a general environment of zero tolerance to violence and harassment". The Preamble acknowledges that "gender-based violence and harassment disproportionately affects women and girls" and also recognizes that "an inclusive, integrated and gender-responsive approach" is required to end such violence and harassment.

DEFINITION AND SCOPE OF CONVENTION

The term "violence and harassment in the world of work" is defined in the Convention to mean "a range of unacceptable behaviours and practices, or threats thereof, whether a single occurrence or repeated, that aim at, result in, or are likely to result in physical, psychological, sexual or economic harm, and includes gender-based violence and harassment".[6] A pragmatic approach has been adopted in the Convention while defining the term *violence and harassment*. The definition will cover *inter alia* "physical abuse, verbal abuse, bullying and mobbing, sexual harassment, and threats and stalking."[7]

The Convention gave a comprehensive meaning to the term *violence and harassment* which need not be *gender-based* in all the cases. The term, however includes "gender-based violence and harassment". Further, "gender-based violence and harassment" is defined to mean "violence and harassment directed at persons because of their sex or gender, or affecting persons of a particular sex or gender disproportionately, and includes sexual harassment".[8] The "gender-based violence and harassment" may also target the transgender as the term includes *sex* or *gender*.

The Member States are required to bring their national laws in conformity with the Convention provisions. The definitions of "violence and harassment in the world of work" and "gender-based violence and harassment" are to be included in the national laws to comply with Article 1. The Convention however, provides that the aforesaid definitions in national laws "may provide for a single concept or separate concepts".[9]

The scope of Convention is very wide as *inclusivity* is the central point of it. In other words, the Convention protects each and everyone who works, whatever his status may be, and irrespective of the sector - whether "public or private"; kind of economy - whether "formal or informal" and the areas - whether "urban or rural", in which he works.[10]

According to Article 2, the persons who are protected by the Convention are "workers and other persons in the world of work, including employees, persons working irrespective of their contractual status, persons in training, including interns and apprentices, workers whose employment has been terminated, volunteers, jobseekers and job applicants, and individuals exercising the authority, duties or responsibilities of an employer". The persons who are entitled for protection under the

6 Article 1 (a), ILO Convention, 2019.

7 Shauna Olney, "ILO Convention on Violence and Harassment: Five Key Questions" available at https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_711891/lang--en/index.htm last visited on 12 June 2020.

8 Article 1 (b), ILO Convention, 2019.

9 Id., Article 1 (2).

10 Shauna Olney, "ILO Convention on Violence and Harassment: Five Key Questions" available at https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_711891/lang--en/index.htm last visited on 12 June 2020.

Convention include those persons also who are not a part of the organization yet such as job seekers as well as job applicants. The provision therefore has been drafted in the most comprehensive manner to rule out any possibility of misinterpretation of provision.

The Convention is applicable to "violence and harassment in the world of work" which occurs in the course of work; which is linked with the work; or which arises out of the work - (i) "in the workplace"; (ii) "in places where the worker is paid, takes a rest break or a meal, or uses sanitary, washing and changing facilities"; (iii) "during work-related trips, travel, training, events or social activities"; (iv) "through work-related communications, including those enabled by information and communication technologies"; (v) "in employer-provided accommodation"; and (vi) "when commuting to and from work".[11]

The Convention thus, is applicable to violence and harassment which occurs in the "course of work"; which is "linked with the work"; or which arises "out of the work". Not only that, the Convention is also applicable to violence and harassment which takes place "during work-related trips, travel, training, events or social activities". Realizing the fact that work need not necessarily take place at a physical workplace and there may be work through virtual platforms, the Convention has rightly covered "work-related communications, including those enabled by ICT".[12]

CORE PRINCIPLES

Each Member is required to "respect, promote and realize the right of everyone to a world of work free from violence and harassment". In this regard, Members are also obligated to adopt "*aninclusive, integrated and gender-responsive approach*" in accordance with their national law and "in consultation with representative employers' and workers' organizations". The approach which will be so adopted, is to take into account violence and harassment involving "third parties", e.g. "clients, customers, service providers and patients" because they can also be "victims as well as perpetrators".

The aforesaid approach is to include - (i) "prohibiting violence and harassment in law"; (ii) ensuring that "violence and harassment" are addressed by relevant policies; (iii) "adopting a comprehensive strategy in order to implement measures to prevent and combat violence and harassment"; (iv) "establishing or strengthening enforcement and monitoring mechanisms"; (v) "ensuring access to remedies and support for victims"; (vi) "providing for sanctions"; (vii) "developing tools, guidance, education and training, and raising awareness, in accessible formats as appropriate"; and (viii) "ensuring effective means of inspection and investigation of cases of violence and harassment".[13]

The Violence and Harassment Recommendation, 2019 suggests that "in adopting and implementing the *inclusive, integrated and gender-responsive approach*" as aforesaid, the Members should, where appropriate, "address violence and harassment in the world of work in labour and employment, occupational safety and health, equality and non-discrimination law,

11 Article 3, ILO Convention, 2019.

12 Shauna Olney, "ILO Convention on Violence and Harassment: Five Key Questions" available at https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_711891/lang--en/index.htm last visited on 12 June 2020.

13 Article 4, ILO Convention, 2019.

and in criminal law".[14]

The Convention thus, obligates Members to adopt a comprehensive approach to ensuring a "world of work free from violence and harassment". The approach not only includes prohibiting violence and harassment, access to remedies and support for victims, provisions for sanctions, inspection and investigation, but also "education and training, raising awareness in accessible formats". *Accessible formats* means in an alternative manner or alternative form. By using the words, in *accessible formats*, the Convention has also taken care of the *visually impaired people*(VIP). The Marrakesh Treaty to Facilitate Access to Published Works for Persons Who are Blind, Visually Impaired, or Otherwise Print Disabled, 2013 (Marrakesh VIP Treaty) defines *accessible format copy* as "a copy of work in an alternative manner or form which gives a beneficiary person access to the work, including to permit the person to have access as feasibly and comfortably as a person without visual impairment or other print disability …".[15] The term may include various formats such as Braille, talking books, Daisy, digital formats, large print, etc.[16]

In addition, Article 5 also requires Members to "respect, promote and realize the fundamental principles and rights at work, namely freedom of association and the effective recognition of the right to collective bargaining, the elimination of all forms of forced or compulsory labour, the effective abolition of child labour and the elimination of discrimination in respect of employment and occupation, as well as promote decent work."

The Violence and Harassment Recommendation, 2019 provides that it should be ensured by Members that all employers and workers that are "more exposed to violence and harassment", should fully "enjoy freedom of association and the effective recognition of the right to collective bargaining consistent with the Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87), and the Right to Organise and Collective Bargaining Convention, 1949 (No. 98)". In other words, the Recommendation suggests that Members of this Convention should also take into account the provisions of aforesaid Conventions of 1948 and 1949 irrespective of the fact whether they are parties to these two Conventions or not. Since the Violence and Harassment Recommendation, 2019 is not a binding instrument as such and only recommendatory in nature, therefore Members are at liberty to accept or not to accept the provisions of the Recommendation.[17]

In addition to above, as per Recommendation, Members should "promote the effective recognition of the right to collective bargaining at all levels as a means of preventing and addressing violence and harassment". They should also mitigate "the impact of domestic violence in the world of work". They should also support such type of collective bargaining; and for this purpose they should disseminate all relevant information, trends and practices of collective agreements.[18]

14 Provision 2, Violence and Harassment Recommendation, 2019.

15 Article 2(b), Marrakesh VIP Treaty, 2013.

16 V.K. Ahuja, "Marrakesh Treaty to Facilitate Access to Published Works for Visually Disabled: Putting an End to Global Book Famine" in Manoj Kumar Sinha and VandanaMahalwar, Copyright Law in the Digital World (2017), 97-107 at p. 99.

17 Provision 3, Violence and Harassment Recommendation, 2019.

18 Id., Provision 4.

The Members also have the obligations to ensure through their laws and policies, "the right to equality and non-discrimination in employment and occupation, including for women workers", as well as for workers belonging to vulnerable group(s).[19] It is recommended by Provision 13 of Violence and Harassment Recommendation, 2019 that "the reference to vulnerable groups and groups in situations of vulnerability" should be interpreted "in accordance with applicable international labour standards and international instruments on human rights". Vulnerable groups may include e.g. migrant workers, disabled persons, transgender, old age person who are working.

The Recommendation further adds that instruments of the ILO on *equality and non-discrimination* should be taken into consideration by Members in their national legal regime. These ILO instruments may include the Equal Remuneration Convention (No. 100) and Recommendation (No. 90), 1951, and the Discrimination (Employment and Occupation) Convention (No. 111) and Recommendation (No. 111), 1958.[20]

PROTECTION AND PREVENTION

Article 7 of the Convention requires Members to "adopt laws and regulations to define and prohibit violence and harassment in the world of work, including gender-based violence and harassment".

Appropriate measures for preventing violence and harassment in the world of work are required to be taken by Members. The aforesaid measures to be taken by Members will include:

(i) To recognize for public authorities the important role in the case of informal economy workers;

(ii) To identify the sectors/occupations and work arrangements in which workers as well as other concerned persons are more exposed to violence and harassment[21]; and

(iii) To take measures to protect such persons effectively.[22]

The Convention obligates Members "to adopt laws and regulations"which will require "employers to take appropriate steps commensurate with their degree of control to prevent violence and harassment in the world of work, including gender-based violence and harassment". The employers shall also be required to do certain acts to the extent reasonably practicable - (i) to adopt and implement a "*workplace policy* on violence and harassment"[23]; (ii) to take into account "violence and harassment and associated psychosocial risks in the management of occupational safety and health"; (iii) to "identify hazards and assess the risks of violence and harassment"[24] and "take

19 Article 6, ILO Convention, 2019.

20 Provision 5, Violence and Harassment Recommendation, 2019.

21 As far as identification of sectors/occupations is concerned, this has to be done in consultation with the organizations of employers and workers concerned. Provision 9 of the Violence and Harassment Recommendation, 2019 recommends that appropriate measures should be adopted by Members for those works in which there is likelihood of more "exposure to violence and harassment". These works may include "night work, work in isolation, health, hospitality, social services, emergency services, domestic work, transport, education or entertainment".

22 Article 8, ILO Convention, 2019.

23 This is to be "done in consultation with workers and their representatives".

24 Regarding "workplace risk assessment" Members should take into consideration factors that "increase the likelihood of violence and harassment, including psychosocial hazards and risks". The emphasis should be on the "hazards and risks" that - (i) "arise from working conditions and arrangements, work organization and human resource management"; (ii) "involve third parties

measures to prevent and control them"; and (iv) to "provide to workers information and training" on the "identified hazards and risks of violence and harassment and the associated prevention and protection measures".[25]

Regarding *occupational safety & health*, the Recommendation suggests that the "occupational safety and health instruments" of the ILO, such as the "Occupational Safety and Health Convention, 1981 (No. 155), and the Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187)" should be taken into consideration by Members in their national legal regime.[26]

Regarding the *workplace policy*, Members should encourage by specifying in their national laws that workers as well as their representatives should participate in the "design, implementation and monitoring" of such policy. The policy should – "(a) state that violence and harassment will not be tolerated; (b) establish violence and harassment prevention programmes; (c) specify the rights and responsibilities of the workers and the employer; (d) contain information on complaint and investigation procedures; (e) provide that all internal and external communications related to incidents of violence and harassment will be duly considered, and acted upon; (f) specify the right to privacy of individuals and confidentiality, while balancing the right of workers to be made aware of all hazards; and (g) include measures to protect complainants, victims, witnesses and whistle-blowers against victimization or retaliation".[27]

Measures, legislative or otherwise, should be taken by Members for the protection of migrant workers from violence and harassment, regardless of "migrant status, in origin, transit and destination countries". Further, in order to prevent and address "violence and harassment in the informal economy", resources and assistance should be provided by Members to "informal economy workers and employers, and their associations". Measures adopted by Members to prevent violence and harassment should not result "in the restriction of the participation" of women and the other vulnerable groups "in specific jobs, sectors or occupations".[28]

ENFORCEMENT AND REMEDIES

Article 10 requires Members to take certain appropriate measures regarding enforcement of laws regarding violence and harassment in the world of work and remedies with respect to their violations. Appropriate measures are to be taken first of all to "monitor and enforce national laws and regulations" in this regard.

Further, in cases of violence and harassment, Members are required to ensure "easy access to appropriate and effective remedies and safe, fair and effective reporting and dispute resolution mechanisms and procedures". Such mechanisms and procedures include - (i) complaint and investigation procedures, and "dispute resolution mechanisms at the workplace" where appropriate; (ii) "dispute resolution mechanisms external

such as clients, customers, service providers, users, patients and members of the public"; and (iii) "arise from discrimination, abuse of power relations, and gender, cultural and social norms that support violence and harassment". See Provision 8, "Violence and Harassment Recommendation, 2019".

25 Article 9, ILO Convention, 2019.

26 Provision 6, Violence and Harassment Recommendation, 2019.

27 Id., Provision 7.

28 Id., Provisions 11 and 12.

to the workplace"; (iii) courts or tribunals; (iv) "protection against victimization of or retaliation against complainants, victims, witnesses and whistle-blowers"; and (v) "legal, social, medical and administrative support measures for complainants and victims".

Members are required to protect the privacy and confidentiality of the individuals who are involved and also to ensure that "requirements for privacy and confidentiality are not misused". Where appropriate, sanctions are also to be provided in violence and harassment cases.

Members are also obligated to provide that "victims of gender-based violence and harassment" have "effective access to gender-responsive, safe and effective *complaint and dispute resolution mechanisms*, *support, services and remedies*".

Members shall also recognize the *domestic violence effects* and "mitigate its impact in the world of work" to the extent reasonably practicable. It is therefore noteworthy that under the Convention, States are required not only to recognize the "effects of domestic violence", but also to "mitigate its impact on the world of work"; and for this purpose, the Recommendation provides that "measures to mitigate the impact of domestic violence" may include – (i) "leave for victims of domestic violence"; (ii) "flexible work arrangements and protection for victims"; (iii) "temporary protection against dismissal for victims"; (iv) "inclusion of domestic violence in the workplace risk assessments"[29]; (v) a "referral system to public mitigation measures for domestic violence"; and (vi) "awareness-raising about the effects of domestic violence".[30] The domestic violence is a worldwide problem and therefore this is really a welcome provision in the Convention in the sense that the effects of domestic violence on work have been taken care of and obligations have been created for the Members in this regard.

The Convention secures the workers the right "to remove themselves from a work situation which presents an imminent and serious danger to life, health or safety due to violence and harassment, without suffering retaliation or other undue consequences". They are however, required to inform management in this regard.

The labour inspectorates/relevant authorities,[31] in Member States must be empowered to deal with such violence and harassment. They should also have the power to issue"orders requiring measures with immediate executory force, and orders to stop work in cases of an imminent danger to life, health or safety". An appeal however, may be made against such an order to a judicial/ administrative authority.

The remedies under Article 10 may include – (i) the right of resignation with compensation; (ii) reinstatement; (iii) compensation which is appropriate for damages; (iv) discontinuation of certain conduct or change in policies or

29 Workplace risk assessments is extremely important as it "can take into account factors that increase the likelihood of violence and harassment (such as gender, cultural and social norms)".

30 See Provision 18, Violence and Harassment Recommendation, 2019.

31 It is recommended that Labour inspectors and other officials should undergo "gender-responsive training" so that they could identifying and address inter alia "psychosocial hazards and risks, gender-based violence and harassment, and discrimination against particular groups of workers". Further, "violence and harassment in the world of work" should be covered in the "mandate of national bodies responsible for labour inspection, occupational safety and health, and equality and non-discrimination, including gender equality". See id., Provisions 20-21.

practices; and (v) legal fees as well as costs. Further, compensation should be provided to victims in cases of "psychosocial, physical or any other injury or illness which results in incapacity to work".[32]

As far as the "*complaint and dispute resolution mechanisms*" is concerned, it should include measures such as(i) "courts with expertise in cases of gender-based violence and harassment"; (ii) "timely and efficient processing"; (iii) "legal advice and assistance for complainants and victims"; (iv) "guides and other information resources"; and (v) "shifting of the burden of proof" in proceedings but excluding criminal proceedings.[33]

The "*support, services and remedies*" for "victims of gender-based violence and harassment" as obligated by Article 10 should include measures *inter alia* - (i) "support to help victims re-enter the labour market"; (ii) counselling & information services; (iii) 24-hour hotlines; (iv) emergency services; (v) "medical care and treatment and psychological support"; (vi) "crisis centres, including shelters"; and (vii) "specialized police units or specially trained officers to support victims".[34]

The Recommendation states that "perpetrators of violence and harassment" should be held "accountable and provided counselling or other measures" with a view to preventing "the reoccurrence of violence" and to facilitate "their reintegration into work".[35] The statistics should be collected and published on "violence and harassment in the world of work".[36]

GUIDANCE, TRAINING AND AWARENESS-RAISING

The Convention also emphasizes the need of providing due guidance, training, etc. to "employers and workers, their organizations, and relevant authorities". This has to be done in accessible formats, so that the visually impaired persons also get the benefit of the same. The Convention thus, requires Members to ensure that in their national policies, particularly "those concerning occupational safety and health, equality and non-discrimination, and migration", the issue of violence and harassment is addressed. The Members are also required to provide to "employers and workers, their organizations, and relevant authorities, with guidance, resources, training or other tools, in accessible formats, on violence and harassment" including gender-based violence and harassment. Further, it will also be ensured by Members that "initiatives, including awareness-raising campaigns, are undertaken".[37]

The Recommendation states that with respect to the issue of violence and harassment in the world of work, Members should "fund, develop, implement and disseminate" - (i) programmes on various aspects of the issue; (ii) "gender-responsive guidelines and training programmes" for judges and all other officials concerned, employers, workers, and organizations; (iii) "model codes of practice and risk assessment tools" on the issue; (iv) "public awareness-raising campaigns in the

32 Id., Provisions 14 and 15.

33 Id., Provision 16.

34 Id., Provision 17.

35 Id., Provision 19.

36 Id., Provision 22.

37 Article 11, ILO Convention, 2019.

various languages" on various aspects of the issue; (v) "gender-responsive curricula and instructional materials" on the issue; (vi) "materials for journalists and other media personnel"; (vii) "public campaigns aimed at fostering safe, healthy and harmonious workplaces free from violence and harassment".[38]

The Recommendation has rightly guided Members to "fund, develop, implement and disseminate" the guidance programmes, training programmes and awareness programmes in their territories to sensitize judges, law enforcement officials, employers and public at large.

THE PREVENTION OF SEXUAL HARASSMENT OF WOMEN AT WORKPLACE IN INDIA

India has a robust system for the prevention of the sexual harassment of women at workplace. In order to give effect to the provisions of Convention on the Elimination of all Forms of Discrimination against Women, which was ratified by India in 1993,the legislature adopted the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 (hereinafter "Act"). The Act not only provides for the prevention and prohibition of sexual harassment of women at workplace, but also deals with the redressal of sexual harassment complaints.

The genesis of the Act can be traced to a landmark judgment of Supreme Court, *Vishaka* vs. *State of Rajasthan*.[39]In this case, Vishaka filed a public interest litigation (PIL) in the Supreme Court after a woman Bhanwari Devi who was working for State of Rajasthan was gang raped after she tried to prevent the marriage of a girl child. The Supreme Court discussed the right to equality and dignity of women as provided by the Constitution of India. The Court also referred to human rights instruments particularly the UN Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and laid down legally binding guidelines.Those guidelines remained in force till the 2013 Act was brought into force.

The term *sexual harassment* is defined broadly under the Act to include "any one or more of the following unwelcome acts or behavior (whether directly or by implication) namely:— (i) physical contact and advances; or (ii) a demand or request for sexual favours; or (iii) making sexually coloured remarks; or (iv) showing pornography; or (v) any other unwelcome physical, verbal or non-verbal conduct of sexual nature".[40]It is noteworthy that the term is defined in an inclusive manner and it is not exhaustive. Any other similar conduct not mentioned in the definition may also be covered in the definition provided it falls within the four corners of the term *sexual harassment*.

The term *workplace* includes (i) governmental establishments, government companies, local authority, co-operative society, etc.; (ii) private sector units, NGOs, etc.; (iii) hospitals or nursing homes; (iv) sports venue, stadiums, sports institutes, etc.; (v) place visited by employee during the course of employment, transportation provided by the employer

38 Provision 23, Violence and Harassment Recommendation, 2019.

39 AIR 1997 SC 3011.

40 Section 2(n), Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013.

for such journey; (vi) a dwelling place.[41] Like *sexual harassment*, the definition of the term *workplace* is also inclusive and not confined to what has been mentioned in the definition. The aforesaid terms have been defined broadly and in an inclusive manner to rule out any possibility for the accused of sexual harassment to take advantage of any loophole of the drafting.

The Act prevents sexual harassment of women at any work place. Section 3 lays down the circumstances, the occurrence of which may amount to sexual harassment. The Act also provides for the constitution of *Internal Complaints Committee*(ICC) by the employer at the workplace.The ICC is to consist of (i) a woman Presiding Officer; (ii) at least two Members from employees; (iii) one member from NGO committed to the cause of women. Half of the ICC Members are required to be women under the Act.[42]The Act also provides for the constitution of Local Committee for the purpose of receiving "complaints of sexual harassment" from those establishments where ICC could not be constituted due to the fact that there were less than 10 workers or where the complaint was made against the employer.[43]

COMPLAINT TO ICC/ LOCAL COMMITTEE

A complaint of sexual harassment at workplace may be made by any aggrieved woman or her legal heir to the ICC/Local Committee, as the case may be, within 3 months from the date of incident. At the request of woman and before initiating an inquiry, the Committee may try to settle the issue between the woman and the respondent through conciliation. Monetary settlement is not to be made on the basis of conciliation. In case the settlement is arrived between them, it will be recoded and no inquiry will be conducted.[44]

Where no settlement is arrived at, and the respondent is an employee, the Committee is to make an inquiry into the allegations as per service rules applicable to such person. Where the respondent is domestic worker and a case exists against him *prima facie*, such complaint is to be forwarded to police for registering the case under section 509 and other relevant provisions of the Indian Penal Code (IPC). Where the respondent does not comply with the terms and conditions of the settlement as discussed above, the Committee may make the inquiry or forward that complaint to the police. Where both of them are employees, an opportunity of being heard is to be provided to them in the course of inquiry.

Where the respondent is convicted, the court may order the payment of compensation to the woman by the respondent in accordance with section 15. Section 15 provides that while determining compensation, regard is to be had to –"(a) the mental trauma, pain, suffering and emotional distress caused to the aggrieved woman; (b) the loss in the career opportunity due to the incident of sexual harassment; (c) medical expenses incurred by the victim for physical or psychiatric treatment; (d) the income and financial status of the respondent; (e) feasibility of such payment in lump sum or in instalments".The Committee, while making an inquiry, has the same power as vested in a civil court under Civil Procedure Code (CPC). The inquiry is to

41 Id., section 2(o).

42 Id., section 4.

43 Id., sections 6-7.

44 Id., section 10.

be completed by the Committee within 90 days.[45]

When the inquiry is pending, the Committee, on the request of woman, has the power to recommend to the employer to (i) transfer either the woman or the respondent; (ii) grant additional leave up to 3 months to woman; or (iii) grant some other prescribed relief.[46]

When the inquiry is completed, the Committee will provide its report to the employer/ District Officer within 10 days. The report will also be provided to both the parties. Where the allegations have not been proved, the Committee will not recommend any action. But where the allegations have been proved, it is to recommend to the employer/District Officer – (a) to take action as per service rules or in the prescribed manner for sexual harassment as a "misconduct"; (b) to deduct salary/wages of the respondent to pay compensation to the woman as aforesaid.[47] A provision for filing an appeal has also been made in the Act. The appeal may be filed within 90 days of the recommendation to the Court/Tribunal.[48]In order to prevent its misuse, the Act also makes provisions for the punishment for a making false or malicious complaint under section 14.

DUTIES OF EMPLOYER UNDER THE ACT

Section 19 lays down detailed duties of the employer under the Act. Every employer is under an obligation to – (i) ensure safe working environment at the workplace; (ii) display constitution of ICC and the penal consequences of sexual harassments; (iii) sensitize employees by conducting workshops/awareness programmes from time to time; (iv) provide essential facilities to ICC for handling complaint and inquiry; (v) secure the attendance of respondent and witnesses before ICC; (vi) provide necessary information to the Committee regarding the complaint; (vii) provide assistance to file a complaint under IPC/other laws, if so desired by woman;(viii) cause to initiate action against the perpetrator under the law; (ix) initiate action for sexual harassment as a misconduct; (j) monitor timely submission of reports by the Committee. The Act also provides for the penalty for employer for non-compliance of the Act.49

CONCLUSION

The adoption of ILO Convention is a historic event as the entire world was waiting for a legally binding international instrument to make the workplace free from violence and harassment. Such a workplace will ensure equality, respect, dignity, freedom from fear which may lead to depression and anxiety, non-discrimination of any kind, among other things. It is very unfortunate that international community took so much of time to adopt the Convention on such an important subject matter. However, it is better late than never. The Convention has been drafted in a comprehensive manner in terms of the meaning of *violence and harassment*, *worker*, *world of work*, etc. The accompanying Recommendation on Violence and Harassment gives guidance to Members for their national laws and policy on the subject matter. The Recommendation is non-binding and therefore, it is upto the

45 Id., section 11.

46 Id., section 12.

47 Id., section 13.

48 Id., section 18.

49 Id., section 26.

Members to adopt it fully or partially or adopt with changes or not to adopt it. It is however advisable to take the recommendation into account while making national laws and policies.

The Convention is a promising binding instrument which takes into account the future work place, i.e. virtual workplace and also takes care of workers from vulnerable group. The Director-General of ILO Guy Ryder rightly stated that "the new standards recognize the right of everyone to a world of work free from violence and harassment" and "the next step is to put these protections into practice, so that we create a better, safer, decent, working environment for women and men".[50]

If we have to conceive of a world where everyone irrespective of his/her sex or gender has the freedom to work without any fear of violence and harassment, the ratification of this Convention by majority of States becomes essential. The time has come when every State should change its mindset and have in place under its jurisdiction a robust system to prohibit violence and harassment at the place of work. If the Convention gets support of a significant number of states by way of ratification, it will also help in dealing with underlying causes such as discrimination in various forms, gender-based power relations and gender stereotypes. By supporting ILO Convention only, the Member States can fulfil their human rights obligations under human rights treaties in a true sense.

As far as India is concerned, her Act of 2013 on the prevention of sexual harassment of women at workplace is doing very well. However, it is not gender neutral but women centric law. The time is ripe when India should come out with a gender neutral law. All men, women, and persons of third gender have the right of equality and dignity. The persons of third gender are more likely to be discriminated than men and women. They are also more vulnerable in society.It is highly recommended that India should become a party to the ILO Convention and bring in place a law that will protect all persons irrespective of their gender from violence and sexual harassment at work place. The legislature may have some additional provisions for women and the persons of third gender, but a law protecting all persons is the need of the hour.

50 https://www.ilo.org/ilc/ILCSessions/108/media-centre/news/WCMS_711366/lang--en/index.htm

Ways of Coping and Mental Health among Male and Female Police Constables: A Comparative Study

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ABSTRACT

Police play an important role in maintaining laws, rules and regulation in the society. In doing so, their nature of duty put them in different kind of mental health issues like stress and anxiety. Ways of coping skills help them to cope effectively with those mental health issues. Gender plays a vital role in determining one's coping strategies and mental health. The effort is made in this piece of work to study gender differences in the variables under study. The data was collected from 300 police constables (an equal number of male and female)in the age range of 25 to 40 years utilizing random sampling technique. Ways of Coping Questionnaire (Folkman and Lazarus, 1988) and WHO Measure of Mental Health (Wig, 1999) were administered to collect the data. Results were obtained on applying t-test which revealed that male and female police constables are significantly different in ways of coping and mental health. Male police constables were found to have higher mean scores on the variables, ways of coping and mental health than female police constables, which, reflects comparatively better ways of coping and mental health in male police constables than female police constables.

Key words: Police, Ways of Coping, Mental Health

INTRODUCTION

Crime and violence rate is increasing gradually. Burden on law enforcement agencies are also increasing. Police service is one of among the law enforcement agencies which directly or indirectly have to face and tackle minor to major crime related cases or incidences. Police personnel have to perform a versatile role and responsibility in order to maintain law and order in society. In doing so, their nature of duty put them in different kind of mental health issues like stress, anxiety, depression etc.

Ways of coping skills help them to cope effectively with those mental health issues. Individual having good skills to cope with life stressors adapt better in their life circumstances than those who have lack of coping skills. Gender plays a vital role in

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determining one's coping strategies and mental health. Due to the biological makeup and socialization process both male and female acquire different characteristics which largely determines individual's coping strategies and mental health. Hence, the effort in this piece of paper is made to study gender differences in ways of Coping and Mental Health among police constables of Union Capital Territory Chandigarh.

POLICE CONSTABLE

Before explaining the concept of ways of coping and mental health, it is important here to consider the definition of the concept 'police constable', their role and responsibilities along with empirical finding. The concept of Police originated from Latin word 'politia' which stands for the condition of a 'polis' or 'state' reported by Mathur (1999). Oxford Dictionary defines Police as a system of regulation for the preservation of order and enforcement of law. It also means, the internal government of a state. In police service, the hierarchy is made from higher level officers to lower level constables to facilitate and enforce rules and regulations in society. Constable can be understood as the person holding a particular office, most commonly in law enforcement department.

ROLES AND RESPONSIBILITIES OF POLICE CONSTABLE

When it comes to understanding the roles and responsibilities of police, Walker and Katz (2000) noted that, the role of police in any particular society is not defined clearly.Police officers are asked to provide a variety of tasks, many of which include crime prevention, order maintenance and law enforcement. There is also the problem of role conflict amongst police officers, politicians and citizens as reported by the author. According to Agolla (2009), the work of police is to protect life and property. In order to do so, they face a lot of challenges such as fighting and prevention of crime. These roles and duties expose police officers to work in different situations that require different physical and mental ability to deal with those circumstances firmly and effectively (Alkus and Padesky, 1983; Violanti and Aaron, 1994; Anshel, 2000; Rollinson, 2005 and Morash et al., 2006).

Sehgal et al. (2006) revealed that women join the police service due to the pressure from women' rights activist and the courts. It was reported further that, women's work in police is generally restricted to cases involving women and children, and to clerical tasks. Usually, women are assigned work relating to victims of sexual crimes, juvenile and female offenders, missing persons and abused children. According to Muhammad and Shukla (2007), the main duties performed by the Indian women police are: helping the investigation, the team in the cases in which a child and woman is involved, interrogation and interview of child/juvenile and woman suspects, offenders and eyewitness. Also, women police assist local police in tracing missing women and children. They work as a security guard at airports, railway stations and bus stands.

Above cited findings reveal that, the police constable's roles and responsibilities are so versatile and challenging that require high level of coping skills and mental health so that they can feel comfortable and serve society in a better way.

WAYS OF COPING

Coping involves responses such as thoughts, feelings and actions that an individual uses to deal with problematic situations that are encountered in everyday life. It is an effortful attempt by an individual to deal with stressors that are beyond the normal range of functioning, with the purpose of reducing the negative impact of that stressor. According to Lazarus and Folkman (1988), coping is the cognitive and behavioral effort to manage specific external and internal demands that are appraised as taxing or exceeding the resources of a person.

There are eight coping strategies identified by Lazarus and Folkman (1988) that are: 1) Confronting Coping: it means an aggressive effort of an individual to change the situation. 2) Seeking Social Support: it involves efforts of the individual to obtain emotional comfort and information from others. 3) Planful Problem Solving: it requires deliberate problem focused efforts by the individual to solve the issues. 4) Self Control: it includes efforts of the individual to regulate their feelings. 5) Distancing: it means efforts made by the individual to detach oneself from a stressful situation. 6) Positive Reappraisal: it requires efforts by the individual to find a positive meaning in the experience by focusing on personal growth. 7) Accepting Responsibility: it means acknowledgment of an individual's role in the problem. 8) Escape Avoidance: it involves an individual's wishful thinking.

Lazarus and Folkman (1984) classified coping strategies in two categories-emotion focused coping and problem focused coping. Emotion focused coping involves the conscious regulation of emotions. It includes accepting responsibility, positive reappraisal, acceptance, denial and/ or cognitive and behavioral avoidance or distraction. Problem focused coping on the other hand attempts to manage the stressful problems or situations. Problem focused coping strategies are intended to get the person who is experiencing stress to change his or her behavior or to develop a plan of action to deal with the stress situation and follow it. The problem focused strategies include active coping, direct problem solving and planning (Folkman and Lazarus, 1988).

In most stressful incidents, people employ both emotion and problem focused coping strategies but use emotion focused when the situation seems to be unchangeable and use problem focused more often in situations where they see as relatively modifiable and changeable situations. The transactional model emphasizes the relationship between the person and the environment, taking into account the characteristics of the person on the one hand and the nature of the environmental event on the other.

MENTAL HEALTH

It is important to recognize that the physical and mental health is not separate construct Wig (1996). The separation between body and mind is only a convenient way of understanding the construct of health. Medical science has made it clear that mind influences the body in the same way as body influences the mind. It is also being said that the healthy body not only keeps a healthy mind but also a healthy mind greatly plays a

role to keep individual's body healthy.

The World Federation of Mental Health (Wig, 1996) explained the concept of mental health on the basis of three criteria that are: being comfortable with self, being comfortable with others and ability to meet life demands. Being comfortable with self means a person who is mentally healthy must be comfortable within him/herself. They need not to have emotions which frequently put them in to discomfort. If they feel emotions like tense, nervous, fearful, sad, aggressive or suspicious which shows that they are not mentally healthy. Being Comfortable with others: a person who is mentally healthy is not only comfortable within oneself but also makes others comfortable around him or her. An individual may be very happy and comfortable within oneself but if they are making life miserable for those around them, in this case too it can be said that they are not mentally healthy. Ultimately mental health is a kind of balance or harmony between an individual's self-interest and social responsibility. Ability to Meet Life Demands means a mentally healthy person is constantly striving to improve further. They never feel that they have reached perfection because they always make further efforts for self-improvement.

Mental health has been recognized as an indispensable aspect of an individual's total health status. It has been considered as a factor that contributes to the maintenance of physical health as well as social effectiveness. Mental health is an individual's innate capacity to keep balance in every life circumstances, either negative or positive. The people in the state having healthy mental health feel peace. They adapt better in every situation. They are said to have adaptive personality characteristics and also they are task oriented. They work productively and cope effectively with the situation experienced to be negative.

Differences in gender role and responsibility at social and family levels reflect ability to balance between social/family and occupational roles and responsibilities. As the gender differences play an important role in performing one's task in the family and at the services. Gender difference also plays are equally important role in determining one's ways of coping skills with psychological distress and mental health. On the basis of the above explanation the aims of the study was formulated which is presented below.

The aim of the study is to understand how male and female police constables of Union Capital Territory Chandigarh are different from each other in terms of ways of coping strategies and mental health. Keeping this aim in mind the following mentioned objective was framed.

OBJECTIVE

To study gender differences in Ways of Coping and Mental Health among police constables.

Hypothesis

Male police constables will be significantly different from female police constables in the Ways of Coping and Mental Health.

REVIEW OF LITERATURE

Ways of Coping among Male and Female Police Constables

Ronen and Pines (2008) reported significant gender difference in burnout, with women

engineers reporting higher levels of burnout than men. The gender differences in style of coping revealed i.e. women's greater tendency to utilize emotion-focused coping. Haarr and Morash (1999) found that women cope with stress by using escape and by keeping written records more often than men. The authors also reported that African-American officers rely on strong relationships with fellow minority officers when symptoms coping with stress. Overall, the constructive coping mechanism is considered to be the more appropriate approach to reducing stress.

Bond and Bunce (2003) found that workers with higher levels of the acceptance coping style significantly predicated better mental health and job performance. It was further suggested that, an intervention would be effective, that enhances acceptance coping styles of workplace stressors and increases behavioral changes to help the law enforcement officers pursue their work objectives that they wish to achieve. Khan et al. (2005) results indicated that both male and female teachers used the same strategies to cope with job strain. Significant difference was not found to exist between the male and female teachers on different types of coping strategies except use of humor.

Mental Health among Male and Female Police Constables

Govind (2012) investigated gender differences in mental health of college students. The study showed gender differences with regard to mental health. Males showed better mental health when compared to female students. Ram et al. (2014) reported from their findings that male and female youth inhabit different social worlds. According to them, female expressed greater restrictions to their independence than male.

Triveni and Aminabhavi (2002) reported that women professionals experience significantly higher occupational stress than men due to under participation. According to Greenglass (2002), men were more likely to confront problems directly or to deny or avoid their existence, on the other hand women in order to solve their problems and to deal with their stress preferred to seek social support from friends and family. It was also found that female employees sought more emotional support and relied more on social network.

Berg et al. (2005), it was found that policewomen perceived and experienced work-related stress more severely than policemen in all factors measured. This finding is supported by the work of Yoo and Franke (2011) who found that female police officers experienced significantly higher levels of stress and poorer health outcomes than their male counterparts.

Eaton and Bradley (2008) investigated the role of gender and negative affectivity in stressors appraisal and coping selection. Differential exposure to stressors was controlled by requiring participants to rate the stressfulness of identical hypothetical scenarios. It was found that women rated the scenarios as more stressful than men, and perceptions of stressfulness increased with participant negative affectivity. Women endorsed the use of emotion-focused coping strategies more than men, even when perceived stress was controlled.

Mental Health Issues among Police Constables

Due to those roles, responsibilities and functions of police mentioned above they are highly prone to face mental health challenges. It is reported in several studies that police work has been identified as the most psychologically stressful and critical profession in the world (Heiman, 1975; Manolias and Hyatt-Williams, 1986; Bonifacio, 1991). According to Selye (1980), due to the inherent nature of police work, this profession is likely to be one of the most stressful occupations in the world.

Miller (2005) reported that law enforcement is one of the important professions in which employees deal with a range of individuals from different levels of society. Police officers interact with criminals, they have many relationships with other community members and they also have mutual communication with other law enforcement professions. Even though personnel of law enforcement agencies are trained to manage interactions with different kinds of people, the necessity of making decisions under time constraints for specific circumstances creates significant stress for law enforcement.

On the basis of above explanation it was felt that consideration of ways of coping and mental health among police constable is needed to be studied in order to help them understand their mental health issues and cope with them effectively adopting an appropriate coping strategy, so that they can serve to the society maintaining balance between their personal and occupational life.

In view of the above explanation based upon the theoretical and empirical rationale of ways of coping and mental health, it is important here to mention that both the constructs are important to consider for the study in every individuals irrespective of their stages of life, nature of work and services they provide because both coping styles and mental health of an individual determines an individual's adaptive nature and effectiveness in society.

Specifically, if we talk about the ways of coping and mental health of police personnel i.e. constables, it has been observed in the findings of the literature that their roles and responsibilities are so much versatile and challenging that make them susceptible to get into mental health problems. Their mental health largely depends on how they cope with challenges in the front while providing services in order to maintain law and order in society.

The inconsistencies in the research findings have been observed which suggest that there is significant gender difference in ways of coping and mental health. There are literature reported to have male police constable with better coping skills and mental health than female police constable. Opposite findings are also available which suggest female constable have better coping skills and mental health comparative to the male police constable. Mix findings have also been reported in the existing literature. Therefore, the present study was formulated to understand gender difference in coping with styles and mental health in police constables of Union Capital territory Chandigarh.

METHODOLOGY

The present study is designed to explore gender difference in ways of coping and mental health among Chandigarh police constables. Therefore, the data is collected keeping in mind the objective of the study. In the subsequent sections necessary information about sample, tools used and the procedure employed for obtaining the relevant information has been presented.

Sample

The data was collected from 300 police constables (an equal number of male and female) serving in different police departments of Chandigarh such as police stations, traffic departments and Police Control room department, in the age range of 25 to 40 years utilizing random sampling technique. Only married constables were selected. And also, only those constables were selected who had been working for at least last 3 years. Educational qualifications of the individuals participated in the study were restricted to minimum 10th to graduation.

Tools

To measure the strategies that police constables use to cope with stress, Ways of Coping questionnaire developed by Folkman and Lazarus (1988) was used. To measure Mental Health, the WHO measure of Mental Health adapted for use in India by Wig (1999) was used. The descriptions of both the tools are presented below:

1. **Ways of Coping Questionnaire (Folkman and Lazarus, 1988)** there are 66 items in this questionnaire which measures 8 empirically derived subscales. Each of the 8 subscales describes different ways of coping which is used by an individual. Those subscales along with their brief descriptions are presented below:

1) ***Confronting Coping:*** It reflects an aggressive effort of an individual to change the situation and suggest some degree of hostility to risk taking.

2) ***Seeking Social Support:*** It reflects efforts of the individual to obtain informational, tangible and emotional support from others.

3) ***Accepting Responsibility:*** It reflects acknowledgment of an individual's own role in the problem with a concomitant theme of trying to put things right.

4) ***Plan-full Problem Solving:*** It reflects deliberate problem focused efforts by the individual to alter the situation, coupled with an analytic approach of problem solving.

5) ***Distancing reflects:*** It reflects cognitive efforts of the individual to detach oneself from the stressful events in order to minimize the significance of the situation.

6) ***Self-Controlling:*** It reflects efforts of the individual to regulate their feelings and actions.

7) ***Escape Avoidance:*** It reflects an individual's wishful thinking and behavioral efforts to escape or avoid the problem.

8) ***Positive Reappraisal:*** It reflects efforts by the individual to find a positive meaning in the experience by focusing on personal growth.

According to Lazarus and Folkman (1984), there are two categories of coping strategies, emotion focused coping and problem focused coping. Emotion focused coping includes the conscious regulation of emotions. Accepting responsibility, positive reappraisal, acceptance and denial/ avoidance or distractions are considered as emotional focused coping. Problem focused coping includes attempts to manage the stressful problems or situations. The problem focused strategies includes active coping, direct problem solving and planning (Folkman and Lazarus, 1988). These coping strategies are required to change behavior or to develop a plan of action to deal with the stressful situation.

Individuals respond to each item on a 4 point scale, including the frequency with which each strategy is used. (0) Indicates 'doesn't apply/or not used', (1) indicates 'used somewhat', (2) indicates 'used quite a bit' and (3) indicates 'used a great deal'. The scale has been widely used in Indian context by Parke (1986), Opara (1999), Mohan (2002, 2004, 2005, 2015), Shourie (2003) and Savneet (2012), and the test is reported to have good reliability and validity.

2. **WHO Measure of Mental Health (Wig, 1999):** The scale has 16 items and is designed to measure Mental Health on 3 dimensions. Those 3 dimensions are presented below along with their brief descriptions:

1) ***Being Comfortable with self*** reflects how comfortable the individual is in his/herself. If an individual who is mentally healthy must be comfortable within him/herself. They need not have emotions like tense, nervous, fearful, sad, aggressive or suspicious which frequently put them into discomfort.

2) ***Being Comfortable with others*** reflects how comfortable an individual feels in establishing and maintaining relation with others. An individual who is mentally healthy is not only comfortable within oneself but also makes others comfortable around him or her. Mental health is a kind of balance or harmony between an individual's self-interest and social responsibility.

3) ***Perceived Ability to Meet Life Demands*** means a mentally healthy person is constantly striving to improve further. They never feel that they have reached perfection because they consistently make efforts for self-improvement.

The test gives three scores on mental health dimensions and a summated score on total mental health. The response format has two categories 'Yes or No'. A score of one is given if the subject ticks 'yes' and a score is given zero if he ticks 'no'. It has been successfully used in India by Mohan (2004, 2005), Puri (2002), Sehgal (2002), Tripathi (2008), Rampal (2011),

Agarwal (2015) and Thakur (2015) reported to have good reliabilityand validity.

RESULTS AND DISCUSSION

The t-test was applied to study the gender differences in Ways of Coping and Mental Health among police constables of Union Capital Territory Chandigarh. The results obtained on applying t-test on the data collected from male and female police constables on the variables of ways of coping and mental health is presented below in the Table.

TABLE

Means, Standard Deviations and t-ratios comparing Male and Female Police Constables on the variables of ways of coping and mental health

Sr. No.	Variables Mean	Male Police Constables (n=150)		Female Police Constables (n=150)		t-ratios
		SD	Mean	SD		
	Variables of Ways of Coping					
	Confronting Coping	9.65	2.39	7.63	2.31	7.42**
	Seeking Social Support	9.41	2.09	7.03	2.21	9.55**
	Accepting Responsibility	7.57	2.07	6.79	2.00	3.32**
	Plan-full Problem Solving	8.53	2.15	6.65	2.23	7.44**
	Distancing	15.91	9.69	11.87	2.45	4.96**
	Self-Controlling	17.00	2.99	12.36	2.88	13.72**
	Escape –Avoidance	18.74	3.40	13.47	4.00	12.30**
	Positive Reappraisal	17.98	3.04	12.61	3.26	14.75**
	Variables of Mental Health					
	Being Comfortable with Self	2.14	1.20	1.82	1.00	2.50*
	Being Comfortable with Others	2.14	1.20	1.61	0.87	4.35**
	Perceived Ability to Meet Life Demands	2.10	1.12	1.46	0.82	5.70**
	Total Mental Health	6.84	2.77	4.89	2.05	6.92**

*t-value significant at 0.05 level=1.97

**t-value significant at 0.01 level=2.60

Results obtained on applying t-ratios reveal significance of difference between two means. The Table shows the mean, standard deviation and t-ratios of the measured variables in male and female police constables in the age group of 25 to 40 years. The group differences are examined on all the variables using t-ratios.

All the variables of Ways of Coping come out to be significant. Those variables are: Confronting coping, Seeking social support, Accepting responsibility, Plan-full problem solving, Distancing, Self-controlling, Escape-avoidance, Positive reappraisal.

Male Police Constables scored higher than Female Police Constables on Confronting coping (t (298)= 7.42, p<0.01); Seeking social support (t (298)= 9.55, p<0.01); Accepting responsibility (t (298)= 3.32, p<0.01); Plan-full problem solving (t (298)= 7.44, p<0.01); Distancing (t (298)= 4.96, p<0.01); Self-controlling (t (298)= 13.72, p<.01); Escape-avoidance (t (298)= 12.30, p<.01); Positive reappraisal (t (298)=14.75, p<.01).

A glance at t-ratios Table comparing male and female police constables revealed that male police constables scored higher than female police constables on emotion focused coping styles (Distancing, Self-Controlling, Escape-Avoidance, Positive Reappraisal) and Problem Focused Coping styles (Confronting Coping, Seeking Social Support, Accepting Responsibility and Plan-full Problem Solving).

Ways of coping, according to Lazarus (1991), refer to the cognitive and behavioral efforts to manage specific external or internal demands and conflicts between them that are apprised as taxing or exceeding the resources of the person. Coping is a continuous cognitive and behavioral process of overcoming stress and stressful consequences of external forces (Mohan, 2003)**.**

Research conducted by Roxburgh (1996) and Hall (2006) showed that just as females reported greater use of emotion-focused coping strategies than males, they also reported higher levels of subjective stressor exposure, higher levels of felt stress, more stress-related health problems, more health and illness behaviors, and also more health-promoting lifestyles. The reason behind this kind of gender differences in ways of coping strategies and mental health can be said that is because of differential gender socialization processes. Due to the socialization of both the gender differently, females have to involve in child birth and their care, they are more prone to health-related risks than male. Women were more attuned to, and more experienced, in terms of coping with stress and health threats, and perhaps these factors helped explain females higher use of coping specifically emotion-focused coping behaviors.

Hobfoll and Freedy (1996) in their study of the multiaxial model of coping reported that men utilized more aggressive and anti-social actions in their coping. Tamres (2002) reported that, women were found to report using all coping behaviors more often than men. In none of the studies did men report engaging in more absolute levels of coping than women. In contrast, studies investigating relative coping showed that men were more likely to use problem- focused coping, whereas women were more likely to seek emotional support. He concluded that gender differences in coping occurred due to appraisal rather than to preferred coping strategies.

All the variables of Mental Health come out to be significant. Those variables are: Being comfortable with self, Being comfortable with others, Perceived ability to meet life demands, Total mental health.

Male Police Constables scored higher than Female Police Constables on Being Comfortable with Self (t (298) = 2.50, p<.05); Being comfortable with others (t (298) = 4.35, p<.01); Perceived ability to meet life demands

(t (298) = 5.70, p<.01); Total mental health (t (298) =6.92, p<.01).

A glance at t-ratios table comparing male and female police constables revealed that male police constables scored higher than female police constables on total mental health and its dimensions viz. being comfortable with self, being comfortable with others and perceived ability to meet life demands.

Mental health can be understood as one's innate "intrinsic, natural state of well-being or wisdom arising from pure consciousness and accessed via a clear mind, or from realizing the infinite capacity for formless creation of new experience via thought" (Pransky and Carpenos, 2000). Mental health also explained in terms of either a level of cognitive or emotional well-being or an absence of a mental disorder.

Caur (2006) reported significant gender differences on the stressfulness of life events, daily hassles, escape avoidance, positive reappraisal and perceived happiness status. Louw (2007) reported from his findings that female police officers were found to experience more stress as compared to the male police officers. He et al. (2005) too reported that female officers had higher levels of stress than males. De Souza et al. (2007) found that female police officers have been shown to experience a greater proportion of psychological distress, and indicate that it could be due to the need for women to work harder in order to achieve the same professional recognition as men in a predominantly masculine institution.

According to Lipp (2009), greater proportion of females than males reported to have stress. Brown and Fielding (1993) reported that women uniformed officers reported higher levels of associated self-perceived stress than their male counterparts. However, the opposite findings have also been reported which reveals that females experienced crime related stressors less intensively and frequently than their male counterparts. McCarty et al. (2007) reported from their study that male and female officers did not report significantly different levels of occupational stress and burnout.

CONCLUSION

Male police constables scored higher than female police constables on all the variables of both emotion focused coping styles and problem focused coping styles. This result reveals that male police constables uses both problem focused coping and emotional focused coping strategies in their life to cope with their life stressors which reflects better coping skills in male than female police constable. And also,male police constables were found to have higher scores on all the three variables of mental health than female police constable. These findings reflect that male police constables have better mental health than female police constables. Over all,the finding of the study reveals that male police constables have better ways of coping skills and mental health than female police constables.

IMPLICATIONS

This study specifically will be helpful for the professionals serving with police department for the purpose of police personnel's training

and counseling. The professional such as psychologist, counselor and criminologist can make use of certain intervention or therapy module keeping gender differences in ways of coping and mental health among police personnel for the better outcome from their counseling or therapy sessions. The intervention or therapy module can consist of different components of ways of coping skills and mental health.

The professional conducts intervention programmes targeting to enhance the **ways of coping strategies** among police constables may be suggested from the findings of this study to incorporate constructs of ways of coping skills in their training module. As the importance of coping skills has been highlighted by Siponet al. (2014) mentioning it as survival skills in encountering various challenges in life. Grant et al., (2003) mentioned that coping strategies is a significant element in life functioning and individual development. The intervention will make police personnel aware, learn, and acquire the skills and knowledge required to deal with harmful, threatening or challenging problems or circumstances causing distress. The intervention module will consist of different components of ways of coping.

Confronting Coping the police constable specifically women police needs to be trained the skills required to make active efforts to change their stressful situation. **Seeking Social Support** training will help them learn the skills required to obtain information, tangible and emotional support from others that is required to cope with the distress. **Accepting Responsibility Skill** training will help them to learn the ways to acknowledge their own role in the problem so that they can work simultaneous to make things better.

Training of **Plan-full Problem Solving** skills will make the police constable learn and acquire the knowledge that how the situations can be altered by focusing upon the problem utilizing analytical approach of problem solving. Training police constables **Distancing** will help them learn and acquire the skills required cognitive efforts to detach themselves from the stressful events in order to minimize the distressing impact of the situation.

Self-Control teaching will help police constable learn the skills require regulating their own feelings and actions so that they can cope effectively with the distressing circumstances. **Escape Avoidance** training will enhance police constables wishful thinking and behavioral efforts to escape or avoid the situation causing stress. **Positive Reappraisal** training will help them learn the ways of attributing positive meaning to their experience by focusing on their personal growth.

The intervention targeting to enhance the **mental health** among police constables may suggest incorporating constructs of mental health which have been studied in this piece of work. Making police personnel aware, learn, and acquire the skills and knowledge require to feel comfortable with self as well as others and also to perceive ability to fulfill their life demands positively through the training, counseling and psychotherapy sessions.

Training the construct of **Being Comfortable with self** of mental health domain will make

them understand how comfortable they are. They will also come to know, if they are healthy they must be comfortable to themselves which will allow them to avoid emotions such as tense, nervous, fearful, sad, aggressive or suspicious which frequently put them into discomfort.

The police constables can be made aware about the construct of **Being comfortable with others** which reflects how comfortable they feel in establishing and maintaining relation with others. Police constable will come to know that those individuals who are mentally healthy being not only comfortable within oneself but also make others around them comfortable. Through the training of this construct of mental health they are educated to learn that mental health is a kind of balance or harmony between an individual's self-interest and social responsibility.

Session pertaining to **Perceived Ability to Meet Life Demands** will encourage police constables to improve themselves further in their life endeavors. The kind of awareness about the feelings that they have not reached perfection will help them make consistent efforts for self-improvement.

Learning these skills of mental health will enable police personnel to develop capacity to keep balance in every life circumstances either negative or positive.People having good mental health feel peace, adapt better in every situation, they are task oriented and possess adaptive personality traits. Also they acquire the knowledge and skills to work productively and cope effectively with life situations.

Cognitive-behavioral coping strategies incorporating emotional and behavioral coping techniques used to manage stressful events. Mindfulness training through meditation, yoga and physical activity/exercise is suggested to be some of the intervention programmes that would have a better impact in learning different ways of coping skills and the constructs of mental health.

Bhole (1977) highlighted that, breathing practices are intended to develop certain types of awareness within oneself. According to Nagendra and Nagarathna (1988), yoga has been emphasized as a key to combat stress. Mathur (1999) reported that physical exercise can play an important part both in reducing stress and in increasing one's ability to cope with a stressful situation. Swanson and Territo (1983) reported that more physically fit an officer feels, the more self-assured and happier he is with himself.

Apart from the training and counseling intervention related implications of this study, there are some other implications like higher authorities in the police department might gain an insight into assigning tasks or duties to the constable police keeping gender differences in ways of coping and mental health in mind. Policy makers of Indian police services can have a better idea from this piece of study to formulate policies related to police personnel's duties, role and responsibilities, and also for their training purposes.

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EDITORIAL NOTE

VIPS Student Law Review is an annual, blind peer-reviewed journal which provides a platform to law professionals, research scholars and students to meaningfully engage in discussions pertaining to law, justice and society. It helps in bringing to the forefront the contemporary issues which are relevant for academic as well as legislative research. The inaugural issue of VIPS Student Law Review, Volume 1 received an overwhelming response and was a great success. VIPS Student Law Review, Volume 2 occupies a unique place in the developing legacy of our journals. Its timely publication during the time of ongoing pandemic was a challenging task. The global, unprecedented pandemic of COVID-19 implied calling on special measures to deal with the task at hand. The unwavering perseverance of all the stakeholders, ranging from authors to faculty to the student team, ensured the timely publication of this issue. This era has also taught us the importance of technology and the need of its adaptability in the education sector. It reflects the committed tenacity and motivated effort of our institute to continuously contribute to the ever growing area of law.

We are, thus, extremely pleased to present VIPS Student Law Review, Volume 2. Our Journal received an overwhelming response of 136 submissions to the call for papers and we are sincerely humbled by the same. The articles selected for publications are lucid, nuanced and tackle contemporary discussions. The research papers selected are not only addressing the issues erupted due to COVID-19 pandemic but are also covering various other relevant contemporary issues which needs to be highlighted.

Ms. Anuja Misra and Ms. Chitra Ahluwalia have critically examined the position of colour trademarks and their acceptability. Ms. Nikita Mittu has compared the system of corporate governance in India and the U.S.A. Dr. Raghuvinder Singh and Ms. Arti Sharma have comprehensively analysed the various aspects of the right of Muslim women to marry on divorce. Mr. Jayanta Boruah has addressed the relevance of international humanitarian law and the Syrian refugee crisis. Ms. B. Yamuna Saraswathy and Mr. R.B. Rishabh have addressed the position of scientific criminal investigation in India. Ms. Ananya Jain undertakes a deep study of the DRM technology and the principles of copyright law in lieu of copyright in ebooks. Ms. Akanksha Badika and Ms. Pragya Mishra write about the intermediary liability regime in India. Ms. Kanak Mishra writes about Narco-Analysis and the Brain Mapping tests through 'Fluid' consent. Mr. Akshit Bhardwaj has expressed his views on sports law jurisprudence in India and the challenges that lie ahead. Mr. Manan Katyal analyses the legality and application of single-color trademarks in India with

reference to *Christian Louboutin S.A.S. v. Abubaker and Ors*. Ms. Merrin Muhammed Ashraf discusses the feasibility of adoption of an inquisitorial model and the impact on the criminal justice system in India. Mr. Rishabh Soni examines the reliance on force majeure clauses to escape liability; with special reference to COVID-19. Ms. Ananya Sanjiv Saraogi and Ms. Vallabhi Rastogi discuss the impact of the pandemic on various walks of life. Ms. Mansi Mishra comprehensively evaluates the relation between merchant bankers and the function of due diligence. Mr. Rupesh Sunil Dhengre and Ms. Omeshwari Pancham analyse the issue of mercy petitions from a socio-religious perspective along with the legal dimension. Ms. Adiba Khan and Ms. Gunjan Kanoongo assess the increased domestic violence cases in light of COVID-19 and the subsequent lockdown. Ms. Nidhi Chhillar and Ms. Ritika Sharma give a holistic account of honour killings. Ms. Samavi Srivastava and Mr. Rounak Doshi critically assess the Biological Weapons Convention. Ms. Manasvita Tejsi and Mr. Mridull Thaplu call upon the criminalisation of marital rape.

The Journal presents three articles under the 'Case Comments' section. Mr. Hartej Singh Kochher explores two contradicting verdicts, delivered by the Competition Commission of India on the issue of "buyers' cartel". Mr. Raj Krishna and Mr. Kumar Mukul Choudhary discuss custodial death in light of *Rathnayake Tharanga Lakmali v. Niroshan Abeykoon*, 2019 SCCOnLine SLSC 14 (Sri Lanka). Mr. Jaideep Singh Lalli analyses the Supreme Court verdict of *Chebrolu Leela Prasad Rao & Ors. v. State of A.P. & Ors*.

I thank our reviewers for reviewing the articles timely and for giving their inputs. Special mention to the COO, VIPS and their staff for their support. I am thankful to the Editorial Committee for releasing the issue in time.

Dr. Rashmi Salpekar
Prof. and Dean, VSLLS, VIPS
Editor

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POSITION OF COLOUR TRADEMARKS, ACCEPTABILITY AND RELATED ISSUES: A COMPARATIVE ANALYSIS

Anuja Misra* and Chitra Ahluwalia**

Abstract

With the growing awareness of the essence of a trademark ranging from small businesses to multinationals, there is a constant development in adopting innovative and unconventional marks. One of such marks, bloomed to the full in recent times are the colour marks; although, they too, in the tedious process of recognition and protection as trademarks, have faced countless impediments. The essence of the paper brings out the same with a comparative analysis of three jurisdictions. Where the Shade Depletion Theory depicts how monopoly over a finite number of colours may lead to ultimate depletion of the colours in public domain, the Confusion Theory suggests innumerable shades of one colour on the Pantone Scale leading to extreme confusion amongst the purchasing public. Another aspect while protecting colour marks the Doctrine of Functionality which relates to the functional or descriptive aspect[1] of the mark. Pink toned milkshake cartons may be presumed as a strawberry product; similarly, monopolising red colour for a fire extinguisher where red represents the colour of danger and high descriptiveness. The second chapter of the paper mentions the plight of the Indian judiciary faced with insuperable difficulties in establishing rights over 'colour combinations' subject to acquired distinctiveness after admittedly hesitating to grant single colour monopolies. Realising the importance that a colour or its combinations play in a trade dress, courts have addressed it through precedents like Colgate Palmolive in light of the unwary consumers. The third chapter of the paper discusses the exclusivity of colour marks across European Union being reluctant in protecting these marks as compared to US where obtaining exclusive right over colour marks is more flexible. The last part of the paper has

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1 Section 9(1)(b), Trademarks Act, 1999

been concluded by raising relevant concerns and providing suggestions regarding the registrability of colour marks. The pace at which businesses are realising the importance of trademarks is impressive and should be tackled with caution as well as creativity.

Colour Mark as a Non-Conventional Trademark

The Indian trademark act in its definition of a trademark states that "a mark which is capable of being represented graphically and which is capable of distinguishing goods or services of one undertaking from those of other undertakings." Since colour at the outset aid in enhancing the visual appeal of a mark, they serve as good graphical representations of a mark. Also, since colours are so distinct that they remain in the minds of the public and help them to identify the goods as coming from the same source, they have proved to be a powerful representation in marketing and advertising. The flashing siren red of Louboutin's[2] sole and the soothing blue colour of Tiffany have great ability of attracting the consumers and henceforth acquire distinctiveness by secondary meaning. As commercialisation grows in the capitalist market, there grows a need to protect such marks.

The European Union has always been apprehensive about granting colour marks. They were from the beginning totally against trademark of primary colours for a simple reason that the primary colours are basic colours and monopolising these basic colours would not only shrink the public domain but also limit its use. Also it has to be kept in mind that if no protection at all is given to these marks then it can lead to widespread copying and deceptively similar competing products will enter the commercial market likely to cause confusion in the minds of the public. A similar thing happened in the Louboutin case where the court did not grant injunction to it against the other competing products and as a result Louboutin suffered great loses in its business.

Colour attributes to the visual perceptibility of a mark and when a word combined with a colour denotes or signifies the products of a brand name, it serves as a successful trademark. What was held in the *Re Owens-Corning*[3] case was that "the colour pink may signify roof insulation, by virtue of both its physical resemblance to, and factual connection with pink roof insulation. Also through the connection of a myth, examined below, the sign pink may associate itself with roof insulation."

2 Kabak, M.L., "*Are Colour Trademarks Valid? : A Sneak Peak at Louboutin's Appeal for Trademark Protection for Red Soled High Fashion Heels*" (2012), http://www.sanfranciscobusinesslawyerblog.com/2012/04/islouboutins-red-sole-for-women-shoes-a-valid-trademark.html.

3 Re Owens-Corning Fiberglass Corp. 774 F.2d 1116 (1985).

Colours play an important role in communicating a lot to people. Like generally we have an assumption that the colour red signifies love or blue signifies peace or green signifies envy and so on. Thus, colours sometimes play this important role of communicating about the products belonging to the trade name company and that is how people remember it and associate the colour with the mark. In the case of *Qualitex v. Jacobson*[4], the court overturned the notion of generic application and held that the ironing pad had acquired its use of the colour green and hence it shall be associated with the company on grounds of secondary meaning. When a colour is being used for a particular product or brand it is easy for people to remember or trace the origin. This is exactly how colours become a 'sign' protected as a trademark.

Colour Depletion Theory

It has been made clear that if a trademark acts as a sign, it can distinguish between the products of one from another like the purpose of any other trademark; or if it has acquired a secondary meaning, then it can be registered as a valid trademark. However there are certain impediments in the way of colour mark being registered. They can be discussed under:

- Colour depletion theory
- Shade confusion theory
- Doctrine of functionality[5]

The colour depletion theory states that the colours which act as a sign for the registration of trademark are limited in number and when a company acquires trademark on a colour, there becomes one colour less from the existing range of colours available for the public to use. Also, if we see it from the manufacturer's point of view, then they will have one less option for choosing a colour as trademark and this will go on with the remaining manufacturing companies who want to register colour as marks, till all the colours are exhausted. In the case of *Campbell soup Co. v. Armour & Co.*[6], the plaintiffs who used to have their goods packed in red and white packaging barred the defendants from using similar colours. While the defendants got a valid trademark on the colour which acted as a sign and was distinctive in nature, it was still contended that the request to have a monopoly over the two colours was not desirable. This would encourage other manufacturers too, to have their colour marks registered leading to a situation where all the colours would

4 *Qualitex Co. v. Jacobson Products Co.* 514 U.S. 1300 159 (1994).

5 Vana, J.L, *"Colour Trademark"* 7 TIPLJ 387 (1999).

6 F. Supp. 114 (E.D. Pa. 1948).

be claimed monopoly upon, and there would be no colour left in the public domain. This situation, forget the difficulties which it brings with it, is not feasible.

However, in the case of *Qualitex*[7], the U.S Supreme Court rejected the view and held that there are a wide range of colours and the shades of those colours and that the mere granting of trademark to a colour would not lead to a limited supply of colours. The court gave this opinion keeping in mind that the manufacturers would be positioned at an inconvenience if they were refused the right to register these marks as trademarks. But if there is a finite number of colours, then granting protection to all of them would lead to an increase in the number of infringement litigations where the use of any colour mark would violate the registration of the said colour as a trademark.

Shade Confusion Theory

When we talk about shades of a colour, the basic assumption is that if a single colour is registered as a trademark, then the usage of its different shades would lead to confusion. This is not taken into account only when dealing with infringement procedures but also the confusion that the customers will face while purchasing goods. Confusion can be created in the minds of the public by using a slightly different shade of colour when going for a trademark registration[8]. The names and colour codes of different shades of the colours can be found on the *"Pantone Scale[9]"*. However, even though the scale provides apt colour codes for the sake of registration, it seems meaningless when we talk about 'likelihood of confusion' in the minds of the public because howsoever colours there may be specified distinctively on the scale, the close shades of a colour will seem the same to an average person of imperfect recollection[10]. What these manufacturers of like products do once they know that a specific colour has been trademarked by the other company, is that they select a close shade of the same colour from the Pantone Scale and file for registration, least caring about the deceptive similarity that it causes. For e.g. the colour shades of Cream Pink and Petal Pink seem all the same to a layman unless the proper code number is specified. This affects not just the brand owners but the general public.

Functionality Aspect of Colour Marks

The doctrine of functionality in colour marks considers keenly the functional aspect of the marks. In cases where a colour is descriptive of its nature in the sense that it provides a

7 *Supra* note 4 at 3.

8 Denoncourt J, Intellectual Property Law, 146 (3rd ed. 2012).

9 *'Find a Pantone colour',* https://www.pantone.com/color-finder.

10 *Amritdhara Pharmacy v. Satyadeo Gupta, AIR 1963 SC 449*.

technical result, then the mark is not workable under the trademark law to get protection. This is done to stop the monopoly over the functional aspect of the mark. This can be elucidated further by help of an example. The colour Black absorbs heat faster and the reason why it is used in non-stick utensils of different companies so as to help food cook faster. If Prestige acquires a monopoly on this black colour on utensils then the other non-stick utensil companies would not be able to even establish a market. This would lead to an anti-competitive practice and hence not desirable under the trademark law. The colour Red painted on fire extinguishers which usually signifies danger, if monopolised by one company would prove to be a setback for the other fire fighting equipment companies.

The functionality doctrine concept under colour trademarks which is not favourable to colours providing a functional element can best be explained with the help of two cases- *Christian Louboutin S.A*[11] and *Maker's Mark Distillery, Inc*[12]. The doctrine seconds the view that such colours cannot be granted monopoly even if they have acquired distinctiveness in the market by secondary meaning[13]. In the *Louboutin* case, the court refused YSL's objection to the use of red colour on soles. The court said that "we see no reason why a single colour mark in the specific context of fashion industry cannot act as a brand or source identifier." Also the court gave protection to the red colour on the sole of Louboutin based on acquired distinctiveness of the brand as it wasn't serving any functionality element. YSL could keep any other colour on the sole as identification. In the other case of *Maker's Distillery,* the plaintiff sued the defendant Jose Cuervo on the use of dripping wax seal on its tequila bottles. The district court barred the defendant from using the red wax seal on the cap of the bottle to which the defendant responded that it was an aesthetically functional feature and appealed to the U.S. Court of Appeals. The apex court upheld the decision of the district court banning the defendant from using the red dripping wax seal on the bottles they were selling.

Therefore, it can readily be concluded that the colour marks are in fact unconventional in its very nature, since they bring along many impediments in their way. Issues in relation to the limited number of colours, confusion amongst the similar/ slightly similar shades of the same colour as well as the functionality aspect making the mark descriptive in nature, wherein the descriptiveness serves as an absolute ground of refusal, are some of the speed

11 *Christian Louboutin S.A. v. Yves Saint Laurent Am. Holding, Inc.,* 696 F.3d 206 (2d Cir. 2012).

12 *Maker's Mark Distillery, Inc. v. Diageo North America, Inc.,* United States Court of Appeals for the Sixth Circuit, 679 F.3d 410 (2012).

13 ZadraSymes, L, *"Sounds, Smells Shapes and Colours Protection and Enforcement of Non-traditional Trademarks in the U.S."*, http://vipo-online.org/wp-content/uploads/2011/10/Sounds_Smells_Shapes_and_Colors-tm-protection-US.pdf.

breakers in the smooth adoption of such marks. The shade depletion theory has been well explained by the US courts in the landmark *Qualitex* judgement stating that refusal to grant protection where a particular colour is associated by the consumers exclusively to such proprietor only, may cause losses to such entity, however on the other hand has also acknowledged that granting protection to over all colours, which lead to an increased infringement cases. Shade depletion theory on the other hand, involves the *Pantone Scale* which provides for a wide range of colours leading to confusion between different shades of a single colour. Another major impediment involved in adoption of a colour is in relation to the functionality aspect of a colour linked with the type of goods/services being provided under it. The functionality is linked directly to the descriptive nature of a mark which has been catered symbolically by the US Courts in *Maker's Distillery*.

Colour Trademark: Position in India

Initial Stage of Non-Acceptance in India

In the Trademarks Act 1999, the definition of "trademark" and the word "mark" both include 'combination of colours' to be acceptable for registration of a trademark provided it is such a graphical representation that it is capable of distinction. Initially the Indian judiciary was a little influenced by the European Union ideology of not granting protection to colours as trademarks because of the colour depletion theory and hence granting monopoly rights over a colour was out rightly rejected.

This was reflected in the case of *Colgate Palmolive*[14], where the court was hesitant in granting a colour a trademark to the red and white trade dress of Colgate giving the reason that both red and white are basic colours and are descriptive in the sense that they depict the colour of tooth and gum. *Prima facie* the court rejected but an exception was held in this case that no party can claim a monopoly in a particular colour but if there is a combination of colours that has been long used by a manufacturer company and due to secondary meaning has been imprinted in the minds of the customer as coming from that particular company only, then such combination could qualify for trademark protection provided it fulfils all the other criteria of a valid trademark. Also if the colour combination, layout, packaging and the overall get up have been attached to a product for quite some time, then in that case, if the competitors come up with a deceptively similar product, there is a very high chance of the public being misled and if the trade dress or the colour is not registered, then, there is only by way of passing off that the infringed can claim their right.

14 (1998) 1 Comp LJ 171 MRTPC.

Shortly thereafter, the judiciary realised the growing importance of trade dress and colour as a trademark and that it casts a lasting impression in the minds of the customers who begin to associate that particular mark with the product. As per the definition given in the act, combination of colours or even a single colour serves as a trademark although a trademark consisting of combination of colours stands at a better chance of having the mark registered as it would face less opposition and also because of the distinguishability factor. It is seen that at present, in India, the courts are more at ease when it comes to granting trademarks to a combination of colours which on the other hand in case of a single colour, a stronger evidence as to its validity is required. "The judiciary understands the mental association of the colour in the mind of an average buyer[15]." As per the Trademarks Manual guidelines, 'in exceptional circumstances a single colour can be considered for registration if the colour is capable of denoting the origin of a product or service and has acquired a high level of distinctiveness.' The judiciary is still a little unconvinced about granting protection to a single colour but keeping in mind the mental association of the people they have started to change their practice on the pretext that if a company has in fact gained reputation in the market for being associated with a particular colour then it would be unfair if he has to bear infringement costs and loss to his repute because of other deceptively similar marks in the market.

Trade Dress Issue and Stand of Judiciary

Trade dress generally refers to the outer facade or the packaging of a product that makes it visually appealing. It is a form of intellectual property and is nowhere as such defined or protected under a different act. Its sanctity flows from the Trademark Act 1999, under section 2(zb)[16] that defines trademark to be inclusive of *"shape of goods, their packaging and combination of colours."* Protection to trade dress began to be given after the manufacturer company without due registration of his trademark established quite a repute and goodwill in the market, and then was threatened by the other party who tried to bring in the market a deceptively looking similar product quite similar to the earlier goods by its outer appearance or packaging. Thus in the cases of alleged infringement of the trade dress, the owner has to prove his established goodwill along with substantial damage to it. The concept of trade dress has been taken from the U.S Lanham Act[17]. A trade dress may include in addition to packaging, graphics, design, shape, size, colour combination, texture or placement of words on it amounting to the general outer appearance of the product.

15 *Rupa and Co. Ltd. v. Dawn Mill Co. Ltd.* AIR 1998 Guj 247, (1999).

16 "Trade mark" means a mark capable of being represented graphically and which is capable of distinguishing the goods or services of one person from those of others and may include shape of goods their packaging and combination of colours.

17 Section 43(a), US Lanham Act, 1946.

The *Colgate Palmolive Co. v. Anchor Beauty Care Pvt. Ltd.*[18] is an important case addressing the issue of trade dress in India. In that the court said that "It is the overall impression that customer gets as to the source and origin of the goods from visual impression of colour combination, shape of the container, packing etc. If illiterate, unwary and gullible customer gets confused as to the source and origin of the goods which he has been using for longer period by way of getting the goods in a container having a particular shape, colour combination and getup, it amounts to passing off."

The court in the case held that there was no monopoly on the particular colour but since similar reproduction of the combination of colours created a likelihood of confusion in the minds of the people, there was a ground for stopping the defendants.

Registrability Issue

Trademarks are generally composed of words or letters or accompanying slogans, but since the recent developments in the law of trademarks has brought in various types of trademarks, there has been considerable controversy regarding colours as a trademark. In India for the registration of a colour, the shade has to be graphically represented on a sheet of paper whereas in U.S. and E.U. the representation is done on the Pantone scale. Even after having all these requirements for registration of the colour on a sheet of paper, in India there are some problems that cannot be done away with when it comes to colour marks. Some of the problems include shade confusion theory and the material to which it is applied. At the time of registration, the applicant is not supposed to submit a sample of the material to which the proposed colour needs to be applied, which makes it all the more difficult to ascertain that over a period of time the shade fades away or changes when applied to a different material, making it extremely difficult to keep a legal record of such legal requisites.

Keeping this entire debate aside the Indian judiciary, which was earlier apprehensive about granting trademarks to colours, now has started believing that colours and the trade dress constitute an important part of the product because of the mental association that it casts in the minds of the consumers. It is now comparatively relaxed in this regard but still suffers from certain hurdles in registration of a single colour as a trademark. There are some desired suggestions that need to be applied for the registration process of colour trademarks which have been separately dealt with in the last part of the paper.

Concluding the position of the colour marks within India, it can be seen that, the initial phase of introduction of these unconventional marks, the Judiciary was essentially hesitant

18 2003 (27) PTC 478 Del.

in offering monopoly to colour marks. This was also reflected in the case of *Colgate Palmolive* where it was pointed out that the combination of red-white was descriptive in nature as it represented the gum-tooth assemblage. However, the court was flexible enough to acknowledge the mental association of the colours by the consumers in respect of only one product thereby providing that such monopoly can only be granted in cases where a mark has acquired a secondary meaning in its favour by the public at large. It cannot be ignored that the concept of trade dress has also been recognised in the same judgement by the Indian courts wherein the overall getup including the colours as shown within the packaging reflects the knowledge of consumers in respect of that product. Indian courts have been comparatively open to adoption of colour combinations instead of monopolising a single colour wherein exceptional circumstances may have to be proven. In practicality, there may be several issues a proprietor may have to face for obtaining protection over his unconventional mark including the graphical representation of a colour, fading away of the colours or the change in the shade of a colour when applied to a different material. Indian courts have usually kept a traditional approach while incorporating new concepts in the field of any intellectual property, however we have witnessed an increased number of instances wherein they have come out of this comfort zone and accorded protection over unconventional marks.

Position across Other Jurisdictions

The TRIPS Agreement, to which all the member states have to be in coherence with provides with a standard definition of Trademark as, "*any sign or any combination of signs, capable of distinguishing the goods or services of one undertaking from those of other undertakings, shall be capable of constituting a trademark. Such signs, in particular words including personal names, letters, numerals, figurative elements and combination of colours as well as any combination of such signs, shall be eligible for registration as trademarks.*"[19]

European Union

The legislation dealing with the registration of Trademark in European Union is the EU Directive which has defined Trademark in Article 2[20]. The registration and enforcement of Community Trademark is regulated by the "Council Regulation on Community Trade Mark" (CTMR).

19 Article 15(1), Agreement on Trade Related Aspects of Intellectual Property Rights, 1995.

20 Article 2**:** A Trademark may consist of any signs capable of being represented graphically, particularly words, including personal names, designs, letters, numerals, the shape of goods or of their packaging, provided that such signs are capable of distinguishing the goods or services of one undertaking from those of other undertaking.

The purpose of trademark is essentially to differentiate one's products from others. The concept of trademark protection in European Union is considerable young as compared to US, which is why it has been centralized.[21]

The TRIPS Agreement expressly mentions that 'combination of colours' can be registered as a trademark but does not mean to exclude the registration of a single colour.[22] Whereas there has been no explicit mention on the same in the definition under the EU Directive but it abides itself by the definition under TRIPS and the list given in its definition of trademark is hence not exhaustive. Following this, the trademark laws of many of the members of the EU have directly incorporated the registration of colour marks as well, which includes the German and Latvian laws.

Fulfilling the registrability criteria can be difficult when it comes to colour marks. From the time period of 1996 to 2012, the OHIM had received around 880 applications pertaining to colour trademarks, out of which only 276 had been accepted and approved.

However, the criteria to apply for the registrability of a colour mark had been laid down in the *Sieckmann's case*[23], according to which the graphical representation of a trademark should be "clear, precise, self-contained, easily accessible, intelligible, durable and objective".

However, in the *Libertel case*[24] of 2003 the general criterion of Sieckmann was observed to be applicable for colour trademarks as well. The court further held that the graphic representation of a colour mark can be fulfilled by consisting of a "description in word, a sample of the colour combined along with the description and designating the colour through an internationally recognised identification code." The court therefore laid down two essentials to get a protection over a colour mark:

1. Capable of graphical representation
2. Capacity to distinguish

21 Taylor Piscionere, *Imitation may not Always be the Sincere Form of Flattery: Why Colour Wars in the United States and Europe may result in Brand Dilution and Colour Depletion*, 25 Pace Int'l L. Rev. 43 (2013).

22 D. GERAVIS, THE TRIPS AGREEMENT: DRAFTING, HISTORY AND ANALYSIS, 2nd Ed. (Sweet & Maxwell) (2003).

23 *Ralf Seickmann v. Deutsches Patent*. C-273/00

24 *LibertelGroep BV v. Benelux*. C-104/01

In the case of *Heidelberger BauchemieGmBH*[25], filed an application for registration in the German Patent and Trademark Office consisting of a "rectangle having the colours blue on the top and yellow below it", which was to be used in connection with the building materials the application was rejected on the ground that it was impossible to represent the sign graphically and neither did it have any distinctive character. Upon an appeal to the Federal court in the present case, the ECJ gave certain guidance regarding the issue. ECJ confirmed the decision by stating that even though single colours are protectable but a combination of colours which is in every conceivable form" may not be able to fulfil the requirement of graphical representation. The court further observed that while dealing with applications relating to combination of colours the exact ratio or proportion must be provided by the owner.

This could lead us to the conclusion that, a liberal approach in order to fulfil the criteria of 'graphical representation' may lead to incorrect decisions and legal uncertainty. It would allow too much monopolization of the mark and the consumers would also not be able to differentiate the products from others.[26]

Therefore, if a mark comprises of multiple shades the accuracy should be higher and the proportion of the colours should be specifically mentioned in the application.

In the 2010 case of *BCS v. John Deere*[27], registration application for the combination of colours green and yellow to be used with respect to agricultural machines was applied on the basis of acquired distinctiveness of the colours in the market. There was evidence to prove the long subsisting use of the colours which was interpreted as an indication to the source or origin by way of books, catalogues and trade fairs and that there was a long persisting usage of the colours which was even recognised by the consumers within the relevant market.[28]

Cadbury had also been successful in protecting the colour purple with respect to its packaging of which was bearing the pantone number 26854c. The court in this case also held that the mark had acquired so much distinctiveness that the consumers associate it with the product of the applicant. Evidence in the form of public survey was also submitted in regard of the same.

25 C-49/02, Heidelberger BauchemieGmBH

26 R 799/2004-1, First Board of Appeal, July (2005), IKEA (Blue & Yellow)

27 T-137/08

28 Hogan Lovells, *Green+Yellow=John Deere; Protection Granted for an Abstract colour Trademark*, Lexology, July (2010), Available at https://www.lexology.com/library/detail.aspx?g=565d82e7-9c70-4d35-b68d-4dc7975c4204

Trade Dress

Trade Dress in European Union is considered to comprise of the product design along with its packaging. Although the relevant statute does not provide with any explicit definition for trade dress, but has been cited in many case laws and has differed across various jurisdictions. The Community Trademark Law extends protection to trade dress only when the particular requirement for distinctiveness has been met. The ECJ has time and again emphasised that the standards to assess the distinctivity is uniform for all types of marks.

The rationale for granting protection to trade dress depends on the subject matter under which it is to be protected. From the perspective of Trademark, a trade dress which has acquired distinctiveness and secondary meaning within the relevant sector of the market can be protected. Moreover, if protected under designs the trade dress should not be an imitation or already publicly known.[29]

United States

Registration of trademarks in US is governed under the Lanham Act and registration procedure is done at the United States Patent and Trademark Office (USPTO). Since trademarks are territorial in nature, the act provides protection to the registered trademarks only in US and after the registration; it is notified to all the other states as well. The act provides liability against the infringer to sue them being a legitimate and viable owner of the trademark.[30] Section 45 of the act defines the trademark and what all could constitute to be a trademark.

The statutory definition does not seem to expressly mention colour mark as a type of trademark and hence not eligible for protection as per the traditional ongoing rule. However, for a long period of time it was not extended to colour marks until the landmark judgement of *Qualitex Co. v. Jacobson Product Co.*[31] For a better understanding of the case, it is necessary to know about the situation prevailing 'Pre-Qualitex' as well.

Pre-Qualitex Position

Previously, colour mark was not recognised or not considered to be capable of registration and the rationale behind the said contention was that it being a 'weak mark', the consumers cannot identify and indicate the origin or source of goods. This has been observed in a

29 Report of Trade Dress Protection in Europe, Sept (2007) pp 1-6.

30 Section 32, US Lanham Act, 1946.

31 514 U.S. 159 (1995).

plethora of judgements.

In the case of *Diamond Match Co. v. Saginaw Match Co.*[32], the court refused the application for registration on the ground that a single colour mark would not be able to serve the purpose of the trademark and hence could not be registered. Thereafter, the court in the case of *Campbell Soup Co. v. Armour & Co.*[33] *(1949)* dealing with the same issue denied the trademark to "horizontal red and white Campbell's soup labels" to the owner. The court reasoned its decision by saying that it would lead to colour monopolization, depletion in colours available as well as confusion of shades. If trademark is given over a particular colour it will grant them the exclusive rights to restrain anyone to use the colour. However, the traditional practice did not bar the registration of a colour absolutely but it was held that in order to make the colour an essential feature of the mark, it should be so intricately connected with the mark or design that the manufacturers of similar products know what they may be allowed to pursue with.

However, in the case of *Re Owens-Corning Fibreglass*[34], the Court of Appeals for the Federal Circuit brought about a twist by stating that the tradition of not granting colour trademarks should be done away with and should be scrutinised or judged as per the facts and circumstances of each case. The fact that Owens-Corning used the colour pink in connection with his insulation products for over 30 years, has acquired distinctiveness among the consumers over a period of time. The court observed that the colour was arbitrarily chosen and could not be connected to the products in any way, and therefore had acquired a secondary meaning. But the judgement was unable to bring about a significant change in the minds of the judges, following which the seventh and ninth circuit courts refused to comply with this decision. This ideology was subsisting until the U.S. Supreme Court decision in the *Qualitex* case.

Post-Qualitex Position

The plaintiff company used to manufacture iron pads that were 'Green-Gold' in colour since 1950s for the purpose of dry-cleaning. The court in this case out rightly accepted that the green-gold colour has acquired distinctiveness among the consumers so much so that it has acquired a secondary meaning and therefore granted the colour mark.

32 142F, 727.

33 175 F.2d 795.

34 774 F.2d 1116.

Trade Dress

It is pertinent to discuss the concept of Trade Dress with regard to issues under colour marks. Trade dress is a form of intellectual property which comprises of the visual elements of the product or its packaging which makes it easier for the consumers to identify the source or its origin.[35]

The Lanham Act does not per se grant recognition to Trade Dress, but Section 43[36] provides for certain remedies available against the infringement of trade dress, when not registered. It states that when a plaintiff files a suit for unregistered trade dress, he shall bear the burden of proving that the "matter sought to be protected is not functional." Thus, one requirement on which it clears its stance is that it should not be functional in nature. Therefore, it is possible to protect trade dress in US till the time it is not functional in nature and of course distinctive in character.

Journey so Far

Having discussed the position of colour trademarks in the European Union and the United States, one thing has prominently been brought into light that nowhere do we have an express denial of the recognition of colour marks as trademarks. The Lanham Act might not expressly recognise it, however in EU or in India the phrase 'combination of colours' is mentioned. Where on one hand the TRIPS Agreement which sets out the minimum standards to be followed by the member countries includes in its understanding of the term 'sign', letters, numerals, figurative elements and combination of colours and any combination of such signs[37], the EU Directive and the Lanham act have in a way by identifying packaging and trade dress exhibited flexibility in extension of protection to instances where the mark through its colour has established association with the attached brand name and has gained popularity among the public for the same.

Agreed that the packaging not only comprises the colour scheme in the backdrop but a combination of that with probably lines or a pattern or how a particular brand name is written, it all adds up to enhancing the visual appeal. Even so, the colour plays a predominant role in the association of the trademark with the manufacturer company that advertises and markets

35 Rituraj Shrivastava, *Trade Dress: Concept*, Mondaq, Sept (2013), http://www.mondaq.com/india/x/262928/Trademark/Trade+Dress+Concept+And+Indian+Practice.

36 § 43 (15 U.S.C. § 1125). False designations of origin; false description or representation:
(3) In a civil action for trade dress infringement under this chapter for trade dress not registered on the principal register, the person who asserts trade dress protection has the burden of proving that the matter sought to be protected is not functional.

37 Article 15 of the TRIPS Agreement.

it. Hence colour trademarks have garnered importance lately By way of 'combination of colours' and 'packaging' many countries all over the world are trying to expand protection to intellectual creativity.

Conclusion and Suggestions

Conclusion

Colours tend to leave behind an impression in the mind of the viewer. It becomes easy for people to identify and recognise things through colour marks. The recent trademark trend has been to look for innovative ways which are fascinating enough for the consumers of the relevant market. A single colour or a combination of it tends to distinguish the products of one owner from the products of others. It also forms a part of the packaging of the product and is even covered under the ambit of trade dress essentially. However, issues regarding monopolization of a colour can be reconsidered and ignored when the relevant market tends to link that particular colour to the product of the trademark owner. Recent trends have shown a development and modernised ideas have been inculcating with the acceptance of colour marks in US and EU.

However, certain level of clarity is needed as far as the registration of colour marks is concerned. Courts have a major role in laying down certain minimal standards to be fulfilled in order to get registration of a colour mark as a trademark. The two main requirements put forward and reaffirmed in cases like *Sieckmann*and *Libertel* includes the possibility of a colour to be capable of graphical representation and the existence of acquired distinctiveness of that colour within the consumers.

Indian courts have now chosen a liberal path in respect of the same issue for example, PayTm has now been granted a trademark over the colour combination of white and blue. However, the judiciary still seems too apprehensive while granting single colour marks as trademarks due to the fear of monopolization and further a misuse. However, the functionality aspect is also one of the major issues while speculating such cases because the justification for the same has been that if the colour is of a functional character it cannot be registered under trademark, same can be observed from the major dispute between *Colgate v. Anchor*.

A balanced approach could be the ideal situation wherein the interests of both the trademark applicant as well as the consumers should be kept in mind. The courts have to judge from the point of view of a person of an average intellect. Colour marks are therefore yet at an

infant stage wherein the judiciary has to play a major role by putting forward the facts and circumstances of each case.

Suggestions

In spite of the colour mark serving as a good trademark, there exist still certain hurdles to the successful registration of the same. Following are some suggestions that can help overcome these issues:

1. As already discussed, Indian scenario is still a little hesitant in granting colour trademarks to a single colour. To this issue, proper guidelines should be set out by the Trademark registry, outlining the problems that can crop up and how to deal with such problems along with ascertaining experienced people who shall deal with the same.

2. With respect to colours, the confusion as to the particular shade of the colour is bound to happen. Robust registration search systems should be made that can find out the exact difference between the colours and also whether there is a chance or likelihood of the public getting confused with the two colours or not.

3. Another issue that was raised was that the shade of the colour proposed to be registered depends on the material that it is applied to, and may change if applied to another material. In this regard, the Registrar along with asking for the exact shade of the colour from the *Pantone scale* should also ask the applicant to furnish along with the colour, a sample of the material to which the colour is proposed to be applied as a live example so that the exact shade of the colour can be registered. To prevent further confusion, the Registrar should have the powers to restrict the applicant to that particular shade only and prevent him from using the colour on a different material as submitted.

4. The issue that came up in the *Nexium* drug case was that people identified drug with the colour bringing up the stance that in India, trade dress is becoming increasingly important in the pharmaceutical sector. Before the registration of a particular colour to a drug, efforts should be made to ensure that it does not coincide with another drug of the same or similar colour and if so, then either the applicant should be notified to change the shade of the drug colour or a public notice should be issued along with big advertisements ensuring that the public which consumes these essential drugs are in no way confused by either the name of the company or the colour.

5. Special individual recognition should be given to trade dress in order to make these two branches i.e. trademark and trade dress, different and eliminate confusion. Also, it would be easier for the courts to litigate on matters when they know what the subject matter pertains to.

On a clear establishment of the fact that colours not only play a vital role in creating a lasting impression in the minds of the public thereby making it way easier for them to choose the product of a company of their choice amidst hundreds of alternatives of the same product available in the market, it goes on to add a visual appeal to the product. Even though a lot many cloth detergents companies have gone for the regular white and blue packaging, with their respective trademarks a part of the same, we have diversity with *'Ariel'* choosing the colour green and *'Tide'* choosing an absolutely out of the box, unrelated colour orange for its packaging to create this lasting impression in the minds of the public ensuring and making the best efforts with their creative thinking so that their product cannot be confused with another's at all costs.

However, the paper surely raises concerns about monopolising particular colours majorly the primary colours, which have been many a time refused by the courts until and unless they are presented in a combination with other colours or are different shades on the pantone scale or have proven the strength of their mark to be well known having earned secondary meaning after years of operating in the market. Be it Cadbury's purple or PayTm's blue, all had to go through a rigorous tussle in the courts to prove their strength of the mark, although examples like Christian Louboutin's red sole[38] does give us a hint that there is light at the end of the tunnel after all!

38 *See,* Anand and Anand, *'Single-colour trademarks – enforcement of Christian Louboutin's 'red sole' trademark',* World Trademark Review, 19 December 2019, https://www.worldtrademarkreview.com/single-colour-trademarks-enforcement-christian-louboutins-red-sole-trademark

Comparative Analysis of Corporate Governance in India and USA

Nikita Mittu*

Abstract

Corporate Governance is the process of ensuring that management activities take place with transparency and efficiency. It is the responsibility of the Board of Directors of a company towards the shareholders. It is required to incorporate a culture which ensures maximization of the visions and mission of the company in relation to its performance.

This paper will discuss the concept of Corporate Governance, its origins in the international market and the process of Internal Governance in markets of India and United States of America. It further discusses Corporate Governance practices followed by companies in India and USA, thereby analysing the similarities and the difference between the two established legal systems, including internal control, Committees, Independent Director and their duties and Audit Committee. Furthermore, this paper discusses the cases which led to the need for Corporate Governance in India and USA and established the legal provisions for the same. In the conclusion, the paper gives a summary of the provisions of Corporate Governance in India and USA in relation to its implementation ad impact.

Introduction

Corporate governance is the method of creating effective relationships to ensure corporate direction of the company. The main responsibility of corporate governance i.e. the oversight and control of management activities hence lies on the Board of Directors of the company, who are appointed by the shareholders. As we come down from the managerial graph of any company, responsibilities are diluted along the graph. Further, additional participation to corporate governance lies upon the shareholders, who appoint the Directors, employees, the creditors and suppliers. A Board of the company has numerous responsibilities related to

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management of the business and reporting the same to the shareholders. Hence, Corporate Governance is the responsibility and work accomplished by the board of directors of a company in order to ensure effective functioning of the corporation to yield maximum value of the company.

Thus, Corporate Governance, hence essentially revolves around the board of directors of a company. It provides structure and directly affects the performance of the company.[1]

Academic and Legal Definitions

Organisation for Economic Co-operation and Development (OECD) defines 'Corporate Governance' as the "procedures and processes according to which an organisation is directed and controlled. The corporate governance structure specifies the distribution of rights and responsibilities among the different participants in the organisation – such as the board, managers, shareholders and other stakeholders – and lays down the rules and procedures for decision-making."[2]

'Corporate Governance' is defined by Institute of Company Secretaries of India as, "the application of best management practices, compliance of law in true letter and spirit and adherence to ethical standards for effective management and distribution of wealth and discharge of social responsibility, for sustainable development of all stakeholders".[3]

"The act of steering, guiding and piloting—describes what boards [should] do when in session. It does not describe and is not a proxy for the board itself, nor any other party or activity outside the boardroom. Regulators (to set rules), proxy advisers (lobbyists on behalf of shareholders and other interests), and shareholder meetings (communications) are all important, but none is corporate governance."[4]

Further, corporate governance acts as an accountability to capital generators and investing agencies.[5] It is the management's control which ensures effective functioning of the

1 James McRitchie, 8/1999.

2 Annual Report, European Central Bank, 2004 (Aug. 04 2020, 2:35 PM), https://stats.oecd.org/glossary/detail.asp?ID=6778.

3 Smita Jain, Corporate Governance — National and International Scenario, (Aug. 04. 2020, 2:42 PM), https://www.icsi.edu/media/webmodules/programmes/33nc/33souvearticle-smitajain.pdf.

4 Peter Crow, *Corporate governance: Is our understanding flawed?*, (Mar. 12, 2020, 10:05 AM), https://www.petercrow.com/musings/on-corporate-governance-is-our-understanding-flawed.

5 Bruce Weber, Dean of the Lerner College of Business at the University of Delaware, at the inaugural meeting in November of the newly reconstituted advisory board for the John L. Weinberg Center for Corporate Governance.

company by working in its best interest and making the shareholders accountable to elect directors and auditors.

Corporate governance is generally the practice which affects the control of a business in a company. It not only affects the persons who control the companies but the allocation of risks and returns from the business of the company to persons including stockholders and directors.[6]

Concept of Corporate Governance

When we talk about any corporation, the first aspect which comes to the mind is the goodwill of the company and output it generates. In order to ensure an impact on the public, investors as well as the shareholders, every corporation prepares its management with utmost care. Corporate governance is the set of rules and regulations which ensure an effective corporate functioning of any company which decides its existence and accountability in the market. It exhibits a balance between the interest of the stakeholders of the company and the public. It includes all aspects of management within its ambit including the internal controls and the disclosures required by a company in its functioning. Internal controls ensure that the financial and the accounting details of the company are reliable and the disclosure of the information at every level ensures transparency to the Board. The National Association of Corporate Directors (NACD) was established in the United States of America (USA) to ensure effective leadership in board of directors of the company.

NACD published 'Key Agreed Principles to Strengthen Corporate Governance for U.S. Publicly Traded Companies'[7] to improve the concept of corporate governance. Hence, it suggested that a Board of Directors shall be the first essential requirement to ensure 'long term value creation', thereby leading to transparency in the practices of the company to the shareholders. It suggested that directors of the Board should be from difference academic backgrounds to ensure diversity of skills and experience on the Board. This Board should be accountable to the shareholders only and shall be independent from the management of the company. [8]

6 Business Roundtable, *Principles of Corporate Governance,* (Apr. 04, 2020, 12:30 PM), https://corpgov.law.harvard.edu/2016/09/08/principles-of-corporate-governance/.

7 *Key Agreed Principles to Strengthen Corporate Governance for U.S. Publicly Traded Companies,* (Apr. 04, 2020, 12:46 PM), https://www.nacdonline.org/insights/publications.cfm?ItemNumber=2686.

8 Pallak Bhandari, *Corporate Governance: A Comparative Analysis in India and the US,* (Apr. 01, 2020, 11:30 AM), https://pdfs.semanticscholar.org/4a7d/6a7c1479c42f04227c61e1b0bd57ede189e6.pdf.

Corporate Governance in India

Corporate Governance plays a crucial role in the economic condition of India. From 1991, the economy in India has seen a better size of the stock market.[9] For Indian market to ensure more foreign direct investments, the companies in India need to focus more on 'Shareholders value maximization'.[10] Although the concept and attempts of corporate governance has existed since 1961 globally, it is observed that only in 1992 did India take an initiative by reforming the Securities and Exchange Board of India (SEBI). SEBI ensured supervision and standardization of stock trading leading to formulation of corporate governance rules and regulations. Later, Confederation of Indian Industry (CII) was formed in 1996, which led to laws essential for companies in India to act for corporate governance.

Kumar Mangalam Birla Committee and Narayan Murthy Committee were formed, which were constituted under Securities and Exchange Board of India, whereby they were required to substantiate the meaning and importance of corporate governance for the companies in India. After an in-depth understanding and analysis of the companies, clause 49[11] was then introduced for listed companies with SEBI relating to listing contracts, which was later reformed after cases like Satyam, WorldCom, etc. to deal with issues which led to dismantling of these company's structure and management, thereby degrading the economy of the country.[12] Clause 49 of the Listing agreement provides for a minimum number of independent directors, board members, committees, code of conduct, audit committee rules and limitations, etc. Financial penalties were imposed on companies which did not follow the principles as laid down in Clause 49.[13]

On improving corporate governance in a company, the relation of the company with its stakeholders improves. Since corporate governance ensures that the property is protected

9 L. Som, *Corporate Governance Codes in India*, Economic and Political Weekly, vol. 41, no. 39, pp. 4153-4160, 2006.

10 R. Ramakrishnan, *Inter-relationship between business ethics and corporate governance among Indian companies*, International Seminar at The Institute of Management, NIRMA University, Ahmadabad, January 5-7, 2007,(Mar. 24, 2020, 01:30 PM), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1751657.

11 Clause 49 of the Listing Agreement by Securities Exchange Board of India (SEBI) is applicable to all the listed Companies under SEBI w.e.f. Oct. 01, 2014. It provides for listed companies to ensure optimum combination of directors in the Company including executive and non-executive directors and include at least one woman director. It essentially includes the rights of the shareholders, the responsibility of stakeholders and directors and the disclosures required by the company to maintain transparency.

12 N. Sanan and S. Yadav, *Corporate governance reforms and financial disclosures: A case of Indian companies*, IUP Journal of Corporate Governance, vol. 10, no. 2, pp. 62-81, 2011.

13 K. Han and Y. Lu, *Corporate governance reforms around the world and cross-border acquisitions*, Journal of Corporate Finance, 2013.

and the registration of ownership is effectively and securely done, this benefits the company's capital mobilization. In order to receive funds, the company requires to be transparent in their disclosure of funds. Companies have to ensure that the funds are received and are effectively allocated.[14]

Clause 49 of the Listing Agreement

Clause 49 of the Listing Agreement is the agreement between the company and the stock exchanges on which it is listed, such as National Stock Exchange and Bombay Stock Exchange. This clause provides for the system set up relating to all the information necessary for the Stock Exchanges from the company. In order to ensure that India is able to participate in the competitive business around the world effectively, there led to the constitution of the regulatory framework to ensure corporate governance for listed companies. The Code of Corporate Governance published in 1998 by Confederation of Indian Industries (CII) was one of the first codes in Asia.[15]

Corporate governance is governed internally and externally. External factors include the market and the competition. Internal factors majorly include the internal functioning of the company. Internal governance of a company is done by the shareholders and directors. The board of directors are required to ensure that the financial statements of the company are audited. Executive compensation is provided to the members of the board for the purposes of compensation. In countries like the USA, the shareholders do not decide on the compensation amount. However, in India, Kumar Mangalam Birla Committee was constituted in 2000 by the Securities and Exchange Board of India (SEBI) which provided that it is the responsibility of the board of the company to provide for guidance in regard to leadership and strategy, management of the company independent of objective judgement and accountability to the shareholders of the company.[16]

Hence, the Board of Directors of a company has a huge responsibility for which it is required to be updated and acquire all necessary information to take important decisions of the company. In the case of *M.S. Pharmaceuticals Ltd. V. Neeta Bhalla and Anr.*,[17] the three judge bench of the apex court held that the Managing Director or the Joint

14 *Supra* note 8.

15 Sanjay P.S. Dessai, Dr. I Bhanumurthy, *Corporate Governance in India Clause 49 of Listing Agreement,* (Aug. 05, 2020, 10:51 AM), https://www.researchgate.net/publication/228122798_Corporate_Governance_in_India_Clause_49_of_Listing_Agreement.

16 Report of the Kumar Mangalam Birla Committee on Corporate Governance, (Apr. 04, 2020, 12:56 PM), http://www.nfcg.in/UserFiles/kumarmbirla1999.pdf.

17 *M.S. Pharmaceuticals Ltd. V. Neeta Bhalla and Anr.,* (2005) 8 SCC 89.

Managing Director may have different responsibilities in the company; however, they have the responsibility to ensure that the business of the company is conducted effectively. Therefore, in this case, the signatory of the dishonoured cheque is liable under Section 141(2) as the liability of the concerned person office or position in the Company.

Further, in the case of the *Uttar Pradesh Pollution Control Board v Mohan Meakins Ltd.*[18], the Supreme Court opined that any person who holds the office of a Manager or in charge of the conduct of the company is liable under Section 47[19] of Water (Prevention and Control of Pollution) Act, 1974.

Analysis of Clause 49 and Sarbanes Oxley

Clause 49 of the Listing agreement has been based on the principles of Sarbanes-Oxley Act, 2002 (SOX Act). Sarbanes-Oxley Act, 2002 was ensued for listed companies on US stock exchanges. The SOX Act was passed by the U.S. Congress to aid the investors from fraudulent financial reporting. It broadly covered four areas, corporate responsibility, the increase in criminal punishment, accounting regulation and providing for new protection. The similarities include the number of directors, rules in relation to insider trading, etc. The main difference between Sarbanes-Oxley and SEBI is that under Sarbanes-Oxley, reports of fraud or annihilation lead to 20 years of imprisonment, however, SEBI can initiate criminal proceedings or charge a fine leading to delisting of the company.[20]

The aim of both the legislations is the same, however the structure of SOX Act and Clause 49 are different.

Under Section 404 of the SOX Act, the Management and the auditors establish internal controls for financial reporting ("ICFR")[21]. However, under Clause 49, all aspects to corporate governance are covered and it is not restricted to only financial reporting.

1. Under the SOX Act, the responsibility of internal control lies on the board, which is the certifying authority. However, under Clause 49, Chief Executive Officer (CEO) and Chief Financial Officer (CFO) are the certifying authority[22] for internal controls and are responsible for frauds in the company.

18 *Uttar Pradesh Pollution Control board Vs. Mohan Meakins Ltd.*, (2000) 2 SCALE 532.

19 Offences by companies

20 *Supra* note 10.

21 Sarbanes-Oxley Act, 15 U.S.C., 2002.

22 Securities and Exchange Board of India Act, Listing Agreement, Clause 49, Para V.

2. Under the SOX Act, a committee is established by the board, to ensure financial and accounting reporting. In cases where no such committee is established, directors of the board are considered as member of the audit committee whereby such directors are independent directors. However, the frequency of the meetings is not specified in the SOX Act. Under Clause 49, such details are specified, whereby it is provided that audit committee should consist of at least three directors as members, the audit committee should also consist of Independent Directors constituting two-third members of the committee, and at least one member of the audit committee shall have experience in relation to accounting and management of finance.

3. SOX Act and Clause 49, both require an independent director as a member of the audit committee. However, Independent director is defined differently under both laws. SOX Act defines independent director as a member without consultation fees, whereas Clause 49 defines independent director as:

   - A Director taking only director's remuneration and takes no other monetary benefits.
   - Is not related to any of the management members or the promoters of the Company.
   - Has not been an executive in the previous three years and also did not hold the position of partner in any legal or audit firm of the Company.
   - Does not hold the position of a service provider or supplier to the Company.
   - Holds up to two percent of voting shares of the Company.

4. Under the SOX Act, Section 301 provides for duties of the audit committee in relation to resolution of complaints and process of retaining them. Such complaints maybe of audit, accounts and internal controls[23] of the Company. However, Clause 49 provides for 'Investors Grievance Committee'. Therefore, it may be noted that SOX takes in account the accounting related issues with specificity.

5. Under SOX Act, a code of conduct should be declared and if such code of conduct is not accepted, the reason for the same should be duly mentioned. However, under Clause 49, it is mandatory to publish a code of conduct on the website of the Company. The senior management is required to adhere to such code of conduct. Code of conduct under Clause 49 is also applicable to stakeholders, however under SOX Act, the code of conduct is only applicable to the financial members of the Company.

23 *Supra* note 15, Section 301.

Case Studies

1. Enron Corporation was one of the biggest companies of America. In 2001, Enron inflated its earnings by 600 million dollars since 1994 by using shell companies and did not disclose its losses in its financial statements. Eventually, Enron had to file for bankruptcy protected in 2002 since its stocks had been reduced to less than $0.75 from $90.75 and the employees lost their savings and the investors of the company lost their equity in the company worth billions of dollars. Enron Corporations was one of the biggest failures of the capital markets in America. This failure was considered to be of the audit committee of the company since it did not have a model of corporate governance to rely on. The audit committee works in accordance with the regulation and SEC which provided for gaps and irregularities in the corporate governance system in the US in early 2000s. The Directors of Enron were paid with the stocks to ensure their interests to be same as the shareholders. This however, led to pressure on the executive members to want higher stock prices using any procedure and prevented the independent directors from questioning the creative accounting process. Further, the audit committee set up Enron was not itself well equipped to accounting practices since it did not hold the knowledge or expertise in accounting practices.

   The Enron scam was due to the inefficiency of the theories of the corporate governance model, the agency theory and the stakeholder theory. The efficient market hypothesis failed since the performance was connected with the compensation, the Board of Directors and the management of the company had close relations and the financial reporting method was ambiguous. Further, it would have been preventive if the stakeholders including supplies and customers were not made part of the management decisions.

2. The Satyam scandal[24], which is also known as 'Enron of India', is considered to be one of the biggest corporate frauds in the country, in which, 94% of the money reflected in the books of the company was shown as the earning of the company, which led to the investor losing around $2.2 billion. In 2015, the Chairman, B. Ramalinga Raju was held liable[25]. The Satyam Computer was established in 1987 and listed on the Bombay Stock Exchange in 1991. These were the few IT companies in the country which recognized the importance of outsourcing in the industry; Satyam Infoway, which was its subsidiary, was the first Indian company from the IT industry to be listed on the NASDAQ.

24 *Chintalapati Srinivasa Raju vs Securities and Exchange Board of India*, AIR 2018 SC 2411.

25 *Satyam Computer Services Ltd.* Before the Securities and Exchange Board of India, 2015 SCC OnLine SEBI 157.

In 2008, the stocks of the Company fell when the acquisition of Maytas was a failure and Satyam Computer Services was forbidden with the World Bank for the next eight years because of charges of data theft and bribery against the Company. Despite the panel of independent directors on its board, the Company faces issues due to lack of an effective corporate governance model. Therefore, Raju was forced to resign from the position of Chairman by accepting the transactions amounting to fraud which were almost of $1 billion (Rs. 7000 crores) and the intention to replace the fictitious assets of its company's with that of Maytas'. The Board of Directors, employees and the auditors (PricewaterhouseCoopers) of the Company were not aware of these activities and intentions for many years. Hence, the Government of India was forced to disband the Satyam board and thereby appointed a competent board of directors.

After the Satyam scandal, the government implemented the Companies Act, 2013 to prevent such frauds in the future. Furthermore, various amendments were initiated in Clause 49 of the Securities and Exchange Board of India (SEBI) to ensure effective market regulation. These amendments led to power with the board of directors and audit committees of the board, requirement of at least one woman director on the board and rotation of the audit company every ten years. However, the major reason behind the issues of corporate scandals lies with lack of effective enforcement and fraudulent practices.

3. The corporate scandal of Wells Fargo & Co. further raised the need of requirement of corporate governance. As the CEO pushed the employees to ensure every customer buy eight products of Wells Fargo, this led to higher pressure on employees who had to meet the requirements by working extra, failure of which would lead to their termination in two months. Hence, the employees started accounts and credit cards for customers without authorization and signatures which creation of over 1.5 million such accounts in a period of 6 years.

   L.A. Times conducted an investigation in 2013 which exposed this scandal and in 2016, Wells Fargo agreed with the regulations in Los Angeles and paid a fine of $185 million. Further it was found that the unethical behaviour of the employees was caused due to the incentive program of the company was against the corporate values. The report suggested that as the Company had fired over 5000 employees for such behaviour, this was no solution to the problem as the issue was the sales goals created by the Company.

Conclusion

It is observed that the laws like the SOX Act, 2002 and Clause 49 under the Indian legislation are similar in regard to the purpose and function, whereby they aim to protect the stakeholders of the companies. These laws are amended in order to maintain governance on the corporate activities. The Corporate governance featured under the Indian legislation is stringent and also forms part of the Companies Act, 2013; however certain provisions like PCAOB (Public Company Accounting Oversight Board), which is a non-profit corporation created under SOX to ensure effective audit in the company, the PCAOB is not included under clause 49.

Under SOX, PCAOB has the power to ensure audit, inspection and regulate the activities of the auditors or the firms of auditing in the USA. These powers are provided to Indian organisations through the Institute of Chartered Accountants of India (ICAI), whereby it provides for the act of auditing and inspecting the activities of the auditors. However, ICAI does not have the power to make regulations in regard to code of conduct of the auditors. Further, it is observed that certain terms, like internal controls have not been exhaustively defined under the Indian legislation, i.e., Clause 49 and Companies Act, 2013. However, SOX defines internal controls and intends to implement the same with the Committee of Sponsoring Organisations, which is constituted to implement the framework of internal controls in the companies. Such provisions provide a clear and better understanding of the terms and the Committee constitutes the aspect of reliability for the companies. Indian legislation may also begin to provide an unambiguous and reliable meaning of internal controls which would thereby help with the investor's interest and cooperation.

Hence, it may be concluded that by studying the provisions of corporate governance under US laws and Indian laws, the aim and purpose of the provisions are the same in reality. Indian laws, though, have a wider aspect of implementation, however SOX addresses non-compliance and crimes with a stringent view. Therefore, it is essential that amendments are made in order to ensure effective implementation of the Acts owing to the changing times and requirements in the market. This shall ensure that the corporate governance system is strong and reliable.

Syrian Refugee Crisis and its Impact on International Humanitarian Law

Jayanta Boruah*

Abstract

Due to several internal, socio-economic and political crises, Syria is witnessing the human barbarism. Inhuman tortures, and brutalities have made the headlines of daily newspapers in India. Although this crisis was initially an internal issue, subsequently, International interference gave it a global status and has also increased the rate of Refugees. The International Humanitarian Law is therefore expected to protect the rights of the victims and the Refugees in the Syrian Crisis and at the same time it is also expected to point out the wrong doings of those who are actively involved in this inhuman war. But, the facts in and around Syria proves the reverse stand. This Article will therefore make an attempt to analyze the success of the law keepers in implementing the International Humanitarian Law in the case of Syrian Civil War.

Keywords: *Syrian Crisis; Humanitarian Law; Human Rights; Refugees; and ICRC.*

Introduction

International Humanitarian Law (IHL) includes rules and regulations to defend and protect the aspects of humanity during war and conflicts. Its main aim is to establish a regulatory framework to provide relief and protection to the sick and wounded soldiers in armed conflicts, either International or Non-international.[1] Its aim extends to the providing of protection to the civilians from the impact of war by regulating the means and methods of war and the weapons to be used in such conflicts.[2] Protection to the civilians also include protection to those who are displaced during armed conflicts (mostly wars), generally

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1 THE SYRIAN REFUGEE CRISIS: REFUGEES, CONFLICT, AND INTERNATIONAL LAE, 5-7 (Al-Marsad, Democratic Progress Institute).

2 GEOFFREY COM, THE LAW OF ARMED CONFLICT: AN OPERATIONAL APPROACH (Wolters Kluwer Law & Business, New York, 2012).

known as refugees.[3]

Meaning of International Humanitarian Law

IHL is generally termed as the law of wars and its main objective is to regulate the conduct of war.[4] It positively provides protection to human rights of the non-combatants and civilians in war situations and negatively restricts the rights of the combatants by providing norms on the means and methods of warfare. The main foundations of IHL are- the Four Geneva Conventions and the Two Additional Protocols to the Geneva Conventions backed by several treaties and customs related to warfare.[5] Since refugees are mostly displaced due to war situations therefore the factors relating to refugees and their influences come under the domain of IHL.

Meaning of Refugee

A Refugee is generally a person who has been forced to leave his/her country of residence due to fear of being persecuted, war or violence. They are the people who most often face the fear of being persecuted on the grounds of race, religion, rationality, political opinion or membership in a particular social group.[6] From this we can conclude that following are the main reasons that in majority of cases leads to the situation where a normal citizen is forced to gain the status of a refugee-

a. Violence due to war,

b. Ethnic and Tribal conflicts,

c. Racial and other forms of discrimination,

d. For being a member of a particular political group,

e. Due to invasion of a rival country conducting inhuman tortures on native civilians, etc.

3 Olivia Dunn, *The Syrian Refugee Crisis: Making a Case for State Obligation and Humanity,* ROMAPO COLLEGE OF NEW JERSEY (Jun 01, 2020, 01:11 AM) https://www.ronapo.edu/law-journal/thesis/the-syrian-refugee-crisis-making-a-case-for-state-obligation-and-humanity/.

4 *Supra* note *3*.

5 Martti Koskenniemi & Paivi Leno, *Fragmentation of International Law? Postmodern Anxieties,* 15(3), LJIL (Jan. 15, 2020, 01:11 AM) https://doi.org/10.1017/S0922156502000262.

6 *What is a Refugee?*, UNHCR (Jan. 12, 2020, 02:17 AM) https://www.unrefugees.org/refugee=facts/what-is-a-refugee/.

Although the issue of refugees are stated above, the causes are very dynamic and multi-dimensional, they may differ from place to place or even from time to time. In most cases refugees are interchangeably referred to as 'Internally Displaced Persons (IDP)' but there is a huge difference between the two. Refugees are those who take shelter by crossing international borders while the IDPs are those who are forced to leave their residence but they don't cross the international borders rather they take shelters in schools, public places and so on. The reasons for people being internally displaced although are similar to those of refugees, but they might be different in most cases like for instance, environmental disasters like Tsunami, Flood Earthquake, etc. and therefore they might not come under the scope of IHL. While refugees are mostly forced to leave their land due to wars and conflicts.[7]

It is estimated that around the world nearly 67% of refugees are from the five countries-Syria, Afghanistan, South Sudan, Myanmar and Somalia. So, there is no doubt that Syria suffers from a huge problem of Refugees and also of IDPs. [8]

International Legal Perspective on Refugees

The subjects of protecting the Rights of the Refugees as well as of those who seek asylum have always been under consideration of both International Customary Laws as well as International Treaty Laws. Under the International Customary Laws, the Principle of Non-Refoulement and the provisions of Universal Declaration of Human Rights are recognized. Principle of Non-Refoulement means that no State shall force their Refugees to return back to their home State, where such Refugees can be subjected to torture and exploitations. The Principle further provides for right to life; right to freedom from torture, cruelty, inhuman treatments and other basic forms of human rights to the Refugees.[9] This Principle, besides forming a core aspect of the International Customary Laws on Refugees, has also been recognized under the Convention on the Status of Refugees, 1951 under Article 3 and Article 33.[10] While the Universal Declaration of Human Rights provides for respecting the human rights of all human beings merely on the ground of them being born as humans in

7 Martti Koskenniemi & Paivi Leno, *Fragmentation of International Law? Postmodern Anxieties*, 15(3), LJIL (2005) (Jan 15, 2020, 01:12 AM) https://doi.org/10.1017/S0922156502000262.

8 A GUIDE TO INTERNATIONAL REFUGEE PROTECTIONAND BUILDING STATE ASYLUM SYSTEMS, 15-19 (UNHCR, Inter-Parliamentary Union For Democracy For Everyone, 2017).

9 Vanya Verma, *Syrian Refugee Crisis and Its Implication on International Law,* IPLEADERS (Jun 01, 2020, 03:11 AM) https://blog.ipleaders.in/syrian-refugee-crisis-implications-international-law/emp/.

10 *Convention and Protocol Relating to the Status of Refugees,* UNHCR (Jun 02, 2020, 01:11 AM) https://www.unhcr.org/en-in/3b66c2aa10.pdf#zoom=95

this planet. This particular Declaration is the epitome of all legal sources for protecting the basic human rights as well as for recognizing majority of the International Customary Laws. Under Article 14(1), the Convention has given all human beings the right to seek and enjoy asylum in any country from persecution.[11] This particular provision is very important for all the Refugees in order to live a life with dignity since it entrusts upon all the States a corresponding responsibility of providing shelter to the Refugees within their countries rather than expelling them or returning them back to their home States.

Under the International Treaty Laws, the major source of Laws governing the Rights of Refugees originates from the Convention on the Status of Refugees, 1951 and the 1967 Optional Protocol.[12] The scope of this 1951 Convention was however initially limited to the Europeans who became refugees due to several instances that occurred prior to January 1951 but the Optional Protocol of 1967 made the provisions of this Convention applicable to all Refugees irrespective of any time deadline, thereby making it globally applicable. The Convention brought into existence the Office of United Nation High Commissioner for Refugees (UNHCR) with the main function to provide protection to the Refugees and to assist the Governments of the respective States in bringing solutions to the issues related to Refugees. This Convention has provided a multidimensional approach towards solving the issue of increasing Refugees across the globe which includes legal, political as well as ethical perspectives. Under its legal perspective, it seeks to provide an universal guideline for protecting the Rights of the Refugees; under its political perspective, it enables the States for establishing mutual corporation for sharing the burden of Refugees thereby recognizing one another internationally accepted principle of Burden Sharing and finally its ethical perspective is highlighted from the fact that almost 140 States have signed the Treaty accepting their responsibilities of protecting the Rights of most of the vulnerable sections of population that comes within the ambit of this Convention.[13] The Convention seeks to protect the Rights of the Refugees through several provisions, the approach of which can be categorized into three broad categories, via-

a. Naturalization and assimilation- under this approach the States are made responsible to allow the Refugees with the minimum facilities for getting assimilated within the State and they must be given access to valid documentation. No penalties on them shall be imposed for their illegal entry within the State territories and they shall be given access to the Courts of Law

11 Universal Declaration of Human Rights, 1948.

12 *Supra* note 9.

13 *Supra* note 10.

b. Access to Basic Services- under this approach the Convention has made all its signatories responsible for granting equal treatment as regards public services and assistance are concerned, to the Refugees in the similar manner as they are provided to the Nationals.

c. Employment- the Convention has also made the States responsible for granting the Refuges access to employment and access to Justice against any exploitations made on them in the same manner as they are provided to the Nationals.[14]

Besides these main International Laws on Protection of the Rights of Refugees, there are several other International Laws that more or less provides protection to such Refugees, some of which includes- The Geneva Convention of 1949 and the Additional Protocols that provides for extensive set of Rules protecting the humanitarian Rights of Individuals during the warfare. These set of Rules seek to provide protection to the civilians from the hostilities of war, who are not parties to the war and includes- health workers, aid workers, children, women, etc. and also to those who were involved in the war but later surrendered or got captured or injured or due to any other reasons has become non-parties to the hostilities. The Geneva Convention of 1949 was a combination of Four Geneva Conventions that were previously enacted while the two Additional Protocols strengthened the Rights of the Victims of both International and Non-International Armed Conflict respectively. There is a Third Additional Protocol that recognizes the Red Crystal with the same status as that of the Red Cross and the Red Crescent.[15]

Further there are several International Human Rights Laws that protects the Rights of the Refugees and the Asylum seekers from gross human rights violations like- The Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment also recognizes the Customary International Law of Non-Refoulement; The Convention on Rights of the Child where Article 2 provides the children of Refugees protection from discriminations, Article 3 provides for their best interests, Article 6 provides such children with the Right to life, survival and development, Article 12 provides them with the Right to be heard, etc.; the International Covenant on Civil and Political Rights also grants the Refugees with several Rights, like- Right of freedom from inhuman cruel treatment, Right to liberty of movement, etc. in whichever territory they reside; the International Covenant on Economic, Social and Cultural Rights provides such Refugees with the Right

14 *Supra* note 9.

15 *The Geneva Conventions of 1949 and Their Additional Protocols,* INTERNATIONAL COMMITTEE OF THE RED CROSS (Jun 03, 2020, 01:45 AM) hhttps://www.icrc.org/en/document/Geneva-conventions-1949-additional-protocols.

to have a minimum standard of living for having a proper physical and mental development including other Rights like Right to education; Similarly all Human Rights Conventions like- Convention on the Elimination of All Forms of Racial Discrimination; Convention on the Elimination of All Forms of Discrimination against Women; etc. seek to provide protection to different categories to Rights of the one or more classes of Refugees.[16]

Even Protection of the Rights of Refugees can be sought from the International Criminal Law, like the Rome Statute of International Criminal Court which provided that the International Criminal Court shall have jurisdiction for trying cases related to genocides, war crimes and all crimes that are against the very notion of humanity. This law seeks to provide protection to all human beings including Refugees from cross-border criminal offences, like forceful prostitution, sterilization, pregnancy, or any other like kinds of sexual violence. In the Judgements of International Tribunal for the Former Yugoslavia for Rwanda, activities like enslavement, rape, genocides, torture, etc. were declared as criminal offences against humanity. And based on such Judgements, the Rome Statute becomes relevant in determining the criminal activities that makes someone being excluded from the status of Refugee.[17]

Background of Syrian Crisis and its Impact on IHL

The Syrian civil war has a very long history and legacy, there is not a single cause that can be attributed to be the main cause of the war. However, the genesis of the war can be traced from 31 January, 1973 when Hafez al- Assad, the then President of Syria implemented a new Constitution whereby the condition that for being the President, one must be a Muslim was withdrawn. Since then many Muslim rival groups took arms against the government and started raising attacks to overthrow it. Later after the death of Hafez al-Assad in 2000, his son Bashar al-Assad became the President but most of his critics had opined that he failed to address any constructive reforms and to implement them. However, Assad later in 2017 opined that these protestants are merely Jihadis who were raising their voices against his secular democratic principles.[18] One another reason that can be attributed as a cause of this civil war is the huge socio-economic inequalities that mostly occurred due to the Free market policies introduced by Hafez al-Assad and then further accelerated by Bashar

16 *Human Rights and Refugee Protection (RLD 5),* UNHCR (Jun 01, 2020, 12:47 AM) https://www.unhcr.org/3aa5bd900.pdf.

17 *Supra* note 10.

18 Associated Press, *Rebels in Syria's largest city of Aleppo mostly poor, pious and from rural backgrounds,* FOXNEWS (Jan. 15, 2020, 01:47 AM) https://www.foxnews.com/world/rebels-in-syrias-largest-city-of-aleppo-mostly-poor-pious-and-from-rural-backgrounds.

al-Assad. Due to these open market policies, only a few nationals that belonged to the Sunni-merchant class having good relations with the governments were able to get jobs and maintain their families. While on the other side, there prevailed absolute poverty amongst the non-supporters of the government who later started joining the armed rebellion.[19] Moreover, the great immediate cause for this outbreak can be attributed to the massive and intense draught that occurred in 2008 and lasted till 2011 which led to several issues like-severe crop failure, increase in food prices, huge migration of farming families to urban centers that further increased the burden over the available resource stock, since lakhs of refugees from the Iraq war were already taking shelter there. This drought is alleged to be the result of anthropogenic global warming and it indicates that climate change which is an environmental concern is also a reason behind this war.[20] At last, the major reason behind this outbreak is the outburst of frustration amongst the Syrian citizens, since they were constantly restricted from exercising their basic human rights like freedom of expression, assembly, association, etc. They were all either curtailed by stringent measures or by repeatedly declaring emergencies.[21]

At present this crisis has led to gross human rights violations. The recent chemical attacks in a Damascus suburb has impacted millions of Syrian populations that has also led to the huge increase in the rate of migration of refugees in order to escape this inhuman action in 21st century civilization. It is not the only instance; in other words, it has been near about a decade that Syrian population is experiencing the other side of human civilization that we sitting at home cannot even dare to imagine. There is no doubt that now Syrian civil war has become the epitome of a humanitarian crisis. It is estimated that over 6 million people have been Internally Displaced and 5 million Syrian refugees have been relocated to neighboring countries. The people who want to flee from this war situation and to survive require medical support, pure drinking water, food and such other basic stuff, but unfortunately all these are rarely available.[22] In such a situation, it becomes difficult to decide, whether to die in war or to die in search for survival?

19 Rozanne Larsen, *Youth exclusion in Syria: Social, Economic and Institutional Dimensions*, JOURNALIST RESOURCES (Jan 15, 2020, 11:13 PM) https://journalistsresources.org/studies/international/development/youth-wxckusion-in-syria-economic/.

20 Francesco Femia & Caitlin Werrel, *Syria: Climate Change Draught and Social Unrest,* THE CENTER FOR CLIMATE & SECURITY (Jan. 15, 2020, 12:14 AM) https://climateandsecurity.org/2012/02/29/syria-climate-change-draught-and-social-unrest/.

21 Ian Black, *Human Rights Watch says virtually nothing has been done to improve human rights in 10 years of his presidency* THEGUARDIAN (Jan. 15, 2020, 12:13 AM) https://www.theguardian.com/world/2010/jul/16/syrian-human-rights-unchanged-assad.

22 Rahma Aburas, et al., *The Syrian conflict: a case study of the challenges and acute need for medical humanitarian operations for women and children internally displaced persons,* BMC MEDICINE (Jan 16, 2020, 01:23AM) https://www.mobi.ncbi.nlm.nih.gov/pmc/articles/PVC5946430/.

According to the United Nation High Commissioner for Refugees (UNHCR) the rate of Syrian Refugees will increase as the war progresses. But although the civil war is the primary reason for the suffering of Syrian Refugees, there are many other secondary causes that led to the massive suffering of these refugees.[23] First being that, due to the increase of birth rates in the refugee camps, the neighboring countries who initially gave shelter to these refugees are now facing shortage of resources to supply to their camps and even natives of those countries are not willing to adopt those refugees for which most of such countries are closing their international borders for these refugees, thus violating their obligations under the Convention of 1951. Second, since the war is still in progress the number of refugees is increasing as already mentioned.[24] In such a situation, it is obvious that refugee camps will be overcrowded. For instance, from the shelters in Idlib and Aleppo governorates many people had been forced to escape to safer place due to the ongoing war while many are still unable. Third, the refugees are still provided with some sort of reliefs by International Organizations and to some extent by neighboring countries, but the conditions of IDPs are even more pathetic since the governance of Syria has broken down for which they are mostly devoid of any security agencies and safety measures when war takes place and even in normal situations due to economic crisis they are unable to afford even the basic needs for their survival including healthcare facilities, education, etc. Further, the injured and disabled persons remain at the receiving end during war and even after the war.

Due to the war and emerging hostilities several infrastructures are also getting destroyed and those that are left undestroyed are wanting repair and so are in a non-functioning stage. For instance, the Allouk pumping station that was serving water to more than 400,000 people in and around Hasakeh, stopped functioning from 30 October, 2019. This water pump is very critical since it was used to supply water to more than 400,000 people. But its repairing is highly difficult since its servers are located near the front line where the hostilities are at the top. This is a great evidence, which proves that civilians who are not part of any hostilities are made to suffer without any of their cause.[25]

Further the health scenario is also pathetic. In most cities like in AI HoI, hospitals are failing to provide adequate facilities to treat the needy. Cases of malnutrition and injuries from weapons are mostly registered among whom many suffers from critical stages since they were not able to receive preliminary medical treatment, and this has made their situations

23 *Ibid*.

24 Sans Frontierers, *Unacceptable Humanitarian Failure*, MEDICINES SANSFRONTIERERS (Jan. 16, 2020, 01:17 AM), https://www.msf.org/syria-unacceptable-humanitarian-failure.

25 *Refugees and Displaced people in Syria,* ICRC (Jam 15, 2020, 01:11 AM), https://www.icrc.org/en/where-we-work/middle-east/syria/syrian-refugees.

even more difficult.[26] At one side resources are limited while at the other side many are unable to get access to whatever resources are available.

Among the millions of refugees, the majority are children, whose parents are in a dismal condition since while escaping the fear of death in their motherland, they are forced to enter a situation where they have only two alternatives- either to buy food for their children or to defend them from cold. While many such parents do not possess the money even to afford either of those alternatives. Most of such refugees take shelter in countries like- Lebanon, Iraq and Jordan but the residents and the refugees who are already there are suffering from severe conditions especially when the harsh winter arrives, since the present infrastructure is not enough to support all of them. Even it is estimated that around 2 million children have been devoid from going to school which shadows the future of the country besides affecting the present. Further, the children in the refugee camps had to work very hard like carrying water from distant places at the age of hardly 4-5 years in order to survive.[27] Most of the children in the refugee camps are suffering from physical and mental traumas created by this devastating war. Physical injuries however more or less may get healed with the passing of time but the fear is about the mental trauma that these children are undergoing. Most of them have experienced the emotions of losing their parents and are witnessing unprecedented violence In Front of their eyes and that also at the age when they should have been playing in kindergartens. Recently, UNICEF stated that over 500 children were injured or killed in this war in the first three quarters of 2019.[28] Such is the situation which makes a question relevant that if these children survive this phase of inhuman legacy then in the near future will they be able to live the life of a normal human being in this world?

As of January 2020, more than 380,000 people were killed in this war, as reported by Syrian Observatory for Human Rights. The death consisted of military personnel, government soldiers, armed rebel troops, and most importantly civilians including children.[29] While a report from SNHR in 2018 stated that 82000 victims were forcibly made to disappear by the Syrian regime which includes 14,000 confirmed deaths. Similarly, it is reported that girls of 6-8 years of age are brutally raped or converted to sex slaves while boys of same age group being tortured and are forced to conduct public killings.[30] In this year only, on January 1,

26 *Supra* note 22.

27 *Supra* note 24.

28 '*Children in Syria bearing blunt of intensifying violence*, UNICEF (Jan. 15, 2020, 11:12 PM) https://www.infomigrants.net/en/post/21848/children-in-syria-bearing-blunt-ofintensifying-violence-unicef.

29 *Syria death toll tops 380,000 in almost nine-year war: Monitor,* LIVEMINT (Jan. 16, 2020, 03:1 AM) https://www.livemint.com/news/world/syria-death-toll-tops-380,000-im-almost-nine-year-war-monitor-11578143112160.html.

30 Jamey keaten, *UN report lays out agonies faced by Syrian child amid war*, LOCAL 12 (Jan. 16, 2020,

eight civilians including four children were killed in a Rocket attack in a school in Idlib by Syrian government.[31] Nothing can be a better example than this about the violation of not only humanitarian rights but also internationally recognized principles of humanitarian law.

Role of Humanitarian Organizations

The International Committee of the Red Cross (ICRC), that is an international organization historically working for the protection of humanity in war as well as conflict situations, and which has also contributed to the development of the IHL, is requesting the warning parties to spare the civilians and their infrastructure. Further, the ICRC is recommending not to attack those who want to flee from the war and has prohibited attacks that are indiscriminate in nature and are on hospitals, schools, etc. They have further issued restrictions on indiscriminately firing of Rockets and Mortars that are blindly targeted into the urban cities from either side of the Front Line. [32]

ICRC along with the Syrian Arab Red Crescent (SARC), which is providing reliefs to the sufferers of this civil war, are extending their support to an Emergency Response Center providing for first aid reliefs and also a neonatal Intensive Care Unit within the pediatric hospitals in the Idlib city. The ICRC has also established two polyclinics and provided three mobile health units in Western Rural Aleppo serving the escapers of war from Idlib and nearby areas. ICRC and SARC together are striving hard to protect the IDPs and to make them survive by providing daily food and other stuff in the relief camps. For instance, a recent report of ICRC on January 03, 2020 provided that a collective kitchen organized by SARC with the assistance of ICRC has been providing food with a target of serving 37,500 newly emerged IDPs, while they had been able to provide only 7,500 household kits in the city of Idlib. [33]

Similarly, few other international groups and activists are helping these victims of war to make life a slight better than hell. For instance, on December 30, 2019 Ireland welcomed 50 Syrian Refugees including 27 children under the Irish Refugee Protection Program.[34]

03:1 AM) https://local12.com/news/nation-world/un-report-lays-out-agonies-faced-by-syrian-children-amid-war.

31 Matilda Coleman, *Four Syrian Children killed in New Year's attacks on School*, UPNEWSINFO (Jan. 16, 2020, 02:13 AM) https://upnewsinfo.com/2020/01/01/four-syrian-children-killed-in-new-years-attack-on-school-news-from-syria/.

32 *Supra* note 24.

33 *Ibid*.

34 Alison Bray, *Fifty Syrian Refugees promised the warmest of Irish welcomes*, HERALD.IE (Jan. 16, 2020, 02:13 AM) https://m.herald.ie?news/fifty-syrian-refugees-promised-the-warmest-of-irish-welcomes-

While on the other hand, there are many more left who are claiming that they have not received any assistance from any of the international or regional groups.

Conclusion

It shows that humanity has a lot to learn from what is happening in Syria. It must be taken as an example for addressing conflicts in the future in any part of the world. While from IHL perspective, it also shows that there is much to be developed in order to avoid a massive conflict in the near future particularly in this nuclear age. The IHL advocates more or less, will now have to adopt a two way approach- first a protective and defensive approach where the main agenda will be to provide relief to the victims of the Syrian war, to monitor and to condemn violation of humanitarian law and the second approach- prevention and deterrence approach where they must spread the lessons taught by this war through the passing time to the entire world fraternity so that a fear is created in the minds of the young generations, thereby proving as a deterrence, to avoid themselves from getting involved in such huge conflicts. It is the responsibility of all of us to adopt this dual approach by providing donations and assistance in whatever manner we can to those victims and at the same time we must also frame our opinion about their pathetic stories and must educate our upcoming generations about the consequences that such conflicts can lead to.

Fortunately, now we can hope that after seeing such devastating consequences, no political party in this democratic civilization would dare to undermine public opinion. Further, this might act as a great lesson for the governments to learn before drafting and enacting any policy against the majority. Moreover, it appears that such conflicts are merely the result of economic disparity which is again caused by improper planning and settlement. The Syrian crisis was fueled by the drought of 2008 which is attributed to be the result of climate change. All these indicate that in the near future humanity might seem to be fighting for every resource in the same manner since we all are aware about the present state of the global atmosphere. Every beginning has its end and every end has a new beginning, similarly we can hope that this Syrian crisis will come to an end and then will lead to a new beginning.

38823817.html.

RIGHT TO MARRY OF MUSLIM WOMEN ON DIVORCE : AN ANALYSIS

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Abstract

Divorce alters the status of married woman and can leave her destitute. The condition of Muslim women, especially the poor ones, is pathetic than the divorced women belonging to other communities for twin reasons; firstly, because of the husband's unilateral and private declaration of divorce; Secondly, after divorce she is entitled to claim maintenance for a limited period. Therefore, in such circumstances, remarriage is better option for her. However, remarriage is also not easy for a woman because of the stigma attached to the word 'divorce'. Thus, in such a scenario the law should be such that it encourages remarriage of divorced women. Therefore, in this paper, an attempt is made to analyze the grey areas, in the present Muslim law, as regards the right to marry of Muslim woman on divorce are concerned and also to provide suggestions for the existing grey areas.

INTRODUCTION

Divorce in '*vinculo matrimonii'* is a Latin phrase meaning divorce from the bond of marriage.[1] A kind of divorce of husband and wife dissolving the marriage tie; reverting the parties to their unmarried status from their matrimonial obligations and parties once again acquire the right to marry a person of their choice. It is different from 'an annulment' since it ends the marital status, whereas an annulment substantiates that a marital status never existed. It is also different from a *menso et thoro* which is a divorce from bed and board that means separation of parties by law, than a dissolution of the marriage.[2]

When the relationship between married couples runs aground, it is better to resort to the remedy of divorce for the welfare of the parties and family as a whole.[3] However, the

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1 BRYAN A. GARNER, BLACK'S LAW DICTIONARY, 1450 (8th ed. 2004).

2 *Ibid*.

3 Furquan Ahmed, "Muslim Law" LII ASIL 797 (2016), (May 30, 2020, 04:20 PM), http://14.139.60.114:8080/

segregation of family unit has always brought upheavals and vagrancy in the life of the Muslim women especially the poor ones, for two reasons; firstly, because of the unbridled and arbitrary power of the husband to pronounce unilateral talaq upon his wife; and secondly, after divorce, she is entitled to maintenance for a limited period called iddat, and then she is left to the vagaries of fate. Although, she can claim maintenance under Section 125 Cr.P.C., however, that too only if her former husband consents to it.[4] In such circumstances, the option of remarriage after divorce can be proved to be very helpful to protect her from destitution. Nonetheless, it is also true that after divorce, there are fewer possibilities for women getting married easily than men.

Table 1 below shows the divorce rate, according to Census 2011, in the Hindu and Muslim communities. The divorce rate is defined as the total number of divorces of males/females in a particular community during a specific year to the total married males/females of that community.[5] Thus, the divorce rate formula is;

"Divorce rate = D x K/P

Where D is the total number of divorces in one year, P is the population at risk of divorce and K is a constant 1000"[6]

Table 1- Divorce Rate in the Year 2011

	HINDU	**MUSLIM**
FEMALE	2.64	5.64
MALE	1.54	1.60
TOTAL	2.09	3.66

Source: Census of India 2011[7]

jspui/bitstream/123456789/43231/1/27_Muslim%20Law%20%28793-842%29.pdf.

4 S.N. MISRA, THE CODE OF CRIMINAL PROCEDURE, 1973, 136 (Central Law Publications, Allahabad, 17th ed. 2010).

5 CLIFTON D. BRYANT and DENNIS L. PECK (ED.), 21ST CENTURY SOCIOLOGY A REFERENCE HANDBOOK, Vol. 1, , (May 30, 2020, 04:25 PM); https://books.google.co.in/books?id=C6g5DQAAQBAJ&pg=PA277&lpg=PA277&dq=divorce+refined+ratio+formula&source=bl&ots=dYf1RLkXIN&sig=ACfU3U09ihSkEZ5NgYEwA59MqvQvmBLbDg&hl=en&sa=X&ved=2ahUKEwjPu6zQudjpAhUryjgGHXiPA8Q6AEwD3oECAsQAQ#v=onepage&q=divorce%20refined%20ratio%20formula&f=false.

6 *Ibid.*

7 C-3 Marital Status by Religious Community and Sex – 2011, (May 29, 2020, 01:04 PM), https://censusindia.gov.in/2011census/C-series/c-3.html.

Table 1 shows that the divorce rate is higher in the Muslim community than the Hindu Community. The divorce rate for Hindus is 2.09 and for Muslims is 3.66, which implies that there are 2 divorced Hindus per 1,000 married Hindus and there are 3.7 divorced Muslims per 1,000 married Muslims. Across gender, the gap is larger because most men remarry but women cannot, hence, the disparity.[8] There are 5.6 divorced Muslim women per 1,000 married Muslim women, while there are 1.60 divorced Muslim men per 1,000 married Muslim men. In the Hindu community, there are 2.64 divorced Hindu women per 1000 married Hindu women, while there are 1.54 Hindu divorced men per 1000 married Hindu men. This means that after adjusting population and marital status, Muslims are more likely to be divorced than Hindus, and Muslim women bear almost the whole burden of this difference.[9]

To skew the Muslim women's divorce rate and to save them from destitution after divorce, there is a need for improving the legal status of Muslim divorced women by the codification of Muslim personal law, in such a way that could broaden the range of their right to marry after divorce. Article 25(2) and Article 44 read with Entry 5 of the Concurrent List contained in the Seventh Schedule empower the state to regulate secular affairs surrounding religion and to enact measures of social welfare and reform.[10] Further, on this, Mohammad Ghouse[11] argued that in matters relating to marriage and divorce and other aspects relating to personal law, the state can validly enact measures of social welfare and reforms in the Muslim Personal law. Reforms so made and replacement so made of the Muslim personal law is valid and not unconstitutional.[12]

Presently, the matters relating to marriage and divorce are governed by the Muslim Personal law (Shariat) Application Act, 1937 (hereinafter called the Muslim personal law), which makes the principles of *Shariah* applicable on the right to marry of Muslim women after divorce. The rules governing the matters of marriage and divorce under the Muslim personal law, however, are not expressly codified and are, thus, governed according to the prevailing customs and usages. These customs and usages provide for certain impediments on the right to marry of Muslim women after divorce. In this paper, an attempt is made to

8 Yugank Goyal, *Hindu and Muslim: The True Picture Of Divorce*, (Mar 17, 2020, 12:25 AM) https://www.livemint.com/Opinion/ydCWT2mGxmg4d9NXrMaxEI/Hindus-and-Muslims-The-true-picture-of-divorce.html,

9 *Ibid*.

10 The Constitution of India, arts. 25(2), 44.

11 Mohammad Gouse, *Personal Law and the Constitution of India*, (Mar.17, 2020, 10:04 AM) http://14.139.60.114:8080/jspui/bitstream/123456789/736/15/Personal%20Laws%20and%20the%20Constitution%20in%20India%20.pdf.

12 *Ibid*.

analyze the right to marry of Muslim divorced women and the present impediments on the right to marry of Muslim women after divorce, as provided by the prevailing customs and usages and also to suggest some remedies.

Right to Marry as a Human Right

The right to marry and to form a family is a human right, universally recognised by all the civilized nations. As a human right, it occupies a significant place in the Universal Declaration of Human Rights (hereinafter called UDHR) passed by the UN general assembly on December 10, 1948. As per Article 16(1) of the UDHR, all men and women of full age, without any discrimination on the basis of race, nationality or religion, have the right to marry and to found a family. Further, it provides that the family being a natural and fundamental unit of society is entitled to be protected by the state.[13] Furthermore, it provides that the marriage shall be entered into by the intended spouses only with their free and full consent.[14] Besides this, similar provisions are contained under Article 23 of the International Covenant on Civil and Political Rights, 1966 (hereinafter called ICCPR). Whereby, Article 23(2) provides that the right to marry and found a family of all men and women of marriageable age shall be recognised. And, article 23(3) of the said convention provides that no marriage shall be entered into by the intended spouses without their free and full consent.[15] Also, in 1979, the UN general assembly, adopted a Convention for the Elimination of all forms of Discrimination against Women (hereinafter called CEDAW) which also contains similar provisions for women. The convention, vide Article 16, provides that the state parties shall take all appropriate measures to remove discrimination against women in all matters relating to marriage and family relations. Further, it specifically provides that the state parties shall ensure, on the basis of gender equality, the same rights to enter into marriage, to freely choose a life partner, and to enter into marriage only with their free and full consent.[16] India is a state party to these conventions and covenants and, as such, is bound to give effect to them. Further, Article 253 read with Entry 10 and 14 of the Constitution empowers the Parliament to make laws to give effect to the said Conventions.

13 Universal Declaration of Human Rights, 1948, art. 16.

14 *Ibid*.

15 International Covenant on Civil and Political Rights, 1966, art 23.

16 Convention on the Elimination of all forms of Discrimination against Women, 1979, art 16.

Right to Marry as a Constitutional Right

In India, every adult individual has a right to marry a person of his/her choice and form a family. In *Lata Singh v. State of U.P.*,[17] and in *Shakti Vahini v. Union of India and Others*,[18] the courts have recognised that an individual's exercise of choice in choosing a life partner is an integral aspect of the right to life and liberty, and therefore, is protected under Article 19 and 21 of the Constitution. In the *Shakti Vahini Case*, the court observed;

> "The petitioner is a major and was free to marry anyone she liked or live with anyone she liked. Since there is no bar to an intercaste marriage under Hindu Marriage Act or any other law, no offence was committed..."[19]

Further, the learned Justice observed;

> "[W]hen two adults consensually choose each other as life partners; it is a manifestation of their choice which is recognized under the constitution. Such a right has the sanction of the constitutional law and once that is recognized, the said right needs to be protected..."[20]

That means, for exercising the right to marry; firstly a person must be of the age of majority according to the law to which he is a subject; secondly, two adults consensually choose each other as their life partners; and thirdly, if such law creates a bar, then, he or she can remarry only after removal of that bar.

Right to Marry of Muslim Women on Divorce and Muslim Law

Under Muslim law, certain impediments are provided for contracting a valid marriage. A marriage in contravention of these impediments is either rendered void or irregular. Here we are concerned with impediments on the remarriage of a Muslim divorced woman and their effects on her second marriage.

Muslim Divorced Woman and Incapacity to Marry during *Iddat* Period

Iddat or *idda* may be defined as the period during which it is obligatory for a woman, whose marriage has been dissolved either by death or divorce, to remain in seclusion, and

17 *Lata Singh v. State of U.P.,* AIR 2006 SC 2522 (India).

18 *Shakti Vahini v. Union of India & ors*,, AIR 2018 SC 1601 (India).

19 *Ibid*.

20 *Ibid*.

to refrain from marrying another man.[21] According to Fyzee, the most suitable definition of *iddat* is 'the term, by the completion of which, a new marriage is rendered lawful'.[22] According to Section2(b) of the Muslim Women Protection of Rights on Divorce Act, 1986, the period of *iddat,* 'in the case of a divorced woman, is; (i) three menstrual courses after the date of divorce, if she is subject to menstruation; (ii) three lunar months after her divorce, if she is not subject to menstruation; and (iii) if she is enceinte, i.e., pregnant, at the time of her divorce, the period between the divorce and the delivery of her child or the termination of her pregnancy, whichever is earlier.'[23]

The purpose of imposing abstinence from marrying another man during iddat period is to ascertain whether the divorced woman is pregnant by the estranged husband or not, so as to avoid confusion of parentage.[24] Muslim personal law provides that if a woman undergoing iddat marries another man; her marriage would be rendered irregular under Sunni law and void under Shia law, as the Shia law does not recognize the difference between irregular and void marriage. Marriages, that are irregular under Sunni law, are void under the Shia law[25]

The Lahore High Court, at one instance, treated the marriage contracted during iddat period, under Sunni law, as void.[26] However, in *Mohammad Hayat & Ors. v. Mohammad Nawaz & Ors.*,[27] when again the question about the validity of such a marriage came up for consideration, the court held that a marriage contracted between Sunni parties, during *iddat* period, was only a *fasid* marriage and not *batil* and the children born of such a marriage were held to be legitimate.

Where a Muslim divorced woman remarries, while she is undergoing *iddat* period, the Muslim personal law prescribes the following consequences on her second marriage:

Under Sunni Law[28]

a) If her second marriage is consummated, then, on divorce; firstly, the woman would be entitled to proper or specified dower, whichever is less; secondly, even though the children born of such a marriage would be legitimate but it would not create mutual rights of inheritance between the parties.

21 Sir Dinshaw Fardunji Mulla, PRINCIPLES OF MAHOMEDAN LAW, 343 (22nd ed. 2017).

22 Tahir Mahmood (ed.), Outlines of Muhammadan Law 81 (5th ed. 2008).

23 The Muslim Women (Protection of rights on Divorce) Act, 1986, sec. 2(b).

24 *Supra* note 21 at 343.

25 *Supra* note 21 at 350.

26 *Supra* note 21 at 350, *Jhandu v. Mst Mussain Bibi ,* (1923) 4 Lah. 192.

27 *Supra* note 21 section 257(2*), Mohammad Hayat & ors v. Mohammad Nawaz & ors,* 1935 Lah 622.

28 *Supra note* 21 at 350.

b) If her marriage is not consummated then, no legal effects from such a marriage would flow on divorce.

Under Shia Law

(a) The second marriage of the divorced woman, while she is undergoing *iddat*, would not create any civil rights or obligation between the parties and;

(b) Children born of such a marriage would be illegitimate.[29]

The Waiting Period under Hindu law

Before 1976, the Hindu Marriage Act, 1955, by the proviso attached to Section 15, prohibited the parties to marriage from remarrying before the elapse of one year from the date of the decree of divorce from the court of the first instance till the date of their second marriage.[30]

One of the purposes, of the said prohibition, was to avoid the confusion as to the parentage of the child born. However, the said proviso was deleted by Section 10 of the Marriage Laws (Amendment) Act, 1976 on the recommendations of the Law Commission of India. The commission recommended that the considerations of the parties and the freedom to marry, available to parties, outweigh the object of the proviso.[31]

Muslim Divorced Woman and the Right to Remarry Former Husband until Nikah Halala is Performed

Nikah halala is made up of two Arabic words. Nikah meaning 'union of sexes' and in law it means 'marriage'. Marriage, according to Muslim law, is a contract for legalisation of intercourse and procreation of children.[32] Halala means 'halal' or 'to make permissible'. Thus, nikah halala is a practice to make a marriage permissible which has become forbidden. Remarriage between parties becomes forbidden as soon as talaq becomes absolute.

Before proceeding further it is necessary here to understand different kinds of divorce under Muslim personal law, as the practice of nikah halala is closely connected with it. Divorce,

29 *Ibid.*

30 MAYNE'S, TREATIES ON HINDU LAW & USAGE*, 417(*Bharat Law House, New Delhi, 17th ed., 2014).

31 Law Commission of India, 59th Report on *Hindu Marriage Act, 1955 and Special Marriage Act, 1954,* (March, 1974), at p.30.

32 *Supra* note 21 at 338.

under Muslim law, is divided into three categories; firstly, divorce which proceeds at the instance of the husband is called *talaq*; secondly, *khula* or *mubara'at* are types of divorce by mutual consent; thirdly, divorce by a judicial decree at the suit of husband or wife.[33] Divorce (*Talaq*) which is at the instance of the husband is of three types vis. *Talaq-e-ahsan*, *talaq-e-hasan* and *talaq-ul-biddat*. *Talaq-e-ahsan* is a single pronouncement of the formula of talaq by the husband during a *tuhre*, followed by a period of abstinence, which is called, *iddat*.[34] A talaq in *ahsan* mode becomes irrevocable and complete as soon as the period of iddat expires.[35] *Talaq-e-hasan*, is a form of divorce whereby the formula of talaq is pronounced thrice by the husband in successive *tuhrs* and no intercourse takes place during any of the three *tuhrs*.[36] Talaq in *hasan* mode becomes irrevocable and absolute on the third pronouncement, of the formula of talaq, irrespective of iddat.[37] Talaq-ul-biddat or triple talaq is pronouncing the formula of talaq thrice in single *tuhr*. It becomes irrevocable and absolute immediately on the pronouncement of the formula of talaq. As the talaq becomes irrevocable at once hence, it is also called *talaq-i-bain* i.e. irrevocable talaq.[38] The practice of triple talaq has been set aside by the Supreme Court on August 22, 2017 by a majority of 3:2.[39] Later, by passing the Muslim Women (Protection of rights on Marriage) Act, 2019, the Parliament has made it void and illegal.[40]

Khula is a divorce at the instance and consent of the wife, whereby, she offers or agrees to give consideration to her husband for her release from the marital tie.[41] As soon as the offer is accepted by the husband, it becomes *talaq-i-bain*.[42] *Mubara'at* is a divorce by mutual consent of both the parties. Herein, the offer may proceed at the instance of the husband or the wife, but once, it is accepted by either, it becomes complete and operates as *talaq-i-bain*.[43]

Ameer Ali says, 'When the power of reconciliation is lost, the separation becomes *bain* or absolute, while it continues, the talaq is simple *raja* or reversible.'[44] When a definite

33 *Supra* note 21 at p. 400.
34 *Shayara Bano v. Union of India*, LNIND 2017 SC 415 (India).
35 *Supra* note 21 at p. 408.
36 *Supra* note 21.
37 *Id*. at 409.
38 *Id*. at 408.
39 *Supra* note 34.
40 The Muslim Women (Protection of Rights on Marriage) Act, 2019, sec. 3.
41 *Supra* note 21 at 414.
42 *Ibid*.
43 *Ibid*.
44 SYED AMEER ALI, STUDENT'S HAND BOOK OF MOHAMMEDAN LAW, (S.K. Lahiri & Co.,

and complete separation takes place the parties so separated cannot remarry without the woman undergoing the formality of nikah halala.[45] However, the question which arises here is whether every irrevocable or absolute talaq creates a legal bar on remarriage and incumbents a wife to perform nikaha halala? To this the court, in Mrs. Sabah Adnan Sami Khan v. Adnan Sami Khan,[46] held that the formality of *nikah halala* was not necessary in the case where the husband had repudiated his wife by *ahsan* or *khula* mode. It is only in the case, when, the husband has repudiated his wife by pronouncing three *talaqs* against her, as in the case of *talaq hasan* and *triple talak*, it is not lawful for the couple to remarry again unless; firstly, the divorced wife observes *iddat* of divorce; secondly, she marries someone else; thirdly, the marriage is actually consummated with the other husband; fourthly, the latter husband has divorced her or dies after actual consummation of the marriage.[47]

The rule was framed to limit the husband's proclivity to pronounce *talaq* in Arabia. The check was intended to control a jealous, sensitive, but half-cultured race, by appealing to their sense of honors.[48]

Consequences of the Practice of *Nikah Halala*

A marriage performed in contravention of the formality of *nikah halala* is irregular and not void.[49] However, courts in pre-independence India have taken a different discourse as in *Saiyid Rashid Ahmed v. Anisa Khatun*,[50] case. The facts of the case are that the plaintiffs were the brother and sister of the Ghiyas-ud-din, who would have been the heirs, if respondents no. 1 to 6 were unable to establish their claim to be a widow and legitimate children. The dispute is related to the succession to the estate of Ghiyas-ud-din, a Muhammadan, who died on April 04, 1920. On September 13, 1905 he pronounced the triple talaq in the presence of the witnesses, though in the absence of his wife. Though, the later received Rs. 1,000/- as payment of her dower on the same day for which a registered receipt was produced. There was also prepared a *talaqnama*, a deed of divorce on September 17, 1905. Anisa Khatun, respondent no.1, challenged the validity of divorce on two grounds that the divorce was pronounced in her absence and second that after as husband and wife for fifteen years and five children were born to the couple. Thus, Ghiyas-ud-din did not

Calcutta 6th ed. 1912).

45 *Ibid*.

46 *Mrs. Sabah Adnan Sami Khan v. Adnan Sami Khan,* AIR 2010 Bom. 109 (India).

47 *Supra* note 20 at 83, 124; *Mrs. Sabah Adnan Sami Khan v. Adnan Sami khan*, AIR 2010 Bom.109 (India)

48 *Supra* note 45.

49 *Supra* note 20 at 430.

50 *Saiyid Rashid Ahmed v. Anisa Khatun*, AIR 1932 PC 25 (India).

intend to divorce her. The Privy Council held that triple talaq pronounced in the absence of wife by Ghiyas-ud-din was valid and immediately effective. The validity and efficacy of the talaq would not be affected by Ghiyas-ud-din's mental intention. Further, since the respondent had not undergone *nikah halala* after divorce, the Privy Council held that she was not legally married to Ghiyas-ud-din and the children born were held to be illegitimate, resulting in the rejection of her claim for succession.

Again, in *Mrs. Sabah Adnan Sami Khan v. Adnan Sami Khan*,[51] the husband of the woman tried to misuse this practice against the claims of the wife. However, the court held that the formality of *nikah halala* was not necessary in the case where the husband had repudiated his wife by *ahsan* or *khula* mode.

Nikah Halala: An International Perspective

Mahmood, in 'Muslim law in India and Abroad', said that the laws in Egypt, Iran, Jordan, Kuwait, Morocco, Philippines, Sudan, Syria, USE and Yemen, had totally derecognized the concept of triple talaq... the so-called device of halala for legalizing remarriage between the parties, which required wife's intervening marriage to someone else and subsequent divorce from him, also stood abolished in these countries.[52]

On Remarriage Mother Loses the Right to Custody (hizanzt) of Minor

Under Muslim personal law, the right of the mother to the custody (*hizanat*) of the child is greater than the father. She is entitled to the custody of her male child till he attains seven years of age and her female child until she has attained puberty.[53] This right of a mother to the custody of her minor male/female child continues, although she has been divorced by the father of the child.[54] However, the mother, upon remarriage with a person stranger to the child, forfeits her preferential right to the custody of the minor child.

In *Mir Mohamed Bahauddin v. Mujee Bunnisa Begum Sahiba*,[55] the question before the Madras High Court was, whether, by the reason of marriage to a stranger, the mother loses the right to continue to have the custody of the minor child? The Court held that the custody of the child could not be given to a woman, who had married a second husband, as

51 *Mrs. Sabah Adnan Sami Khan v. Adnan Sami Khan,* AIR 2010 Bom. 109 (India).

52 TAHIR MAHMOOD*, MUSLIM LAW IN INDIA AND ABROAD*, 145, (Lexis Nexis, Delhi 2nd ed. 2016).

53 *Supra* note 20 at 446-447.

54 *Ibid.*

55 AIR 1951 Mad. 280 (India).

it was not possible for her to take care of the child and look after her well being. Further, the court observed that the mother of the child was firstly answerable to the husband and took care of his comforts before she could invest time for her child. Furthermore, the court observed that where there was a father who was not totally unsuitable or there were other relatives who could take care of the child, the mother, who had remarried, was not at all the person to whom the custody should be given. Again, in *Arafathunnisa v. T. I. Zeeyavudeen, Taraja Beevi and Mohammed Yasin*,[56] the Madras High Court, while deciding a similar question, observed that if a woman married a person who was not related to the child within the prohibited degree i.e. a stranger, then, as per the Mohammedan Law, she was disqualified to have the custody of the child and therefore, the court held that, though under the Mohammedan Law, she was entitled to have the custody of her girl child, till she attained puberty, as, she had married a stranger, therefore, she was not entitled to have the custody of the child.

However, the Bombay high court, in *Irfan Ahmed Shaikh v. Mrs. Mumtaz*[57], observed that there was no hard and fast rule under Mohammedan law that the mother became disqualified for the custody of her minor child, the moment she married a stranger regardless of the wishes and welfare of the minor child. The court, further, observed that in such cases the court must see the treatment to be met out to the child at the hand of her stepfather, with whom the mother had remarried. So also, the Andhra Pradesh high court, in *Saiful Islam Habeeb Ali v. Asma Begum*[58], held that the mother, who had married a second husband, was entitled to the custody of the minor child, as the child expressed her desire to stay with the mother only. Further, the court observed that solely based on the personal law, the father could not claim custody of the child since it is settled that in case of conflict between the personal law and the consideration for the welfare of the child, the latter should prevail over the former.

56 *Arafathunnisa v. T. I. Zeeyavudeen, Taraja Beevi and Mohammed Yasin*, (May 19, 2020, 12:25 AM) https://indiankanoon.org/doc/1429323/

57 AIR 1999 Bom 25.

58 Saiful Islam Habeeb Ali v. Asma Begum (A.P.)(D.B.) : Law Finder Doc Id # 502869, (May 31, 2020, 09:00 PM) https://www.lawfinderlive.com/Judgement.aspx?v=3n8ya6tOyaEIFYyx1n4feYc6Yq9yADGuQLat%2bMEuws4wd2vBKwBllKDlD26oLm5QE1BPCmkW%2f88zvrwWqtyyp8pCdmTrpVMvWqdmV%2fvZOZLDF5PiN89UMMSm20j9RGDyF1He0hioRRUZrj3Cfy0xN%2fgLld4tc13OjraJEQ6myPiVYA7TQypOZ6XFN9ykIesYUhpUqMBGm0ul99lcvZKtzm80XTPpPDdsmnmpWFLHi7KTJeMBmylakIZV4xybFgNigb%2botg2XdGHdOnmxfXiNSzXaVGXMV0rqcs0M9XmaU4TISQmY7BtIlrNRANYYd%2fkN2vuOnOoYukB3%2b8EJbcTbRksYjA9q%2bnG4E%2bOWztJiF8VqcqGb201rwPAqwXdb1OrOqVPMJ5RcYJTwG%2fo%2fShA7%2bQcc%2fv4K3oWDzqyqkjBWoXIAXO%2fRlwYHmF9B1l%2by8iaHpeRwKAgQrEFnWylJh6r64vhfmEeUMmm9bKHXoGFGibo%3d.

Therefore, it is evident that the Bombay and Andhra Pradesh high court went beyond the dictates of the Muslim personal law in a case where the minor child was capable of expressing himself/herself, however where the child could not express his/her wishes, as in case of Mir *Mohamed Bahauddin v. Mujee Bunnisa Begum Sahiba* and *Saiful Islam Habeeb Ali v. Asma Begum*, the Madras high court did not go beyond the dictates of Muslim personal law, that disqualifies a mother, upon marriage, of her right to custody.

Muslim Women's Right to Custody of her Children upon Remarriage: An International Perspective

Today, almost all Muslim countries follow traditional *fiqh* rules, which divide the functions of parents into that of a custodian and guardian. The custodian is, generally, the mother of the child, who is responsible for the physical care and upbringing of the child up to a certain age, and the guardianship always rests with the father, who has the duty and authority over financial matters of the child. However, if the mother, after divorce, marries a person who is not a close (*mahram*) relative of the child, she forfeits her preferential right to custody of the child. In some Muslim countries, this traditional *fiqh* rule is considered as discriminatory against women and to grant the mother of her right to remarry, without the fear of losing custody of her children, has been modified by the statutory laws.

In Iraq, a mother has a preferential right to the custody of her children, as long as, it is in their interest. Article 57 of the Personal Status Law, 1959 has increased the maximum age to 15 years to which a mother is entitled to retain the custody of her children. After 15 years of age, a child himself can choose with whom he wants to stay.[59] Furthermore, before 1986, the mother used to automatically lose her right to custody of her children upon remarriage with a person not related to the child. To guarantee the mother's right to have a happy marital life, the legislator intervened in 1987 to repeal and redraft para 9b and 2 of Article 57 of the law. Now after 1987, vide article 57(2) of the law, the right to custody of mother remains valid after her marriage, provided, inter alia, that the court is satisfied that no injury would be caused to the child.[60] In case of a dispute between the father and the mother, regarding the custody of the children when the mother has remarried, the court is expressly empowered to decide the matter in the interest of the children.[61]

59 Article 57(5) of the Personal Status Law of 1959, (Aug 06, 2020, 04:30 PM) https://www.refworld.org/pdfid/5c7664947.pdf.

60 Article 57(2) of the Personal Status Law of 1959, (Aug 06, 2020, 04:30PM) https://www.refworld.org/pdfid/5c7664947.pdf.

61 *Ibid*.

In Morocco also, upon divorce, the mother has a preferential right to the custody of her children until the children attain the age of 15 years.[62] Upon the completion of the age of 15 years, a child himself is entitled to decide with whom he wants to stay. Further, a mother may forfeit her right to custody of her child, if she remarries a person, who is not within the prohibited degree of relationship or who is not a legal representative of the child.[63] However, Article 175 of the code provides certain circumstances in which the remarriage of the custodian mother does not result in the loss of the custody of her children, i.e., if the child is under 7 years of age or if such separation would inflict harm on him; if he suffers from some illness or is handicapped; or if she is the legal representative of the child.[64]

In United Arab Emirates (UAE) also, a mother has the preferential right to the custody of the child, after her, the father, then the maternal grandmother, then paternal grandmother and so on. A mother is entitled to the custody of her male child until he attains the age of 11 years and the female child until she attains 13 years of age.[65] However, the court is expressly empowered to increase the prescribed age limit in the interest of the child. Further, Articles 143 and 144 of the law provide certain conditions upon which a custodian may be disqualified from the custody of the child. Although, Article 144(1) of the law, inter alia, provides that a mother may forfeit her right to the custody of her children if she has married a person not related to the child, but the law also specifically states that the court is empowered, in such a case, to decide otherwise in the interest of the child.

Thus, Iraq, Morocco, and UAE, by way of codification of the rule, that the mother will not *ipso facto* lose her right to custody of her children and by expressly empowering the court to decide in the best interest of the child, have not only protected the right of the mother to remarry a person of her choice but also has gone beyond the dictates of traditional *fiqh* rule which denies the custody of the child to her in case she marries a person not a close relative of the child.

Conclusion and Suggestions

The rules and customs, discussed above, are centuries old and these should be changed keeping in view the changing needs of the society. Social reforms should be brought in the

62 Article 166, the Moroccan Family Code (Moudawana) of February 5, 2004, (Aug 05, 2020, 04: 45PM) http://www.hrea.org/wp-content/uploads/2015/02/Moudawana.pdf.

63 Article 174, the Moroccan Family Code (Moudawana) of February 5, 2004, (Aug 05, 2020, 04: 45PM) http://www.hrea.org/wp-content/uploads/2015/02/Moudawana.pdf.

64 Article 175, the Moroccan Family Code (Moudawana) of February 5, 2004 , (Aug 05, 2020, 04: 45PM) http://www.hrea.org/wp-content/uploads/2015/02/Moudawana.pdf.

65 Article 156(1), Federal Law No. (28) of 2005 On Personal Status, (Aug 05, 2020, 03:30PM) https://legaladviceme.com/legislation/140/uae-federal-law-28-of-2005-on-personal-status.

present Muslim Personal law by way of codification, to ameliorate the plight of Muslim divorced woman and to save her from destitution. Thus, it is concluded and recommended that;

1. The rule relating to the waiting period, under Muslim law, has twin purposes; firstly, to allow parties to reconcile within iddat period of three months; secondly, to know the paternity of the child in the womb, if any. Hence, it is recommended that the period of waiting should be reconsidered, in case of iddat period running beyond three months, as the same is required for knowing the paternity of the child. Moreover, a similar provision under the Hindu Marriage Act, 1955, has been deleted keeping in view the freedom of marriage available to the parties to the marriage. Secondly, with the advancement of modern medical techniques of blood test and DNA testing, now, it is easy to determine the paternity of the child. Also, the courts in India have started using these methods for determining the disputed paternity of the children.[66] Further, the law commission of India has also recommended to include blood test and DNA testing methods as proof of paternity in addition to the non-access rule under Section 112.[67]

2. Nikah Halala: The practice of nikah halala is necessary in case of triple talaq and talaq-e-hasan. Since, the practice of triple talaq has been declared void and illegal by the Muslim Women (Protection of Rights on Marriage) Act, 2019, the Muslim women would be considered as a legally wedded wife, and would not be required to undergo the formality of nikah halala. As far as, the practice of nikah halala in the case of talaq-e-hasan is concerned, the practice restricts a Muslim divorced woman's right to marry her former husband, thereby, restricting her right to choose her life partner. It is, not only, against her human right to marry and found a family, as enshrined under Article 16(1) of Convention on Elimination of all forms of Discrimination against Women, but also, against her right to autonomy and dignity as envisaged by the Constitution under Article 19 and 21.[68] In *Navtej Singh Johar v. Union of India*,[69] the court observed;

   "[A]utonomy establishes identity and the said identity, in the ultimate eventuate, becomes part of dignity in an individual."

66 *Radhey Shyam v. Pappi*, AIR 2007 Raj 42, *Vandana Kumari v. P. Praveen Kumar*, AIR 2007 AP 17 (India).

67 The Law Commission of India in 185th Report on the Indian Evidence Act, 1972 (March, 2003).

68 *Supra* note 15.

69 AIR 2018 SC 4321 (India).

Thus, the practice is against her right to autonomy, which in turn is against her dignity. Under Article 51-A (1) (e), the state is duty-bound to renounce practices that are derogatory to the dignity of the women. Therefore, it is recommended to abolish the practice of nikah halala by making an appropriate law.

3. On remarriage, the mother loses the right to custody of minor: Although, the paramount consideration, in custody cases, is the best interest of minor children, but the remarriage of the Muslim mother should not be a ground for depriving her of her parental right of custody. She should be treated as a normal and independent woman. This practice restricts a mother's right to marry on divorce, guaranteed by the Constitution, by creating a threat of losing the custody of her children. Further, it is also violative of her human right to equality, in matters relating to marriage and family, as enshrined under Article 16(1)(d) of CEDAW, which provides for the same rights and responsibilities of men and women in matters relating to custody of children, irrespective of their marital status. The law commission of India has also highlighted the need for reconsideration of this rule as it would easily create a bias against the mother.[70] Besides, Iran, being a Muslim country, has also abolished this rule by expressly codifying that a mother does not forfeit her right to custody after remarriage. Therefore, it is recommended to reconsider this rule.

70 The Law Commission in Consultation Paper on Reform of Family law (August 31, 2018) at page 78 para 3.50.

INDIA'S CALL ON SCIENTIFIC CRIMINAL INVESTIGATIONS

B. Yamuna Saraswathy* and R.B. Rishabh**

Abstract

"Most Indian investigators work towards getting a confession rather than investigating the case. It is the easiest way to get a conviction in court – and the laziest."

Avirook Sen, Aarushi

Law is adaptive in nature so as to keep in nexus with the transforming social order. Law is being interpreted by the judiciary and so the judiciary must be kept updated with the various advancements occurring in the society. Gone were those days where criminals had no access to the technology and criminals today are the ones who take up sophisticated and contemporary means to commit crimes. This shows that there is a need to crack them down using equivalent scientific/ psychological tests. The constitutionality of the scientific tests like polygraph, P-300, narco analysis are in question because during the recent times these tests have been gaining judicial acceptances, which it did not previously receive. So now there is an exigency for serious consideration regarding its constitutional validity from the perspective of human rights.

Keywords*:* Article 20(3), Criminal investigation, P-300, Polygraph, Narcoanalysis.

INTRODUCTION

The basis of law is justice. The criminal law has got a major role to play in every civilized society in the world. The presence of criminal law provision can be seen among the citizens of the state in his day-to-day living. Still, the Indian criminal law is not found to be up to the mark. The investigation by the police forms the foundation of the Indian criminal justice system. The duties of the police are to investigate the matter, ascertain the facts, compile

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their conclusions and then present the whole to the court to figure out whether the person accused is guilty or not. Nowadays getting bail for a criminal case is not regarded as a big deal. So there are a number of cases wherein the person accused has been acquitted due to lack of evidence and the person who had suffered the trauma is left helpless. The trial judges do not hold an upper hand in the criminal justice system because they have to only rely on the conclusions or materials presented before them by the police. Therefore if the investigation methods applied are not up to the standards, if the witnesses become pugnacious, if there are no enough evidence or zero evidence, the judge presiding the trial is left with no other option other than to give the person accused the 'benefit of doubt' because law generally requires proof and confirmation beyond reasonable doubt. In India, the main problem is that there are many to defend the rights of the accused but no one to think about the victim. Criminals nowadays have been incorporating or applying hi-fi and sophisticated techniques to commit the crimes. The police often resort to third degree methods during police investigations to extort the truth from the criminals. India of all countries being a civilized society and governed by the principles of rule of law cannot permit such methods. The principle which India has been following is that 'evil cannot be destroyed by another evil' in any case. Therefore, all the methods adopted by the police in interrogations must be well within the permissible limit provided in the legal frameworks. Thus, the investigators nowadays seek the help of scientific evidence as it combines both science and law. They incorporate a number of scientific techniques like polygraph, brain mapping and narco analysis etc. in order to extract the truth from criminals in extraordinary cases. The fundamental principle in applying all these scientific methods is to promote the rule of fair play, unbiased approach and use these scientific evidences both by investigators and forensic experts.

Crime detection has turned to be easier due to the application of forensic science. Forensic science is regarded as a powerful soldier in the army of justice administration. When an investigation seems to be weak, forensic science acts as a strengthening agent of such investigation. The needs of forensic science have arrived because criminals are clever enough these days that they hardly leave any evidence to catch them. In *Som Prakash v State of Delhi*[1], polygraph, P-300 and narco analysis were stated to be the rebellious tools of forensic science but prove to be very beneficial in criminal investigation.

1 *Som Prakash v. State of Delhi*, AIR 1974 SC 983 (India).

Scientific Tests and their Validity:

P-300

P-300, which is also known as brain mapping is used as an interrogative method on criminals in the recent era. Here the subject is made to wear a headband with sensors and electrodes with the help of a physician mostly a neurosurgeon. These electrodes help in detecting the Multifaceted Electroencephalographic Response (MERMER) emitted from the subject's brain. MERMER is a mere brain wave emitted by the subject when he recognizes something said or shown to him in his memory. Hence it is clear that the electrodes will not detect any MERMER from subjects who does not have any related memory i.e., innocent persons. These brain waves are recorded with the help of EEG-ERP Neuro Scan Recording system which will later be studied and analysed by a neurosurgeon. The results thus arrived will help the investigation process and in collection of any evidence. It is crucial to note that this test does not involve any oral response from the subject.

Polygraph

Polygraph or a lie detector uses the psychological variations in the subject's body to analyse him. In this method, the psychiatrist attaches various probes on the subject's body which detects the variations in his heartbeat, blood pressure, pulse rate, skin conductance etc. It is believed that when a person lies he becomes nervous and his heartbeat, pulse rate increases as a result. For this purpose, a base line of the subject's psychological character is determined and then the interrogative questions are asked. So, any variation from such baseline will lead to the fact that the subject has lied in the specific interrogation. It is notable that this test does not involve any direct invasion in the subject's body.

Narco Analysis

Narco analysis also known as truth serum is one of the controversial scientific investigation methods. In this method, 3 grams of sodium pentothal is mixed with 3000 milliliters of distilled water and then administered in the subject's body along with 10% of dextnose for a period of three hours with the help of anesthetist. In medical terms, the drug injected exposes the neural membranes in brain to chloride ions which results in inhibition of the subject. This mixture kind of hypnotises the subject and makes him attain a stage where he cannot repress any of his emotions or facts while the interrogation is made. In layman language it can be said that the subject attains a drunken stage because of this sedative drug. Hence it is easy for the officers to extract truth from the subject which will help their investigation process. As said earlier, it is one of the controversial methods because

it involves direct invasion of drug in the subject's body. Any misstep in the mixture or dose level will lead the subject to comatose stage or even death. This can be said as a sophisticated barbaric method used by the investigation officers.

Constitutional Validity

During the past few years, the investigation methods have seen a shift from third degree interrogations to scientific methods. The officers nowadays are keen in extracting the truth using their wits rather than their fists. But the question here is, won't it amount to self-incrimination if the statement is made by the subject himself with the help of scientific investigations? This attracts the question of legal validity under Article 20(3) of The Constitution of India[2]. The article runs as follows: "No person accused of any offence shall be compelled to be a witness against himself". Thus, any statement made under these scientific tests will be considered as testimonials and not taken as an evidence as it attracts bar under Art. 20 (3). It is also significant to note that mostly every country around the world entitles its citizens the right to remain silent. Similarly, in India the witnesses and accused are protected by the law from self-incrimination. This part analyses the extent of legal validity of such scientific tests.

Polygraph and P-300 uses only probes and electrodes and does not involve any direct invasion. The investigation is made only with the help of analysis given by the doctors after getting the psychological reports of the patient. In these tests, the subject doesn't even give any oral responses while the investigation is made. Thus, there are no statements made by the accused and what is not said cannot be considered as a statement. The bar on self-incrimination is attracted only when there is a statement. Therefore, there is no reason to stop using this kind of scientific methods. The courts in India have acknowledged polygraph and P-300 as constitutionally valid scientific tests and the reports or analysis made from such tests can be used as evidence before the court of law.

As of narco analysis, it is still controversial as it involves administration of drugs into the subject's body. In this test the mental state of the subject is compromised with the help of sedatives as discussed above. The important question that should be considered in narco analysis is the consent of the suspect. Under Indian Laws, every human has the right to presumption of innocence and therefore forcing to undergo the narco analysis test would result in intrusion of privacy. Furthermore, while considering the legal validity of narco analysis, it is pertinent to take into account that an oral statement is made by

2 INDIAN CONST. art. 20(3).

the subject during the test which in the end might result in self-incrimination. Some high courts in India have upheld the validity scientific tests including narco analysis in cases like *Ramchandra Reddy v. State of Maharshtra*[3], *State of Bombay v. Kathi Kalu Oghad*[4] and *Nandhini Satpathy v. P.L. Dani & Anr*[5]. The constitutional validity was given in these cases because of the view that the legal permission got before the test is conducted does not amount to self-incrimination. However, the recent judgment of three judge bench consisting of the then Chief Justice K.J. Balakrishnan, Justice R.V Ravindranan and J.M. Panchal of the supreme court of India held narco analysis as unconstitutional and violative of Article 20(3) in the case *Smt. Selvi and Others v State of Karnataka*.[6] To that end, narco analysis is unconstitutional in India as of now. Nevertheless, it can be used for helping the investigation process and in collecting evidences.

Evidentiary Value

The Indian Evidence Act, 1872[7] regulates the confessions and admissibility of evidence before the court of law. A material or confession to become evidence must fulfill various factors and the court may either accept or reject such evidence. Section 24 to 30 of this act provides for admissibility of confession by the courts. These provisions clearly provide that any confession made in an unstable mental state or by way of inducement or threats cannot be accepted as evidence by the courts. Therefore, it is clear that any statement made by the accused during narco analysis test cannot be accepted as evidence because it is made under the inducement of narcotic drugs and the accused will not have a stable mind in such cases. This stand was taken in the *Smt. Selvi case*[8] where the Supreme Court decided narco analysis to be unconstitutional and not legally valid even if the consent of the person is attained by the authorities before such test is conducted. The narco analysis test also attracts bar under other criminal laws such as Indian Penal Code[9] and Criminal Procedural Code.[10] As per Sections 352, 323, 324, and 328 of Indian Penal Code, inflicting hurt to extort information or inducing any dangerous drugs in a person's body is a serious offence which is punishable under the court of law. This makes narco analysis a legally invalid scientific investigation method under all the criminal laws of the country. However, Section 45 of the

3 *Ramchandra Reddy v. State of Maharshtra*, Cr. L.J. July 2006 P.2401 (India).
4 *State of Bombay v. Kathi Kalu Oghad,* AIR 1961 SC 1808 (India).
5 *Nandhini Satpathy v. P.L. Dani & Anr,* AIR 1978 SC 1025 at 1032 (India).
6 *Smt. Selvi and Others v. State of Karnataka,* AIR 2010 SC 1974 (India).
7 The Indian Evidence Act, 1872 (India).
8 *Supra* note 7.
9 The Indian Penal Code, ACT NO. 45 OF 1860 (India).
10 The Criminal Procedural Code, ACT NO. 2 OF 1974 (India).

Evidence Act allows expert opinion in certain cases which makes the reports of scientific investigation methods such as polygraph and brain mapping a valid one.

Highlights and Challenges of Scientific Investigations

The polygraph and brain mapping tests are similar in some ways. Both tests need a well-trained doctor and equipments or machines to analyse the activities of the subjects. The polygraph uses probes on the subject's body whereas the brain mapping uses electrodes on the subject's brain. But in the end both the tests analyse the psychological behavior of the subject only. The highlights of these tests are that they do not involve any threat to the subject's health as there is no direct invasion in the body. Furthermore, the reports can be used as evidence before the court of law as it is constitutionally valid. Nevertheless, these tests are not free from shortcomings. The reliability of these tests still remains to be a questionable one. A person can easily deceive the polygraph test by knowing the tactics of the interrogations made. The person undergoing the test shall remain calm by having a stable mind which will not affect his polygraph report. On the other hand, an innocent may become a victim of the polygraph test due to his apprehension towards such test which in turn will give a false report. As in the case of brain mapping, it involves a huge amount of money to conduct these tests and the reading of such reports is not always easy which might end in misreading by the doctors.

In this ever growing scientific age, the investigators opt to use narco analysis rather than polygraph or brain mapping as it highly helps in the interrogation process even though it cannot be produced as evidence before the court of law. The drawbacks of narco analysis are lot more than that of the other tests. Firstly, this test has a high probability of affecting the subject's health. Any wrong mixture of the sedative can lead the person to comatose stage or even death. It is to be noted that the level of dosage depends on the subject's health conditions and varies from person to person. Thus, there is a high degree of going wrong in the mixture. Furthermore, it is not worthy to put a person's life at stake for a scientific test which cannot even be used as evidence in courts. Secondly, it is not proven that the statements made by the subject under the test are factual and truth. This is because; when a person is at inhibition stage it is not certain that he only speaks the truth, he can also talk about any fantasy of his own regarding the questions asked. Hence the reliability of narco analysis test is considerably low. Finally, even though narco analysis is a sophisticated scientific test, it is still being considered a form of third degree torture in psychological aspect.

Conclusion

The state governments and central authorities in India work in a correlated manner. Working in such a correlated manner has enhanced the investigative capabilities of police department. It is evident that in India there is a very low criminal conviction rate[11] and the situation needs to be checked on. These scientific techniques would be very helpful in bringing out the truths from the criminal thereby increasing the conviction rate. In *Aarushi murder case*[12], *Nithari killings case*[13], *Telgi scam*[14] and *Mumbai Bomb blast case*[15], the scientific criminal investigation methods were used which hastened the justice. Various courts in India have given judgments favoring these tests. Nowadays, as we already mentioned that the criminals have been using science and technology in performing their criminal offences has now compelled the drafters to rethink on the part of criminal justice to seek the help of scientific community in helping the investigators and the courts. To add on, the provisions in the evidence act which are more than a hundred years old are now found to be inadequate in today's rapidly growing science and technological world. Mostly these tests have been carried out only in high profile cases. Slow and steadily these scientific tools of investigation can become a legal alternative to the third degree physical torture while in police custody. In *D.K. Basu v. State of West Bengal*[16] the Supreme Court has rightly held that there is an urgent need to develop scientific tools of investigations and interrogations because torturing the accused by using third degree methods is nothing other than a huge hit at the principles of rule of law.

Suggestions

1. A clear policy must be enacted by the parliament regarding the scientific investigation methods inculcating the standards to be followed while conducting the tests by making them non violative of the fundamental rights guaranteed by law.

11 Arun Bothra, *Why is our conviction rate so low?,* THE NEW INDIAN EXPRESS (Feb.21, 2019, 10:04 AM), https://www.newindianexpress.com/opinions/2019/feb/21/why-is-our-conviction-rate-so-low-1941680.html.

12 *Aarushi Talwar & Anr. v. CBI*, (2013) 82 ACC 303 (India).

13 *Surendra Koli v. State of U.P,* (2011) 4 SCC 80 (India).

14 Anupama Katakam, *The Truth Serum Trial,* FRONTLINE (Mar.12, 2004, 10:10AM), https://www.google.co.in/amp/s/frontline.thehindu.com/the-nation/article30221420.ece/amp/.

15 *Ruling on the 1993 Mumbai bomb blasts, Supreme Court sends a strong anti-terror message*, TOI (Mar. 22, 2013, 11:00AM), http://articles.timesofindia.indiatimes.com/2013-03-22/edit-page/37935918_1_blasts-case-bomb-blasts-tada-court.

16 *D.K. Basu v. State of West Bengal,* AIR 1997 SC 610 (India).

2. In this changing world, development and advances in science and technology must be adopted by the law so as to ensure fair play with the criminals who have started using developed crime techniques and thereby serve justice.

3. With lower criminal conviction rate in developing countries like India, the scientific investigation methods should be adopted for the greater good because the public interest prevails over the individual rights and interests.

4. The legislations such as Indian Evidence Act and Criminal Procedural Code (CrPC) must be amended for providing evidentiary value for these scientific criminal investigations.

5. Article 20(3) of the Constitution of India must be amended to provide legal validity for these scientific criminal investigations at least in high profile cases.

COPYRIGHT IN EBOOKS: A TUSSLE BETWEEN DRM TECHNOLOGY AND PRINCIPLES OF COPYRIGHT LAW

Ananya Jain*

Abstract

Market of eBooks in India is expanding and people have failed to take note of the copyright issues that it brings for authors and the publishers, due to the ease of copying and distributing work over the internet involving negligible time and cost. The situation has compelled Copyright owners in digital sphere to use technology and software to restrict the rights of purchaser of an eBook. This new technology, called Digital Rights Management (DRM) brings with it a protective environment for the Copyright owner but at the same time, curtails certain rights which are conferred on the consumer by the Copyright Law, in order to ensure a balance between interests of the Copyright owner and the public at large. This paper argues against the fundamentalist view that people have taken of the DRM technology who see it as a bane to Copyright Law effecting various well settled principles of First Sale and Fair Use. Present paper suggests some technological and policy changes in the DRM technology to find a middle path which provides the opportunity to apply these principles in the digital environment while appreciating the challenges faced by the Copyright owners in protecting their material online and that the principle laid down for the physical work cannot be applied on as it is basis for the digital world.

Keywords: Copyright, eBooks, Digital Rights Management, Doctrine of Fair Use, Doctrine of First Sale.

INTRODUCTION

If anyone wants to buy a latest bestseller book in any genre, the person has various options as to how s/he wants to procure the book. Either the person can buy a physical copy of the book from a bookstore, can order a copy online or can opt to buy an eBook that s/he can

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read on any electronic device like kindle, tablets or phones. Technology of eBooks in lay man's terms refers to the electronic version of a book that can be read on a variety of electronic devices.[1] This technological advancement has brought about a lot of advantages for the consumers, making the book available to a large number of people spread over a large geographical area at low cost and in a more efficient manner. This wide reach has also facilitated the author and the publisher to reap more benefit from royalties and sales respectively, reducing the high cost of physically printing each copy of the book. The market for eBooks in India is believed to make a great potential and is currently valued at US$ 221 million in 2020 and is expected to grow at a rate of 8.8% and reach US$ 295 million by 2024.[2]

However, emergence of digital technologies has posed a great challenge to the authors and publishers to protect their copyright in books published in digital formats or as eBooks from the possibility of an individual to copy and manipulate the work. Traditionally, copyright infringement dealt with the physical imitation of the copyrighted work, and the unauthorized sale and distribution of the copyrighted work. The new technologies have brought with them, new and easier ways of infringing copyright in digital work that might have a greater impact on the author owing to its faster and wider reach.[3] Such social, economic and technological challenges require legal responses and the Copyright Act is no exception to the general rule. One of the legislative response to the issue was the introduction of Section 65A and 65B to the Copyright Act, 1957[4] (herein after referred to as 'the Act') vide the Copyright (Amendment) Act, 2012[5] which lays down liability for any person who circumvents a technological barrier used to protect copyright in digital works.

Present paper presents a viewpoint on the software of Digital Rights Management (DRM) which is used to protect copyrighted material online and detect copyright infringements. The paper would further analyze the threats posed by the application of DRM technology on various well settled Doctrines of Copyright Law like the Doctrine of First Sale and Fair Use and how certain policy and technological changes can be used under the current system to ensure that the purpose of the Copyright Law i.e. to ensure a balance between the rights conferred on a Copyright holder to be adequately rewarded and the right of consumers to access information by ensuring free flow of ideas and information, is always upheld.

1 *eBook*, Cambridge Dictionary, (May 29, 2020, 12:05 PM), https://dictionary.cambridge.org/dictionary/english/ebook.

2 *eBooks,* Statista, (May 30, 2020, 2:13 PM), https://www.statista.com/outlook/213/119/ebooks/india.

3 Siriginidi Subba Rao, *IPR in the ensuing global digital economy,* 19 Library HiTech, 179, 182 (2001).

4 The Copyright Act, 1957, No. 14, Act of Parliament, 1957 (India).

5 The Copyright (Amendment) Act, 2012, No. 27, Act of Parliament, 2012 (India).

Ownership v. License Dichotomy

It is not uncommon for a person 'buying' an eBook online to believe that s/he is the owner of the eBook. Therefore, the relevant question that arises is that, whether the purchaser really is the owner of the eBook purchased, or is s/he really only a licensee. The truth is that the eBook publishers merely license the purchaser the right to access the book and there is no transfer of actual title.[6] License is the permission granted by the Copyright owner, of revocable nature, giving the right to do an act which would otherwise be considered as unlawful.[7]

In the landmark case of *Vernor Vs. Autodesk*[8], the US 9th Circuit District Court, held the user of a software to be a licensee and not an owner as the title was retained by the company and restrictions were put on their transfer and usage. The analogy can be used in respect on eBooks as well, as even the terms and conditions of the so called 'sale' of eBook does not transfer the title of the eBook and puts complete restriction on its transfer and distribution. One of the clauses from the Terms of Use for the Amazon Kindle India, which is the most used eBooks platform in India, is reproduced below:

"**Use of Kindle Content**: ....Kindle Content is licensed, not sold, to you by the Content Provider.

Limitations: Unless specifically indicated otherwise, you may not sell, rent, lease, distribute, broadcast, sublicense, or otherwise assign any rights to the Kindle Content or any portion of it to any third party...."[9]

Hence, it can be said that an eBook is only licensed to the so called "purchaser", and limited rights to access the book is conferred under the license unlike the sale of a physical copy of a book which transfers the title and confers various other rights to the consumer.

Digital Rights Management (DRM)

Digital Rights Management, usually shortened to DRM refers to a system established for the purpose of protecting copyrighted material in electronic media and is used to guide the proper utilization of the digital content. It helps in trading, tracking and monitoring the

6 Lukas Feiler, *Birth of the First-Download Doctrine—The Application of the First-Sale Doctrine to Internet Downloads Under EU and US Copyright Law,* 17 Stanford-Vienna TTLF Working Papers, 2013, 16-18.

7 Henry Campbell Black, Black's Law Dictionary 1059 (10th ed. 2014).

8 Vernor v. Autodesk, 621 F.3d 1102, 1110–11 (2010).

9 *Amazon.in Kindle Terms of Use*, Amazon (May 30, 2020, 1:00 PM) https://www.amazon.in/gp/help/customer/display.html?nodeId=200771440.

digital data in order to prevent any copyright infringement and to catch hold of such cases.[10] Section 14[11] of the Act confers certain exclusive rights on the copyright holder in a literary work including the right to reproduce and distribute the work to public. DRM acts as an additional protection for the intellectual property by blocking third parties from doing any act which the copyright holder has the exclusive right to do.

It is easier to understand the working a DRM through an example. Suppose an author decides to publish his book online and launch it as an eBooks, the first layer of protection of the work is given by the Copyright Act, which protects the work from any infringement. Another layer of protection is provided by the new regime of DRM, through which the work can be assumed to be locked and can only be accessed by a person who is authorized and has a key to the lock. This extra protection becomes of prime interest of any eBook publisher due to the infringement becoming much easier and very hard to control when its starts to spread in the electronic world.[12]

However, with the pace at which technical advancement is happening in the world, it won't be long before people would find a way to circumvent the protection of DRM and start infringing copyrighted work without getting caught. Therefore, in order to protect the sanctity of DRM or any other software designed to protect copyrighted work, the Indian Legislature introduced sections 65A and 65B into the Copyright Act, making it unlawful to circumvent such technical protections, through Copyright Amendment Act, 2012. An action was taken even though India is not a party to the WIPO Internet Treaties, namely, WIPO Copyright Treaty[13] (WCT) and WIPO Performers and Phonograms Treaty[14] (WPPT), which makes it obligatory for contracting parties to lay down an adequate and effective legal solution against a person involved in unauthorized tampering of the rights management system being used by Copyright owner to protect his Intellectual Property.

Section 65A clause (1)[15] of the Act lays down penalty for anyone who circumvents the applied technological measure, used to protect rights of the copyright holders conferred on

10 Gulshan K. Sachdeva, *A Digital Right Management and IPR in the Information Age*, 1 International Journal of Librarianship and Administration, 13, 14-16 (2010).

11 The Copyright Act, Section 14 (1957) (India).

12 Frederick W. Dingledy, *What is Digital Rights Management?*, William & Mary Law School Scholarship Repository (2016), (May 30, 2020, 01:00PM), https://scholarship.law.wm.edu/cgi/viewcontent.cgi?article=1121&context=libpubs.

13 World Intellectual Property Office Copyright Treaty on Protection of works and the rights of the authors in digital environment, Dec. 20, 1996.

14 World Intellectual Property Office Performers and Phonograms Treaty on the rights of performers and producers of phonogram in digital environment, Dec. 20, 1996.

15 The Copyright Act, Section 65A (2012).

them by the Act, with the aim of copyright infringement, of imprisonment that could be extended to two years, along with fine. However, clause (2) lays down various exceptions to the above penal measure.

Section 65B[16] of the Act makes any person who tampers with rights management information without consent or sells, distributes or communicates to public, copies of the electronic work having knowledge about the rights management information being tampered with, shall be liable for imprisonment that could be extended to two years, along with fine.

Therefore, DRM plays a primary role in ensuring that authors are properly compensated for their work and rights of the authors are very well protected and further DRM technology is protected through statutory law. However, technology of DRM, as seen in its current form, does not complement the purpose of Copyright Law of maintaining a balance between the rights of Copyright holder and the consumers.[17] Though protecting rights of the author, it puts unregulated constraint on the consumer with no freedom of dealing with the books as per his wish, thereby affecting the free flow of information. Besides posing threats to Privacy of the users and making the use of eBooks complicated, the system grossly violates two very well settled principles of Copyright Law i.e. Doctrine of First Sale and Doctrine of Fair Use.

Doctrine of First Sale

Copyright Act confers certain exclusive rights on the Copyright holder by virtue of section 14 of the Act. Such exclusive right in case of literary work includes the right to reproduce the work in any material form, to issue copies to public, to make translation and to communicate the work to public. One of the most important right is the right to distribute copyrighted work to public or to authorize such distribution. However, the right of distribution is only related to copies that are not already in circulation by virtue of section 14(a)(ii) of the Act[18]. This means that the Copyright holder has exclusive right to regulate first sale of the copy of a book and once such copy is sold to a purchaser legally, the Copyright holder loses the right to regulate subsequent use and sale of the copy. This is known as the Doctrine of First Sale. This Doctrine acts as a favorable defence in cases of copyright infringement as it makes the Copyright holder incapable of exerting control over copies that are already sold to a purchaser. The Doctrine was first applied by the US Supreme Court in the case of

16 The Copyright Act, Section 65B (2012).

17 Divyesh Pratap, *Is 'Fair Use' of Copyrighted Work a thing of the past?,* Lexpress (Aug 30, 2015,08:00AM), http://www.lexpress.in/law-development/digital-rights-management-provisions-and-indian-copyright-law.

18 The Copyright Act, Section 14(a)(ii) (1957).

Bobbs-Merrill Co. v. Straus[19], where it was categorically laid down that one who has sold a copyrighted article, loses all the rights to control subsequent sale and hence, the publisher has no right to control the price at which a subsequent retailer sells the book.

It is important to understand that the right granted under the Doctrine is to resell the copy of the work and not to make unauthorized copies. The purchaser only has the right to resell the legally obtained genuine copy of the copyrighted work and the purchaser is not entitled to make or distribute any illegitimate copies of the work. This means that the purchaser cannot buy one copy of the eBook and then go on to duplicate it to make 50 illegal copies of it and then seek protection under the Doctrine. The Doctrine only confers a right to resell the one copy which was legally obtained.

The issues that arises in digital sphere brings up the question of whether the Doctrine is applicable to digital materials including eBooks and specially in case where there is a mere license to use the copyrighted material. In respect to the first question i.e. whether the Doctrine of First Sale can be applied in cases of digital products, it can be said that under the current system, most ePublishers use DRM technology which restricts copying and transfer of the work and this clearly acts as a threat to the Doctrine as it is restricts purchasers from further utilizing the copyrighted material as per his own wishes and the Copyright holder retains full control over the eBook.[20]

There is no jurisprudence on this issue in India and the same has not yet been discussed by Indian judiciary. Therefore, one has to analyze judicial decisions in other jurisdictions to bring in more clarity. The US District Court of Southern District of New York, in the case of *Capitol Records, LLC v. ReDigi Inc*.[21], held that consumers does not have any right to resell the digital music owned by them. The Defendant ReDigi provided a platform to resell digital music that was purchased from iTunes after a software called Media Manager had authenticated the file. After verification, the file would be uploaded on remote Cloud Locker, from where anyone could purchase the music. Once purchased the music file could no longer be accessed by the first purchaser. The Court denied the defence of First sale Doctrine and held it be a copyright infringement as the user was creating a copy and uploading it on the cloud server. The Court further held that the Doctrine is applicable only to material items that the Copyright holder has put into the stream of commerce. The same line of reasoning can be applied in respect of eBooks as well, to conclude that in the present scenario, law does not facilitate the applicability of First Sale Doctrine to eBooks.

19 *Bobbs-Merrill Co. v. Straus*, 210 U.S. 339 (1908).

20 Joseph Gratz, *Digital Book Distribution: The End of the First-Sale Doctrine?*, LANDSLIDE (2013).

21 *Capitol Records, LLC v. ReDigi* Inc., 934 F. Supp. 2d 640, 655 (2013).

With respect to the second question i.e. whether Doctrine of First Sale can be applied to licensed products, it is important to analyse the judgement of United States Court of Appeals for the Ninth Circuit, in *Vernor v. Autodesk, Inc.*[22], wherein the Court held that the Doctrine does not extend to licensees of the digital copy but only to legal owners of the copyrighted material. Further, licensee is governed and restricted by provisions of the license agreement. Therefore, in case of license where the company retains the title, and only confers a non-exclusive license with restriction on copying and distributing, no right to resell by the way of First Sale Doctrine can be claimed. Therefore, it is clear that in the current judicial scenario, the Doctrine of First Sale does not apply to digital products and eBooks.[23]

The lack of any judicial decision or any legislative intent to extent the Doctrine of First Sale to digital products actually brings in a question of whether is it not really feasible to apply the historic well settled principles of Copyright Law in the current situation or has it really become obsolete owing to the fast paced technologically changing environment. One of the most evident fall back for Digital First sale Doctrine would be loss of control that the Copyright holder can assert over digital content, which are at a high risk of being easily and quickly exchanged between people as compared to tangible products. This would not only give the consumers an easy chance of piracy but would have a huge impact on the sale of eBooks as people can purchase a copy of the eBook through the secondary market place at cheaper cost with no difference in quality. Therefore, Digital First Sale Doctrine may have an adverse effect on the authors and publishers of eBooks due to loss of revenue and high risk of piracy.[24]

Therefore, the publishers of eBooks are compelled to use techniques like DRM and licensing in order to protect their copyrighted work and hence, granting Digital First Sale rights would not be a great idea under the present circumstances. However, the author is not in favor of completely separating the Doctrine from digital products and suggests designing of the First Sale Doctrine in a way to ensure balance between rights of the Copyright holder and that of the consumers to alienate their property.

The author proposes a system that could be called “Digital Transfer Doctrine”, whereby the eBook publishers are bound by law to modify their licensing agreement to permit licensees to resell the eBook license, in such a way that a part of resale price has to go to

22 Vernor v. Autodesk, 621 F.3d 1102, 1110–11 (2010).

23 Tanya Aplin, Copyright Law in the Digital Society (1st ed., 2005).

24 Eurie Hayes, *Digital First Sale: Friend or Foe?,* 22 Cardozo Arts & Ent. L.J. 853, 854 (2005).

the Copyright owner.[25] Royalties on sale in secondary digital market tries to maintain a balance between the interest of Copyright owner and user, while appreciating the difference between physical books and eBooks. Allowing resale of digital books brings in a unique risk non-degrading digital files, connected with a vast and boundaryless distribution system, and hence, the benefit sharing on resale would help the Copyright owner offset some risks posed by this new system.[26]

Further, stakeholders of an eBook can utilize the technology called 'Rights Locker Architecture', which would enable the publisher to store the content on a remote server, rather than it being stored locally on each device. When a consumer wants to access the eBook, it shall be directly done from the server, after verifying the authentication of the request.[27] This would help facilitate the application of the Doctrine by preventing the creation of any copy of the work. When any consumer decides to resell his license, access of the consumer to the eBooks from the server would be cancelled and would be granted to purchaser in the secondary market, thereby preventing any chances of a duplicate copy still remaining with the first purchaser as no copy was ever stored locally with the consumer and s/he was only granted access through the server.

It is not feasible to apply the Doctrine of First Sale on as it is bases to eBooks as it might ignore some of the valid risks that Copyright owner might face. On the other hand, the complete non-application of the given Doctrine would give unrestricted control to the Copyright owner and hamper rights of the consumer to alienate their property and be entitled to free flow of information. Therefore, no change in the statuary law is required as it already recognizes the Doctrine of First Sale. However, a detailed guideline by the Government allowing royalties for resale as well would indeed serve the purpose of Copyright Law of maintaining a clear balance.

Doctrine of Fair Use

Copyright Act as also discussed earlier, by virtue of section 14 confers certain exclusive rights on the Copyright owner, including the right to distribute or make the work available to public. Any person who violates any of these rights can be made liable for

25 Kristin Cobb, *The Implications of Licensing Agreements and the First Sale Doctrine on U.S. And EU Secondary Markets for Digital Goods*, 24 Duke Journal of Comparative & International Law 529, 536-542 (2014).

26 Sarah Reis, *Toward A "Digital Transfer Doctrine"? The First Sale Doctrine In The Digital Era*, 109 Northwestern University Law Review, 174, 194-197 (2015).

27 Tomas Sander, *Golden Times for Digital Rights Management?,* 5 Financial Cryptography, 64, 68-71 (2002).

copyright infringement. However, these rights are not absolute in the sense that under certain circumstances a person doing an act which would otherwise amount to copyright infringement cannot be held liable for the same as it falls under the scope of 'Fair Use'. The Doctrine of Fair Use is laid down under section 52 of the Act[28], which states certain acts that are exempted from the purview of copyright infringement. Under the Copyright Act, Fair Use in respect of literary work includes use of the copyrighted work for private use including use for research or for purpose of review or criticism or to report it as news. Purpose of the Doctrine is to encourage creation of new works and to develop knowledge. This is based on the belief that if copyright is absolute and unrestricted, adverse economic incentives would be created.[29]

In the case of *Chancellor Masters and Scholars of the University of Oxford v Narendra Publishing House and Ors.*[30], the Delhi High Court has very rightly summarized the Doctrine of Fair Use. The Court laid down that the very purpose behind the Doctrine is to maintain a balance between the rights conferred on the Copyright owner by the law and the opposing interest of enriching public domain. Therefore, it legitimizes reproduction of copyrighted work for private use and not for making commercial gains. Doctrine aims at promoting creativity by enriching the public domain, however, at the same time it condemns and prohibits blatant copying of protected work. However, digital market has brought about new challenges to the application of the Doctrine. Publishing an eBooks brings with it a certain set of challenges not faced by a publisher in the physical world and hence, the application of the traditionally Doctrine of fair is on as it is basis would not be the greatest idea.[31]The application of the Doctrine is dependent on the use of the copyrighted material for private versus public use. Such a distinction has been eroded in the digital environment where an individual has the capability to put the work on the internet to reach people across the globe who can use the same and utilize the work for private use. Therefore, in such cases even though the copy of the work is used only for private use of the third party, its availability over the internet to a large number of people may work in derogation of the interests of the Copyright owners.[32] Therefore, publishers of eBooks are compelled to use

28 The Copyright Act, Section 52 (1957).

29 Sangharsh Pandey, *Changing Mechanisms in Copyright Ontology: Digital Rights Management,* Manupatra, (June 1, 2020, 10:00 AM) http://www.manupatra.com/roundup/328/Articles/digital%20rights%20management.pdf.

30 *University of Oxford v Narendra Publishing House and Ors.*, CS(OS) 1656/2005 (India).

31 Shih Ray Ku R, *The creative destruction of copyright: Napster and the new economics of digital technology*, 69, The University of Chicago Law Review, 263, 275-276 (2002).

32 Megha Nagpal, *Copyright Protection through Digital Rights Management in India: A Non-Essential Imposition,* 22 Journal of Intellectual Property Rights 224, 228 (2017).

technologies like DRM in order to restrict the unauthorized usage which in turn also has the effect of restricting certain activities that would fall under the ambit of Fair Use and hence, the digital work brings in its own set of new issues into the world of Copyright.

DRM technologies permits only certain kind of access to the copyrighted material and forbids all other, thereby having the effect of preventing use of the work in a way that would otherwise would had come under the purview of Fair Use. Therefore, DRM technology is in direct derogation with the well settled principle of Fair Use, giving the Copyright holders in digital environment an upper hand over their work and hampering the rights of fair users, who might now become liable for copyright infringement of the digital work as any kind of Fair Use is also prohibited[33]. However, the author is of the belief that certain tweaking of the DRM technology might help it foster the Doctrine of Fair Use rather than hamper it. The author proposes a system where in a person can utilize copyrighted material for any purpose falling under the Fair Use category, only after an authorization through remote or local means has been granted through the DRM, which would be further monitored by a Rights Expression Language.

The author proposes a hybrid approach to the authorization process involving two types of authorization for different situation, in case a person wants to make Fair Use of the copyrighted work. Through this approach a person may seek authorization locally, for a set of preauthorized uses which clearly fall under the scope of section 52 of the Act, and for permissions that are not preauthorized, the person would have to seek the authorization through a remote process, showing adequate proofs in order to receive a digital key necessary to use the material beyond the scope of preauthorization. Remote authorization would help curb the issue created by the ambiguity of the scope of Fair Use and try to accommodate uses that do not directly fall under the scope of the Doctrine.[34]

With the help of a built in authorization mechanism combined with the subjective authorization though remote process, the Copyright holder would be able to provide a reasonable opportunity to the public to make Fair Use of the copyrighted material. As there would be no incentive for the Copyright holder to introduce such a mechanism, Parliament has to make the required amendments in the Copyright Law in order to obligate the same.

Once an authorization has been granted, the person to whom the authorization has been given will have the capability of using the material beyond the scope of the license and

33 James T C, *Indian Copyright Law and Digital Technologies*, 7 JOURNAL OF INTELLECTUAL PROPERTY RIGHTS, 423, 430-434 (2002).

34 Timothy K. Armstrong, *Digital Rights Management and the Process of Fair Use,* 20 HARVARD JOURNAL OF LAW & TECHNOLOGY, 50, 81-84 (2006).

the DRM restriction are removed in respect of the purpose for which the authorization was availed. This makes the copyrighted material again susceptible to easy copying and distribution. Therefore, the stakeholders of an eBook have to further lay down an another layer of technological protection called "Rights Expression Language" (REL). It is used to lay down clear set of rules for the usage of the copyrighted material once the authorization is granted. Even after the authorization to use the copyrighted material is granted, REL ensures that user cannot use the material in whatever way s/he deems fit. The right granted to use and access the digital content may be given with certain restrictions on the time period, geographical extent of use, devices and certain other restrictions.[35] Also the number of time and the frequency at which it can be accessed can also be limited. Therefore, this would ensure that once the authorization is granted, the user does not have a blanket right to use the copyrighted material and REL can be imposed to limited such rights and monitor the activities to prevent any chances of copyright infringement.[36]

Such a mechanism is not full proof solution and might come with certain drawbacks, however, it has the capability of conferring the right of Fair Use to the public while taking into consideration the unique risks that are faced by the copyright holder in digital sphere, thus maintaining a balance between the rights of copyright holder and the public at large.

Conclusion

In the coming future, India is going to witness a steep growth in the market for digital goods including eBooks, which would bring with it a wide range of legal issues besides the technical issues as already being faced. The difficulty faced to apply well settled principles of Copyright Law is one such legal issue that needs to be addressed by the Parliament and the judiciary.

Consumers and the Copyright owners in digital work have to adapt to the new digital environment and the first step towards achieving that is through building a sense of trust in the system. eBook publisher have to be more open and transparent about their licensing policies and make the consumers well aware before persuading them to buy the eBook, that they are mere licensee of the eBooks and no title is transferred to them.

The Indian Legislature, Judiciary and also the public at large have to accept and appreciate various new issues that the digital world has brought to the copyrighted material and

35 Stefan Bechtold, *The Present and Future of Digital Rights Management,* Springer, 597, 600-605 (2003).

36 Deirdre Mulligan & Aaron Burstein, *Implementing Copyright Limitations in Rights Expression Languages,* Springer, Apr. 12,2020, 01:00AM), https://link.springer.com/chapter/10.1007/978-3-540-44993-5_9.

that application of the law drawn to protect the physical work cannot be applied without modification to suit the new environment. Copyright owners have to be more careful and vigilant than ever to protect their work online and hence, have to be given extra protection than traditionally conferred to them.

The paper argues against fundamentalist viewpoint that people have towards the new technology of DRM, who see it as a tool only capable restricting the access to the copyrighted material. Fundamentalists are against the adoption of such a technology as they view it as a bane to the Copyright world and believe that it hampers the Doctrine of First Sale and Fair Use, which are considered to be the two strong pillars of the Copyright Law which are required to ensure a balance between the rights of the Copyright holder and the interests of public. While discussing the various concerns against DRM technology, the paper shows that it is more flexible than it is commonly perceived to be and a little framework change in it can help foster the purpose of Copyright Law.

The DRM technology is believed to be the heaven for the Copyright owners and hell for consumers, however, people fail to understand the middle path between these two extreme opinions. It is difficult to think of a balanced DRM system which protect the rights of the Copyright owner and that of the society at large, but the suggestions presented in the paper show that it is not impossible. The potential of DRM to create a balance and information friendly environment is by large still unexplored by the humans. Just like all technologies, even DRM is malleable, and people shall not miss an opportunity to create a value addition design that fulfills the requirements of the well settled principles of Copyright Law while appreciating the difference in environment created in the digital world. Further, Parliament and the Judiciary is duty bound to lay down better Laws for protection against the circumvention of any such technological measures and encourage and facilitate the formation of a new system in a Copyright friendly manner.

ASSIMILATING INTERMEDIARY LIABILITY REGIMES IN COPYRIGHT INFRINGEMENT

Akanksha Badika* and Pragya Mishra**

Abstract

The concept of intermediary liability has always been a bone of contention as intermediaries at times become medium of infusing infringing content on the web. In this modern era, where circumvention becomes rampant and massive, the copyright holder loses control on its dissemination. This article will primarily focus on the evolved intermediary liability regimes which have evolved to the rescue of copyright holders and their assimilation in Indian judicial environs as these intermediaries play a pivotal role in circumvention of material all over the world. Firstly, the article would introduce the concept of intermediaries and their conditional liability in the digital world uploaded by third parties in wake of numerous judgments with a brief discussion on their accountability as per the US DMCA and EU Directives on Copyright Act. Secondly, the article would analyze the historical background and evolution of the regime in realms of copyright laws in India and other sovereigns resulting from digitization and the need to curb circumvention of infringing content being the intellectual domain of its rightful copyright holder. Subsequently, the article assesses the qualifications of an intermediary within the purview of IT Act (hereinafter, "the Act"), Indian Copyright Act and recent judgments. Thereafter, the article would explore the synergy between Indian legislative framework, combating the above mentioned in light of Intermediary Guidelines Rules, 2018 and judicial precedents highlighting how digitization has made more vigilant yet inept in harmonizing safe harbour exception to import immunity to intermediaries. Conclusively, the article would suggest the alternatives available to infer the conception with a more preferable option, minimizing the discrepancies of the present mechanism to make copyright laws inhibitory rather than following a 'take-down' approach post-infringement when the damage has already materialized.

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INTRODUCTION

The principle of intermediary liability has always been a bone of contention because intermediaries often become a tool for infusing web-based infringement content. In this new age, in which circumvention is widespread and huge, the holder of copyright loses power over its dissemination. Recent judgements have held intermediaries as not liable as they come under the safe harbour provisions of Sec. 79 of the Act, others have held them liable despite safe harbour which at times is vaguely applied. Dynamism has been the epicentre of a ubiquitously contemporary world. The emergence of e-commerce and digitization has always been a boon for the society as it has provided a platform for discussion; however it has also been a bane for copyright holders, as intermediaries disseminate information at the click of a mouse.[1] In the process of such circumvention of infringing content the copyright holder gradually loses control over this dissemination, impacting the society at large as if they do not feel confident about posting content over the net, their freedom of speech and expression does get curbed. This article will primarily focus on the intermediary liability regimes which have been evolved to the rescue of copyright holders and their assimilation in Indian judicial environs as these intermediaries play a pivotal role in circumvention of material all over the world.

The word 'intermediary' in Indian context has been defined as storage, transmission, receipt of information or message or provision of any service related to information on behalf of another person and includes- telecom and network service providers, search engines, internet auction websites, internet service providers, etc.,[2] the definition has been widened to include the enumeration after the IT (Amendment) Act, 2008. In EU, the E-Commerce Directives define intermediaries as any person providing an information society service, which in turn is defined as a remunerated service at individual's request by electronic means[3],

1 R. S. Gowda, Sonakshi Banerjee, *Intermediary Liability – The Inconsistencies in the European Union Jurisprudence*, The Indian Journal of Law and Technology (Nov. 10, 2018), http://ijlt.in/index.php/2018/11/10/intermediary-liability-the-inconsistencies-in-the-european-union-jurisprudence/#_edn2. *See* Lemley MA, "*Rationalising Internet Safe Harbours*", Journal on Telecommunication and High Technology Law (2007).

2 The Information Technology Act, 2000, § 2 (w).

3 E- Commerce Directive 2000/31/EC article 2(a) & rec.17-18, cf. Directive 98/34/EC article 1(2) as amended by Directive 98/48/EC. *See* Faculty of Law, UiO, *Intermediary Liability for Copyright Infringement in the EU's Digital Single Market*, University of Oslo, (Nov. 10, 2018) https://www.duo.uio.no/bitstream/handle/10852/60876/Thesis-Intermediary-Liability-for-Copyright-Infringement-in-the-

Recital 18 further clarifies that it includes not only internet contracting but also services not paid for as it constitutes an economic activity.[4] In US, the DMCA the term intermediaries are known as 'service providers' to broaden their ambit to include even universities which provide students with access to information,[5] the definition includes transmission, routing and providing connection,[6] with some eligible conditions for limitation.

The old Copyright Act, 1957 did have provisions relating to secondary liability for copyright infringement much before the advent of internet. These provisions along with ISP liability provisions[7] of the Act, have formed the base for safe harbour provisions in India until Intermediary Liability Rules of 2011 were framed and published. There have been a host of case laws which have changed the statutes, one among them being, *Super Cassettes Industries Ltd. v. MySpace Inc. Ltd.*[8], wherein the court had opined that intermediaries should be responsible in uploading content on the website and should carry due diligence for the same at the time of infringement rather than conducting the same after the damage has already occurred. The court further handed down that legislative mechanism in India and USA are completely different and post infringement measures can work there but India needs to have more pre-infringement measures to prevent copyright infringement in the online world. During this case, the defendants, MySpace had enough opportunity to change the work by obtaining permissions from the customers, inserting advertisements to the plaintiff's works. However, the 2012 Amendment to the Copyright Act has significantly stifled such possibilities to materialize. In of *Avnish Bajaj v. State of Delhi*[9], the Court observed that Baazee.com had failed to practice the requisite due diligence because its filters were defective and allowed pornographic material, despite the post containing salacious material, the intermediary could not justify any amendments in its policy to counter the likelihood that such content could be published on the website.

EU-s-DSM.pdf?sequence=1&isAllowed=y.

4 Recitals 2 and 19 of Directive 98/48 state that services as used in the definition cited is to be understood as defined in Treaty on the Functioning of EU (TFEU) Article 57: services which are "normally provided for remuneration".

5 Akanksha Kumar, *Intermediary Liability for Contributory Copyright Infringement in USA and India: Lack of Uniformity as Tarde Barrier*, 19 J. Intellec. Prop. Rights 272, 274. (2014).

6 Digital Millennium Copyright Act, 17 U.S. C. § 512(k)(1)(A) (1998). *See* Mohammad Sadeghi, The Knowledge Standard for ISP Copyright and Trademark Secondary Liability: A Comparative Study on the Analysis of US and EU Laws, Brunel University London (2013) 48, https://bura.brunel.ac.uk/bitstream/2438/8922/1/FulltextThesis.pdf.

7 IT (Amendment) Act, 2008, S. 79 & S. 81, IT (Amendment) Act, 2008.

8 *Super Cassettes Industries Ltd. v. MySpace Inc. Ltd.,* IA Nos, 15781/2008 & 3085/2008 in CS(OS) No. 2682/2008.

9 *Avnish Bajaj v. State of Delhi,* (2005) 3 CompLJ 364 Del.

The Intermediary Safe Harbour: An Escape Route

A safe harbour provision provides for a conditional immunity to the intermediaries for liability of third-party infringers. The safe harbour rules have evolved over times in different jurisdictions and accordingly formed the much-needed backbone in ensuring intermediaries are not pestered for infringements or illegal activities in the digital space which has unrestricted flow of information. However, the immunity provided to intermediaries is subjected to conditions in international spheres.

International Approach

In the EU, a sectoral and vertical approach is followed for intermediary liability. The ECD divides the liability –exempt intermediaries in three distinct categories based on which the liability of an intermediary depends, those have been mentioned in Art. 12, 13 and 14 of the ECD. If the ISPs function as conduits for information i.e., only transmission or providing access, then the ISPs are exempt from liability.[10] If the information received by a client is transmitted in a communication network where the intermediary stores the information in a 'safe, temporary and intermediate manner' solely for the purpose of transmitting the information to other recipients of the service, then the intermediary is also not liable solely for the storage of such information (popularly known as caching).[11] The intermediary's responsibility will depend upon the knowledge of contents of the information where the ISP provides for the storage of the receiver's information. If they have no actual knowledge of the infringing content, they are pardoned and the Article have different thresholds of civil claims which depends upon the degrees of awareness of the infringing material to the operator.[12]

The US has twin conditions for enabling intermediary to claim immunity, which have been embodied in Section 512 of the DMCA, which further create four safe harbour provisions: for conduits, there exists no monetary liability, only injunctive relief, for caching, the liability is limited to only those ISPs who upon notification to take down infringing content, take it down expeditiously, for information residing at the direction of users, the liability arises only when the ISPs had actual knowledge about the infringing content and they do not actively take efforts to disable access after a notice and when the ISP provides a referral or link to an online location or domain, the liability does not arise provided the conditions

10 E- Commerce Directive 2000/31/EC Article 12(2).

11 E- Commerce Directive 2000/31/EC Article 13.

12 E- Commerce Directive 2000/31/EC Article 14(1)(a).

of aforementioned case are fulfilled about the actual knowledge of infringing content.[13] The case of *Doe v. MySpace*[14] also illustrates that an intermediary cannot be held responsible for third party communications and how they are protected extensively, where MySpace was not held liable when minors interacted with sexual predators after lying about their age, the US Court held that MySpace cannot be held liable for any communication published by third parties and the case of negligence was dismissed.[15]

Indian Legal Regime

The intermediary liability regime in India has evolved over the years. Initially, the IT Act did not provide for any safe harbour significantly it was after the *Avnish Bajaj v. State*[16], where the managing director was able to escape because of inadequate intermediary liability and the amendment thereafter in 2008, which brought in the requisite broadening of the intermediary liability by inserting Section 79 of the IT Act, which provides immunity to intermediaries from all unlawful activities if they cater to the due diligence and other condition provided in the Section. According to the Section, it only includes those cases in which the intermediaries do not have any knowledge or control over the information that is being transmitted.[17] Moreover, the intermediary will only take down the information upon receiving actual knowledge of the same.[18] The Intermediary Guidelines 2011 clarified the conditions for claiming safe harbour under the IT Act and later the judgements of *Shreya Singhal v. Union of India*[19] and *MySpace*[20] case also added to the existing literature of intermediary liability of the 'actual or specific knowledge requirement'. *M/s Luxottica Group SPA v, M/s Mify Solutions*,[21] also clarified the laws regarding interaction of Intellectual Property Rights with e-commerce platforms, wherein an e-commerce platform cannot escape the liability if it allows for storage of counterfeit goods, advertises marks of

13 Kumar, *supra* note 7, at 275.

14 *Doe v. MySpace, Inc.*, 528 F.3d 413 (5th Cir. 2008).

15 Smitha K. Prasad et al., *Intermediaries –Messengers or Guardians? How India and US deal with the role and liability of intermediaries*, Legal Services Newsletter, US-India Business Council (2013). See Stefan Kulk, Internet Intermediaries and Copyright Law: EU and US Perspectives 216-220 (Kluwer Law International BV 2019) (2019).

16 *Supra* note 11.

17 Malvika Kapila Kalra, *Intermediary Liability under the Information Technology Act: Time for an Amendment?,* Bar & Bench (July 28, 2019), https://www.barandbench.com/columns/intermediary-liability-under-the-information-technology-act-time-for-an-amendment.

18 IT (Amendment) Act, 2008, S. 79 (3) (b).

19 *Shreya Singhal v. Union of India*, (2013) 12 S.C.C. 73.

20 *Supra* note 10.

21 *M/s Luxottica Group SPA v, M/s Mify Solutions*, CS (COMM) 453/2016.

plaintiff, stating that active participation would render them liable.[22] Further, the Copyright Amendment in 2012 had broadened the safe harbour for 'transient or incidental storage', thereby indicating how and why the storage of content is actually effectuated.[23]

To claim immunity under the Act and the Information Technology (Intermediary Guidelines) 2011, the function of such intermediary of ISP should be restricted to providing ingress or where the intermediary doesn't modify the information uploaded by a third party or does not select the receiver or does not initiate the process and the intermediary follows Rule 3 of the guidelines issued in 2011, namely publishing of rules and regulations which informs the user not to host, share or display any information which belongs to some other person and over which he possess no right or infringes any patent or copyright or any other Intellectual Property Right.

Despite all the efforts of the of the government to make the laws related to intermediaries simpler, however everything was in vain and in the year 2013 mouthshut.com along with the other petitioners like Shreya Singhal challenged the validity of Section 66 and Section 79 of the IT Act and claimed it that these Sections are infringing their Right to Freedom of Speech and Expression under Article 19 of the Constitution. The main reason for mouthshut.com to file the case was that they had received humongous amount of take down notices which is infringing their freedom of speech. According to the owners of the website it is "privatisation of censorship"[24]. The apex court gave its decision in the petitioners favour and ordered reading down of Section 79.

Under the Indian legal regime, one of the difficulties arising in pretext of Copyright law was the scope of Section 51(a)(ii), however in *MySpace*[25] judgement, the same was clarified to include even cyberspace, however the broad interpretation of the word 'place' as virtual space would effectually require more consideration as online platforms are more vulnerable as the control is lost eventually over the content.[26]

However, in these cases even, can an intermediary claim immunity in cases of public advertisements which they agree to publish, as then the ISP possess actual knowledge

22 Chadha & Chadha Intellectual Property Law Firm, *Tracing the Development of "Intermediary Liability" in India*, Lexology (Apr. 3, 2020), https://www.lexology.com/library/detail.aspx?g=be8df572-55b1-499a-85cf-8b44b59ee0bc.

23 *Supra* note 17.

24 Sourav Datta, *This Supreme Court petition could be a big step in the fight for Internet democracy in India*, Scroll.in, (Sep 18, 2014), https://scroll.in/article/678539/this-supreme-court-petition-could-be-a-big-step-in-the-fight-for-internet-democracy-in-india.

25 *Supra* note 10.

26 Ananth Padmanabhan, *Give Me My Space and Take Down His*, 9 IJLT 1, 7 (2013).

about the illegal or infringing content not enough to shield them from liability in the garb of being an intermediary as per Sec. 79 of the Act, as while advertising, they act more like a publisher.[27]

Fixing Liability on Intermediaries: Increased Digitization and its Impact

With rampant digitization and massive dissemination of information, intermediaries can heavily influence the way content is read worldwide. As a result of which the Intermediary Guidelines have proven to be useful wherein the liability has been more clearly specified for various categories of intermediaries, though not as segregated in types of intermediaries in terms of functional variations as that in US or EU. It becomes really impossible for intermediaries to filter content or even be aware about the content which could have been published by over millions of populations across the world due to digitization and increased computer literacy, hence the red flag test, with subjective and objective elements, to understand an intermediary's liability about the knowledge factor to fix liability becomes important. *Viacom v. YouTube*[28] has significantly demonstrated this point, where Viacom sued You Tube for copyright infringement of content which belonged to Viacom and uploaded on You Tube by third party users, to which You Tube claimed immunity under S. 512 of the DMCA, the court ruled in favour of YouTube based on the red flag test and further observed that real knowledge involved clear and observable violations of sensitive information and not general understanding of its existence and YouTube had already followed the notice and take down procedure.[29] However, the take down approach only has remedied the damage after it has materialized but not looked after the damage which has already occurred due to infringement, it becomes really easy for an intermediary to escape liability without the need to monitor content. This way, the intermediaries claim vast immunity from liability as there are no civil or criminal claims against them. However, the intent of the Act was to absolve them from criminal liability as has been reinstated in the Standing Committee Report on the IT Amendment Act.[30]

27 P. Reddy, *Do Online Advertising Platforms Qualify for 'Intermediary Liability' Protection?*, Spicy IP (Aug. 7, 2016), https://spicyip.com/2016/08/do-online-advertising-platforms-qualify-for-intermediary-liability-protection.html.

28 *Viacom v. YouTube*, 07 Civ. 3582, (LLS).

29 Amlan Mohanty, *Intermediary Liability for Copyright Infringement in India: Few Thoughts in the Wake of Viacom v. Youtube [Part I]*, Spicy IP (July 8, 2010), https://spicyip.com/2010/07/intermediary-liability-for-copyright.html.

30 Ministry of Communications and Information Technology (Department of Telecommunications), *Sixty-Eighth Report Standing Committee on Information Technology (2008-2009),* PRS India (February 17, 2009), https://www.prsindia.org/sites/default/files/bill_files/scrTRAI.pdf.

Under the Intermediary Guidelines Rules of 2018, Rule 3(8) of the Guidelines, mention a take-down approach, according to which an intermediary shall, upon receipt of specific information in the form of a court order or upon notification by the Government or its agency, remove or disable access to material legally restricted under Article 19(2) of the Indian Constitution no later than 24 (twenty-four) hours. It is a robust step because it helps in protecting the rights of the intermediaries and the users as it is becomes a herculean task for the intermediaries to examine all the uploaded documents or content and check the validity of the same. After this Rule, the intermediaries are required only to examine those documents for which the court has specifically asked them to do so. However, the factors on which the content should be removed have still not been clear. In addition, the Draft Rule does not cover the request for taking down of content in case of infringement of Intellectual Property which was there in the earlier Rules.

Under Rule 3(5) the intermediary needs to provide information or assistance as asked for by any government agency or assistance concerning security of the State within 72 (seventy-two) hours of communication. This step of providing assistance is a welcoming step however; the provision to ask for assistance is really wide giving too much power to the government agency immense powers to request any kind of assistance. In addition, the rules have just mentioned the government agencies and do not specify which kind of government agency. Therefore, the revision to Rule 3(5) is necessary to clarify which all rights of assistance is vested to the government agencies and to whom.

Moreover, according to Rule 3(9) intermediaries must also deploy automated tools for proactively identifying and removing unlawful information or content[31] however, the criteria for installing automated tools is unclear, because there is no explanation under the Draft Rules as to how such automated tools can detect unlawful information or content. The Rules do not define the term 'unlawful information or content' the absence of which creates confusion and inconsistency between intermediaries.[32] The usage of automated tools has been previously discussed in the landmark

31 The Information Technology [Intermediaries Guidelines (Amendment) Rules] 2018, Rule 3(9).

32 *Supra* note 15.

case of *Sabu Mathew George v. UOI,*[33] where the Supreme Court directed the respondents, Google, Microsoft and Yahoo to 'auto-block' sex determination advertisements. They also ordered establishment of a 'nodal agency' whose main work is to provide a list of blocked websites to the search engines[34].

In addition, Rule 3(7) of the Draft Intermediaries Guidelines makes it compulsory for all the intermediaries incorporated with more than 5 million users in India to get a permanent registered office in India and appointment of a nodal officer for all time coordination with the different Law Enforcement Agencies. The particular rule does not elucidate the method to calculate the numbers of users. An intermediary's number of users can be determined using different methods such as the registered user or active regular members, or number of installations or VIP users etc. This leads to a lot of uncertainty, as it is very difficult for an intermediary to determine whether or not it has passed the threshold of fifty lakh[35]. Moreover, registering also leads to a lot of burdensome formalities and statutory compliances.

Recent Judicial Observations: Stringency or Harmony?

The recent judicial response on intermediary's liability in cases of copyright infringement, will help us delve deeper into the intricacies of the Act and Copyright Act, especially when no objective tests exists for determination of fixing accountability on an intermediary, one can always determine the type of intermediary and its involvement with target audience while considering the same.

In case of *M/S Shree Krishna International Film Productions v. Google India and YouTube LLC*[36], the plaintiff was alleging that the defendants had been reproducing various sound recordings, cinematographic films and audio-visual recordings of the plaintiff on its platform

33 *Sabu Mathew George v. UOI*, 2017 (1) RC R (Civil) 175.

34 CCG NLU Delhi, *Roundup of Sabu Mathew George vs. Union of India: Intermediary liability and the 'doctrine of auto-block'*, Legally India - News for Lawyers (Feb 3, 2017), https://www.legallyindia.com/views/entry/roundup-of-sabu-mathew-george-vs-union-of-india-intermediary-liability-and-the-doctrine-of-auto-block.

35 *Draft Information Technology [Intermediaries Guidelines (Amendment) Rules] 2018*, PRS India (Jan 3, 2019), https://www.prsindia.org/billtrack/draft-information-technology-intermediaries-guidelines-amendment-rules-2018.

36 *M/S Shree Krishna International Film Productions v. Google India and YouTube LLC,* CR No.2198 of 2016.

without authorization, the defendants on the contrary argued that they were intermediary and had no knowledge of the infringing content, as they cannot plausibly evaluate each user generated or user uploaded content. The court ruled that defendants should have taken down the content after getting a notice for the same from the plaintiff as per the Intermediary Rules, 2011, the defence that proper notice procedure under the Rules have been catered to is invalid as the burden was on defendant to locate the URL even if the same was not mentioned in the notice. The decision has been appealed in Punjab and Haryana HC and has been admitted by the Bench, the grounds being- Status of You Tube as intermediary under the Act, no notice in furtherance of Article 51(a)(ii) prior to filing infringement case, no URL mentioned in the notice, 15 of the 18 works were assigned to Shemaroo which was not party to the suit.[37]

Also in case of Fermat Education v. Sorting Hat Technologies P. Ltd[38], the court observed that the defendant, Unacademy (managed by Sorting Hat Technologies) had about 200 questions and answers of the plaintiff (2IIM-CAT course), copied in literary and video form, the issue was whether Unacademy was an intermediary and can claim safe harbour and if not, whether the same was fair use under Sec. 52(1)(i) of the Copyright Act. The court held that Unacademy was not an intermediary as the Terms and Conditions stated that user content could be created by Unacademy itself, publication can only occur only after being approved by Unacademy and they have editorial control over the content being uploaded, hence Unacademy was not qualified as an intermediary. Also, when the defendants claimed fair use, which is an exception to infringement, the court held that Unacademy was paying consideration to educators for furnishing content hence, it was a business venture and the same will not come under fair use exception.[39]

In the case of *Amway India Enterprises Pvt Ltd v. 1Mg Technologies Pvt Ltd & Anr*.[40], the court observed that most of the e-commerce platforms are actively involved and thus cannot come under the safe harbour provision of Section 79 given to intermediaries. It was held that the e-commerce platforms will be liable for fine if they fail to comply with the statutory requirement given in the Intermediary Guidelines.

37 Akshat Agrawal, *Shree Krishna International Film Productions v. Google India and You Tube LLC: Revisiting the Intermediary Liability Jurisprudence in the Indian Copyright Law*, IPR MENT LAW (Dec. 8, 2019), http://iprmentlaw.com/2019/12/08/shree-krishna-international-film-productions-vs-google-india-and-youtube-llc-revisiting-the-intermediary-liability-jurisprudence-in-the-indian-copyright-law/.

38 Fermat Education v. Sorting Hat Technologies P. Ltd, CS(OS) 330 of 2018.

39 Sreyoshi Guha, *Unacademically Speaking: Madras HC Upholds Copyright Claim in 2IIM-CAT Questions*, Spicy IP (Aug. 22, 2018), https://spicyip.com/2018/08/un-academically-speaking-madras-hc-upholds-copyright-claim-in-2iim-cat-questions.html.

40 *Amway India Enterprises Pvt Ltd v. 1Mg Technologies Pvt Ltd & Anr*, CS (OS) 410/2018.

Analysing the Judicially *Cold-Shouldered* Aspects of Intermediary Liability

Intermediaries play a significant role in case the data uploaded is an infringing content, however their liability has to be matched with the interests of third party provider of information, who significantly has no role to play as per the Act and Intermediary Guidelines, hence a balance between freedom of speech and intermediary liability (following the chilling effect after the take down approach) needs to be achieved. A lot of intermediaries lack the ability to determine legality of expression, the qualifications and objective due diligence requirements have not been mentioned under the rules, third party provider of information is not informed about the take down, no mechanism for put back, no reasonable rejection by intermediaries is accepted, no transparency in take down procedure, procedural lacuna exists as there are no CPC or CrPC provisions with respect to it.[41] Also, one of the criteria to affix responsibility should be the nature of interaction an intermediary has with the target audience, here we can say the level of interactivity be categorised as- active, passive or intermediate and then, it will be even easier to compute damages.

Conclusion and Suggestions

Intermediary liability regimes have undergone tremendous change as now the liability depends upon the role intermediary plays in dissemination of infringing content. However, the Copyright Act should always follow an inhibitory approach rather than a notice and take down approach where the damage is remedied long after it has materialized and when the copyright holder gets apprised of the fact of such infringement. The diligence system should be clearer on the type of content that is infringing and what action an intermediary should take and the degree to which such action may be taken as intermediaries cannot always act as censorship boards inhibiting freedom of speech which is a Fundamental Right. At times, these intermediaries do over comply and take down content even if it does not result in copyright infringement in order to avoid the consequences as per the research done by Centre for internet and Society, Bangalore.[42] However, more clarity on working of these intermediaries is required and the blocking orders by governmental agencies should also take into consideration the aftermath of these intermediaries. Wilful blindness to infringing content can always lead to following an approach which will diminish the possibility of inhibitory approach.

41 Rishabh Dara, *Intermediary Liability in India: Chilling Effects on Free Expression on the Internet, 2011*, Centre for Internet and Society (2011), https://cis-india.org/internet-governance/intermediary-liability-in-india.pdf.

42 *Supra* note 30.

Automated mechanisms have also proved to be ineffective in determining copyright infringement as they rely on matching technologies in order to detect such infringements and have been criticized by rights holders and fair use advocates. Hence, a clear approach in defining the law clearly and then focusing towards its implementation can to some extent balance the intermediary liability regimes with freedom of speech and expression. The Draft amendment rules, 2018 are somewhere vague in nature. However, the State has tried to take a liberal approach to solve the earlier problems raised by the earlier rules.

A few suggestions to ascertain intermediary liabilities are as follows:

- **Harmonisation of conflicting laws**- The conflict between the safe harbour provisions under the Act and IPR laws in India need to be in harmony. The legislators and the judges should have a balanced view towards ascertaining intermediary liability.
- **Restricting the safe harbour window**- The legislation should mention the specific acts of intermediary that would lead to disqualification of an ISP from escaping liability under Sec. 79 of the Act in copyright infringement cases.
- **IT professionals as *amicus curiae* for determination of intermediary liability** - It would be more objective in ascertaining the Intermediary's liability by having an opinion of a reasonable IT professional working in some other intermediary having similar target audience other the intermediary in question. Such IT professionals can act as *amicus curie* in adjudging the liability as InternetLab had presented an amicus curiae brief where Facebook was alleged liable due to a fake profile generated on the platform of the plaintiff.[43] When third party information provider is willing to fortify, no real knowledge is ascribed to the intermediary, and if not, the intermediary is liable to actual knowledge.

With such balanced view, India can successfully assimilate the Intermediary liability regimes in cases of copyright infringement keeping in view rampant dissemination of content in this digital world.

43 Dennys Antonialli & Thiago Oliva, *InternetLab Files Amicus Curiae Brief in a Federal Supreme Court Case that Can Change Internet Intermediaries' Liability Regime in Brazil*, InternetLab (Dec. 14, 2018), https://www.internetlab.org.br/en/news/internetlab-sends-contribution-to-the-stf-on-the-constitutionality-of-article-19-of-the-brazilian-internet-civil-rights-framework/.

SQUINTING AT THE NARCO-ANALYSIS AND THE BRAIN MAPPING TESTS THROUGH 'FLUID' CONSENT

Kanak Mishra*

Abstract

In today's scenario where science has reached its zenith, the law of the land does not wish to lag behind by keeping technology distant from the legal domain. Criminal investigation in India has time and again considered the admissibility of some of the most exceptional and technologically advanced forms of gathering evidence through the Narco-analysis test and brain mapping test. Both these tests involve cognitive sub-systems that play a significant role in determining the criminal intent of an individual. The study of the formation of criminal intent by the theory of culpability, however, is quite an abstract process. So, if it is feasible to read a person's mind through science and technology to gather all such information, without any overt efforts, then why not use this instead? The reasons attributed to the denial of the evidence obtained through these tests and arguments in favor of their admissibility are many. Therefore, the purpose of this scientific – legal paper shall be to deal with the intricacies of both these tests through the lens of 'fluid consent.'

INTRODUCTION

Science and technology have become the driving forces of the current epoch. Scientific advancement has also seeped into law, which is known to adapt to the changing social order. With the increase in population, the rate of crime is also consequently increasing, thereby multiplying the burden on law enforcement and courts. With a sudden surge in the crime rate over the years, the change in the types of crimes and criminal mindset can also be attributed to technology to an extent. However, the role of technology in determining criminal intent or human behavior is still deliberated with a pinch of salt. Scientific tests like Narcoanalysis and Brain Mapping, are increasingly being brought up time and again as a viable source of evidence in the name of the evolution of law and the changing societal

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order. These tests have time and again been brought under judicial scrutiny for being violative of fundamental freedoms enshrined in the constitution. The efficiency of drug-induced tests, along with its potential health effects, privacy violation issues, as well as torturous techniques, are also deemed to be a threat.

This paper aims to further the understanding of scientifically induced tests and the scope of its use and misuse. A rigorous effort has been made to interpret various landmark precedents of National and International value to analyze the constitutional and evidentiary value of these tests in the light of Articles 20(3) and 21 of the Constitution as well as Sections 27 and Section 29 of Indian Evidence Act, 1872.

Narco-Analysis Test

Narco analysis test is a type of deception detection test which is conducted by infusing the truth serum into the subject's body, causing a state of "hypnotic trance," and thereby "monitoring the blood pressure and heart rate continuously."[1] The word narco is derived from the Greek word 'narkc,' which means "anesthesia" or "torpor". Narco-analysis is the inducement of deep-sleep or the state of 'hypnosis' through injections of drugs on the patients.[2] The primary drug used in this test is Sodium Pentothal or Sodium Amytal (also known as the "truth serum"), which is heavily criticized for being hazardous and lethal.[3] The technique in which these drugs are administered, and the subject's consciousness is monitored continuously.[4] In this test, the subject goes through four stages out of which the second stage, i.e., the 'hypermnesia' stage that occurs after the first stage of 'hypnosis' is the most relevant one wherein it is believed that the subject becomes incapable of "suppressing the memories associated with the relevant facts." The inducement of this stage evokes a "re-integration of the disassociated personality" while the patient is in a dream-like state of mind. It is medically proven that the drugs given decrease the extent of anxiety and fear, which results in reduced pressure on the subject's 'ego'.[5] This makes

1 *Narco-analysis Test: An analysis of various Judgements of Indian Judiciary* | Semantic Scholar, (Jun. 19, 2020, 10:00AM), https://www.semanticscholar.org/paper/Narco-analysis-Test%3A-An-analysis-of-various-of-Barnwal-Ambedkar/54f79559f6e51bc2c4ab1e09582960274259dcd7.

2 J. S. Horsley, *Narco-Analysis*, 82 Journal of Mental Science 416 (1936), (Jun.19, 2020, 11:00AM), https://www.cambridge.org/core/article/narcoanalysis/01140C736B73C7A15E709FCF97047A33.

3 Linda M. Keller, *Is Truth Serum Torture?*, SSRN JOURNAL (2004), (Jun.19, 2020, 11:00AM), http://www.ssrn.com/abstract=599143.

4 Bannur Muthai Mohan, *Misconceptions about narco analysis*, IJME (2007), (Jun. 19, 2020, 11:20AM), http://ijme.in/articles/misconceptions-about-narco-analysis/?galley=html.

5 George H. Dession et al., *Drug-Induced Revelation and Criminal Investigation*, 62 The Yale Law Journal 315 (1953), (Jun.17, 2020, 12:00PM), www.jstor.org/stable/793442.

it easier for the subject to 'relive' that particular crime scene or traumatic situation. And it is only after this stage that a series of explanations, persuasions, and other forms of psychoanalysis procedures are performed that can stimulate the flow of associations in the brain of the subject to obtain oral responses.[6] The process of conducting a Narco-analysis test resembles that of psychotherapy. It is conducted under the supervision of registered medical practitioners "consisting of a physician, an anesthetist, and a clinical psychologist or a psychiatrist."[7] The responses of the subject and video-recorded and sent along with a brief report to the concerned authorities for the formal process of collection of evidence.

Brain Mapping Test

This test is also famously known as the P300 Waves test. Its close variants are the lie detector test, also known as the Polygraph test. Brain-mapping, on the other hand, evaluates the physical fluctuations in the brain of the subject to detect the possibility of a potential lie. This test does not require the subject in an unconscious state and nor does it necessarily require the presence of medical professionals. Unlike narco-analysis, no verbal exchanges between the subject and the interrogator take place during the tests.[8] Such tests work on the principle of 'target stimuli,' wherein upon certain audio-visual display, the neurons of the subject get triggered, and this produces a 'different' response from what a reasonable person in an ordinary course of nature would produce. A guilty person would thus pay more attention to the critical stimuli rather than the control stimuli, and this behavior would help in the detection or evaluation of lie by the experts.[9] The critical stimuli being the 'target word,' that gets invoked by the brain upon a visual or verbal representation of the crime, whereas the control stimuli being the neutral words for the purpose of psychotherapy.

Despite many successful criminal guilt determinations, the polygraph or P300 Waves tests have been under constant doubt for the way an accused can prep themselves before partaking the test. Considering the logic of determining guilt through the polygraph test is the amount

6 Horsley, *supra* note 2.

7 A.S. Dalal & Arunava Mukherjee, *Constitutional And Evidentiary Validity Of New Scientific Tests*, 49 Journal of the Indian Law Institute 529 (2007), (Jun 19, 2020, 01:00PM), https://www.jstor.org/stable/43952091.

8 Court equates brain-map, narco-test - Indian Express, (Jun 19, 2020, 02:00 PM) http://archive.indianexpress.com/news/court-equates-brainmap-narcotest/615711/.6,19]]}}}],"schema":"https://github.com/citation-style-language/schema/raw/master/csl-citation.json"}

9 William M. Waid & Martin T. Orne, *The Physiological Detection of Deception: The accuracy of polygraph testing can be affected by such variables as attentiveness, drugs, personality, and the interaction between examiner and subject*, 70 American Scientist 402 (1982), (Jun. 19, 2020, 03:00 PM), https://www.jstor.org/stable/27851548.

of attention a subject pays to the critical stimuli, it seems easy to tailor the test to be less detectable, be it by consuming drugs or any other form of medication. Constructing various scenarios to cover up the actual situation, preparing answers to the questions that are most likely to be asked, tackling body movements, gestures and expressions accordingly, all way in advance, are some other ways in which a P300 Wave test or a lie-detector test may lose its value as a legitimate form of evidence.[10] A Polygraph and Lie-Detection report[11] which came up as an opposition to employee screening in the U.S. completely debunks the accuracy of such tests and points out that "the physiological responses measured by the polygraph are not uniquely related to deception," i.e., some other responses also accompany the same which are consciously made by the subjects. An example of such a response could be that of fear, which might arise out of the related questions asked by the interrogator. Also, it is not just the mere process or technique of the tests which should be under consideration. Still, even the slightest chance of error while and after the performing of the transaction of the polygraph test too should be given relevance. In a U.S. case of Daubert v. Merrell Dow Pharmaceuticals Inc.[12], it was noted that even though the attribution of accuracy can be given to the brain-mapping tests for sixty to seventy percent, yet, there remains a substantial amount of accuracy which might get hindered due to the type of environment under the test, the qualifications of the examiner and involvement of a subject with the crime.

Thus, on the face of it, both the tests, be it the Narco-analysis test, or the Brain mapping test, seem problematic enough to be taken as a primary piece of evidence. However, the following section shall hopefully be able to determine if these tests can be taken up as a piece of secondary or corroborative evidence. The upcoming section deals with some of the most prominent arguments proposed by various jurists and scholars trying to locate the specificity of scientific tests. The next section shall be an attempt to introduce a detailed understanding and analysis of the arguments pinned in the previous section.

The Argument Proposed on the Violation of Article 20(3) - The Right against Self-Incrimination

The primary issue with the narco test is a constitutional one, which is that the involuntary administration of the truth serum, leading to testifying against oneself in a hypnotic state, is violative of the right against self-incrimination. Article 20(3) of the Constitution of India

10 *Id.*

11 "*The Polygraph and Lie-Detection: Committee to Review the scientific evidence on the Polygraph*", WASHINGTON D.C.: NATIONAL ACADEMIES PRESS 2003, 212-213.

12 *Daubert v. Merrell Dow Pharmaceuticals Inc.*, 509 US 579 (1993).

holds the right against self-incrimination to be a fundamental right. This right ensures that any accused should not be made to make any statement against their will. Hence, it is pertinent to evaluate how the concept of 'will or consent' comes into play under the Narco-analysis test.

The landmark Indian judgement of Selvi v. State of Karnataka[13] provides a detailed analysis against the use of the narco-analysis test. Still, unfortunately, while explaining the rule against self-incrimination, the court draws out comparisons with foreign[14] and Indian[15] judgements which deal with confessions and admissions to the police only. The court, despite discussing the difference between the words voluntary and compelled, missed considering the disputed territory of how 'consent' works under the Narco Analysis Test.

The jurisprudence on the matter of the validity or admissibility of the Narco-Analysis Test in India has been severely restricted only to the admissions and confessions to the police. The cases cited above acknowledged that while undergoing the Narco Analysis procedure, the subject is compelled to make an involuntary admission under the influence of heavy drugs (while the subject is in a hypnotized state) that severely block the brain's ability to engage in the standard cognitive process but failed to acknowledge the concept of fluid consent.

Selvi[16] case had its flaws, but it was also an incredibly transformative judgement because of the way it dealt with the idea of the 'state.' It shows the gradual shift of the Supreme Court from viewing any case at hand only through the lens of crime control, to now liberally understanding the domain of criminal psychology alongside valuing the due process of law.[17] Thus, by collating the two ideas of crime and the right to life of an accused, the judgement indeed laid down an improved framework of the modern criminal investigation. While the case, firmly established that determining the guilt of the accused solely based on either the Narco Analysis Test or brain mapping test would be violative of the right to self-incrimination under Article 20(3) of the Constitution, it also grappled with the issue of violation of Article 21, i.e., the Right to Life and personal liberty of the individual. The right to life angle of the case, discussed in detail the scope of the word 'compelled' in Article 20(3). The reasoning in the case describes that when an accused is either coerced or

13 *Selvi and Ors. v. State of Karnataka*, (2010) 7 SCC 263 (India).

14 *Brown v. Walker*, 161 US 591 (1896).

15 *Nandini Satpathy v. P.L. Dani*, 0139 MANU SC 1978 (India).

16 *Selvi v. State of Karnataka, supra* note 14.

17 Gautam Bhatia, *Privacy and the Criminal Process: Selvi v State of Karnataka* (2018),(Jun. 18, 2020, 2:00 PM), https://papers.ssrn.com/abstract=3166849.

is made to confess against himself, then it would amount to being compelled. Such coercion would be the exact opposite of the word 'voluntary' and, thus, would be a violation of the right against self-incrimination. This reasoning of the court sufficiently addresses the inherent opposition between the terms - coercion and voluntariness, but it fails to engage in the scientific conundrum about the concept of consent revocation while a person is undergoing any drug-induced test.

In the famous Canadian case of Horvath v. R,[18] it was held that statements extracted through narco tests would be inadmissible as evidence because a person cannot be said to have made a statement of his own will when hypnotized. This case, unlike the Selvi[19] case, recognizes that although before the commencement of the test, the subjects are made to sign certain documents affirming their consent for the test, how does one evaluate if the consent seizes to exist in due course of the test? How does the law then grapple with this scientific mystery of consent when a person is heavily drugged? Does it distinguish between conscious consent against subconscious admissions that may not have been made if conscious?

The Argument Proposed Under Article 21- The Right to Life

Both these scientific tests violate Article 21, i.e., "Protection of life and personal liberty" on two grounds. Firstly, conducting such tests without the permission of the court would be violative the procedure established under law.it is because, the ambit of Article 21, i.e. Right to life, includes the "substantive due process of law".[20] Secondly, in Maneka Gandhi v. Union of India[21], Subba Rao, J. opined that an essential element of personal liberty is 'privacy'. Hence it is not just the liberty of an individual that is infringed but also their privacy when they are forced to undergo such tests without their consent.

Arguments Proposed for the Inclusion of Narco-Analysis Test Results as Evidence

Furnishing the test results derived by Narco analysis and brain mapping tests as corroborative evidence is premised on the idea of a valid 'consent.' The first argument given by scholars is generally that when a subject is made to undergo scientific tests, no compelled testimony seems to be extracted, which the Nandini Satpathy v. P.L. Dani[22] case describes in detail.

18 *Horvath v. R*, 385 C.C.C. 44 (1979).

19 *Selvi v. State of Karnataka, supra* note 14.

20 *Id.*

21 *Maneka Gandhi v. Union of India*, 0133 MANU (SC 1978) (India).

22 *Nandini Satpathy v. P.L. Dani,* 0139 MANU (SC 1978) (India).

As at the beginning of the test, the subject consents out of their own free will, to get exposed to the conditions mentioned above, the argument of compelled testimony cannot be raised. This argument was rejected by the court in Selvi[23] by reasoning that a compelled testimony is the one which is extracted not just by exercising physical threats or violence per se but also by intimidation methods, tiring interrogative process, psychic torture, environmental coercion, etc.

Scholars' second argument is that, even during the various stages of the test, no force is applied onto the subject, and it is only the drugs that are infused to merely block a certain thought process of the brain, in which case no scope of a hindrance with the personal knowledge of the subject remains. This argument was clarified by the court in the case of State of Bombay v. Kathi Kalu Oghad[24] wherein the court differentiated between "to be a witness" and to "appear as a witness." Thus, the 'Personal knowledge' that can be attributed to a person by 'being a witness' either orally or in writing is the same when extracted from a subject in a hypnotic trance under narco test and brain mapping tests. And would, therefore, amount to a compelled testimony.

Fluid Consent

With respect to both the arguments stated above, it can be said that the idea of consent in the case of scientific tests such as these becomes hugely debatable. While the subject may give their consent at the beginning of the procedure, the point at which their consent would seize during the test is not taken into consideration. This amounts to a flawed understanding of how consent works, and a subsequent continuation of the test would then be tantamount to a clear violation of privacy. Both the arguments as proposed by given by multiple scholars and jurists time and again do not take the 'fluidity of consent' into consideration. Their understanding of consent is limited to a static concept, that is incapable of changing once given. This is extremely problematic and deserves more attention. Thus, an understanding of consent as a fluid consent would help such scientific tests gain a heightened degree of certainty.

23 *Selvi v. State of Karnataka, supra* note 14.

24 *State of Bombay v. Kathi Kalu Oghad,* 0134 MANU 43-44 (SC 1961) (India).

The Argument Proposed for Section 27 of the Indian Evidence Act, 1872[25]

Also, no rational nexus can be attributed to the argument of constructive custody during the Narco test, wherein the team comprises of "one anesthetist, one physician, and one clinical/ forensic psychologist."[26] The concept of custody under Section 27 of the Indian Evidence Act, 1872 includes Constructive custody[27] , too, in which the accused is not physically present in the court. Still, his freedom is monitored by the legal authority in some way or the other outside the court.

Extraction of any admission through scientific tests in the presence of the above-stated team members can be attributed as a 'legal authority outside the court' because the ultimate aim of the medical professionals conducting the scientific tests on the subject would be to extract the admission or involvement in any crime. This would amount to constructive custody under Section 27 of the Indian Evidence Act, 1872, and would also be violative of Article 20(3) of the constitution and hence should be admissible as evidence.

The Argument Proposed for Section 29 of the Indian Evidence Act, 1872[28]

It is also argued by some that the hypnotic state of the subject can be compared to that of a drunk person. And in such a situation, Section 29 of the Indian Evidence Act, 1872 comes to the rescue, which states that merely "because a person is drunk and is made to answer questions which he need not have answered", then such evidence cannot be dismissed as

25 Section 27 in The Indian Evidence Act, 1872 (India). How much of information received from accused may be proved.—Provided that, when any fact is deposed to as discovered in consequence of information received from a person accused of any offence, in the custody of a police officer, so much of such information, whether it amounts to a confession or not, as relates distinctly to the fact thereby discovered, may be proved.

26 Mohan, *supra* note 4.

27 *Aghnoo Nagesia v. State of Bihar,* AIR 119 (1966) (India).

28 Section 29 in The Indian Evidence Act, 1872 (India). Confession otherwise relevant not to become irrelevant because of promise of secrecy, etc.—If such a confession is otherwise relevant, it does not become irrelevant merely because it was made under a promise of secrecy, or in consequence of a deception practised on the accused person for the purpose of obtaining it, or when he was drunk, or because it was made in answer to questions which he need not have answered, whatever may have been the form of those questions, or because he was not warned that he was not bound to make such confession, and that evidence of it might be given against him.or when he was drunk, or because it was made in answer to questions which he need not have answered, whatever may have been the form of those questions, or because he was not warned that he was not bound to make such confession, and that evidence of it might be given against him., , https://indiankanoon.org/doc/962897/ (last visited Jun 19, 2020

being irrelevant altogether. The underlying argument being that in the hypnotic stage of the Narco-analysis test, the state of the subject resembles the inebriated state. Hence, such evidence cannot be considered as inadmissible on the lines of Section 29.

This analogy is seriously flawed as it equates drunkenness with the hypnotic state of a subject while undergoing a scientific test. The difference between the two lies in the fact that while the former would amount to 'extorting communication,' the latter would constitute 'using the body for extracting evidence.'[29] This difference was laid down in two U.S. cases of *Armando Schmerber v. California*[30] and *United States v. Holt*.[31]

Conclusion

The formulation of these tests was done by the scientists to make efficient the process of a criminal investigation by providing the most relevant-direct evidence. So, no malafide intention can be attributed to the interrogators, to be able to reject the admissibility of the test. The types of drugs administered in the process and the authenticity and accuracy of such a test are the two aspects that are the most contested in the case of scientifically obtained evidence. It is not an unfamiliar fact that the drugs administered for the tests, do cause pain. These drugs are also harmful as they restrict a person's ability to suppress their memories and hence, would amount to torture (as and when India ratifies UNCAT) in violation of Article 1 of the U.N. Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (UNCAT) if done without the consent of the subject.[32] Conducting the test in the absence of the subject's consent would amount to a violation of Article 21 and 20(3) of the Constitution of India. Additionally, it is also pertinent to note that irrespective of the subject's consent at the beginning of the test, the consent can be revoked at any point during the test, and this prima facie makes the scientific tests violative of privacy. The arguments advanced in favor of scientific tests based on Sections 27 and 29 of the Indian Evidence Act of 1872 cannot be sustained because of the concept of constructive custody and the difference between the state of drunkenness and hypnosis, respectively.

29 The Legal Blog, Narco-analysis & Polygraph Tests: Constitutional Validity, (Jun. 19, 2020, 07:00PM). http://www.legalblog.in/2011/05/narco-analysis-polygraph-tests.html (Jun. 19, 2020, 07:00PM).

30 *Armando Schmerber v. California*, 384 757 (1966).

31 *United States v. Holt,* 218 245 (1910).

32 Narco-Analysis and the Indian Criminal Justice System: | Economic and Political Weekly, (Jun. 19,2020, 07:00PM), https://www.epw.in/journal/2008/36/commentary/narco-analysis-and-indian-criminal-justice-system.html.

The drugs administered during Narco-analysis and other like scientific tests work on the highest cognitive level of the brain. If the doses are given in the wrong proportion, then the tests could turn out to be lethal. Additionally, some or the other uncertainties always loom such technological procedures. Hence, it is pertinent to allow the Narco-analysis test and the brain mapping test only with a pinch of salt. Both these tests can be used cautiously, as a last resort, in determining guilt only as corroborative evidence and not as a primary piece of evidence.[33] Corroborative evidence derived through either the Narco-analysis test or brain-mapping test would indeed prove out to be very useful in the cases wherein the accused wants to plead innocence, especially in the cases of high-profile criminal investigations and terrorism-related matters.[34] It is essential to realize that while the results of such tests are admissible as corroborative evidence in the court, it is not the most sound form of evidence. Law enforcement authorities should be extremely cautious in running after these tests for extracting evidence. This is because such tests are still novel in a developing country like India. Hence, only those cases that are at the forefront of media coverage get to see the application of Narco-analysis or brain-mapping tests. It takes a reasonable person to determine the hue and cry created by the media in prominent cases. The Arushi murder case was an apt example of the extent to which media trials can affect the verdict of a case.[35]

Law, as we know, is not limited to the legislation itself, it is a 'living process,' which evolves. Hence, it is imperative to imbibe all sorts of technological advancements into the law, as long as fundamental principles of law, or the rights of individuals are not sacrificed. But considering the ways in which these tests undermine the concept of fluid consent, its application with or without consent of the subject should be resisted. A viable option would be to encourage the use of these tests only after exploring the alternatives that value the subject's static as well as fluid consent. So, by the end of this paper, I believe that I have addressed some pertinent concerns regarding the two scientific tests, namely, the narco-analysis test and the brain mapping test, which would hopefully be used and not misused in the future.

33 South Asia Human Rights Documentation Centre, *Narcoanalysis: A Dangerous Mirage*, 42 Economic and Political Weekly 2857 (2007), (Jun. 19, 2020, 08:00PM), https://www.jstor.org/stable/4419780.

34 Rights activists hail Indian truth drug ban, The National, (Jun. 19, 2020, 08:00 PM), https://www.thenational.ae/world/asia/rights-activists-hail-indian-truth-drug-ban-1.524656.

35 Tribune News Service, *Lessons From Arushi Case Tribune india News Service,*(Jun. 19, 2020, 09:00 PM), https://www.tribuneindia.com/news/comment/archive/lessons-from-aarushi-case-481820 .

Changing Dimensions of Fantasy Games in India and its Legality

Akshit Bhardwaj*

Abstract

Technological advancements have paved way for a digitalized community across the world providing minute-to-minute access to different sports games played across diverse regions. With grand winnings that are just a click away requiring the right combination of skills and arrangement of real players, the young managers are virtually managing their own dream team after meticulously examining their career statistics. This has resulted in wide viewership and has provided significant access to e-games including fantasy sports in India. However, the existence of fantasy sports is yet again under scrutiny even when the judicial pronouncements have been in their favour in the past. With no specific laws and guidelines, the users and companies are still waiting for the government to strike a balance between gaming laws and their application on fantasy games.

This article analyses the statutory position of skill- based fantasy games in India while examining the recent judicial trends. It further identifies the challenges that are experienced by the online gaming industry that can potentially damage the growth of fantasy games. Lastly, the article proposes suitable measures to safeguard the interest of all stakeholders.

Keywords- The Sports (Online Gaming And Prevention Of Fraud) Bill 2018, Fantasy Sports Games, Dominant Factor Test, Challenges, Self- Regulation

Introduction

The evolution of fantasy sports games can be traced back to the United States, wherein offline records of fantasy sports players exist since 1960.[1] These records constitute data of sports

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1 Eddie Brown, *The history of fantasy football*, The San Diego Union-Tribune (Aug. 09, 2020, 10:00

like football etc. and provide details of their account holders.[2] Due to the rise in domestic leagues and commercialized international events, fantasy sports games are becoming a part of this culture. Significantly, a recent study of the Broadcast Audience Research Council (BARC) establishes that the game of cricket draws 93% of sports viewership in India.[3] It further reveals that other sports like kabaddi, wrestling, and football are also gaining popularity due to the advent of homegrown leagues and mass commercialization.[4] The growth of young athletes and the interest of youth in sports has contributed significantly to the viewership of sporting events leading to more revenue for broadcasters and streaming industry.[5] This has eventually contributed to the growth of fantasy sports games in India, making it a $150 Billion market due to the formation of multiple competitive platforms.[6]

According to a report prepared by the *Pennsylvania Gaming Control Board*, the characteristics of fantasy sports can be defined as:

"a fantasy or simulation sports game or contest involving athletic events in which a participant owns or manages an imaginary team and competes against other participants or a target score for a predetermined prize determined by statistics generated based on performance by individual athletes participating in actual professional athletic events, provided the outcome shall not be based solely on the performance on an individual athlete, or on the score, point spread, and any performance of any single real team or combination of teams."[7] In simpler terms, fantasy sports enable individuals to act as managers or team coaches while creating their own team involving real-world professional players participating in a particular contest. However, due to its dynamic nature fantasy sports cannot be restricted to a particular definition.

AM), https://www.sandiegouniontribune.com/sports/chargers/sdut-the-history-of-fantasy-football-cure-2014jul28-story.html.

2 *Ibid*.

3 Ians, *Cricket draws 93% of sports viewers in India: BARC*, Business Standard (Aug. 09, 2020, 04:10 PM), https://www.business-standard.com/article/news-ians/cricket-draws-93-of-sports-viewers-in-india-barc-119060400786_1.html.

4 Kunal Dhyani, *Cricket accounts for 93% of sports content consumption in India: BARC*, Inside Sport (Aug. 04, 2020, 04:15 PM), https://www.insidesport.co/cricket-accounts-for-93-of-sports-content-consumption-in-india-barc/.

5 *Ibid*.

6 Rohan Abraham, *A $150bn market: How fantasy sports transformed cricket fans from being spectators to stakeholders,* The Economic Times (Aug 09, 2020, 08:19 PM), https://economictimes.indiatimes.com/magazines/panache/a-150bn-market-how-fantasy-sports-transformed-cricket-fansfrobeingspectatorstostakeholders/articleshow/70185196.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

7 David M. Barasch, *Fantasy Sports Report*, Pennsylvania Gaming Control Board (Aug. 09, 2020, 08:30 PM), https://gamingcontrolboard.pa.gov/files/communications/PGCB_Fantasy_Sports_Report_2016.pdf.

These sporting platforms/companies work on the notion of providing an array of contests to the public, ranging from paid leagues to free entries. The users accessing these services get an opportunity to test their sporting expertise by picking teams from a real-world player pool for the upcoming matches. Such drafts are drawn up using virtual credits provided for each game by the host. Weighted credit scores are given to players based on their recent form. For example, if there are 100 credits available, users must pick 11 players within the allotted budget. Moreover, marquee players hold the highest credit against their names. The participants are ranked based on the points earned by their selected players during the contest according to their on-field performance and scoring metrics for the relevant match. Companies have created their marking system for the activities carried out by the athletes during a contest.

Regulatory Framework Governing Skill Games in India

Participation and engagement in sports is an extensively practiced, recreational, and social activity that offers opportunities for customer engagement, brand advertisement and promotion, and involvement of fans.[8] Significantly, to regulate those offering complex competitive formats such as board games or fantasy sports, Indian laws distinguish between game involving 'skill' and game involving 'chance', and specify a strict prohibition on participation and the offering of 'chance' games for consideration, while at the same time taking a more favorable position with 'skill' games.[9] A historic characteristic of Indian law has been the distinguished treatment granted to games of skill and games of chance, with the former allowed and the latter prohibited.[10] The above differentiation appears to originate from India's traditional gambling treatment, where while it features throughout the millennia in Indian culture and history, it is associated with negative connotations and societal stigma.[11]

Public Gambling Act, 1867 and Prize Competitions Act, 1955

India's gaming framework at the national level is regulated by the Public Gambling Act, 1867, and the Prize Competitions Act, 1955. The Public Gambling Act, 1867[12] (hereinafter "PGA") criminalizes and prohibits the activity of gambling in the public forum and the keeping of a '*Common Gaming House*' in India. According to *Black Law Dictionary*,

8 *Games of Skill in India: A Proposal For Reform*, The Sports Law & Policy Centre, (Aug. 09, 2020, 10:00 AM), https://drive.google.com/file/d/0B6LE5s8UEIKGZXNKNGRnQk94ZEE/view.

9 *Ibid.*

10 *Ibid.*

11 *Ibid.*

12 The Public Gambling Act, 1867, No. 03, Acts of Parliament, 1867 (India).

Gambling refers to "*the act of risking something of value for a chance to win a prize.*"[13] Gambling is not defined in the PGA, however, the Act has incorporated the definition of '*Common Gaming House*' referring it as *"any house, walled enclosure, room or place in which cards, dice, tables or other instruments of gaming are kept or used for the profit or gain of the person owning, occupying, using or keeping such house, enclosure, room or place, whether by way of charge for the use of the instruments of gaming, or of the house, enclosure, room or place, or otherwise howsoever."*[14] It can be concluded that an act to qualify as gambling essentially requires chance, consideration, and a prize. Furthermore, it is safe to assume that web-servers that facilitate online gaming houses fall within the ambit of PGA.[15]

Moreover, the Act exonerates the liability of any game involving mere skills, thereby excluding the '*game of skills*' from any liability.[16] Games based entirely on participant's skills and knowledge and involve a factor of little or no luck would not, therefore, be considered illegal because such legislation or law imposes no penalty on games comprising of skills. Although, PGA does not define the ambit of the game of skills or any other factor to interpret the term '*mere skill*'. However, in the case of *State of Bombay v. R.M.D. Chamarbaugwala*[17], the court interpreted a game of "*mere skill*" as the game which primarily includes skills and enunciated that it will be only applicable to games that are preponderantly of skill, and in-spite of a certain degree of chance the game preponderantly remain a game of skill.

The Prize Competitions Act, 1955[18] (hereinafter "PCA") further sets out regulatory guidelines for the rewards and operation of prize competitions across the country. Under PCA, a prize competition can be defined as any competition providing a prize for the answer/ solution that is achieved through arranging or setting up pictures, puzzles, numbers, etc. It governs the restrictions and application on the conduct and hosting of a prize competition or a game. The Supreme Court while determining the background and intent of the legislature behind PCA's enactment enunciated that games that are predominantly based on skill are excluded from the regulatory framework and liability terms of the PCA.[19]

13 *Black's Law Dictionary* 750 (4th ed. 2009).

14 Section 12, The Public Gambling Act, 1867, No. 03, Acts of Parliament, 1867 (India).

15 Anand Jayachandran & Aditya Prasad, *All In or Fold – The Legal Conundrum of Real Money Online Poker,* India Corporate Law (July 10, 2020, 10:15 AM), https://corporate.cyrilamarchandblogs.com/2019/07/real-money-online-poker-legalities/.

16 *Supra* note 14.

17 A.I.R. 1957 S.C. 699.

18 The Prize Competitions Act, 1955, No. 42, Acts of Parliament, 1955 (India).

19 *Supra* note 17.

Furthermore, according to the Seventh Schedule of the Indian Constitution (List II, Entries 34 and 62), the state governments have been vested with the power to make betting and gambling legislation for their respective territory. Hence, where there is a state gambling legislation state, it prevails over the PGA. Consequently, many states in India in addition to the PGA have introduced legislation regulating gambling and gaming within their jurisdictions. These state regulations are essentially in accordance with the PGA, and also exempt games that involve skills as a predominant factor.

Conundrum between Game of Skills and Game of Chance

Dominant Factor Test

To adjudge a game as of a skill or chance it is important to take into consideration the facts and circumstances as the deciding factor of each case.[20] To determine the true character of a game, U.S courts have established a "Dominant Factor Test". Significantly, this test acknowledges that most of the games include some form of chance and thus focuses upon deciding whether luck or the skill involved is the most important factor in choosing the winner in those situations where predominantly skills are required.[21] In the case *Bayer v. Johnson*[22] Appeals Court of South Dakota (U.S.) held that: *"The test of the character of the game is not whether it contains an element of chance or an element of skill, but which of these is the dominating element that determines the result of the game."* Perhaps, the test elucidates that the mere influence of chance alone does not affect the nature of the game. Rather, it entails that the element of chance must achieve a certain degree of significance before it makes a game illegal.

Despite the evolution of this test, issues have persisted regarding its application. Initially, U.S courts failed to interpret whether the application of the test is in quantitative terms or in qualitative terms. Consequently, the Supreme Court of Washington explained that: *"The measure is a qualitative one; that is, the chance must be an integral part which influences the result. The measure is not the quantitative proportion of skill and chance in viewing the scheme as a whole."*[23] Thus, it can be safely concluded that the "Dominant Factor Test" is qualitative and not quantitative.

20 *Manoranjithan Manamyil Mandram v. State of Tamil Nadu*, A.I.R. 2005 Mad 261.

21 See *Roberts v. Comm. Inv. Club of Woonsocket*, 431 A.2d 1206, 1211 & n.5 (R.I. 1981).

22 349 N.W.2d 447, 449 (S.D. 1984).

23 See *Sherwood & Roberts-Yakima, Inc. v. Leach*, 409 P.2d 160, 163 (Wash. 1965).

Indian Position & Dominant Factor Test

Courts in India have adopted a similar approach as laid down by the U.S. precedents. The test of predominant nature has been applied to identify the true character of the game.

Game of Rummy

In the landmark case of *State of Andhra Pradesh v. K. Satyanarayana*[24] (hereinafter "Satyanarayana Case"), the court held that even though there is a slight risk involved in the game of Rummy, it is a game of skill as it is predominantly based on the skill of the player playing the game. The court further held that: *"The "three card" game which goes under different names such as "flush", "brag" etc., is a game of pure chance. Rummy, on the other hand requires a certain amount of skill because the fall of the cards has to be memorised and the building up of Rummy requires considerable skill in holding and discarding cards. We, cannot, therefore, say that the game of Rummy is a game of entire chance. It is mainly and preponderantly a game of skill."*

Interestingly, the court in the above case adopted a two-step test to identify the nature of the activity. These steps involved: firstly, to identify whether the game in question is mainly and preponderantly a skill game, and secondly, whether the organization involved in the operation of these games is making any gain or profit from such activity except for the service fee charged for operations of the game. For the Game of Rummy, the court opined that it majorly requires skills to learn and understand the fall of the cards and needs considerable skills to finish the game and win. The logic behind identifying the true nature of a game has been applied by the legislation and the courts, however, the additional step pertaining to the determination of profit and gain that has been received by the organizer stands a point of issue. This is because if a game is a game of skill then the gambling laws and other allied provisions must not be applied under any given circumstances. This further creates a tussle between the fundamental rights of a person to carry out free trade and business guaranteed under Article 19 of the Constitution and the gambling statutes. It further jeopardizes business models with irrelevant and illogical differentiation.[25] Nevertheless, the *Satyanarayana Case* has laid down the foundation of clearing the confusion pertaining to skill games and chance games by applying the dominant factor test.

Horse Racing

Horse racing has been a part of the rich heritage and traditions and has served as a stage to display strength and valour. While dealing with aspect of wagering in it, the issue before

24 A.I.R. 1968 S.C. 825.

25 *Supra* note 8.

the Supreme Court was whether wagering on horse races constitute a game of skill or chance. In *K.R. Lakshmanan v. State of Tamil Nadu*[26] (hereinafter "*Lakshmanan Case*"), the Supreme Court held that: "*Horse-racing is a sport which primarily depends on the special ability acquired by training. It is the speed and stamina of the horse, acquired by training, which matters. Jockeys are experts in the art of riding. Between two equally fast horses, a better trained jockey can touch the winning-post. 'Gaming' in the two Acts would, therefore, mean wagering or betting on games of chance. It would not include games of skill like horse-racing. We, therefore, hold that wagering or betting on horse-racing - a game of skill does not come within the definition of 'Gaming' under the two Acts.*"

The court by this ruling allowed wagering on horse racing and declared it as a lawful activity that is outside the scope of PGA and PCA. The court formed such a basis due to the availability of numerous publication and information that assists the participant to learn about the maintenance of horses and the nuances of racing. Furthermore, with the application of such knowledge and the right information about the past performances of the horse and the racer, a high degree of skills get involve to determine the outcome of the race. The court also reiterated the principle of the dominance of skills as laid down in the *Satyanarayana Case* while ruling out the aspect of high degree of chance.

The landmark ruling in the *Lakshamanan Case* has special significance as it was the first time that a game directly related to field sports was declared legal in terms of betting. *Lakshmanan Case* and the *Satyanarayan Case* paved way for the fantasy games companies and sports enthusiasts to combine their skills online. The observation of the courts in these two cases rightly supports the legality of the skill based fantasy games as there are major skills involved in choosing the winning team and the right combination.

The Curious Case of Poker

The legality of poker games is surrounded by uncertainties and societal stigmas. Lack of clear and comprehensive legislation clarifying its status and legality has resulted in uncertainty regarding its operation in India. The Supreme Court had earlier propounded that there was no scope for the use of one's skill to reach the desired result in games such as poker, double up, blackjack and Pacman because electronic setups relied upon to play these games might be manipulated and therefore the chances of winning are no more in control of the player who is using his skills.[27]

26 (1996) 2 S.C.C. 226.

27 *M. J. Sivani v. State of Karnataka,* A.I.R. 1995 S.C. 1770.

However, the efforts of the Indian Poker Association (IPA) to legalize poker games have resulted in two favorable judgments from the Karnataka High Court and the Calcutta High Court based on their State legislation on Gambling. Although, these two decisions did not delve into the legality of poker altogether, resulting to be limited in nature. The Karnataka High Court in *Indian Poker Association v. State of Karnataka*[28] held that poker, if played like a game of skill, does not require a license and is legal when played in such a manner. However, the court did not test its legality by determining its nature and is therefore considered as a narrow interpretation. In *Indian Poker Association v. State of West Bengal*[29], the court by prima facie considering the game of poker outside the purview of West Bengal Gambling and Prize Competitions Act, 1957 considered it to be legal. Both these judgments have not relied on the "Dominant Factor Test" to identify the true characteristics of the game of poker.

However, the Gujarat High Court after perusing the rules of the game held that *'Texas Hold Em Poker'* was a game of chance and thus prohibited under Gujarat Prevention of Gambling Act, 1997.[30] The court relied upon the observations made in *Satyanarayan Case,* wherein the Supreme Court considered the '*3 Card Game'* like a game of pure chance and therefore declared it illegal. Furthermore, in *M/s Gaussian Networks Pvt. Ltd. v. Monica Lakhanpal and State of NCT*[31], the District Court (New Delhi) distinguished between games played in a physical space and those played on an online platform, and opined that playing 'games of skill' for money is lawful only when played in the physical form. Additionally, the court observed that when games are played on an online forum, various factors are involved that influence the degree of chance, and the predominance of skill over chance becomes uncertain, as other elements like arbitrariness, cheating, and collusion take over. Although, due to withdrawal of the original petition the observation of the court was subsequently set aside.

It can be concluded with regards to the observations made by different courts that poker is primarily a game of chance. However, different positions adopted by various states and lack of a common precedent is adding to the ambiguity regarding its current position. Predominantly, there are high chances involved in the Game of Poker when played online as rightly highlighted in the above case. Due to unreliable algorithms, the operating system might favour any person playing online even though he/she has displayed a minimum amount of skills. However, if a suitable regulation/ measure can be carved out to overcome this uncertainty, the courts must reapply the established tests to reach a balanced outcome.

28 2013 SCC OnLine KAR 8536.

29 WPA No. 394 of 2019 (High Court of Calcutta, 29/08/2019).

30 *Dominance Games Pvt. Ltd. v. State of Gujarat and Ors.*, (2018) 1 G.L.R. 801.

31 Suit No. 32/2012 (Delhi District Court, 17/09/2012).

Legality of Fantasy Sports in India

According to a recent study released by the Massachusetts Institute of Technology (MIT), the majority of sports fantasy games are based on skills rather than luck.[32] The researchers at MIT by analyzing the win/loss ratio and statistics of thousands of fantasy players involved in different sports over multiple seasons have concluded that a fantasy game is inherently a contest that rewards skill.[33] This adds to the rampant rise of online fantasy games that are flourishing amongst the virtual sports managers. Moreover, the dimensions of the online gaming market in India have been growing with revenues reaching approximately Rs. 43.8 billion in Financial Year 2018-19 and are expected to reach Rs. 118.8 billion by 2023.[34]

To effectively deal with the rise of fantasy sports games, Nagaland enacted *Nagaland Prohibition of Gambling and Promotion and Regularization of Online Games of Skill Act, 2015*. Prior to the enactment of this Act, fantasy sports games were not explicitly considered as 'game of skill' under any other policy or judgment. The State of Nagaland through this Act introduced a licensing regime to expressly recognize '*virtual sports fantasy league games*' and '*virtual team selection games*' as the skill based games.[35] Additionally, the State of Sikkim enacted *Sikkim Online Gaming Regulation Act, 2008* that legalized online betting in sports games. The majority of Indian States except Sikkim and Goa have enacted legislation barring betting and gambling after placing their reliance on PGA.

Significantly, the High Court of Punjab and Haryana in 2017 (hereinafter "*Dream 11 Case*") had held that a fantasy sports game was predominantly a game based on skills.[36] In this particular case, the plaintiff moved to the court against fantasy sports game company "Dream11" (defendants) alleging that the game was not based on skill and that Dream11 was conducting business that was covered within the definition of gambling in the State of Punjab. The High Court relied upon the *Lakshmanan Case* and opined that *"petitioner himself created a virtual team of a cricket match between two countries by choosing players, who were to play for two countries collectively and after forming a virtual team as per his own selection, knowledge and judgment, which is thoughtful will, he joined various leagues and after registration which was declared before participating, was not about possibility of winning or losing like horse riding not every bettor is winner."*

32 Jennifer Chu, *Study: There's Real Skill In Fantasy Sports*, MIT News Office (Aug. 07, 2020, 10:00 AM), http://news.mit.edu/2018/hosoi-study-skill-fantasy-sports-1107.

33 *Ibid*.

34 IFSG & KPMG, *The Evolving Landscape Of Sports Gaming In India*, KPMG (Aug. 02, 2020, 11:00 AM), https://home.kpmg/in/en/home/insights/2019/03/online-gaming-india-fantasy-sports.html.

35 *Supra* note 8.

36 *Varun Gumber v. Union Territory of Chandigarh and Ors.*, 2017 CriLJ 3827.

Consequently, the plaintiff's appeal was dismissed by the Supreme Court by upholding the observations made by the High Court in favour of the defendants.[37] This resulted in legalizing skill-based fantasy sports game in India. However, this does not imply that every fantasy game that is created is a game of skill. The Supreme Court at any given time possesses the power to test the merits of the game by determining its character.

Although, there have been instances in multiple States wherein the legality of skill games have been challenged even though when the Supreme Court has affirmed that skill-based games are legal. Recently, in *Chandresh Sankhla v. The State of Rajasthan and Ors*[38], a Public Interest Litigation was filed before the Rajasthan High Court alleging that Dream 11 constitute betting and gambling, and is illegal. The respondent company (Dream11) pleaded that Section 12 of the Rajasthan Public Gaming Ordinance, 1949 grants immunity of game involving "mere skill" and Dream 11 has been held to be a game involving skills (majorly). The court after considering the view adopted by the Punjab & Haryana High Court and the Bombay High Court dismissed the PIL while ruling that skill games are legal as exempted by Section 12 and out of the purview of Gambling laws.

Significantly, the Bombay High Court in *Gurdeep Singh Sachar v. Union of India and others*[39] ([hereinafter "*Gurdeep Singh Case*"), dismissed a Criminal Public Interest Litigation by placing its reliance on previous judicial pronouncements of the Supreme Court and other High Courts. The court upheld the legality of online fantasy sports gaming in India and asserted that such games preponderantly involve skills. The court further opined that unlike betting, the outcome of any team winning or losing in fantasy sports was not dependent on any team losing or winning in the actual world.

However, the Bombay High Court's decision in the *Gurdeep Singh Case* was challenged before the Supreme Court in 2019. Furthermore, the Union of India had also filed an appeal before the court. Subsequently, the petitions were clubbed and were jointly dismissed by the Supreme Court while upholding that Dream 11 facilitates a game of skill.[40] However, the Supreme Court had allowed the Union of India to apply to the Bombay High Court for a specific review for the application of Goods & Services Tax (GST) to Dream 11's operations. Thereafter, the State of Maharashtra filed a special leave petition challenging the Bombay High Court's ruling in the *Gurdeep Singh Case* and subsequently, the court

37 *Varun Gumber v. Union Territory of Chandigarh and Ors.*, Diary No. 27511/2017 (Supreme Court of India, 15/09/2017).

38 Civil Writ Petition No. 6653/2019 (High Court of Rajasthan, 14/02/2020).

39 (2019) 75 G.S.T. 258 (Bombay).

40 SLP (Crl.) Diary No. 42282 of 2019 and SLP (Crl.) Diary No. 43346 of 2019.

ordered a stay on the effect of the Bombay High Court's ruling and has initiated fresh hearings after notifying all the parties.[41] Interestingly, to determine the scope of Good & Services Tax (GST), the court has to pierce the veil to identify the true character of the activities. With the rise of such platforms, there is a possibility that the court might get into the merits of such operations. If the second step of the two-step test established by the court in *Satyanarayan's Case* which lays down to identify the profit or gain made by the organizer of a skill game except for the service fee, there are chances that the court can restrict the activities of the fantasy companies.

This order has created problems for the existing judicial pronouncements that are in favour of online fantasy games.[42] Nonetheless, the question that now persists is whether the Supreme Court will end the speculations regarding the legality of fantasy sports games in India, once and for all.

The Sports (Online Gaming and Prevention of Fraud) Bill, 2018

The Sports (Online Gaming and Prevention of Fraud) Bill, 2018 aims to maintain the integrity of sports in India by curbing fraudulent activities and regulating the commercial nature of sporting events.[43] The Bill primarily addresses the corrupt practices that are prevalent in sports such as spot-fixing, inside information etc., and proposes to punish the offenders.[44] It further proposes to regulate the online betting structure including the functioning of fantasy games by introducing systematic licensing for the operators.[45] Additionally, it lays down the procedure for renewal and suspension of such licenses that have been obtained under the Bill.[46] Significantly, Section 20 of the Bill seeks to establish an Online Sports Gaming Commission[47] that will perform the following functions;[48] a) to keep check on the activities of Online Gaming Websites; b) tracking illegal activities and

41 SLP (Crl.) Diary No. 42282 of 2019.

42 Rishabh Bhardwaj & Neil Deshpande, *Supreme Court Stays Operation Of High Court Judgment On Online Fantasy Sports In India*, Khaitan & Co. (Apr. 14, 2020, 10:00 AM), https://www.khaitanco.com/thought-leaderships/Supreme-Court-stays-operation-of-High-Court-judgment-on-online-fantasy-sports-in-India.

43 Gaurav Laghate, *Shashi Tharoor moves bill to regulate online gaming*, The Economic TimeS (Jan. 15, 2020, 06:48 AM), https://economictimes.indiatimes.com/news/economy/policy/shashi-tharoor-moves-bill-to-regulate-online-gaming/articleshow/67534323.cms?from=mdr.

44 *Ibid.*

45 Section 15, The Sports (Online Gaming and Prevention of Fraud) Bill, 2018, Bill No. 259 of 2018.

46 Section 19 & Section 20, The Sports (Online Gaming and Prevention of Fraud) Bill, 2018, Bill No. 259 of 2018.

47 Section 11, The Sports (Online Gaming and Prevention of Fraud) Bill, 2018, Bill No. 259 of 2018.

48 Section 13, The Sports (Online Gaming and Prevention of Fraud) Bill, 2018, Bill No. 259 of 2018.

suggesting suitable measures to curb illegal functioning of Online Gaming Websites; c) to monitor suspicious betting trends of the user including the Licensees; d) coordination with State and Central law agencies to limit illegal transactions; e) to prepare special reports pertaining to Online gaming for the Central Government; f) to grant, revoke and suspend licenses and to decide fees for renewal and other applications. It is to be noted that Section 14 of the Bill sets out the ambit of Online Sports Gaming.[49] It states that no person shall engage in any online gaming activity except through an Online Gaming Website formulated under the Bill, and no person shall host any Online Gaming Server or Website without a prior License obtained under the Bill.[50] The provision further discusses the punishment in the form of imprisonment for a term 1 year and 3 years respectively and fine for the contravention of the above mentioned.[51] Consequently, the provisions of the Bill address the major concerns of functioning and governance of betting and gambling that have never been discussed in the past.

However, the Bill suffers from certain irregularities as it does not particularly state the name of the games that can be declared as a skill or chanced based games. Furthermore, the element of solving a dispute within a reasonable time arising between different stakeholders is also missing in the proposed draft. It is also important that the role of all stakeholders including the service platforms and the governmental agencies must also be clearly determined to avoid overlapping and unnecessary interference.

Although, in view of the success of sports leagues in India the Bill if implemented can prove to be a major contributor to the revenue regime. Significantly, Justice Mudgal, who headed the probe on IPL spot-fixing and betting scandal, himself added that legalizing betting in India would help the government generate income by reducing illegal spot-fixing, betting, etc.[52] Interestingly, the Indian Premier League, one of the richest league in the world places itself at the top of the offshore betting companies' revenue list across the world.[53] Moreover, the Betfair Exchange in 2018 traded a total of $4.3 billion, which is just a small part of the overall legal betting transactions taking place across the world.[54] Additionally, on 5

49 The Sports (Online Gaming and Prevention of Fraud) Bill, 2018, Bill No. 259 of 2018.

50 *Ibid*.

51 *Ibid*.

52 *Mudgal for Legalised Betting*, The Telegraph (Apr. 29, 2020, 11:30 AM), https://www.telegraphindia.com/sport/mudgal-for-legalised-betting/cid/1335100.

53 Somshuvra Laha, *Legally illegal, but you can bet online in India*, The Hindustan Times, (May 21, 2020, 01:15 PM), https://www.hindustantimes.com/india/legally-illegal-but-you-can-bet-online-in-india/story-SW04haVrqOq1MzlFBvOjiP.html.

54 Vithushan Ehantharajah, *Professional betting and how it works during IPL*, Cricbuzz (Mar. 22, 2020, 10:42 AM), https://www.cricbuzz.com/cricket-news/107235/professional-betting-and-how-it-works-

July 2018, the Law Commission of India (headed by Justice B.S. Chauhan) tabled its final report on the prospect of legalizing online betting in India.[55] The Commission functioning under a 2016 order passed by the Supreme Court concluded that it is difficult to prohibit the practices of betting and gambling, although, it is desirable to formulate a regulation to oversee such activities.[56] In countries like the U.S. thee ae over 20 States that have legalized sports betting and are relying on it to cover the budget deficit in 2020.[57] It is expected that in total, sports betting will account for $1 billion in taxable gross gaming revenue this year, with the vast majority of this tax income coming from the 4 leading markets namely New Jersey, Nevada, Pennsylvania, and Indiana.[58] Indian Government should also consider such possibilities to cover the deficit by implementing such Bills.

One of the many reasons against legalizing sports betting is morally based. However, law and morals are not correlated. All the state should and has done to ensure a balance between law and morality is to control actions that for certain people do not perform well on a moral compass; such as drinking, smoking, etc.[59] With respect to the criminalization of betting in sports, we must bear in mind that criminal legislation will only be involved in the event of a breach. There is a gambling or betting agreement between two parties resulting in one party winning and the other losing, and such an arrangement is unlikely to be public harm or a danger to society's morality.[60]

In light of the above, The Sports (Online Gaming and Prevention of Fraud) Bill 2018 has taken into account all the necessary provisions for the smooth regulation of fantasy sports and betting activities. The licensing regime proposed by the Bill will act as an established structure that will guide companies to follow a systematic mechanism. Also, the system of levying fines for the breach of the provisions of the Bill will reduce the chances of contravention as it can lead to suspension and cancelation of the license.[61] In addition to

during-ipl-cricket-rcb-csk-mi-cricbuzzcom.

55 PRS Legislative Research, *Legal Framework: Gambling and Sports Betting Including Cricket in India*, PRS Legislative Research (Mar. 22, 2020, 10:50 AM), https://www.prsindia.org/report-summaries/legal-framework-gambling-and-sports-betting-including-cricket-india.

56 *Ibid*.

57 Charles Norton, *Why States Are Betting On Sports Gambling To Cover Budget Deficits*, Forbes (Jul. 1, 2020, 12:15 PM), https://www.forbes.com/sites/charlesnorton/2020/07/01/why-states-are-betting-on-sports-gambling-to-cover-budget-deficits/#2075ab965255.

58 *Id*.

59 Snehal Walia, *Legalisation Of Sports Betting In India: What Is The Best Bet?*, Lex Sportiva (Jun. 4, 2020, 11:45 AM), https://lexsportiva.blog/2020/06/04/legalisation-of-sports-betting-in-india-what-is-the-best-bet/#_edn7.

60 *Ibid*.

61 Section 20 & Section 22, The Sports (Online Gaming and Prevention of Fraud) Bill, 2018, Bill No. 259 of

this, the penal provisions of the Bill will act as a deterrent against the threat of fraudulent and illegal operations. However, the Sports (Online Gaming and Prevention of Fraud) Bill 2018 lapsed due to the dissolution of the Assembly prior to the 2019 elections. It has not been reintroduced, although, it is considered to be an important foundation for the regulation of sports activities in India.

Challenges Faced by Fantasy Sports in India

The *Dream 11 Case* has changed the landscape of paid online skill fantasy games in India. According to industry estimates, there are nearly 50 to 80 companies scrambling for users in this market with Dream 11 emerging as industry leaders due to hefty investments made by Tencent and Kalaari, while others such as Fantain, Halaplay, and My Team are also witnessing major attention.[62] Perhaps this judgment has laid down a foundation for the industry's surge over the last few years.

However, as different states have the power to control the affairs of gambling within their territories through their legislation, the users and companies are in a constant dilemma to identify between skill and chance-based games that qualify as legal games in different states. Moreover, stakeholders broadly face the following challenges:

I. Lack of a Common Precedent- Games such as Poker and Rummy suffer due to irregularities and vague interpretations laid down under state legislations. Moreover, due to multiple legislations in different states, it becomes difficult to establish a common understanding throughout the country as PGA does not have the authority to rule over the state law.

II. Data Privacy and Data Protection - Right to Privacy is a fundamental right enshrined under Article 21 of the Indian Constitution.[63] A user registering on a paid fantasy sports website needs to provide his personal details including his bank account and PAN Number to withdraw his winnings (if any). The user providing this information gives exclusive access to the operating company. As new companies are entering the market and facilitating the use of fantasy websites, the users are creating their accounts on multiple platforms to experience

2018.

62 Rahul Sachitanand, *Despite Initial Success, Fantasy Gaming May Need A New Strategy*, The Economic Times (Apr. 16, 2020, 12:30 PM), https://economictimes.indiatimes.com/industry/media/entertainment/despite-initial-success-fantasy-gaming-may-need-a-new-strategy/articleshow/68867473.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

63 *Justice K.S. Puttaswamy v. Union of India*, (2017) 10 S.C.C. 1.

different games. However, there is a significant risk that these details might not be completely protected and secured due to the lack of a policy to regulate the functioning of these companies. With the advent of server hacking, and consistent breaches leading to data leaking, the details of users and companies face an imminent danger that requires immediate attention.

III. Lack of a Regulatory Framework- Due to the absence of a *sui-generis* policy to administer the functioning of skill games in India, companies are facing difficulties in executing a systemic business model. With the changing dynamics of technology and gaming interface, a policy to address the issues relating to gaming infrastructure is a necessity. Additionally, at the central level there is no procedural and substantial framework to govern online establishments. Moreover, the lack of clarity regarding games that form part of a legal regime further adds to the problems faced by companies.

IV. Fair Play and Dispute Resolution- A major challenge for the companies is to design a fair-play violation policy that ensures stringent adherence to the guidelines laid down in the rules and regulations. According to the *ThreatMetrix Gaming and Gambling Cybercrime Report*, nearly one out of 20 new accounts are created for fraudulent transactions.[64] This suggests that this rapidly rising industry is affected by fraud and has become a prime target for fraudsters.[65] Moreover, the lack of a dispute resolution mechanism further adds to the problems as the disputes being dynamic in nature require a suitable procedure to resolve the issues of the users.

Conclusion & Recommendations

Skill gaming in India is experiencing tremendous growth that is driven by technological advancements, innovation, and changing patterns of consumer consumption. The current state of regulatory environment and perception of individuals would require this industry to develop policies and procedures such as self-regulation, maintaining high standards of corporate governance, honesty, and accountability. It is imperative that different stakeholders must collaborate with self-regulatory bodies such as the Federation of Indian Fantasy Sports (FIFS) to organize their structure according to a formal code of conduct. Organizations like FIFS promote self-governance for fantasy sports by creating a system

64 Team Springworks, *The importance of background checks in the gaming industry*, Springworks, (Aug. 09, 2020, 12:15 PM), https://blog.springrole.com/the-importance-of-background-checks-in-the-gaming-industry-1be8bdf7326.

65 *Ibid*.

of common industry practices and organizes research-oriented studies to focus upon the changing dynamics of sports industries. It further establishes a complaint and redressal mechanism for the users to resolve their issues and queries pertaining to the functioning of online fantasy games.

Furthermore, the government at the central level must formulate a *sui-generis* policy to promote and establish guidelines for the operation of skill-based games. For example, Malta Gaming Authority has issued *The Skill Gaming Regulations, 2017* to provide a broader framework and logical criteria for the assessment and characterization of a game of skill and their functioning. These criteria consist of multiple conditions such as nature and objective of a game, the required skills, and eligibility to participate.

In addition to this, the government must address the issue of obtainment and the protection of the user's data. This issue can be resolved by the companies by following a set of principles such as end-to-end encryption of the user's transaction to safeguard his details and banking operations. Additionally, a secured system must be developed to store sensitive information of the users. These initiatives would not only reduce the ambiguity pertaining to skill games but will also improve consumer protection while ensuring growth of an industry that contributes to the development of all stakeholders.

Little Red Riding Lawsuit :

An Analysis of The Legality and Application of Single-Color Trademarks in India, With Reference To Christian Louboutin S.A.S. v. Abubaker and Ors.

Manan Katyal*

Abstract

With the shift in international trade, the manner in which brands choose to manifest themselves in the global domain has been modified considerably. Trends worldwide are being experienced which result in the deviation from conventional to non-conventional trademarks, which include a variety of components beyond the traditional words, figures, shapes, etc. This paper focuses on signifying the importance of such a shift and incorporating single-color trademarks into the Indian legislation in light of the implications of its absence, and furthermore, how the position established by the Indian Trade Marks Act, 1999 has failed the development of the jurisprudence on single-color marks across the world. The case of Christian Louboutin S.A.S. v. Abubaker and Ors., comes into play as it shows how a multi-million dollar multinational organization, which has catered to society's crème de la crème for the past three decades, after attaining trademark protection for its red-soled footwear in more than 35 countries worldwide, including India, has been failed by the Delhi High Court in asserting a right over its own distinctive image and single-color mark. A critical analysis of this judgment highlights the impact of the limitation imposed by the exclusive interpretation of the legislation and the archaic and restrictive approach adopted by Courts while assessing matters related to single-color marks. More importantly, this paper suggests that these marks play an invaluable role in strengthening and invigorating an inadequate trademarking regime by widening its applicability, approach and functionality. Lastly, this paper proposes that the impact of inclusivity in trademarking on the economics of trademarks,

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business operations and national market and economy is a proposition considerable enough to allow their adoption under the Indian Trade Marks Act.

KEYWORDS: Non-traditional trademarks, Single-color trademarks, Trade Marks Act 1999, Christian Louboutin

INTRODUCTION

Initially, the purpose and function of trademarks was to act as a source identifier[1], but with the increasing dynamicity of international trade and globalization, the approach has experienced a shift towards providing an immersive and distinguishable brand experience. In coherence to this, businesses worldwide are exploring the infinite opportunities provided by non-conventional or non-traditional trademarks. Such marks have often been considered to be the most striking branding strategy of the 21st century.[2] The technological revolution persuaded many companies to experiment with 'extreme branding' with the aid of color, sound, smell, tastes or even 3D and holographic images.

An integral element of non-conventional trademarks is single-color marks, which associates a specific color with a brand, possessing a certain degree of acquired distinctiveness. Color psychologists and experts hold that through marketing studies and analysis, color can increase brand recognition by up to 80%.[3] Single-color trademarks act as a more potent source-identifier than a conventional trademark as practical employment of these marks have shown visual aspects of brands that transcend languages.[4] For example, a candy bar wrapped in a purple packaging, irrespective of whether the text on the wrapping is in Greek or Japanese, would instinctively allow consumers to associate it with Cadbury.

Hence, single-color marks encompass a full spectrum of sensory perception beyond commonplace visual signs and bear a high potential of economic value, leaving a greater degree of commercial impression on the consumers with its unique appearance, smell, touch or experience.

1 Mark A. Lemley, *The Modern Lanham Act and the Death of Common Sense,* 108 YALE L J 1687, 1695 (1999).

2 LINDSTORM MARTIN, BRAND SENSE: BUILD POWERFUL BRANDS THROUGH TOUCH, TASTE, SMELL, SIGHT AND SOUND 205-6 (1st ed. 2006.)

3 Jill Morton, *Why Color Matters*, COLORCOM (Aug. 09, 2020, 10: 02 AM), https://www.colorcom.com/research/why-color-matters.

4 Margaret A. Boulware, *Emerging Protection for Non-Traditional Trademarks: Product Packaging & Design,* Baker & McKenzie LLP 68 (2015).

Single-Color Marks as Non-Traditional Trademarks

Concept of Non-Traditional Marks

Traditional or conventional trademarking includes a variation between words, figures, symbols, numbers, combination of colors, etc. but of late trademarks have undergone a revolutionary change and have proved to serve a holistic purpose. Modern innovative technology has produced more products to see, smell, touch, taste or hear than people would otherwise get through their non-augmented faculties. Corporations are no longer limiting their scope to only provide a tangible good as they are witnessing a shift towards selling experiences alongside commodities or services. Hence, the new form of trade requires a new form of trademarks, which go beyond the traditional trademarks in nature, characteristics, scope and economic potentials.[5] The development of non-traditional marks proves to show that trade mark law is subject to a dynamic process from which new types of marks may constantly evolve.[6] These marks are of great commercial value to an enterprise and an important part of evolving business strategy and intellectual property portfolio.[7]

Color is arguably one of the most potent tools in packaging, which a single-color mark perfectly encapsulates. Multiple studies of eye movement have reiterated that colors prompt the fastest response of any aspect of a package.[8] It can serve as a fundamental base to assert brand identification and distinction in consumers. The impact and significance of a color in trademarking would be further discussed.

International Jurisprudence on Single-Color Marks

Although a single color had been protectable as a trademark globally, it was only in the 1980s that its registrability was recognized in a judicial precedent. This was a result of the *Think Pink* campaign launched by Owens-Coming Fiberglass Corp. by insulating its fiberglass with a pink tint.[9] This campaign was the genesis which led to the development of the jurisprudence on single-color trademarks around the world. From here on, the impetus required by such marks to develop globally was predominantly contributed by the United States and European Union.

5 Lisa P. Lukose, *Non-traditional Trademark: A Critique,* J. IND. L. INS. 197, 198 (2015).

6 WIPO Secretariat 'New Types of Marks' (SCT/16/2) Sep. 1, 2006, at 57.

7 GRAHAM DUTFIELD & UMA SUTHERSANES, GLOBAL INTELLECTUAL PROPERTY LAW 73 (2nd ed. 2008).

8 D. P. MITTAL, TRADE MARKS: PASSING OFF & GEOGRAPHICAL INDICATIONS OF GOODS, 1.15 (2002).

9 *Re Owens-Coming Fiberglass Corp.*, 774 F.2d 1116 (Fed. Cir. 1985).

Contributions by the US

The authority relating to single color trademarks in the US is *Qualitex v. Jacobson*[10] where the court ruled that there would be no *per se* bar to registration as long as the mark meets the imperative condition of acquired distinctiveness. Trademarks, in their own essence, do not possess the ability to be inherently distinctive. Only once they have been associated with a brand and have acquired the distinctiveness by generating a secondary meaning for themselves, they can be legally registrable. The threshold of acquired distinctiveness can only be passed through consistent usage and market reach with the passage of time. In other words, the mark must have acquired a secondary meaning or a considerable level of significance, which differs from its most obvious and literal interpretation, throughout a substantial period of time.

This is the dominating reason because of which single-color trademarks have remained in the public domain. The mandate that the proprietor must be able to indicate the distinctive nature of the mark is rather restrictive due to the subjective interpretations a color may allow. More often than not, courts are of the opinion that a pure color can never have inherent distinctiveness, but leave open the scope of it being acquired through the process of time.

The acceptance that single-colors can acquire distinctiveness in order to be associated with a brand defied the principles heretofore established across the world and still continues to operate as a precedent even for the more contemporary issues. Since the *Qualitex* case, numerous companies have been successfully able to register their single-color marks, such as UPS[11], 3M[12], Tiffiany & Co.[13], etc. under the United States' trademark legislation.

Additional Mandates Imposed by the EU

The EU, however, adopted a more skeptical and cautious approach by further complicating the law on single-color trademarks and introducing an additional pre-requisite of graphical representation, which poses as a strong barrier to non-traditional trademark registration. A mark can only be graphically represented if its nature, description, features, technicalities, etc. can take the form of a pictorial representation, written description or both, concisely and accurately. Nonetheless, the implications of this condition were slightly more relieved for single-color marks due to the prevalence of a uniform system to standardize colors and

10 *Qualitex Co. v. Jacobson Prods. Co.*, 514 U.S. 159 (1995).

11 Registration No. 2131693 (registering brown as applied to vehicles).

12 Registration No. 2390667 (registering canary yellow as applied to adhesive notes).

13 Registration No. 2359351 (registering robin's egg blue as applied to boxes).

reduce them to a specific and definite shade. This system graded colors by allotting them a numeric code, serving as their unique identifier worldwide. The most prominent example of such is the Pantone Matching System (PMS), apart from the lesser popular ones, such as CMYK, RAL and RGB. Since color standardizing techniques ensure consistency, courts have found them to be admissible while analyzing the graphical representation of single-color marks.

In the forefront of the precedents on graphical representation, lies *Sieckmann v. Deustsches Patent und Markenant*[14], which ruled that a single color could be represented graphically through a "*clear, precise, self-contained, intelligible, durable and objective*" manner.[15]

The irony of the whole situation came into play in 2017 when the EU Trade Mark Implementing Regulation (EUTMIR)[16] was passed which overrode the requirement of graphical representation in the EU altogether. This ultimately loosened the noose around companies on trademarking their non-traditional marks. However, the mandate of graphical representation still subsists in countries such as India, Australia, China and most of Latin America.

Protection through International Agreements

Single-color marks have quite literally left a huge mark worldwide that it even finds itself seeped into the purview of various international treaties, but most particularly covered by the following:

1. The International Registration of Marks under the Madrid Agreement and the Madrid Protocol, 1891, (to which India has been signatory since April 8th 2013)
2. The International Classification of the Figurative Elements of Marks, as established by the Vienna Agreement, 1973
3. The Trade Mark Law Treaty, 1994
4. The European Union Community Trade Marks Regulations, 1996

Despite that these marks are not explicitly mentioned in the definition clause of the TRIPS Agreement of 1994, a plain reading of the section suggests that since it provides an inclusive and open-ended definition, it is wide enough to include such unconventional marks within its ambit.[17]

14 (2003) Ch 487 ECJ.

15 *Id.* at 511. Also see *Libertel Group BV v. Benelux Merkenbureau*, (2004) FSR 65 (ECJ: Sixth Chamber).

16 Regulation (EU) 2017/1001.

17 *Supra* note 5.

Law on Color Trademarks in India

The Trade Marks Act 1999

The Trade Marks Act 1999 (hereinafter referred to as 'the Act'), as metamorphosed from the Trade and Merchandise Marks Act 1958, functions as the leading legislation in India which governs and regulates the qualifications and procedure of registrability of trademarks and the rights and liabilities of their holders.

Section 2(1)(zb) reads:

> *"'trade mark' means a mark capable of being represented graphically and which is capable of distinguishing the goods or services of one person from those of others and may include shape of goods, their packaging and combination of colors."* [18]

Section 2(1)(m) reads:

> *"'mark' includes a device, brand, heading, label, ticket, name, signature, word, letter, numeral, shape of goods, packaging or combination of colors or any combination thereof."* [19]

Hence the conditions to be qualified for a registered trademark in India are similar to those as contributed by the EU, i.e. graphical representation and acquired distinctiveness. Additionally, a mark must not fall within the absolute grounds for refusal of registration as provided under Sections 9 & 10 of the Act.

The Manual of 2015 by the Ministry of Commerce

In order to compliment the Act, the Ministry of Commerce and Industries released The Manual (Draft) of Trademarks Practice and Procedure of Indian Trademark Registry. The Manual analyzed that Section 2(1)(m) does not exhaustively cover the categories of legally protected marks and due to its open-ended nature determined that single color packaging has the potential to be classified as a valid trademark, subject to judicial scrutiny on a case-to-case basis.[20] Adopting a cautious stance towards assessing distinctiveness for colors, the Manual states:

> *"As color per se is not normally used by traders as a means of brand identification, unlike words or pictures, consumers are not in the habit of*

18 Section 2(1)(zb), Trade Marks Act, 1999, No. 47, Acts of Parliament, 1999 (India).

19 Section 2(1)(m), Trade Marks Act, 1999, No. 47, Acts of Parliament, 1999 (India).

20 Dev Gangjee, *Non-Conventional Trademarks in India,* 22(1) NLSI R. 67, 86 (2010).

> *making assumptions about the origin of goods and services based solely on their color or the color of their packaging. It follows therefore, that a single color will only in exceptional circumstances be capable of denoting the origin of a product or service. Marks consisting of a single color will usually be liable to objection under Section 9(1)(a) of the Act because they inherently lack the capacity to distinguish."* [21]

The Manual also suggests that unless colors are used in a special or particular pattern or arrangement, it is not an imperative that the color would lend distinctiveness as a badge of origin,[22] i.e. the colors may be considered generally decorative or a mere property of things, and not sufficiently distinctive as a trademark.[23]

Case Study of Christian Louboutin S.A.S. v. Abubaker & Ors.

Background of Christian Louboutin

French footwear designer Christian Louboutin sells more than five hundred thousand pairs of shoes bearing his name each year[24], generating an average annual revenue of $300 million through its 71 stores spanning 29 countries. At prices between $400 and $6,000 a pair[25], these high-heels are fashion's ultimate symbol of status and opulence.[26] In a comparatively short span of time, Louboutin's brand skyrocketed as it had been spotted on many of their high profile clients, including celebrities, global icons and even the royalty. Over the years, the red sole has become a great visual cue, widely recognized by consumers as a trademark of the Louboutin brand[27] and shaken the fashion industry to its core. Louboutin, apart from trademarking its red soles in more than 35 countries across the world is also a valid holder of a total of eight marks in the Indian Trademark Registry[28] since 2008.

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21 Ministry of Commerce & Industries, Section 12.2.5, The Manual (Draft) of Trademarks Practice and Procedure of Indian Trademark Registry, 2015 (May 28, 2015).

22 *Id.* Section 5.2.1.

23 *Supra* note 20.

24 Lauren Collins, *Sole Mate: Christian Louboutin and the Psychology of Shoes,* NEW YORKER (Aug. 09, 2020, 11:30 AM), http://www.newyorker.com/reporting/2011/03/28/110328fa_fact_collins.

25 *Ibid.*

26 *High Net Worth Shoppers Rank Luxury Brands on Multiple Criteria,* LUXURY INSTITUTE BLOG (Aug. 09, 2020, 11:45 AM), http://blog.luxuryinstitute.com/?p=993.

27 Alison Frankel, *Louboutin Red Sole Trademark Case: Color War at the 2nd Circuit,* THOMSON REUTERS (Aug. 09, 2020, 12:10 PM), http://blogs.reuters.com/alison-frankel/2012/01/06/louboutin-red-sole-trademark-case-color-war-at-the-2nd-circuit/.

28 Indian Trademark Registration Numbers 1644051, 1839047, 1922048, 1931553, 2341890, 2341891, 2341895 & 2341896.

Analysis of the Judgment

Genesis of the Dispute: The Original Civil Petition

The case finds its origin from the Original Civil Petition filed in the Delhi High Court, adjudged on 25th May, 2018 by a Single-Judge Bench comprising of Justice Valmiki J. Mehta.[29] In this matter, Louboutin had filed for an injunction against the Respondent, a Mumbai-based company named Abubaker, who had been manufacturing and selling footwear bearing a red sole, alleging infringement and passing-off. Not only was the placement of the mark on the sole problematic, but the shade used by the Respondent appeared to be strikingly similar to the one globally used by Louboutin.

The judgment manifests a sense of peculiarity as on one hand the Court acknowledges Louboutin's trademarks of its red sole, as granted by the Registrar of Trademarks,[30] and on the other hand considered multiplicity of colors as a *sine qua non* for the interpretation of Section 2(1)(m). In conclusion, the Court isolated a single color mark from the scope of Act and stated that if the red sole cannot qualify as a valid mark under the Act, then it corresponds to the validity of its trademark.

The court also relied on the functionality doctrine, a well-established principle of trademark law which invalidates any mark that may be functional in nature.[31] Any feature of a product that may be considered functional cannot be trademarked in order to prevent a brand from unduly monopolizing it and in the larger scheme of events, to foster healthy competition. Section 9 of the Act declares functionality as an absolute ground for refusal by stating that color is applied to certain goods for the purpose of creating appeal, resulting in aesthetic functionality and the use of color performs only a non-trademark function, as it is a characteristic of the goods.

Appeal to the Division Bench

Subsequently, an appeal was filed to a Division Bench comprising of two judges of the same court, which released a homonymous judgment on April 11th 2019.[32] The Court ruled that the Single Judge was incapable of rendering an accurate decision due to the limitation of representation on behalf of the Respondents and any determination could only be provided after a deliberation of their case. Also, the procedure adopted by the Single

29 *Christian Louboutin S.A.S. v. Abubaker and Ors.*, 2018 (74) PTC 301 (Del) (India).

30 *Supra* note 28.

31 *See* Qualitex.

32 *Supra* note 29.

Bench, of determining a trademark matter *suo motu* by the Court on its very first hearing, was looked down upon. In conclusion, this Court adjudged to set aside the judgment of the Single Bench and ridiculed the lack of procedural compliance, but reinstated the original civil petition by referring this case to a different bench. Regardless of the consequences, the Division Bench had implicitly agreed with the rationale provided in support of the previous judgment, without going into the merits of the case.

Criticism of the Judgment

Narrow Interpretation of Section 2(1)(m)

Section 2(1)(m) defines a mark within the scope of the Act. On a bare reading, without an in-depth interpretation of the statute, the nature of the section is open-ended, inclusive and, more importantly, inexhaustible. Noticeably, it uses the word 'includes' while enlisting examples of permissible marks and not 'is limited to'. The Bench analyzed the legislation to have *deliberately* and *intentionally* used the expression 'combination of colors' and is of the opinion that the legislators carefully omitted a singular color. This signifies the narrow interpretation of the section as the Court looked deeper into it than necessary. A primary function of any statute is to be accommodating towards the advancements or developments in the jurisprudence of the law as well as with the time, which the open-ended nature of the section aimed to fulfill. Unfortunately, a motive the court had completely overlooked.

Disregards Louboutin's Registered Trademarks under the Indian Trademark Registry

As specified, Louboutin holds 8 valid trademarks with the Indian Trademark Registry.[33] Irrespective of whether the court deems the Louboutin's trademark status to be tenable, it essentially allowed the Respondent to pass-off and misuse a registered trademark under Indian law and override the status of registration granted by the Registrar of Trademarks. The jurisprudence of trademarks in India recognizes both a statutory and common-law remedy in order to protect the mark of a proprietor, both of which were bypassed by the judgment. By disregarding these registered trademarks while stating that the single-color mark cannot qualify as a trademark, the Bench set a very dangerous precedent that may prove to be detrimental in upholding the value, status and integrity of not only trademarks, but intellectual property as a whole.

33 *Supra* note 28.

Violates Sections 29(1) & 31 of the Act

Each of the conditions of infringement, as provided under Section 29(1) have been fulfilled in this case and each of the resultant circumstances have been actualized as under Section 29(4). Irrespective of whether such a mark is within the common practice of the industry, it was infringed by Respondent, who, rather than being penalized, was awarded the case. Additionally, the judgment omitted the consideration of Section 31 which affirms that there exists a *prima facie* presumption in the validity of a registered trademark in any legal proceedings, as the Bench failed to provide the benefit of the doubt to the Petitioner regarding the acquired distinctiveness of the brand.

Neglects the Application of Section 2(1)(zb)

Each mark contesting registration under the Act must pass the two conditions under Section 2(1)(zb); the mark must be capable of being graphically represented and distinct/ distinguishable. As put forward, single-color trademarks can be graphically represented through international color standardizing systems. Louboutin's red can be graphically represented on the Pantone scale as PANTONE 18-1663 TPX Chinese Red.[34] Moreover, Louboutin has acquired its distinctiveness through the differentiation of their product from the prevalent standards in the fashion industry in the past three decades. At the time of its conception, no brand had ventured into capitalizing on the color of the soles of a pair of stilettoes. Also, through the passage of time, the mark has become a symbol of high fashion and a unique brand identifier, not only to a fashion-savvy person, but even an extra-terrestrial.

Overlooks Indian Jurisprudence and Precedents on Trademarks

Previously in the same court, in the case of *Christian Louboutin S.A.S. v. Pawan Kumar & Ors.*[35], the Bench relied on the following in determining the red sole as a distinct trademark: (i) Louboutin's status as a well-known luxury brand in over 60 countries; (ii) extensive and continuous use of the red sole trademarks since 1992; (iii) knowledge of Indian customers of the red sole trademarks; (iv) Louboutin's status as the sole licensor of the red sole trademarks and several successful enforcement actions in the past and (v) extensive promotion of the red sole trademarks in India. However, the Single Judge failed to give their regard towards this precedent and a contradictory judgment had been released. Not only so, but with respect to the cancellation or revocation of registered trademarks

34 *Pantone 18- 1663 TPX Chinese Red,* PANTONE (Aug. 09, 2020, 12:05 PM), https://www.pantone.com/color-finder/18-1663-TPX.

35 (2018) 73 PTC 403 (Del) (India).

that the Single Bench had moved for, neither did the Act nor its bylaws authorize the court to invalidate the registration on a *suo motu* basis. The Hon'ble Bombay High Court has previously held on this matter that a court has this exceptional authority only when the invalidity of registration is raised by the Respondent at an interim stage.[36] The court also cautioned that such discretionary power can only be exercised as a consequence of a considerable threshold of *prima facie* proof being submitted before the court establishing the ex facie illegality or fraud involved in securing the registration from the Trade Marks Registry.[37] Since this condition was not met in the present case and the motion of revocation was solely raised by the Bench, it was in contravention with the precedent set by the apex court.

Should the Indian Legislation Focus on Inclusive Trademarking by Adopting Single-Color Marks within its Ambit?

In the absence of an encompassing legislative system, various grey areas tend to appear with respect to the application of laws, which ultimately led to inconsistent judicial pronouncements. The battle fought in *Christian Louboutin SAS v. Abubaker* was not one specifically for single color marks but was a fight for a greater representation of inclusive trademarking in India. Many a times, the Indian judiciary has turned a blind eye towards maintaining an inclusive approach with ruling on non-traditional trademarks,[38] which have only deepened the ambiguity with respect to their legality.

In a nutshell, the essence of this section moves to substantiate the case for the adoption of single color marks within the Indian legislation, as this approach strengthens and invigorates a national trademark regime. As non-traditional marks, most notably single-color marks, instill flexibility within a trademark system, they can serve the most integral and fundamental purposes of trademarks in a more efficient and effective manner, as compared to traditional marks. From functions such as enforcing product differentiation to enhancing branding, single-color marks witness an all-pervasive impact on the trademarking regime. The chain reaction that this has on business operations w.r.t. the economics of trademarks can allow businesses to expand their market reach and experience greater profits. With limited trademarking, not all business can take advantage of their intellectual currency, which as the recent age has shown, can be of any form and feature. Inclusivity in trademarking allows business to expand their brand presence in unprecedented ways. Further, stronger

36 *Lupin Ltd. v. Johnson & Johnson*, 2015 (61) PTC 1 [BOM] [FB] (India). See also *Shakti Bhog Foods Ltd. v. Parle Products Pvt. Ltd.*, NM (L) No. 2178 of 2012 along with Appeal (L) No. 674 of 2012 (India).

37 *Ibid.*

38 See *Britannia Industries Ltd. v. ITC Ltd.*, (2017) 70 PTC 66 (Del) (India); *Cipla Ltd. MK Pharmaceuticals*, (2008) 36 PTC 166 (Del) (India).

trademarks have a significant influence on the domestic market and economy as it allows the Indian legislation to be more consistent and compliant with international trends and practices in trademarking, providing a lucrative growth to both FDI and foreign exchange.

How Does the Adoption of Single-Color Marks Strengthen & Invigorate a Trademark Regime?

Product Differentiation & Identification

Any form of trademarks across the world primarily aim towards product identification & differentiation.[39] Single-color trademarks are a more potent source-identifier than a conventional trademark as they manifest visual aspects of brands that transcend languages.[40] Clinical psychology and neuroscience tell us arguably that color is a very powerful tool in learning and educational settings as our brain can recall a color stronger, faster and with a greater sense of recollection than it can for words or figures.[41] Color psychologist and expert, Jill Morton goes beyond to hold that through marketing studies and analysis, color can increase brand recognition by up to 80%.[42] Courts have also been of the opinion that if a color is sufficiently distinct and peculiar, it has the power of overriding all of the brand's other trademarks and can serve as a sole primary mark.[43] As a conclusion, colors have a greater weightage in our minds, which allows us to associate and link it with a brand in a way that traditional trademarks would be incapable of. While making consumer choices, a consumer would, hence, be able to identify and differentiate a product bearing a single-color mark in an unprecedented way, allowing trademarking to be more effective and impactful.

Protects the interests of the Consumer

As the identity of a brand has been embedded deeper in our minds with the help of color, these marks assist in protecting the consumer, one of the fundamental objectives of trademark law. An ordinary consumer is riddled with a myriad of choices in the market, which can only be filtered through their image of the brand. This protection can be against deceptive and unethical trade practices, misrepresentation or even extended by providing a standard of authentication. Not only so, but once product identification and differentiation

39 V. V. Solpe, Managing Intellectual Property 39 (5th ed. 2016).

40 *Supra* note 4.

41 Mariam Dzulkifli & Muhammad Mustafar, *The Influence of Color on Memory Performance: A Review,* 20(2) MALAYS. J. MED. SCI. 3, (2013).

42 *Supra* note 3.

43 Dyson Ltd's Trade Mark Application, 2003 RPC 47.

is enhanced, a consumer's search costs reduce considerably, which plays a compelling role while exercising consumer choices.

Allows Branding to Adopt a Wider Approach

Additionally, single color marks provide a wider approach in low literacy areas. Companies are continually endeavoring to expand into a new consumer base, market or territory and with single color trademarks, they are able to provide a multi-sensory perception. Visual perceptibility cannot be the unconditional prerequisite for developing a brand image.

In low-literacy areas, people often perceive and connect brands with the corresponding color of the product or its packaging. As the illiterate populace is more susceptible to being misled or misguided, their only source of identification is a color, which to them surpasses language. They simply cannot rely on the arrangement of characters they cannot decipher in a word mark or shapes and figures they have no relatability towards in a shape mark. Not only so, but non-conventional marks in general have tapped into the market of specifically catering to visually impaired people where they identify goods through their scent, feel and sounds.[44]

Provides an Enhanced Appeal

Selling a product with which a consumer can associate a memory or an experience, has been proven to be more appealing and attractive. Modern-day marketing doesn't limit itself to a mere product or service, but to a whole immersive and memorable experience. Attaching a memory or a cultural significance to a product makes it more preferable as it doesn't only provide a good, but a holistic service. In this way, colors have often been used to express an emotion or a sensation with which a consumer can attach with the brand.

Taking the example of Christian Louboutin, the reason why the color red was chosen to represent the identity of the brand is because it is flirtatious, the color of passion and irresistible by men.[45] Analyzed through a historical sociological approach, the color red was reserved only for the nobility, as it signified power, status and privilege,[46] and in

44 Lisa P. Lukose, *Non-traditional Trademark: A Critique,* J. IND. L. INS. 197, 198 (2015).

45 *Why Christian Louboutin Heels Have a Red Sole*, CULTURE TRIP (Aug. 09, 2020, 01:15 PM), https://theculturetrip.com/north-america/usa/new-york/new-york-city/articles/why-christian-louboutin-heels-have-a-red-sole/; *The Secret Behind the Red Soles of Christian Louboutin,* CATAWIKI (Aug. 09, 2020, 01:20 PM), https://www.catawiki.com/stories/4533-the-secret-behind-the-red-soles-of-christian-louboutin.

46 Susan Stamberg, *The Color Red – A History in Textiles,* NPR (Aug. 09, 2020, 10:00 AM), https://www.npr.org/2007/02/13/7366503/the-color-red-a-history-in-textiles.

order to allow his consumers to break from the constrains of society, he opposed from the industry standard to have a monochromatic or black sole. Only by employing one color, Louboutin has expressed his ideology and intent behind the whole brand.

Effect of a Stronger & More Inclusive Trademark System on the Economics of Trademarks and Businesses

Contribution to the Intellectual Currency of a Business

The modern economy has taken a complete shift from the *brick and mortar* economy, where wealth was measured through the possession of assets, to an economy governed by intellectual currency.[47] The number and diversity of a firm's IP is now paid an unprecedented weightage while ascertaining its wealth, market value and economic potential. In the long run, the competitiveness of the business organizations and their economic prosperity is enhanced by their trademarks and brand image.[48] In other words, the more trademarks an organization owns, it acts as a factor in reassuring investors and other stakeholders of their economic position, reaffirming their market reach, market value[49] and investment in R&D, and furthermore, enhancing their intellectual currency.

Including single-color trademarks would provide a comprehensive and thorough system which allows businesses to cover aspects of its trade dress that would've otherwise been unprotected and unregulated. This only opens the doorway for brands to counterfeit and pass off marks of another, which technically are excluded under law, but for the development of which, an uncountable sum of money, innovation and research has been invested. These marks go beyond the scope of traditional trademark protection and opens various avenues for brands to capitalize on their creations. This form of trademarking can be viewed as an additional tool to create exclusive rights[50].

Results in the Reduction of Marketing Costs

As firms in countries with a weaker system of trademarking cannot legally protect each aspect of their trade dress, they expose their brand to multiple risks. This subsequently

47 Kamil Idris, *Intellectual Property: A Power Tool for Economic Growth,* WIPO 55 (2003).

48 *Brand - Reputation and Image in the Global Marketplace*, WORLD INTELLECTUAL PROPERTY ORGANIZATION (Aug. 09, 2020, 02:30 PM), https://www.wipo.int/edocs/pubdocs/en/intproperty/944/wipo_pub_944_2013.pdf.

49 Christine Greenhalgh & Mark Rogers, *The Value of Innovation: The Interaction of Competition, R&D and IP,* 35(4) R POL. ELSEVIER 562, 577 (2006).

50 Irene Calboli, *Beyond Patents: The Problems of Non-Traditional Trademark Protection for Medicines and Health Technologies,* 51 INTL. R. IP & COMP. L. 1, 4 (2020).

translates into enhanced costs as compared to their counterparts in order to differentiate their products and strengthen their brand image. These costs can arise in the form of extraordinary promotional or marketing costs, costs incurred towards innovation and product development, and investments made to reinforce or emphasize their Unique Selling Proposition (USP). As counterfeiting and imitating goods muddle the perception of consumers with relation to originality, source and quality, such costs are primarily incurred to combat the counterfeited or imitated goods being sold in the market due to lack of protection provided by the legal regime. Under an inclusive trademarking system, a brand would not be compelled to expend a great amount towards aggressive marketing and promotion as the distinctive image of each element of their dress can be legally protected, allowing their products or services to be easily identifiable.

Boosts Innovation & Invention

Stronger trademarks also stimulate innovation and invention with the interplay between IP and competition. Trademarks regulate competition in the market as it grants the holder an exclusive right to monopolize their mark, restricting the power of competitors to make an undue profit. As competition and innovation are inversely related due to the entry of a large number of rivals in the market,[51] limiting competition through trademarking facilitates and encourages innovation. Once businesses are provided with security of protection against new entrants in the market, by stronger trademarks, it is perceived as an economic incentive to invent and as a tool to monetize on innovations into more and new aspects of their trade dress that previously fell within the public domain. These undertakings require substantial amount of expenditure and resources, they can only be entered into if foreseeably a business can be afforded protection.

The sole of a stiletto had often remained as an afterthought for any footwear designer, up until the rise of Louboutin. The brand's ability to attain a trademark moved the designer to adopt this unique and innovative take towards branding by trademarking a part of a stiletto often overlooked. With the protection granted worldwide, Louboutin has been incentivized to make the most of the sole by using innovative techniques to amplify its sales.

Allows Budding Companies to Establish their Unique Selling Proposition (USP)

Broader trademarking policies can assists micro, small and medium companies in finding their USP. As a nascent company, in order to compete with market leaders, it is essential to establish a competitive edge and a unique and differentiable identity. Smaller brands are

51 Philippe Aghion et al., *Competition and Innovation: An Inverted-U Relationship,* 120(2) QUART. J. ECON. 701, 703 (2005).

required to be more creative and inventive while developing their mark and brand image. In order to facilitate this, they often employ non-traditional trademarks to stand out from the norms. Considering the example of Christian Louboutin, in the early 90s, multinational brands such as Manolo Blahnik, Fendi and Gucci, just to name a few, were the frontrunners in the international luxury footwear market, each being valued at more than a hundred million dollars. The red sole played a huge role in allowing Louboutin to establish his mark and surpass his competitors, which had been reigning the market for half a century. It was *sole*ly on this mark that he was able to establish a secure customer base and attract media publicity with his unconventional take on the fashion industry

Effects on the Domestic Market and Economy

Reinforces the Flow of FDIs

Once a country is able to strengthen their trademark regime, the most primary and direct impact is on the inflow of FDIs, due to the enhanced appeal of the national market to the international economy. Quite naturally, a stronger legal system attracts and incentivizes businesses to expand operations as it assures security of their intellectual property and also contributes significantly to the ease of doing business.[52] Also, if a country's policies at are par with the developments on an international scale, expansion becomes a more harmonious process.

Often, businesses choose to avoid expanding into countries where they can foresee that they would not face utmost protection. As a matter of fact, around 25% of leading American, German and Japanese high-tech firms have been reluctant from investing, either directly or through joint ventures, in countries with weaker IPRs in order to prevent decade-long legal battles and also to avoid the complexities regarding their functioning.[53] Therefore, it is quite reasonable for business to take a precautious approach by inclining themselves towards expanding and diversifying in countries where they feel that every aspect of their intellectual property would be protected.

Further, econometric studies have indicated that FDIs respond positively and elastically to stronger IPR regimes, most notably towards trademarks.[54] Empirical work demonstrates that

52 Amanda Perry, *An Ideal Legal System for Attracting Foreign Direct Investment? Some Theory and Reality,* 15(6) A.U. INTL. L.R. 1627, 1632 (2000).

53 Edwin Mansfield, *Academic Research Underlying Industrial Innovations,* 77(1) R. ECON. & STATS. 55, 59 (1995).

54 Keith E. Maskus, *The Role of Intellectual Property Rights in Encouraging Foreign Direct Investment and Technology Transfer,* 9 DUKE J COMPARATIVE & INTL. L 109 (1998).

the strength of trademarks have important effects on multi-national enterprises' decisions on where to invest and whether to transfer advanced technologies and capital.[55]

To substantiate this school of thought, Park[56] and Reynolds[57] had developed a trademark rights index, which served as the standard for comparing and measuring the development of a country's trademark system. This index includes coverage (referring to the types of names and symbols which can be legally protected), procedures (which considers the degree of enforcement of rights and restrictions on the holder) and implementation of international treaties. As per a study conducted by the OECD over a period between 1990 and 2005, with a range of 120 countries, it was suggested that a 1% increase of the indices of trademark protection corresponded a 3.8% increase in FDI.[58] In conclusion, intricate and specialized trademark policies have been witnessed to be a factor in influencing investment decisions to a great degree.

Augments the GDP

While analyzing the bigger picture, a direct correlation can be found between the strength of a country's trademark protection and its economic competitiveness. In the words of the International Chamber of Commerce:

> *"…the countries that are perceived as having the strongest IP protection are routinely found to be among the most economically competitive countries in the WEF (World Economic Forum) surveys … those (countries) perceived as having the weakest IPR systems tend to rank among the bottom for growth and competitiveness."*[59]

The most noticeable impact can be discerned through the GDP. IP-intensive industries have been accounted as one of the most significant contributors to GDP in the US, as single-handedly in 2014, they had added a value of USD 6.6 trillion to the GDP which was 30% higher than that of 2010, out of which trademarks played the second largest

55 Keith E. Maskus, *Intellectual Property Rights In The Global Economy*, 151 (2000)

56 Walter G. Park, *Do Intellectual Property Rights Stimulate R&D and Productivity Growth,* AMERICAN U. J. 77, 90 (2003).

57 Taylor W. Reynolds, *Quantifying the Evolution of Copyright and Trademark Law,* AMERICAN U. J. 145, 151 (2003).

58 Cavazos Cepeda et al., *Policy Complements to the Strengthening of IPRs in Developing Countries*, 104 OECD TRADE POLICY 21 (2010).

59 International Chamber of Commerce, *Intellectual Property, Source of Innovation, Creativity, Growth and Progress* 7 (2005).

role, after patents.[60] According to a study conducted on the effect of IP on the German economy between the period of 1999-2009, trademarks have a viable potential to influence a country's GDP with the strongest economic impact, ahead of patents and designs by a great margin.[61]

Positively Influences Imports & Exports

Moreover, empirical evidence prescribes that, *ceteris paribus*, countries with stronger trademarks are able to attract more imports and facilitate a greater volume of exports. Interestingly enough, the application of trademarks seems significantly important in increasing exports of relatively low-technology goods, for e.g. clothing and other consumer goods.

This is because under a more developed system, the goods produced by foreign firms would be lesser exposed to imitation and counterfeiting, hence incentivizing them to boost their exports.[62] This starts off chain reaction ultimately resulting in lowered costs of exporting, as global firms would not find themselves in a predicament to discipline local imitators through decreasing their prices in order to appear more competitive, aggressively market themselves or even undertaking legal action.[63]

Upgrades the Quality of Goods & Services

In an industry, which witnesses a large number of firms producing the same line of products, a competitive advantage can only be obtained by higher quality products. The operation of stronger and more inclusive trademarks upholds the quality of goods and services as it represses counterfeiting and infringement. This prevents free riding by firms with lower investments in R&D and innovation off of the products of their counterparts and producing lower quality products. This process is particularly important in the case of food products, beverages, pharmaceuticals, cosmetics, etc. where counterfeited goods can prove to be hazardous or injurious. Not only so, but it ups the ante for the standard of goods available in a national market, allowing it to be internationally competitive and simultaneously enhancing consumer expectations. This creates a ripple effect as firms would be compelled to invest a greater deal of resources in innovation to enhance their product quality and grasp a greater market share.

60 *Ibid.*

61 Andreas Bielig, *Intellectual Property and Economic Development in Germany,* 39 EU. J LAW & ECON. 607 (2015).

62 Keith E. Maskus & Mohan Penubarti, *How Trade-Related are Intellectual Property Rights,* J. INT'L ECON. 227, 234 (1995).

63 M. Scott Taylor, *TRIPs, Trade, and Technology Transfer,* 26 CAN. J. ECON. 625, 626-27 (1993).

Additionally, brands producing higher-quality products once trademarked would have assured returns on their products as trademarking allows them to monopolize over a market, product or service. Once a firm can foreseeably predict returns, they are encouraged to uphold the quality of their products, if not to enhance it, in order to maintain their consumer base. After all, a brand's trademark is not only an identifier of its source but also of its quality.

Conclusion

The decision of the High Court in *Christian Louboutin S.A.S. v. Abubaker and Ors.*[64] can be viewed as a setback to intellectual property law development in India as the judiciary deemed it appropriate to adopt such an archaic approach in the realm of trademarks. The Court showed inconsideration towards the magnitude to which non-conventional trademarks, specifically single-color trademarks, have increased in terms of popularity and consumer-response, not just globally but even in India.

One of the pressing questions of the case is the unclear and unspecified ambit of a 'mark' under the Act[65], continually unanswered by the Judiciary. The definition utilizes the word 'includes', from which it can be construed that the list of marks in the section is not exhaustive and not limited to the conditions provided in the section. The basis of the judgment is on a presumptuous ground as the Hon'ble Single Judge construed the interpretation of the section to not include any other ground for granting trademark protection. Ambiguity in statutory interpretation opens the doors for an inconsistent and incoherent judiciary, which in turn may invalidate and discredit the sole purpose for which a piece of legislation may have been enacted.

Middle-income economies have come to account for most trademark applications filed across the world, i.e. 54 percent.[66] To a considerable extent, this trend has also been witnessed in India. According to the WIPO, India received 2.5 times more trademark applications by GDP in 2011 than it did in 1985.[67] Undeniably, it is experiencing a spurt in the number of trademark applications and with the marks protectable under traditional trademarking limiting more day by day, businesses would be indubitably compelled to shift to non-traditional trademarks. This foreseeable shift, however, cannot be accommodated by the Trade Marks Act, 1999 presently.

64 (2019) 78 PTC 262 (Del).

65 Section 2(1)(m), Trade Marks Act, 1999, No. 47, Acts of Parliament, 1999 (India).

66 *Supra* note 48.

67 *Ibid.*

As single-color marks invigorate existing policies to provide a more realistic and an *avant-garde* touch, their inclusion would only strengthen and expand a trademarking regime by not only fulfilling its integral purposes in a more efficient and effective manner, but would also allow trademarks to go beyond the conventional scope of appeal, applicability and relatability. As a result, such an impact creates a ripple effect on businesses and the economics of trademarks, which cannot be overlooked as an actor in benefitting the national economy overall.

Hence, the Legislature is ultimately met with two options; it can either expand the scope of its trademark regime in order to accommodate the growth in trademarking being experienced or be left behind on a global sphere by letting its businesses and economy take the blow for its regressive approach.

A Shift to Inquisitorial Model: Assessing the Challenges to India's Criminal Justice System

Merrin Muhammed Ashraf*

Abstract

The criminal justice system in India is largely adversarial in nature. The Malimath Committee Report (2003) found faults with the adversarial system for failing to secure conviction of the accused persons without delay and proposed a shift to the judge-controlled inquisitorial system. This recommendation of the Malimath Committee has now found favour with the Union Home Ministry that is reportedly deliberating wide-ranging changes to India's criminal justice system with a view to secure higher conviction rates and speedy disposal of cases. This article examines whether adoption of an inquisitorial system is an appropriate measure to salvage India's ailing criminal justice system. The article critically examines the arguments in favour of adoption of an inquisitorial system and the benefits that are claimed to flow from it. It is seen that though inquisitorial system is better at arriving at a less erroneous verdict, adversarial system ensures procedural fairness to the parties, especially the accused. Moreover, India's institutional preparedness to shift to a judge-controlled procedure under the inquisitorial system without jeopardizing the rights of the litigants is also doubtful. Therefore, instead of a shift to inquisitorial system, the article proposes reformation of the existing system so that it satisfactorily meets the ends of criminal justice. In that regard, the article highlights two out of the many issues that plague India's criminal justice system -- failure to ensure a level-playing field for the indigent accused and failure to adequately protect the rights of victims – and suggests solutions for the same.

Introduction

The Union Ministry is reportedly mulling wide-ranging changes to the criminal laws of the country by amending the Indian Penal Code, 1860, the Code of Criminal Procedure,

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1973 and the Indian Evidence Act, 1872.[1] One of the changes proposed is the adoption of inquisitorial system of criminal justice or at least some elements of it.[2] The expectation is that a judge-controlled procedure of the inquisitorial system will result in speedy disposal of cases and larger number of convictions than the lawyer-led trials of the adversarial system.[3] In fact, the Malimath Committee Report of 2003 also recommended a shift from the adversarial to the inquisitorial model.[4]

This article aims to examine whether adoption of the inquisitorial system would be an appropriate measure to cure India's ailing criminal justice system and whether higher conviction rate is a goal worth pursuing at the sake of fair trial rights of the accused. A change in the criminal justice system will have implications beyond the court-room; it has the potential to impact popular perception of legitimacy of the criminal law process.[5] An important issue to be considered is India's preparedness to deal with the consequences of giving more power to the judges, particularly for the rights of the parties involved. Instead of a wholesale shift to inquisitorial model, the author suggests reformation of the existing system in order to satisfactorily meet the ends of criminal justice.

Adversarial System *versus* Inquisitorial System – A comparison

Adversarial system and inquisitorial system are the two major criminal justice systems practiced in the world. While adversarial system emerged from the common law tradition, inquisitorial system owes its origin to Roman law and is adopted by civil law countries.[6] Though both systems have as their primary objective punishment of those guilty of crimes, the method adopted to achieve this objective differs greatly.

In an adversary system, as the name suggests, the trial is envisaged as a contest between the two parties (the prosecution, representing the victim, and the defence) who strive to establish their version of facts as the truth with the help of evidence. The prosecution is required to prove the guilt of the accused beyond reasonable doubt.[7] The accused is also

1 Rahul Tripathi, *IPC, CrPC in for change as Union home ministry tries to speed up justice*, The Economic Times (Jan. 7, 2020, 10:00AM), https://economictimes.indiatimes.com/news/politics-and-nation/ipc-crpc-in-for-change-as-mha-tries-to-speed-up-justice/articleshow/73063397.cms?from=mdr.

2 *Id.*

3 *Id.*

4 MINISTRY OF HOME AFFAIRS, GOVERNMENT OF INDIA, COMMITTEE ON REFORMS OF CRIMINAL JUSTICE SYSTEM 265 (2003) [hereinafter, *Malimath Committee report*].

5 Janet Ainsworth, *Procedural Justice and the Discursive Construction of Narratives at Trial: Global Perspectives*, 4 Languages Cultures Mediation 79 (2017), (Jan. 07, 2020, 11:00AM), https://digitalcommons.law.seattleu.edu/faculty/807.

6 *Id.* at 79.

7 K.N.C. Chandrasekharan Pillai, R.V. Kelkar's Criminal Procedure 346 (6th ed. 2018).

given fair opportunity to defend himself and is also given important rights like the right to remain silent.[8] In an adversarial trial, it is the parties that control the narrative presented before the court; they decide the evidence to be presented, the witness to be examined etc.[9] Adversarial system lays emphasis on live testimony of witnesses before the court and their cross-examination by the opposite side.[10] Thus, adversarial system is based on the premise that 'contested and oppositional presentation of facts best reveal the truth'[11].

The role of the judge in an adversarial trial is limited and he is often equated to a neutral and passive umpire.[12] He is not involved in the pre-trial investigation. He also does not control the evidences to be presented and the witnesses to be examined. His role is limited to deciding the case in favour of one side or the other solely based on the controverted facts and evidences presented before him by the partisan advocates. He has no latitude to go beyond the evidence placed.[13] Therefore, adversarial system results in a party-controlled criminal trial.

Coming to inquisitorial system of criminal justice, we see a role-reversal. Here the judge plays an active role to determine the truth. The trial is preceded by an elaborate pre-trial investigation under the supervision of '*juge d'instruction'* or the investigating magistrate.[14] The investigation is conducted by the state officials in a neutral and objective manner by collecting both evidences that favour the accused and those against him.[15] In order to properly conduct investigation, the investigating magistrate is empowered to issue warrants, direct search, arrest the accused and examine witnesses.[16] The findings of the investigation are presented as a dossier to the trial judge.[17] Therefore, the judicial officials, rather than the parties determine what information should be presented in the trial, in what order, and for what purpose.[18]

8 *Id.*

9 Y.S. Vijay, *The adversarial system in India: Assessing challenges and alternatives* 3, (Jan. 08, 2020, 11:00AM), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2147385.

10 Ainsworth, *supra* note 5, at 80.

11 Carrie Menkel-Meadow, *The Trouble with the Adversary System in a Postmodern, Multicultural World,* 38 Wm. & Mary L.Rev.5,13, (Jan. 08, 2020,11:00AM) https://scholarship.law.georgetown.edu/cgi/viewcontent.cgi?article=2757&context=facpub.

12 Vijay, *supra* note 9.

13 J M Adele, *Similarities and Comparative Analysis between Inquisitorial and Adversarial Legal Systems* 8, (Jan. 08, 2020, 11:00AM), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3077365.

14 *Adversarial and Inquisitorial System of Justice,* LawTeacher, (Jan. 08, 2020, 11:00AM), https://www.lawteacher.net/free-law-essays/criminal-law/adversarial-and-inquisitorial-systems-of-justice.php.

15 Vijay, *supra* note 9.

16 *Id.*

17 *Id.*

18 Ainsworth, *supra* note 5, at 81.

Before the trial judge also, the parties' role is limited to suggesting the questions to be put forward to the witnesses.[19] The actual questioning of witnesses is mainly done by the judges and the parties have very little say in the mode and manner of examination of witnesses. However, more than live testimony of witnesses, the judge largely relies on written statements.[20] The judge in an inquisitorial trial is therefore not tied down by the narratives presented by the parties. He is the ultimate fact-finder.[21]

There has always been a debate as to which of the two systems is preferable. While inquisitorial system is lauded for its ability to arrive at less erroneous verdicts, the adversarial system is perceived to be better at ensuring procedural fairness to the parties, especially the accused.[22] However, now very few countries follow the pure model of either adversarial or inquisitorial model. Now what we see is a convergence of legal systems – countries with inquisitorial systems are borrowing elements of adversarial system and vice-versa.[23] As Prof. Goldstein stated:

"It is becoming increasingly apparent to criminal justice scholars that single theory models of criminal procedure – whether termed inquisitorial or adversarial – are being stretched beyond their capacity by the phenomena they are designed to control. Virtually everywhere, formal systems of charge and adjudication cannot possibly be enforced in accordance with the premises underlying them."[24]

Why is there a Demand to Change India's Criminal Justice System from Adversarial to Inquisitorial?

From the limited information available from news reports, the reason behind the present proposal of the Union Ministry to adopt an inquisitorial model seems to be to address the issue of low conviction rate in the country. As per the latest available data of NCRB, the pendency of criminal cases in the court has reached its highest level since the turn of the 21st century.[25] This delay in disposing of cases is also evidenced by the large number of under-

19 Vijay, *supra* note 9, at 4.

20 Ainsworth, *supra* note 5, at 81.

21 *Id.*

22 *Id,* at 87 and 90.

23 Abraham S. Goldstein, *Converging Criminal Justice Systems: Guilty Pleas and the Public Interest*, 49 SMU L. Rev. 567 (1996), (Apr. 09, 2020, 11:00 AM), https://scholar.smu.edu/smulr/vol49/iss3/13

24 *Id.*

25 Deepti Jain and Tadit kundu, *Why the wheels of justice turn ever slower in India,* Livemint (Dec. 25, 2019, 09:00AM), https://www.livemint.com/Politics/1vsBJNtsqgpzUlV31BbmWL/Why-the-wheels-of-justice-turn-ever-slower-in-India.html.

trial prisoners languishing in jails.[26] The data also reveals that conviction rate is quite low in case of serious crimes like rape, rioting etc.[27] Even as far back in 2003, the Malimath Committee had noted that India's criminal justice system is virtually collapsing under its own weight as it is slow, inefficient and ineffective[28] and that people are losing confidence in the system[29]. One of the major recommendations of the Committee for remedying the situation was also adoption of inquisitorial system or at least certain elements of it.[30]

A major criticism against the adversarial system is the passive role played by the judge. Instead of endeavoring to ascertain the truth, the system requires him to confine himself to the facts and evidences presented by the parties, however faulty or convoluted they may be. The Malimath Committee Report noted:

"The Adversarial System lacks dynamism because it has no lofty ideal to inspire. It has not been entrusted with a positive duty to discover truth as in the Inquisitorial System. When the investigation is perfunctory or ineffective, Judges seldom take any initiative to remedy the situation. During the trial, the Judges do not bother if relevant evidence is not produced and plays a passive role as he has no duty to search for truth."[31]

In an adversarial system what the judge looks for is not truth but proof[32] and whichever side is able to put forward the best proof according to the evidentiary rules wins the case, regardless of whether it is the actual truth. Since the trial is envisaged as a combat between the two parties, each of them put forward only that evidence which favour them.[33] Such an approach fails to give complete presentation of facts and thwarts the discovery of truth. As a consequence, in many cases there seems to exist "a gap between judicial truth and what actually happened"[34]. This leads to many guilty persons escaping and sometimes innocent persons getting convicted. It is expected that a transition to an inquisitorial model with a judge-controlled investigation and trial will remedy this situation by enabling the judges to determine the truth without being tied down to procedural rules and parties' version of facts.

26 Vrinda Bhandari, *India' s criminal justice system; An example of justice delayed, justice denied,* (Dec. 25, 2019, 09:00AM), https://www.firstpost.com/long-reads/indias-criminal-justice-system-an-example-of-justice-delayed-justice-denied-3475630.html.

27 Jain, *supra* note 25.

28 Malimath Committee Report, *Supra* note 4, at 181.

29 *Id.* at 186.

30 Malimath Committee Report, *supra* note 4.

31 *Id.* at 27.

32 Dr R.Venkataraman, Former President of India as quoted in Malimath Committee Report.

33 Adele, *supra* note 13, at 8.

34 Daniela Berti and Gilles Tarabout, *Questioning the Truth. Ideals of Justice and Trial Techniques in India 1* (Mar. 5, 2020, 09:00AM), https://hal.archives-ouvertes.fr/hal-01612781.

Another criticism usually raised against the adversarial system in India is the high standard of proof required to establish the guilt of the accused. This is proffered as another reason for the dismal rate of convictions. The standard of proof required is 'proof beyond reasonable doubt'. The Malimath Committee observed in its report that such a high standard of proof would make it difficult to secure the conviction of accused "on whom the burden is very little and who hires a very competent lawyer, while the Prosecution, on whom the burden is high, is very often represented by persons of poor competence."[35] The Committee, therefore, recommended a lowering of standard to the inquisitorial system's "the court's conviction that is true" that requires only the inner satisfaction of the Judge".[36]

Before proceeding to examine whether an adoption of the inquisitorial system is the most appropriate way to strengthen the criminal justice system in India, the author would like to point out certain faults in the Malimath Committee's arguments for a shift to an inquisitorial model. Firstly, it is important to note that India's criminal justice system is not truly adversarial but it contains some elements inspired from the inquisitorial system. Our criminal laws already contain provisions to enable a judge to play a more active role in a criminal trial. For instance, Section 311 of CrPC allows the court to examine any person as a witness even if he was not called as one by the parties. Similar power is given to the court under Section 165 of Evidence Act also. Section 319 of CrPC empowers the court to proceed against persons other than the accused if it appears from the evidence that such person/persons is also concerned in that very offence or in a connected offence. This section is premised on the doctrine *judex damnatur cum nocens* a*bsolvitur* (judge is condemned when guilty is acquitted).[37]

More importantly, the presence of Section 313 of CrPC puts into doubt whether the judge in a criminal trial in India is expected always to be a silent spectator to the contest between the two sides. This section permits the court to question the accused at any stage of a trial without previously warning him, with a view to enable the accused to personally explain the circumstances appearing in evidence against him. The section also imposes a duty on the court to question the accused generally on the case after the witnesses for the prosecution have been examined and before he is called or his defence. While the statement of the accused under Section 313 is not substantive evidence, according to Section 313(4), it may be taken into consideration at the trial.[38] Section 313, hence, makes way for a direct interaction between the judge and the accused in order to get a wholesome picture of the

35 Malimath Committee Report, *supra* note 4, at 125.

36 *Id,* at 270.

37 *Arun Dube v. State of Madhya Pradesh*, 11991 Cri LJ 840, 845 (MP) (India).

38 PILLAI, *supra* note 7, at 447.

facts.[39] However, the courts have repeatedly warned that the above-mentioned sections should not be regarded as authorizing an inquisitorial interrogation of the accused.[40] The judges should make use of these sections *"without unduly trespassing upon the functions of the Public Prosecutor and the defence counsel, without any hint of partisanship and without appearing to frighten or bully witnesses".*[41]

Secondly, the Malimath Committee's recommendation to lower the standard of proof to establish the guilt of the accused will constitute a violation of India's obligation under Article 14(2) of ICCPR which makes it a human right for a person charged with a criminal offence to be presumed innocent until proven guilty according to law[42]. Commenting on this right, the Human Rights Committee stated that by reason of presumption of innocence, the burden of proof is on the prosecution which has to prove the charges beyond reasonable doubt.[43] Therefore, convicting an accused without proving his guilt beyond reasonable doubt will constitute a serious violation of human rights.

The Malimath Committee's recommendation to adopt the standard of proof used in French and German inquisitorial systems i.e. 'the court's conviction that is true' seems to be based on a wrongful understanding that this standard is same as 'proof on preponderance of probabilities'. As the International Commission of Jurist pointed out, what this standard actually refers to is the free reign given to judges in an inquisitorial system to assess the legality, admissibility, and persuasive force of evidence according to their inner conviction, without being tied down by evidentiary rules as in the adversarial system.[44] When it is said that the guilt of the accused is determined based on the 'inner conviction of the court', what it actually demands is a persuasion of the court, based on its free conviction, that the accused is guilty beyond reasonable doubt.[45] Hence, the standard of proof required in both adversarial and inquisitorial system to convict the accused is the same.[46] It is also to be noted that the European countries that have adopted the inquisitorial system are also

39 *Id,* at 443.

40 41st Law Commission Report, The Code of Criminal Procedure, 1898 (1969) 204.

41 *Ram Chander v. State of Haryana,* AIR 1981 SC 1036 (India).

42 International Covenant on Civil and Political Rights, art. 14(2), Dec. 16, 1996, 999 U.N.T.S. 171.

43 UN Human Rights Committee, General Comment 13, art. 14.

44 International Commission of Jurist, *Review of the Recommendations made by the Justice Malimath Committee from an international human rights perspective* 21, 22 [hereinafter *ICJ Position Paper*], (Apr. 19, 2020, 08:00AM) https://www.icj.org/criminal-justice-reform-in-india-icj-position-paper-review-of-the-recommendations-made-by-the-justice-malimath-committee-from-an-international-human-rights-perspective/.

45 *Id.*

46 *Id.*

signatories to the ICCPR and are also bound by the European Convention on Human Rights, both of which require a proof beyond reasonable doubt to rebut the presumption of innocence of an accused.[47]

With these pointers in mind, the next section critically examines the benefits to India's criminal justice system that are claimed to flow from a shift to an inquisitorial system.

Is Inquisitorial System a Panacea to India's Ailing Criminal Justice System?

According to Malimath Committee, shift to a criminal justice system that has 'quest for truth' as its focus will *'reduce the level of criminality in society by ensuring maximum detection of reported crimes, conviction of the accused persons without delay, awarding appropriate punishments to the convicted to meet the ends of justice and to prevent recidivism'*[48]. The committee proceeded on the rationale that giving judges investigative powers and more control over the trials will lead to higher rate of conviction. One cannot help note the fact that securing higher rate of convictions seems to be the primary concern of the Committee and rights of the accused takes a back-seat. No doubt, determination of guilt is the main objective of any criminal law process. However, in the pursuit of this objective, considerations of ensuring a fair trial and protection of rights of the parties, especially the accused, should not be ignored.

Inquisitorial system is definitely preferable to the adversarial system in terms of the latitude given to the judge to find out the truth for himself, instead of being subjected to the materials presented by the partisan advocates. His control over the entire process of trial and investigation helps to ensure that important evidences are not overlooked and that the trial process is not unduly delayed by the dilatory tactics adopted by the counsels. However, with an active judge taking center-stage, there also comes the danger of departure from impartiality and objectivity that is expected from a judge. This is because when the judge plays the dual role of an investigator and a judge, it makes it difficult for him not to be prejudiced against the accused at the start of the trial.[49] Moreover, the limited role of the defence counsel in an inquisitorial system makes it even more difficult to persuade the judge to give due weight to the exonerating factors. That inquisitorial system allows for a greater scope of bias was also expressed by Prof Lon L. Fuller and according to him, "an

47 Convention for the Protection of Human Rights and Fundamental Freedoms (European Convention on Human Rights, as amended) (ECHR) art 6(2); ICCPR (n 42).

48 *Malimath Committee Report, supra* note 4, at 21.

49 Adele, *supra* note 13, at 7.

adversary presentation seems the only effective means for combating this natural human tendency to judge too swiftly in terms of the familiar that which is not yet fully known"[50]. His proposition was later confirmed by an empirical social experiment conducted by two professors of psychology and a professor of law which suggested that adversary evidentiary presentation is better at overcoming the biasing effect of pre-trial expectancies about a defendant's guilt than the inquisitorial model.[51]

It is also said that adversarial system does a better job in securing procedural justice.[52] Procedural justice is different from substantive justice. While the latter occurs when there is an accurate determination of facts and application of law to the facts, the former occurs when the litigant is satisfied that the system has operated in a fundamentally fair manner.[53] Thus, an individual may feel that he has been treated fairly even when the judgment actually went against him. Similarly, a person who has won the case may not be satisfied with the system if he feels that he has not been treated fairly.

Experiments conducted by social psychologist Tom Tylor suggests that procedural justice or feeling of 'being treated fairly' has three components – (i) the party felt able to give voice to their side of the story; (ii) the adjudicator gave evidence that they had been listened to; and (iii) throughout the process, the party felt that they were treated with dignity and respect. Inquisitorial system, with its judge-controlled procedure, provides limited opportunity for the parties to shape their cases. The judge decides what information are relevant and written witness statements are preferred over oral examination of witnesses. All these contribute to the parties ending up feeling totally excluded from the trial process. In contrast, adversarial system provides litigants a greater control in shaping the narrative through their lawyers. Witnesses are also examined live before the court and this gives them a chance to tell their story directly. As a result, parties' perception of procedural justice is said to be greater in an adversarial system.[54]

Further, shifting to an inquisitorial model necessitates an examination of India's preparedness for the same. Giving judges more power will have implications for the entire system, especially for the rights of the accused. Safeguards need to be created in order to check the possibility of abuse of power by the judges. It is highly doubtful whether our

50 Lon L. Fuller, *The Adversary System, in* TALKS ON AMERICAN LAW 34 (Harold Berman ed., 1971).

51 Allan Lind et. al., *A Cross-Cultural Comparison of the Effect of Adversary and Inquisitorial Processes on Bias in Legal Decision Making*, 62(2) Virginia Law Review 271, 282 (1976).

52 Ainsworth, *supra* note 6, at 90.

53 *Id.* at 88.

54 *Id.* at 90.

existing institutions and laws are capable of facilitating a transition to inquisitorial system without jeopardizing the rights of the litigants. It is also wrong to assume that a shift to an inquisitorial system will make India's criminal justice system more efficient when other deeper-rooted causes for its failure, unconnected to the type of system, are left unaddressed. These include lack of resources, both in terms of funding and personnel, inefficient police investigation, corruption, confession-oriented approach, police torture etc.[55]

Finally, whether we adopt an adversarial or inquisitorial system, it is of utmost importance that the system complies with the human rights principles. As the International Commission of Jurists observed: "*Human rights must be the benchmark for any criminal justice system... the rights of the accused must be at the center of all proceedings, and the rights of the victim must be protected at all stages*"[56]. When the Malimath Committee recommended lowering of safeguards available to the accused in order to secure greater conviction, it proceeded on the wrongful assumption that all accused are well-informed of their rights and are capable of engaging counsels to defend their case.[57] This is anything but the truth. A large number of criminal defendants and prisoners are poor who are unaware of their rights.[58] Even if securing higher rate of conviction is assumed as the aim of an effective criminal justice system, lowering the protections available to the accused is not the right way of achieving it, taking into consideration the inherent imbalance in the position of prosecution (backed by the state apparatus) and the accused, in terms of power and resources.[59] It is interesting to note that India is reconsidering the Malimath Committee's recommendation to adopt inquisitorial elements at a time when many countries that were traditionally following the inquisitorial model are shifting to an adversarial system of criminal justice in order to infuse greater procedural fairness.[60] In fact, the Malimath committee had also admitted that the fair trial rights of the accused are better protected in an adversarial system.[61]

Given the uncertainty about the supposed benefits that may flow from adoption of an inquisitorial system and the lack of institutional preparedness to make such a shift, a better alternative would be to reform India's existing criminal justice system by infusing it with dynamism and efficieny. Apathy of the judges and the consequent judicial gaming at the

55 *ICJ Position Paper, supra* note 45, at 11.

56 *Id.*

57 *Malimath Committee* Report, *supra* note 4, at 19.

58 Ministry of Law and Justice, Government of India, Report of the Expert Committee on Legal Aid: Processual Justice to the People, 70 (1973)

59 *ICJ Position Paper, supra* note 44, at 23.

60 Ainsworth, *supra* note 5.

61 Malimath Committee Report, *supra* note 4.

expense of justice[62], no doubt, lead to acquittal of guilty persons and conviction of innocents. As mentioned earlier, Indian criminal laws already contain provisions to enable the judges to play an active role during criminal trials by calling for witnesses and questioning the accused in order to get a complete picture of facts. However, as Justice Sudhansu Dhulia commented, these provisions remain largely a dead-letter as it is very rarely that a trial judge calls upon persons as witnesses on their own.[63] Judges must shed this reticence when the need demands and must endeavor to "discover the truth and advance justice"[64] by making use of the powers given to them by the criminal laws. However, whenever he endeavors to don such an active role, care must be taken not to step into the shoes of the prosecution or the defence counsel. He must act "without any hint of partisanship and without appearing to frighten or bully witnesses"[65]. Suitable training must be imparted to judges, especially at the trial level, on how to make use of these provisions at appropriate times without affecting the impartiality and objectivity expected from them and without prejudicing the rights of the litigants.

Suggestions for Reforms

A shift to an inquisitorial system, without adequate safeguards and institutional reforms, is likely to do more harm than good. However, this is not to suggest that the adversarial system practiced currently in India is without any problems. In this part of the article, the author highlights two of the many issues that plague the criminal justice system of our country – *first*, failure to ensure a level-playing field for the indigent accused and; *second*, failure to adequately protect the rights of the victims.

Adversarial system of criminal trial proceeds on the assumption that "State using its investigative resources and employing competent counsel will prosecute the accused who, in turn, will employ equally competent legal services to challenge the evidence of the prosecution"[66]. In other words, the system pre-supposes equality of arms between the parties involved and the truth is expected to emerge from their confrontational presentation of facts. Hence, if the parties are not equally situated in terms of resources, the narrative presented before the court is likely to be one-sided, resulting in factually wrong decisions. In India, it is a known fact that many of the accused persons are poor and lack resources to engage the

62 Allan Lind et. al., *supra* note 51, at 271.

63 Justice Sudhansu Dhulia, *Role of courts in the administration of criminal justice*, (Jan. 20, 2020, 09:00AM), http://ujala.uk.gov.in/files/ch2.pdf.

64 *Ram Chandra v. State of Haryana (*1981) 3SCC 191 (India).

65 *State of Rajasthan v. Ani alias Hanif & others* (1997) 6 SCC 162 (India).

66 *Supra* note, 59.

services of a competent lawyer.[67] Many of them are also uneducated and therefore incapable of defending themselves in the court of law and asserting their constitutionally guaranteed rights.[68] Without ensuring adequate representation for the accused, much of the ideals that our criminal justice system seeks to achieve, like equal rights, fairness, and accuracy remain as just ideals. In order to remedy this situation, our laws confer on the accused the right to get legal aid for his defence at State's cost.[69] However, more often it is seen that the defence counsels employed by the government for the accused do not take much interest in their case due to the low amount of honorarium paid and lack of any incentive from the government.[70] As a result, even state legal aid fails to create a level-playing field for indigent accused. In such situations, the judge should play an important role to ensure that the rights of the accused are adequately safeguarded during both the investigation and the trial phase. Also, the government must take steps to strengthen the legal aid service by creating incentives for competent lawyers to come forward.

The second issue that the author would like to focus is on the limited participation of victims in the criminal proceedings. Earlier the author mentioned about how the adversarial system gives more control to the litigants to shape their case than the inquisitorial system. However, in practice, as litigants are represented by the lawyers before the court, the creation of legal narratives is often done by them and the litigants have very little say in it. The lawyers carefully prepare the answer that their clients need to say before the court, as a result of which the litigants are deprived of the ability to tell their story in the terms that they think are significant.[71] Such an approach is especially disadvantageous to the victim, whose role in the criminal justice process in India, is limited to that of a prosecution witness.[72] Even though the victim is the prime source of evidence and we rely on them for reporting the crime, representation of victim's interest and their participation in the trial is very limited.

67 PILLAI, *supra* note 7, at 346.

68 *Id.*

69 Code of Criminal Procedure, 1973, s. 304; Indian Const. art. 21, as construed by the Supreme Court in *Hussainara Khatton (4) v. State of Bihar*, (1980) 1 SCC 98 (India).

70 Mitali Vani, *Right to Free Legal aid and Legal Aid Functionaries under the Legal Services Authority Act, 1987*, 44 (Apr. 19, 2020, 07:00PM), http://nja.nic.in/Interns_Report_2015-16/Research%20Report%20Mitali%20Vani%2027-11-15.pdf.

71 Ainsworth, *supra* note 5, at 91.

72 Anupama Sharma, *Public Prosecutors, Victims and the Expectation Gap: An Analysis of Indian Jurisdiction*, 13 Socio- Legal Review 87, 98, (Apr. 19, 2020, 07:00PM), http://docs.manupatra.in/newsline/articles/Upload/116BE5E2-14EF-4753-BD49-3E308403D5E7.pdf.

The victims rely on the prosecutor to prosecute their case with efficiency and to secure them justice. However, the role of a prosecutor is perceived as a minister of justice and it is considered that his duty is to place before the court whatever evidence is possessed, whether it is in favour of or against the accused.[73] The court in several cases has opined that the 'impartiality of prosecutor's conduct is as vital as the impartiality of the court itself'[74] and that he must not be overly concerned with securing convictions[75]. However, such an approach may run contrary to a victim's expectation from his/her prosecutor. Added to this is the prosecution lethargy resulting from overload of cases, unsatisfactory remuneration and lack of competency. The option of private prosecution is also limited in India as CrPC requires the private prosecutor to act under the directions of the public prosecutor.[76] All these lead to a sense of dissatisfaction among the victims who feel that their grievances are not adequately represented by the prosecutor. Their role during the trial is also limited to answering questions put forward by the counsels. In this respect, inquisitorial system seems to be better accommodative of the interests of the victims as they play a more active role in the investigatory and trial stage. They get an opportunity to say their version of the story directly to the judge. 'The victim is given voice, validation and respect in more, and better, ways than in the adversarial system.'[77]

In order to meet the expectations of victims from our criminal justice system, several steps can be taken. One is to institute a mechanism to enable the victims to complain about the unsatisfactory performance of their prosecutor like, failure to present crucial evidences or to adequately represent their interest before the court. There is also a need to give more participatory rights to the victims. Today we see the sorry situation of victims receiving little to no communication about the status of their case from the prosecutor and they having to helplessly depend on case diaries to know the progress of their case.[78] In this regard, Malimath Committee's recommendation is truly notable. It recommended giving the victims the right to participate in the proceedings which includes right to advance arguments after the prosecutor, right to know about the progress of the investigation and right to move to the court to ask for further investigation etc.[79]

73 *Ghirrao v. Emperor*, (1933) 34 Cri LJ 1009, 1012.

74 *State of Tamil Nadu v. L. Ganesan*, 1995 Cri LJ 3849; *Manu Sharma v. State* (NCT of Delhi), (2010) 6 SCC 1 (India).

75 *Sheonandan Paswan v. State of Bihar*, (1983) 1 SCC 438 (India).

76 Code of Criminal Procedure 1973, s. 302 (India).

77 Arie Freiberg, *Post-Adversarial and Post-Inquisitorial Justice: Transcending Traditional Penological Paradigms*, 8 Eur. J. Criminology 82, 93 (2011).

78 Sharma, *supra* note 73, at 102.

79 Malimath Committee Report, *supra* note 4, at 270-271.

Lastly, the author also suggests the infusion of restorative justice principles while prosecuting crimes. Restorative justice essentially calls for restoring the parties, especially the victim, to the position that he/she occupied before the commission of the crime. While the usual sentencing practices may fulfill the state's interest in creating deterrence, it may not alleviate the physical/psychological impact of the crimes on the victim. Though India has taken some steps in this direction by introducing victim compensation scheme[80], it is cumbersome and largely inadequate to practically help the victim.[81] Restorative justice requires giving the victims a say in the sentencing process. Other means of achieving restorative justice like victim-offender mediation, family or community group conferencing, community service[82] are also worth considering. Adopting restorative justice principles will not only repair the injuries and trauma suffered by the victims and improve their satisfaction of the criminal justice system, but it will also help to ease the pressure on our over-crowding prisons.

Concluding Remarks

Adoption of an inquisitorial system is not going to be a panacea to all the problems that currently plague India's criminal justice system. Instead, it may give rise to new issues like abuse of power by courts, derogation of the rights of accused etc. Therefore, a better approach would be to reform and strengthen the existing system by tackling issues like crunch of resources and man-power, inefficiency in police investigations, corrupt practices etc. Moreover, while safeguarding the rights of the accused, it is important not to forget the victims. Their confidence in the criminal justice system must be improved by ensuring their adequate representation and participation and not by achieving higher rate of conviction and lowering the safeguards available to the accused.

80 Code of Criminal Procedure, 1973, S. 357 (India).

81 Mehak Bajpai, *Advancing of Restorative Justice in Criminal Law in India and Germany: A Comparative Study* (Jun. 19, 2018), https://journals.sagepub.com/doi/full/10.1177/2516606918765495.

82 See, *What is Restorative Justice?,* Centre For Justice & Reconciliation at Prison Fellowship International (May 2005) https://www.d.umn.edu/~jmaahs/Correctional%20Assessment/rj%20brief.pdf.

Analyzing the Enforceability of Force Majeure Clause in Light of COVID-19

Rishabh Soni*

Abstract

Now with the spread of COVID-19 and impositions of lockdown in India, the economy has also suffered; the entire supply chain has broken and businesses are finding it difficult to survive. In these tough times, one most talked about remedy in various types of contracts affecting Businesses, rent agreements, etc., is the emergence of force majeure clause by parties to do away with their contractual liabilities.

Many companies always have a force majeure clause in their agreements to survive during tough times like these. Force majeure clause saves the bonafide party who was very much interested in performing its obligation under the contract but was not able to fulfill its part due to certain factors beyond their control and without any negligence on their part. There are also cases where more and more businesses though not having any force majeure clause in their agreements but are still coming forward to claim the remedy on account of the contract becoming impossible to perform and thus claiming the remedy of frustration of contract.

This paper tries to find out the circumstances under which courts will allow businesses to claim the force majeure remedy in discharging their liability under a contract. Paper also tries to compare the recent judgments given by Court in India and the United States in analyzing the test which needs to be satisfied before granting the remedy of force majeure. The paper also discusses the possible future tussles between insurance companies and businesses in settling claims and losses which the businesses have suffered on account of COVID-19.

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INTRODUCTION

The impact of novel coronavirus (COVID-19) pandemic has not only affected the physical health of humans but at the same time it has also impacted the health of economies of all the nations, and as a result of which businesses are finding it difficult to survive and most of them are unable to fulfill their contractual obligations. Restrictions on travel and imposition of lockdowns have impacted all the industries and more particularly international trade and trade of non-essential items have come to a standstill. In these tough times, the term which is gaining importance as a remedy seeker for businesses is the force majeure clause in business contracts.

Now after the lockdown has started to partially open in a phased manner, more litigations are coming on the subject matter of enforcing this force majeure clause as a defense by businesses to abstain from liability arising from contractual obligations We are seeing that many suppliers either want their contractual obligations to be delayed or their contract should be terminated. Many companies are citing reasons like restriction in movement, stoppage of production, increase in costs, labor shortage, and broken supply chains as the main factors for enforcement of force majeure as a remedy. Even big companies like Gateway terminals, Adani ports, Indian oil, Mangalore refineries, etc. have already invoked force majeure clause and many more are likely to join them.[1] The force majeure remedy which according to many was only a part of formality and rarely used remedy is now proving to be very fruitful and everyone is flipping their contracts to look for force majeure clause.

Many countries worldwide are also issuing force majeure certificates to firms, for instance on Feb 17, 2020, the China Council for the promotion of International Trade (CCPIT), revealed that it had issued about 1600 force majeure certificates to firms in 30 sectors, covering contract worth over $15 billion.[2] Even the Indian government through the department of expenditure, Ministry of Finance vide its order dated Feb 19, 2020, issued an office memorandum for procurement of goods. This memorandum states that COVID-19 could effectively be covered under force majeure clause because it is a natural calamity and directed the departments to enforce the same.[3]

1 Poorvi Sanjanwala and Kashmira Bekliwal, *What is Force Majeure? Legal Term Everyone Should Know During Covid-19 Crisis*, THE ECONOMIC TIMES (May 22, 2020, 10:42AM), https://economictimes.indiatimes.com/small-biz/legal/what-is-force-majeure-the-legal-term-everyone-should-know-during-covid-19-crisis/articleshow/75152196.cms.

2 *CCPIT Issues the Force Majeure Certificates of Novel Coronavirus Disease (COVID-19) for Enterprises*, CHINA COUNCIL FOR THE PROMOTION OF INTERNATIONAL TRADE (May 22, 2020, 10:45 AM), http://en.ccpit.org/info/info_40288117668b3d9b017080e1f9b5072f.html.

3 *Force Majeure Clause Office Memorandum*, DEPARTMENT OF EXPENDITURE (May 22, 2020, 11:00

Meaning of Force Majeure

The term 'force majeure' has been defined in Black's law dictionary[4] as "an event or effect that can neither be anticipated nor controlled". Force majeure is being used as a clause in contractual agreements from the past, but it has started to gain importance only in recent times after the outbreak of the pandemic. *Force majeure is a contractual provision to deal with uncertain situations due to which contractual obligations could not be performed and these situations can't be acknowledged at the time of entering into the contract*. Generally, a force majeure clause provides a temporary reprieve to parties from performing their obligations under the contract if the events mentioned in the force majeure clause are satisfied.

Entire Jurisprudence on force majeure has been beautifully summarized by Justice RF Nariman of the Supreme Court in the case of *Energy Watchdog v. CERC*.[5] Generally, a force majeure clause includes events beyond the control of parties to contract like an act of God, earthquake, fire, flood, terror attack, epidemics, etc. and the circumstances which are necessary to be fulfilled for the applications of this particular clause and also the aftermaths of enforcement of this clause like whether the contract will be permanently frustrated or is being only delayed for a particular period. In the Indian context, although there is no direct mention of the term force majeure, some linkage to it can be drawn from the concept of contingent contracts[6] as laid down under the Contracts act. Section 32 mainly deals with a situation when a particular contract is contingent on happening of an event and when this event becomes impossible then indirectly contract also gets impossible to perform. Force majeure clause is a very important aspect of any contract and its absence can lead to a very difficult situation for parties. This clause is now being seen to be a part of various types of contracts like power purchase and manufacturing contracts, real estate contracts, supply contracts, etc.

AM), https://doe.gov.in/sites/default/files/Force%20Majeure%20Clause%20-FMC.pdf.

4 *Meaning of Force Majeure*, BLACK'S LAW DICTIONARY (May 22, 2020, 01:15 PM), https://blacks_law.enacademic.com/11167/force_majeure.

5 Justice Nariman in *Energy watchdog v. Central Electricity Regulatory Commission and Ors.*, (2017) 14 S.C.C. 80 (India), quoted "Force majeure" is governed by the Indian Contract Act, 1872. In so far as it is relatable to an express or implied clause in a contract, it is governed by Chapter III dealing with the contingent contracts, and more particularly, Section 32 thereof. In so far as a force majeure event occurs de hors the contract, it is dealt with by a rule of positive law under Section 56 of the Contract".

6 Section 32, The Indian Contract Act, 1872, No. 09, Acts of Parliament, 1872 (India).

Method of Enforcing Force Majeure Clause and the Effect of it on Contracts

Generally in the original contract, only the method of enforcing the force majeure clause should be mentioned and it is up to parties to bilaterally agree on the method for its enforcement, but most of the times parties prefer to enforce this clause by giving notice to the other party and intimidating him/her about the enforcement of same. This notice can be given by one party informing the other about the occurrence of such an event or it can also be given if the force majeure event continues to happen for a prolonged period. These two methods of enforcement will differ with different contractual agreements. Now coming to the effect of this enforcement party enforcing it generally has 2 remedies:

a. Party will be allowed an extension of the period to fulfill his contractual obligations.
b. Party will be allowed to terminate the contract and settle their monitory concerns.

Alternate Remedy Available to Parties in case of No Force Majeure Clause in their Contract and the Doctrine of Frustration of Contracts

There are various cases in which the original contractual agreements between parties do not have any force majeure clause and yet they are unable to fulfill their contractual obligations. So in these particular cases, the only remedy which is generally available with the parties is that of the frustration of contract as governed by Sec. 56.[7] Section 56 is based on the maxim *"les non cogit ad impossibilia"* which means that the law does not compel a man to do what he cannot possibly perform. This doctrine seeks to protect the interest of the party who has suffered on account of the subsequent impossibility of the subject matter of contract.[8] It means that every contract is based on the assumption that parties to contract will be able to perform the same when the due date of the performance arrives. Now if because of some event, the event has either become impossible or unlawful, then the contract becomes void, and liability of the party will also be terminated and the essence of the contract will be frustrated.

The courts in India have held in numerous cases that the word "impossibility" as used in Section 56 should always be interpreted in a practical sense and not in the literal and strict

7 Section 56, The Indian Contract Act, 1872, No. 09, Acts of Parliament, 1872 (India).

8 *Ibid*. A contract to do an act which, after the contract is made, becomes impossible, or, by reason of some event which the promisor could not prevent, unlawful, becomes void when the act becomes impossible or unlawful.

sense and courts should always try to ensure that the object of a contract is fulfilled even if certain changes need to be done. In the leading English law case of *Tsakiroglou & Co. Ltd. v. Nobel Thorl GmbH,*[9] House of Lords observed that even though the contract had become more onerous to perform, it was not fundamentally altered and in this case, the contract was very much possible to perform but at the cost of an increase in freight price.

Moreover, the majority of eminent reference work on contract law has concluded that a rise in cost or expenses has been stated not to frustrate a contact.[10] Thus, to justify this statement a contract will always come under the purview of Section 56 even if it is not an absolute impossibility, but the contract has been fundamentally changed. This particular principle was given by the court in the *Satyabrata Ghose* case.[11] Further, in this case, the Court held that the changed circumstances make the performance of the contract impossible and the parties are absolved from further performance of it as they did not promise to perform an impossibility.

Now the question arises as to what will happen to partial obligations that have been performed before the contract became fundamentally frustrated. To this particular question, Indian law is very much clear with no doubts that if a particular contract is declared void after entering into it then it will be governed by the concept of restitution as laid down in Section 65.[12] So basically Sec. 65 provides that a party who has received any advantage before the contract became void, then he/she is bound to restore that benefit so that parties can be put in the same position as they were in if the contract had never been executed.

A Hypothetical Example Highlighting Force Majeure Clause in a Contract

Company A of (Ludhiana) entered into a contract with Company C of (Mumbai) on 15 February 2020 for the supply of 600 tons of steel. For fulfillment of delivery, a time period of 2 months was given. There was also a force majeure clause in the contract entered in between both the parties in which they both agreed that in case of any uncertain event beyond their control affecting the subject matter of the contract, a grace period of 1 month will be given. But this was subject to notice being given by party affected within 10 days from happening of that event. Now on 25th March 2020 nationwide lockdown was announced by the government, thereby affecting the supply of non-essential goods. As a

9 *Tsakiroglou & Co. Ltd. v. Nobel Thorl GmbH*, [1962] AC 93.

10 JOSEPH CHITTY, CHITTY ON CONTRACTS (31st ed., 2012).

11 *Satyabrataghose v. Mugneerambangur & Co. & Anr.*, 1954 S.C.R. 310 (India).

12 Section 65, The Indian Contract Act, 1872, No. 09, Acts of Parliament, 1872 (India).

result of this event A's consignment was struck for about 20 days on the border of Gujarat and Maharashtra. On 13th April 2020, A sent an email to B conveying him about the actual situation and enforcing the force majeure clause and demanding grace of another 1 month as the consignment was sent back to Ludhiana (Punjab). So now in this particular case, A will be allowed to enforce the force majeure clause as the delay was not in his hand and he made all possible efforts to fulfill the contractual obligations on his part.

Exceptions to the Applicability of Force Majeure Clause in Contracts

Generally, force majeure clauses are applicable without any restrictions, but at the same time, a party cannot hide its negligence and mal intention behind the force majeure clause. So where the non-performance is caused by the usual and natural consequences and not the uncertain consequences which are beyond the control of parties, their force majeure cannot be enforced under those cases. Further force majeure can also not be invoked simply because the contract has become financially and commercially more difficult to perform[13]. So parties taking shelter under the force majeure clause need to convince the court that the force majeure event was beyond their control and the event could not be stopped even after ensuring due diligence & taking all possible steps. These steps will vary as per the facts of each case. However, generally, these include looking for alternate suppliers, an alternate mode of transport and funding, etc. Now broadly analyzing, the event of force majeure must pass the following 3 test:-

a. Unpredictability- It involves that the event amounting to force majeure should be unpredictable and unforeseeable.
b. Irresistibility- The event of force majeure must make the execution of contractual obligations impossible.
c. Externality- It means that the force majeure event must not be created by the default or negligence of the party.

The Increasing Possibility of Businesses Claiming Loss Caused to them from Insurance Companies

There is a greater chance of various big companies claiming the losses suffered by them from insurance companies and trying to bring the claims within the ambit of business interruption insurance policies. It would however be very interesting to see in the coming

13 *Punj Sons Pvt. Ltd. v. Union of India,* A.I.R. 1986 Del 158 (India).

times as to what stand courts take on these claims by companies. Now if we look at the business interruption policies in general, we find that these policies can very much be issued as a separate stand-alone policy.

But in India these are incorporated in Fire policy or machinery loss policy and offer protection to the net profit, compensating for the increase in the working costs, etc.[14] So for the business interruption policy to cover the loss on account COVID-19, experts believe that it is necessary for the property insured to suffer physical damage due to covered perils, and it is very unlikely that such policies would cover losses caused due to COVID-19.

It also needs to be noted that the courts in the U.S have held that if a particular condition deprives the use of insured property, then that particular condition will be covered in sanctioning the claim for the loss occurred to the property. But the similar reasoning for approval of claims will not be applicable in India, firstly because of the specific wording in the insurance contracts in India and secondly US decisions would only be applicable if there is a presence of COVID-19 at the insured property, it also needs to be looked into here is that here in India most of the businesses are suffering losses not on account of being closed as a result of the presence of COVID-19 on their premises, but due to lockdown restrictions being imposed by the government.[15] Now we need to see in the coming times what view will the courts adopt in these matters and there may be some cases in which courts also adopt liberal view.

The Courts of the U.S.A and Force majeure

Many US states have given a narrow interpretation to force majeure as a remedy and have clarified that force majeure will qualify as a defense only if the contract specifically mentions for it to include events like pandemics etc. However, the state of Idaho have interpreted force majeure clauses more broadly and in a recent Idaho Supreme Court case, the court found that denial of building permit will be qualified as a force majeure event where the contract specially defined to include other events which are beyond the control of parties to contract.[16] Another major consideration that courts in the US are giving is that of foreseeability of the event. It is very much clear that COVID-19 as such cannot be foreseen

14 Manish Jha, *An Expert Explains: Can Business Interruption Insurance Cover COVID-19 Claims?*, THE INDIAN EXPRESS (April 16 2020, 07:57AM), https://indianexpress.com/article/explained/explained-can-business-interruption-insurance-cover-covid-19-claims-6363831/.

15 *Ibid.*

16 Steffan Hasselblad, *How To Tell If COVID-19 Qualifies As A Force Majeure In Your Contracts*, IDAHO BUSINESS REVIEW (June 16, 2020, 01:30 PM), https://idahobusinessreview.com/2020/06/16/how-to-tell-if-covid-19-qualifies-as-force-majeure-in-your-contracts/.

from before and also the majority of cases will come under it. But at the same time courts are not granting defense of force majeure to contracts related to supply of medical goods and contracts entered before December 2019.

Moreover like the recent judgment of Delhi High Court, courts in the US are also not giving strict meaning to the term impossibility in performing the contract and courts in the US have found that an even a 40% change in crop price throughout a single growing season did not make performance impossible.[17] Now concerning the occurrence of an event on account of an act of god, no court yet has examined whether a pandemic such as COVID-19 will qualify as an act of god.

Some Important Recent Judgments of Courts in India Interpreting and Deciding the Ambit of Force Majeure Clause in Light of COVID-19

The first major case interpreting the provision of force majeure after COVID-19 was the case of *Halliburton Offshore Service v. Vedanta Limited & Anr.*[18] (Delhi High Court). In this particular case, in the year 2018, Petitioner Halliburton was granted a contract by Vedanta for integrated development of oil and gas fields in Rajasthan for which he also furnished bank guarantees and the petitioner was given the time by 31st January 2020 to complete the project, which was eventually extended and the date was 31st March 2020.

The petitioner further demanded an extension, however, he was denied the same, and then on March 18, the petitioner sent a letter to respondents stating that he is invoking force majeure clause due to COVID-19 for extension of the deadline to complete the project. However, to these response respondents shown their disagreement and enforced bank guarantees against the petitioner which was extended by the petitioner during the signing of the contract. Petitioners moved Delhi high court to restrain the defendants from invoking bank guarantees.

The main issue in this particular case was whether the Petitioner can restrain respondents from invoking bank guarantees in case of non-acceptance by respondents for extending the deadline regarding completion of the project due to ongoing COVID 19. Delhi High Court noted that the alleged non- performance of the contract cannot be executed on the ground of force majeure as claimed by petitioner. *The Court acknowledged that COVID-19 was very much a force majeure event, but at the same time also held that delay on account of*

17 *Ibid.*

18 *Halliburton Offshore service v. Vedanta Limited & Anr.,* (O.M.P (I) COMM) No. 88/2020 & I.As 3696—3697/2020 (High Court of Delhi, 20/04/2020).

the petitioner was not due to COVID-19 as petitioner was already given 2 extensions to complete the project and that too before the lockdown was announced by the government.

The Court also observed that simply enforcing COVID-19 as a force majeure clause will not absolve the liability of parties to contract and they need to show that the non-performance was the direct result of COVID-19 and therefore this is to be determined from facts & circumstances of each case.

The Court also gave few points which were to be considered in each case before granting the relief to the party claiming force majeure clause on account of COVID-19. These are

a. Conduct of parties before outbreak
b. Deadlines for completion in contract
c. Steps that were taken to complete the contractual obligation
d. Other compliances that were required to be made.

Another important judgment concerning the application of the force majeure clause in tenant-landlord dispute is the case of *Ramanand and Others v. Dr. Girish Soni and Another (Khan market case)*[19].

In this case also, the Delhi High court after analyzing various clauses of the contract entered in between landlord & tenant, came to the decision that as such there was no mention of force majeure event in the agreement, but still, on account of prevailing situations, the Court agreed to allow a time frame to the tenant to pay rent but rejected their request of quashing the rent for a period of lockdown.

Conclusion

Force majeure clause in contracts is proving to be of great help to genuine parties who have suffered without any fault on their party and it can very much be claimed as a defense by a party to contract to abstain itself whether temporary or permanently from performing the contractual obligation, but it needs to be seen here that there is no straitjacket formula which will be applicable in all cases of an force majeure event to save a party from fulfilling its contractual liability. Courts will always analyze the facts & circumstances of each case and will always look into the actual reasons due to which contract was not been able to be performed either temporarily or permanently.

19 *Ramanand and Others v. Dr. Girish Soni and Another,* C.M. APPL. 1848/2020 (High Court of Delhi, 21/05/2020).

After this, if the force majeure event was a reason for causing delay or termination then the court can allow the party to claim shelter under the doctrine of force majeure. But in today's time businesses relying on the force majeure, will be required to show and convince the courts that the actual reason for non-fulfillment of the contract was COVID-19 and they were having no fault on their part. Also, we have seen in the recent judicial pronouncements that courts have adopted a strict approach towards granting relief on account of force majeure clause in contracts, so business solely relying on force majeure needs to be extra cautious and should approach courts only when they have been genuinely affected by the force majeure event and not to hide for their mistake.

LOCKDOWN IN INDIA - A MAJOR SETBACK?

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Abstract

The current pandemic situation created an outburst in the whole world. The Indian Prime Minister had announced nation-wide lockdown on March 24, 2020 which continued for at least three months. During this period, there was a complete shutdown of industries and employable sectors; the economy of the nation was drooping down. The employment rate has fallen down which has in turn largely affected the migrant workers. These daily wagers had experienced a turmoil as they could not be transported to their hometowns. Apart from the less privileged population, the other sect faced the issue of job security. The motto, "Unity in Diversity" has tumbled under an exception; celebration of festivals and pilgrimages are forbidden.

Meanwhile, the education system has adopted the advanced methods of teaching the students at the primary and secondary level. Technology is the new mode of transmission of knowledge, whether the mode is easily accessible or not is the current question. The efficiency of the teachers and students has been affected along with the comfort level shared between them. Currently, India is a developing nation where there are various districts and villages which lack the basic resources like electricity and network towers to avail the facility being provided by the country.

The source of information, in the current situation, is the media which has taken undue advantage of being in power to impart the information. The ethical and moral principles including unbiasedness has seemed to be washed away with the pandemic. Unnecessary detailing on areas of lesser concern and direct comments without authentication of data has become the main agenda of the media. This paper has tried to elaborately explain the above-mentioned issues and discuss the consequent sub issues.

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Keywords: COVID-19, migrant workers, media, education, travel, lockdown

Employment

Novel Coronavirus created a line of tension across the globe followed by the lockdown in nations including India. The Lockdown has created a great fall in the economy of the world and created a space of recession. The IMF had recently reported the future of Lockdown being worse than the Great Depression.

India has reportedly been handcuffed in a similar situation – complete lockdown has caused a big crisis for industries including MSMEs in this period of confinement. The non-functioning of various sectors which involve the workforce has thrown up a bigger question of the issue of employment. The economy of the nation has drooped and so has the rate of employment. According to reports by CMIE, there has been a great shoot up in the rate of unemployment in India from March 2020 to April 2020 by an approximate difference of 14.77%.[1]

Automobile, Aviation, Tourism and Hospitality sectors have witnessed major setbacks in economical graphs. The research would mainly be confined to the various kinds of employees affected by the pandemic and the future prospects of employment specially for the upcoming graduates.

Migrant Workers

The most affected in this lockdown period have been migrant workers – the vulnerable cult. The nation-wide lockdown had created a rift among the workforce; the lot was eager to return to their homeland. March 24, 2020 was the beginning of the series of lockdown and on March 29, 2020 the Ministry of Home Affairs had passed an order citing all the employers from the "*industries, commercial establishments or shops*" to pay the wages to the employees till the continuation of the shutdown. Several companies had approached the Supreme Court against MHA's order.

Meanwhile, upcoming weeks of first lockdown noticed a rush of migrant workers on the streets of Bandra (Mumbai). Similar events were witnessed in Gujarat and Delhi. The main demand of workers was to be transported to their hometowns, the reason being loss

1 Unemployment rate in India, CMIE Report
March 2020 – 8.75 % (India): 9.41% (Urban) and 8.44 % (Rural)
April 2020 – 23.52 % (India): 24.95 % (Urban) and 22.89 % (Rural).

of livelihood of these people, no food or shelter. Another reason was that the harvesting season had begun and these migrant families act as labour at minimal rates. State borders were closed and farms located on the borders faced problems related to workforce [2]. Due to shortage of labour, transportation of essential goods had become a major issue for the farmers.

India is the second most populated country in the world thereby, the majority of the work is dependent on man labour. Migrant workers belong to the labour force and form the backbone of the Indian economy. Transportation had been prohibited during lockdown thereby stalling them. Workers had adopted other means of travel i.e. by foot. These workers are the ones who either work on contractual basis or without contracts. Manufacturing industry, Tourism industry, or restaurants – workers are required in every form. But with reduction in demand of certain goods from the given industries due to the pandemic, requirement of labourers would also reduce.

Various events and government policies for the migrant workers are worth mentioning. Bengaluru had witnessed the most heart-melting incident. Post the announcement of lockdown, approximately 200 to 250 huts were burnt down and few days later 60 huts were set on fire in the district of Kalaburagi[3]. These huts belonged to those migrant workers who had departed before the lockdown.

Kerala had a positive impact on the migrant workers. The state comprises a larger population of this labour. '*Apna Ghar* project' has provided relief to the workers while *Roshni* has been helping migrant children to stay in school and also educate them [4]. Kerala has been the first state in the country to provide relief in the form of food and shelter to the workers in such dire situations.

Shramik Special Trains, Indian Railways initiative, was introduced to deport migrant workers since lockdown. Surprisingly, certain media reports have stated that migrant workers have been charged an amount they could not afford for which they had to take loan from their relatives but the news has not been confirmed yet. The current report that has been affirmed to is that more than half of the fares are being borne by the Central Government and the rest by the State.

2 Lola Nayar, Jyotika Sood, Yagnesh Kansara & Salik Ahmad, *100 Million and More Indian Jobs Are at Risk After COVID-19 Lockdown. Is Your Job Safe*, Outlook.

3 Mustafa Plumber, *Burning Huts of Migrants Taking Advantage of Lockdown Unfortunate: Karnataka HC*, Live Law.

4 Dr Jamon Mathew & Jose M A, *Political Interference for Migrant Welfare: An Evaluation of Kerala Model,* PKP., at 657, 660.

The Supreme Court has recently passed the MHA's order by stating that the payment of wages need to be paid to the employees after settlement with employers. If employers are unable to come to consensus with employees then the two parties may approach the requisite labour authorities. This has been a relief for migrant workers as their travel would be curbed in lieu of being paid thereby maintaining their safety and reducing the spread of virus.

Government might provide relief which may not be a permanent solution to unemployment and recovery of the economy.

Uncertainty in Jobs

Lockdown had caused a complete shutdown including workplaces. Assured by the extension of lockdown for a longer period, companies, enterprises adopted work from home concept. Various commercial and industrial establishments have also adopted the concept but there are no specific guidelines on the method of working for employees. In the whole chaos, employees currently are not assured of their job security. There are chances that the companies may sack employees as the current situation is worse than the recession period.

Even if there is job certainty, there has been salary cut for the employees. Most of the private companies have reduced income by 15% to 25% for the individuals earning a certain amount. The security or cleaning staff or lower income groups have been saved from the cut. But the recipients have suffered a backlash as they are facing multiple problems. While their food and shelter has been taken care of, rest of the income has to be spent for payment of fees or loan payment for the rest of the family specially if the individual is the sole breadwinner.

Salary cuts, work from home are some of the issues which do not guarantee job security but act as factors of job stagnancy. Untimely requirement from client's needs to be entertained by employees. There are no specific hours of work and various companies have also warned of laying off employees. In such scenario's individuals have been forced to think about changing their job but they are unaware of the unavailability of new jobs. Although new jobs may be provided but the joiners are required to stay on a standby period till the situations have not settled. This further creates grave concern for these individuals and the ones searching for a new job as they are unable to live on their savings.

Sectors that have barely been affected by the pandemic are the e-commerce platforms, medical including pharmacy, hospitals, telecom industry which have been functioning in the

crisis. While the e-commerce platforms faced difficulties in supplying goods to consumers due to lack of workforce, the healthcare sector has evolved with the maximum employment rate. Individuals working under this sector have not faced the wrath of unemployment or recession.

India has been in a dire situation in terms of economy and economists believe that V-shaped recovery is difficult to attain. Even though analysts have mentioned in a promising note that closing of the lockdown will flock to fresh demands for which workforce is required, the achievement of the same seems like a far- fetched dream.

Future Prospects

Rate of unemployment has been growing steadily thereby raising various questions in regard to the employment. Every year universities produce new graduates – the final human products for placement in best companies or firms. The lockdown period has proved to be a barrier for the graduates to present their skills as the placements of these students are currently on hold. Complexities would arise once normality comes into form as these graduates would have to prove their worth in the market which already consists of the players who have better experience and abilities to build the company. Inviting newcomers would involve high risk as every industry sector would require analysts, individuals with the capability to lift the economy.

India has adopted the policy for utilization of the local products so as to build the SMSEs. The campaign of Make in India has strengthened further due to pandemic.

Also, the graduates who have been looking forward to foreign education would have to search for various other online platforms to build their skills. Universities like Stanford and Harvard have introduced certificate courses for aspirants. The future of the upcoming generation is under question, their education is dependent on the income of the current generation and the economic growth of the nation.

Media

Media regarded as the fourth pillar of democracy was once restricted under the Vernacular Press Act, 1878 due to the criticism of the British. The Indian Constitution enabled these rights through Article 19(1) but the present media has been misusing these rights.

In the current pandemic situation, especially during the lockdown, the media was the bridge between the citizens and actions of the State. This further build responsibility on the

broadcasting channels, editors and journalists to be accurate and unbiased in their speech and written material. Publishing articles or reports require information and various media platforms have been unable to find the source due to the situation.

Due to COVID-19, monotony has befallen on the news. The reason could be the unavailability of resources, approaching well-acknowledged individuals who could throw light upon the issue. Technology has bridged the gap but the analysts or researchers providing data are unsure of the accuracy. The news related to society has all been based on mere instances and not proven facts and figures.

Neutrality

The fundamental principle in mass media and communication is neutrality – in research, speech and articles. Opinions are to be formulated by the readers, listeners or authors who are not employed by news publishing houses or media houses.

Presentation of the daily events have included media reporters; writers being biased in their display. News is to be portrayed on the basis of facts and figures or the major decisions taken by the government. The span of time the news is depicted is for a short while. While the figures on coronavirus have been regularly displayed due to the government guidelines, the rest of the information has always been biased i.e. in criticism or favour of the government. Only one side of the story is presented thereby hampering the construction of opinions in an individual's mind.

Reports on the reason for the spread of coronavirus had mainly targeted the religious cult which had arrived in Delhi for a meeting. The other factors like the infusion of people from infected countries and lack of awareness program among masses were not given due attention. Also, the cover over the plight of migrant workers were not being discussed during the initial days of lockdown.

Indian media has begun to lose the basic ethical standards to be followed to represent particular news. Usage of jargons have become common which has further degraded the quality of news and aroused misinterpretation among the masses.

This has led the media to the doors of law due to the misuse of their right. Alongside the fundamental right to speech are reasonable restrictions which involve not to defame an individual. Arnab Goswami, an Indian journalist and television news anchor, was charged for defamation for questioning one of the politicians from the opposing party over silence on the lynching case. Recently a legal notice of defamation was issued against a media

house for portraying an actor's death as an act of cowardice [5].

Questions raised on the appropriate use of right and negation of duties while dealing with presentation of current events.

Social Media

Misinformation is never welcome in this field as media is the medium through which the individuals are informed. Social media is the current hub of the tech-journalism. News about Uttarakhand forest fire were doing rounds until the authorities confirmed the pictures were previous years and that the fire was not of that intensity as reported by various social media platforms.

The new-age of journalism, social media has covered the generation of all times, especially in the pandemic situation. It has created an obstacle for the news channels as this platform tends to fabricate the news. But apart from this social media has played a role in raising questions that the broadcasting channels have unable to publish. Questions on the employability rate, the conditions of migrant workers and views of the public on the ongoing events. 'Bois Locker Room' was one such incident which had reached the court due to the reports filed against it on social media.

The platform has been passing certain statements which are not verified by the authorities and due to the coronavirus, there is no policing on the statements. The platform enables individuals to attack each other without realizing their duties as a citizen of India. There have been various cases that have been reported on defamation, stalking and use of indecent language through comments or personal conversations with the users. This has led to lack of sensitivity among the users. Statements that could mentally affect another individual as a virtual conversation does not depict the personality of the person. The political comments and direct attack on the government without any authentic data has created a doubt on the awareness of the parliamentary privileges these individuals do not possess. Since direct comments on the stature of an individual could only be made in the Parliament as the parliamentarians are given the privilege to do so.

In a population of almost a billion and a smaller number of employees in cyber security to control the misuse of the platforms, awareness about proper conduct on social media is mandatory.

5 Tanurag Ghosh, *Aaj Tak Served Legal Notice for Spreading Misinformation On Sushant Singh Rajput's Death*, LAW STREET JOURNAL, (Jun. 05, 2020, 08:00AM), https://lawstreet.co/crime-police-and-law/aaj-tak-legal-notice-spreading-misinformation-sushant-singh-rajput-death.

Forsaken Data

The pandemic had restricted the movement of individuals due to lockdown. In such occasions the public was to be made aware of the ongoing events. The international treaties or policies, India's take on their relations with other nations, the funding scheme, government's schemes for the financial stability of the public and most important the current situation of the pandemic-- these events were brilliantly landscaped by the media as the information was government authorised. But such information was available only to the financially growing media houses, the local media houses in different parts of the country were facing grave issues. The local media centres are unable to display the news as the data collected would require government's approval which would be ineffective without it.

Issues being faced by the prisoners in the cells; the concern has not been showcased by the media. The Maharashtra government released certain prisoners on temporary bail to reduce the spread of COVID19. But are the prisoners being provided proper sanitation or are their basic rights being protected? – such questions have rarely been raised by the media. Women are being subjected to domestic violence and every day such cases are being reported but there is no debate in the media about the same. Is the media restrained from questioning or is it neglecting these issues considering it to be trivial?

Need of Artificial Intelligence

Artificial Intelligence has been a ray of hope in relation to technology. Its adoption has benefited sectors and researchers. AI has been collecting data to distinguish between the behavior of a human and machine through machine learning. While the AI can be misused in commission of crimes, it can also be used for assistance in finding the culprit through the data of such individuals or through DNA.

AI in the media could be used in eliminating fake news through its processed data. AI has the capability to adjust in accordance to the situation and give solutions related to the situation. The adaptability and decision-making power are quicker due to its algorithm. Recently WHO had also taken the aid by collaborating with Facebook so as to eliminate misinformation [6]. Humans are bound to get misguided from the ethical values required in the field of media.

AI could in future hold flags of neutrality, equality, peace which the human race has been debating on, if utilized in a proper manner.

6 Geetika Sachdev, *Artificial Intelligence: A shield against 'fake news'?*, India AI, at 2.

Education

The education system in India has been in a crippled and debatable state for quite some time. Education is a privilege which is still denied to the majority of the population. Education is the key which can socially elevate the poor, restructure the society, free it from its prejudiced and intolerant norms and boost the economy of the nation. Despite making education free for children of 6-14 years of age under the Right of Children to Free and Compulsory Education [7], India still comprises a huge fraction of the illiterates in the world.

The UNESCO while releasing its Global Monitoring Report in the year 2015-16 revealed that India has the largest population of illiterate adults in the world and that the country ranks 106th out of the 127 countries. Though this report was based on 2001 census statistics but the reason behind such low ranking has not changed much. Most of the aggrieved individuals, generally the rurals, that are able to make it to educational institutions are burdened to pursue only those fields that help in money making. Higher education suffers due to poor infrastructure, untrained teachers, lower government incentives, unjust public funding, unplanned curriculum for growth [8]. Adding on to the issue, government school teachers remain absent most of the time majorly due to their full time election duties or for several other excuses which goes unnoticed. However, these loopholes were trying to be reduced by awareness, night schools in villages and several other improvement measures. By the time results of such measures were to be analyzed, the outbreak of COVID19 deepened the crack of these loopholes. COVID19 outbreak has been deemed a global health emergency [9]. This pandemic has increased the inequality and intensified the breach in the education system.

Disparity in Resources = Difficulty in Access

While the country continues to fight against the perils of COVID-19, a gradual but relatively equal issue is posing a threat to this nation's progress. The teaching environment has completely changed. Online classes and tutorials are being conducted to educate the children, that is, virtual classes are being conducted instead of physical ones. This pattern of imparting education can be said to be a trial and error method as it has not been analyzed and examined earlier. One does not know whether it would prove to be a success. This can also be a medium that can give way to greater problems due to unequal distribution of

7 INDIA CONST. art. 21 A.

8 Pawan Agrawal, *Higher Education in India: The Need for Change*, ICRIER, June 2006, 5-7.

9 Catrin Sohrabi, et al., *World Health Organization Declares Global Emergency: A Review of the 2019 Novel Coronavirus (Covid-19),* 76 Int. J. Surg., 71-76.

wealth and resources across the nation. Mission Antyodaya, a nationwide survey of villages conducted by the Ministry of Rural Development in 2017-18, showed that approximately 16% of India's households received one to eight hours of electricity daily. For most of the parents, considering their income, sending their child to school is the maximum they can spend. Further expenditure on renting/buying computer devices and affording internet facility is not an option. The lower strata of the society do not have resources to avail the privilege of online classes for their children. It is also to be noted that some students of an institution, who can avail such devices, may be living in remote areas where the network connectivity is poor or negligible. They have no option but to miss those classes since they cannot leave their houses to get a network range, otherwise, it would have induced them into risking their lives when the entire nation was in a lockdown. Poor connectivity can be an issue on either end. Even the teacher may be a resident of a place where signal failures are common. According to the 2017-18 National Sample Survey report on education, only 24% of Indian households have an internet facility, while 66% of India's population lives in villages, only a little over 15% of rural households have access to internet services.

Self-Evaluation

Furthermore, several teachers have to be trained to operate online portals. They may not be accustomed to using such technological devices for imparting education. They may not be comfortable when it comes to virtual teaching. Few might be conscious with their pronunciation, voice modulations, intonations and may experience difficulty in speaking without an actual, physical audience. While physically present in class the students adapt themselves according to the teacher's dialect and expression. Generally, a teacher comes to know when a student is mentally absent though physically present in class. However, this changes when it comes to virtual education. Students know that even if they don't pay attention to what the teacher shares, they would not be pointed out and scolded. Therefore, most of them may take this method of teaching as unserious. With such lack of concentration, it is not the teacher who is at loss exactly but the students. In this pandemic situation, many might opine that only the education of high school (class 10) and intermediate level (class 12) are a concern since the primary classes do not have much to lose. Even the Government has laid relatively greater emphasis on higher levels by discussing their problems. However, the primary classes form the roots and fundamentals of any education system. The primary levels hold equal importance with the senior levels. Without primary education, which teaches the basics that form the prerequisite of higher levels, focusing on the latter would be a waste.

Imparting Knowledge - An Issue?

Other than online classes, parents are also a source of educating their children. Under lockdown, primary schooling is parents' responsibility. However, this will only be applicable when the parents, themselves are literate and educated. The parents, who are uneducated, are unable to teach and impart knowledge as far as syllabus is concerned. This also makes way for inequality as literate parents are at an edge whereas the illiterate lag behind. The measures taken by Government and various Non-Governmental Organizations to run rural schools and night education camps for the rural workers prior to this pandemic have also come to a standstill. Internships and student volunteer programs are other areas adversely affected by COVID-19. To illustrate a few, medical and law students require internships, since online classes would not suffice them. Practical experience and observations are a must for specific professional courses and the students cannot only rely on theory and watching online videos.

Admission Process- A Dilemma

Many private universities are enrolling students on the basis of interviews only rather than aptitude tests or merit basis. This might not be an issue where such practice was prevalent prior to lockdown. However, it might be unfair in cases where prior to the lockdown, private colleges conducted aptitude tests and interviews both or only aptitude tests or enrolled on merit basis. Candidates who are uncomfortable with interviews or had put in several hours of practice to prepare for aptitude tests are now at a disadvantaged position since these universities are enrolling students through interviews. Candidates might lose their opportunity to study in their dream college. Whom do they have to blame? They cannot blame themselves for working hard and putting in efforts. There might be students who have shortlisted colleges on the basis of their admission procedure, long before the start of their class 12th. However, now the candidates have to either miss their opportunity or put in further efforts to prepare for the interview in such a short span which would not have been the case, had it not been for this public health emergency.

Considering all these issues, one might say that COVID-19 has adversely affected the education sector and most importantly, the future of the youth which will eventually, mould the progress and growth of this nation.

Travel and Transport

According to the World Travel and Tourism Council, India's Tourism has contributed Rs. 16.91 Lakh Crore that is 9.2% to India's GDP in 2018. It provides 8.1% of its total employment. On the contrary, this Council had projected that travel could fall by 25% in 2020 putting at risk 12-14% of the jobs in the sector, which implies 50 million jobs at risk, globally, but the global pandemic outbreak might further worsen these figures. According to estimates from CMIE's Consumer Pyramids Household Survey, travel and tourism accounts for five per cent of total employment in India (nearly 20 million jobs).

Unplanned Agenda

Travel is the single most important contributor to disease transmission [10]. The first steps to prevent transmission to others include taking precautions (mask and sanitizing equipment), avoiding close contact and ensuring adequate isolation. At the community level, people were asked to avoid crowded areas and postpone non-essential travel to places with ongoing transmission [11]. With having several people in its grip, several nations have imposed travel restrictions not only within their boundaries but have also denied people to enter their borders. Indian Government was astute enough to suspend travel and impose shutdown strategies to avoid cases of transmission and curb the spread at an early stage. This abruptly announced lockdown across the nation, though done to prevent the spread, was perceived as a hard hit by a few since there was no planned agenda for recovery and the people were not prepared with sufficient resources.

Religious Inadvertence

India, being a nation where religions like Hinduism, Islam, Sikhism, Buddhism trace their origin, had to intervene in the religious affairs due to this global outbreak. With travel bans, people were unable to celebrate festivals including Eid-al-Fatr, Easter, Baisakhi and travel to holy shrines and other religious institutions. Some had to let go their age - old traditions and customs while some were unable to go on pilgrimages. Such inability to fulfil their divine and sacred beliefs has caused resentment among the orthodox followers. Saudi Arabia suspended the year round Umrah pilgrimage to curb the widespread, however, Iran witnessed large regional outbreaks since it did not intervene in the religious pilgrimage [12].

10 Shahul H Ebrahim, et al., *Covid-19 And Community Mitigation Strategies in A Pandemic,* BMJ, at 368.

11 Tanu Singhal, *A Review of Coronavirus Disease-2019 (Covid-19),* 87 Indian J Pediatr. 281-286 (2020).

12 Ebrahim, *supra* note 11, at 368.

State of Abandonment

With state borders being sealed, international flights being banned, buses and trains stopped, several people who were away from their hometowns or migrated to different states for work were left stranded, away from their families and friends and some even in a completely unknown place. With no work for the daily wagers, going home was a better choice but since no mode of transportation was available, few succumbed to their misery when walking hundreds of miles to meet their family while some were subjected to the police brutality on their way back home [13]. During the lockdown, few of the poor migrants had to stay in quarantine camps outside state borders with no clue as to when would they be allowed to travel to their native districts and live with their family. The Economic and Political Weekly stated that this situation was "reminiscent of the partition era, when refugees were forced to shift their entire household within the span of a few hours, the groups of migrants can be seen walking on highways, with the entirety of their belongings on their shoulders". Several newspapers reported that many labourers were so desperate to return to their villages that they hid in tankers and trucks, defying the lockdown and social distancing orders and travelled to their respective hometowns once the state borders were opened. Few succeeded to reach their destination without being noticed by the authorities while the others were stopped when the vehicles were inspected.

Livelihoods at Stake

With people following the lockdown and containment orders, livelihoods were at stake. Not only were there production halts, but also offices, business chains, outlets and stores remained shut allowing only a marginal fraction of essential services owners to provide for the basic amenities. Another reason for the stores being shut was that they received no supplies from the manufacturers with the ongoing travel restrictions. Inhabitants of remote areas are some of the people who were majorly affected due to the lockdown, since they had limited access to essential necessities including food and medicines. Some people are practicing work from home during the lockdown while some who are without any work have become lethargic, less productive and lost their workflow. This has psychologically and mentally strained them.

With the lockdown being lifted in orange and green zones, certain industries, offices, firms and shops were opened. However, labourers, workers and employees continue to face inconveniences with the inability of local trains, metros and buses. Those who have their

13 Bhupen Singh, *Media in The Time of Covid-19,* 55 EPW. 1 (2020).

workplace at far off places are either unable to turn up or report late. Moreover, even if these public transports start, people might fear travelling to avoid congestion and ensure their safety.

With all these increasing concerns, it is quite evident that a planned and well-structured agenda for recovery is necessary to reinstate, if not improve, the nation back to where it was prior to this public health emergency.

CONCLUSION

The novel coronavirus outbreak which was declared a public health emergency by the World Health Organization has adversely affected innumerous sectors across the globe. Not only has it suspended their operations but has also put them in a state from where revival is quite strenuous and distressing. This global outbreak has magnified the complexities and initiated novel challenges. With India still falling under the category of Third World nations, it would require effective measures for a favourable and satisfactory retort. Normalcy has become a long-lost dream! People have given up their conventional habits and usual comfort zones in order to survive and adjust in these extraordinary circumstances. New procedures have been adopted for sustenance.

Travel, tourism and education were the first set of sectors being severely hit by the pandemic. With no vaccination or effective solution available, the Government's strategy of imposition of lockdown and travel ban was more than necessary. However, taking such restrictions into consideration many businesses have taken a backslide and some are even on the verge of extinguishment. With no transportation and distribution of goods to retail stores, shops are devoid of the products and customers are returning empty handed. Moreover, in the near future people will have to self-regulate their travel. Instead of leisure travel, people will have to choose to confine themselves to their homes except for purposes which are essential. An article published by the Business World reported that social distancing has become the prevalent norm and sectors like travel, tourism and entertainment are not expected to recover soon.[14]

The increasing slope of unemployment and stumbling income levels have widened the extent of impact, COVID-19 has had. With travel regulations, revenues in the

14 Ishwinder S. Suri, *Impact of Covid on Indian Economy and Road Ahead for corporate Sector,* BUSINESS WORLD, (Apr. 30, 2020, 11:00AM), http://bwdisrupt.businessworld.in/article/Impact-of-COVID-19-on-Indian-Economy-and-Road-Ahead-for-Corporate-Sector-/30-04-2020-190322/.

transport industry have experienced a slump. Many employees might have to be sacked if similar scenarios continue to disrupt the revenue generation. This can be for other sectors as well. As a result of which another issue of job security props up. One can anticipate that people would be employed on a contractual basis rather than full time in the coming months. Work from home may be the new normal concept. With being confined at homes, most of them will have no choice but to shift to digital and internet economy- online education, online groceries and shopping, online jobs. Businesses which cannot be carried on without the internet will be forced to restructure their marketing strategies.

Educational institutions will have to identify and create a comprehensive way that is easily accessible for both the students and the teaching fraternity. Until then, virtual classes over the internet have to serve the purpose. Both the students and the faculty need to understand the gravity of the situation and act cooperatively. Helping one another will pave the way forward.

With everything getting digitalized, people might shift from print media to digital media in the upcoming phase. Though, much of the media which is corporate-owned has surrendered, a small section is still courageously following journalistic ethics [15] to highlight what news is actually all about. Instead of becoming a tool regulated by the 'Big Corporate Houses', the media must focus on outlining the actual concerns which have been neglected or otherwise overlooked. There are some vulnerable aspects which require urgent attention of not only the Government but also the people. However, the media has failed to bring such susceptible and sensitive situations to light. The escalation of misinformation through fake news has been another alarming issue during this critical phase which needs to be taken care of.

The citizens need to remain poised to understand and survive these grave circumstances. Being panic stricken and blaming others for the global outbreak is not the solution. At this time, India as a nation requires its people to cooperate with the measures adopted by the Government and form a recovery plan which might alleviate the perils and help in restructuring the society back to where it was prior to this public health emergency.

15 Singh, *supra* note 14.

DUE DILIGENCE EXERCISE: DEMYSTIFYING THE DUTY OF MERCHANT BANKERS IN INDIAN SECURITIES LAW REGIME

Mansi Mishra*

Abstract

The Securities and Exchange Board of India, after much deliberation, adopted a disclosure based regulatory regime. This framework rests on the disclosure of relevant details by issuers, acquirers and intermediaries about their products, themselves and the regulations for facilitating informed decision making by potential investors. Adequate, timely and fair disclosures form the cornerstone of any disclosure mandated by the Board. In this regard, merchant bankers have been vested upon with the solemn onus of exercising due diligence by examining veracity of disclosures made by issuers in securities' transactions. This duty has attained gravity because it decides the fate of companies inclined to enter the securities' market. It is a means of preventing unscrupulous companies from defrauding investors and other stakeholders. Consequently, it becomes essential to regulate the duty of due diligence and prevent collusion by merchant bankers with issuer companies. This gives rise to various questions: - What is the statutory framework that governs due diligence by merchant bankers? What is the standard of this due diligence? How to determine the threshold of materiality of disclosures to be made by merchant bankers? What are the penalties for negligence in due diligence? Are there any factors that mitigate such penalties? In this article, the author shall provide answers to all the aforementioned questions. The author shall further provide analytical insights as to whether the interpretations and approaches adopted by the Regulator are effective in regulating due diligence exercise and furthering the aim of investors' protection.

INTRODUCTION

Since the inception of Securities and Exchange Board of India ("*SEBI*") in 1992, the capital markets in India have witnessed systematic reforms for protection of interests of investors.

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The most beneficial reform from investors' perspective has been the shift to a disclosure based regulatory regime. This framework involves disclosure of relevant details by issuers and intermediaries pertaining to themselves, the market, the products and the regulations in order to facilitate the investor to take informed investment decisions.[1] As such, SEBI is mandated to protect the interest of the investors and the securities market, and in pursuance of the same, it monitors both initial and continuous disclosures. In order to obtain assistance in smooth functioning of the disclosure based regime, SEBI enacted the SEBI (Merchant Bankers) Regulations, 1992 ("*Merchant Bankers Regulations*"). Merchant Bankers play a unique role in advancing the aim of investor protection by ensuring veracity of disclosers made by an issuer or an acquirer in the offer documents and other public documents. This process is termed as due diligence. Thus, the importance of due diligence conducted by merchant bankers cannot be over-emphasized.[2] This article seeks to discuss the obligation of conducting due diligence vested upon merchant bankers in Indian securities law regime and scrutinize certain aspects pertaining to it. Part I discusses the statutory framework providing for merchant bankers' duty of exercising due diligence in various securities transactions. Part II delves into the aspect of the standard of care and caution required to be exercised by merchant bankers while discharging responsibilities related to due diligence. Part III elucidates upon the importance of determining materiality of information for disclosure during due diligence, and the test prescribed for assessing such materiality. Part IV seeks to identify and examine the factors that result in mitigation of penalty for negligence by merchant bankers due diligence. Part V concludes the article and stresses upon importance of clarification of anomalies.

Statutory Framework

SEBI monitors the authenticity and adequacy of disclosures by casting solemn onus on merchant bankers to conduct due diligence before an offer document or other public documents are made available to potential investors. Currently, the legislation forming the foundation of merchant bankers, statutory duty of due diligence is the prescribed Code of Conduct under the Merchant Bankers Regulations, adherence to which is mandatory[3]. The Code of Conduct requires a merchant banker to protect the interests of the investors and to fulfill its obligations in a prompt, ethical and professional manner[4], while exercising

1 *Office of Investor Assistance and Education*, Securities and Exchange Board of India,(May 2, 2020, 11:00AM), https://investor.sebi.gov.in/ipms.html.

2 *In the Matter of IPO of PG Electroplast Limited in Respect of M/s. Almondz Global Securities Limited*, 2012 SCC OnLine SEBI 117, ¶9 (India).

3 Securities and Exchange Board of India (Merchant Bankers) Regulations, 1992 §3.

4 Securities and Exchange Board of India (Merchant Bankers) Regulations, 1992, Code of Conduct §3.

due diligence and independent professional judgment at all times.[5] The aim behind such an obligation is the adequate supply of true information to the investors and making them aware of the underlying risks associated with an investment decision.

The Code of Conduct further requires merchant bankers to make timely disclosures to the investors in a timely manner in accordance to the applicable regulations and guidelines to enable investors to make a balanced decision.[6] In the words of the Securities Appellate Tribunal ("*SAT*") in the matter of *Enam Securities Private Limited v. SEBI*[7]:

"*The Code of conduct places an onerous duty on a merchant banker not only of protecting the interest of the investors but also of ensuring that adequate disclosures are made in a timely manner without making any misleading or exaggerated claims and to render best possible advise to the clients. A merchant banker is required to maintain high standards of integrity, dignity and fairness in the conduct of its business and is required to promptly inform the Board any violation or non-compliance of the regulatory framework that come to its notice*".

While Merchant Bankers Regulations is a blanket legislation governing the merchant bankers' duty of due diligence, there are regulations pertaining to specific securities transactions requiring merchant bankers to conduct due diligence. When acting in the capacity of an underwriter, SEBI (Underwriters) Regulations, 1993 mandate merchant banker to exercise of due diligence, independent professional judgment and proper care.[8] In a buy back transaction, the merchant banker appointed by the company under the SEBI (Buy Back of Securities) Regulations, 1998 is required to verify the contents of draft letter of offer as well the public announcement to ensure that they are true, fair and adequate by performing due diligence. The same has been incorporated in the provisions[9] of the SEBI (Buy Back of Securities) Regulations, 2018 as well. Furthermore, the SEBI (Issue of Capital and Disclosure Requirements) Regulations, 2009 provide for appointment of merchant bankers as lead managers to the issue who are required to conduct due diligence and satisfy themselves about the veracity of disclosures made in the offer documents.[10] Additionally, merchant bankers are obligated to carry out due diligence and verify the

5 *Id.* §4.

6 *Supra* note 5, §8.

7 *Enam Securities Private Limited v. SEBI*, 2012 SCC OnLine SAT 29, ¶3 (India).

8 Securities and Exchange Board of India (Underwrites) Regulations, 1993, Code of Conduct for Underwriters §5.

9 Securities and Exchange Board of India (Buy back of securities) Regulation, 2018 §16, §25(viii).

10 Securities and Exchange Board of India (Issue of Capital and Disclosure Requirements) Regulations, 2009 §121 §24(3).

disclosures under the SEBI (Issue and Listing of Debt Securities) Regulations, 2008[11]. The same has been reiterated under the SEBI (Substantial Acquisition of Shares and Takeover) Regulations, 2011[12].

Despite such regulations in place for merchant bankers' duty of due diligence, there is no statutory framework laying down binding due diligence norms governing and elaborating upon the said duty. The blanket legislation and the detailed legislations for each securities transactions simply provide for the duty, instead of giving clear directions as to the necessary steps that the Regulator expects the merchant bankers to take in the due diligence process. Furthermore, there are no basic guidelines that could clarify the essential requirements of the process, neither is there any codified minimum threshold which, if not met with, would amount to negligence. SEBI recognized the same in 2011, and approached the Association of Merchant Bankers of India ("*AMBI*"), now Association of Investment Bankers of India ("*AIBI*"), to frame guidelines for due diligence for its members.[13] The Regulator had instructed AMBI to include norms for verification of corporate records and specific instructions on the method of conducting due diligence of promoters, company management and group companies for protecting investors' interest. Thereafter, AIBI brought out the Due Diligence Manual ("*Manual*") in 2012.[14] However, the Manual is merely indicative in nature and does not have the force of law, as stated in the Manual[15] itself. Even so, no steps have been taken till date towards imparting to it the imperative binding value so as to provide merchant bankers with guidelines recognized by SEBI. Another limitation of the manual is that it has set out guiding principles for due diligence to be performed only within the scope of SEBI (Issue of Capital and Disclosure Requirements) Regulations, 2009. Interestingly, even though formulated on the behest of SEBI itself, the Manual has never been cited as a recognized or generally accepted set of rules of due diligence by SEBI, SAT or any Court of law, which could be useful for merchant bankers in understanding SEBI's

11 Securities and Exchange Board of India (Issue and Listing of Debt Securities) Regulations, 2008 §26(2) (India).

12 Securities and Exchange Board of India (Substantial Acquisition of Shares and Takeovers) Regulations, 2011 §12; *see SEBI v. Meghraj SP Corporate Finance*, 2006 SCC OnLine SAT 632, ¶3.11(India).

13 Mehul Shah, *Regulator Wants Due Diligence Norms for Merchant Bankers*, Business Standard (Jan. 20, 2013, 10:58 PM), https://www.business-standard.com/article/markets/regulator-wants-due-diligence-norms-for-merchant-bankers-111070800042_1.html; Bijith R, *AMBI Gets Cracking on Due Diligence Guidelines for Merchant Bankers*, Financial Express (Aug. 31, 2011, 07:13 AM), https://www.financialexpress.com/archive/ambi-gets-cracking-on-due-diligence-guidelines-for-merchant-bankers/839377/.

14 *About Us*, ASSOCIATION OF INVESTMENT BANKERS OF INDIA,(Apr. 30, 2020, 09:00AM), http://www.aibi.org.in/about.asp

15 *Due Diligence Manual*, Association of Investment Bankers of India (Aug12, 2012, 09:00AM), http://www.aibi.org.in/AIBI%20Due%20Diligence%20Manual.pdf, p.6.

stance. Therefore, there continues to persist unavailability of detailed guidelines of binding character prescribing basic steps to be followed by merchant bankers which SEBI would consider to constitute proper due diligence.

Standard of Due Diligence

The disclosure based regime in Indian securities market is not static, but possesses an evolving character. As a result, the process of due diligence itself is dynamic and complex in nature. Whilst due diligence is not defined in any statue, in practice the phrase generally constitutes collection of information about the acquirer or an issuer that would assist the merchant bankers in drafting and assessing the disclosures made in the offer documents.[16] The particulars which are required to be disclosed are intended to give a clear picture to a member of the company or prospective investors to the purpose for which the securities are being transacted and by whom.[17] However, both the Manual and the Code of Conduct are silent as to what is the standard of due diligence that is expected from merchant bankers involved in securities transactions.

This gap with respect to the requisite standard created by the silence has been attempted to be filled by the judicial precedents, which reveal that due diligence is concerned with efforts made, *bona fide* conduct of the merchant banker concerned and the facts and circumstances amid which such merchant banker acts.[18] There is no prescribed strait-jacket formula or fixed benchmark of due diligence and the law requires only 'reasonable diligence' even from the experts including merchant bankers.[19] In order to better put forth the standard of due diligence, it would be pertinent to mention the case of *Chander Kanta Bansal v. Rajendar Singh Anand*[20], wherein the Honorable Supreme Court had held that due diligence in law means reasonable diligence and doing everything reasonable and not everything possible. The meaning of the expression "due diligence" was elaborated upon by the Apex Court in the following words:

> *"According to Oxford Dictionary (Edn. 2006) the word "diligence" means careful and persistent application or effort. "Diligent" means careful and steady in application to one's work and duties, showing care and effort.*

16 *Supra* note 16 at 30.

17 *Shirish Finance and Investment (P.) Ltd. v. M. Sreenivasulu Reddy*, 2002 (1) BomCR 419, ¶58 (India).

18 *Imperial Corporate Finance & Services Pvt. Ltd. v. SEBI*, 2005 61 SCL 197 SAT, ¶21(India).

19 *Almondz Global Securities Ltd. v. SEBI*, 2016 SCC OnLine SAT 219, ¶39; Shadi Lal Batra v. Unknown, AIR 1968 Delhi 283, ¶17(India).

20 2008 (5) SCC 117.

> *As per Black's law Dictionary (18 Edn.), "Due Diligence" means the diligence reasonably expected from, and ordinarily expected by, a person who seeks to satisfy a legal requirement or to discharge an obligation. "Due Diligence" means reasonable diligence; it means such diligence as a prudent man would exercise in the conduct of his own affairs".*

In another case of *SEBI v. JM Morgan Stanley Private Limited* [21], SAT had placed reliance upon the dictionary meaning of the said words as defined in the Law Lexicon (2nd Edition) which provided that diligence implies the care and prudence as is usually by persons of common or average care and prudence. Whether or not there is a lack of due diligence runs from the facts of each case and ultimately, there is no hard and fast rule as to what constitutes lack of due diligence.[22] In fact, it has been held that the merchant banker cannot be expected to look at each and every statement and information provided by the issuer with suspicion unless the facts and circumstances at the relevant time so demand.[23] In order to prove a fault in due diligence, there must be a convincing preponderance of evidence, as held by the Supreme Court in the case of *Pandurang dattatray Khandekar v. Bar Council of India* [24]. The Apex Court further clarified that before any violation of the concept of due diligence is found, there must be an enquiry and the finding must be sustained by a higher degree of proof than that required in a civil suit, but falling short of the proof required to sustain a conviction in a criminal prosecution.

However, upon observation, it becomes evident that this standard of reasonableness has acquired a stricter enforcement in the current regime. That is to say that the reasonableness cannot be equated with immunity from exercising due care. In fact, the disclosure based regulatory regime has resulted in imposition of heavier responsibility on merchant bankers of issuers of securities in respect of the accuracy and completeness of the information disclosed by them.[25] The premise underlying such a standard of due diligence is that the access to securities market for issuers and acquirers, as per the case, is conditional upon the disclosures verified by the merchant bankers. Probably, that is the reason why SEBI has tightened its approach in interpreting the established standard of prudence. It follows from the above that a merchant banker is not required to assume the role of a detective and look at every statement or document possible. In other words, the job of due diligence performed

21 2005 SCC OnLine SAT 79, ¶6.

22 *Supra* note 19.

23 Order in matter of *M/s. Karn Merchant Bankers Limited,* AO No. EAD/BJD/BKM/99/2017-18, ¶15.

24 AIR 1984 SC 110, ¶6.

25 Ad-Interim Ex-Parte order in the Matter of *Bharatiya* Global *Infomedia* Ltd., 2011 SCC OnLine SEBI 155, ¶2.9.

by merchant banker cannot be limited to mechanical perusal of documents submitted to it. Neither can it be equated to disclosing whatever is given to it by the issuer. Rather it involves exercise of reasonable diligence to ensure adequate, true and fair disclosures in an offer document, prospectus or other public documents. This standard has been rightly set at reasonableness expected from a prudent person. However, the push of the Regulator towards stringency and stricter enforcement has tended to dissolve the element of reasonableness, even though the orders and judgments continue to pay lip service to it. This has given rise to the need of codification of the standard in the Code of Conduct itself in order to provide a clear picture to the merchant bankers with regards to the dynamics of the role that SEBI expects them to perform. Such codification also becomes imperative for assisting merchant bankers to differentiate between what could amount to a negligent conduct and what kind of actions by merchant banker could give rise to charges of collusion.

Materiality of Disclosures

The guiding principle in any disclosure-based regulatory regime is the need for the issuers of securities to provide the potential investors with full, accurate and timely disclosure of all relevant information in respect of the issuer and the security being issued.[26] The underlying object of disclosure provisions in Merchant Bankers Regulations is to ensure that the offer document contains all disclosures that are material for the applicants permitted to participate in the transaction to take an informed investment decision.[27] The merchant bankers discharge the duty of ensuring that the aforementioned requirement of adequacy of material disclosure is met with. Hence, it becomes pertinent to analyse the concept of materiality, which assists merchant bankers in determining as to what is material enough to disclose. The analysis of materiality serves the purpose of shaping the content of mandatory disclosures. Additionally, it crystallizes the content of non-mandatory disclosures made for the sole purpose of clarification in order to avoid misstatements. While the mandatory disclosures are straightforward in nature and do not involve exercise of professional judgment on part of the merchant banker, it is the clarifying disclosures whose absence can result in potential misstatements. The Merchant Bankers Regulations do not provide any threshold of materiality of disclosures. This glaring absence of a threshold renders scope for conflict between the judgment of materiality of a particular disclosure by SEBI and by the merchant banker. Another plausible consequence constitutes merchant bankers getting away with omissions in disclosures resulting from collusion with issuer companies, on the

26 *Supra* note 3.

27 *Kotak Mahindra Capital Company Limited v. SEBI*, 2016 SCC OnLine SAT 201, ¶14 (India).

pretext that in that their reasonable and professional judgment, the particular information was not material enough to be disclosed.

The vacuum around the position with regards to materiality of disclosures in offer documents by merchant bankers was put to an end in 2016 in the SEBI Adjudication Order in the matter of *M/s Electrosteel Steels Limited ("ESL") and M/s Electrosteel Castings Limited ("ECL")*.[28] ECL was the parent company of ESL and the former had promoted the latter in 2006 post a Memorandum of Understanding (MoU) with the Government of Jharkhand for setting up a steel manufacturing plant. Iron ore being a core raw material in the manufacturing process, ECL had applied to Ministry of Environment and Forests ("*MoEF*") for project clearance for obtaining iron ore mining blocks in Jharkhand. The said application got rejected in January, 2009. However, the matter of rejection was being reconsidered by the MoEF on request made by the Government of Jharkhand in July, 2009. In the meanwhile, ESL floated an Initial Public Offering ("*IPO*") in March, 2010 and completed the same in September, 2010. The MoEF gave the clearance only after the completion of the IPO. The substantive legal question for consideration before SEBI was whether the rejection of the application made by ESL to MoEF with regards to project clearance constituted 'material' information which ought to have been disclosed in the offer documents pertaining to ESL's IPO.

SEBI *vide* its Adjudication Order penalized, among other parties, the merchant banker in the case for failure to exercise due diligence by not disclosing the rejection of the said application which constituted 'material' information for prospective investors. With regards to the materiality of disclosures by merchant bankers, SEBI observed the following:

> "*Assessment of the materiality of an event or development requires a contextual determination that takes into account all of the relevant circumstances, including the nature of the event or development and its consequences to the issuer's business.… Thus, true and adequate disclosure is said to be made, if the disclosure is accurate and not misleading and does not omit a fact that is either material itself or is necessary to understand the facts that have been disclosed, so as to enable the investors investing in the issue to take an informed investment decision*".

SEBI further clarified that the subjective assessment or optimistic views of the issuer do not have any role to play in materiality analysis done by merchant bankers. Instead, the test of materiality is of objective nature. SAT, while upholding SEBI's finding with respect to the

28 Adjudication Order in the matter of *M/s Electrosteel Steels Limited and M/s Electrosteel Castings Limited*, AO No. AK/AO- 8-12/2016 (2016).

materiality of information, observed that the letter and spirit of the disclosure requirement is such that by disclosing every material event in clear terms, there is no scope left for judging the degree of materiality.[29] The emphasis has to be placed on disclosure, not otherwise. In other words, the merchant banker has to disclose even when the issuer has doubts regarding existence of element of materiality in the information concerned. The only facts that can be ousted from the purview of disclosure are those which the issuer is undoubtedly sure of lacking relevance to the issue.[30]

While SEBI favored the assessment of materiality from the perspective of a reasonable investor, SAT limited the scope of subjective analysis and shifted the onus upon the issuer to be sure about any piece of information being irrelevant. Furthermore, the SAT order mandating to disclose all information that is relevant to the issuer without determination of the relevance of that information to the investors runs contrary to the mandate of Merchant Bankers Regulations. In this regard, the Code of Conduct explicitly provides that merchant banker has to ensure that adequate disclosures are made in order to achieve the aim of enabling investors in making a balanced and informed investment decision.[31] Another significant observation, in the opinion of the author, is that the principle enunciated by SAT requiring blanket disclosure of all the information is also in contrast with the established standard of due diligence requiring exercise of care, caution and analysis on merchant bankers' end instead of mechanical disclosure by them. Hence, there is an anomaly in interplay of materiality and standard of due diligence expected from merchant bankers by law.

The emphasis on disclosure is justified; but disclosure of information of dubious significance has been held to accomplish more harm than good.[32] The vice of dubious disclosures lies in the fact that this leaves the potential investors with analyzing a bulk of information and nuanced task of identifying the material information on their own. Unlike merchant bankers, who are technical experts, the investors might suffer from high risk of over passing the material information amidst the dubious disclosures owing to their lack of expertise. Such an outcome is in sharp contrast to the aim that SEBI sought to achieve through a disclosure based regime. Not only does dubious disclosure undermine the sanctity of investors' protection, it also undermines the exercise of independent professional judgment that merchant bankers are envisaged to exhibit under the Merchant Bankers Regulations.

29 *Electrosteel Steels Limited* v. *Securities and Exchange Board of India,* 2019 SCC OnLine SAT 244, ¶16 (India).

30 *Id.*

31 *Supra* note 5 §6.

32 *TSC Industries, INC. v. Northway, INC.*, 1976 SCC OnLine US SC 119, ¶19(India).

Therefore, use the objectivity test while determining whether or not any information is material enough to be disclosed in a due diligence exercise is well founded. However, lack of clarity continues to exist because of the inconsistency created post SAT's ruling in *Electrosteel Steels Limited* case. It shall be interesting to see the degree of reliance that shall be placed on this case in future cases involving the question of materiality.

Factors Mitigating Penalty for Faulty Due Diligence

When merchant bankers fail to exercise due diligence, SEBI exercises its powers vested upon it under Section 11B of the SEBI Act, 1992 by imposing monetary penalty for violating due diligence requirement. Section 11B(ii) empowers SEBI to issue directions to intermediaries if the regulator deems it fit in the interest of the securities market and the investors. In some cases, the penalty may take the form of merchant bankers being restrained from accessing the securities market under the aforementioned provision read with Section 11A. The question arises as to whether there are any mitigating factors that result in exoneration of merchant bankers from penalty, or do all due diligence violations result in heavy penalties irrespective of any circumstance whatsoever. The following three factors have been identified for the purpose of this analysis:

i) violation of due diligence requirement on account of an inadvertent error;
ii) non-cooperation by company in providing information; and
iii) absence of harm to investors despite non-disclosure

Violations Due to Inadvertent Errors

The first factor essentially denotes the situation wherein the merchant bankers conducted the due diligence in a *bona fide* manner, and omitted to disclose certain information owing to a genuine error. The question arises as to whether the law has underlined any difference of treatment between mere inadvertent or technical lapse and deliberate non-disclosure by the merchant bankers. This was answered in the affirmative by the Supreme Court in *Hindustan Steel Ltd v. State Of Orissa*[33] by observing that a penalty for failure to carry out a statutory obligation cannot be ordinarily imposed unless the party obliged acted deliberately in defiance of law. Furthermore, refusal to impose penalty shall be justified if the breach is venial that flowed from a *bona fide* belief. SAT placed reliance on this judgment in 2003 in the case of *Doogar & Associates Ltd. v. SEBI*[34], where the merchant banker in the case

33 1970 SCR (1) 753, ¶7.
34 2003 48 SCL 115 SAT, ¶6.

was penalized by SEBI for filing the public announcement required to be filed with SEBI after it was already published in the public domain. SAT overturned the penalty imposed by the Adjudicating Officer and the merchant banker was let off because "*it had acted bona fide*". However, in another case in *J.M. Financial Investment Consultancy Services Ltd.* v. *Ananta Barua*[35], SAT refused to entertain the contention that the failure to exercise proper due diligence was not intentional. Interestingly, yet another change in approach was observed in 2004 in a subsequent judgment in the case of *SEBI v. Cabot International Capital Corporation*[36] where the Bombay High Court pronounced that if a breach was merely technical and unintentional, it does not merit penal consequence, and it ultimately depends on the facts of each case. In the same year, i.e. 2004, SAT placed reliance on the aforementioned judgment in the case of *Reliance Industries Ltd. v. SEBI* [37] and absolved the merchant bankers of penalty on the ground that the breach could not be called deliberate.

Ultimately when the Supreme Court was met with this question in 2006 in the matter of *Chairman*, *SEBI vs. Shriram Mutual Fund*[38], the Court held that penalty is attracted as soon as the contravention of any obligation as contemplated by SEBI Act and the Regulations framed hereunder is established and hence, the intention of the parties committing such violation becomes wholly irrelevant. The aforementioned ruling was further relied upon by SEBI in *Corporate Strategic Allianz Ltd*. Order[39] where the merchant banker acting as lead manager had failed to disclose track record of public issues managed by it and certain intangible assets of the issuer on its website. SEBI did not agree to the contention that the breach was not willful, and penalized the merchant banker for failing to exercise proper due diligence.

Hence, erroneous interpretation and error in judgment were earlier recognized as a mitigating factor especially if such interpretation was honest and bona fide to the knowledge of the merchant banker. As per the author's observation, there has been a shift in approach to a more stringent imposition of penalty in disregard of absence of element of deliberateness. This shift is a welcome one in furtherance of SEBI's aim of investor protection. Since the merchant bankers cater to the securities law regime critically by preventing unscrupulous companies from accessing the market, it calls for measures for propelling the merchant bankers in discharging their duties with utmost care and caution, leaving no scope for connivance and negligence. A minor inaccuracy, intentional or not, might result in massive

35 (2001) 30 SCL 357 SAT), ¶15.

36 *SEBI v. Cabot International Capital,* (2004) 2 CompLJ 363 Bom, ¶31(India).

37 2004 SCC OnLine SAT 69, ¶11.

38 (2006) 5 SCC 361, ¶15.

39 Order in the Matter of *Corporate Strategic Allianz Ltd*, AO No. NP/AS/AO/20/2017 (2017), ¶20.

losses to the potential investors who rely on due diligence reports and the offer documents certified by merchant bankers. However, care must be taken to keep this strict regulatory approach balanced out in order to avoid overregulation, which is turn deincentivizes independent judgment. Nonetheless, the norm of disregarding the element of intention and tightening the standard while examining the violations of due diligence norms by merchant bankers has been rightly adopted by the Regulator in India.

Non-Cooperation by Company in Providing Information

The second factor deals with question as to whether non-cooperation by a company in providing information to merchant bankers during the due diligence process can mitigate the penalty for omission of the information withheld by the company. Perusal of approach by SAT[40] in this regard disseminates that merchant bankers cannot merely escape the responsibility by shifting the blame on the company without verifying the veracity of information. The allegation by merchant banker that the company concerned did not cooperate does not hold much weight while disproving lack of care while exercising due diligence on part of the merchant banker[41]. Furthermore, absence of anything on record to show that merchant banker took any proactive step to find out the correct information or made a specific query in this respect from the right source of such information weakens the plea of non-cooperation by company.[42] This leads to the observation that passively disclosing whatever is provided by a company and not independently exercising reasonable diligence to ensure adequate, true and fair disclosures amounts to failure comply with the Code of Conduct. The regulator considers the mitigating circumstance of non-cooperation only when the circumstances reveal that merchant banker did not have any means of knowing or reasonably anticipating of the existence of any information or document[43]. Another factor that has lead SEBI to exonerate merchant bankers was that the information withheld by a company could not have been obtained in public domain.[44] On the other hand, the argument of non- production of documents by company has been observed to hold no ground when the information captured by available disclosures made to merchant banker could have led to the concealed information.[45] Interestingly, even the case of an information

40 Order in matter of *M/s. Karn Merchant Bankers Limited*, AO No. EAD/BJD/BKM/99/2017-18 (2017), ¶15.

41 Order in the Matter of *Medicamen Biotech Limited,* AO No. Order/KS/VB/2019-20/4864 (2018), ¶14.

42 *HSBC Securities & Capital Markets (India) Pvt. Ltd. v. The Whole Time Member,* SEBI, 2008 SCC OnLine SAT 25, ¶12 (India).

43 *Almondz Global Securities Ltd. v. SEBI,* 2016 SCC OnLine SAT 219, ¶38.

44 *Supra* note 42, ¶13.

45 *Supra* note 44.

asymmetry combined with non-availability of information in public domain does not put an end to exercise of independent judgment. In such cases, merchant bankers are expected to bring the violations and gaps in disclosures made by the company to SEBI's notice.[46]

However, SAT's ruling in the case of *SEBI v. Imperial Corporate Finance & Services Pvt. Ltd*.[47] has highlighted another facet of this independent duty of merchant bankers. In this case, the promoter of the issuer company concealed his criminal records from the merchant banker. Later, the merchant banker was anonymously tipped about the pending criminal litigation just a few days before the issue and there were no available means to verify it. Additionally, the concerned promoter refused to cooperate. As a result, the offer letter did not contain the information about the litigation and the merchant banker was penalised by SEBI. When the case came before SAT, it overturned the penalty by holding that the merchant banker duly discharged the independent duty of verifying the anonymous tip of criminal records. Merely because the verification could not be completed before the issue was complete was out of merchant banker's control. While criticizing the levy of penalty by SEBI, SAT also remarked, "*one must not carry the concept of due diligence to ridiculous levels*".

Hence, it can be deduced that by virtue of exercise of independent judgment, merchant bankers are vested with additional responsibility of verifying the information provided by the company. Additionally, they are entrusted with vigilance of corporate entity they're offering services to and act as a point of contact between the regulator and the corporate entity. Therefore, non-cooperation on part of a company in providing information leads to condoning of penalty only in extreme circumstances where there is an absolute absence of means of gathering the information withheld. In other cases, the success of plea of non-cooperation depends upon the extent of independent pro-active steps taken by merchant banker for verifying information. To understand this with the help of an illustration, assume that there are two merchant bankers- A and B. Both of them erred in conducting due diligence by not disclosing about a pledge on shares of the companies they were acting for. Subsequently, both of them claimed that the respective companies failed to provide them with the pledge documents. The fact that A tried to obtain the documents independently from the Registrar of Companies, unlike B, shall strengthen A's plea of non-cooperation, compared to B's plea. This is yet another interpretation by the Regulator for providing incitement to merchant bankers in discharging their duties with utmost prudence.

46 *Supra* note 45, ¶9.

47 2005 61 SCL 197 SAT.

No Harm Caused to Investors

This factor refers to a situation wherein even though a merchant banker omitted to include any information from the offer documents, etc., but such omission did not cause any harm to the investors concerned. Whether or not such a situation would warrant overturning or reduction of penalty has been answered by SAT on various instances, but after taking account of factual circumstances. A significant case in this regard is *SEBI v. Imperial Corporate Finance & Services Pvt. Ltd.*[48] In this case, the matter concerning the criminal case pending against Chairman and Managing Director (CMD) of the issuer was not disclosed in the letter of offer, and merchant banker was suspended from accessing securities market for three month. It was alleged that merchant banker acted negligently while exercising due diligence. A pivotal fact was that the omitted information was subsequently revealed in a clarification letter issued by the merchant banker to the investors after the issue was closed for subscription. Additionally, an exit option was given to the investors before allotment. Considering the fact that potential harm to the investors was averted because of the clarification letter, SAT reduced the penalty from suspension for three months to just fifteen days. SAT reiterated the aforementioned approach in a subsequent case[49] where the merchant banker had omitted to disclose a detail in the public announcement but disclosed it through another remedial announcement. The penalty was overturned and the merchant banker was let go with a warning in view of no harm causes to the investors.

However, a shift in approach can be observed in *Electrosteel Steels Limited* case discussed in Part III, where SAT refused to condone a technical violation despite the fact that no loss was caused to investors because ultimately, the license was obtained post the IPO. A possible repercussion of the approach in *Electrosteel Steels Limited* case being followed in the future might be unnecessarily harsh consequences for the merchant bankers in some cases. Furthermore, it might cause an imbalance between the twin objectives of investor protection as well as development of securities market because merchant bankers are an essential part of the securities market. Nevertheless, the lack of harm being caused to investors is more often than not an unintentional result of a merchant banker's faulty due diligence. Thus, it should not be overlooked by the Regulator. Corporate governance practices in companies shall take a backseat if non-disclosures by merchant bankers would be condoned where the investors do not suffer from a monetary loss by pure coincident. Even though the absence of harm caused to investors has been previously treated as a strong

48 *Id.*

49 *SEBI v. JM Morgan Stanley Private Limited*, 2005 SCC OnLine SAT 79, ¶16; *see Chona Financial Services Pvt. Ltd.* v. *SEBI*, 2005 SCC OnLine SAT 100, ¶16; *also see SATCO Securities and Financial Services Ltd.* v. *SEBI*, 2005 SCC OnLine SAT 7, ¶18 (India).

mitigating factor against penailising merchant bankers, the approach has righty been taken a divergence from. However, *Electrosteel Steels Limited* case is an isolated one and has not been relied upon by any other case till date. Therefore, it shall be entrancing to see SEBI's treatment of such situations in cases in the future.

Conclusion

While the different transactions and clients requiring customized styles of conducting due diligence calls for flexibility for merchant bankers, regulation cannot be disregarded. The need for regulation of merchant banker stems from the imminent role they play in the market. In pursuance of the same, the Merchant Bankers Regulations and the Code of Conduct has provided for indicative principles that are to be adhered to at all times. Even so, there persists a lack of any legally binding and codified course of action indicating the course of due diligence. This gap has been attempted to be filled by SEBI and SAT through their rulings by establishing standard of due diligence, threshold of materiality and factors condoning penalty. The analysis of these rulings sheds light upon a shift towards stringent approach of tackling instances of inaccuracies and misdemeanors by merchant bankers. This tightening of due diligence norms seems promising in reinforcing the aim of investors' protection and combating collusion by merchant bankers with issuer companies. However, measures should be taken to increase clarity with regards to what the Regulator expects from merchant bankers while discharging duty of due diligence, in form of indicative guidelines having the force of law. Till then, the steps prescribed in Due Diligence Manual of AIBI can prove helpful to merchant bankers in conducting efficient due diligence.

THE USE AND MISUSE OF MERCY PETITIONS : ITS GROWTH AS A DEFENCE

Rupesh Sunil Dhengre* and Omeshwari Pancham**

Abstract

Mercy Petitions have been a matter of discussion for a long time, in terms of social values, cultural beliefs and political ideologies. While all religions ardently believe in the concept of forgiveness and mercy, they also talk about punishing one who does crimes. But the question lies here: should punishment is declared, go as far as awarding death penalty? As soon as capital punishment is declared, victims may have the option to ask for mercy and to be forgiven from the death penalty, depending on the law governing them. This is so because some countries do not have provisions for mercy petitions, and some have no place in their law for death penalty.

As it always happens in laws, the loopholes in the law is used to the advantage and leaves scope for misuse and abuse of the law. In the context of mercy petitions to escape from death penalty, it was either no time limit to file mercy petition or difference in approach taken by different governments over the years. India has learnt from its mistakes and has been on its path to improvement.

Keywords: - *Mercy, Punishment, Death Penalty, Capital Punishment.*

INTRODUCTION

One of the most debated agendas that in law today is the issue of 'mercy petition', be it at the national or at the international level. Times are moving forward and different countries across the globe are moving towards abolishing death penalty, however, India is working towards reforms on mercy petition and death penalty.

Mercy Petition is asked for when one is awarded a death penalty. The Constitution gives provision for mercy petition which may be granted by the President under Art. 72 and the

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Governors under Art. 161 of the Constitution. This means that the one can ask for mercy petition (which may be granted or rejected subsequently) only after the death penalty has been pronounced.[1]

Even after 7 decades of Independence, our law has been subjected to many hurdles in terms of its application and this hold true even towards the issue of mercy petition (and its execution). Only to state a few are long delays stretching over numerous years, inefficiency in pointing out clemency cases, etc. The negative effects of the present structure for implementation of the law relating to mercy petition, especially the part that is imposed upon the prisoners is termed by many as a 'misery' which is far beyond the utmost suffering permitted under Art. 21.[2]

Although most countries having a law on mercy petition do not contain an entailing provision that clarifies the time limit for the execution of a death penalty, it has been widely recognized by countries that delay in the process may be violative of the humane treatment of a convict. Such delay often leads to mental health issues among convicts as well.

In *Sunil Batra v. Delhi Administration*[3] the court had held that when one is kept in isolation and solitary confinement leads to violation of Art. 21. Further, in *T.V. Vatheeswaran v. State of Tamil Nadu*[4] the Honourable Supreme Court held that the retardation of two years is violative of Art. 21 and also held that such retardations may be the ground for shuttling of capital punishment.

The 262nd Law Commission Report brought attention to the fact that 140 countries had already abolished death penalty, implying that it did not need a law on mercy petition. However, on the basis of the 'Retributive Theory' of punishment, the provisions for death penalty is defended, which means that the law on mercy petition is also present in India. Deflecting from the words of the father of the nation, Mahatma Gandhi, 'an eye for an eye will make the world blind', the law for death penalty exists and mercy petition is a solution to the strict punishment. This is done in order to bring some relaxation on the harshness of a punishment like death penalty.

1 Satendra Pratap Singh, *Mercy Petition v. Death Penalty*, LEGAL SERVICE INDIA, (May 11, 2020, 10:04 AM), http://www.legalserviceindia.com/legal/article-974-mercy-petition-vs-death-penalty.html.

2 Rajgopal Saikumar, *Negotiating Constitutionalism and Democracy: The 262nd Report of the Law Commission of India*, Vol. 12(1) Socio-Legal Review 81, 81-107 (2016).

3 *Sunil Batra v. Delhi Administration*, (1978) 4 S.C.C. 494 (India).

4 *T.V. Vatheeswaran v. State of Tamil Nadu*, (1983) 2 S.C.C. 68 (India).

Religious Values Attached to Mercy Petitions

Religion is a set of beliefs that a group of people follow. Although the world has seen a lot of religions, but the core values of all the religions have certain ones in common. Generally, these are those values which empower the human civilization as a whole including love, compassion, peace, mercy. To look at mercy from a religious point of view might add more perspective, especially in the Indian context.

The Islamic preaching are also very strict about heinous crimes (which in the modern times might attract death penalty) and has also laid down that "whoever saves a life, it is as though he has saved the lives of all men. whoever kills a person, it is as though he has killed all men". At the same time, it has been said that according the Quran and the Sunnat in Islam, forgiveness and mercy is allowed even to the extent of pardoning a murderer if he is forgiven by the victim's family.[5] There is a differential criteria of possessing the power to grant forgiveness in a situation, it lies with the State[6] and in the other, it seems to be in the hands of the victim/victim's relatives. But it does establish the presence of values of forgiveness and mercy, even for the most serious crimes.

Even in Christianity, dating back at least to the New Testament era, the power to grant pardon for various crimes lied with the head/leader of the state. One of the earliest formal inclusion of this power in the Constitution was done by the USA, however its meaning and scope of it was left to be interpreted by the judiciary. This power starkly reflected the powers that were given in the hands of English monarchs who were believed to hold the power of pardoning, politically equivalent to pardon sins committed by the convict. Moreover, it was considered as an act of kindness by the monarch and which could not be demanded to be granted as a matter of right.

The judiciary has played a significant role in taking forward this line of thought. In United *States v. Wilson*,[7] it was held that "A pardon is an act of grace, proceeding from the power entrusted with the execution of the laws, which exempts the individual, on whom it is bestowed, from the punishment the law inflicts for a crime he has committed". This interpretation of the nature of forgiveness power was reviewed and then upheld accurately

5 UK Border Agency, *Country of Origin Information Service: Pakistan*, HOME OFFICE OF UK BORDER AGENCY (May 11, 2020, 11:00 AM), https://www.refworld.org/pdfid/4b5827122.pdf.

6 RFE/RL's Uzbek Service, *Uzbek President Pardons Dozens Of Inmates On Eve Of Eid Al-Fitr*, RADIO FREE EUROPE/RADIO LIBERTY (May 11, 2020, 09:00AM), https://www.rferl.org/a/uzbek-president-pardons-dozens-of-inmates-on-eve-of-eid-al-fitr/29288052.html.

7 *States v. Wilson*, 32 U.S. 150 (1833).

by the Supreme Court in *Burdick v. United States*[8] case and therefore it paved the way for mercy petitions.

Hindus considers the Bhagavad Gita as its sacred book and Lord Krishna is believed to have been an ardent follower of it. It is said that in the Mahabharata, around five thousand years ago, he had referred and read the Bhagavad Gita.[9] It is also said and widely believed that all the animals that passed away during the war that took place in the Kurukshetra attained their initial and original form after the end of their lives.

The Vedas in many documents also refers to the term "Prayashchita" finds mention and explanations. This is a reflection of how early the genesis way laid down for the forgiveness and mercy shown towards those who repent their mistakes. It formed the essence of the Indian society and till dates such values can be seen deeply imbedded into the Indian culture and value system.

Mercy Petition: Boon Or Bane?

Mercy Petitions were brought with the intention of saving those, in other words, showing mercy to those, who had been wronged while trying to deliver justice. When a convict goes through the fear of being hanged till death and craves for mercy be shown to his/her life, it is expected that it will serve as an incentive to correct his behaviour and action if he is pardoned his life. This is the main intention behind mercy petitions – ultimately, to correct the behaviour of the convict.[10]

Many developed countries like the United States of America and Canada also have a law relating to Mercy Petitions. India too has a law relating to it, mentioned in the Constitution under Art. 72 and Art. 161. It is believed to add a 'humane touch', in the hands of the President, to the otherwise strict laws that are in place when there are harsh provisions like that of capital punishment – it creates a balance. It authorizes the State to look at the matter from a case to case and from a more holistic view as examining a mercy petition requires to look beyond legal provisions and evidences. At the same time, there is no obligation on the President or the Governor to accept all such mercy petitions. Most of the petitions till date have been rejected.

8 *Burdick v. United States*, 236 U.S. 79 (1915).

9 Eternal Religion, *The Only Proven God of Mercy, Forgiveness, and Love*, ETERNAL RELIGION (May 12, 2020, 06:00 AM), https://eternalreligion.org/the-only-proven-god-of-mercy-forgiveness-and-love/.

10 Prashanti Upadhyay, *Mercy Petition: Boon or Bane?*, LEGAL SERVICES INDIA (May 10, 2020, 01:23 PM), http://www.legalservicesindia.com/article/2026/Mercy-Petition-Boon-or-Bane.html.

In the Ranga Billa Case,[11] the scope of Art. 72 was discussed wherein capital punishment was pronounced for one of the convicts. The right of having reprieving power of president specifically of the mercy petition was bought into question. Herein, the mercy petition filed by the convict was rejected by the President which led him to file a writ before the Apex Court challenging the element of discretion available at the behest of the President while deciding on such cases of mercy petition. He argued that it was arbitrary that the President denied his mercy petition, allowing him to be hanged till death, without giving any reason for rejecting his petition. However, the Honourable Supreme Court upheld the rejection given by the President and held that he holds discretionary powers and may pronounce such a rejection without giving reasons.

The above ratio was once again upheld by the Honourable Apex Court in *Kehar Singh v. Union of India*[12] wherein it also explained that a person cannot demand his a mercy petition to be accepted. The granting of pardon or reprieve by the President was an act of being lenient towards convict and therefore it is a privilege and cannot be claimed by the convict. Getting his pardon granted is not a right.

It might seem like that the law is unfair to the convict, however, it must be taken into account that the Constitution of India confers a right to the convicts for making an appeal for mercy but, At the same time it also imposes a duty on the Presidents and the Governor to duly evaluate all the relevant facts and circumstances before deciding on whether to allow the mercy petition or not.as at last it's not the duty of the president or the governor to take decisions on any mercy petition promptly so as to not delay the process.

In 1983, the Supreme Court shifted its position on putting a time limit[13] of three months for the discarding a petitions which were filed under Art. 72 or Art. 161, or under Sec 432 or Sec 433 of the Criminal Procedure Code. Despite having such a mechanism in place, Afzal Guru's case is worth mentioning. He was sentenced to death on the accusation for being involved in the Attack on the Parliament happened in 2001. At first, the execution of his sentence was stayed due to a clemency petition filed in the Supreme Court. Again, a mercy petition was filed in 2013 which was eventually rejected by the President, the execution of his death sentence was delayed. Thereafter, he was finally hanged till death in the Tihar Jail in February 2013 and his cremation rites were also carried on within the jail premises.

11 *Kuljeet Singh @ Ranga v. Union Of India & Anr.*, AIR 1981 S.C. 1572 (India).

12 *Kehar Singh v. Union of India*, (1989) 1 S.C.C. 204 (India).

13 *Sher Singh & Ors. v. State of Punjab*, AIR 1983 S.C. 465 (India).

Similar was the case of Yakub Memon who was held guilty of being involved in the Mumbai serial blasts. He too was awarded a death sentence. He exhausted all his legal remedies before invoking the provision of filing a mercy petition before the Governor of Maharashtra. However, when all his remedies exhausted and he was not granted pardon, death sentence was finally executed on him.

Keeping in mind the abuse of remedies that were partaken purposely to hinder the execution of their death sentence, the Centre has urged the Supreme Court to limit the time for filing mercy petition to seven days after pronouncement of death sentence. This development took place as a response to recourse to multiple legal remedies being taken by the various accused, on by one, in the Nirbhaya Rape Case.

The Case of Yakub Memon: A Paradigm Shift

Another controversial case involving mercy petition has been that of Yakub Abdul Razak Memon, who was accused of criminal conspiracy in the Mumbai serial blasts of 1993. He was awarded death sentence and it was set to be executed on 30th July 2015. However, looking at the history of mercy petitions and the politics behind it reveals how the process of granting or rejecting a mercy petitions how involves individual thoughts and beliefs.

In April 2014, the President of India had rejected the mercy petition filed by Yakub Memon after having received the recommendation, reliefs and advice from the council of ministers, headed by the newly elected Prime Minister, Narendra Modi. The fact that a change in the government brought into action the law related to mercy petitions and execution of death sentences reflects on the role of politics on this matter.

In 1997, there was only one mercy petition pending before the President, the authority that either grants or rejects the request of a mercy petition. By 2014, this number rose to 28 pending mercy petitions. However, with the change of the government, a new perspective on mercy petitions was seen in action. The mercy petition of Yakub Memon was rejected by President Pranab Mukherjee.

If looked at who held the post of Presidents before President Pranab Mukherjee had different opinions on the subject and issues related to the 'capital punishment' and the harshness of death penalty. President KR Narayanan, President APJ Abdul Kalam and President Pratibha Patil were all hesitant to take a call on the question of death penalty. The discomfort in taking such tough calls was widely being observed in the previous governments, which

changed in 2014.[14] In fact, in 2012, when President Pratibha Patil was questioned as to why she was not acting on the petitions, she sought to the defence of Art. 74 of the Constitution and saying that she could not act on her own as she is supposed to take suggestions on the matter as per the aid and advice of the council of ministers. However, the Supreme Court had already mentioned in Kehar Singh v. Union of India[15] that the President of India under Art. 72 of the Constitution can go into the merits of the case in spite of that it has been judicially concluded and may come to a conclusion that may not be the same as the Court.

The entire scenario had changed by May 2015 wherein the Rashtrapati Bhawan records show that none of the mercy petitions were pending. It displays how with a change of the government, the approach towards a serious matter like mercy petitions changed. It shows the paradigm shift from a hesitant outlook on death sentences and mercy petitions to one where action and decisions are taken head on.

In most cases, when a decision is not taken on mercy petitions, the situation, especially of the convict, is left in a limbo. Taking prompt decisions is therefore an important aspect. It was stated in *Madhu Mehra v. Union of India*[16] that Art. 21of constitution grants the right to life and personal liberty as a fundamental right also implies that getting a speedy trial is also one part of this right. This aspect of having the right to life and personal liberty equally applies to discard of a mercy petitions.

In the famous case of *Bacchan Singh v. State of Punjab*,[17] the Supreme Court had also addressed an issue in performing a capital punishment. The Court observed that if there is no uniformity in the manner how a capital punishment is then it can often lead to the process being arbitrary. This has the potential to violate the right to equality under Art. 14 of the Constitution. This has led to different approaches of different governments who came to power on the issue of mercy petition exercised by the titular head of President.

The Nirbhaya Rape Case: Creating a Balance

In recent times, one of the most controversial cases related to death penalty and mercy petition has been that of the Nirbhaya Rape Case wherein the convicts were awarded with death sentence. However, because of the lengthy process involved in filing mercy petitions,

14 Manish Tewari, *The Politics of Mercy Petitions*, DECCAN CHRONICLE (May 14, 2020, 02:25 PM), https://www.deccanchronicle.com/150722/commentary-op-ed/article/politics-mercy-petitions.

15 *Supra* note 12.

16 *Madhu Mehra v. Union of India,* (1989) 3 S.C.R. 775 (India).

17 *Bacchan Singh v. State of Punjab,* AIR 1980 S.C. 898 (India).

as well as filing it before authorities multiple times, the death penalty was being postponed as by considering the facts of the case they had committed an extremely heinous crime cause of which death sentence was awarded to them. But due to the delay in executing it, the society's outcry for 'justice delayed is justice denied' led the Honourable Supreme Court in putting a cap on the delays in the procedure.[18]

On repeated delaying of executing the death sentence of accused due to filing of mercy petitions, the Honourable Delhi High Court said that the law cannot be abused by always resorting to it at the eleventh hour.[19] The Supreme Court was urged by the Government at the Centre to certain guidelines to end such malpractices. It sought for a move which would be in favour of the victim and society-centric (to bring back faith in the rule of law) and for the limiting the convict to file for mercy petition beyond seven days.[20] The Supreme Court confirmed that the right to file for mercy petition with the convict was rather being used a privilege, and was against the interest of the victim. Since the death penalty was awarded as a penalty for the sufferance of the victim, such privilege was not approved by the Apex Court. Therefore, a bench comprising of Chief Justice Bobde and Justice Surya Kant issued a notice to the Centre to modify the execution guidelines.

Focusing on the necessity to amend or re-outline the current rules which initially brought up to assure the interest of a death row convict. But the Solicitor General Tushar Mehta presented before the Court that these rights and privileges was being abused as an instrument to postpone the execution of the death sentence and it required reconsideration. He argued before the Court that "There is no time-limit for availing the legal and constitutional remedies available to a death row convict. The court should now take into account the interests of victims and society and lay down the guidelines which are in furtherance of the already laid down guidelines for the accused". The execution of the death sentence was delayed twice as three of the convicts were yet to exhaust their legal remedy to file for mercy petition.

18 Times of India, *Mercy plea: Supreme Court to consider seven-day limit*, Times of India (May 11, 2020, 10:00AM), https://timesofindia.indiatimes.com/city/delhi/mercy-plea-sc-to-consider-7-day-limit/articleshow/73818059.cms.

19 Aditi Singh, *You Always Come at the Eleventh Hour: Delhi Court Seeks Report from Tihar in Nirbhaya Convicts Plea to Stay Execution of Death Warrant*, Bar and Bench (May 11, 2020, 04:25 PM) https://www.barandbench.com/news/litigation/you-always-come-at-the-eleventh-hour-delhi-court-seeks-report-from-tihar-in-nirbhaya-convicts-plea-to-stay-execution-of-death-warrant.

20 Aditi Singh, *Nirbhaya: No stay on trial court order postponing execution of convicts, HC directs convicts to avail all legal remedies within 7 days*, Bar and Bench (May 11, 2020, 04:25 PM), https://www.barandbench.com/news/litigation/breaking-nirbhaya-no-stay-on-trial-court-order-postponing-the-execution-of-convicts-directs-convicts-to-avail-all-legal-remedies-within-7-days.

Highlighting that how rules were abused, the Centre said that denounced convicts and specially if there were multiple (as in the Nirbhaya Case),should be embraced with a procedure to document corrective appeal in the Supreme Court in a steady progression to defer execution of capital punishment granted to them. It was addressed to the court to fix a specific time limit in which as convict could for a curative petition after dismissal of survey appeal by the Supreme Court. The service said the rules set somewhere around January 2014[21] for seeking mercy petition and execution of capital punishment considered the interests of those waiting for capital punishment and this must be adjusted by another arrangement of solutions which considered the interests of the person in question, their families and larger public interest.

The implementation of the Centre urged the Apex Court to order all subordinate courts and relevant authorities, including state governments, to enforce a sentence of death penalty within seven days from the date of rejecting the mercy petition that was filed. It was urged that this be enforced without any effect of a pendency of review of order or a curative petition filed by other convicts. With this, there was a shift in the law relating to mercy petitions from being inclined towards a convict a more balanced approach. This made sure that while the right to file for a mercy petition by a convict is still effective, the delaying of giving justice to the victim is not hampered.

Conclusion

The existence of death penalties in a legal system paves the way for use of mercy petitions. Death penalties have become a norm when the case falls within the category of 'rarest of the rare' which means that the court often faces cases which it has not faced before. Therefore, even the laws sustaining mercy petitions have evolved over the years and to be fair, it is still evolving. The dynamic nature of the law owing to new emerging situations has inevitably led to developments in the jurisprudence of the law governing mercy petition in India, mostly through judicial activism.

Indian culture witnesses the genesis of values of mercy and forgiveness to way back. In a country where moral values are deeply imbedded, it is only an enhancement of the beliefs of the people that the concept of mercy petition was included in its grundnorm. It was revealed by news outlets that the convicts of the Nirbhaya Rape Case went through a breakdown when the news reached them that their mercy petitions had been denied on them. This meant that their next step was to prepare themselves for their hanging. To get a

21 *Shatrughan Chauhan v. Union of India,* (2014) 3 S.C.C. 1 (India).

hold on the tensed situations, the Gita was also read out to them.[22]

Politics and different approaches taken by different governments has played a role in what verdict is given on a mercy petition, and under the current government (starting from 2014), all pending petitions were also discharged. However, as we have seen in the Nirbhaya Rape Case, the repeated use of the mercy petition provisions one by one at the eleventh hour led to delaying the execution death sentence. Therefore, the Centre urged the Supreme Court to formulate regulation to set a time bar of 7-days beyond which a convict awarded death sentences cannot seek to file a mercy petition. Now it lies in the hands of the Supreme Court as to how it will form guidelines to ensure use and prevent misuse of the mercy petition. Since the Supreme Court has previously shied away from formulating regulation on mercy petition, it is awaited to see if it will finally take a call now that the Centre has submitted its plea.

22 Ananya Bharadwaj, *Night Before Hanging, 16 December Rapists 'Crying Bitterly', Counsellors read Gita to them*, The Print (11 May, 2020, 05:30 PM), https://theprint.in/judiciary/night-before-hanging-16-december-rapists-crying-bitterly-counsellors-read-gita-to-them/384186/.

A Surge in Domestic Violence : Manifestations of the Virus

Adiba Khan* and Gunjan Kanoongo**

Abstract

The Coronavirus Pandemic has transformed into an era that has caused distress on a global scale. Inevitable quarantine has resulted in multiple problems like reduction in daily physical activities, psychological stress due to either lack of work or being trapped inside a place especially, if the individual is staying alone. The pandemic has already been the cause of several negative repercussions. But there are still indirect effects that have not been identified by the authorities. During such difficult times, persistent problems have only worsened. Recession is an issue encountered by various economies around the globe. Poverty has become widespread and almost all activities have come to a halt. One problem which has further contributed to such troubled times is Domestic Violence.

India is already considered to be country unsafe for women. The crime rate against women and children remains at a consistent, all-time high. The justice system has failed to curb or even address this issue decently over and over for decades. The Coronavirus induced a nationwide lockdown similar to most countries all over the world. This has also caused growing concerns for the victims of domestic violence in India. The victims of domestic violence are trapped indoors with the perpetrator and only a few to no remedies to avail.

The paper aims to discuss the issue of domestic violence independently and in the light of coronavirus. It aims to study the state action concerning the same and suggest changes that could help the victims of domestic violence in India and countries all over the world.

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INTRODUCTION

The beginning of this decade was a new start for everyone around the world, a chance for setting up new businesses, pursuing higher education, getting married, or starting a family. But since the incipience of COVID-19, the world has been in complete lockdown. The Coronavirus originated in Wuhan, China but gradually found its way to almost every country on the planet.[1] Approximately, 7.42 million people worldwide have been tested positive for the virus.[2] Almost every sector and industry across the globe has taken a hit from the lockdown. The impact of coronavirus is so enormous that stock markets everywhere observed their most significant decline. The oil prices have seen the lowest crash in 21 years as there is a major drop in oil consumption.[3]

While the world is struggling to get back on its feet from the effects of COVID-19, there is another issue that has broken out- Domestic Violence. The United Nations has said that the increase of domestic violence across the world is acting like a shadow pandemic. Abuse has risen by about 20% as people have been urged to stay at home.[4]

Authorities around the globe have urged people to stay home while failing to see the heightened domestic responsibilities generated by the lockdown. The people most prone to such abuse are children who are required to stay home all day, elderly people who are particularly unsafe to the virus, and toddlers who can no longer be babysat with reliable neighbours. These people do not have any choice but to remain indoors.

If domestic abuse was a virus in itself, the lockdown not only expanded its breeding rate but also modified its DNA into a more vicious alternative. Other contributing circumstances involve the ability of the abuser to exert persistent scrutiny over the telephone, the decreased work of the courts, the failure and anxiety of travel to counselling centres, the uncertainty of virus infection in such centres and the growing financial dependency of women who are more prone to encounter salary reductions and job losses during the pandemic.[5]

1 Muhammad A. Shereen et al., Suliman Khan, Abeer Kazmi, Nadia Basheer & Rabeea Siddique, *COVID-19 Infection: Origin, transmission, and characteristics of human coronaviruses*, 24 J.A.R. 91, 92 (2020).

2 Lisa Schnirring, *Global COVID-19 cases top 7 million, deaths exceed 400,000*, CIDRAP (June 19, 2020, 10:00 AM), https://www.cidrap.umn.edu/news-perspective/2020/06/global-covid-19-cases-top-7-million-deaths-exceed-400000.

3 Jazmin Goodwin Business et al., Laura He & Mark Thompson, *Global oil prices bounce back after hitting 21-year low*, CNN (June 19, 2020, 10:05 AM), https://www.cnn.com/2020/04/21/investing/global-stocks/index.html.

4 *Stopping lockdown domestic abuse on my street*, BBC NEWS (June 19, 2020, 10:10 AM), https://www.bbc.com/news/av/world-53014211/coronavirus-domestic-violence-increases-globally-during-lockdown.

5 Harshitha Kasarla, *India's Lockdown Is Blind to the Woes of Its Women*, THE WIRE (June 19, 2020,

Increased drinking at home or forced abstention from alcohol due to the local wine shops being closed can provoke the abuser and complicate the relationship between the abuser and domestic violence. The child helpline received 92,000 calls in 11 days of the lockdown being enforced.[6] The inaccessibility of contraceptives and abortion services further impedes domestic abuse. This is particularly true because the country's top hospitals have ceased elective surgery and perform only crucial or life-saving surgery.

Domestic Violence: An Independent Concept

Definition of Domestic Violence

The universally accepted definition of violence against women is provided by the United Nations Declaration on the Elimination of Violence against Women (1993). It states that "*any act of gender-based violence that results in or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or private life*."[7] The United Nations' definition is rooted in gender-based origins of domestic violence stating "*violence against women is one of the crucial social mechanisms by which women are forced into a subordinate position compared with men*."[8] This definition broadly covers it but is not restricted to, three spheres of domestic violence, i.e., "*violence occurring in the family, within the general community, and violence perpetrated or condoned by the State*."[9] The definition not only highlights the physical aspect of violence but also includes aspects of psychological harm undergone by survivors of such violence. It also considers aspects of private as well as public life.

In India, the enactment of The Protection of Women from Domestic Violence Act, 2005 introduced the legal definition of domestic violence. According to Section 3 of the Act, the act of abuse constitutes both an action and an omission which may lead to any physical injury or hurt inflicted on the woman that leads to a threat to life and limb, overall well-being including psychological health and physical health of the women and an act that may include any kinds of abuse; or any kind of harassment, hurt, physical injury or a threat

10:15 AM), https://thewire.in/women/indias-lockdown-is-blind-to-the-woes-of-its-women.

6 *Coronavirus lockdown | Govt. helpline receives 92,000 calls on child abuse and violence in 11 days*, THE HINDU (April 8, 2020, 11:00 AM), https://www.thehindu.com/news/national/coronavirus-lockdown-govt-helpline-receives-92000-calls-on-child-abuse-and-violence-in-11-days/article31287468.ece.

7 United Nations Declaration on the Elimination of Violence against Women art. 1, Dec. 20, 1993, General Assembly Resolution 48/104.

8 *Ibid*.

9 *Ibid*.

to endangering the woman with a purpose of forcing her to meet illegal demands of the perpetrator for dowry or other objects economically or otherwise valuable to the woman whether directly through her or indirectly through a person known to her; or implies a threat on the victim herself or a person is known to her by acts mentioned previously, or any kind of threat to the well-being of the woman whether psychological or physical.[10]

Domestic Violence has become a topic of concern over the last few decades. This increase in concern has been rooted in the constant struggles made by women for the acknowledgement of these problems faced by women globally. The strife to spread awareness about crimes against women, sensitize the issues and fight the defensive behavior of female survivors towards these crimes has led to the minimal increase in awareness about domestic violence. India is a country with a huge rural population (*Rural – Urban distribution: 68.84% & 31.16%)*[11] and a discriminated rate of literacy in women as compared to men (58.8% rural women were literate as compared to 78.6% rural men. 79.9% urban women were literate as compared to 89.7% urban men. A total of 65.5% women were literate as compared to 82.1% men).[12] These factors can be regarded as perpetuating factors of domestic violence.

History of Domestic Violence

The roots of domestic violence in India can be roughly placed around the post – Vedic period. During this period, it was observed that the birth of a daughter was regarded as a shameful event and was perceived to have brought upon disaster to the family. The birth of a son, on the other hand, was regarded as a blissful event.[13] The establishment of women as the biologically superior sex did not affect the social status of women. There is sufficient evidence to prove that the largely patriarchal society has rendered women the inferior sex and regards women as minors throughout their lives irrespective of their actual age. Thus, requiring women to be protected by males throughout their lives. This imposition of roles as protector and subordinate has been instilled in the minds of individuals throughout innumerable generations and results in men treating women in a brutal, barbaric manner in the guise of being a protector even in today's 'modern society'.[14]

Del Martin, in her book on Domestic Violence, has observed that "*Wife-beating, is a complex problem that involves much more than the act itself or the personal interaction*

10 Protection of Women from Domestic Violence Act, 2005, No. 43, Acts of Parliament, 2006 (India).

11 *Census of India, 2011, Rural Urban Distribution of Population*, Government of India (June 19, 2020: 11:30 AM), https://censusindia.gov.in/2011-prov-results/paper2/data_files/india/Rural_Urban_2011.pdf.

12 *Id*. at 10.

13 Rinki Bhattacharya, Behind Closed Doors: Domestic Violence In India 16 (Rinki Bhattacharya ed., Sage Publications 2004).

14 *Id*. At 17-18.

between husband and wife."[15] Further explaining, she pointed out that the domestic violence is rooted in the perception of the concept of marriage in society and the attitude of the society towards women as an entity in that concept of marriage throughout history. She also emphasizes on the sustenance of these kinds of violence by the "intricacies of civil and criminal law and delivery system of social service agencies."[16] The World Development Report of 1993 depicts that out of the total disease (physical and non-physical) burden on women (in the age group of 15 – 44), 5% constitutes rape and domestic violence.[17]

Domestic Violence in India: Perpetration

Domestic Violence Portrayed by the Media

An established author of a book on domestic violence, Rinki Bhattacharya, has also made a documentary film named 'Char Diwari' on the same subject. In her book, she has provided instances where she came across the varying and shocking perceptions of domestic violence by individuals belonging to various sectors that are considered to be the pillars of any society like the executive branch of the Government. While making her documentary, she interviewed an Additional Commissioner of Police (ACP) in a suburban Mumbai police station. The Officer was eager in pointing out the number of false cases filed under section 498A of the Indian Penal Code that penalizes the husband of a woman or the relative of the husband for subjecting her to cruelty.[18] However, in the same year, lawyer Flavia Agnes pointed out that barely 100 cases were filed under the section and the conviction rate was negligible.

The ACP did not agree for his interview to be publicized and thus, it could not be depicted in the movie. However, another ACP stepped up and cited frustration at home, workplace issues or jealousy as excuses for abusive behavior among men. This incident only gives a brief account of how gross misconceptions regarding violence against women are instilled in individuals belonging to systems that have a responsibility of protecting the citizens.

The producers of the movie themselves, the Department of Women and Child in the Ministry of Social Welfare, New Delhi, refused to provide funds for English subtitles because it would tarnish the image of 'Indian Husbands and the sacred notions of marriage in India'.[19]

15 Del Martin, Battered Wives XIV (Rev. Ed., 1980).

16 *Ibid*.

17 World Bank, World Development Report 1993: Investing in Health (1993).

18 Indian Penal Code, 1860, No. 45, Acts of Parliament, 1860.

19 *Supra* note 13 at 19.

This further highlights the ignorant attitude of authorities that have a responsibility to uproot domestic violence. In the times of a pandemic, the ignorance of these authorities can be twice as dangerous as it already would be under normal circumstances.

Another study observes the various legal factors that perpetuate domestic violence, these include, but aren't restricted to, "Lesser legal status of women either by written law and/ or by practice; Laws regarding divorce, child custody, maintenance and inheritance; Legal definitions of rape and domestic abuse; Low levels of legal literacy among women; Insensitive treatment of women and girls by police and judiciary."[20]

Statistical Reports on Domestic Violence

India in most of its regions and states at least ticks off three of these five factors, which can be posed as a dangerous threat to the safety of women.

As per data issued by the Ministry of Home Affairs in 2013, in consensus with the National Crime Records Bureau of India, the differences between filing, registration and conviction of cases are visible in the given table:

Table 1:

Year	Cases registered	Cases charge-sheeted	Cases convicted	Persons arrested	Persons charge-sheeted	Persons convicted
2009	7803	1641	236	641	695	9
2010	11718	4330	415	182	323	5
2011	9431	4499	17	695	713	3

Source: Ministry of Home Affairs[21]

The number of cases charge-sheeted out of the number of cases registered was only 47% in 2011. The number of cases with a definite conviction is a bare minimum and the number of persons convicted is negligible.

During a pandemic, the victim is locked in with the perpetrator with very little means of escape. It is difficult for them to avail medical resources even with government easements. The opening of liquor stores by the state[22] has further caused a worrisome situation for

20 Heise L.L. Et Al. Pitanguy J. & Germaine A., *Violence Against Women. The Hidden Health Burden*, *In* World Bank Discussion Papers 225 (The World Bank Ed., 1994).

21 Shri R.P.N. Singh, *Unstarred Question No. 283 - Lok Sabha*, Ministry of Home Affairs, (June 19, 2020, 11:50 AM), https://www.mha.gov.in/MHA1/Par2017/pdfs/par2013-pdfs/ls-260213/283.pdf.

22 Ministry of Home Affairs, *Notification No. 40-3/2020-DM-I(A)*, GOVERNMENT OF INDIA.

alcohol-related violence against women. In a study published in the Indian Journal of Medical Sciences, it was stated that alcohol abuse had a direct relation with chances and degree of abuse.[23] The study shows that use absence of social support to the woman also denies her an out from the situation she is in.[24] Social Support, here, means the support of maternal family members. Under normal circumstances, the support of family members could be possible if available, however, due to the pandemic, acquiring their physical support has become more difficult than it already was.

The factors that usually perpetrate domestic violence seem to have become worse throughout the pandemic, thus posing a big question on the safety of women in their own homes. The state needs to review its policies on the safety of women for the pandemic and otherwise to improve the situation.

"There is a conflict in our houses, more than 8,500 women were murdered by their spouses and family members, and 1,03,272 cases of domestic abuse were recorded in 2018. Domestic violence is a fact that subsisted before the coronavirus and has grown as a consequence of the lockdown because women are barred in with their abusers. The pressure and stress of the perpetrator's home and work duties are released on women" said Anuradha Kapoor, Director of Swayam, an NGO in Kolkata.[25]

"The kind of violence that is being inflicted on them now is much more serious. We had a woman locked up in a room asking us to call the police to save her because she was afraid of her life. Another woman who was pregnant was beaten so badly that she and her 5-year-old daughter fled the house and walked home to her parents in the middle of the night. Young girls have also been seeking help because they are being abused by their brothers and fathers," she added.[26]

This is likely because this responsibility has traditionally been carried, and remains to be disproportionately supported, by women. The contrast is even more skewed for Indian women who do more uncompensated care and work at home than women in any other country. Indian women spend up to 6 hours a day working at home, which is more than an hour spent by men.

23 Anju H. Khosla et al., Dua Deepti, Devi Lajya & Shyam S. Sud, *Domestic Violence in pregnancy in North Indian women*, 59 I.J.M.S. 195, 197 (2005).

24 *Ibid*.

25 Jagriti Chandra, *NCW records sharp spike in domestic violence amid lockdown*, The Hindu (June 15, 2020, 10:00 AM), https://www.thehindu.com/news/national/ncw-records-sharp-spike-in-domestic-violence-amid-lockdown/article31835105.ece.

26 *Ibid*.

Domestic Violence and State Action

Lockdown Resulting in Surge of Abuse Cases

The Ministry of Health and Family Welfare has issued guidelines to state that abortion has been categorized as an essential service, but the Government needs the same mandate. Gender disparity and violence are an entrenched part of our daily lives and cannot be eradicated during the pandemic. But this cannot be the reason for us to set it aside while we're 'fixing' the pandemic. Our lopsided balance of household work and domestic violence need not worsen.[27]

The National Commission for Women has displayed a large number of cases being filed for domestic violence since the lockdown began. Domestic abuse constitutes an abuse of a person, physically, psychologically, sexually, emotionally, and financially. When a person is harmed, the victim faces other perils such as depression, post-traumatic stress disorder, and chronic illness. The people most sensitive to such harm are women but women, children, house help, elderly and men can also be a victim to it. As people are exacted to stay inside, the perpetrator can be triggered due to stress, anxiety, financial dilemmas, or any other disturbances.

An examination carried out by the Hindustan Times revealed data on two aspects. In some of the states in the country, there has been an increment in the number of grievances about domestic abuse while in some states there has been a reduction in the number of complaints and calls collected by the helpline. This review assists in explaining that it is challenging for the victims to record a complaint during the lockdown since they reside with the perpetrator.[28]

The Delhi Police in April recorded about 2,446 cases associating to women out of which 600 were for abuse against women, 23 for rape, and 1612 for domestic force. In Telangana and Rajasthan, the number of complaints has declined. While on the other hand, states like Punjab saw an enormous increase in grievances about domestic abuse. The Punjab State Commission for Women states that there have been at least 30 complaints every day for domestic abuse since March. It has also affirmed that before the lockdown, there were only one-third calls booked for domestic violence.[29]

27 *Supra* note 5.

28 Dhamini Ratnam, *Domestic violence during Covid-19 lockdown emerges as serious concern*, Hindustan Times (June 04, 2020, 11:00 AM), https://www.hindustantimes.com/india-news/domestic-violence-during-covid-19-lockdown-emerges-as-serious-concern/story-mMRq3NnnFvOehgLOOPpe8J.html.

29 *Ibid*.

Problems Arising Due to the Circumstances

Although there are many state-funded and private forums available that provide help and shelter to such victims, no support can be provided due to the lockdown. Since the police across the country are busy handling the duties assigned to them for reducing the spread of COVID-19, there is no place where these victims can register a complaint about investigations. Since domestic violence is a civil dispute, it has to be filed in the lower court. But due to the ongoing situation, the courts are only hearing emergency cases like bail pleas.

Another dilemma that has arisen out of this is retaining the perpetrator in confinement. Due to the stern rules of obeying social-distancing, prisons cannot sustain a high number of offenders. Parole has to be awarded and the perpetrator goes back home. Some High Courts in the country have received intimation of the condition and have enacted special orders to manage domestic abuse cases. The Jammu and Kashmir High Court proclaimed a command affirming that it will exercise a case on their own of domestic violence during the lockdown phase and also implemented regulations for organizing a special fund and designating special secure areas like drugstores and supermarket shops for victims to report domestic abuse without alarming the perpetrator. The state government of Karnataka has said that all the helplines, shelter homes, counsellors, are running throughout the day to attend to the victims of abuse.[30]

Activists also point out that the moment there is a shortage of food, as in a crisis like this when there is not much commercial activity, the immediate victims are the daughters and mothers in the house. The same is true of health care, as the total spending on women's health in families is expected to reduce further in this period of ongoing economic stress. "The likelihood of women in abusive relationships and their children being exposed to violence is dramatically increasing, as family members spend more time in close contact and families face additional stress and potential economic or job losses," the WHO said in its note.[31]

The World Health Organisation has also pointed out how violence against women has a significant impact on the survivor's health. They have pointed out that this has various implication including "*physical, mental, sexual, and reproductive health problems, including sexually transmitted infections, HIV and unplanned pregnancy*," apart from the

30 *Supra* note 28.

31 Shemin Joy, *Coronavirus Crisis: No lockdown for domestic violence*, Deccan Herald (June 09, 2020, 11:15 AM), https://www.deccanherald.com/specials/insight/coronavirus-crisis-no-lockdown-for-domestic-violence-829941.html.

obvious physical injuries and impact on physical health.[32]

With women also succumbing to losing jobs in the lockdown, their vulnerability has risen. In many events, whatever bare minimum amount women make is handed over to their husbands, and they are stripped of their right to do what they wish to with their own money. This is another contributing factor for violence, many activists say. There seems to be no acknowledgement of this problem by the Government. The financial independence of married women has posed many threats to the safety and security of women, not just in India but across the World.

Young girls are more vulnerable during the period of COVID-19, as families are trying to get then married. Karnataka State Commission for the Protection of the Rights of the Child Rights Chairperson Antony Sebastian recently highlighted the recent spike in such cases in the state. With the police and authorities focusing on the implementation of the lockdown, families are using it as an opportunity.[33]

It's not just the estimates, but also the psychological and social influence that the lockdown would have on women. "There is every cause to examine, as more advanced studies have proposed, that there is an increment in gender-based abuse during such crises," Jayashree Velankar of women's organization stated.[34]

Ineffectiveness of Divorce in lockdown

Divorce, as described by the Oxford Dictionary, is 'the legal ending of a marriage'.[35] But when you approach the Indian courts for a divorce, you are put through the legal wringer and you come out spinning, with or without a divorce, a few years later. Incorporation of a few changes would go a long way in making this a less cumbersome process.

A divorce case ends up lasting longer than the duration of a marriage. In India, most divorce cases go on for decades with no sign of instant relief. In the United States of America or the United Kingdom, acquiring a divorce is more accessible. With the rise of domestic violence cases in the country, likely, divorce cases will also rise. The already present system in India can make a separation for couples difficult and they may have to reside with each other for a more extended period, meaning that the victim is at more risk of abuse from the perpetrator.

32 *Ibid*.

33 *Ibid*.

34 *Supra* note 31.

35 *Little Oxford Dictionary, Thesaurus and Wordpower Guide*, 2nd ed. 2005.

Striking a Ray of Hope

Uttar Pradesh, India has one of the world's most recorded cases of domestic violence in the region. The police also introduced a new domestic violence helpline to report a spike in the number of incidents. On the front page, a newspaper advertisement printed the words "Suppress corona, not your voice." The police have decided to require a female officer to deal with these incidents and the police should have the right to prosecute the suspect.[36]

A local phone line has been set up in the Thar region in India to take calls from isolated women. These helplines receive calls and also deliver food to people who are in need. Through this process, they can check up on these vulnerable women to see if they are doing better, or are they still being abused.[37]

To counter the increasing domestic violence during the Coronavirus pandemic, the Pune Zilla Parishad was motivated by the virus control manual. Abusers in the Pune district will now be disciplined with institutional quarantine if a case of domestic violence is brought against them. Ayush Prasad, CEO, Pune Zilla Parishad, narrated to The Hindu, "Globally, there has been a sharp surge in domestic violence cases during the pandemic. So, we have taken this proactive step to preclude similar cases from occurring in the Pune rural region. The definition of a particular case is as given by the Protection of Women from Domestic Violence Act 2005 and the Criminal Law (Amendment) Act, 2013 (Nirbhaya Act)."[38]

Small but dedicated organizations like the Gauravi Centre, established by Sarika Sinha in Bhopal is aiding the vulnerable people during the Pandemic. These people include abused women, sex workers, Muslim minorities, homeless people, and transgender communities. They all come together to contribute towards their community to ensure that the families most affected by the virus are aided. The centre has collaborated with 18 other organizations to distribute food, rations, and clothes to the needy. The centre strives to contribute and educate the women to stand up for themselves. They hope to inculcate the value of self-dependence so that they do not face any kind of abuse in the future.[39]

36 *The shadow Pandemic: Lockdown and domestic violence*, Kartavya Sadhana (June 19, 2020, 10:30 AM), https://kartavyasadhana.in/view-article/lockdown-and-domestic-violence-writes-prachi-patil.

37 *Stopping lockdown domestic abuse on my street*, BBC News (June 19, 2020, 10:30 AM), https://www.bbc.com/news/av/world-53014211/coronavirus-domestic-violence-increases-globally-during-lockdown.

38 Shoumojit Banerjee, *Coronavirus lockdown | Pune zilla parishad plans tough action to check domestic violence*, The Hindu (April 18, 2020, 12:15 PM), https://www.thehindu.com/news/national/other-states/coronavirus-lockdown-pune-zilla-parishad-plans-tough-action-to-check-domestic-violence/article31371216.ece.

39 *How women in India are helping those most vulnerable during the coronavirus pandemic*, Actionaid UK (June 20, 2020, 10:00AM), https://www.actionaid.org.uk/blog/news/2020/05/26/how-im-helping-indias-

The All India Council of Human Rights Liberties and Social Justice has filed a petition for safeguarding victims who have faced domestic abuse, especially during the COVID-19 lockdown. The bench of the Delhi High Court consisting of Justices J.R. Midha and Jyoti Singh ordered the Central Government, the Delhi Government and the Delhi Commission of Women to direct a meeting to discuss the matter at hand during these troubled times and to come up with a solution which should be implemented at once.[40]

There needs to be a decent way out of a country with deep-rooted patriarchal values, where women are expected to accept anything that is thrown of their direction. With the continuation of the lockout, the term of imprisonment for the sufferers is only extended. Fighting these predators and the beasts that prey on the frangibility of women is as important as tackling the pandemic. Administration and law enforcement officials need to realize the gravity of the matter. Women's health cannot be put on hold until we win the battle against the pandemic. The administration will take corrective measures without deviating from the COVID-19 work plan to protect and support victims of domestic abuse.[41]

It is believed that these measures will go a long way in uprooting domestic violence from society both during and after the pandemic. The urgency of the situation and the need for immediate and effective state action needs to be acknowledged by Governments across the globe.

International Perspective

Abuse Not Constricted to India

Every city across the globe has declared a lockdown due to the surge in coronavirus cases. The already identified vulnerable group- the abused women and children- has had it worse than others. As has been mentioned, the individual who abuses also is confined indoors. The vulnerable people are at more risk of being abused this way. Other parts of the world have also seen an increase in domestic violence cases.

Hubei province, the origin point of the Coronavirus, had reported thrice the number of domestic violence cases to the police. Activists in the region had notified that the number went from 47 reports from the previous year to 162 in just the last 2 months.

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most-vulnerable-women-during-the-coronavirus-pandemic.

40 *Pandemic Triggers Domestic Violence*, The Leaflet (June 20, 2020, 10:20 AM), https://theleaflet.in/pandemic-triggers-domestic-violence/.

41 *Ibid*.

Wan Fei, a police officer who established a charity for fighting against abuse informed the Sixth Tone website, "The epidemic has had a huge impact on domestic violence. According to our statistics, 90% of the causes of violence [in this period] are related to the Covid-19 epidemic."[42] This is a pattern that is being reported everywhere across the globe. The situation in Brazil has also deteriorated. Adriana Mello, a judge specializing in domestic abuse cases from Rio de Janeiro stated, "We think there has been a rise of 40% or 50% and there was already really big demand. We need to stay calm to tackle this difficulty we are now facing."[43]

Activists in Italy informed that they received a large number of text messages and emails asking for assistance. "One message was from a woman who had locked herself in the bathroom and wrote to ask for help. For sure there is an overwhelming emergency right now. There is more desperation as women can't go out"[44] said Lella Palladino, from EVA Cooperativa, an activist group for the prevention of violence against women.

Activist Movements across the Globe

Spain had enforced strict rules during lockdown to ensure no one stepped out of their homes. They were fined if they left their homes. But the government made sure that women had the right to go report any abuse they faced. This was after a woman had been murdered by her spouse in Valeria, five days before the lockdown. The increased danger to women and children was a foreseeable side effect of coronavirus lockdowns, activists said. Increased violence is a trend that is replicated in many crises, including war, economic crisis, or disease outbreaks, although the quarantine rules present a particularly important challenge. There have been demands in several countries for legal or regulatory reforms to represent the increased danger to women and children in quarantine.

In the United Kingdom, Mandu Reid, leader of the Women's Equality Party, called for additional police powers to remove the victims from their homes for the duration of the lockdown and for the government to waive court fees for security orders.

The prosecutor in Trento, Italy, has ruled that, in cases of domestic violence, the attacker must flee the family home and not the victim, a move praised as "fundamental" by the CGIL trade union. The union asserted, "Being confined to home because of the coronavirus

42 Emma Graham-Harrison, Angela Giuffrida Helena Smith in Athens & Liz Ford, *Lockdowns around the world bring rise in domestic violence*, The Guardian (March 28, 2020, 09:15 AM), https://www.theguardian.com/society/2020/mar/28/lockdowns-world-rise-domestic-violence.

43 *Ibid*.

44 *Ibid*.

is difficult for everyone, but it becomes a real nightmare for female victims of gender-based violence."[45]

In Germany, the leader of the Green Party, Katrin Göring-Eckardt, said this week that she feared the lives of thousands of women living with abusive spouses and called on the government to free up funds for safe houses. "The spaces in women's safe houses are small even during normal times,"[46] she said to the German media, urging the government to acknowledge the renovation of empty hotels and guest houses and the conditions for people who are vulnerable to leave their homes. Her colleague, Katja Dörner, said that house visits should proceed in situations where there is evidence that children have been exploited despite rules banning contact.

Officials in Greece said they were speeding up a program to help women cope with issues arising from the issue of confinement. "Recognizing that this is usually an issue in times of crisis, we're working around the clock to get the message out. Once official figures are released next week, and we know the true scale of the problem, we'll be enlisting TV channels as well as social media and the mainstream press. There is no question in my mind that with the economic impact of the crisis this will get worse"[47] said Maria Syrengela, who heads the General Secretariat for Family Policy and Gender Equality

SUGGESTIONS

State Action

- Consideration of financially deprived victims of abuse is necessary. The Government may facilitate technological assistance in police stations or other Government sanctioned/recognized safe places across the country. The victims can go to these places in specific time slots to prevent overcrowding and attend their hearings.
- The Government should set up psychological assistance units with multiple objectives that can be developed upon further in due course of time. The first objective would be to provide emotional support to the victims of such abuse. The second objective would be to conduct regular local surveys across the country to keep a check on existing and potential cases of abuse. It is important to note that the questions asked in the survey should preferably be indirect so that the

45 *Ibid.*
46 *Ibid.*
47 *Ibid.*

victim discloses full information without fear of the perpetrator inflicting further harm. These surveys may be conducted on the phone for the pandemic. The third objective would be to set up safe houses for women in uncontrollable or extremely violent situations. These safe houses may be made in a way to ensure social distancing and the safety of women.

- A huge contributor to this type of abuse is a lack of financial security and basic resources. To overcome this, a specific amount of state fund should be allotted for those requiring financial aid. This would remove the financial stress and reduce the risk of stress-induced violence against women. It has also been observed that men resort to alcohol when in times of difficulty. This habit soon develops into alcoholism which, again, is a leading cause of violence against women.

- A highly neglected possible solution to the problem is psychological assistance to the perpetrators themselves. The Government should implement programs and initiatives to help the men understand how their courses of action during times of stress may affect people around them.

- Men across the globe must be sensitised to these issues carefully and help them develop better Emotional Quotients to prevent the risk of violence against women. This absence of psychological or emotional awareness is what ultimately causes men to react in inhumane and unlawful ways.

- It is a dire need of the current society for its individuals, irrespective of gender, financial status or any other differentiation to be psychologically sensitised. Therefore, the Government should make efforts to remove the stigma around mental health.

- Going forward, States must promote the creation of alternative reporting mechanisms; increase shelter options; improve protection and justice capacity; retain critical sexual and reproductive health programs where victims of domestic and sexual abuse are frequently reported and supported; support independent women's groups; financing economic protection measures for women workers, especially those working on the frontlines of the pandemic or in the informal economy, and other groups disproportionately affected by the pandemic, such as migrants, refugees, homeless and trans women; and collecting detailed data on the gendered effects of COVID-19.[48]

48 *The COVID-19 shadow pandemic: Domestic violence in the world of work: A call to action for the private sector* | Digital library: Publications, UN WOMEN (June 20, 10:20 AM), https://www.unwomen.org/en/

Course of Action for Friends and Family of Aggrieved

- The right to record domestic violence to the police is always open. Nevertheless, if the victim does not plan to do so, they can set up a security system for themselves, with a secure message to inform the people with whom they live when confronted with an unsafe circumstance.
- It is prudent to have a friend, family, neighbour or someone nearby notified in the case of intensifying peril. It is also necessary to explain this to trusted family members or friends so that the perpetrator can be held accountable.
- There are also many helplines for domestic violence and useful online counselling websites that victims can utilize for welfare purposes.
- People with previous injurious, destructive inclinations and anger control difficulties must strive to keep their stress as low as feasible. Exercising self-care, reducing media exposure, taking on online motivation programs, or soliciting remedy by counselling can make them better.
- Parents must keep in mind that their temporary lack of control may have a more profound influence on their child than they apprehend.
- When your loved one tells you that she is at risk, it's a good idea for her to make a safety plan with the assistance of professional support service. This may include, for example, putting some money away and ensuring that she has access to a mobile phone via contact with emergency services.
- When your friend is still engaged in a legal matter with an abusive ex-partner, be sure to know that community law centres and legal aid programs are also offering online advice to clients.[49]

Judicial Course of Action

- With the lockdown being imposed, it is tough to have fast-tracked courts and to have regular hearings. The government should take suitable actions to assure that the victim is protected like improving the scheduling of the trial, filling in the vacancies of the judge, and, of course, the necessary Virtual Courts.
- The courts should do away with so much needless paperwork while listing any required lockdown hearings, the same can be done when routine court hearings recommence.

digital-library/publications/2020/06/brief-domestic-violence-in-the-world-of-work.

49 *Ibid.*

Organisational Course of Action

- The COVID-19 pandemic is an opportunity to reconsider how the private sector will collaborate with other stakeholders to end domestic violence. With the removal of locks as women return to work, there will likely be a further rise in demands for assistance in the workplace to aid survivors of domestic abuse.
- Organizations must also be prepared to scale up their activities in the medium and longer-term. The private sector should be at the forefront of creativity, dialogue, and cooperation with governments, workers' unions, service providers, and non-governmental organizations.[50]

Conclusion

It is important to note that domestic violence was a global pandemic even before the outbreak of COVID-19. According to data obtained by the United Nations, 243 million women and girls between the ages of 15 and 49 in the world have been exposed to sexual or physical abuse by an intimate partner over the last 12 months. Put differently, one in three women has witnessed physical or sexual harassment at some stage in her life. LGBTQ+ people face equally high rates of aggression. As the Inter-American Commission on Human Rights and the United Nations have pointed out, countries must have a gender viewpoint in their response to the COVID-19 crisis.[51]

Victims of domestic violence must remember not to blame themselves for what is happening to them. Violence is unacceptable and the perpetrator has to be held accountable. Victims must not make excuses for the perpetrators' actions. Accepting these acts will lead to a vicious cycle of violence. However, understanding this may not be possible for everyone because of the society or environment they were brought up in. In a country like India, it has been a long-known practise to instil the idea of husband worship in the minds of young women. This perpetuates the notion that a husband is equivalent to God and can do nothing wrong.

The urgency of the situation and the need for immediate and effective action needs to be acknowledged by Governments across the globe. It is believed that the aforementioned measures will assist the concerned authorities in uprooting domestic violence from society.

50 *Helping women at risk of domestic violence during the coronavirus pandemic* - ABC Life, (June 20, 10:20 AM), https://www.abc.net.au/life/helping-at-risk-dv-women-during-coronavirus/12110004.

51 *A Double Pandemic: Domestic Violence in the Age of COVID-19*, Council on Foreign Relations (June 21, 2020, 11:30 AM), https://www.cfr.org/in-brief/double-pandemic-domestic-violence-age-covid-19.

HONOUR KILLING : PRESERVING HONOUR OR ATTRACTING IGNOMINY

Nidhi Chillar* and Ritika Sharma**

Abstract

Honour killing is one of the most serious offences against humanity. Women have been viewed as property from time immemorial and that is the reason that the present patriarchal society is unable to accept the fact that women have the right to choose their male counterparts. It is expected from them to live according to the norms of the families and the community she lives in; even the slightest deviance may lead them to lose their lives. The situation becomes worse when the woman falls in love with a man who is from a different caste. It is believed that inter-caste marriage brings dishonour to the family and this is the reason that many girls have fallen prey to honour killing. The families kill their daughter, sometimes even her male counterpart to preserve what they think to be the honour of the family. The Khap Panchayats also have a major role to play in honour killings. Khap Panchayats which are seen as the authority to preserve the tradition and custom of the villages often instigate and engages in the brutal act of honour killing.

Honour killing is a crime not only against an individual but the society as a whole. Various measures have been taken by the legislature to enact strict laws against honour killing. Judiciary has also played an important role in punishing the perpetrators of such a brutal offence.

The present paper tries to cover the topic "honour killing" in detail. The paper tries to focus on the causes responsible for honour killing, the infamous cases on honour killing, how the Khap Panchayats have played a major role in instigating honour killing. The paper has also tried to bring in light the consequences of honour killing and to describe the laws to protect the victims from honour killing, the response of the

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judiciary on such crimes. The paper has also provided for the desired solution to combat the menace of honour killing.

The paper is primarily concerned with India, however, certain cases that took place outside India has also been highlighted to understand the concept better. The paper has also analysed the judicial response in Honour Killing cases.

Keywords: *honour killing, honour, caste, patriarchy, Khap Panchayats, dishonour, murder, homicide.*

INTRODUCTION

Killing females in the name of honour expresses a despotic society dominated by arbitrary culture

- Khaled Hishma

Honour killing is one of the barbarous offences. An honour killing is a homicide of a member of a family by the other members of the family, due to the belief that the victim has violated the norms of the community or a religion thereby bringing shame to the honour of the family.[1] Honour killing is nothing but a plain murder in the name of so-called honour. Women have been thought of as a chattel and her chastity a matter of honour. She is brutally killed if she marries, or loves someone who is not of the same caste or religion. The perpetrators justify themselves by citing that the acts of the victim have brought shame to the family and they killed the victim to preserve the honour of the family, with no sign of remorse.

Most of the time, it is the woman who fell prey to honour killing but there can be no denial of the fact that men can also be victims of honour killing by the members of the family of the women with whom is believed to have an inappropriate relationship.[2] It is sad to note that in many countries the data of honour killing are not sufficiently collected and the cases are often difficult to be traced as the cases go unreported or the family members of the victims register or report the cases as suicides or accident.[3]

1 Seied Beniamin Hosseini & C Basavaraju, *Study on Honor Killing as a Crime in India- Cause and Solutions*, 2(1) MYSINTCON 90 (2015).

2 *"Honor' crimes in India: An Assault on Women's Autonomy" Al Jazeera English (Aug. 02, 2020, 10:05 AM), https://www.aljazeera.com/indepth/opinion/honour-killings-india-assault-women-autonomy-180314090856246.html.*

3 Hillary Mayell, "*Thousands of Women Killed for Family "Honor"*", National Geographic News, 12

Causes of Honour Killing

There are various factors responsible for honour killing. Some of them are discussed below:

- Dressing in a way unacceptable to family or community norms.
- Denying arranged marriage or being in a relationship with a man of the caste lower than the girl's caste. It is one of the major reasons for honour killing. In a recent *Kevin Murder Case*, Kevin Joseph who belonged to a Scheduled Caste was murdered for loving a girl named Neenu, who is a Malankara Catholic.[4]
- A woman wanting to obtain a divorce without the consent of the husband. It is considered as a shame for the husband's family.
- Allegation on the character or morale of the women. Sometimes the mere allegations are enough, however false they may be. It is believed that the women should be chaste and pure, any deviance from the prescribed norms is considered as a shame for the whole family.
- If a woman is raped it is believed that it brings dishonour to the family, it is especially the case when the woman becomes pregnant.
- Having an extramarital affair is perceived as bringing dishonour to both the families i.e. the husband's family and the girl's family.

Infamous Cases Related to Honour Killing

Honour killing has often led to major high-profile murders of women in the name of dishonour brought on the family. Honour killing is often done by a male member of a particular family claiming that the action of that woman has defamed the name of the family or its prestige. Such crimes are widely suspected to be underreported and they take place throughout the world. The UN estimates that around 5,000 women and girls are murdered each year in so-called "honour killings" by the members of their families.[5] Honour killings are widely reported in the regions of the Middle East and South Asia but most of these crimes occur in countries like Bangladesh, Brazil, Canada, India, Egypt, Iran, Italy and the United States. The crime of honour killing is not limited to women and girls rather is also on the rise against LGBTQE, particularly gay men.

February 2002, (20th March 2020), https://www.nationalgeographic.com/culture/2002/02/thousands-of-women-killed-for-family-honor/.

4 Shaju Philip, Kerala court finds 10 guilty in case of honour killing, The Indian Express, 23 August 2019.

5 The Horror of 'Honor' Killings' Even in US, Amnesty International, (20th March 2020), https://www.amnestyusa.org/the-horror-of-honor-killings-even-in-us/.

Manoj-Babli Case

The infamous Manoj-Babli honour killing case shocked entire India when a couple from Kaithal district, Haryana were brutally murdered just in the name of ignominy which was brought to the family by the act of the couples. The cruel act was carried out on the orders of Khap Panchayat as the couples married in the same *gotra* which took place in June 2007. On June 23, two decomposed bodies were found from Barwala branch canal in Hisar.[6] The investigations unfolded the shocking details about the case. According to the reports, the couples were forcefully asked to accept each other as brother and sister. When they both denied, the vengeance of the family members came into the picture. The couples were forcefully fed pesticides and were brutally strangled to death. The dead bodies were thrown in the canal. The families of couples lived in Karoran Village, Kaithal. Manoj's family consists of five members. Similarly, Babli's family included five members with the only earning member who was her eldest brother. Manoj's mother confessed that she knew about Babli long before they decided to marry each other. In April 2007, Manoj and Babli got missing from their houses. It was alleged that Manoj has eloped Babli to Chandigarh and they got married to her at a Durga temple which was a mere commitment to one another transcending their willingness to abide by societal norms.[7] The Khap Panchayat intervened and annulled the marriage. However, Babli's relatives were chasing Babli and Manoj even after the Court provided police protection to the couples. Even after all the security and protection of the police and the efforts of the couples to escape, they were kidnapped, beaten and were strangled to death. Their bodies were wrapped in a gunny sack and were dumped in the Barwala Link Canal in Hisar District. The case was brought before the trial court convicted the accused and the policemen who did not comply with their duties rather misused their powers. There were constant threats to the judge also, who gave the verdict in the matter. The matter went for the appeal in the High Court of Punjab and Haryana Court and the four convicts were awarded death sentence.[8]

Qandeel Baloch's Case, 2016

The pattern and the reason for killing in this are not new at all. A Pakistani social media celebrity named Qandeel Baloch was murdered ruthlessly by her brother. She was drugged and asphyxiated by her brother when she was sleeping in her parents home in Multan.

6 Nitish Katra muder case: what you need to know, The Hindu (Aug. 03, 2020, 11:35 AM), https://www.thehindu.com/news/national/Nitish-Katara-murder-case-what-you-need-to-know/article15423924.ece.

7 Death sentence commuted in Manoj-Babli case, THE HINDU, 12 March 2011.

8 Manoj-Babli honour killing: SC allows plea against acquittal of accused, The Times of India (Aug. 05, 2020, 11:40 AM), https://timesofindia.indiatimes.com/india/Manoj-Babli-honour-killing-SC-allows-plea-against-acquittal-of-accused/articleshow/9844060.cms.

Autopsy reports confirmed the same. Her brother Waseem confessed that he murdered her sister as she was bringing disrepute to their family's honour and reputation.[9] The murder was widely condemned all over the world by several famous personalities.

Ghazala Khan's Case, Denmark, 2005

Ghazala Khan was the Danish woman who was killed by her brother as she married against the will of the family. It was confessed by her brother that the murder was ordered by their father to save the honour of the family. It was being mentioned by the family that the girl was involved in an intimate relationship with Emal Khan, three years before her marriage.[10] After the confession of her feelings, she was badly beaten up by her mother and was locked inside the home in isolation. After they were married, the family member played a trick to kill the couple. They pretended to meet and reconcile the issue. They convinced the couples to meet at a railway station and this was the location where both Emal and Ghazala were shot. The accused were convicted in the court proceedings and were awarded requisite punishment.

Bhavna Yadav Death Case, 2014

Bhavna Yadav was a 21-year-old Delhi University student who was strangled to death by her parents just after three days of her marriage. This was because she married against her parents' wishes. This case was one of the most shocking cases as so-called honour crimes rarely involve middle class educated families in big cities.[11] The girl was brutally killed for marrying her batchmate as according to the family, she brought disgrace to their reputation.[12]

Khap Panchayats and Honour Killings

What is Khap?

Khap is a cluster of villages, where every boy and girl is deemed to be brother and sister. Thus, they cannot form the ties of affinity within a khap[13].

9 Qandeel Baloch's absconding brother arrested, THE HINDU, 06 October 2019.

10 Lewis Frazier, "What You Should Know about the honor killing of Ghazala Khan", BBC NEWS, 15 September 2017.

11 Bhawna Yadav,"Small dreams of Delhi 'honor killing' victim", BBC NEWS, 21 November 2019.

12 Urban honor killings: Backlash against change, The TIMES OF INDIA, 23 August 2015.

13 Kachhwaha, K. 2011. Khap Adjudication in India: Honouring the Culture of Crime, International Journal of Criminal Justice Sciences Vol 6 Issue 1 and 2 January-June/July-December (Combined Issue).

Khap Panchayats and their Role in Honour Killing

Khap panchayat is the traditional local judicial body active in north-western states like Haryana, northern Rajasthan, the rural belt of Delhi and western Uttar Pradesh.[14] The leadership of the Khap Panchayat is decided on the parameters of caste, status, gender and financial status etc.

The very mention of khap panchayat brings to our minds the horrifying picture, where the couples are brutally killed for loving each other against the norms of the community.[15] According to the Justice Verma Committee Report, the Khap Panchayats have no sanction under law.[16] The Khap Panchayats have always tried to maintain caste order by preventing inter-caste marriages and debarring *sagotra* marriages. These practices have severely restricted the individual's freedom to choose their life partners. This further unduly emphasises a woman's honour, thus, not only controlling her sexuality but also her marital choice by stigmatising inter-caste marriages.[17]

Khap Panchayats are considered as the custodian of the customs, culture and traditions of the community. Khap Panchayats are seen opposing the marriage within the village, *Sagotra* marriage; marriage within the khap and inter-caste marriages.

The Khap Panchayats does not allow the violation of the above-stated norms. Any violation of these norms attracts strict and barbarous punishments, often leading to humiliation and even the murder. In *Arumugam Servai v. State of Tamil Nadu,*[18]the Hon'ble Supreme Court pointed out that there is nothing honourable in "honour killing" and, it is nothing but a shameful and barbaric murder.

Consequences of Honour Killings on the Society

Honour crimes are usually considered as a convenient expression to describe the incidents of violence and harassment caused to the young couple intending to marry against the

14 Kachhawah, Kavita (2011): Khap Adjudication in India- Honouring the Culture with Crimes (ICJS, Vol 6 Issue 1 & 2 January-June/July-December 2011).

15 Japdeep Singh & Anju Beniwal (eds.), Panchayati Raj and Rural Development (Pointer Publishers, Jaipur, 2015).

16 Government of India, "*Report of the Committee on Amendments to Criminal Law*" (January 2013).

17 Chakravarti, U. 1993. '*Conceptualising Brahmanical patriarchy in early India: Gender, caste, class and state'*, Economic and Political Weekly, Volume (14): 579-85. See also; Baxi, P., Rai, S. M. and Ali, S. S. 2006. *'Legacies of common law crimes of honour in India and Pakistan'*, Third World Quarterly, Volume (7): 1239-53.

18 *Arumugam Servai v. State of Tamil Nadu*, (2011) 6 S.C.C. 405.

wishes of the so-called community or the concerned family members. However, the terms of such kind are often used as catchy phrases and not as apt and accurate expressions.[19] It has been widely observed that men are also targeted by honour killings. The consequences are far more negative. Honour killings are not at all honourable. It is a wrong perception in the minds of the perpetrators that by killing the couples who have disobeyed the norms and the rules of the community would lead to deterrence and no other individual will think of taking any step of this kind. This misconception has led to the deaths of many innocents. There are perils of falling in love. A kind of mental trauma and a deep fear of being killed is usually instilled in society by such acts of honour killings. People begin to fear to fall in love. Love becomes a tool to commit crimes of such sort.

Laws to Protect the Victims from Honour Killing

There is no specific legislation on honour killings as of now and it is generally considered as murder or culpable homicide. However, there are various provisions contained in various statutes and the Constitution that deals with the same. These provisions are discussed below:

- Honour killings are the cases of murder and homicide both of which are the grave offences under the Indian Penal Code (IPC). Section 300 of the IPC deal with murder while Section 299 and 301 deal with culpable homicide not amounting to murder. Since the honour killing is committed with the intention of killing the victims because their acts have brought the dishonour to the family, therefore, the act of honour killing falls within the murder and culpable homicide.[20]
- The members of Khap Panchayat or the family can be made liable under Section 302 of the IPC for instigating to commit suicide those who have violated the norms of the community.[21]
- Since the honour killing particularly targets the woman, it is against Article 14 of the Constitution which provides for the Right of Equality before the Law. Honour killing has given rise to Gender Violence[22].
- Killing someone in the name of honour is violative of Article 21. Article 21 guarantees the right to life and personal liberty. The family members and the

19 Law Commission of India, "*242nd Report on Prevention of Interference with the Freedom of Matrimonial Alliances: A suggested Legal Framework*" (August, 2012).

20 Puneet Kaur Grewal, "*Honour Killings and Law in India*", *5* IOSR JHSS 28, 28.

21 *Ibid*.

22 Seied Beniamin Hosseini, C Basavaraju, "*Study on Honor Killing as a Crime in India-Cause and Solutions*", 2(1) MYSINTCON 90, 91 (2015).

Khap by killing the victim violate Article 21. Every person has the right to live and the capital punishment can only be given as per the rule established by law. Since neither the Khap Panchayats nor does the family members authorised to invoke capital punishment by law, they act in violation of Article 21.[23]

- The Special Marriage Act, 1954 came into force to legalise the marriage solemnised outside the caste, religion or within the same village, khap or gotra. Thus, making such marriages completely legal. The couples belonging to different castes can thus marry under the Special Marriage Act, 1954[24].
- Scheduled Tribe and Scheduled Caste (Prevention of Atrocities) Act, 1989 was enacted to protect the SC's and ST's from any kind of humiliation and atrocities. The Act is connected with honour killings as most of the cases of honour killing are committed in connection to caste and religion.[25]
- The Protection of Human Rights (Amendment) Act, 2006 contains provisions for protecting the individual rights of human beings. It also provides for the establishment of the National Human Rights Commission, the State Human Rights Commission and Human Rights Courts for better protection of Human Rights.[26]

Judicial Response

Every society has its customary practices. Some practices are good for society while others may turn out to be bad. Honour killing is the most barbaric and brutal nature of the customary practice. The judiciary has always condemned Honour killing through its judgments and has been successful in awarding appropriate punishments to perpetrators.

In the *State of Uttar Pradesh v. Krishna Master and Another*[27], the accused were guilty of murdering six members of the family in the name of honour killing. The Hon'ble Supreme Court in its judgment observed that killing six members of the family on the flimsy ground of saving the honour falls within the rarest of the rare cases. The Supreme Court thus awarded rigorous imprisonment for life and a fine of ₹25,000 each, in default, RI for two years.

23 *Supra* at 29.

24 *Ibid*.

25 *Supra* at 91.

26 *Ibid*.

27 *State of Uttar Pradesh v. Krishna Master and Another,* Criminal Appeal No. 1180 of 2004, decided in 2010.

In *Lata Singh v. State of U.P. and Another*[28], the Supreme Court of India observed that the caste system is dividing the nation into two parts. It was observed that inter-caste marriages are in the national interest as they will result in destroying the caste system. The Supreme Court further stated that India is a free and democratic country, and once a person becomes major, he/she has every right to marry any person who he/she likes. If the parents don't agree with the choice of their child what they can do is that they can cut their social relations with the child but cannot threaten or harass them. The Court held that such threats and harassment are wholly illegal and those who commit these shall be severely punished.

The decision of the Supreme Court in *Arumugam Servai v. State of Tamil Nadu*[29] is noteworthy. The case arose in connection with the violation of certain provisions of Scheduled Tribe and Scheduled Caste (Prevention of Atrocities Act), 1989. The Supreme Court observed that the act of Khap Panchayat (khatta Panchayats) in Tamil Nadu in encouraging the honour killing is wholly illegal and is needed to be ruthlessly stamped out. The court further observed that the Khap Panchayats by indulging in such acts takes the law in their hands, and amount to kangaroo courts, which are wholly illegal.

The Supreme Court in *Bhagwandas v. State (NCT of Delhi)*[30] observed that "*honour killing for whatever reason would come within the category of rarest of rare case deserving death penalty*."

Present Situation

In the present situation, crimes of honour killings are taking novice and distinctive forms. It is increasing day by day and there has been no break in the increment if the same. The National Crime Record Bureau statistics depict that honour killings in India have grown by more than 76%-79% from 2014 to 2015.[31] While 28 murders were reported under this category in 2014, this number jumped to 251 in 2015. Moreover, there are many cases which go unreported. The data available is only of the cases which are reported. There have been thousands of cases in the interiors which are not reported.

28 *Lata Singh v. State of U.P. and Another,* (2006) 5S.C.C. 475, AIR 2006 SC.

29 *Arumugam Servai v. State of Tamil Nadu,* (2011) 6 S.C.C. 405.

30 *Bhagwandas v. State (NCT of Delhi,)* (2011) 6 SCC 396.

31 National Crimes Record Bureau, Ministry of Home Affairs, "*Crimes in India*" (2016), (20th March 2020) https://ncrb.gov.in/sites/default/files/Crime%20in%20India%20%202016%20Complete%20PDF%20291117.pdf.

Desirable Solutions

- There is a need for the transformation in the attitude of the people. Inter caste-marriage should not be viewed as a stigma. There's no honour in an honour killing.
- Honour killing should be made a separate offence as it would help in bringing more clarity for the law enforcement agencies.
- Legal Protection should be given to the couples who are threatened for marrying against the wishes of their families.
- Severe Punishments should be awarded to the perpetrators of the offence to give a strong message to all.
- Regular statistics should be collected, studied and analysed to decide the steps that must be taken to combat such crimes.

Conclusion

To sum up, it is important to note that the very act of honour killing itself defies the very rule of nature. Nobody has been embodied with the right to take anybody's life. This authority vests in God only. A mere misconception of false honour and ego leads to such heinous crimes. This has proved to be the greatest setback on the entire social structure. In the name of honour, plain murder is executed. People do not understand that for whom they do such acts, those people of society will never support in any circumstances, whatsoever. In the end, it is only the blood relations who stand in the situations of crisis. The incidents of honour killings have always been a debatable one. It is a stain on society. There is a need to understand that taking life just for the momentary pleasure of maintaining one's honour, status and reputation in society cost huge amounts in the long run.

THE BIOLOGICAL WEAPONS CONVENTION: LEGAL LACUNAE AND THE WAY FORWARD IN LIGHT OF COVID-19

Samavi Srivastava* and Rounak Doshi**

Abstract

Biological Weapons are weapons of mass destruction that may cause various forms of damages. The use of Biological Weapons substantially impacts a considerable population all over the world. With the advancement of technology, the need of development of a Convention which prevents the development and usage of such weapons has become an agenda of paramount importance. Efforts have been made all over the world to curb the menace of use of biological weapons, and so far, one of the most successful steps taken in this regard has been the excogitation of the Biological Weapon Convention which prohibits the production, use, and proliferation of Biological Weapons. This paper provides an insight into the recent allegations against China for manufacturing the virus that led to the COVID-19 pandemic; which constitutes a violation of the BWC. The authors will discuss in detail the salient features, working, implementation, as well as shortcomings of the Convention, and will critically assess and analyse the present global position on the said issue while stressing upon the need of certain amendments to ensure the proper functioning of the BWC.

INTRODUCTION

In today's time and age, biomedical advances have made it possible to control features of living organisms in helpful manners, prompting breakthroughs in health, the economy, farming, the life sciences, and other sectors. Research in biology and the opening of biological laboratories across the world has provided a platform for the development of vaccines and solutions to even the deadliest viruses and diseases that humankind has ever faced. Nevertheless, in times such as these, its negative repercussions cannot be overlooked. Such technological advancement is also the path to the development of biological weapons

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that threaten international peace and human security.[1] Rapid advances in biotechnology and the proliferation of biological weapons capabilities have already posed serious threats to society by enabling the production of biological weapons with unique and unpredictable characteristics.[2] They have unprecedented rates of proliferation and are hard to trace, therefore being able to pass off as natural occurrences, making them the perfect weapons for hostility. In fact, biological weapons are considered to fall under the umbrella of "Weapons of Mass Destruction"[3] and even in *Nuclear Weapons* Advisory Opinion, the International Court of Justice has specified that the use of weapons of mass destruction tense to be a prohibited activity.[4]

The fundamental question that arises is; how do we distinguish between biology being used for peaceful purposes and harmful ends. To provide some clarity, WHO has defined biological weapons as microorganisms or toxins that are delivered and discharged intentionally to cause disease and death in people, animals, or plants.[5] Toxins refer to those poisonous products of organisms that are lifeless and incapable of reproducing themselves.[6] Further, Biological Weapons consist of two inalienable parts – a weaponized agent and a delivery mechanism.[7] The harmful or negligent use of these biological weapons can cause serious harm at the national and international levels.[8] They may cause socio-political-economic harms that are terrifying.[9]

The Biological Weapons Convention (hereinafter "BWC") is the first multilateral treaty that prohibits the development, production, stockpiling, and use[10] of biological weapons.

1 S.C. Res. 1540 (April 28, 2004).

2 Erik Frinking Et Al., *The Increasing Threat Of Biological Weapons Handle With Sufficient And Proportionate Care* 20-21 (The Hague Centre for Strategic Studies, 2017).

3 Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996 I.C.J. Reports p.226, ¶228.

4 Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996 I.C.J. Reports p.226, ¶264.

5 *Biological Weapons,* World Health Organization, (June 18, 2019, 10:00AM) https://www.who.int/health-topics/biological-weapons#tab=tab_1.

6 Jozef Goldblat, *The Biological Weapons Convention-An Overview,* International Committee of the Red Cross, (June 18, 2019, 10:00AM) https://www.icrc.org/en/doc/resources/documents/article/other/57jnpa.htm.

7 *What are Biological and Toxin Weapon?,* Biological Weapons Convention, (June 18, 2019, 10:00AM), https://bwc1972.org/home/the-biological-weapons-convention/about-biological-weapons/.

8 Michael P. Scharf, *Clear and Present Danger: Enforcing the International Ban on Biological and Chemical Weapons Through Sanctions, Use of Force, and Criminalization,* 478 Mich. J. Int'l L. Vol. 20:447 Spring (1999).

9 Joseph P. Dudley & Michael H. Woodford, *Bioweapons, Biodiversity, and Ecocide: Potential Effects of Biological Weapons on Biological Diversity: Bioweapon disease outbreaks could cause the extinction of endangered wildlife species, the erosion of genetic diversity in domesticated plants and animals, the destruction of traditional human livelihoods, and the extirpation of indigenous cultures,* Bio Science Vol. 2 Issue 7 583 (2002).

10 U.N. BWC, 4th Review Conference, U.N. Doc. BWC/CONF.IV/9 (Dec. 6, 1996).

It bans an entire category of weapons of mass destruction (hereinafter "WMD"). After all the preparatory sessions in the United Nations' Office of Disarmament Affairs forum starting in 1969, the BWC opened for signature on April 10, 1972, and entered into force on March 26, 1975.[11] It currently has 183 states-parties.[12] Its conception was based on the acknowledgment of the dangerous nature of biological weapons.

In recent times, this discussion on biological weapons and the BWC has specifically gained a lot of relevance and importance because of COVID-19, also known as the coronavirus, a deadly disease spread by a virus through rampant human to human transmission that has brought the world to a standstill. Emanating from China,[13] it has wreaked havoc on the lives of many people. It has displaced and disrupted humankind and their activities globally. As of June 14, 2020, coronavirus has killed more than 430139 people and infected nearly 7787271 persons across the globe.[14] The virus has caused world trade to fall by around 30% and also seriously impacted cultural and sports events all around the world.[15] and[16] A lot of speculation has been made regarding the emergence of Covid-19. Various media outlets[17] have claimed that Covid-19 is a Biological Weapon artificially developed by the People's Republic of China in its high-security biochemical Wuhan lab to cause a substantial amount of harm to other nations and severely impair the global economy.

Recently on April 3 2020,[18] a complaint against the People's Republic of China before the United Nations Human Rights Council (hereinafter UNHRC) was jointly filed by

11 *Biological Weapons,* United Nations Office for Disarmament Affairs, (June 18, 2019, 10:00AM), https://www.un.org/disarmament/wmd/bio/.

12 *Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction*, United Nations Office for Disarmament Affairs, (June 1, 2019,11:00 AM), http://disarmament.un.org/treaties/t/bwc.

13 *Rolling Updates on Coronavirus Disease (COVID-19)*, World Health Organization, (June 1, 2019, 11:00AM), https:// www.who.int /emergencies/diseases/novel-coronavirus-2019/events-as-they-happen.

14 *Covid-19 Dashboard by the Centre for Systems Science and Engineering at Johns Hopkins University,* Coronavirus Resource Centre, (May 14, 2020, 09:00AM), https://coronavirus.jhu.edu/map.html.

15 Stephen Hall, *This is how COVID-19 is affecting the world of sports,* World Economic Forum (April 9, 2020,09:00AM), https://www.weforum.org/agenda/2020/04/sports-covid19-coronavirus-excersise-specators-media-coverage/.

16 *Trade set to plunge as COVID-19 pandemic upends global economy,* World Trade Organization (April 8, 2020, 09:00PM), https://www.wto.org/english/news_e/pres20_e/pr855_e.htm.

17 Sandhya Sharma, *Coronavirus is a bio-weapon experiment gone wrong, suspect global experts,* ET Prime (February 11, 2020,09:00PM), https://prime.economictimes.indiatimes.com/news/74068009/economy-and-policy/coronavirus-is-a-bio-weapon-experiment-gone-wrong-suspect-global-experts%20dated%20February%2011,%202020;%20https://www.news18.com/news/opinion/biological-weapons-and-biosecurity-lessons-from-the-covid-19-war-2615103.html; *$20 trillion lawsuit in US against.*

18 Dr. Adish C Aggarwala, *Complaint to the United Nations Human Rights Council, Geneva* (April 3, 2020,09:00AM), https://www.livelaw.in/pdf_upload/pdf_upload-372096.pdf.

the International Council of Jurists and All India Bar Association for the violations of International Human Rights and Serious Violations of International Humanitarian Laws. The complaint places its focus on the conjecture that COVID-19 is a carefully assembled biological weapon, aimed at crippling major countries in the world leaving only China as the beneficiary.[19] Moreover, on April 21 2020, a petition against the People's Republic of China for using the biological weapon was filed by the Attorney-General of the State of Missouri in the United States District Court for the Eastern District of Missouri Southeastern Division.[20]

Further analysis of this accusation and the relevance of the BWC forms the crux of this paper. It has been broadly divided into four parts- the history and status quo of the BWC, the legal lacunae and loopholes that persist within the BWC, past-allegations of non-compliance, and suggested solutions and changes which could be incorporated by the BWC.

History and Status of the Biological Weapons Convention

The usage of biology for the advancement of weapons made for hostile purposes or armed conflict was discovered by mankind many years ago, as early as the 12th century AD. Biological toxins have historically been used as destructive forces against armies as can be seen in instances such as of the year 1155 when the Roman Empire used human bodies to poison water wells in Italy during the battle of Tortona, 1495 when the Spaniards mixed wine with the blood of patients suffering from leprosy to sell to their French enemies, or more recently in 1863 when Confederates, or British forces, sold clothes of patients suffering from yellow fever and smallpox to troops in the United States.[21] In modern times, during the first World War, many countries initiated the development of biological weapons on a military scale, and allegations were made that Germany infected horses that were being shipped to the Allied powers with anthrax or glanders, thereby making use of biological toxins.[22]

19 Dr. Adish C Aggarwala, *Complaint to the United Nations Human Rights Council, Geneva* para 5, p. 25 (April 3, 2020,11:00 AM), https://www.livelaw.in/pdf_upload/pdf_upload-372096.pdf.

20 The State of Missouri v. The People's Republic of China, 1:20-cv-00099-SNLJ, (Jun. 19, 2020, 09:00AM), https://www.courthousenews.com/wp-content/uploads/2020/04/missouri-china.pdf.

21 Stefan Riedal, *Biological Warfare and Bioterrorism: A Historical View*, National Center for Biotechnology Information, (Jun. 19, 2020, 09:00 AM), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1200679/.

22 Jamie Bisher, *Anthrax sabotage in Finland or Baron Von Rosen's sugar-coated anthrax weapon,* Military History, (Jun. 19, 2020, 09:00 AM), http://www.geocities.ws/jamie_bisher/anthrax.htm.

Subsequently, the dangers of using biological weapons became abundantly clear to the international community. In order to ameliorate the situation, the League of Nations drew up a protocol that prohibited the use of chemical and biological weapons in warfare, and it was signed by member States at a conference held in Geneva in 1925. Being brought into force in 1928, it came to be called the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare[23], or more commonly, the Geneva Protocol. However, the shortcomings of the Protocol were inescapable as many countries, especially the major powers such as the United Kingdom, France, and the Soviet Union, reserved the right to legally use such weapons in retaliation.[24] Further, there was no mention of the production or storage of such weapons in the Protocol, thereby allowing countries to accumulate large quantities of biological and chemical agents.

The adoption of the Geneva Protocol did not prevent the usage of biological weapons, examples being the second World War and the Vietnam war. There was a need for a more definitive convention that had to be adopted and implemented, and in hopes of the same, the United Nations started working towards the disarmament of biological weapons. Initially, most nations were unwelcoming of this suggestion, but this position was drastically altered once the then President of the United States, Richard Nixon, announced his support for renunciation of biological weapons.[25]

At the very onset, the BWC specifies in its preamble that it finds its foundation in the Geneva Protocol and adheres to all its principle and objectives. The essence of the convention is the prohibition of the storage, development, or usage of any biological weapons or toxins for hostile purposes or armed conflict.[26] It places a positive obligation of due diligence on each member State to prohibit and prevent the development of such weapons in their territory or area of jurisdiction[27], further iterating that no member State shall in any way assist or induce another State to acquire any biological toxins, weapons or the equipment thereof.[28] The BWC envisages a world free of biological weapons and therefore stipulates that all

23 Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare, June 17, 1925, 94 L.N.T.S. 65.

24 Julian Perry Robinson, Public Health Response to Biological and Chemical Weapons 110, World Health Organization (2d ed. 2004).

25 Jonathan B. Tucker and Erin R. Mahan, President Nixon's Decision to Renounce the U.S. Offensive Biological Weapons Program (National Defence University Press, 2009).

26 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Art. 1 (1972), 1015 U.N.T.S. 163.

27 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Art. 4 (1972), 1015 U.N.T.S. 163.

28 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Art. 3 (1972), 1015 U.N.T.S. 163.

existing biological weapons, toxins, or equipment must be destroyed or diverted to peaceful purposes within nine months of it being brought to force.[29] There is also an undertaking of cooperation that exists among the states to ensure the application of the stipulations of the convention.[30]

It must be acknowledged with due care that this prohibition on the usage of biological weapons is not absolute; it is only for purposes that are not prophylactic, peaceful, or protective.[31] In fact, the convention urges all Member States to participate in the fullest exchange of research and knowledge to develop themselves in the field of biology. It clarifies that there is no intention to hamper any technological or economic developments arising from research in this field.[32]

Finally, it asserts that any complaint one member State has with another regarding breach of obligations of the convention can be addressed to the Security Council of the United Nations. Upon consideration, it may investigate the matter further.[33]

This convention, like most international treaties, relies hugely on State cooperation and confidence-building. In order to pursue the successful implementation of the convention, the member States hold review conferences every five years to discuss developments in the implementation of the stipulations as well as future plans and endeavours of the countries. Implementation Support Units (hereinafter ISUs) were established in the sixth review conference for administrative support and assistance as well as the national implementation of the BWC.[34] There have been eight review conferences so far, the most recent one being held in 2016,[35] the results of which found most state parties disappointed as there was minimal consensus amongst the members. Therefore, despite the presence of a Final Document that commanded agreement of all members, the text of the same was barely different from the same of the seventh review conference.

29 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Art. 2 (1972), 1015 U.N.T.S. 163.

30 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Art. 5 (1972), 1015 U.N.T.S. 163.

31 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, art. 1 (1972), 1015 U.N.T.S. 163.

32 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, art. 10 (1972), 1015 U.N.T.S. 163.

33 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, art. 6 (1972), 1015 U.N.T.S. 163.

34 *ISU,* Biological Weapons Convention, (Jun. 19, 2020, 09:00AM), https://bwc1972.org/home/the-biological-weapons-convention/isu/.

35 U.N. BWC, 8th Review Conference*,* U.N. Doc. BWC/CONF.VIII/4 (Jan. 11, 2017).

Despite the seemingly bleak future of the BWC, it has suddenly emerged as a convention of immense relevance and deliberation following the allegations of its violation by China. The conjecture that the coronavirus was manufactured by laboratories in China intentionally is a clear violation of the very essence of this convention. However, it has been maintained by China consistently, as by all other countries faced with similar allegations in the past, that its laboratories dedicated to biological research are only for peaceful developmental purposes.[36] Whether or not the allegations against China have any veracity is beyond the scope of this article, however, the extent of the legal lacunae that plagues the BWC has been explored extensively and is discussed in the next part.

Legal Lacunae and Loopholes of the BWC

The BWC is undeniably a crucial step that the international community has taken towards disarmament. It is a specialization of the text of the Geneva Convention and highlights that chemical and biological weapons ought to be differentiated in order to truly achieve complete weapons reduction. However, there are certain shortcomings of the Convention which act as barriers in allowing it to reach its full potential.

The first major impediment in the BWC is incontrovertibly evident in the very first article itself. The article states that "*each State Party to this Convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain microbial or other biological agents, toxins, weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict*".[37] It seems to be a forthright article, however, there is no clear definition of "weapons, equipments or means of delivery" that has been agreed upon by the State parties.[38] Biological weapons had been defined as those the design of which indicated that they could have no other use than for hostile purposes, or that they were specifically intended to be used for such purposes.[39] Initially, Switzerland, stating that since there is no clear definition provided by the convention, held the right to determine for itself what would constitute a biological weapon.[40] The explanation offered by Switzerland was that since there are hardly any

36 *Biotechnology in China,* National Center for Biotechnology Information, (Jun. 19, 2020, 09:00AM), https://www.ncbi.nlm.nih.gov/books/NBK236101/

37 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Art. 1 (1972), 1015 U.N.T.S. 163.

38 Julian Perry Robinson, Public Health Response to Biological and Chemical Weapons 110, World Health Organization (2d ed. 2004).

39 *Documents on Disarmament*, United States Arms Control and Disarmament Agency (1970).

40 *Switzerand: Ratification of Biological Weapons Convention,* United Nations Office for Disarmament Affairs, (Jun. 19, 2020, 09:00AM), http://disarmament.un.org/treaties/a/bwc/switzerland/rat/washington.

weapons which are peculiar to being used only for hostile purposes, it ought to decide for it what auxiliary means fall within that definition.[41] The United States of America, albeit agreeing to the limitation of this definition, objected to this reservation and maintained that a country must not unilaterally reserve with itself the right to determine what constitutes a weapon as that undermines the very essence and authority of the BWC.[42] In today's rapidly developing world where new advancements in science and technology take place regularly, such a clear distinction between a weapon and machinery is difficult to observe. This has commonly been recognised as the 'dual-use dilemma', where the results of well-intentioned scientific research can be used for both good and harmful purposes. There is no black and white differentiation, and the BWC has no clear definition of what constitutes 'weapons, equipment, or means of delivery' to navigate this grey area. Hence, its stipulations are always at risk of being subverted.

Secondly, another glaring limitation present in the first article is the specification of the prohibition of only those biological weapons which use toxins or agents for hostile purposes or armed conflict. The convention explicitly allows the use of biological toxins or agents for peaceful, prophylactic, and protective purposes.[43] While ipso facto this seems to be a straightforward stipulation, it is perhaps the most controversial article of the Convention. In research facilities, in the initial stages of research and development, and perhaps even later, it is difficult to stratify the research into hostile and peaceful slots. Just as to manufacture an antidote one must deal with the toxin that would develop the antibodies required for such a cure[44], for developing vaccines, protective equipment, and other prophylactic research, a laboratory will have to host the biological toxin in question. Thus, the difficulty here arises in ascertaining the intention of the member State while handling these biological toxins and agents. This could have been solved by appropriate measures of verification of such intentions coupled with accountability for the same, however, attempts towards the same have so far been unsuccessful.

The third Review Conference of the BWC had tasked a group of experts called VEREX (verification experts) to discuss potential measures of verification to determine the purpose of research as well as the adherence to the Convention by the State Parties.[45] Based on the

41 *Switzerand: Ratification of Biological Weapons Convention,* United Nations Office for Disarmament Affairs, (Jun. 19, 2020, 09:00 AM, http://disarmament.un.org/treaties/a/bwc/switzerland/rat/washington.

42 *Documents on Disarmament*, United States Arms Control and Disarmament Agency (1970).

43 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Art. 1 (1972), 1015 U.N.T.S. 163.

44 *International Programme on Chemical Safety,* World Health Organization, (March 13, 2020, 11:00 AM), https://www.who.int/ipcs/publications/training_poisons/guidelines_poison_control/en/index7.html

45 U.N. BWC, 3rd Review Conference, U.N. Doc. BWC/CONF.III/23 (Sept. 27, 1991).

report of this group, an Ad-Hoc group was established to create a legally binding protocol regarding verification to strengthen the Convention.[46] However, the recommendations of this ad-hoc group were never adopted due to differences between the member States.[47] Currently, no binding verification mechanism exists to ensure compliance with the Convention.

An Accountability Framework for the BWC reporting on national compliance to the Review Conferences was initiated in the First Review Conference itself, however, government reports remained unsystematic and lacked uniformity and compliance. In 2006, there were only 22 national reports to the Sixth Review Conference from among 155 States Parties.[48] The BWC has no stipulation which obliges the Member States to declare the possession of such banned weapons, the laboratories engaged in research and development surrounding biological agents which could be used for hostile purposes, or the usage of biological agents in non-prohibited activities. There is no limitation to the quantity or type of toxins that are permissible as per the Convention. Further, no external organisation outside the framework of the BWC has the legal authority to implement any verification mechanism. This essentially serves the member States with a carte blanche with no accountability, where submitting themselves to the inspection of the BWC is merely voluntary.

Thirdly, the nebulous line that divides research for peaceful and hostile purposes also infests as a problem while reading Article 3 of the BWC in consonance with Article 10. Article 3 states that each State Party to this Convention undertakes not in any way to assist any State in manufacturing or otherwise acquiring any of the agents, toxins, weapons, equipment or means of delivery specified in Article I of the Convention.[49] Further, Article 10 states that the States Parties to this Convention undertake to facilitate and have the right to participate in the fullest possible exchange of equipment, materials and scientific and technological information for the use of biological agents and toxins for peaceful purposes in order to avoid hampering the economic or technological development of States Parties to the Convention.[50] Firstly, without a clear and uniform understanding of what constitutes a 'hostile purpose', these articles regrettably act as contrary forces. Most machines and equipment using biological toxins, or even otherwise, are not exclusive in their usage; as

46 *Press Release DC/2688*, United Nations Media Coverage and Press Releases (March 13, 2020, 11:00AM), https://www.un.org/press/en/2000/20000313.dc2688.doc.html.

47 The Biological Weapons Convention: An Introduction, United Nations Publication 22-23 (2017).

48 Nicholas A. Sims Et Al., An Accountability Framework of the BWC 4 (2010).

49 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, art. 3 (1972), 1015 U.N.T.S. 163.

50 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, art. 10 (1972), 1015 U.N.T.S. 163.

such, they can be weaponised. Since the BWC's *raison d'être* is disarmament, co-operation in the exchange of biological agents is hard to accommodate without leaving room for misuse. Secondly, Article 10 promotes co-operation in exchange for technology which has led to a significant technological gap between the developed and developing countries as most developed countries exchange information without accommodating other countries which are behind in technological developments, as was acknowledged by the Member States in the Fourth Review Conference of the BWC.[51] This has hampered economic growth in developing countries, contrary to its intention.

The fourth shortcoming presents itself in the observation that countries are often reluctant to disclose information regarding their military facilities. Their own plans and actions are 'information' and those of another state is 'propaganda'.[52] This resistance in co-operation might stem from international politics, but it creates a perplexity with regard to the BWC as it is dependent on confidence and meaningful co-operation amongst the member States for successful implementation. The secrecy surrounding biological research could create suspicions and lead to allegations of breaches. Further, in order to get ahead in the arms race, countries might act on those suspicions, true or not, and embark on their defensive, or offensive, weapons programmes.

The fifth problem is the complaint mechanism as stipulated in the Convention. The BWC provides for a complaint mechanism in case the aforementioned allegations do arise. Article 5 of the BWC provides that the state parties may consult each other to solve any problem in relation to the objective of the BWC.[53] Article 6 of the BWC states that any State Party to this Convention which finds that another State Party is acting in breach of obligations may lodge a complaint with the Security Council or the Secretary-General[54] of the United Nations, which, based on the evidence provided by the complainant, it may take into consideration for further investigation.[55] However, due to the secrecy surrounding such research discussed above, it is very difficult for a member State to gather such information which has enough force for the UNSC to initiate investigations. Nonetheless, there is no instance when parties have used the procedure prescribed under Article 6 of the BWC. This

51 U.N. BWC, 4th Review Conference, U.N. Doc. BWC/CONF.IV/9 (Dec. 6, 1996).

52 Jeff Gerth, *Military's Information War is Vast and Often Secretive,* The New York Times (Jun.11, 2020,11:00AM), https://www.nytimes.com/2005/12/11/politics/militarys-information-war-is-vast-and-often-secretive.html.

53 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Art. 5 (1972), 1015 U.N.T.S. 163.

54 U.N. BWC, 3rd Review Conference, U.N. Doc. BWC/CONF.III/23 (Sept. 27, 1991).

55 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Art. 6 (1972), 1015 U.N.T.S. 163.

may be because of its highly political nature of formally accusing another State Party of non-compliance. Further, if any allegations are against the permanent members of the Council, which is a probable condition considering they are leading powers in technological and military advancements, they can veto any investigation which may have been conducted.[56] Additionally, there has been no punishment specified in the stipulations of the BWC which may be accorded to defaulting parties. Another forum for addressing such complaints can be the International Court of Justice.[57] However, member states often have reservations to their declarations to the ICJ limiting its authority and jurisdiction on certain matters[58], thereby often rendering this topic of investigation out of bounds.

The sixth and final issue that cripples the BWC has been the lack of available funds for its functioning and the negligence and lack of assistance of Member States in this regard. In the 2018 Meeting of the State Parties, it was affirmed that "the financial problems encountered by the BWC result from: (a) Structural non-payment, which is a persistent pattern of non-payment of contributions within the calendar year, creating a consistent deficit in the revenues available for the work of the intersessional programme as well as accumulated debts currently in excess of $130,000; (b) Delayed payment, which is a payment within the budget year, but later than the thirty days expected upon receipt of the invoice, such that funds may not be available at the time they are required; (c) Inadequacy in applying the Financial Regulations and Rules of the United Nations to the agreed programme of work of the BWC, in light of the requirement that full funding is on hand before staff contracts are signed or meetings are held and thus have led to difficulties in extending ISU contracts, as well as to cancelling (or reducing) meetings agreed in the intersessional programme"[59]. Further, in 2016, the Implementation Support Unit of the BWC distributed a document prepared by the Financial Resources Management Service (FRMS) of the United Nations which states that 62% of the State Parties owed a total of US$ 96,519 to the Convention between 2001-16 only.[60] This has significantly hampered the effective implementation of the BWC, as well as the smooth functioning of the ISU and convening of meetings in the future.

56 UN Charter, Art. 27 (1945), 557 U.N.T.S. 143.

57 ICJ Statute, Art. 36 & 40 (1945), 33 U.N.T.S. 993.

58 ICJ Statute, Art. 36 (1945), 33 U.N.T.S. 993.

59 U.N. BWC, Elements of a Decision on Measures to address the Financial Predictability and Sustainability of the Convention, U.N. Doc. BWC/MSP/2018/CRP. 1 (Dec. 4, 2018).

60 Kathryn Millett, Financial Woes Spell Trouble for the Biological Weapons Convention, in Health Security Vol. 15 (2017).

Allegations of Non-Compliance

Ever since its implementation, there have been many instances of allegations of non-compliance with the BWC. At several review conferences, States Parties have openly accused others of violating the provisions of the BWC. For instance, during the Third Review Conference, in 1991, Australia, the United Kingdom, and the United States blamed the Soviet Union for manufacturing biological weapons,[61] and at the principal meeting of the Fifth Review Conference,[62] in 2001, the United States made claims against four States Parties, namely Iraq, Iran, North Korea, and Libya for violating the BWC. Discussed further are those cases which have received the most attention amongst such allegations.

The Sverdlovsk Case

In the year 1980, an accusation against the Soviet Union for maintaining an offensive biological weapons programme which included production, weaponization, and stockpiling of biological warfare agents was made by the United States of America.[63] An airborne release of anthrax spores from a Soviet biological facility, which caused an outbreak of anthrax in the city of Sverdlovsk in 1979,[64] was considered to be the basis of this accusation. The Soviet Union attributed the breakout of this infection to the sale of anthrax-contaminated meat in violation of veterinary regulations.[65] Interestingly, this incident is eerily similar to the current case of the spread of the coronavirus. Subsequently, various meetings of scientists from all over the world were held to evaluate the Soviet account of the incident, but to no avail.[66] Finally, in 1992, after the internal disintegration of the Union of Soviet Socialist Republic,[67] the Russian authorities admitted that a breach of the BWC had been committed.[68]

61 U.N. BWC, 3rd Review Conference, U.N. Doc. BWC/CONF.III/23 (Sept. 27, 1991).

62 U.N. BWC, 5th Review Conference, U.N. Doc. BWC/CONF.V/17 (Nov. 22, 2002).

63 *Keeping an eye on Russia,* The New York Times Magazine, (Jun. 09,2020,09:00AM), https://www.nytimes.com/1981/11/29/magazine/keeping-an-eye-on-russia.html.

64 *Soviet City exposed to Lethal Germs*, The Kansas City Times p. A2 (March 19, 1980).

65 *Anthrax in Humans and Animals,* World Health Organization (4d ed. 2008); U.N. BWC, 1st Review Conference, U.N. Doc. BWC/CONF.I/SR.12 (Mar. 25, 1980).

66 Robert Lee Hotz, *Anthrax Deaths Tied to Soviet Lab: Biological warfare: Finding by U.S., Russian researchers raises possibility that international treaty was broken in 1979 outbreak that killed 68 people,* The Los Angeles Times, (Jun. 09,2020,09:00AM), https://www.latimes.com/archives/la-xpm-1994-11-18-mn-64333-story.html.

67 *The Collapse of the Soviet Union,* Office of the Historian, (Jun. 09,2020,09:00AM), https://history.state.gov/milestones/1989-1992/collapse-soviet-union.

68 Jozef Goldblat, *The Biological Weapons Convention-An Overview,* International Committee of the Red Cross (Jun. 09,2020,09:00AM), https://www.icrc.org/en/doc/resources/documents/article/other/57jnpa.htm.

The "Yellow Rain" Case

In 1981, the Soviet Union was again accused of violating both the Geneva Protocol and the BWC by the US government.[69] The accusation was based on the production, transfer, and use of Trichothecene Mycotoxins (a group of toxins).[70] The Soviet Union unequivocally rejected the allegation. US charges were based on observers who reported that an adversary airplane had been showering a toxic yellow material on fields. The USA used several reports from chemical laboratories to substantiate their case. However, the veracity of the proof was increasingly questioned[71] as broad systematic endeavours in a few labs neglected to affirm the initial positive reports of Trichothecenes.[72]

The Cuban Allegation

In 1997, the United States of America was accused by Cuba for committing biological aggression.[73] Cuba alleged that an American crop-spraying plane was witnessed releasing an unknown mist into the air.[74] A few months later, the Cuban National Pest Control Center discovered Thrips palmi, a bug that feeds on many agriculturally important crops, for the first time in Cuba.[75] The Cuban government requested an investigation under Article 5 of the BWC. After inspecting the proof from the two nations, States Parties submitted reports to the Chairman of their meeting. Of the 12 States Parties that made entries, 9 commented that the data didn't bolster the Cuban charges and 2 (China and Vietnam) said that no concrete conclusion could be drawn.[76]

Iraq Accusation

In the year 2002, the USA and the UK accused Iraq of non-compliance of the BWC.[77] Iraq

69 US Department of State, Press Release (Sept. 13, 1981)

70 US Department of State, Press Release (Sept. 13, 1981)

71 U.N. GAOR, 37th Sess., UN Doc. A/37/259 (Dec. 1, 1982); U.N. GAOR, 36th Sess., UN Doc. A 36 613 (Nov. 20, 1981).

72 J.P. Robinson Et Al, Yellow Rain in Southeast Asia: The Story Collapses, MIT Press, Cambridge Mass. (1990).

73 Jenni Rissanen, *The Biological Weapons Convention,* Nuclear Threat Initiative (Mar. 1, 2020, 09:00AM), https://www.nti.org/analysis/articles/biological-weapons-convention/.

74 Jenni Rissanen, *The Biological Weapons Convention,* Nuclear Threat Initiative (Mar. 1, 2020, 09:00AM), https://www.nti.org/analysis/articles/biological-weapons-convention/.

75 Jenni Rissanen, *The Biological Weapons Convention,* Nuclear Threat Initiative (Mar. 1, 2020,09:30AM), https://www.nti.org/analysis/articles/biological-weapons-convention/.

76 Raymond Zilinskas, Cuban Allegations of Biological Warfare by the United States: Assessing the Evidence, in Critical Reviews in Microbiology 173-227 (2008).

77 Erhard Geissler, Chemical and Biological Warfare and Arms Control Developments, in SIPRI Yearbook: World Armaments and Disarmament (Oxford University Press, 1992)

became a member of BWC in the year 1991[78] when it also agreed to disclose information of all of its weapons of mass destruction and undertook to destroy them.[79] The UNSC created a body called UNSCOM[80] to review Iraq's chemical, biological, and missile abilities and accommodate their annihilation. It was revealed that Iraq's biological weapons program produced anthrax bacteria, ricin, botulinum toxin, aflatoxin, and wheat cover smut fungus.[81] Iraq professes to have finished its natural weapons program in 1991, but it is generally accepted that Iraq kept up the program all through the 1990s. These convictions are substantiated by Iraqi attempts to hide its program from UNSCOM overseers. In 1998, Iraq suspended collaboration with UNSCOM leaving numerous issues unanswered.[82] The gathering was disbanded and supplanted with the UN Monitoring, Verification, and Inspection Commission (UNMOVIC).[83] On November 8, 2002, the UNSC adopted Resolution 1441 expecting Iraq to allow unlimited access to UNMOVIC controllers. However, Iraq has neglected to reveal numerous subtleties of its biological weapons program to UNMOVIC.[84]

These cases further go on to prove that despite actions and evidence pointing to violation of the Convention, it has proved difficult for State Parties to actively use the Convention to prohibit such acts. This is substantiated by the fact that the complaint mechanism of the BWC has never been invoked so far.[85] This is indicative of the assertion that the BWC ought to incorporate a few changes and solutions in order to further its goal of complete disarmament.

Improving The BWC

In pursuance of the previously discussed shortcomings of the BWC, certain alterations and additions to the Convention may go a long way in improving its implementation and efficiency.

78 *Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction*, United Nations Office for Disarmament Affairs.

79 S.C. Res. 687 (April 8, 1991).

80 S.C. Res. 687 (April 8, 1991).

81 John Pike, *Biological Weapons Program: History,* Webmaster (Nov. 3, 1998), https://fas.org/nuke/guide/iraq/bw/program.htm.

82 *Collapse of Iraq-UNSCOM Relations*, Disarmament Diplomacy, (Mar. 21, 2020, 09:00AM), http://www.acronym.org.uk/old/archive/20iraq.htm.

83 S.C. Res. 1284 (Dec. 17, 1999).

84 *Press Release SC/7664,* United Nations Meetings Coverage and Press Releases (Feb. 14, 2020, 11:00PM), https://www.un.org/press/en/2003/sc7664.doc.htm.

85 Wanda Archy, *The Biological Weapons Convention (BWC) at a Glance,* Arms Control Association (Mar. 13, 2020, 09:00AM), https://www.armscontrol.org/factsheets/bwc.

> "*Endogenous reinforcement can be intelligently steered, in such a way as to put flesh on the bare bones of the BWC, and to do so with a care for internal balance so that all its sectors move forward together. Its sectors include a regime of compliance, a regime of development, a regime of permanence, and a prospective regime of research.*"[86]

The most limiting barrier in the effective execution of the stipulations of the BWC is the lack of a clear distinction between peaceful and hostile purposes of biological agents or toxins. This ambiguity is justified due to the nature of research that goes into the development of biology-related technology. Therefore, for the BWC to be successful in preventing the development and usage of toxins for hostile purposes, a verification mechanism can be established which confirms compliance with the Convention and monitors the nature of research taking place in member States. Inspiration may be taken from the establishment of the IAEA (International Atomic Energy Agency) that verifies whether a State is living up to its international commitments to not use nuclear programmes for nuclear-weapons purposes.[87] Treaties concerned with non-proliferation, such as the NPT (The Treaty on the Non-Proliferation of Nuclear Weapons), entrust the IAEA as their nuclear inspectorate.[88] It has been granted extensive powers and authority through the Additional Protocol to the safeguards agreement which enhances its abilities of verification.[89] A similar Agency or organization which ensures the implementation of the BWC by conducting safeguard activities such as verification of reports submitted by State Parties, scheduled and unscheduled on-site inspections of facilities, laboratories or other locations containing biological toxins and equipment, verification of biological material inventory, surveillance measures, etc. will significantly increase the compliance of State Parties to the Convention and eventually play a role in building confidence amongst them by lifting the veil of secrecy.

The problem of the lack of accountability can be approached keeping in mind the Canadian proposal of an Accountability Framework at the Sixth Review Conference of the BWC.[90] An annual meeting of the State Parties of the BWC can be conducted where the focus would be on a State's accountability of its biological research and development to other States. Each State Party would report its actions towards the fulfilment of the stipulations of the BWC, article by article. This would ensure that the structure of the Framework

86 Nicholas A. Sims Et Al., An Accountability Framework of the BWC 200 (2010).

87 Statute of the International Atomic Energy Agency, Art. 2 (1957), 276 U.N.T.S. 3.

88 *IAEA Safeguards Overview: Comprehensive Safeguards Agreements and Additional Protocols,* IAEA, (Feb. 14, 2020, 11:00PM), https://www.iaea.org/publications/factsheets/iaea-safeguards-overview.

89 *Additional Protocol,* IAEA, (Feb. 14, 2020, 11:00PM), https://www.iaea.org/topics/additional-protocol.

90 Nicholas A. Sims Et Al., An Accountability Framework of the BWC 200 (2010).

would already be known to the members. To enforce a sense of uniformity, a general list of questions and criteria may be provided based on which the members can proceed with their reports.

The difficulty in observing Articles 3 and 10 of the BWC conjointly can also be solved if, in a meeting such as this, any exchange of biological research, equipment, or agents and toxins of a significant decided quantity is declared. This declaration could be substantiated by a report of its nature and usage by the receiving country. This would ensure that such exchange is accounted for and is solely being used for peaceful purposes and economic and technological development. This meeting need not be annual, but the essence is regularity.

While a meeting such as the one discussed above may go a long way in increasing transparency, other forms of Confidence Building Measures (hereinafter CBMs) can be adopted to increase trust and allay insecurity amongst member States. CBMs are agreements between parties for the exchange of information regarding military and security activities along with verification.[91] Keeping the BWC in mind, these measures could include prenotifications of tests conducted for biological equipments, joint training programmes fostering biological research and development, exchange programmes for sharing such research, on-site visits by officials, etc. These measures will ensure that usual developmental activities aren't mistaken for being hostile and thereby reduce suspicions.

The complications in the complaint mechanism pose a menace to the foremost purpose of minimizing the use of Biological Weapons. A remedy to this predicament could be a modified version of the remedy used by the IAEA. In the IAEA, a separate organ deals with the investigation of complaints of non-compliance; when this organ finds some violation by a state party, then it may refer the matter to the UNSC.[92] The proposal here is that a new representative body of state parties should be established, like the one in IAEA rather than the United Nations, having the sole authority to deal with the investigation of matters of non-compliance. In adjudging complaints of violations of the BWC, the newly established representative body of the state parties should play the primary role in doing the investigation, when this body finds a violation then it must report it to the UNSC, which shall further take suggestions of the representative body whilst making a decision. Additionally, following an already proposed suggestion during initial negotiations,[93] the

91 Simon JA Mason & Matthias Siegfried, Confidence-Building Measures in Peace Processes, in Managing Peace Processes: A Handbook for AU Practitioners, Vol. 1 57-77 (African Union and the Centre for Humanitarian Dialogue, 2013).

92 Laura Rockwood, Legal Framework for IAEA Frameworks (IAEA Library, 2013).

93 The Biological Weapons Convention: An Introduction, United Nations Publication (2017).

permanent members of the UNSC should waive their right to veto with regards to matters or resolutions related to investigations of complaints.[94] This suggestion would also facilitate in upholding the principle of natural justice *nemo judex in causa sua*.[95] No specification of punishment for violation of provisions of BWC is also a major concern. As William Blackstone said, "*It is a settled and invariable principle of law, that every right when withheld must have a remedy*".[96] As we have already suggested the relegation of the UNSC from its status as the primary investigation authority in cases related to the BWC, thus we propose an alternative way for punishing the responsible state; reparations[97] in the form of restitution,[98] compensation,[99] and satisfaction[100] must be demanded from the responsible state under the Responsibility of States for Internationally Wrongfully Acts (ARSIWA).

Finally, every organization needs financial adequacy to manage its functions. The lack of funds[101] has been the least addressed issue in BWC's review conferences since its inception.[102] The measures to ameliorate the financial sustainability of the Convention ought to be urgently addressed. These could involve asking the UNODA to send invoices to the state parties at earliest and asking them to pay their past evaluated contributions without further delay. Additionally, creating a contingency fund of 10% to the cost estimates for a year would facilitate in meeting the unforeseeable requirements.[103] Moreover, a mechanism for enhancing liquidity within a budget year would succour; a reserve fund, financed by voluntary contributions should be created to serve this purpose. This reserve fund should focus on generating contribution amounting to at least 50% of the expected annual expenditure;[104] it shall be utilized as a method for financing costs of mandated exercises.

94 *Press Release GA/12091,* United Nations Meetings Coverage and Press Releases (Mar. 20, 2020,09:00AM), https://www.un.org/press/en/2018/ga12091.doc.htm; Gareth Evans, *Should the UN Security Veto be Limited?,* World Economic Forum (Feb. 5, 2020,08:00AM), https://www.weforum.org/agenda/2015/02/should-the-un-security-council-veto-be-limited/.

95 Adrian Vermeule, *Contra Nemo ludex in Sua Causa: The Limits of Impartiality*, 384 - 420 Yale L.J. (2012).

96 William Blackstone, *Commentaries on the Laws of England* 23 (1765).

97 Responsibility of States for Internationally Wrongful Acts, Art. 34 (2001).

98 Responsibility of States for Internationally Wrongful Acts, Art. 35 (2001).

99 Responsibility of States for Internationally Wrongful Acts, Art. 36 (2001).

100 Responsibility of States for Internationally Wrongful Acts, Art. 37 (2001).

101 Jenifer Mackby, *BWC Meeting Stumbles over Money, Politics,* Arms Control Association (Feb.11, 2019,11:00AM), https://www.armscontrol.org/act/2019-01/news/bwc-meeting-stumbles-over-money-politics.

102 Prevention, Response and Recovery, in Countering Bioterrorism: The Role of Science and Technology (Institute of Medicine and National Research Council, 2002).

103 U.N. BWC, Elements of a Decision on Measures to address the Financial Predictability and Sustainability of the Convention, U.N. Doc. BWC/MSP/2018/CRP. 1 (Dec. 4, 2018).

104 U.N. BWC, Elements of a Decision on Measures to address the Financial Predictability and Sustainability

In furtherance, a firm budget should be created. Proper accounting of financial documents should take place every year. Furthermore, it is proposed that careful consideration should be given to the arrears of a particular State Party before electing its citizen as an officeholder under the BWC. All the non-state parties that attend a BWC meeting should be asked to pay a certain amount of contribution in respect of the meeting attended. At the very least, the financial condition of the BWC should be an agenda in upcoming BWC meetings and conferences.

Conclusion

Conventions and Protocols play a large role in ensuring peace and stability globally. Each State voluntarily accepts a Convention and the text of the same is also decided based on the consent of the member States.[105] This requires cooperation and trust, both of which are severely hampered if feelings of suspicions infest within international relations. Additionally, wars have historically been a recurring hurdle that societies have had to face, and often they have had catastrophic results on civilians due to the usage of certain inhumane weapons. Biological weapons are a dangerous and intractable form of weapons and can destroy societies with ease if not eliminated. Therefore, a Convention such as the BWC potentially acts as a source of trust and cooperation and a barrier between humanity and a dystopian society; its goals of the elimination of biological weapons are essential for the survival of mankind. The suggestions contained in this paper are a glimpse of how the Convention can serve its purpose to its fullest.

As for the question of China and the allegations posed against it; if such allegations are true, then China would have violated the BWC. If China has manufactured the virus as a biological weapon[106], it is a direct violation of Article 1 of the Convention which prohibits the development and usage of biological toxins for hostile purposes. Further, even if China claims that in such a circumstance there was no government involvement, the mere presence of such a BW programme within their territory would constitute a violation of the duty of due diligence stipulated under Article 4 of the Convention. However, due to the shortcomings of the BWC, prima facie it cannot be conclusively held whether there was a violation of the BWC or not. China, like all accused countries, will maintain that any and all biological laboratories are only used for peaceful and developmental purposes. Due to

of the Convention, U.N. Doc. BWC/MSP/2018/CRP. 1 (Dec. 4, 2018).

105 Vienna Convention on the Law of Treaties, Art. 9 (1969), 1155 U.N.T.S. 331.

106 Dr. Adish C Aggarwala, *Complaint to the United Nations Human Rights Council, Geneva* para 5, p. 25 (April 3, 2020,08:00AM), https://www.livelaw.in/pdf_upload/pdf_upload-372096.pdf.

the barriers of secrecy, lack of evidence, lack of proper definition of what could constitute a biological weapon, no obligations to declare biological research and development, and no verification mechanisms, the veracity of either claim will be implausible to determine beyond doubt.

The BWC is in dire need of certain changes to improve its efficiency and validity, the most important of which is a verification mechanism that instills a sense of accountability in the State Parties. Each State ought to make collective efforts to build confidence and negate feelings of suspicion and secrecy which are the main reasons behind the escalation of an international crisis. They must also bear the onus of financing the BWC more responsibly as it is a Convention that will only become more and more essential with developing technology and intelligence.

To ensure that no country, organization, or group of people use the loopholes in the BWC to cause harm to the society, and to ensure that in case of pandemics such as today's coronavirus, the trust and security amongst countries are not shattered, it is imperative that these inconsistencies be addressed and rectified. This will be the international community's quantum jump towards mankind.

MARITAL RAPE - NEED FOR ITS CRIMINALISATION IN INDIA

Manasvita Tejsi* and Mridull Thaplu**

Abstract

Matrimony is a sacred bond that ties two people, and two families, together. However, if this matrimony is without consent or the people involved in the marriage are not content, then it can turn sour. Our society is inclined towards a patriarchal system from the ancient times of hunting and gathering. So, it comes as a nature for men to display emotions of dominance. Looking around the globe, law and order has a huge role in prescribing and limiting standards for human conduct. Under the Indian Penal Code, 1860, the laws have been made and appropriate punishment for the same have been provided. Neverthess, what most of the people fail to comprehend is that these laws were made by the British a long time ago. At that time, Marital Rape was not considered a crime which can be one of the reasons why it was exempted under the penal laws. This research paper substantiates and focuses solely on evolution of the rights for women; mainly the effects of Marital Rape; and the reasons how it is in violation of the Constitution of India.

Keywords: - Marital, Rape, Woman, Section 375, Dowry, Harassment, Legality, Domestic Violence, Wife

INTRODUCTION

For a long time, people believed that a woman's duty in her married life is to look after her husband, bear children, take care of household matters, cook and provide emotional and sexual needs to her husband. This was first noted in Manusmriti which is considered to be an ancient legal text and has been used to formulate the Hindu Law.

imaṃ hi sarvavarṇānāṃ paśyanto dharmamuttamam |
yatante rakṣituṃ bhāryāṃ bhartāro durbalā api ||[1]

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1 GANGANATHA JHA, MANUSMRITI WITH THE COMMENTARY OF MEDHATITHI 9.6 (Vol. 2,

The same text states that it is the duty of a man to protect his wife, even if he is physically weak. This kind of stigma has been created by the society itself and men assume the role of dominance, sometimes taking it too far. The women were not given the status similar to that of their male counterparts and, before marriage, were considered the property of their fathers, and after their marriage, were considered the chattel of their husbands.[2] The father could wed off his daughter to whomsoever he deemed fit. The woman had to provide her husband with an offspring for continuation of the family line. If her husband could not provide her with an offspring, she had to get impregnated by her brother-in-law.[3] This made the woman believe that being sexually available to her husband and providing progenies was a necessity and her duty; she could never decline her husband's wishes.[4] Manusmriti contained all the laws and principles which were in the earliest days followed by the people of the subcontinent irrespective of their caste, creed or sex.

Women were considered to be the slave of man and the ill practices like Sati and child marriages were prevalent in the country but the situation in the country changed after the movement of Raja Ram Mohan Roy. Even Mahatma Gandhi took a great initiative to improve the social conditions of the women because it was the first time in the Indian Independence Struggle that women participated in the same and were at par with their male counterparts. The outcome of these very movements was a Constitution which gave equality to the women and almost all the rights that are given to the men; be it Right to Vote or Right to contest elections. Post-Independence, there were improvements and advancements in almost all the fields and focus on the life being given to woman could be made better. They were rather discriminated on the basis of their gender. The women have always fought for their rights and this was one of the main reasons why the status of women and men was equated in the Indian Constitution. There were many legislative reforms taken after the independence of the country to strengthen women and improve their status in the country so that no discrimination takes place with them. With the introduction of a Constitution, women have been granted equal social as well as political rights to that of men.

Women have been given the freedom and all the support from the constitution so that they can help in shaping the future of the country. The recent example of *Mangalyaan* is worth quoting because the whole team in the same consisted mostly of female scientists. Even though women have achieved great heights and are striving in almost all the fields whether it is education, law enforcement agencies or science and technology, there are many areas where our country lags behind.

University of Calcutta, 1920).

2 *Id.* at 9.3.

3 *Supra* note 1, at 9.59.

4 *Id.* at 5.154.

Marital Rape

Marital rape in layman's terms can be explained as a person having sexual intercourse with their spouse without their consent.

According to Section 375 of the Indian Penal Code –

> *"Rape means unlawful sexual intercourse or any other sexual penetration of the vagina, anus, or mouth of another person, with or without force, by a sex organ, other body part, or foreign object, without the consent of the victim."*[5]

However, there is an exception provided which says that if non-consensual sexual intercourse takes place between a married couple, in that case, it will not amount to rape[6]. Domestic violence refers to the violent or aggressive behaviour within the home which involves the violent abuse of a spouse or partner[7] which takes place with a woman because the husband in all the circumstances is powerful and most males comprehend that marriage gives them the right to have sexual intercourse with the wife at any point of time whether she is willing or not. This is the face of a patriarchal society; this act is detrimental to the institution of marriage. IPC, 1860 provides for rape and punishment for rape under section 375 and 376, respectively.

Marriage is a form of social bonding between both the spouses and everything in this institution needs to have the consent of both; Justice Ahmad in the case of *Bodhisattwa Gautam v. Subhra Chakraborty* said that this *"cruel act, in turn, destroys the entire psychology of a woman and pushes her into deep emotional crises"*[8].

Marital Rape is a crime in almost all the countries of the world wherein they have either made amendments to the existing law or added a new law for the same. Marital Rape has been criminalised in around 150 countries of the world wherein countries have brought amendments in their law for criminalising marital rape. In the United States, marital rape is a crime in all the 50 states whereas in the United Kingdom the maximum legal penalty for marital rape is life imprisonment. In countries like the United Kingdom[9], Fiji it was criminalised due to decision delivered by courts, in some countries like Brunei[10] the offence

5 Section 375, The Indian Penal Code, 1860, No. 45, Acts of Parliament, 1860.

6 Exception to Section 375, The Indian Penal Code, 1860, No. 45, Acts of Parliament, 1860.

7 Section 3, The Protection of Women from Domestic Violence Act, 2005, No. 43, Acts of Parliament, 2005 (India).

8 *Bodhisattwa Gautam v. Subhra Chakraborty,* (1996) 1 S.C.C. 490 (India).

9 *R. v. R,* [1992] 1 AC 599 (UK).

10 Section 375, Brunei's Penal Code.

is explicitly criminalised. In some countries like Bangladesh, India[11] the law for marital rape does not exist because women are considered the property of the husband and the state does not interfere in the institution of marriage.

Many legislations have been passed in the country to check violence towards the woman such as dowry, domestic violence or cruelty but amongst them is marital rape that has not yet been criminalized in the country. Marital Rape is inhumane and the woman knows that she has to live her whole life with the perpetrator which has a substandard physical and mental effect on her. It is a very under-reported crime in the country because most of these women know that going to the authorities will be futile as there are no laws for marital rape; they can also face social boycott.

In the 21st century, when society is well aware of their rights and needs, laws need to be amended. Indian Penal Code, 1860 provides that having sexual intercourse with a wife who is under 15 years of age, is a crime. However, there existed a loophole in this situation, According to the Prohibition of Child Marriage Act, 2006, In India, *child marriage* is only voidable and not void which means that it is not immediately illegal[12]. The minor party, when attains the age of major, can file for divorce within one year of attaining majority otherwise, the marriage is considered legal. But there existed a lacuna in the law under which there was no provision for men asking for consent with their wife aged 15-18 years, and this provided a window for husbands to have sexual intercourse with their wives till they reach the age of majority.

The Hon'ble Supreme Court in the case *Independent Thought v. Union of India*[13] raised the age of consent for marital sexual intercourse in the case of a minor wife to 18 years which was earlier 15 years for the Exception because it was violative of Fundamental Rights as well as provisions of the POCSO act of the minor wife thus amounting to discrimination between minor girls on their marital status. Though the Hon'ble bench did not comment anything on the issue of Marital Rape in a case where the age of wife is above 18 years and added that the issue presented before the court was only regarding the marital rape of a girl who is below 18 years of age and it should not be observed in any way for that of above 18 years. The court did not comment on the issue of "marital rape" where the victim is an adult wife, thus the main lacuna in the law still exists in the country.

However, Under the Protection of Women from Domestic Violence Act, 2005, the definition of domestic violence is given under Section 3(a) which says that *"harms or*

11 *Supra* note 6.

12 Section 3(a), The Prohibition of Child Marriage Act, 2006, No. 6, Acts of Parliament, 2007 (India).

13 *Independent Thought v. Union of India,* (2017) 10 S.C.C. 800.

injures or endangers the health, safety, life, limb or well-being, whether mental or physical, of the aggrieved person or tends to do so and includes causing physical abuse, sexual abuse, verbal and emotional abuse and economic abuse".[14] Sexual abuse mentioned under this definition includes any conduct of a sexual nature that abuses, humiliates, degrades or otherwise violates the dignity of woman[15], which in turn gives a chance to wives to initiate legal proceedings. The drawback of this act is that it is more civil in nature than criminal. It does not provide for a period of imprisonment. Rather it provides for compensation, monetary gain, restraining and protective orders.

Effects of Marital Rape

Marital Rape leaves scars in the life of a woman; they include physical, psychological and mental health issues which hurt the emotional as well as the physical wellbeing of the women in the long run. This section is widely bifurcated into psychological and health issues that a woman may encounter during or after rape.

Psychological Effects

Women who have had encounters relating to Marital rape have had cases of depression, PTSD, fear, self-esteem issues, rape trauma syndrome and also being sexually unstable, unavailable or dysfunctional.[16] As soon as a woman is married, she is expected to fulfil her husband's sexual desire. The first time any female must have experienced this, it must come as a shock to her that such a thing might be required without her consent. Any occurrences after that must seem dreadful but numb to her but she knows there is no use denying or not obeying her partner. The woman feels her family name will be tarnished. So, she feels this pressure to maintain her family's name.

Rape Trauma Syndrome is the medical term given to the response that survivors have to rape and it is the natural response of a psychologically healthy person to the trauma of rape[17]. This may be immediate or may occur after months or even years. The victims may feel humiliated or degraded. The victims may also feel confused as to why this happened

14 Section 3(a), The Protection of Women from Domestic Violence Act, 2005, No. 43, Acts of Parliament, 2005 (India).

15 Section 3(d), The Protection of Women from Domestic Violence Act, 2005, No. 43, Acts of Parliament, 2005 (India).

16 Campbell, R., Dworkin, E. and Cabral, G., *An ecological model of the impact of sexual assault on women's mental health. Trauma, Violence, & Abuse*, PUBMED.GOV (June 10, 2020, 08:15 AM), https://pubmed.ncbi.nlm.nih.gov/19433406/.

17 *Surjibhai Badaji Kalasva v. State of Gujarat*, (2018) 59 (3) G.L.R. 2498.

and how could they not help themselves during the incident. Some victims may also blame themselves for being weak not to stop it or for not wanting sexual intercourse as their husbands want them to[18]. A quintessential psychological aftereffect of rape also is self-blame due to which the victim undergoes Post-Traumatic Stress Disorder because of the feeling of helplessness; not being able to help yourself from being raped and self- blaming their self to justify it.

As this issue is not even looked at as a problem so, victims may feel shame and embarrassment telling anyone about it. They feel that this is a taboo and talking about it with other people will raise eyes and questions. In the case of *Bodhisattwa Gautam v. Subhra Chakraborty*[19], a criminal complaint was filed based on a consensual affair and a questionable finding of rape due to failure to marry. Also, in a hearing for criminalizing marital rape, Hon'ble Delhi High Court in 2018 said that: *"Force is not a pre-condition for rape. If a man puts his wife under financial constraint and says he will not give her money for household and kids expenses unless she indulges in sex with him and she has to do it under threat."*[20] All these situations put mental pressure on the victim and their children if they have any. This can cause the children to have a severe mental breakdown or go into clinical depression. It, therefore, becomes evident that such acts not only destroy a woman and her life but also have severe impacts on the health of the children leading to a whirlpool effect.

Health Issues

Although there is a provision provided in the Protection of Women from Domestic Violence Act, 2005[21], but that accounts for only civil liability for sexual abuse. The psyche behind the violent act can be to show dominance and to instil fear that if they do not get what they desire, they may resort to violence.

Most women suffer from perpetual soreness due to frequent rapes. This eventually leads to having broken ribs, knife wounds, marks on their body due to the assault, black eyes. These are just a few examples of what women may experience. Most victims have reported feeling sore and bleeding from the vaginal tract. Bleeding occurs due to intense rupture of

18 Ann Burgess and Lynda Holmstrom, *Rape Trauma Syndrome*, American Journal of Psychiatry 981-986 (1974).

19 *Supra* note 8.

20 *Delhi HC on marital rape: Marriage doesn't mean wife always ready for physical relations with her husband* THE FINANCIAL EXPRESS (Aug. 05, 2020, 11:45 AM), https://www.financialexpress.com/india-news/delhi-hc-on-marital-rape-marriage-doesnt-mean-wife-always-ready-for-physical-relations-with-her-husband/1248987/.

21 *Supra* note 7.

the vagina.[22] Those forced to have anal sex can report bleeding, pain and irritability. They may feel nausea if are somehow reminded of the incident of abuse. Amidst this unwanted pregnancy can also be caused and this further causes mental and psychological pressure on the victim[23]. This can call for premature motherhood and can seriously impact the infant in question. Infertility can also be caused due to vaginal rupture and this can cause the victim to never have children. This can seriously deteriorate the victim for the future if they would ever actually want to start family planning. They can be scarred for life. This can also drive the victims to take their own life. With the notions revolving around marital rape, and the victim not being able to tell anyone anything about the abuse, the victim may think of suicide as the only option.

Marital Rape Laws in India

Our country has advanced in almost all of the fields and there have been many amendments and new legislations in our country, but till date marital rape is not considered to be an offence in the country. The laws for protecting a woman in the institution of marriage does not exist and the matters related to the same are left to the discretion of the court.

Under Section 375 of the Indian Penal code, has mentioned exception that – *"Sexual intercourse by a man on his own wife, who is above 18 years of age, is not rape"*[24]

Under the Indian Penal Code, the instances where punishment is awarded to the husband under marital rape is as follows:

i. When the age of wife is between 12-15 years, there can be imprisonment up to 2 years or fine or both;[25]

ii. When the age of wife is below 12 years, there must be imprisonment for term which shall not be less than 7 years but can also extend to life and shall also be liable to fine.[26]

iii. When the wife is judicially separated, there can be imprisonment up to 2 years and fine[27]

iv. When the age of wife is above 18 years, the rape is not punishable.[28]

22 *Supra* note 12.

23 Sarkar J., *Mental Health Assessment of Rape Offenders*, 55(3) Indian J Psychiatry 235243 (2013).

24 *Supra* note 6.

25 Section 376(1), The Indian Penal Code, 1860, No. 45, Acts of Parliament, 1860.

26 *Ibid.*

27 Section 376A, The Indian Penal Code, 1860, No. 45, Acts of Parliament, 1860.

28 *Supra* note 6.

Hence, we can conclude that once a female crosses the age of 18 thereafter as a wife, she has no legal protection if she is sexually harassed by her husband which is also a direct attack on her human rights. It is very shocking because the Constitution has set 18 years as the legal age for marriage whereas the law will protect only those females from sexual abuse which are below 18 years of age and beyond this age limit there exists no remedy for the women.

Thus, it is depicted that the law which is meant for the safety of the victims, is not able to protect those who are victimised and have gone through the trauma of marital rape because according to the obsolete law, marriage in itself has given the consent to have intercourse at any point of time after the marriage and the consent of the female is not needed. Violence takes place with a woman due to which she has to submit herself to sexual activity and further on, she gets hurt physically as well as emotionally. Our judiciary, as well as the legislature, is still silent on the very fact that "*Is marriage a license to rape"?*

The Report of 42nd Law Commission[29] talks about the removal of exception of Section 375 from the IPC because it is discriminatory towards women and is not in accordance to the law. Even the Report of 172nd Law Commission[30] was in favour of removing the exception to Section 375 thereby making marital rape a criminal offence but more than 10 years have passed and no action has been taken on the same issue.

Constitution of India on Marital Rape

This law which seemingly permits marital rape can be challenged on several grounds some of which are enumerated herein. According to the Indian Constitution, all the laws which are passed by the legislature should follow the basic structure doctrine of the Constitution. If any law is in contravention of this, it can be declared as unconstitutional by the Courts. Any law or provision, if made, in favour of marital rape it would have to be in consonance with the basic doctrine of the Constitution.

Article 14

Article 14 of the Indian Constitution[31] guarantees the Fundamental right of equality before the law and equal protection of the laws within the territory of India. However, criminal law is still silent on the discrimination that is faced by the victims of marital rape. The

29 Law Commission of India, *42nd Report on Indian Penal Code, 1860* (June, 1971).

30 Law Commission of India, *172nd Report on Review of Rape Laws* (January, 1998).

31 INDIA CONST. art. 14.

Exception to Section 375 of IPC is a discriminatory law for the married women because there is a new stratum of women created by this law who will not get protection from the law if they face sexual harassment from their husbands which does not fulfil intelligible differentia because it is arbitrary, artificial and evasive.

Section 375 does not include rape which is done by a husband to his wife. Protecting a person from the ambit of Section 375 of the IPC based on the marital status is discriminatory and it violates the Article 14 of the Indian Constitution. Rape or marital rape is one and the same thing and the only difference is that the victim is married in the latter case, and everything else is similar to what is in the rape. It is, in turn, difficult for a married woman because she has to live her whole life with the perpetrator and they are dependent on their husband. In the real sense, this exception encourages the husbands to commit forced sexual intercourse because they know that the same is not punishable under the law. Hence, marital rape is in clear violation to Article 14 of the Indian Constitution because equal protection is not available to the female victims and it does not pass the twin test laid down in Article 14 of the Constitution in terms of intelligible differentia and reasonable nexus.

Article 21

Article 21 of the Indian Constitution says that:

> *"[N]o person shall be deprived of his life or personal liberty except according to a procedure established by law."*[32]

In the case of *Kharak Singh v. State of Uttar Pradesh*[33], the Hon'ble Supreme Court held that *"[b]y the term "life" as here used something more is meant than mere animal existence"* There have been many cases where the Supreme Court has interpreted this article and given a whole new shape to it. Under Article 21, there are many rights which are given to the citizens which include the right to health, dignity, safe environment, sexual privacy, human dignity, among others. In the case of State of *Karnataka v. Krishnappa*[34] , the Hon'ble Supreme Court held that *"[s]exual violence apart from being a dehumanizing act is an unlawful intrusion of the right to privacy and sanctity of a female.",* it further held that rape in itself is a serious blow to the self-esteem and dignity of the victim and it degrades her, leaving behind a traumatic experience.

32 INDIA CONST. art. 21.

33 *Kharak Singh v. State of Uttar Pradesh*, A.I.R. 1963 S.C. 1295.

34 *State of Karnataka v. Krishnappa*, (2000) 4 S.C.C. 75 (India).

Right to Healthy and Dignified Life

In the case of *C.E.S.C. Ltd. v. Subhash Chandra*[35], the Hon'ble Supreme Court held that Right to Life also includes the Right to live a healthy and dignified life which is one of the most important things to maintain the individuality of a citizen in the country[36]. The exemption to Section 375 is a violation to the right to the good health of a married woman because marital rape causes emotional, psychological and physical problems to a woman and puts her into depression, moreover in the case of forceful sexual intercourse, there always exists a chance of transmission of STDs to the victim. There are many cases held by the Hon'ble Supreme Court wherein it talks about rape as a crime against the society and also violative of Article 21 of the Indian Constitution[37]. Hence the exemption to Section 375 of IPC is in clear violation to the woman's right to live a healthy and dignified life because sexual intercourse without the consent of the woman challenges her dignity, as well as her health, therefore it violates the very basic structure of Article 21 and is unconstitutional.

Right to Sexual Privacy

There are numerous cases in the Apex Court where it has been held that Right to Privacy is to be protected constitutionally under Article 21.[38] Therefore, any type of forceful sexual act to a woman is a violation of her privacy as it is her body and she has full right to consent to it and protect it. If we talk about sexual privacy the same has been discussed by the Hon'ble Supreme Court in the case of *State of Maharashtra v. Madhukar Narayan*[39] where it was held that "*[e]very woman is entitled to her sexual privacy and the same is not open to for any and every person to violate her privacy"*. However, the exemption of marital rape in the IPC is violative to the right to sexual privacy of a married woman because nobody should force her to have sexual intercourse against her will. Therefore, this exemption is in violation with the Right to Privacy and therefore should be held unconstitutional.

Right to Bodily Integrity

A woman is the owner of her own body and all the decisions regarding her bodily matters are to be taken by her, without the interference of anybody, whether it is having sexual intercourse or not; that is something which is to be decided by a woman and she has the

35 *C.E.S.C. Ltd. v. Subhash Chandra*, (1992) 1 S.C.C. 441 (India).

36 See also *Bandhua Mukti Morcha v. Union of India* (1997) 10 S.C.C. 549, *Francis Coralie v. Union Territory of Delhi,* A.I.R. 1981 S.C. 746.

37 *The Chairman, Railway Board v. Chandrima Das*¸ A.I.R. 2000 S.C. 988 (India).

38 *Govind v. State of Madhya Pradesh*, A.I.R. 1975 S.C. 1378.

39 *State of Maharashtra v. Madhukar Narayan*, A.I.R. 1991 S.C. 207.

right to deny the same and nobody can force her; in the eyes of IPC if a woman denies sexual intercourse and is forced into it, the same is termed as rape but if a married woman is forced into sexual intercourse by her own husband, the same is not rape. Hence, the exemption to Section 375 is a violation of a married woman's right over her own body because marriage does not mean that consent for having sexual intercourse is not needed.

Hence, the exemption to the Marital Rape under Section 375 of the Indian Penal Code is in clear violation of Article 14 & 21 of the Indian Constitution. This exemption does not pass the tests of "just, fair and reasonable law" and the test of reasonable classification because it is not a fair law and is discriminatory towards a married woman and makes a distinction towards them. This exemption is now obsolete and needs not to be present in the IPC, rather India should also take strict measures to guard the rights of the married woman because there is a large portion of women who are victims of marital rape but they do not have a law which can support them; the only remedy available to them is the Section 498A of the IPC and the Domestic Violence Act. The Supreme Court in the case of *State of Maharashtra v. Madhukar Narayan Mandikar* [40] held that "*A prostitute had the right to refuse sexual intercourse if she is being forced and the same is being done without her will; not withholding the same will amount to Rape.*" This is a vast problem, Indian judiciary in a plethora of cases have criminalised almost all types of rapes but made an exemption to marital rape due to which a large fraction of the females is victimised.

Human Perspective

A majority of people are in favour of not criminalizing marital rape. This creates the face of public opinion and portrays the nation in an incorrigible light. These arguments have gained momentum because most people in India are culturally active and believe that the laws that defined India a thousand years ago are prevalent even today. Moreover, these arguments hold no place in the current times because this exception is discriminatory. Here are some arguments and their rebuttal.

Arguments against Criminalising Marital Rape

The Sanctity of Matrimonial Institution

The first argument regarding not criminalizing marital rape is that it would destroy the sanctity of the marriage and this would furthermore destroy the family. The sacred bond that a husband and a wife share would be broken and the meaning of marriage would be

40 *Ibid.*

lost. Criminalization of marital rape would mean that the state is entering the fine line between home and law which creates a brick wall situation for the judiciary. Providing a legislation for the same would mean that the state is crossing boundaries and going beyond its jurisdiction. Marriage is between two people and any decision encroaching upon this line can be met with opposition and harsh criticism.

Marriage is Consent

Marriage is how two individuals enter into a legal union in their personal capacities. Similarly, people have argued that if these individuals have entered this contract on their volition then the woman has already consented to the marriage. If the marriage is not by her own choice, the parents are responsible for matching the matrimonial relation and that is considered as consent. The tradition of not asking for the woman's consent is widely prevalent. The consent of sexual relationship is thought to be given, to the husband, while consenting to marriage or getting their marriage fixed by their parents. Arranged marriage and forced marriage are two entirely different concepts. Arranged marriage is when both parties are willing to get married upon meeting each other whereas forced marriage is when either one of the parties is not consenting for marriage.

Cultural Boundaries

People have been taught to follow certain traditions, norms and values since they were infants. These values have been etched into one's brains and anything that may go beyond it or does not match the frequency is termed to be taboo. These socio-cultural norms have taught people that it is normal for a man to expect from his wife to fulfil his sexual needs. Culture is what makes a nation.

Pseudo Cases

A large majority of the people have also argued that if legislation is made on marital rape, some wives will use this as a tact to get out of their marriages or to intimidate their partners into doing anything, threatening to use the said legislation. In the case of *Arnesh Kumar v. State of Bihar,* the Supreme Court held that [s]ection 498A is being used as a weapon by disgruntled wives rather than a shield[41]. It would then be the men who would come under the scrutiny of the judiciary every second. This can create a ruckus in judicial proceedings as a plethora of false cases can be filed which will delay the justice of more quintessential cases. India still does not have the means to compensate for all the cases being delayed from years.

41 *Arnesh Kumar v. State of Bihar*, (2014) 8 S.C.C. 273.

Pre-existing Legislation

The Protection of Women from Domestic Violence Act, 2005 is said to be the remedy for marital rape. Arguments are made that if this legislation is already in force, there is no need for a separate legislation for the same in the state. Marital rape can be considered under Section 3(a) *"harms or injures or endangers the health, safety, life, limb or well-being, whether mental or physical, of the aggrieved person or tends to do so and includes causing physical abuse, sexual abuse, verbal and emotional abuse and economic abuse"*.[42] An existing provision has been provided to foresee sexual and verbal abuse at the hands of the husband.

Arguments in Favour of Criminalisation

Sanctity is Distorted

When a man has sexual intercourse with his wife without her consent, the sanctity of matrimony has already been tainted. There is no option of going back and claiming that marital rape can be exempted as it is crossing the boundaries of issues between a man and his wife. Similarly, High Court of Gujarat, in the case of *Nimeshbhai Bharatbhai Desai v. State of Gujarat*[43], held that the "*[n]on-consensual act of marital rape violates the trust and confidence within a marriage and the prevalence of marital rape in India is what has damaged the institution of marriage"*. The Court while hearing the case observed that marriage does not make the wife a chattel of the husband and it does not give the right to violate the dignity, autonomy and privacy of the woman by coercing her into a sexual act without her free consent. The court added and said that the time has come when we need legislative intervention into the matter so that this serious problem gets solved in the earliest possible time. When the concept of sanctity has been contradicted, this argument becomes ethically flawed.

Consent is Important

The Prohibition of Child Marriage Act, 2006, makes child marriage voidable rather than void[44]. Parents can marry off their minor offspring to anyone and the children cannot take a divorce or an annulment from their spouse until they are not minor anymore i.e. 18 years of age. However, Section 375 of IPC, 1860 prohibits sexual intercourse of a man with wife

42 *Supra* note 12.

43 *Nimeshbhai Bharatbhai Desai v. State of Gujarat,* 2018 SCC OnLine Guj 732.

44 *Supra* note 14.

less than or of 18 years of age.[45] This, however, creates a loophole for those who are above 18 years of age. They have to co-inhabit with someone who may or may not force them into sexual activities against their consent. This is an old tradition that pledges marriage is consent. Being in the 21st century, these archaic laws can be changed according to the advancement of society.

Changing of Culture

Taking the mythology 'Mahabharat', it is believed that Yudhishthira bet his wife in a game of 'chauras' against Duryodhana. From ancient times, women have been objectified and have been treated as a mere chattel. In marriages, the giving away of the bride is called 'kanyadaan' by the father to the husband. A girl is deemed to be foreign to her family members and is believed to be owned by her husband. Old traditions like this should be logically debated upon and it has to be understood that in this era, women have rights and cannot be objectified. The cultural paradigm should be encouraged. This would help in evolution or banishment of old traditions which seem irrelevant.

A Criminal Liability

The Hindu Marriage Act and the Domestic Violence Act provides the women with a means so that they can remove themselves from a threatening situation in turn for a civil liability. People have argued that if there is an existing legislation for domestic violence which is inclusive of 'sexual abuse', then why do the women of India need another legislation. The Protection of Women Domestic Violence Act, 2005, only provides the offenders with civil liability. Moreover, in civil liability, the perpetrator can get away with just providing compensation to the victim. For this crime, the perpetrator needs to be imprisoned. This will set an example for the rest of the society that this crime needs to be recognized and the state will not turn a blind eye to such behaviour.

Conclusion

Justice Krishna Aiyar in the case of *Rafiq v. State of Uttar Pradesh* said that *"A Murderer kills the body but a Rapist kills the soul"*.[46] The State says this is not sacrosanct and it is the sole business between a husband and wife; the state has already made laws relating to marriage e.g. dowry, cheating, cruelty and divorce. It is the firm belief of this paper that there is an immediate need to criminalise marital rape. Adding marital rape to the list would

45 *Supra* note 25.

46 *Rafiq v. State of Uttar Pradesh*, 1980 Cr. L.J. 1344 S.C.

be nothing but a huge success for India towards healthy mental development. The state also said that criminalising marital rape would "destabilize the institution of marriage"[47] and it can be easily used to "harass husbands". When an act has already been done to taint the very sacrosanctity of marriage, how would getting justice for the very same act destabilize the marriage of the two individuals? The marriage has already been destabilized when the spouse tried or did sexually abuse their partner. The second point of 'harassing husbands' can be met with fast-track courts and their speedy trials. Setting up of various other fast-track courts all over the country would help in solving this issue of false cases. Sacrosanctity and harassment of husbands should not be reasons behind not criminalising marital rape. This could be cited as missed justice on the part of the legislature and the judiciary. There has to be a stringent punishment for marital rape. Consent should not be considered as given on the grounds of having a spouse; this is highly subjective. Marital Rape should be added as a ground for divorce which cruelty does not cover as marital rape in itself is not a law in the current scenario of the Indian Justice System.

In 2019, Advocate Anuja Kapur filed a petition in the Supreme Court to make marital rape a ground for divorce; a two-judge bench comprising of Justice S.A. Bobde and Justice B.R. Gavai, asked the petitioner to file for relief in the High Court.[48] When the state itself can be rigid in not taking any steps in furtherance of marital rape, then it can take years to get the act criminalised. There is a need to criminalise the same because these steps are necessary to be taken so that the married woman can also use the law to address their grievances. Marital rape will only be criminalised when the distinction between rape and marital rape is understood.

Sensitisation of marital rape is the need of the hour. As a society, we are tremendously cultural and put traditions on a pedestal. This ceases the need of discussing about taboos. Turning a blind eye towards these taboos will not solve the problem itself; the problem still looms. Marital rape cannot be put in force until the very own citizens of the nation are familiar itself with the same. Even if marital rape becomes a crime, there would have to be a thorough explanation of the said act/statute. Awareness of marital rape would have to be made in order to achieve the zenith of justice. Various organisations have been committed towards the same but until the citizens do not bring the attention of the judiciary to how grave the issue already is, no big steps will be taken. Studies show that 70 per cent of women have experienced physical and/or sexual violence from an intimate partner in their

47 *Nimeshbhai Bharatbhai Desai v. State of Gujarat,* 2018 SCC OnLine Guj 732.

48 *Marital rape as ground for divorce: SC asks petitioner to approach Delhi HC,* BUSINESS STANDARD (Aug. 06, 2020, 02:00 P.M), https://www.business-standard.com/article/news-ani/marital-rape-as-ground-for-divorce-sc-asks-petitioner-to-approach-delhi-hc-119070100334_1.html.

lifetime.[49] This goes against the very thing our forefathers fought for- fundamental rights. Article 14 and Article 21 of the Indian Constitution talks about equality and freedom of life and liberty. India needs to take a decision on the furtherance of marital rape. In a land where goddesses are revered and worshipped, India can certainly not afford to stay silent on this issue any further. Doing so would be a gross miscarriage of justice.

49 World Health Organization, Department of Reproductive Health and Research, London School of Hygiene and Tropical Medicine, South African Medical Research Council, *Global and Regional Estimates of Violence against Women,* WORLD HEALTH ORGANISATION (Aug. 06, 2020, 02:30 PM), http://www.who.int/reproductivehealth/publications/violence/9789241564625/en/.

Buyers' Cartels – Two Differing Opinions by the Competition Commission of India

Hartej Singh Kochher*

Abstract

The author, by way of this study, would shed light on how the CCI has given diametrically differing views in two separate cases on the issue of "buyers' cartels". The two cases would be contrasted and studied and the legal rationale behind them would be understood. Further, this paper will also dwell on the proposed change under the Draft Competition (Amendment) Bill, 2020 to amend the definition of a 'cartel' under the Act. The impact of the proposed change would be gauged and finally, the author will offer his suggestions on the "buyers' cartels' jurisprudence of the CCI and the proposed change to the definition of a 'cartel'.

Critical Analysis

Competition Commission of India (hereinafter referred to as "CCI"), is the regulatory expert body[1], tasked with addressing competition concerns in the Indian market. It was constituted under the Competition Act, 2002. According to the author, the CCI, in its domain, has functions which can be divided into four broad spheres- (i) to prevent anti-competitive agreements in the market; (ii) to prevent the abuse of a dominant position enjoyed by an enterprise in a market; (iii) to regulate combinations which are proposed and finally; and (iv) competition advocacy.

Under the first sphere, i.e. to prevent anti-competitive agreements, the CCI has powers to strike against "*Cartels*". The Competition Act gives us an *inclusive* definition of a cartel, stating that it "*includes an association of producers, sellers, distributors, traders or service providers who, by agreement amongst themselves, limit, control or attempt to control the production, distribution, sale or price of, or, trade in goods or provision of services*".[2]

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1 The status of the CCI as a regulator performing roles which are administrative, quasi-judicial and that of an expert body in nature has been emphatically stated in *Brahm Dutt v. Union of India*, A.I.R. 2005 S.C. 730 and more recently, in *Mahindra Electric Mobility Ltd. v. CCI*, (2019) SCCOnline Del 8032.

2 Section 2(c), The Competition Act, 2002, No. 12, Acts of Parliament, 2002 (India).

Hence, according to this definition, an '*agreement*' which points to some '*collusion*' is necessary to constitute a cartel.

Section 3 of the Competition Act, is the operative provision, which explicitly prohibits '*anti-competitive agreements'*.[3] One such sub category of anti-competitive agreements which are frowned upon are agreements between parties engaged in "*identical or similar trade of goods or provision of services*".[4] It is under this sub-category, that the Act, explicitly mentions any agreement between 'cartels' to be presumed as an anti-competitive agreement[5] if it satisfies any of the following circumstances- (i) it fixes prices; (ii) it fixes output; (iii) it divides the market; or (iv) it enables bid rigging or collusive bidding.[6]

While the CCI has adjudicated upon various cases which deal with 'cartels' per se, there have only been two instances[7], where the regulator has been specifically called on to settle action against what could be called "*buyers' cartels*".

It was in *Pandrol Rahee Technologies Pvt. Ltd. v. Delhi Metro Rail Corporation and Ors.*[8] (hereinafter referred to as "*Pandrol*") that a question pertaining to a buyers' cartel, came up before the CCI for adjudication, for the very first time. Anti-competitive conduct was alleged by the informant, in light of subsisting agreements, by the five Opposite Parties in the procurement of the *"rail fastening systems for ballastless track in metro rails"* in India. An argument for abuse of dominant position was also advanced.

It was claimed that the Delhi Metro Rail Corporation (DMRC) had not initiated any tendering process for the said procurement. This tendering process was stated to be an incumbent responsibility upon a public body. Other Metro rail projects in different cities were also recommended the procured products by the DMRC.

In the final decision, the procurer was adjudged to be a consumer i.e. a buyer, per the majority's opinion, since the "*production chain can be said to end where the last transaction takes place and after which point the utility of the product or service is consumed by the person who buys it*". This criterion, of being the end consumer, of a good or service, was satisfied by the DMRC and the other metro projects. As per the opinion, even though this

3 Sections 3(1), 3(2), The Competition Act, 2002, No. 12, Acts of Parliament, 2002 (India).

4 Section 3(3), The Competition Act, 2002, No. 12, Acts of Parliament, 2002 (India).

5 The burden, hence, shifts on the parties accused thereof to disprove.

6 For a more detailed discussion on the conditions, please see Sections 3(3)(a), 3(3)(b), 3(3)(c), 3(3)(d), The Competition Act, 2002, No. 12, Acts of Parliament, 2002 (India).

7 In the research of the author.

8 Case No. 3 of 2010 (Competition Commission of India, 07/10/11). One order given by the majority and one dissenting order. This study will only be confined to the majority order as the dissent did not address any of the issues relevant for this study.

was a public body, it was an entity which was a representative consumer on behalf of the public, and a consumer was expected to know what was best for him. Consequently, a consumer could freely select a product by exercising consumer choice.

The legal rationale advanced was that the considerations stated under Section 19(3), which are taken into account to determine appreciable adverse effect on competition, did not contemplate a purchaser to be able to cause competitive harm. Further, Section 3(3), categorically, states that sub-units forming a cartel, are required to be engaged in "*identical or similar trade*"[9], and the term '*acquisition*' was not stated in the definition of '*trade*'[10] under the Act. Hence, any sort of acquisition i.e. purchase, did not fall in the definition of a 'trade' and thus, no purchaser/ consumer could be brought under the bounds of Section 3(3). As a consequence, a buyers' cartel would be outside the regulatory jurisdiction of the CCI.

After some considerable gap, a second case pertaining to buyers' cartels came up for hearing before the CCI in the form of *XYZ v. Indian Oil Corporation Ltd. and Ors.*[11] (hereinafter referred to as *"XYZ"*). As per the information supplied by the informant, the Opposite Parties had allegedly indulged in collusive/ joint tendering. Three public sector oil companies were the Opposite Parties, and the tender was concerned with procurement of services of Tank Trucks for transportation of LPG cylinders. The CCI, while detailing the factual matrix of the case, clearly expressed that *"...the Commission notes that in the present case the Informants have alleged an existence of a buyer/purchase cartel. Section 3(1) and 3(3)(a) covers both sellers' as well as buyers' cartel..."*

According to the decision, Section 3(1), which prohibits anti-competitive agreements, explicitly used the term '*acquisition*'. Pricing fixing[12] by a cartel is to be treated as a per se violation under Section 3(3). Hence, it was clearly mentioned in the verbiage of the Act itself that fixing of a purchase price by a cartel was a violation. As a result, buyers' cartels came under the jurisdiction of the CCI.

However, taking into account a peculiar aspect of buyers' cartels, it was observed, *"... the creation of 'buyer power' through joint purchasing agreements may rather lead to direct benefits for consumers in the form of lower prices bargained by the buyers"*. Thus, *"... treating buyers' arrangement/cartel, at par with sellers' cartel may not be appropriate"*. Hence, each case, with its unique factual matrix, needs to be adjudicated upon individually while taking the possible benefits to a consumer of a buyers' cartel into account.

9 Of either goods or services.

10 Section 2(x), The Competition Act, 2002, No. 12, Acts of Parliament, 2002 (India).

11 Case No. 5 of 2018 (Competition Commission of India, 04/07/18).

12 Section 3(3)(a), The Competition Act, 2002, No. 12, Acts of Parliament, 2002 (India).

The CCI did not venture to discuss the definition of "*trade*" as it had referenced in the *Pandrol* case. To the author, the reasoning given in *Pandrol* seems to stand on firm legal footing and the decision in *XYZ* is erroneous.

Section 3(3) of the Act states the "*identical or similar trade*" criteria and even though the Opposite Parties in *XYZ* were in the identical/ similar trade, they were '*acquiring*' the service (of the trucks) for their consumption, thereby, becoming end users of the service. They were not going to further 'trade' in the services they acquired, thus, satisfying the letter of the law, strict interpretation followed in *Pandrol*. A consumer, as per a strict reading of the Act, cannot be interpreted to be a constituent of a cartel. Buying goods or services for final consumption cannot be stated to be a '*trade*' under the Act.

An even more perplexing omission is regarding the absence of *Pandrol* in the *XYZ* order. This situation followed even after *Pandrol* being the only other case the CCI had inquired into pertaining buyers' cartels. This leads to a scenario where precedent ceases to be of concern and ad-hoc adjudications can be made in any matter. If a previously decided case is referred to explicitly, its decision-making rationale can be relooked at. It can be affirmed fully or partially or overruled fully or partially. It gives a certain stability to the jurisprudence.

In the present scenario, we have two wildly differing opinions regarding the ability of the CCI to inquire into buyers' cartels. If *XYZ* is the correct law, then the Opposite Parties in the *Pandrol* matter slipped through the jurisdiction of the CCI. If *Pandrol* is correct, the CCI should have not gone beyond the preliminary inquiries in *XYZ,* after it realized that the case pertained to buyers' cartels.

Further, if the previous case was referenced and specifically overruled, a situation with two diametrically opposing decisions in the same realm would not have come into being. It has been held by the Apex Court itself that "*The doctrine of binding precedent has the merit of promoting a certainty and consistency in judicial decisions, and enables an organic development of the law, besides providing assurance to the individual as to the consequence of transaction forming part of his daily affairs".*[13] In light of the two different perspectives on the issue of buyers' cartels, it is the individual, who cannot gauge the impact of his transaction and thus, cannot determine whether he or she is falling foul of the Competition Act or not.

In the opinion of the author, a possible line of argument in *XYZ,* to justify the inclusion of a buyers' cartel within the definition of a 'cartel' under the Act, could have been the fact that

13 *Union of India & Anr. v. Raghubir Singh (Dead) by LRs. Etc.*, A.I.R. 1989 S.C. 1933.

the definition given and stated in full above, is inclusive in nature and thus, not exhaustive.[14] Hence, a buyers' cartel, can be envisaged within the definition of a cartel itself. However, no such reasoning was pursued. In spite of this, the hurdle created by the definition of 'trade' not containing the word 'acquisition' remains. It becomes pertinent to note that the definition of 'trade' furthers that '*control of goods'* constitutes a trade.[15] When a buyer buys a good, it comes within his or her control, hence, a consumer could be brought under the definition of trade. This would, plainly, be quite a stretched legal reasoning.

Adding to the intrigue is the recommendation of the Competition Law Review Committee (CLRC) to incorporate the word 'buyer' in the definition of a cartel.[16] Based on the recommendations of the CLRC, a Draft Competition (Amendment) Bill, 2020 has been put out in the public domain to seek comments from the public at large. The Draft Bill, in consonance with the recommendations of the CLRC has duly proposed to amend the definition of 'cartel' in Competition Act, 2002 by incorporating the word 'buyer' in it.

Under Section 2(c), the definition of a cartel as proposed to be amended by the Draft Bill would be (with proposed amendments underlined and in italics):

> *"cartel" includes an association of producers, buyers, sellers, distributors, traders or service providers who, by agreement amongst themselves, limit or control or attempt to limit or control the production, distribution, sale or price of, or, trade in goods or provision of services."*[17]

However, no amendment is proposed to the definition of 'trade'. Hence, the questions raised by the reasoning in the *Pandrol* order still remain. The CLRC, in its report while suggesting the said amendment, only referenced the *XYZ* decision, and stated that in its decisional practices, CCI has recognised that Section 3(1) and 3(3), cover both buyers' and sellers' cartels.[18] Thus, the *Pandrol* decision seems to have been completely discarded and the way forward seems to be in sync with the reasoning advanced in *XYZ*.

14 Section 2(c), The Competition Act, 2002, No. 12, Acts of Parliament, 2002 (India).

15 Section 2(x), The Competition Act, 2002, No. 12, Acts of Parliament, 2002 (India).

16 Ministry of Corporate Affairs had constituted a Competition Law Review Committee ("CLRC") in 2018 to ensure that the Act *"is in sync with the need for strong economic fundamentals". Government constitutes Competition Law Review Committee to review the Competition Act*, PRESS INFORMATION BUREAU, GOVERNMENT OF INDIA, MINISTRY OF CORPORATE AFFAIRS (May 20, 2020, 10:00 AM), https://pib.gov.in/PressReleseDetail.aspx?PRID=1547975.

17 Draft Competition (Amendment) Bill, 2020, MINISTRY OF CORPORATE AFFAIRS (Apr. 28, 2020, 11:00 AM), http://feedapp.mca.gov.in/pdf/Draft-Competition-Amendment-Bill-2020.pdf.

18 *Report of the Competition Law Review Committee*, GOVERNMENT OF INDIA, MINISTRY OF CORPORATE AFFAIRS (May 20, 2020, 10:05 AM), http://www.mca.gov.in/Ministry/pdf/ReportCLRC_14082019.pdf.

Rathnayake Tharanga Lakmali v. Niroshan Abeykoon: Sri Lankan Supreme Court Recognises Custodial Death as a Violation of Right To Life

Raj Krishna* and Kumar Mukul Choudhary**

Abstract

Police brutality is a point of concern for the entire world. Post the George Floyd incidence, questions have been raised all over the world on the extent of force which can be used by the law enforcement agencies for maintaining law and order. Similar questions were also raised before the Supreme Court of Sri Lanka in the case of Rathnayake Tharanga Lakmali v. Niroshan Abeykoon wherein the Court held that custodial death violates right to life of an individual and therefore, is prohibited by law.

In the light of the above facts, the authors in this case comment have analysed the judgement of the Sri Lanka Supreme Court. The authors have also discussed about the impact this judgment will have on the Sri Lankan constitutional and human rights jurisprudence. Furthermore, the authors in this case comment have also discussed about the significance of this ruling for the Indian legal system.

Introduction

"The rule of law doesn't mean the police are in charge,
but that we all answer to the same laws"

- Edward Snowden

Custodial torture is a major disgrace for a society governed by rule of law. The most pertinent question before any adjudicating authority dealing with the issue of police brutality is that, to what extent deference may be provided to law enforcement agencies in matters of use of force for implementation of law. Furthermore, whether rule of law should be implemented

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by courts in formal sense or substantive sense while determining these questions? Should authorities be given free hand or should they be held accountable for their acts just like a common man? There are many such questions which pop up when we discuss about the use of force by police authorities.

The U.S Supreme Court has answered these questions by way of qualified immunity. Initially the Court held that *"[a] policeman's lot is not so unhappy that he must choose between being charged with dereliction of duty if he does not arrest when he had probable cause, and being mulcted in damages if he does."*[1] As a result police officials were provided with immunity from civil suits for their actions. But for grant of such immunity mental intent of the police officers has to be seen which should not be malicious. However after sometime this requirement was also diluted. Furthermore to protect the officials the courts applied the test of reasonableness instead of trials to see whether the action of the official would reasonably violate law or any constitutional principle.[2] As a result cases of police brutality increased in United States.

Recently, similar questions were raised before the Sri Lankan Supreme Court[3] i.e. to what extent deference may be provided to law enforcers in their act of use of force upon general public. The Supreme Court of Sri Lanka in the landmark judgment has held that "*extra-judicial killing of a detainee in police custody violates the fundamental right to life of an individual, despite the fact that there is no explicit right to life mentioned in the Sri Lankan Constitution.*[4]*"* Furthermore, the standard of evidence required to make police accountable must not be too burdensome. This would make contention of victim too hard to prove and would give a free hand to the law enforcement authorities.[5]

Facts of the Case

This Fundamental Right application was filed by the wife of the deceased Rathnayake Tharanga Lakmali, on behalf of her husband Ranamukage Ajith Prasanna who died in a Police Custody on September 18, 2010. The petitioner in her application contended before the Supreme Court that her husband was wrongly arrested and detained. After arrest, her husband was subjected to torture, cruel inhuman treatment and was eventually killed by

1 *Pierson v. Ray*, 386 U.S. 547 (1967).

2 *Harlow v. Fitzgerald*, 457 U.S. 800 (1982).

3 *Rathnayake Tharanga Lakmali v. Niroshan Abeykoon*, 2019 SCCOnLine SLSC 14 (Supreme Court of Sri Lanka).

4 *Id.* at 14.

5 *Id.* at 12.

the police officials in the custody. As a result, several police officers from the Embilipitiya Police Station were made respondents in this case.[6]

However, the respondents argued that the arrest of the deceased was a lawful arrest and the deceased was not subjected to any torture, cruel, inhuman or degrading treatment. Furthermore, the Respondents claimed that the death of the petitioner's husband was merely accidental and thus justified by law.[7]

Critical Analysis of the Judgment

On the basis of arguments of both the parties and the post mortem report, the three-judge bench of the Supreme Court held that the respondents and the State have infringed the Fundamental Rights of Ranamukage Ajith Prasanna guaranteed to him under Articles 11[8] (which says *"No person shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment."*) and 13(1)[9] (which says *"No person shall be arrested except according to procedure established by law. Any person arrested shall be informed of the reason for his arrest."*) of the Constitution. The Court in its judgement further observed that, the Sri Lankan legal system provides for investigation, inquiry, trial, and punishment by proper authorities. As per Article 13(4) of the Constitution, *"no person shall be punished with death or imprisonment except by order of a competent court.[10]"* Though the Constitution of Sri Lanka does not explicitly recognize right to life. However, it has been held that Article 11 (freedom from torture) read with Article 13(4) (freedom from arbitrary punishment) recognizes, by necessary implication, right to life under Sri Lankan Constitution.

This judgment of the Sri Lankan Supreme Court has been hailed as a landmark judgment for holding constitutional values and essential principles of victim justice. It should also be appreciated for being given in a nation which holds such a grim record in the field of protection of human rights.[11]

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6 *Id*. at 4-5.

7 *Id*. at 9.

8 Article 11 "No person shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment." The Constitution of Sri Lanka 1978.

9 Article 13(1) "No person shall be arrested except according to procedure established by law. Any person arrested shall be informed of the reason for his arrest." The Constitution of Sri Lanka 1978.

10 Article 13(4) "No person shall be punished with death or imprisonment except by order of a competent court." The Constitution of Sri Lanka 1978.

11 U.N High Commission for Human Rights, '*Report of OHCHR Investigation On Sri Lanka*' 16 September 2015, A/HRC/30/CRP.2.

In this judgement another contention raised by the respondents was that the victim was an aggressive criminal having relation with underworld and doing contract killings. Therefore, deference should be provided to police in matter of extensive use of force. To prove this point, they also relied upon *Jeganathan v. Attorney General,*[12] wherein the Supreme Court held that *"The petitioners' allegations against the 4th and 5th respondents if proved will carry with them serious consequences for these respondents. Furthermore, the allegations are of a very serious nature. They must therefore be strictly proved. This degree of cogency is seriously lacking in these proceedings which must fail.*[13]" This implies that to support the proposition that allegations of torture and extra-judicial killing which are of a very serious nature must be strictly proved.[14] But in the present judgement, Court did not accept the above-mentioned proposition. The Court further held that, even though victim was barbaric criminal causing severe law and order problems. But on the day of encounter, police took him out with minimal security.[15] They have even not entered the record of such investigation in their record book.[16] Furthermore, by way of post-mortem report it came to the knowledge of the court that severe injuries have been caused to the victim in the police custody. The court held all of these evidences are sufficient proof of improper working of police.[17] The Supreme Court further held that merely because prisoner is a hardcore criminal, it does not power the authorities to commit gruesome acts upon the prisoner and take his life and liberty away without proper application of the law. This could be gathered from following words of the court- *"Our legal system provides for investigation, inquiry, trial and punishment by proper authorities which is the base of democracy and the Rule of Law. As per Article 13 (4) of the Constitution, no person shall be punished with death or imprisonment except by order of a competent court. Hence, even a convicted criminal has a right not to be arbitrarily deprived of his life except in accordance with procedure established by law.*[18]" By these words courts not only recognised the right of the prisoners but it also incorporated principles of rule of law in substantive sense i.e. substantive version of the rule of law described by Tamanaha as the "social welfare" concept, which "imposes on the government an affirmative duty to help make life better for people, to enhance their existence, including effectuating a measure of distributive justice.[19]" The Supreme Court of

12 *Jeganathan v. Attorney General*, (1982) 1 Sri LR 294 (Sri Lanka).

13 *Supra* note 3.

14 *Ibid.*

15 *Id.* at 10.

16 *Id.* at 9.

17 *Id.* at 14.

18 *Id.* at 12.

19 BRIAN Z. TAMANAHA, ON THE RULE OF LAW: HISTORY, POLITICS, THEORY 1644 (Kindle ed. 2004).

Sri Lanka vide this judgment imposed the duty upon the government and the executive to look after the rights and interest of the prisoners to protect their basic fundamental rights.

However, there are certain grounds on which this judgment can be questioned. Some of the grounds are as follows: -

Restrictive Constitutional Interpretation

On page 13 of the judgment, the court has recognized that Constitution is a living document and should be interpreted liberally.

> *"The Fundamental Rights Chapter in our Constitution does not expressly refer to a right to life. However, the Constitution, as a living document, should not be construed in a narrow and pedantic sense. I am of the view that constitutional interpretation should be informed by the values embodied in it.*[20]*"*

However, at the time of ratio, the court has emphasized upon its earlier judgment[21] in which the Court has recognized life as a mere existence and distinct from dignified existence. Thus, it can be said that right to life has not been recognized by the Court in its absolute sense which in turn puts rights of weaker section of public in jeopardy.

Evasive Approach of the Court

The Supreme Court took nearly 10 years to deliver this verdict, whereas the Sri Lankan Constitution under Article 126(5)[22] (which says *"The Supreme Court shall hear and finally dispose of any petition or reference under this Article within two months of the filing of such petition or the making of such reference.")* provides that petitions related to fundamental right should be disposed of within two months of filling.

However, the Sri Lankan Supreme Court in another case[23] has held that this regulation is not mandatory. This creates a negative impact upon the ambitions of general public to stand against wrongs committed by state. It brings uncertainty in their mind with regards to time and resource required to protect their rights.

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20 *Supra* note 3.

21 *Sriyani Silva v. Iddamalgoda*, *Officer-in-Charge, Police Station Paiyagala and Others* (2003), 2 Sri LR 6 (Sri Lanka).

22 The Supreme Court shall hear and finally dispose of any petition or reference under this Article within two months of the filing of such petition or the making of such reference.

23 *Visuvanagam v. Liyanage,* [1983] 1 Sri LR (Sri Lanka).

Non Determination of Duty

The Sri Lankan Supreme Court in its judgement observed that fundamental rights have been violated under the constitution. But still it did not order the investigation of killing. Furthermore, it also doesn't determine that whether the killing was intentional or not. The court in its judgement also failed to understand that monetary compensation may be sufficient for victim, but not for the public in general. The court in this matter should have decided that what amounts to ex-judicial killing or torture along with what liability can be imposed upon accused if such acts were committed. If the same would have been done then the judgment of the court would have created a deterrent impact upon the authorities which may have retracted such horrendous acts in future.

Significance of this Ruling for the Indian Legal System

This judgment of the Sri Lankan Supreme Court is even important for the Indian Legal System. In India, police encounters, custodial deaths and brutalities are common phenomenon and courts often find themselves incapable of dealing with such issues. The Supreme Court of India in *D.K Basu*[24] judgement has laid down guidelines pertaining to arrest which has also been incorporated into the provisions of Cr.P.C and Evidence Act. But, still the approach of police officials towards torture and brutalities has not been transformed in any sense. According to latest report of N.C.R.B, since 2005 to 2017 more than 1300 people either died or disappeared from police custody[25].

There are provisions in Cr.P.C., which provides for enquiry by judicial magistrate in case of custodial death. But only in 20% of the above-mentioned cases these enquiries were ordered.[26] This undoubtedly shows lethargic approach of courts and authorities to act against custodial death or torture. The main reasons behind custodial deaths are ancient investigative approach of police and too much burden of work upon officers.[27] This results into confession by way of torture and brutality. Although, Supreme Court always condemned this manner of confession. But lacklustre approach of lower courts in dealing with enquiries does provide police officers deference for their actions. This approach of lower courts has on many occasions restricted authorities from taking action against culprit

24 *D.K. Basu v. State of West Bengal,* (1997) 1 S.C.C. 416.

25 *Excerpts from the W.P. (Crl.) No. 354/2019*, LIVE LAW (June 10, 2020, 10:00 AM) https://www.livelaw.in/pdf_upload/pdf_upload-369455.pdf.

26 *Ibid*.

27 *Bound by Brotherhood*, HUMAN RIGHTS WATCH (June 12, 2020, 10:05 AM), https://www.hrw.org/report/2016/12/19/bound-brotherhood/indias-failure-end-killings-police-custody.

officers because deference provided to them by lower courts.[28] These tactics of judiciary and authorities has further undermined the right of weak and vulnerable.

Furthermore it is also an accepted view in the Indian Legal System that police encounters are necessary. The Supreme Court of India while dealing with the legitimacy of encounters has pointed out in *Public Union for Civil Liberties v. Union of India*[29] that *"if the version of the police with respect to the incident in question were true there could have been no question of any interference by Court. Nobody can say that the police should wait till they are shot at. It is for the force on the spot to decide when to act, how to act and where to act. It is not for the Court to say how the criminals should be fought.*[30]*"*

Even Section 46 of the Code of Criminal Procedure permits police encounters in India. The acceptance of validity of encounters in our legal system is based upon a misleading fact. The fact is that the State and the accused are on the same footing and the authorities do not have any other option than encounters.[31] This assumption can be rejected with the help of present judgment of the Sri Lankan Supreme Court. It is because in this case the court deviated from the strict proof and recognized the unequal footing of the petitioner and the respondent in the given case.[32]

The Indian courts should also follow their Sri Lankan counterparts in cases involving police brutality instead of saying that they cannot do much.[33] The Indian Courts should accept that police hold sheer power of state sovereignty from which the citizens require thoughtful protection, who are no way close to police power.

Furthermore, Parliament has a responsibility to protect vulnerable people from the access of the law enforcement agencies. Hence it is expected from the legislature that they will bring legislation to limit the extensive use of force by police officials. For this purpose, they can rely upon recommendations of 273rd report of Law Commission.[34] Furthermore,

28 *Ibid*.

29 *Public Union for Civil Liberties v. Union of India*, A.I.R. 1997 S.C. 1203.

30 *Ibid*.

31 The Code of Criminal Procedure, 1973, No. 2, Acts of Parliament, 1974 (India).

32 *Ibid*.

33 Utkarsh Anand, *Courts Can't Do Much: SC Adds 'Peace' Caveat to Hear Pleas Against Police Crackdown on Jamia, AMU Students Tomorrow*, NEWS 18 (June 9, 2020, 11:00 AM), https://www.news18.com/news/india/courts-cant-do-much-its-law-and-order-problem-sc-refuses-to-hear-plea-on-violence-in-jamia-2425595.html.

34 Law Commission of India, *Implementation Of United Nations Convention Against Torture And Other Cruel, Inhuman And Degrading Treatment Or Punishment Through Legislation*, Report No. 273 (Oct. 2017).

the law commission has also annexed a draft prevention of torture bill[35] which could help legislature in forming a new law. Therefore, it could be anticipated and wished that parliament possibly will bring a law in future to prevent torture in this vibrant democracy in order to protect the rights of most vulnerable in the society.

CONCLUSION

This judgment of the Sri Lankan Supreme Court may not be of much significance for the Western democracies. However, in a country like Sri Lanka which has history of torture and war crimes,[36] recognition of constitutional principles and rule of law is a great achievement.

This judgment further brings a new hope that Sri Lanka will now ensure rights to its prisoners and vulnerable. Even though this judgment can be criticized on various grounds but it deserves an appreciation because this judgment has recognized the rights of the prisoners and other constitutional principles. The Court vide this judgment has tried to remind the authorities that even a convicted criminal has a right not to be arbitrarily deprived of his/ her life except in accordance with procedure established by law.

At last the authors will like to conclude by saying that the judges while deciding the case of police brutality should remember the lines of Justice White [U.S. Supreme Court Judge] from the case of *Wolff v. McDonnell* wherein he observed that, *"A prisoner is not wholly stripped of constitutional protections when he is imprisoned for crime. There is no iron curtain drawn between the Constitution and the prisons."* [37]

35 *Ibid*.

36 *Supra* note 11.

37 *Wolff v. McDonnell*, 418 US 539.

Dissecting The 100% Reservation Case: Case Analysis of Chebrolu Leela Prasad Rao & Ors. v. State of A.P. & Ors.

Jaideep Singh Lalli*

Abstract

This paper is first and foremost, an exercise of separating the ratio from the obiter for a 152-page judgment to allow the reader to engage with the reasons given by the Court for arriving at its decision with considerable ease and provides an account of the author's opinion not just on the Court's reasoning but also on the unfair criticism that the judgment has received from other academicians. Discussing the SC's view on Andhra Pradesh's policy of reserving 100% seats for the post of school teachers in Scheduled Areas for local S.T. candidates to conclude that the Apex Court's preoccupation with the constitutional repugnancy of a reservation to the tune of 100%, relegated the issue of examining the justification for the policy to haughty disdain that lacked reasonable substantiation.

Keywords: 100% reservation, Chebrolu Leela case, Scheduled Areas, teacher absenteeism

Introduction

Judicial review of reservation and preferential treatment policies has been quite the spectacle ever since cases like *Kesava Iyenger v. State of Mysore*[1], *M.R. Balaji v. State of Mysore*[2], *T. Devadasan v. Union of India*[3], *State of Kerala v. N.M. Thomas*[4], *A.B.S.K. Sangh (Railway) v. Union of India*[5] and a catena of others started to surface in the realm of academic scrutiny. The instant case is yet another intriguing instance of the Apex Court's

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1 *Kesava Iyenger v. State of Mysore*, A.I.R. 1950 Mysore 20.

2 *M.R. Balaji v. State of Mysor*e, A.I.R. 1963 S.C. 649.

3 *T. Devadasan v. Union of India*, A.I.R. 1964 S.C. 179.

4 *State of Kerala v. N.M. Thomas,* A.I.R. 1976 S.C. 490.

5 *A.B.S.K. Sangh (Railway) v. Union of India*, A.I.R. 1981 S.C. 298.

exercise of its power of judicial review of a policy which in its opinion fails to pass the test of rationality. Jurisprudence on the essentials of the constitutional scheme of equality (specifically, that of access to educational and public employment opportunities) has undergone marked interpretative change throughout the period since the late 1950s; all of which achieved finality to a considerable degree in the nine judge bench judgment of *Indra Sawhney v. Union of India*[6]. Principles like the 50% ceiling on vertical reservation, creamy layer exclusion and compelling reasons (like backwardness, inadequacy of representation and efficiency) developed in *Indra Sawhney* have enjoyed axiomatic judicial imprimatur since their consecration in *M. Nagaraj v. Union of India*[7]; the same trend has been followed more recently in *Jarnail Singh v. Lachhmi Narain*[8]. The *Chebrolu Leela Prasad Case* is a further addition to the long list of judgments that have predicated their rejection of outlandish reservation proportions on the principles evolved in *Indra Sawhney*. However, it appears that the *ratio decidendi* of the Court is preoccupied with the abhorrence of the 'percentage' amount prescribed for the reservation, to the exclusion of providing enough reasoning for why the actuation or reason of ushering such a 100% reservation policy is itself repugnant.

Contextualising the Judgment's Discussion

Factual Matrix: Tracing Governmental Obstinacy

The seemingly problematic reservation policy under challenge in the instant case was not the starting point of the controversy. The genesis of the issue was that the Governor of the erstwhile State of Andhra Pradesh (hereinafter abbreviated as 'A.P.'), in exercise of his powers under para 5(1), Schedule V to the Constitution of India issued G.O.Ms. No. 275 (dated Nov. 5, 1986) by which the posts of teachers in educational institutions in the scheduled tribe (hereinafter abbreviated as 'S.T.') areas had to be reserved for S.T.s only. But in Aug. 1989, the notification was quashed by the A.P. Administrative Tribunal. Another notification, G.O.Ms. No. 73 (dated Apr. 25, 1987) had been issued to amend G.O.Ms. No. 275, by which non-tribals were allowed to hold the post of teachers in the scheduled areas till such time any qualified local tribals were not available. Subsequently, non-tribals who had been appointed as teachers in such areas filed a writ petition in the High Court of A.P. against termination of their services. The High Court then declared G.O.Ms. No. 73 and the advertisements pursuant to that notification as violative of Article 14 of the

6 *Indra Sawhney v. Union of India*, A.I.R. 1993 S.C. 477.

7 *M. Nagaraj v. Union of India*, (2006) 8 S.C.C. 212.

8 *Jarnail Singh & Ors. v. Lachhmi Narain Gupta & Ors.*, (2018) 10 S.C.C. 396 (India).

Constitution of India. Later, the Government issued a new notification (G.O.Ms. No. 3 dated Jan. 10, 2000; hereinafter referred to as 'the impugned notification') that provided for 100% reservation for the posts of teachers in schools located in Scheduled Areas in A.P. to the local S.T. candidates only, out of whom 33 had to be women. A 'local S.T. candidate' was one who either himself was continuously residing or whose parents had continuously been residing in the scheduled areas of the district of which they were residents since Jan. 26, 1950. The tribunal set aside this notification again. Thereupon, writ petitions were filed at the A.P. High Court, where a three judge bench upheld the constitutionality of the impugned notification by majority. The aggrieved parties then preferred appeals to that decision at the Supreme Court, following which, the matter was referred to a Constitution bench of five judges (comprising Arun Mishra, Indira Banerjee, Vineet Saran, M.R. Shah and Aniruddha Bose, JJ.). The bench delivered a unanimous opinion on the legal questions referred to it. The case was decided on Apr. 22, 2020, and the judgment was delivered by Justice Arun Mishra. The bench came down heavily on the government for its obduracy in pushing for a policy that had previously been declared invalid by the tribunal, by issuing a new notification with a similar purpose.

The Majority Opinion Imbroglio: Scrutinising A.P. High Court's Reasoning

The A.P. High Court's majority ruling upholding the validity of the 100% reservation notification was based on four basic arguments: firstly, that the Governor possessed the power to issue the notification as per para 5(1), Schedule V to the Constitution, the non-obstante clause of which overrides all other provisions in the Constitution including Part III; secondly, that the policy was based on intelligible differentia and the classification had a nexus with the object sought to be achieved since the reservation was being provided in light of absenteeism of staggering proportions, of teachers in schools situated in scheduled areas; thirdly, the Court sought to legitimise the necessity for the impugned policy by shrouding it with the claim that the scheme aimed at increasing literacy in scheduled areas by way of ensuring that teachers are available; and fourthly, the Court attempted at using the scope allowed in *Indra Sawhney* for the existence of exceptional scenarios where the 50% ceiling limit could be relaxed in to say that the ceiling limit wasn't an absolutist ordainment.

The minority opinion of the High Court naturally, projected an entirely different viewpoint. The judge asseverated that providing 100% reservation by its very nature was the antithesis of the constitutional structure of equality of opportunity, since the impugned policy was discriminatory not just to the open category, Scheduled Caste and Other Backward Classes candidates but also to those S.T. candidates who did not pass the arbitrarily fixed 'local S.T.

candidate' threshold. It was emphasized that the exception for the 50% ceiling permitted little relaxation, and that absenteeism by itself was not sufficient to justify the dogmatic policy. All these arguments were eventually considered by the five judge Constitution bench to arrive at its final decision.

Overview of A.P.'s Legal Framework on Reservation: Rules in 'Act'ion

The percentage amount of reservation to be provided to different classes in A.P. was substantively regulated by Rule 22 and 22A of the A.P. State and Subordinate Service Rules, 1996 (hereinafter referred to as 'the Rules'), which had been made under the proviso to Article 309 of the Constitution of India. The A.P. Regulation of Reservation and Appointment to Public Services Act, 1997 ((hereinafter referred to as 'the 1997 Act') *inter alia*, ensured that the scheme of reservation specified in Rule 22 is observed. The Act itself however did not spell out any percentage specifications for reservation. Apart from this scheme of reservation, as per Presidential Order[9] issued under Article 371D of the Constitution, aspiring candidates of any category could not apply for teaching posts outside the district/zone of their residence, which is why the Appellants asserted that the impugned notification would result in unfair ramifications since residents belonging to other categories in the scheduled areas would be completely deprived of the opportunity to apply (because, they can neither apply for the posts of these areas due to the 100% S.T. reservation and nor can they apply for posts outside such areas since the Presidential order prohibits that). The impugned notification in the instant case, issued by the Governor under para 5(1), Schedule V to the Constitution referred to the Rules and not to the 1997 Act for a modified application of the reservation percentages.

Accordingly, one of the main questions in the instant case at the Supreme Court was with respect to the scope of the Governor's power under para 5(1), Schedule V to the Constitution, since the Appellants had misgivings about interpreting the Governor's power under that provision to mean unbridled modification; and also because this power of modifying or creating exceptions (conferred on the Governor by para 5(1) of Schedule V) existed only with reference to an Act of the Parliament or the State Legislature. Naturally, the question of whether this power could be exercised with reference to the Rules was confounding. Needless to say, this issue found its way to the Constitution bench's attention, as the judgment provides a lengthy exposition on the law surrounding this quandary.

9 Andhra Pradesh Public Employment (Organisation of Local Cadres and Regulation of Direct Recruitment) Order (1975).

Detestable 100%: Sifting the Prolix Judgment

The five judge bench declared the 100% reservation policy to be *ultra vires* on the basis of four propositions: firstly, the Court held that the Governor could not have promulgated the policy with reference to the Rules (which were an amalgamate piece of subordinate legislation) under para 5(1), Schedule V powers because these powers could only be exercised in relation to an Act; secondly, the impugned notification's conflict with the Presidential Order results in consequences that upset the constitutional balance of equality; thirdly, 100% reservation has no place in the jurisprudential scheme of Article 16; and fourthly, the cutoff date, i.e., 26th Jan. 1950 is unreasonable. Each one of these propositions is accompanied by related questions of constitutional interpretation in the judgment, which is where complexity intensifies.

Extensive Modification or Inaccurate Legislative Reference: Where did the Governor Go Wrong?

As explicated earlier, the impugned notification was issued by the Governor under para 5(1), Schedule V to the Constitution, a provision which only allows the Governor to make exceptions or modifications to an Act as regards its application to a specific Scheduled Area. The two questions arising from this verity are: (i) 'can the Governor exercise this power without reference to any Act?'; (ii) 'does the Governor have the power to modify the reservation scheme to such an extent that the percentage scheme is entirely replaced by a new one?'.

The answer to the first question is already crystal clear. The answer to the second one is still somewhere in a boundless sea of uncertainty. The judgment relies on past precedent to clarify that there is no rationale behind limiting the word 'modification' only to such modifications that do not make any radical transformation.[10] With that, the Court also refers to judgments that speak for a more restrictive interpretation of the word 'modification'. However, the Court fails to provide any clarity on which side lays down the correct law. Towards the end of the discussion on the problem posed by the second question, the Court does say "the exceptions and modifications are created by the law, which is already applicable in the area. It is not the formulation of a new law which is contemplated under Para 5(1) of Schedule V…The power of modification cannot extend to rewriting the entire statute". Albeit, the Court makes these general remarks, but it is still unclear whether the Court regards the change in the percentage scheme (from those under Rule 22 to 100% local S.T. candidates) as an action that seeks to 'redraft the complete statute' under the false garb

10 *Puranlal Lakhanpal v. President of India*, A.I.R. 1961 S.C. 1519.

of mere modification or whether it only objects to the Governor's peccadillo in referring to the Rules (and not the 1997 Act) for making a modification in policy which is valid in as much as it's merely a modification and not a complete repudiation. It is unequivocal that the Governor has erred in exercising his power under para 5(1), but inexactitude remains as to whether the 'excessive modification flaw' has been committed or not. The judgment further provides countenance to the analysis of how the combined effect of the impugned policy and the Presidential Order is glaringly discriminatory not just to the open category incumbents but also to those of other disadvantaged sections.[11]

100% Reservation for Chronic Absenteeism: Is the Justification Reprehensible or the Percentage?

The judgment in the instant case proffers two reasons to advance the assertion that 100% reservation is incompatible with constitutional requirements. Firstly, as per *Indra Sawhney* reservations for S.C.s, S.T.s and O.B.C.s under Art. 16(4)[12] are not founded on the 'proportionate representation' principle (reservation for a specific class proportionate to the population of that class in the area for which the reservation has to be made), instead, they are based on the 'adequate representation' concept (which contemplates larger considerations of social backwardness, inadequacy of representation and administrative efficiency for arriving at a decision on the percentage). For this reason, 100% reservation for S.T.s cannot be permitted merely because it is sought to be enforced in Scheduled Areas (with a sizeable S.T. population) as, such a percentage defies logical corollaries of the precepts of adequate representation (one of which is Dr. B.R. Ambedkar's recognition that reservations under Article 16 are to be confined to a minority of seats[13]). The court also added that unlike in art. 330 and 332 of the Constitution (which follow the proportionate representation principle), the proposition that only tribal teachers could effectively teach tribal students could not be affirmed for such employment. Secondly, the significance of the 50% ceiling is reiterated to insist that the discriminatory effects of this percentage amount (when placed in the context of the Presidential Order) validate its spurning.

The Court does not shy away from engaging with the characterisation of the need for the 100% reservation policy, as is propounded by the Respondents. The Respondent side contended that due to serious dearth of requisite facilities and inaccessibility, teachers in

11 The right to affirmative action through reservation that the Indian Constitution assures to other disadvantaged sections like SCs & OBCs, stands to be whittled down because of the impugned scheme as it provides for reservation of all the seats only for a specific vulnerable group, i.e., the STs of the concerned region, to the exclusion of SCs & OBCs.

12 Indian Const. art. 16, cl. 4.

13 Constituent Assembly Debates, 30 Nov. 1948.

Scheduled Areas were not turning up to teach, which led to phenomenal absenteeism of non-tribal teachers; this in turn necessitated a reservation policy by which local tribal teachers could be provided for whom accessibility wouldn't have been an issue, since they would've been local residents. According to the Respondents, this peculiar predicament was sufficient to warrant the 100% stipulation. The Apex Court emphatically disagreed. The judgment's non-acceptance of this justification was based on a two-pronged argument: firstly, the absenteeism complication could have been taken care of by providing "better facilities and other incentives"; and secondly, the decision to release the impugned notification was not taken on the basis of any verifiable data, but only on the ground of absenteeism. Albeit, the four propositions tendered for declaring the impugned policy as unconstitutional form a well-founded and compelling *ratio* in their conglomerate capacity, yet, the two pronged argument meant to counter the 'absenteeism justification' seem half-heartedly proposed at best and inadequate at worst. This is because the application of the generic platitude of 'other alternatives' can be extended to almost any justification for a reservation, for instance, it can be argued that a reservation policy motivated by inadequacy of representation should be rejected because 'other alternatives' exist in the form of providing 'better facilities and perks' at the educational level to incentivise students from disadvantaged communities to work harder for enhancing their merit positions. This is not to say that the impugned policy of 100% reservation is anyhow valid just because one of the sweeping arguments against its justification is perfunctorily explained.

Similarly, it is unfortunate that the Court does not explain what it implies by insinuating that required data wasn't collected and the policy was only based on absenteeism. The Court's only mention of this argument in the entire judgment deserves to be reproduced *in extenso* for clarity: "The decision to issue G.O. Ms No.3/2000 was taken not on verifiable data, but it was taken on the basis that there was chronic absenteeism of nontribal teachers in the schools in scheduled areas." It is uncertain whether the Court was doubting the veracity of the 'absenteeism justification', because the sentence structure implies that the Court regards the subject of the verifiable data to be different from the justification that the Respondents provide. The question of what this 'verifiable data' was supposed to indicate remains eclipsed by incertitude. It would still be instructive to acknowledge that it is plausible that the Court was trying to make an 'insufficient factual foundation' argument to say that Respondent's justification cannot be accepted on face value without necessary statistics.

This examination of the Court's response to two parts of the policy's analysis, i.e., the content of the policy (100% reservation) and its actuation (the absenteeism justification) reveals that the Court was not shaken as much by the justification that the respondents

provided as it was by the magnitude of the reservation's percentage. This translated into a preoccupation with establishing that the impugned policy is *ultra vires* because it specifies for reservation to the tune of '100%' seats (a condemnably disproportionate stipulation), and in this absorption with the alarming percentage specification, focus on engaging with the absenteeism explanation was inexorably lost.

Judgment's Legal Elucidation: Regrettable for Banality or Desirable for Stare Decisis?

The judgment's reasoning may not seem to have been guided by a significant degree of novelty *ex facie*. Most of its *ratio decidendi* is a mere reproduction of portions from past precedents that are germane to the discussion of the issues referred to the Constitution bench in this case. That by itself should not inspire any disparaging critique to refer to this as an instance of unoriginality, as long as the precedent being cited is relevant to rendering a decision characterised by a consistent application of established dictum. The judgment deserves plaudits for contributing some clarity to the difference between the Governor's power of modifying and creating exceptions to the application of Acts for specific Scheduled Areas under para 5(1), Schedule V of the Constitution and the Governor's law making powers under para 5(2), Schedule V. Its discourse on non-obstante clauses in the Constitution and their relationship with Part III also irons out the wrinkles in that regard, since it provides a conclusive pronouncement to the effect that exercise of powers under non-obstante clauses in the Constitution cannot escape the scrutiny of Part III rights and the Constitution's basic features.

Concluding Remarks: Addressing Unwarranted Denigration

It is lamentable that academia is fraught with instances of unfair critiques that use cherry picked lines from a judgment to present a dismal (but apocryphal) picture. Sadly, even the *Chebrolu Leela Prasad Case* has not remained immune to this phenomenon. The judgment has recently been lambasted for purportedly expressing disdain and tacit contempt for tribal culture.[14] That critique is uncalled for in so far as the judgment does not, firstly, extend 'primitive' as an adjective to tribal culture as a blanket ascription. The judgment's emphasis on the lack of access to education and healthcare which invariably imply exposure to scientific living (and not one rooted in divine reveries) provides ample context to understand what exactly the Court means by integration of tribal people who have lived primitively in isolation for decades. Saying that the judgment makes scornful generalizations is an exercise

14 Amit George, *Tribal Culture(s) and the Supreme Court: A Critique of Chebrolu Leela Prasad & Ors. v. State of A.P. & Ors.*, Bar and Bench (Apr. 28, 2020, 9:07 AM), https://www.barandbench.com/columns/tribal-cultures-and-the-supreme-courta-critique-of-chebrolu-leela-prasad-ors-v-state-of-ap-ors.

in unnecessary sensationalism. Secondly, labeling the judgment as an ethnocentric account of tribal culture is preposterous in light of the objective context of national integration and commitment to an educated & scientific way of life, supported by healthcare, which the judgment provides as a vision for tribal people. The judgment at no point seeks to address the tribal people as disgraceful savages that need occidental reformation. It merely acknowledges the history of disenfranchisement of tribal people and thereby presses the need for their meaningful integration into the national life through representation, education and healthcare. Therefore, the surmise that the judgment exhorts its readers to harbour a hankering for cultural uniformity is gravely misplaced.

This careful examination of the judgment and the opinions of its critics discloses that the five judge bench has applied the principles developed in past precedents consistently to the facts of the instant case. With a reasoning mostly based on well-established constitutional requirements like the 50% ceiling, the adequate-proportionate representation dichotomy and data collection to establish foundation, the judgment really is old wine in new bottles.

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Precautionary Principle and Environmental Jurisprudence: An Appraisal

Dr. Rajinder Verma*

Introduction

One of the most controversial principles of International Environmental Law is the precautionary principle. The need and the pitfalls of the principle have been highlighted by many. The debate however cannot be said to have exhausted itself, as the precautionary principle has been welcomed, criticized and ignored all at once. The actual contents of the rule have been difficult to formulate, as most of the existing formulations appear to be a result of political compromise clouded by sovereign need and greed. The objective of this research paper is to make an effort in crystalizing the constituents of the precautionary principle. In the course of the paper analysis of municipal jurisdiction with special reference to India is also made. The paper will take inductive approach by first analysing the international perspective and then broaden towards the Indian scenario. Most of the analysis in the paper will be restricted to the way the judiciary has played its hand in appreciating the intricacies of the principle.

Precautionary Principle- Conceptual Analysis

The precautionary principle means the principle of establishing a duty to take such measures that anticipate, prevent and attack the causes of environmental degradation even when there is not yet scientific proof that the environment is being harmed. [1] The taking up of measures does not require sufficient scientific evidence to identify a threat of serious of irreversible harm to the environment. The concept assumes that science does not always provide the insights needed to protect the environment effectively, and that undesirable effects may result if measures are taken only when science does provide such insights. Furthermore, it assumes that scarce financial resources may be allocated inefficiently if action is taken only after scientific certainty as to detrimental effects has been ascertained, particularly when alternative technologies and products are available. In fact, the precautionary concept rejects the so called assimilative capacity approach to environmental policy. The assimilative capacity principle is based on the belief that scientific theories are certain and adequate to provide the remedies for ecological restoration whenever environmental pollution occurs. The principle is built on the foundation of scientific certainties and adequacies. However, assimilative capacity principle suffered setback when the inadequacies and the uncertainties of science became visible in environmental context. It has

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[1] Gurdeep Singh, "Legal Status of Precautionary Principle in Environmental Jurisprudence", *National Capital Law Journal,* Vol. 5 (2000) Pg. 36

been revealed that inadequacies of science result from identification of adverse effects of a hazard and then working backwards to find causes.[2]

From a legal point of view, the most important facet of the principle is that positive action to protect the environment may be required before scientific proof of harm has been provided. The new element is the timing of, rather than the need for, remedial action. Preventive action once damage has been determined is a long standing requirement of international environmental law. In fact, the essence of the precautionary concept, the precautionary principle is that once a risk has been identified the lack of scientific proof of cause and effect shall not be used as a reason for not taking action to protect the environment. The timing between exposure and observable effect creates intolerable delay before regulation occurs.[3]

International Perspective

The precautionary concept has become intrinsic to international environmental policy, especially with the adoption in 1992 of the Rio Declaration at the United Nations Conference on Environment and Development (UNCED).[4] Principle 15 of the Rio Declaration provides that in order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as reason for postponing cost effective measures to prevent environmental degradation.[5] The Convention on Biodiversity in the preamble stated that where there is a threat of significant reduction or loos of biodiversity, lack of full scientific certainty should not be used as a reason for postponing the measures to avoid or minimize such a threat.[6] This statement indicates that the parties' obligations under the convention can be interpreted in the light of the precautionary principle. Agenda 21 also employs precautionary language tied to specific measures which would enhance the policy of a precautionary and anticipatory rather than a reactive approach is necessary to prevent the degradation of marine environment. this requires the adoption of precautionary measures, environmental impact assessment, clean reproduction techniques, recycling, waste audits and minimization, construction and improvement of sewage treatment facilities, quality management criteria for handling of hazardous substances and a comprehensive approach to damage impact from air, land and water.[7]

[2] *Id at 34.*
[3] *Ibid.*
[4] David Freestone, "The Road from Rio, International Environmental Law after the Earth Summit", *Journal of Environmental Law*, Vol. 6 (1994) Pg. 210-216.
[5] Rio Declaration on Environment and Development, June 14, 1992, UN Doc. A/Conf. 151/26 (Vol. 1). ILM, Vol.31 (1992), Pg. 874. Principle 15. (Here in after Rio Declaration).
[6] Convention on Biological Diversity, June 5, 1992, ILM Vol. 31 (1992), Pgs. 818-841. Article 7(C). (Here in after Biodiversity Convention).
[7] Agenda 21, the program of action adopted at UN Conference of Environment and Development (UNCED), Rio De janeiro, June 1992, Ch. 17, Para. 17.21

A perusal of the codification of the precautionary principle in few of the above instruments highlights that diversity in the understanding of the principle. After a similar study, it has been classified into the following:

First, the degree of harm that is required to get the precautionary principle into action. It varies from irreversible or serious harm to reasonable grounds for concern. The Bamako Convention[8] reduces the standard to just 'May Harm.' Moreover, since the standard of proof is not specified in any of these instruments, identifying the level on which scientific evidence is sufficient to override arguments postponing measures or at which measures might even be required as a matter of international law is still an open question.

Second, while the UN Framework of Convention on Climate Change (UNFCCC) requires that measures to anticipate, prevent or minimize the causes and mitigate its adverse effects through cost effective means,[9] Rio Declaration and the Bamako Convention link prevention and precaution thereby requiring total prevention of environmental degradation. The Ozone layer protocol requires that 'measures to control equitably.[10]'

Third, there is also a debate on whether the principle should take into account the relative capabilities of the nations to address environmental problems. For example, Principle 15, Rio Declaration and those instruments which use a verbatim reproduction of the same requires the implementation of the precautionary principle according to their capabilities. The European Energy Charter, for instance requires measure to be implemented in a cost effective measure, which impliedly brings the question of balancing the needs and capabilities of the states involved.[11]

Thus, precautionary principle has various elements like non-preclusion which means regulation should be precluded by the absence of scientific c uncertainty about activities that pose a risk of substantial harm. Margin of safety is another constituent of precautionary principle states that regulation should include a margin of safety, limiting activities below the level at which adverse effects have not been found or predicted. Best available technology requirements should be imposed on activities that pose an uncertain potential to create substantial harm, unless those in favour of those activities can show that they present no appreciable risk. Last component is prohibition should be imposed on activities that have an uncertain potential to impose substantial harm unless those in favour of those activities can show that they present no appreciable risk.

Indian Scenario

[8] Bamako Convention on the Ban of The Import into Africa and the Control of Trans-boundary Movement and Management of Hazardous Wastes within Africa, Jan 29, 1991, Art. 4(3)(f), 30 ILM 773, 781 (1991) (Here in after Bamako Convention)

[9] UN Framework of Convention on United Change(UNFCCC), May 9, 1992, Art. 3(3), 31 ILM 849-854, (1992) (Here in after UNFCCC).

[10] Protocol on Substances that Deplete the Ozone Layer, Sept, 1987 Preamble, 26 ILM 1541-1551, (1987); Vienna Convention for the Protection of the Ozone Layer, Mar 22nd, 1985 Preamble, 26 ILM 1516-1529 (1987); Protocol to the 1979 Convention on Long Range Trans-Boundary Air Pollution on Further Reduction on Sulphur Emissions, June 14, 1994, Preamble, 33 ILM 1540-1542 (1994).

[11] European Energy Charter Treaty, Dec 17, 1984, Art. 19(1), 33 ILM 360-394, (1995).

Environmental jurisprudence has seen considerable development in the last few decades. With the expansion of public interest litigation[12] and a more proactive definition of the fundamental right to life to include the right to environment,[13] the need to take positive steps in furtherance of such an objective became apparent. Keeping in mind the need to address the growing issues surrounding environment, its importance in the international arena and the lack of legislative and executive action in fulfilling this duty, the Supreme Court of India has taken a very proactive role in environmental jurisprudence. Keeping in mind its constitutional duty under Article 32 to protect the fundamental rights guaranteed in the Indian Constitution, the Supreme Court has incorporated various principles into our domestic system to fill the legislative and executive void. Once such principle is the precautionary principle, whose content, according to the court,[14] consists of;

- Environmental measures by the state government and the statutory authorities must anticipate, prevent and attack the causes of environmental degradation.
- Where there are threats of serious and irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- The onus of proof is on the actor or the developer or industrialist to show that his action is environmentally benign.

The above definition has been taken to be an authoritative one and has been reiterated in the decisions.[15] Nonetheless, each of these points has certain unsettled issues; does precautionary principle mandate a total prevention of environmental degradation by completely abdicating the activity? What significance must be attached to the serious and irreversible damage? How must one satisfy the onus in case of scientific uncertainty? Interestingly, there was no necessity to deal with the precautionary principle in Vellore Citizens case, there being no issue of uncertainty since the effects or pollution caused by the tanneries was already well researched and documented. How the principle is to be applied and how the onus is to be fulfilled were not discussed. The court, however did mandate that individual pollution control devices be set up for all the tanneries. In fact, most cases allegedly applying the precautionary principle do not actually apply the principle at all. In the Taj Trapezium matter,[16] court expressly stated that it is proved beyond doubt that the emissions generated by the use of coke/ coal by the industries in TTZ are the main polluters of the ambient air. The same applies to the case regarding emission standards for vehicles.[17] The discussion of the principle was thus futile. The only case that the author feels had any relevant application of the precautionary principle is the case of Nayudu[18].

[12] S.P. Gupta v. Union of India, (1981) Supp. SCC 87.
[13] Subhash Kumar v. State of Bihar, (1991) 1 SCC 598 at 604.
[14] Vellore Citizens Welfare Forum v. Union of India and Ors., AIR 1996 SC 2715.
[15] A.P. Pollution Control Board. v. Prof. M.V. Nayudu, (1999) 2 SCC 718.; S. Jagannath v. Union of India and Ors, (1997)2 SCC 87.
[16] M.C. Mehta v. Union of India and ors, (1997), 2 SCC 353.
[17] M.C. Mehta v. Union of India, (1999), 6 SCC 12.
[18] *Supra Note 15.*

In an effort to provide an answer to the third question mentioned above, the court held that they are to discharge this burden by showing the absence of a reasonable ecological or medical concern. That is the required standard of proof. The result would be that if insufficient evidence is provided by them to alleviate concern about the level of uncertainty, then the presumption should operate in favour of environmental protection.

The court in a subsequent order,[19] applying the above test, denied permission to one industry to construct within ten kilometre radius of certain lakes which were providing drinking water to nearby cities. The court after making an in detail examination of three independent scientific reports stated that it cannot be said that the two lakes will not be endangered[20] and rejected the solution provided by the industry since it did not take care of elimination of effluent effects. When it was argued that this can be taken care of by making sure that during storage of raw material and after release of the hazardous liquids, they are put in containers and removed; the court rejected the same on the basis of the reasonable man's test. The court held that the burden cannot be discharged by relying upon a bare assurance that care will be taken. If one has a relook at the decision, there was no uncertainty for dispute regarding the ecological impact of the industry, even in case of seepage; rather the developer himself was committed to taking steps to prevent such pollution. The dispute was whether the proposed solution could actually keep the possibility of pollution at bay, the answer being no, the court did not permit the construction of industry. The following quote form another decision of the court seems appropriate.[21] It appears to us that precautionary principle and the corresponding burden of proof on the person who wants to change the status quo will ordinarily apply in the case of polluting or other project or industry where the extent of damage likely to be inflicted is not known. When there is a state of uncertainty due to lack of data of material about the extent of damage or pollution likely to be caused then in order to maintain the ecological balance, the burden of proof that the said balance will be maintained must necessarily be on the industry or the unit which is likely to cause pollution. On the other hand where the effect on ecology or environment on setting up of an industry is known, what has to be seen is that if the environment is likely to suffer, then what steps to mitigate can be taken to offset the same. Merely because there will be a change is no reason to presume that there will be ecological disaster. Although, the court's opinion that construction of dam does not lead to ecological disaster may be questionable, what is of our concern is the implication of the above paragraph. When the petitioner questioned the environmental effects of the project, including the magnitude of a few, the court just .chose once scientific opinion over another that favouring the project coupled with a solemn oath on the part of the state to monitor the ecological impact. The court held that since the studies have been undertaken and further studies are underway in assessing the impact of the project, there was no need for the court to interfere.

[19] *Ibid*
[20] ibid
[21] Narmada Bachao Andolan v. Union of India and Ors., (2000) 10 SCC 664.

Similarly, in the Tehri Dam case,[22] the court refused to take a stand in case of uncertainty. Experts in science may themselves differ in their opinions while taking decisions on matters related to safety and allied aspects. The opposing viewpoints of the experts will also have to be due consideration after full application of mind. When the government or the concerned authorities after due consideration of all viewpoints and full application of mind took a decision, then it is not appropriate for the court to interfere. Such matters must be left to the mature wisdom of the government or the implementing agency. In such cases, if the situation demands, the courts should take only a detached decision based on the pattern of the well settled principles of the administrative law, if any such decision is based on irrelevant consideration or non-consideration of material or is thoroughly arbitrary, then the court will get in the way. Here the only point to consider is whether the decision making agency took a well informed decision or not. If the answer is yes then there is no need to interfere. The consideration in such cases is in the process of decision and not in its merits. Even when deliberating upon these proposed mitigation factors, the court presumed the ill effects of the dam, though not their magnitude. On the contrary, there was scientific uncertainty as to the seismic stability of the dam, the court in such a situation, ordered that further tests be done in this regard.

The preliminary conclusion is that most cases which declare the precautionary principle to be law do not apply the same and reliance on such cases would not be prudent. In those few cases in which the court does seem to have applied the principle, the facts never warranted the application of the same. Typically in this category of cases, the subject matter involved was the emission of pollutants or the use of hazardous substances, whose negative effects were well documented. Even in those rare cases where there was a need to apply the principle, the court has taken a backseat approach by limiting itself to procedural requirements of further studies and reiterating mitigating factors, the utility and effect of which were never discussed.

One may clearly conclude from the above that the precautionary principle appears as a very bleak object in the eyes of the judiciary, a vision that is clouded by limited judicial review. The use of the precautionary principle as a shield rather than as a weapon in testing any action reduces the scope of the precautionary principle to merely a tool of executive or legislative prerogative. Judicial deference to administrative bodies in such cases highlights the inherent policy issues involved in making decisions on the basis of the precautionary principle. So what are these inherent difficulties with the precautionary principle? The answer is the concept of risk, one thing that seems undisputed is that the precautionary principle applies only in cases of uncertainty. Of course, for our purposes, we restrict ourselves to the studies of the potentially negative environmental consequences of an activity. In simple words, prior to the application to the principle, there is a need to understand the environmental risk involved with an activity, risk being defined as the possibility of an unfortunate event occurring.[23] This is done through the mechanism of risk assessment or Environment Impact Assessment in the appropriate cases. The goal of risk assessment is to measure the overall magnitude of the risk taking into account

[22] N.D. Jayal and Anr. v. Union of India and Ors., (2004) 9 SCC 362.
[23] Environmental Damage in this case.

probability of harm, pathways of causing harm and size of at risk population. The assessment process can result in either a quantitative measure of the risk or a qualitative description such as substantial risk or high risk depending on the purpose of the assessment and the availability of data. When such an assessment is made, there could be certain risks which may remain controversial at the scientific level but which may not be unreasonable to expect. In other words, even uncertain risks require a minimal level of scientific evidence of a probability of a risk.

Risk management is the next step involved in the precautionary principle. The question is how to respond? Perplexing questions like, should the activity be forgone? Or should measures to mitigate the damage be taken etc. confront the decision maker at this stage. Logically, this depends on the probability of the event occurring and the damage it may cause in case of occurrence. In other words, the decision maker will have to balance the cost of the measure as against the cost of inaction. Thus, what action is to be taken is a function of factors. Briefly speaking, the application of the precautionary principle may result in three types of unintended results; risks from alternatives by unintentionally exposing an individual to other untested alternatives due to banning a substance by application of the precautionary principle. Further, by denying the benefits of the product which may have more benefits than harm. Lastly, risks of remediation, since the remedial action may itself cause new risks cleaning up hazardous wastes.

Conclusion

Thus, precautionary principle comes into play when the risk is too high, so high in fact that full scientific certainty should not be required prior to the taking of remedial action.it is to be applied in those cases wherever activity may result in long lasting or irreversible damage to the environment as well as in those cases where the benefit to be derived from a particular activity is completely out of proportion to the negative impact which that activity may have on the environment. in certain cases, the number of consideration that needs to factored into the decision making process becomes to many to handle with a sequential flow of thought. This inevitably will lead to the introduction of personal and professional judgements into the assessment process. The challenging of this decision is an adjudicatory mechanism is an even more mind boggling task. The objective of this research paper is not to dismiss the precautionary principle. Instead, what the author wishes to underscore here is that the precautionary principle does not necessarily result in making the correct decisions at the right time.

A consequence of this analysis is that the precautionary principle is not in the nature of a standard that we have always come across in the field of law. It is principle with potentially no standards or basis to review. It is an open ended policy question. It is for this reason that judiciaries all over the world have been grappling with applying the precautionary principle to each case, it is for the same that interpreting the precautionary principle as positive obligation upon the state to be enforceable in a court of law would require stretching common sense too far, to such an extent that the system may fall under its own weight. This highlights the need for other mechanisms, apart from the judicial process in regulating and applying the precautionary

principle. As the Law Commission of India in 2003 in its 186th report on proposal to constitute environment courts noted, under the existing system, most appeals against decisions taken are to various officers of government or departments of government and not to a court manned by persons with judicial knowledge and experience assisted by experts in various aspects of environmental science. Even if such other mechanisms are established, reviewing a decision by running through every single document, a new will remain a daunting task. On the other hand, this analysis highlights the need for an effective and efficient decision making process and procedure at the very beginning. This is yet another area that emphasizes the requirement of a vigilante and strong executive in the governance of any nation.

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RIGHT TO PRIVACY VIS-A-VIS RIGHT TO INFORMATION

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1. INTRODUCTION

Right to Privacy has been included in to the Constitution of India by the Hon'ble Supreme Court as a component of two Fundamental Rights - the right to freedom under Article 19 and the right to life and personal liberty under Article 21. The higher judiciary of the country, consumer redressal forums as well as Information Commissions have developed the right to privacy over decades since independence.[1] The much-debated right of privacy so provided is conditional under almost all the laws. The laws that once were restricted to privacy alone now affirm that the information being a valuable asset may be claimed by other individual, corporation, national entity etc. The right to information strives to promote transparency and accountability in the functioning of the Government. After the commencement of Right to Information Act in 2005, various new provisions permitting the right to seek information came into practice.

The clash of individuals with each other or clash of groups or associations with each other or with individuals to achieve wants and desires often may give rise to conflict or competition between interests.[2] Different statutes governing the privacy rights attempt to create harmony between the right of individuals and social interests.[3] The year 2000 has been selected to discuss the provisions before and after the commencement of Information Technology Act,2000. The present paper examines the pattern of carving out the exceptions against the privacy right by the government. It presents out harmony between pro-privacy and anti-privacy legal provisions. The paper is confined to existing provisions under Indian legal system and does not cover proposed Bills. The paper is based on doctrinal research, covering various scattered legislative provisions.

2. PRIVACY OF COMMUNICATIONS UNDER INDIAN LAWS BEFORE 2000

The Indian legislative regime under various areas such as Postal Articles, Medical Information, Public Information relating to Deaths & Births etc. embodies the powers on one hand and restrictions to protect the privacy on the other hand.

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1 Kharak Singh v. The State Of U. P. & Others AIR1963 SC 1295; . M. Malkani v. State Of Maharashtra AIR 1973 SC 157; R. Rajagopal v. State of Tamil Nadu AIR 1995 SC 264; Mr. 'X' v. Hospital 'Z' AIR 1999 SC 495 etc. are some of the landmark decisions of the Apex Court upholding right to privacy .

2 *See* ROSCOE POUND, JURISPRUDENCE Vol. III , 17 (1959).

3 *See* ROSCOE POUND, JURISPRUDENCE Vol. III , 23-24 (1959) ,W. FRIEDMAN, LEGAL THEORY 336 (2003).

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ASSIMILATION OF TECHNOLOGICAL ADVANCES VIS-À-VIS INDIAN CRIMINAL JUSTICE SYSTEM

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ABSTRACT

The present paper aims to highlight current technologies deployed in the criminal justice system in India along with identifying the impacts of technology on the criminal justice system and specify interactions between criminal justice and technology. Technology has been seen as a dependent and independent variable.[1]

1. INTRODUCTION:

Technology does not determine social structure; it simply widens all kinds of possibilities. The thoughtful incorporation of technology into our society requires an active evaluation of our values as a society, of how our society can and should be reshaped by the technology, and of how the technology should be shaped by our society. Although each technological change may have very different impacts on both law and society, useful observations can be made at a more general level. Technological change has an impact on existing legal rules-enhancing uncertainty, making them over-inclusive or under-inclusive, and rendering them obsolete.[2] The criminal justice system as a whole results from the interaction between legal rules, administrative practice, and societal attitudes and behavior.[3] The developments in medical sciences, psychology[4] and information technology has enabled the smooth working of the criminal justice system. The police community must use technologies to combat the technological sophistication of the criminals.

2. ADOPTION OF NEW TECHNOLOGIES BY CRIMINAL JUSTICE SYSTEM:

In most cases, a suspect enters the criminal justice system as a result of investigation and apprehension by the police. Since the beginning of organized police work in the early 19th century, technological advances have widened the net cast by police investigations and have improved the ability to identify offenders and capture suspects. Now new technologies are providing police with powerful new capabilities. By improving the abilities of local and State law enforcement agencies to cooperate across jurisdictions, these new technologies and have may also decrease their dependence on Central law enforcement agencies. Innovations in criminal justice technology can be divided into two broad categories: hard technology (hardware or materials) and soft technology (computer software, information systems).[5] Hard technology innovations include new materials, devices, and equipment that can be used to either commit crime or prevent and control crime.[6] Soft technologies involve the strategic use of information to prevent crime and to improve the performance of the police.[7]

2.1 Use of Technology in Investigation, Identification and Apprehension:

(a) Technology in Investigation:

Forensic science has developed over the past 300 years or so, and its processes continue to improve and evolve today as science and technology find better and more accurate techniques. In 1929, the first American forensic lab was created in Los Angeles by the police department. Forensic science plays an integral role in the criminal justice system.

(b) Technologies Used for Identification:

Cell Phone Records:

Generally, cell phone record investigations are a type of telephone surveillance, cell phone surveillance that can be part of a larger investigation or can stand on their own as an investigation. These investigations are crucial to many types of investigations, including asset searches, missing persons cases, skip tracing, fugitive recovery, process serving, cheating spouse investigations, domestic investigations, background checks, telephone account investigations, employee checks, business checks, fraud investigations, criminal investigations, phone call record theft investigations, child custody investigations, child abuse investigations, and others.

The Indian Evidence Act, 1872 and Information Technology Act, 2000 grants legal recognition to electronic records and evidence submitted in form of electronic records. According to section 2(t)[8] "electronic record" means data, record or data generated, image or sound stored, received or sent in an electronic form or micro film or computer generated micro fiche. The Information Technology Amendment Act, 2008 has recognized various forms of communication devices and defines a *"communication device"* under section 2 (ha)[9] of the Act *"communication device"* means cell phones, personal digital assistance or combination of both or any other device used to communicate, send or transmit any text, video, audio or image.

DNA Technology[10]:

DNA profiling (also called DNA testing, DNA typing, or genetic fingerprinting) is a technique employed by forensic scientists to assist in the identification of individuals by their respective DNA profiles. DNA profiles are encrypted sets of numbers that reflect a person's DNA makeup, which can also be used as the person's identifier. In India, initially the judges took very conservative views regarding the application of DNA evidence in resolving the paternity/maternity dispute cases. What is striking is that the dominant controversies about DNA technology now revolve around the competence of the criminal justice system rather than the reliability of the technology itself.

Automated Fingerprints Identification System[11]:

One of the most important parts of a forensic investigation is fingerprinting. As fingerprints are unique to each individual, they serve as a highly accurate way for law enforcement agencies to identify a suspect, as well as potentially prove their guilt or innocence. The Indian Version of Automated Fingerprint Identification System (AFIS) is called FACTS, which was co-developed, by NCRB and CMC Ltd., India. The current version of FACTS is 5.0. The system uses Image Processing and Pattern Recognition technique to capture, encode, store and match fingerprints, including comparison of chance prints. It uses pattern class, core and delta information, minutiae location, direction, neighbouring information, ridge counts and distances, density, type, print background/foreground information etc. for matching Finger Prints. Apart from the above details, FACTS also stores non-fingerprint information or demographic details like gender, region and conviction details.

In Drojan Singh and another v. State (Govt. of NCT of Delhi)[12], the Delhi High Court empowered the investigating agencies that the fingerprints or specimen handwriting of an accused taken by an Investigating Officer during probe into a case was admissible as evidence even though permission from a magistrate was not taken.

Detection Deception Tests:

The deception detection tests (DDT) such as polygraph[13], narco-analysis[14] and brain-mapping have important clinical, scientific, ethical and legal implications. The DDTs are useful to know the concealed information related to crime. This information, which is known only to self, is sometimes crucial for criminal investigation. Narco Analysis, Polygraph and Brain Mapping are main deception detection tests. Till 2010, various High Courts have interpreted the validity of such tests as per their judicial knowledge. In Selvi & others v. State Of Karnataka & Another , the Apex Court was of the view that the compulsory administration of the impugned techniques violates the `right against self- incrimination'. Forcing an individual to undergo any of the impugned techniques violates the standard of `substantive due process' which is required for restraining personal liberty.

(c) Electronic Surveillance for Apprehension[15]:

CCTV:

CCTV is used extensively and can be found in many places including in commercial premises, at ATM venues, on public transport, at airports, in central business districts, and shopping malls. The rate of uptake seems to be accelerating. As most central business districts now have them the most recent and future expansion of CCTV is in suburban and rural areas. India has now moved into an age where security seems to be the primary issue for most

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SUNTEXT REVIEWS

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Reflections on Rights of Health-Care Workers: A Study with Special Reference to State of Himachal Pradesh

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Abstract

The professional life of the doctors and other health-care workers is laborious due to the nature of their occupation. The primary and inherent peril of their occupation is risk of various infections. Their jobs may become life-threatening while treating patients having contagious diseases. They also have to deal with the physical and mental fatigue, the torment of difficult decisions, the agony of deaths of their patients and colleagues. The present situation in the world of Covid-19 has raised the challenges for them as the vast number of health-care workers got affected with it across the world. The state of Himachal Pradesh had slow emergence of the Covid cases and the present paper looks at how the government has implemented the rights of the health-care workers.

Keywords: Covid 19; Health care workers; Himachal Pradesh; World health organisation

Introduction

As per Guidelines of W.H.O., there are numerous rights of the health-care workers during the current pandemic. Some of important rights include to receive all necessary preventive and protective measures to minimize occupational safety and health risks; to receive adequate IPC and PPE supplies (masks, gloves, goggles, gowns, hand sanitizer, soap and water, cleaning supplies) in adequate quantity to healthcare and other staff engaged in caring for suspected or confirmed Covid-19 patients. They must be acquainted with technical updates relating to Covid-19 and provided appropriate tools to assess, test and treat patients. They should be able to disseminate infection prevention and control information with patients and the public. Their rights extend to obtain information, training as well as instruction regarding occupational safety and health such as refresher training on infection prevention and control (IPC). They also have to know the correct manner of use as well as disposal of personal protective equipment (PPE). The right to receive proper working hours with breaks; to respect the right to compensation, rehabilitation and curative services if infected with Covid-19 after exposure in the workplace are included in the list of the rights. The right receive access to mental health and counselling resources is also primary. Due to a lack of personal protective equipment's, healthcare workers are being infected in hospitals. Others are also being infected outside hospitals, in their homes or communities. More than 3,000 healthcare workers from 79 countries around the world have died due to the novel coronavirus infection [1]. Almost 1,302 doctors have found positive for the virus. In terms of infections, private consultants and resident doctors count for the highest number of cases. Out of the total infected healthcare workers, resident doctors were 566, private consultants were 586 and house surgeons were 150. Till April 30, more than 5% accounted for healthcare workers. The above figure is expected to be a major undervalue due to a lack of reporting. They have also experienced reprimanding including arrests and dismissals from the authorities and their employers for voicing safety concerns. In some cases, they have been exposed to violence and stigma from members of the public. On 30th July, 2020 six months passed since a global health emergency was

declared under the International Health Regulations by the World Health Organisation. The research objectives of the present study are to discuss the rights of the health-care workers during Covid-19; to enumerate the measures taken by the Govt. of India and Govt. of H.P. for protecting the rights of health care workers and to study the enforcement of the rights of various health care workers in the state of H.P [2].

Ministry of Health and Family Welfare, Government of India vis-a-vis Rights of Health Care Workers

Inspirational series on Healthcare Service Personnel has been launched by the MoHFW. The series include musical tribute to the health-care workers; break the stigma-do and don'ts; gratitude towards them; felicitation of the nurses etc. The series is made available in Hindi and English. Insurance Scheme for Health Workers Fighting Covid-19 under Pradhan Mantri Garib Kalyan Package was approved in the end of March 2020. It will provide an insurance cover of rupees fifty lakhs for ninety days [3]. It aims to cover around 22.12 lakh public healthcare providers, along with community health workers, approaching Covid-19 patients in direct contact and care. It will also embrace accidental loss of life due contracting Covid-19. Due to the extraordinary situation, private hospital staff, retired, volunteer, local urban bodies, contract, daily wage, ad-hoc, outsourced staff employed by States, Central hospitals, autonomous hospitals of Central or States or UTs, AIIMS & INIs or hospitals of Central Ministries can also be included. An advisory dated 18th June 2020 requires detailed instructions; activation of Hospital Infection Control Committee (HICC), stipulates Standard Operating Procedure for health work force deployment during COVID-19 , different procedure to be adopted in case a health care worker reports symptoms suggestive of COVID-19 and mandates regular quarantine of healthcare workers after performing duty in COVID-19 areas. Country-wide Toll free helpline numbers have started under the aegis of the Ministry and under Indian Medical Association for pscyho-social support for the various health professionals [4-8].

Government of Himachal Pradesh vis-a-vis Rights of Health-Care Workers

On 28th March, Himachal Pradesh State Government formed a 'HP Covid-19 Solidarity Response Fund' to offer personal protection equipment to the health workers and other related officials. It would ensure even supply of essential commodities such as food items and medicines. A new bank account with HDFC Bank, Chotta Shimla has been opened to allow donors for generous donating to help the persons suffering during the COVID-19 pandemic. A number of Guidelines and Advisories have been issued by the Government of Himachal Pradesh dealing with Covid-19. List of Training resource material for the purpose of capacity building of health care professionals for Covid 19 containment was released in April, 2020. Committee for giving advisory for managing Health Care Work was constituted on 26th May, 2020. Covid Clinical Committees have been established in the six Government Medical colleges in State to monitor cases on day to day basis on 4th June, 2020. Additional incentive of Rs.1000 to all ASHA workers from March, 2020 to June, 2020 was announced on 26th June, 2020. HP SDMA Covid-19 State Disaster Response Fund is a secure way to contribute to the state of Himachal Pradesh efforts to respond to Corona pandemic. Essential supplies such as PPEs to various health workers and food, medicines etc. may be provided to communities with the assistance from this fund [9,10].

Study conducted in the State of Himachal Pradesh

The doctrinal and non-doctrinal methods of study have been adopted by the researchers. The health-care workers were interviewed through digital means. Around 25 questions were asked including the nature of job, district of posting, and the knowledge about the rights of the health-care workers. As on 30th July, 2020, the total number of cases in H.P. are 2403; active cases are 1057. Total 14 deaths have taken place so far in the State [11].

Universe of the study

The researchers have adopted convenience sampling. The universe of the study is state of Himachal Pradesh. Himachal Pradesh is located in the Western Himalayas and is one of the eleven mountain states and is characterized by an extreme landscape featuring several peaks and extensive river systems. It has a total population of 6,864,602. The state covers an area of 55,673 square kilometres (21495 sq mi) [12,13].

Nature of Respondents

108 respondents were included, from various categories of health care workers. Doctors, nurses, final year students, interns etc. constituted the respondents (Table 1) (Figure 1-5).

Findings

- Around 58% did not made any complaint regarding violation of their rights during Covid-19. Almost 20% of the respondents made violation of their rights whereas almost 22% made no complaint.
- Out of the respondents who made complaints, only 35% respondents found improvements after making the complaints. Whereas, for 65%, situation remained the same.

- 32.4 % respondents replied that they have not been provided any training on infection prevention and control; and use/ disposal of Personal Protective Equipment. Whereas 67.6% respondents were provided the training.

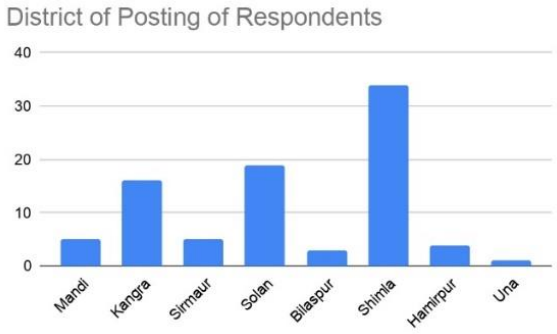

Figure 1: *District of posting of respondents.*

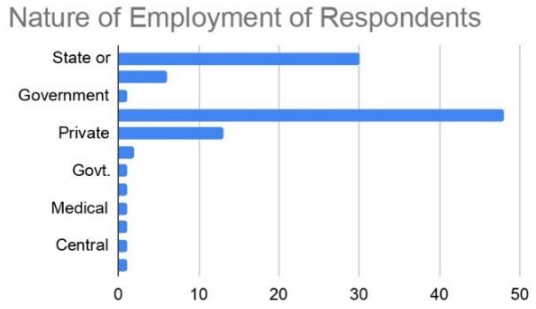

Figure 2: *Nature of employment of respondents.*

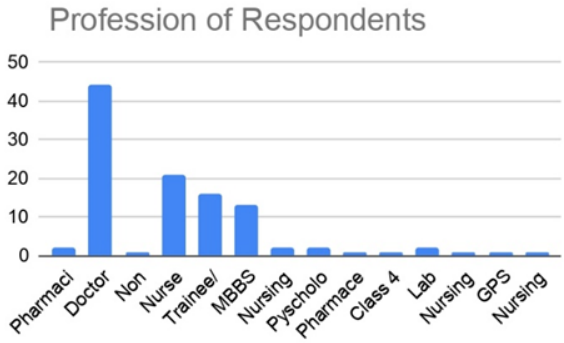

Figure 3: *Profession of respondents.*

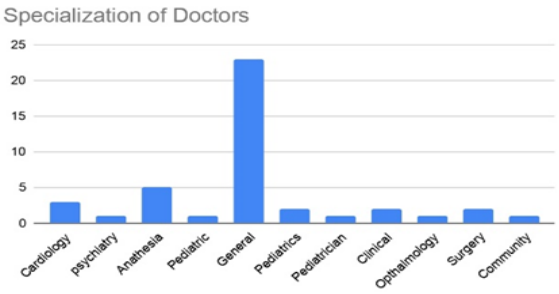

Figure 4: *Specialization of doctors.*

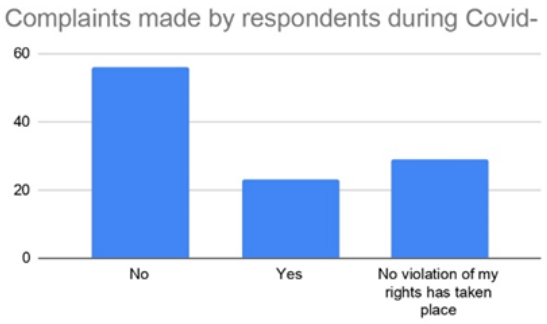

Figure 5: *Complaints made by respondents during Covid.*

Table 1: *Respondents from different parts of H.P.*

S.No.	District	Percentage of Respondents
1.	Bilaspur	3.4%
2.	Hamirpur	4.6%
3.	Kangra	18.4%
4.	Mandi	5.7%
5.	Shimla	39.1%
6	Solan	21.8%
7.	Una	1.1%
8.	Sirmaur	5.7%

- 58.3 % respondents answered that mental health and counselling services exist in your workplace, if required by a health-care worker. 41.7 % answered the absence of such services for the health care workers.
- 62.6% respondents were not aware of the toll-free helpline – "08046110007" for psycho-social support for health care workers in India. Only 37.4 % of the respondents had knowledge of this Toll-Free Helpline.
- 76.5% respondents found adequate availability of equipment's like pulse ox meter, temperature measuring devices etc. in their hospital or college. 23.5% answered negatively.
- Regarding regular sanitization of the hospital or the medical college, 64% respondents believed that their workplaces were sanitized whereas more than 20% of the respondents had no knowledge of sanitization. 16% believed that the hospital or college were not sanitized.

Conclusions and Suggestions

Health care workers have played a significant role in the global comeback to the Covid-19 pandemic. Across countries, they have put their health and wellbeing at peril. They continue to work in very difficult circumstances and with very little support, to ensure that people are able to access the essential services they need. It must be accepted that the health-care workers are a dominant

resource and their lives are precious for everyone. Recognizing and accepting that every health system is vulnerable would help to trace any existing gaps and would enable the protection of both health workers and the public at large.

- The national and state governments must take measures such as provision of food, rest and care for Health care workers and their families.
- The psychological support for Health Care Workers also needs to be focused.
- Adoption of proper security and sanitization measure by the hospitals and its supervision by the dedicated department of the Government.
- Enhanced incentive scheme for work over-time and extra shifts.
- Organized training and emergency drill sessions for the health workers.
- States should ensure that employers provide all health and essential workers with adequate PPE to protect themselves during the Covid-19 pandemic, in accordance with international standards, as set by W.H.O.
- States should place Covid-19 under the category of an occupational disease. The workers who contract Covid-19 as a result of work-related activities should be allowed to claim compensation and medical and other necessary care. This should comprise all health and essential workers regardless of the nature of their contract.
- Health and essential workers safety concerns must be attended to and addressed in a suitable manner. There must be no adverse action against workers for raising concerns or lodging a complaint related to health and safety.
- Prompt investigation in an independent and fair manner of any by attacks or acts of violence against health and essential workers must be done by authorities. Perpetrators must be brought to explanation.
- The States should acknowledge that health care workers are at a higher risk on account of their work.
- Effective, comprehensive and independent reviews should be undertaken regarding preparedness for and responses to the pandemic.
- Data on the basis of occupation, who have been infected by COVID-19, and how many have died as a result should be collected and published by States.

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3. Ensure that all preventive measures like frequent washing of hands/use of alcohol-based hand sanitizer, respiratory etiquettes (using tissue/handkerchief while coughing or sneezing), etc. are followed at all times. He/she shall use appropriate PPE at all times while on duty. Under buddy approach, two or more-person team is formed amongst the deployed hospital staff who share responsibilities for his/her partner's safety and well-being in the context of appropriately donning and doffing of PPEs, maintaining hand hygiene and (iii) taking requisite steps on observing breach of PPEs. Any breach in PPE and exposure is immediately informed to the nodal officer/HoD of the department. HCWs after leaving the patient care units (wards/OPDs/ICUs) at the doctor's duty rooms/hostels/canteen or outside the HCF must follow social distancing and masking to prevent transmission to/acquiring infection from other HCWs who may be positive. Pregnant/lactating mothers and immuno-compromised healthcare workers shall inform their medical condition to the hospital authorities for them to get posted only in non-Covid areas.
4. Hospitals shall activate its Hospital Infection Control Committee (HICC).The HICC in the health facility is responsible for implementing the Infection Prevention and Control (IPC) activities and organizing regular trainings on IPC for HCWs.
5. All the Healthcare workers must report every exposure to COVID-19 to the concerned nodal officer and HOD of the concerned department immediately. The Nodal officer will get the exact details of exposure to ascertain whether the exposure constitutes a high risk or low risk exposure.
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Environmental Protection and Role of Judiciary in India

Dr. Rajinder Verma*

Introduction

The law should vary with time and with changing needs of the generations. The legal theory of social engineering propounds that there should be an improvement in the law in the light of social wants of the time. An active judiciary adopts various means to meet the growing needs of a society. One of the major vehicles of justice in this regards is the public interest litigation. Indian Judiciary started adopting the concept of public interest litigation for promoting various interests of the society including its enforcement. Judicial activism may not only serve to improve the dynamism of the existing laws and jurisprudence but also lead to newer direction and fields where legal system has not developed at all. One of the classic examples is this regard should be environmental protection. With the limited number of specific legislations, the judiciary went on to adopt newer strategies to fill the gaps. In the 1980s, the judiciary started playing an active role. Though the activism of the Supreme Court was in different fields, the enthusiasm shown by the judiciary in protecting the environment is remarkable. It may not be an exaggeration to say that the active period of the Indian judiciary is overwhelmingly focused in rendering environmental justice. This active period saw the adoption of new techniques by the Supreme Court in recognizing liberal 'rules of standing.' It was a time when environmental consciousness was not as strong as of today and judiciary realized that limiting the standing to raise environmental issues to the traditional bodies, may not prove effective in saving the threatened environment.

A five judge Bench of the Supreme Court,[1] held that even a letter addressed to an individual Justice of the Supreme Court could be admitted in case of a public interest litigation. The court in admitting such letters even dispensed other procedural requirements like affidavits which are otherwise necessary to initiate litigation. In this progressive judgement, the Supreme Court emphasized the significance of judicial activism in the words that- 'Law has to grow in order to satisfy the needs of the fast changing society and to keep abreast with the economic development taking place in the country. As new situations arise, the law has to be evolved in order to meet the challenge of such new situations. Kaw cannot afford to remain static. We have to evolve new principles and lay down new laws, which would adequately deal with the new problems which arise in a highly industrialized economy.'

Judicial Activism

The innovation of the Public Interest Litigation by the Supreme Court into the judicial system has to a large extent contributed constructively in the protection of the environment. In lieu of

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[1] M.C. Mehta v. Union of India, AIR 1987 SC 1086.

this positive development, that opened upstairs for affirmative action. Social action litigation or Public Interest Litigation has come of age in India and the higher judiciary is doing a remarkable service in enforcing the rights of the Indian people in socio-economic and environmental matters in the face of executive apathy and indifference. In the process, the Supreme Court has established in resolving these matters is commendable. The court seeks the help of experts in the field through the constitution of committees and decides the relevant issues on the basis of technical reported data.[2]

This fresh approach to enable the judiciary to be more proactive has led the Supreme Court to adopt, apply, evolve and derive a range of principles to guide the development of environmental jurisprudence. In Municipal Council, Ratlam v. Vardhichand,[3] the resident of a locality within the limits of Ratlam municipality, tormented by the stench and stink caused by the open drain and the public excretion by nearby slum dwellers, moved the magistrate under Section 133 of the Criminal Procedure Code of 1898, to be its duty towards the members of the public. Another complaint was that the municipality had failed to prevent the discharge of malodorous fluids onto the public street. Due to this mosquitoes found in a stagnant stream, which was hospitable to breed and flourishing in. it was pointed that no municipal agent took note of the problem and adopted redressive measures. The Supreme Court, directed the municipality to remove the public nuisance and observed that if the centre of gravity of justice is to shift, as the Preamble to the Constitution mandates, from the traditional individualism of the locus standi to the community orientation of Public Interest Litigation, their issues must be considered. The municipality and the citizen of a ward are path finders in the field of people's involvement in the rusting process.[4] Accordingly, the court directed the municipality to take immediate action to stop the effluent from the alcohol plant from flowing in to the street. It also directed the state government to take appropriate steps to prevent pollution. The court also observed that industries cannot meet profit at the expense of public health after taking the excuse of budgetary provisions.

The first articulated indication of the right to a wholesome environment is in the Subhash Kumar v. State of Bihar and Ors.,[5] the Supreme Court held that Article 32 is designed for the enforcement of the fundamental rights of a citizen by the Apex Court. It provides for an extraordinary procedure to safe guard the Fundamental Right of a citizen. Right to live is a fundamental right under Article 21 of the Constitution and it includes the right of enjoyment of pollution free water and air for full enjoyment of life. If anything dangers or impairs to have recourse to Article 32 for the prevention of pollution is maintainable at the instance of the affected person or even by a group of social workers or journalists.[6] The doctrine of locus standi, applicable in the traditional private law litigation has been liberalised by the Indian courts in the

[2] Alice Jacob, 'Responsible Development and Ecological Balance', 27 JILI 485 (1985).
[3] AIR 1980 SC 1622.
[4] Ibid.
[5] AIR 1991 SC 420.
[6] Id at 428.

case of Public Interest Litigation. The traditional concept of standing is based on the doctrine of aggrieved person. The courts have accepted a new approach by allowing any member of the public to seek judicial redress for a legal wrong, caused to a person or to a determinate class of persons who by reasons of poverty, helplessness or disability or a socially disadvantageous position are unable to approach the court directly.[7]

In the Charan Lal Sahu v. Union of India,[8] the validity of the Bhopal Gas Disaster (Processing of claims) Act, 1985 was challenged on the ground that it allows the state to take away the rights of the victims to claim compensation by themselves. To decide the validity of the Act, the Supreme Court discussed the doctrine of parens patriae[9] in detail and asserted that the prerogative of the doctrine is inherent in the supreme power of every state, whether that power is lodged in the most beneficent function. In India, the Preamble to the Constitution read within Articles 38, 39 and 39-A of the Directive Principles of State Policy enjoins the State to take up such responsibilities. The Government is within its duty to protect and control persons under disability. It is the protective measure to which a social welfare state is committed. Supreme Court concluded that conceptually and from jurisprudential point of view, it is possible to authorize the central government to take over the claims of the victims if they were disabled in pursuing their claims. In the Shriram Gas Leak case,[10] Oleum gas leaked from a unit of the Shriram Food and Fertilizer Industries and affected the residents of Delhi. The Supreme Court in this case laid down the principle of absolute liability. The court declared the liability to be absolute and refused to limit itself to the decision in Rylands v. Flechers[11] that evolved a strict liability.

the Supreme Court In India held that the Precautionary Principle is the part of the environmental Law of the country. In the Vellore Citizens' Welfare Forum v. Union of India,[12] the court held that the Precautionary Principle in the context of the municipal law means:

- Environmental measures by the state government and the statutory authorities must anticipate, prevent and attack the causes of environmental degradation.
- Where there are threats of serious and irreversible, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- The onus of proof is on the actor or the developed industrialist to show that his action is environmentally benign.[13]

In a later case,[14] the court elaborated the new concept of burden of proof and observed that it is to be noticed that while the inadequacies of science have led to the precautionary principle. The

[7] S.P. Gupta v. Union of India AIR 1982 SC 149.
[8] AIR 1990 SC 1480.
[9] The doctrine of parens patriae literally means parent of the country and refers traditionally to the role of a state as the sovereign and guardian of a person with legal disability.
[10] *Supra Note 1.*
[11] 1868 (19) L.T. 220.
[12] (1996) 5 SCC 647.
[13] Id at 658.

said Precautionary Principle in its turn has led to the special principle of burden of proof in environmental cases where burden as to the absence of injurious effect of the change the status quo. This is often termed as a reversal of the burden of proof because otherwise in environmental cases, those opposing the change would be compelled to shoulder the evidentiary burden, a procedure which is not fair. Therefore, it is necessary that the party attempting to preserve the status quo by maintaining a less polluted state should not carry the burden of proof and the party who wants to alter it must bear this burden. The Precautionary Principle suggests that where there is an identified risk of serious or irreversible harm, it may be appropriate to place the burden of proof on the person or entity proposing the activity is potentially harmful to the environment.[15]

The Supreme Court in the Bichhri case[16] held that polluter pays principle to be a sound principle and observed that- 'We are of the opinion that any principle evolved in this behalf should be simple practical and suited to the conditions obtaining in this country.' The court further observed that the polluter pays principle demands that the financial costs of preventing or remedying damage caused by pollution should lie with the undertaking which caused the pollution or produce the goods which caused the pollution. Under the principle, it is not the role of the government to meet the cost involved in either prevention of such damage or in carrying out remedial action, because the effect of this would be to shift the financial burden of the pollution incident to the taxpayer.[17] The Supreme Court went on to categorically enshrine the principle as a sound law in the Vellore Citizens' case and observed that the Polluter Pays and Precautionary Principles have been accepted as part of the law of the land. Article 21 of the Constitution of India guarantees protection to life and personal liberty.[18] The court further observed that even otherwise, once these principles are accepted as part of the customary International Law, there would be no difficulty in accepting them as part of the domestic law. It is almost an accepted proposition of law that the rule of customary International law which is not contrary to the municipal law shall be followed by the courts of law.[19]

The Public Trust doctrine primarily rests on the principle on the principle that certain resources like air, sea, water and forests have such a great importance to the people as a whole. Hence, it would wholly unjustified to make them a subject of private ownership. The said resources, being a gift of nature should be made freely available to everyone irrespective of their status in life. The doctrine enjoins upon the government to protect the resources for the enjoyment of the general public rather than to permit their use for private ownership or commercial purposes. The Indian Legal System has inclined this spirit in its understanding of the principle. In the Span

[14] A.P. Pollution Control Board v. Prof. M.V. Nayudu and Ors., AIR 1999 SC 812.
[15] Id at 818.
[16] Indian Council for Enviro-legal Action v,. Union of India and Ors., AIR 1996 SC 1446.
[17] Id at 1466.
[18] *Supra Note 12.*
[19] Id at 660.

Motels case,[20] the Supreme Court held that our legal system, based on English common law includes the public trust doctrine as part of its jurisprudence. The state is the trustee of all natural resource, which are by nature meant for public use and enjoyment. Public at large is the beneficiary of the seashore, running waters, air, forests and ecologically fragile lands. The state as a trustee is under a legal duty to protect the natural resources. These resources meant for public use cannot be converted into private ownership.[21] Consequently, in an attempt to enhance the effective use of the principle, the court further held that the public trust doctrine was a part of the law of the land.[22]

The Supreme Court in the Ganesh Wood Products case[23] recognized the obligation of the present generation to preserve natural resources for the next and future generations. The court relied on the principle of inter-generational equity and explained that intergenerational equity means the concern for the generations to come. The present generation has no right to imperil the safety and well-being of the next generation or the generations to come thereafter.[24] In the judgement, the court quoted from the report of the World Commission on Environment and Development as- 'Environmental protection and sustainable development must be an integral part of the mandates of all agencies of government, of international organisations and of major private sector institutions. These must be made responsible and accountable for ensuring that their policies, programs and budgets encourage and support activities that are economically and ecologically sustainable both in the short and long terms.'[25] The Supreme Court[26] further emphasized in a significant principle that stringent action ought to be taken against defaulters and persons who carry on industrial or development activity for profit without a regard for environmental laws. The court further observed that we are also of the view that the tendency of raising unlawful construction in the entire country and such activities are required to be dealt with by firm hands. Such unlawful constructions are against public interest and hazardous to the safety of occupiers and residents of multi-storied building.[27]

The exercise of inherent powers of High Court under Section 482 of the Criminal Procedure Code depends upon the peculiar facts and the circumstances of each particular case. The Supreme Court in the case of M.C Mehta v. Union of India,[28] in a question raised by Pollution Control Boards relating to quick obtaining of stay orders from High Court under Section 482 of the Criminal Procedure Code, 1973 held that – "It is submitted before us that whenever the Board constituted under the Water Act, 1974 initiated any proceedings to prosecute industrialists

[20] M.C. Mehta v. Kamalnath and Ors., (1997) 1 SCC 388.
[21] Id at 413.
[22] Id at 415.
[23] Ganesh Wood Products v. State of Himachal Pradesh, AIR 1996 SC 149.
[24] Id at 159.
[25] Id at 163.
[26] Pratibha Co-operative Housing Society Ltd. v. State of Maharashtra, AIR 1991 SC 1453.
[27] Id at 1457.
[28] AIR 1988 SC 115.

or other persons, who pollute the water in the river Ganga, the persons accused of the offense immediately approach the High Court and obtain stay orders thus frustrating the attempts of the Board to enforce the provisions of the Water Act. They have not placed before us the facts of any particular case. We are however, of the view that since the problem of pollution in the water of river Ganga has become very active, the High Court should not ordinarily grant orders of stay of criminal proceedings in such cases and even if such an order of stay is made in any extraordinary case, the High Courts should dispose of the case within a short period, say about 2 months from the date of institution of such a case. We request the High Courts to take up for hearing all the cases, where such orders have been issued under Section 482 of the CrPC, 1973 staying prosecution under the Water Act within 2 months. The counsel for the Board constituted under the Water Act shall furnish a list of such cases to the Registrar of concerned High Court for appropriate actions being taken therein."[29]

The Supreme Court has further applied the principle of sustainable development in several cases. The application of the sustainable development theory arose in the Ganesh Wood Products v. State of Himachal Pradesh.[30] The decision in Vellore Citizens' Welfare Forum v. Union of India[31] was the first decision in which the Supreme Court discussed the principle of sustainable development in detail. In that case, the court was agitated over the matter of polluting tanneries in Tamil Nadu. In response to the contention that the industries could not be shut down given the contribution of leather tanneries to the economy, the court held that while industries are vital for the country's development, but having regard to pollution caused by them, the principle of sustainable development is to be adopted a balancing concept. Though the leather industry is of vital importance to the country as it generates foreign exchange and provides the employment avenues, it has no right to destroy ecology, degrade the environment and pose a health hazard.[32] More significantly, the Supreme Court pointed out the basic concepts of sustainable development and this has since subsequent law making in this regard held that the traditional concept that development and ecology are opposed to each other is no longer acceptable. It has come to be accepted that internationally, as a viable concept to eradicate poverty and improve the quality of human life while living within the carrying capacity of supporting ecosystems. Essential features of sustainable development are the Polluter Pays Principle and the Precautionary Principle.[33]

Conclusion

An active judiciary may adopt various means to meet the growing needs of a society. The judiciary has not only served to improve the dynamism of the existing laws but also of its jurisprudence. Environment protection is a classic example in this direction. The Indian Judiciary has earned an excellent record in the creation of environmental rights in India and its

[29] Id at 127.
[30] *Supra Note 23.*
[31] *Supra Note 12.*
[32] Id at 651.
[33] Ibid.

contribution to the jurisprudence of environmentalism has provided an example for everyone, all over the world.

As discussed, the judiciary has adopted, applied, evolved and derived a range of principles to guide the development of environmental jurisprudence. Yet the country has not achieved much. It may be because the judiciary has entrusted the enforcement and compliance totally to the government machinery. People's participation is the most important aspect, which is being so far neglected in the process of environment and compliance. If people's participation could have been enveloped in the enforcement and the compliance, the situation could have been much better than today.

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SCHEDULED TRIBES UNDER INDIAN LEGAL SYSTEM: AN ANALYSIS

Dr.Shalini Kashmiria
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Abstract: The term Scheduled Tribes refers to community of specific indigenous people whose status as such is recognised under the Constitution of India, 1950. The primary criterion adopted for delimiting Indian backward communities as STs include their traditional occupations of a whole range of tribal modes of life which is reflected in their language, customs, traditions, religious beliefs, arts and crafts, archaic traits, occupational pattern and economic development According to the 2011 census, the number of scheduled tribes in India is 10,42,81,034 which is 8.6 per cent of the total population. Approximatly 9,38,19,162 people belonging to Scheduled tribes live in rural India and 1,04,61,872 resides in urban India. In India, there exist labyrinth of laws for the protection of STs namely the Constitution of India,1950 Articles 15,16 17 , 19, 43,338,340-342 along with schedule V and VII.Beside this there exist independent Commissions,Ministry and Acts exclusively dealing with the overall development of Scheduled tribes such as National Commission for Scheduled Tribes,MOTA, TAC,PESA1996,The Scheduled Tribes and Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Scheduled Castes And The Scheduled Tribes (Prevention Of Atrocities) Act, 1989 and so on. Despite activism shown by legislative and administrative authorities still there exist issue of upliftment of ST population in India .The present research work is based on secondary methods of study. The secondary methods are based upon a collection of material from various sources such as the government surveys, reporters, Indian and foreign journals, International Conventions, research articles, newsweeklies, newsletters, internet, books newspaper clippings and various cases on the subject etc. The present research paper will try to critically analyse the limitations of existing statutory provisions and procedural implications and will explore legal possibilities of making amendment.

***Key words*:** Commissions, MOTA, TAC, Indigenous People, Backward Communities, Scheduled Tribes

1.INTRODUCTION

In India Scheduled Tribes represent a group of tribal communities which were designated as STs during the post independence period under The Constitution of India , 1950. In simple terms ST refers to marginalised communities of specific indigenous people demarcated on the basis of geographical isolation and not based on caste system. A collective term used generally to describe these people is '*upajati'* (clans/groups/tribes). The primary criterion adopted for delimiting STs in India include their traditional ancestral occupational pattern which they have inherited and their tribal mode of life reflected in their language, customs, traditions, religious beliefs, arts and crafts, archaic traits, and economic development[1]**.** As per National Law Commission for Scheduled Tribes the Scheduled Tribes are notified in 30 States/UTs and the number of individual ethnic groups notified as Scheduled Tribes is 705.[2]According to the 2011 census, the number of scheduled tribes in India is 10,42,81,034 which is 8.6 per cent of the total population. Approximatly 9,38,19,162 people belonging to Scheduled tribes live in rural India and 1,04,61,872 resides in urban India.[3]**.**

1 Swapan Deb Barma, "Protection of STs Under Indian Constitution", The Lex – Warrier Online Law Journal; 11(2010), available at:http://www.warrierlex.in/2010/11/protection_of_scheduled_tribes_under_indian_constitution (last visited on September 27, 2019).

2 Census 2011, Office of Registrar General and Census Commissioner,India,available at https://censusindia.gov.in(last visited on October 17 2019)

3 Census of India, available at http://www.censusindia.gov.in(last visited on October 17,2019)

2.CONCEPT

Indian Constitution also known as the fundamental law of land aims at securing for all its citizens socioeconomic justice, equality of status and opportunity, thereby assuring the dignity of the individual. Part XIX Article 366(25)[4] of the Constitution, 1950 defines Scheduled Tribes as *'such tribes, tribal areas and tribal communities that are deemed as Scheduled Tribes under Article342'*[5].

2.1 Who will be included in Scheduled Castes and Scheduled Tribes

Although Constitution of India does not define as to 'who' belongs to Scheduled Castes and Scheduled Tribes but empowers the President of India to draw up a list of these Castes and Tribes under Article 341 and 342.. Under Article 341[6] the President, after consultation with the Governor of the concerned State will specify the races, castes or tribes or of groups within these races, castes or tribes for purpose of their notification Scheduled Tribes and if such notification is concerning a state, then the Governor of the State has to be consulted. Any inclusion or exclusion from the Presidential notification of any race, caste or tribe can only be done by the Parliament by enactment of law. If any question arises with respect to status of a particular tribe as a tribe under Article 341, public notification issued under Article 340(1)[7] has to be taken into consideration. Further Article 342[8] explains the scope of Scheduled Tribes and provides that the President after consultation with the Governor with respect to a State or Union Territory (UT) by public notification specify the tribe/tribal community/part of/group within tribe or tribal community to be the STs in relation to that State/UT as the case may be. Further, the Parliament, by enactment of law is empowered to include or exclude any tribe/tribal community from the list of Scheduled Tribes[9]. Articles 330 to 342 of Constitution of India provides for special provisions for safeguarding the interest of Scheduled Tribes.

2.2 Bodoland Territorial Areas District

It is to be noted that a new provision has been added after Article 332 (6) by the Constitution 90th Amendment Act 2003[10]. which provides that the representation of Scheduled Tribes included in the Bodoland Territorial Areas District shall not affect the representation of Scheduled Tribes and Non – Scheduled Tribes in the Legislative Assembly of the State of Assam. Further the Constitution 79th Amendment Act, 1999[11] has substituted the word 'fifty' with the word 'sixty' in Article 334[12], thus extending the reservation of seats for Scheduled Tribes in the Lok Sabha and in the state assemblies up to 60 years from the commencement of the Constitution. Although seats are reserved but they are elected by all voters in the constituency. So there is no separate electorate Scheduled Tribes. As per Article 325 there shall be one general electoral roll which clarifies that a member of a Scheduled Tribe may contest any seat other than reserved also.

3.SCHEDULED AREAS

'Scheduled Areas' means such areas as the President may by order declare to be Scheduled Areas[13]. The President of India is empowered to take the following steps for protection of interest of ST population

- The President can pass an order that whole or part of Scheduled Area shall cease to be a Scheduled Area only after consultation with the Governor of the concerned State/ UT.
- The President of India can increase or decrease the boundaries of Scheduled Areas.
- The President is also empowered to declare any territory not previously included in any State or UT to form part of a Scheduled Area.

In India, there exist labyrinth of laws for the protection of STs and the same have been mentioned as follows

4 See Article 366(25)[4] of the Constitution of India, 1950
5 Mahendra P. Singh, Constitution of India, (Lucknow, Eastern Book Company 2011).
6 See Article 341 of the Constitution of India, 1950.
7 See Article 340(1) of the Constitution of India, 1950.
8 See Article 342 of the Constitution of India, 1950.
9 See Articles 342(1) & 342(2) of the Constitution of India, 1950.
10 For details see Constitution 90th Amendment Act, 2003.
11 For details see Constitution 79th Amendment Act, 1999.
12 See Articles 334 of the Constitution of India, 1950.
13 See Schedule Fifth, Para 6 of the Constitution of India, 1950.

3.1The Constitution of India, 1950

Fundamental rights

Part III of the Constitution which deals with Fundamental Rights are basic human rights in consonance with the Universal Declaration of Human Rights carrying the theme of 'dignity of the individual'. They are enforceable and justifiable in nature against the State and its officials. Under Part III Articles providing safeguards to the ST population are:

Article 15[14]–Prohibition of Discrimination on grounds of religion, race, caste, sex or place of birth.

Article 15(1)[15] prohibits the State government from discriminating against citizens of India on grounds of religion, race, caste, sex, place of birth or any of them in the matter of rights, privileges and immunities .The right is conferred on a citizen as an individual and is available whenever there is a case of discrimination against him/her.

Article 15(2)[16] provides that there shall be no discrimination by the State and the private individuals against a citizen on the grounds mentioned under Article 15(1) from access to public places which includes shops, public restaurants, hotels, places of public entertainment and use of public places such as wells, tanks, bathing '*Ghats*', places of public resorts maintained wholly or partly by State fund.

Article 15(3)[17] empowers the State government to make special provisions for the protection of women and children which includes STs as well.

Article 15(5) was added by the 3rd Constitution Amendment Act 2005[18] provides for reservation in favour of STs in Private Educational Institutions whether aided or unaided by the State, except the minority educational institutions as defined under Article 30(1).

Article 16[19] – Equality of Opportunity in the Matter of Public Employment

Article 16(1) and 16(2) apply only in respect of employment or office under the State government and lays down that there shall be no discrimination against any citizen for any employment or office under the State on grounds of religion, race, caste, sex, decent, place of birth or residence but it is subjected to certain exceptions as mentioned under Article 16(3),16(4),16(4 – A)[20],and 16(4 – B)[21] Article 16(4 – A) added by the 77th Constitution Amendment Act, 1995[22] empowers the State to reserve seats in matters of promotions for STs if the State is of the opinion that they are not adequately represented in the Services under the State. It is to be noted that Article 16(4 – B) seeks to end the 50 per cent limit for Scheduled Castes, Scheduled Tribes and Other Backward Classes in backlog vacancies which could not be filled up due to the non – availability of eligible candidates of these categories in the previous year(s).

Article 17[23] – Abolition of Untouchability

Article 17 of the Constitution abolishes "untouchability" and forbids its practice in any form and makes it punishable in accordance with law. In pursuance of Article 17 the Parliament has enacted the Untouchability (Offences) Act, 1955 which was amended in 1976 . Presently it is renamed as the Protection of Civil Rights Act[24], 1955.

Article – 19[25] Right to Freedom Article 19(1)[26] of the Constitution guarantees to the citizens of India the following six fundamental rights namely:

a. Freedom of Speech and Expression subjected to reasonable restrictions as provided under Article 19(2).,
b. Freedom of Assembly subjected to reasonable restrictions as provided under Article 19(3).,
c. Freedom to form Associations subjected to reasonable restrictions as provided under Article 19(4).,
d. Freedom to Move Freely Throughout the Territory of India; subjected to reasonable restrictions as provided under Article 19(5).,

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14 See Article 15 of the Constitution of India, 1950.
15 See Article 15(1) of the Constitution of India, 1950.
16 See Article 15(2) of the Constitution of India, 1950.
17 See Article 15(3) of the Constitution of India, 1950
18 See 93rd Constitution Amendment Act, 2005.
19 See Article 16 of the Constitution of India, 1950.
20 See Articles 16(4 – A) of the Constitution of India, 1950.
21 See Articles 16(4 – B) of the Constitution of India, 1950. Clause (4 – B) has been added to Article 16 by the Constitution 81st Amendment Act, 2000.
22 For details see Constitution 77th Amendment Act, 1995.
23 See Articles 17 of the Constitution of India, 1950.
24 See The Protection of Civil Rights Act, 1955.
25 See Articles 19 of the Constitution of India, 1950.
26 See Articles 19(1) of the Constitution of India, 1950.

e. Freedom to Reside and to Settle in any Part of the Territory of India and subjected to reasonable restrictions as provided under Article 19(5).,

f. Freedom to Practice any Profession, Occupation, Trade or Business subjected to the restrictions as mentioned under Article 19(2). subjected to reasonable restrictions as provided under Article 19(6).,

Directive Principles Of State Policy

Part IV of the Constitution of India deals with the Directive Principal of State policy which although are not enforceable but are justifiable in the governance of the country. These principles comprise of certain Social, Economic and Political principals, suitable to peculiar conditions prevailing in India. Article 46[27] which comes within the preview of the Social Security Charter enjoins upon the State to promote with special care the education and economic interest of the weaker sections of people in particular of Scheduled Tribes and also to protect them from social injustice and of all forms of exploitation.

3.2National Commission for Scheduled Tribes

History

Several provisions have been incorporated in the Constitution with the motive to safeguard the interests of Scheduled Tribes. Further with the objective of effective implementation of these safeguards it is must to appoint Commissioner of SCs and STs under article 338. The Commissioner must directly report the affairs of their working to the President of India. For effective working of office of the Commissioner 17 regional offices of the commissioner have been setup across the country followed by establishment of a multi-Member Commission named as Commission for Scheduled Castes and Scheduled Tribes w.e.f 21st July 1978 which was renamed as National Commission for Scheduled Castes and Scheduled Tribes w.e.f 1st September 1987. It is a national level advisory body to advice on policy matters and levels of development of SCs and STs and submits its report directly to the Central government. The Commission was given Constitutional status by the 65th Amendment to the Constitution dated 12th March 1992 and the office of the Commissioner was abolished .Later the Government of India felt that geographically and culturally ST population differs from SC population so do their problems. So they constituted separate Ministry of Tribal Affairs in October 1999 for coordinating all the activities relating to the ST population in India [28] followed by the Constitution 89th Amendment Act, 2003[29] which amended Article 338 and added a new Article 338 – A (1)[30] providing for the establishment of National Commission of Scheduled Tribes. Earlier the Constitution 65th Amendment Act, 1990 amended Article 338 (a) thereby providing for National Commission for Scheduled Castes and Scheduled Tribes.

The Commission is empowered to regulate its own procedure under Article 338(4)[31] Moreover the commission shall function by holding the sittings and meetings at any place within the country and also through its officers at the Headquarters and in the Regional offices and carries following activities namely:

- Procedure of investigation and enquiry by the Commission;
- Meetings of Commission and their frequency;
- Duties of the Regional offices ;
- Advisory role of commission ; and
- Monitoring functions.

Constitution of Commission

The Commission shall consist of a Chairman, Vice – Chairman and three other members. The members of the Commission shall be appointed by the President. The conditions of service and tenure of the members of the Commission shall be such as the President may by rule determine for Scheduled Tribes.[32] The headquarter of the commission is located at New Delhi.

Duties of the Commission [33]

The following are the duties of the Commission:

- Investigating and monitoring of all matters relating to the safeguards for STs under the Constitution and in any other law or any order of Government and to evaluate the working of such safeguards.,
- Inquiring into specific complaints with respect to the deprivation of rights and safeguards of STs.,

27 See Articles 46 of the Constitution of India, 1950.
28 For details see Constitution 89th Amendment Act,2003.
29 For details see Constitution 89th Amendment Act, 2003.
30 See Articles 338 – A(1) of the Constitution of India, 1950.
31 See Article 338(4) of the Constitution of India,!950.
32 See Article 338—A(2) of the Constitution of India, 1950.
33 See Article 338—A(5) of the Constitution of India, 1950.

- Participating in the planning process of socio-economic developments of STs and to evaluate the progress of their development under the Union and any State.,
- Present to the President reports upon the working of those safeguards annually and at such other times as the Commission deems fit.,
- Making recommendations as to the measures that should be taken.,
- Discharging such other functions as required for the welfare, development and advancement of the Scheduled tribes.

  Moreover the commission shall function by holding the sittings and meetings at any place within the country and also through its officers at the Headquarters and in the Regional offices.

Powers of the Commission [34]

While investigating any matter the Commission shall have the powers of a civil court as provided under the Civil Procedure Code,1908 trying a suit in respect of the following manners namely-

- Summoning and enforcing the attendance of any person from any part of India and examining him on oath.,
- Discovering and production of any document.,
- Receiving evidence on affidavits.,
- Requisitioning any public record or copy from any court or office.,
- Issuing commission for the examination of witness.,

For the purpose of investigation and inquiry the commission may adopt any one or more of the following methods

- By the commission directly.,
- By an investigating team constituted at the headquarter of the commission.,
- Through its regional offices.

It is mandatory for the Union and the State Government to consult the Commission on all the major policy matters affecting Scheduled Tribes. The commission is authorised to maintain the confidentiality of any matter. All summons and warrants issued by the commission in capacity of civil court shall bear the seal of commission. Legal process shall be issued from the legal cell of the commission. For the service of the legal process the provisions of the Code of Civil Procedure,1908 for the legal process shall be followed.

Advisory Role of the Commission[35]

The Commission through its members, secretariat and regional offices shall interact with the state government and the planning commission at regular intervals of time by way of representations concerning the process of planning ,development and evaluation of all the programmes and schemes concerning the Scheduled Tribes. The secretariat of the commission through its concerned wings would provide necessary assistance and information to the member-in-charge of the concerned State / Union territory.

Other functions of the Commission

The commission shall undertake surveys and evaluation studies in collaborations with the Central or State Government or the Universities or Research bodies by constituting study teams comprising of professionals either at the Headquarters or at the Regional Offices so as to evaluate the impact of developmental schemes on the socio economic development of the Scheduled Tribes. The studies undertaken are compiled in the form of Annual or Special Report of the Commission.

3.3The Provisions of the Panchayats (Extension to the Scheduled Areas) Act 1996 [hereafter referred to as PESA, 1996[36]

The PESA Act, 1996 provides for the extension of the provisions of the Part IX of the Constitution relating to the establishment of Panchayats to the Scheduled Areas under Section 4[37] subjected to the following exceptions-

- The State legislation on Panchayats which is to be implemented in Scheduled Areas must be in consonance with the customary law, social and religious practices and traditional management practices of the areas concerned.,

34 See Article 338—A(8) of the Constitution of India, 1950.
35 For details see National Commission for Scheduled Tribes, Handbook 2016.
36 For details see PESA Act, 1996.
37 For details see section 4 of PESA Act, 1996.

- Village for the application of PESA Act,1996 must consist of a habitation, group of habitations or a hamlet or group of hamlets comprising a community managing its affairs according to its traditions and customs.,
- Every village shall have a Gram Panchayat consisting of persons whose names are included in the electoral roll.,
- Every gram sabha shall be competent to safeguard traditions and customs, cultural identity, community resources sand customary mode of dispute resolution.,
- The reservation of seats in the scheduled areas at every panchayat shall be in proportion to the population of the communities in that panchayat for whom reservation is sought to be given of constitution provided that all the seats of the Chairpersons of the Panchayats at all levels shall be reserved for the Scheduled Tribes. Moreover it is mandatory that half seats shall be reserved for the STs out of the total number of seats.,
- The State government is empowered to nominate persons from tribal community having no representation in Panchayat at the intermediate level or district level provided such nomination shall not exceed one –tenth of the total number of members to be elected in that panchayat.,
- Panchayat shall perform the function of planning and management of the minor water bodies in the scheduled areas at the appropriate level and must be consulted before making any acquisition of land in scheduled areas for developmental projects, re settling and rehabilitation projects.,
- Recommendations of gram sabha and panchayats at the appropriate level shall be mandatory before granting any mining lease or license in the scheduled areas or grant of concession for the exploitation of minor minerals by auction.,

Powers of the Panchayats and Gram Sabhas with respect to the scheduled areas

- Power to enforce prohibition, to regulate or to restrict the sale and consumption of any intoxicant.,
- Ownership of minor forest produce.,
- Power to prevent alienation of land in scheduled areas .,
- Power to manage village markets.,
- Power to exercise control over money lending in scheduled Tribes.,
- Power to exercise control over institution and functionaries in all social sectors.,
- Power to control over local plans and resources and tribal sub plans.,and
- Endow the Panchayats with powers and authority as may be necessary to enable them to function as self government.

3.4The Scheduled Tribes and Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

Chapter II Section 3[38] of the said Act deals with forest rights of forest dwelling scheduled tribes and other traditional forest dwellers which are as follows-

- Right to hold and live in the forest land under individual or common occupation for habitation or for self cultivation for livelihood by member (s) of forest dwelling scheduled tribes
- Community rights such as nistar including those rights which were used in princely states and zamindari regimes.,
- Right of ownership, collect, useand dispose of minor forest produce.,
- Communities rights of entitlements such as fishery, other products of water bodies , grazing and traditional resources access to pastoralist and nomadic communities.,
- Communities tenures of habitatand habitants for primitive tribal groups andpre- agricultural communities.,
- Rights over disputed lands under any nomenclature in any state where claims are disputed.,
- Rights of conversion of pattas or leases or grants issued by any local authority or any state government on forest lands to titles.,
- Rights of settlement and conversion of all forest villages, old habitations, unsurveyed villages and other villages in forests whether recorded , notified or noted into revenue villages.,
- Right to protect, regenerate or conserve or manage any community forest resource which they have been traditionally protecting for sustainable use.,

[38] See section 3 of The Scheduled Tribes And Other Traditional Forest Dwellers (Recognition of Forest Rights)Act,2006

- Right of access to biodiversity, intellectual property and traditional knowledge related to biodiversity and cultural diversity.,
- Any other traditional right customarily enjoyed by forest dwelling scheduled tribes and other traditional forest dwellers.,
- Right to in situ rehabilitation including alternative land in cases of illegal eviction or displacement from forest land of scheduled tribes and other traditional forest dwellers.,

CHAPTER V Sections 7 and 8 of the Act deals with offences and penalties. Section 7[39] provides that if any authority or committee or officer or member of such authority or committee contravenes any of the provision of this act or any rule made there under shall be guilty of an offence under this act and shall be punished with fine extending to one thousand rupees. Section 8[40] provides that no court shall take cognizance of any offence under section 7 unless any forest dwelling schedule tribe in case of a dispute relating to a resolution of a gram sabha or the gram sabha through a resolution against any higher authority gives a notice of not less than sixty days to the State Level Monitoring Committee and the later has not proceeded against such authority.

3.4 The Scheduled Castes And The Scheduled Tribes (Prevention Of Atrocities) Act, 1989

This Act was enforced on 11th September 1949 with the objectives of prevention of atrocities against the members of Scheduled Castes and Scheduled Tribes, for the establishment of special court for the trial of such offences and providing for the relief and rehabilitation of the victims of such offences,
Section 3[41] of the act deals with the kinds of atrocities against the scheduled tribes-

- Forcing a member of Scheduled Tribe to drink or eat any inedible or obnoxious substance.,
- Acts with the intention to cause injury, insult , annoyance to the member of Scheduled Tribes and to parade him naked or with painted face or body or to commit any similar act derogatory to human dignity.,
- Wrongfully occupying or cultivating any land which is owned by, allotted to, notified by any competent authority to the Scheduled Tribes or gets the land allotted to him transferred.,
- Wrongfully disposing a member of the scheduled tribes from his land or premises or interferes with his enjoyment of any land , premises or water.,
- Compels or entices a member of Scheduled Tribes to be a beggar or other similar forced labour.,
- Forces or intimidates any member of the Scheduled Tribes note to vote or to vote to a particular candidate.,
- Intentionally insults or intimidates with the intent to humiliate a member of Scheduled tribes in any place within public view.,
- Assaults or uses force against any women belonging to the scheduled tribes.,
- Being in a position to dominate the will of the women belonging to the scheduled tribes and intentionally uses that position to exploit her sexually.,
- Corrupts or fouls the water of any spring, reservoir or any other source used by the Scheduled tribes community.,
- Denies the member of scheduled tribes any customary right to passage to a place of public resort or to obstruct such members.,
- Forces a member of scheduled tribes to leave his house, village or other place of residence.,
- Section further provides that the person committing the above mentioned offence against any member of the scheduled tribes shall be punished with imprisonment not less than six months which may be extended up to five years and fine.
- The act further provides that whoever not being the member of the Scheduled Tribes gives or fabricates false evidence intending thereby to cause or knowing it to be likely to cause any member of Scheduled Tribe[42]-
- to be convicted of an offence which is capital shall be punished with imprisonment for life and with fine and if an innocent member of the Scheduled tribes is convicted and executed ,the person responsible for it shall be punished with death.,

[39] See section 7 of The Scheduled Tribes And Other Traditional Forest Dwellers (Recognition of Forest Rights)Act,2006
[40] See section 8 of The Scheduled Tribes And Other Traditional Forest Dwellers (Recognition of Forest Rights)Act,2006
[41] See section 3(1) of The Scheduled Castes and the Scheduled Tribes (Prevention of Atrocities) Act, 1989
[42] See section 3(2) of The Scheduled Castes and the Scheduled Tribes (Prevention of Atrocities) Act, 1989

- to be convicted of an offence which is not capital but punishable with imprisonment for seven years or upward shall be punishable with imprisonment for six months which can go up to seven years and with fine.,
- commits mischief by fire or any explosive substance with intention or knowledge that such act is likely to be causing destruction of any building used as place of worship, dwelling by members of scheduled tribes shall be punished with imprisonment for life and with fine.,
- commits mischief by fire or any explosive substance with intention or knowledge that such act is likely to be causing destruction to any property belonging to any members of scheduled tribes shall be punished with imprisonment for six month which can extend up to seven years.,

Section 4 [43] further provides that if a public servant not a member of Scheduled Tribes wilfully neglects his duties, he shall be punished with imprisonment for a term of six months extendable to one year and on second conviction of any person under this act for the same offence shall be punished with imprisonment for one year which can be further extended to such duration as provided under the offence committed.[44] In order to provide speedier justice to the scheduled tribes under the Act the state government in consonance with the Chief Justice of the state concerned by official notification shall specify for each district a court of session to be considered as a special court for the offences under the act followed by the appointment of an advocate in practise for not less than seven years as special public prosecuter for conducting cases under this act [45]

4.ADMINISTRATION OF SCHEDULED AREAS AND TRIBAL AREAS

- Article 244(1)[46] provides that the Scheduled Areas and Scheduled Tribes in any State other than the States of Assam, Meghalaya, Tripura and Mizoram will be administered and controlled in accordance with the provisions of the Fifth Schedule .The Fifth schedule provides that the executive power of the State extends to the Scheduled Areas.
- Article 244 – A[47] was added to the Constitution in order to meet the demands of the hill tribes of Assam for a separate State. This Article empowers the Parliament to form an autonomous State comprising certain Tribal Areas of Assam and creates local legislature and Council of Ministers for such a State. It may by law, lay down constitution, power and functions of the legislature and Council of Ministers.

Fifth Schedule[48]

The Fifth Schedule provides that the executive power of the State shall extend to the Scheduled Areas. But the Governor has a special responsibility regarding such areas. In the sense that he/she is required to make an annual report to the President or whenever required by the President regarding administration of these areas. The Union will exercise its executive power over these areas to the extent of giving of directions to the State regarding administration of the said areas. There exists a Tribal Advisory Council in each State having Scheduled Areas, consisting of not more than 20 members as representatives of the Scheduled Tribes in the State which has no Scheduled Council. The Council shall advise on matters pertaining to the welfare and advancement of Scheduled Tribes in the State referred to them by the Governor.

Sixth Schedule[49]

The Sixth Schedule[50] of the Constitution identifies Autonomous Districts in Tribal Areas in the states of Assam, Meghalaya, Tripura and Mizoram and also recognizes Autonomous Regions within these Autonomous Districts which in turn are specified in Part I ,II, III and IIA of paragraph 20 of 6th Schedule. With respect to matters like fisheries, ferries, ponds, roads, transport, waterways, market, schools and dispensaries in the concerned district, the District or Regional Councils are empowered to make rules with the approval of the Governor and lays down its constitution and powers. These Councils are empowered to make laws for the administration of justice in the autonomous districts and the tribal areas. The Councils may constitute Village Council or Court for the trial of suits between parties belonging to Scheduled Tribes. The High Court shall have such jurisdiction over these areas as the Governor may by order specify. There is a

43 See section 4 of The Scheduled Castes and the Scheduled Tribes (Prevention of Atrocities) Act, 1989
44 See section 5 of The Scheduled Castes and the Scheduled Tribes (Prevention of Atrocities) Act, 1989
45 See sections 15 and 16 of The Scheduled Castes and the Scheduled Tribes (Prevention of Atrocities) Act, 1989
46 See Article 244(1) of the Constitution of India,1950.
47 See Articles 244 – A of the Constitution of India, 1950.
48 For details see the Fifth Schedule of the Constitution of India, 1950.
49 For details see the Sixth Schedule of the Constitution of India, 1950.
50 For details see Sixth Schedule of Constitution of India, 1950.

District Fund to which all money received by the District Council and Regional Council shall be credited. The Governor may make rules for the management of the District Fund. The District Council and Regional Council shall have the power of imposing taxes. The Governor may by public notification direct that any Act of Parliament or of the Legislature of Assam shall apply or shall not apply to the autonomous district or region or shall apply with such modifications as he/she may specify through the notification. The Governor may annul or suspend acts and resolutions of the District Council and Regional Council if he/she is satisfied that such act is likely to endanger the safety of India or is likely to endanger public order . Moreover the Governor may take such steps as he/she may consider necessary (including suspension of Council) and assume to himself/herself all or any power(s) exercisable by the Council. It is to be noted that the Sixth Schedule may be amended by law from time to time. No such law shall be deemed to be the amendment of Constitution of India for the purpose of Article 368.

4.1 Ministries/Departments/Committees[51]

Under the Constitution the following ministries, departments and committees have been constituted for welfare and development of tribal community

- Ministry of Law and Justice
- Ministry of Minority Affairs
- Ministry of Tribal Affairs

Ministry of Law and Justice

The Ministry of Law and Justice is the backbone of the Government of India, dating back to the Charter Act, 1833, followed by Government of India Act 1919, 1935 and finally the Constitution of India, 1950. As the main source of the Indian Constitution, Statutes (legislations), Customary Laws and Case Laws, they are taken into account by the Constitution in India while administering justice in certain spheres[52].

Ministry of Minority Affairs

The Government of India, through Department Justice (DoJ) and Ministry of Law and Justice, in collaboration with United Nations Development Programme (UNDP) has implemented access to justice for marginalized people 2008 - 2017. This access to justice has been extended to the following UNDAF states namely Bihar, Chattisgarh, Jharkhand, Madhya Pradesh and Odisha with the main objective of developing strategies for breaking barriers to accessing justice to marginalized groups in legal/social and economic domains.The following are the achievements of this programme:

- Legal literacy initiatives over 20 lakh people from marginalized communities making them aware of their legal rights.
- Inclusion of legal literacy in Adult Literacy Programme under Sakshar Bharat Abhyyan.
- Training over 7,000 paralegals from various backgrounds for this purpose.
- Providing for the legal aid clinic run by the Law Schools, so as to enable a better understanding of the problems faced by marginalized communities in access to justice[53].

Ministry of Tribal Affairs[54] (MoTA)

This ministry was setup in 1999 when the Ministry of Social Justice and Empowerment bifurcated. It is the Nodal ministry for overall development of Scheduled Tribes and performs the following functions

- Work related to the welfare of tribal people such as planning , policy formation ,research and training.,
- Encouraging development of tribal people and providing them scholarships
- Protection to the interest of tribal communities with regard to land alienation
- Administration of Scheduled Ares as per the guidelines of “Fifth Schedule[55],” and “Sixth Schedule”. under Article 224(1) and Article 224 (2)

Under the Fifth Schedule the criteria for declaring any area as “Scheduled Area” include:

- Preponderance of Tribal Population,
- Size and compactness of the Area under consideration,
- Available administrative entity such as district, block or *taluk*,

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51 List of Ministries/Departments is based on information given under Allocation of Business Rules, 1961 as amended time to time by Cabinet Secretariat, available at http://cabsec.nic.in

52 Ministry of Law and Justice, available at htt://lawmin.nic.in

53 Increasing Access to Justice for Marginalized People, available at http://www.in.undp.org/ content/india/en/home/operations/projects/democratic_governance/access_to_justice.

54 Ministry of Tribal Affairs, Government of India, available at http://www.tribal.nic.in/Content/scheduledtribes.aspx.

55 For details see Fifth Schedule of the Constitution of India, 1950.

- Economic backwardness of the Area,

It is to be noted that a particular area is specified as the Scheduled Area with respect to a State by the President's Notified Order after consultation with the concerned state government. The same is applicable to alteration, increase, decrease and incorporation or rescinding any order relating to "Scheduled Areas".

Moreover with respect to any particular Scheduled Area, the Governor of the concerned State, where the area is located, exercises the rights to prohibit transfer of land from tribal people and right to regulate the business of money lending to members of Scheduled tribes.

In addition the Governor of such a state has the power to repeal any Act of Parliament or State Legislature applicable to the area in question and can through public notification notify the authority and community concerned. He shall make an annual report regarding administration of Scheduled Areas in the State to the President.

Further the executive power of the Union Government shall extend to giving direction to the State concerned as the administration of said area.

Organizations under the Ministry

Following are the organizations under the ministry

- National Commission for Scheduled Tribes, NCST
- National Scheduled Tribes Finance and Development Corporation,NSTFDC
- Tribal Co-operative Marketing Federation of India, TRIFED

*4.2 Role Of Tribes Advisory Council[56] (***TAC)**

TAC advises the State Government on matters pertaining to the welfare and advancement of Scheduled Tribes in State as referred to by the Governor.

Composition of TAC

TAC consists of twenty members out of which 3/4th are MLAs representing the scheduled tribes. TAC can also be established with the permission of the President of India in those States where Scheduled Tribes are present and living but not demarcated Scheduled Area. Moreover, the provision of **Panchayat (Extension to Scheduled Areas) Act, 1996 [PESA][57]** contained in Part IX of the Constitution has been extended to Scheduled Areas for benefit of the Scheduled Tribes.It is to be noted that the Councils have been conferred power under the Civil Procedure Code,1908 and Criminal Procedure Code,1973 for trial of certain suits and also the power of revenue authority for collection of revenue and taxes from their areas along with additional powers to make laws with respect to other matters like secondary education, agriculture, social security and social insurance, public health, sanitation and management of natural resources.ss

Special Officer for Scheduled Castes, Scheduled Tribes etc

Article 338(1)[58] provides that there shall be a special officer for the Scheduled Castes and Scheduled Tribes to be appointed by the President. Article 338(2)[59] provides that it shall be the duty of the special officer to investigate all matters relating to the safeguards for the Scheduled Castes and Scheduled Tribes under the Constitution and submit a report concerning the working of hose safeguards at such intervals as directed by the President and the latter is under duty to cause all such reports to be laid before each house of the Parliament.

5.RESERVATION IN SERVICES.

As per Article 335[60], all the claims of the members of the Scheduled Castes and Scheduled Tribes shall be taken into consideration, in making appointments to services and posts in connection with the affairs of the Union or of a State keeping in mind the efficiency of administration. Constitution 81st Amendment Act, 2000 has added a new provision to Article 335 which provides that 'nothing' in this Article shall prevail in making of any provision in favour of members of Scheduled Castes and Scheduled Tribes for relation in qualifying marks in any examination or lowering the standard of equivalence for reservations in matters of promotion to any class or classes of services or posts in connection with the affairs of the Union or of a State.

The Constitution of India, 1950 provides for reservation of seats for the Scheduled Tribe Community in the Lok Sabha and the State Legislative Assemblies under Articles 330 and 332 of the Constitution[61].

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56 Tribes Advisory Council, available at ://www.pib.nic.in/newsite/PrintRelease.aspx?relid=89727

57 For details see Panchayat (Extension to Scheduled Areas) Act, 1996 (PESA).

58 See Articles 338(1) of the Constitution of India, 1950.

59 See Articles 338(2) of the Constitution of India, 1950.

60 See Articles 335 of the Constitution of India, 1950.

61 See Section 330 & Section 332 of the Constitution of India, 1950.

Article 330[62] provides for reservation of seats for the Scheduled Castes and Scheduled Tribes except the Scheduled Tribes in the autonomous district of Assam[63].

Article 332[64] provides for the reservation of seats for the Scheduled Castes and Scheduled Tribes except the Scheduled Tribes in the autonomous district of Assam in the Legislative Assemblies in every State. The number of seats to bereserved in any state or union territory for such castes and tribes will be made on population basis[65]. Initially this reservation was provided for a period of ten years only but the Constitution (One Hundred Ninth Amendment) Bill, 2009[66] which has extended this time period for further ten years has been passed by both houses of Parliament, assented to by the President in January 2010 and enacted as Constitution (Ninety Fifth Amendment) Act, 2009[67].

Representation of People (Amendment) Bill, 2010 and the rights of Scheduled Tribes

It is to be noted that the rights of Scheduled Tribes are also protected by the Representation of People (Amendment) Bill, 2010 which amended the Representation of People Act of 1950[68]. The Act now provides that every citizen of India (including Tribes) whose name is not in the electoral roll or who has not acquired citizenship of any other country or who is absenting himself from his ordinary place of residence in India owing to employment, education or otherwise, or is outside India, whether temporary or not shall be entitled to have his name registered in electoral roll in the constituency named in his passport after thorough verification by Electoral Registration Officer and Central Government after consultation with the Election Commission of India.

Reservation For Scheduled Tribes In Various Kinds Of Services

The Constitution of India also provides for the reservation of seats for Scheduled Tribes in All India Services. The number of seats in direct recruitment by open competition is 7.5 per cent of the total seats.In case of Group C & D posts, the percentage of reservation for Scheduled Tribes is fixed in proportion to their population in respect of State/Union Territory, provided, total reservation of seats for them remains within the limit of 50 per cent. It is to be noted that reservation for the Scheduled Tribes in India is by mode of vertical reservation. Reservation for Scheduled Tribes is provisioned for:

- AIS (All India Services)
- PSUs (Public Sector Undertakings including Nationalized Public Sector Banks.)
- Autonomous Bodies
- Statutory Bodies
- Semi Government Bodies such as voluntary agencies receiving grant of two lakh or more from Consolidated Provident Fund and employing more than 20 persons on regular basis and at least 50 per cent of its recurring expenditure is met form grant – in – aid form Central Government.
- State governments have also provided for reservations of posts for the Scheduled Tribes[69].

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62 See Article 330 of the Constitution of India, 1950.

63 The 51st Amendment Act clarifies that the reservation of seats in Assam Assembly for the Scheduled Tribe will be made from the entire State except the Autonomous District of Assam. Seats shall be reserved also for the Autonomous District in the Legislative Assembly of the State of Assam.

64 See Article 332 of the Constitution of India, 1950.

65 The expression 'population' refers to population as ascertained at the last preceding population census of which the relevant figures have been published. The Constitution 84th Amendment Act has amended the explanation to Articles 330 and 332 and substituted '2000' with '2026', thus the expression population means the population as ascertained on the basis of 199 census. The Constitution 87th Amendment 2003 has amended the provision to Article 330 and substituted '2001' in place of '1991'. This means that the expression 'population' for this purpose will be ascertained on the basis of 2001 census. The allocation of seats in the Lok Sabha for Scheduled Castes and the Schedules Tribes shall be frozen till the year 2026.

66 See Constitution 109 Amendment Bill, 2009.

67 See Constitution 95th Amendment Act, 2009.

68 For details see, The Representation of People Amendment Bill, 2010. Also see, the Representation of People's Act, 1950.

69 The policy of Reservation to SCs , STs and OBCs is available at http://persmin.gov.in/...Reservation.../Ch_02_2014.pdf

6.PERSONAL LAW

It is to be noted that due to diversity of population in India and very rich cultural heritage consisting of people of different religions and faith, there exist different sets of personal laws in respect of matters relating to family affairs, such as marriage, divorce, succession, adoption, wills etc. These Personal Laws are the subject matter of the Concurrent List (List III), Entry 5, Schedule 7 of the Constitution of India, 1950. Therefore, the Union Legislature and the State legislature are equally entitled to regulate it and make laws in this field[70].

Marriage

In India, the law regulating Marriage and Divorce has been subjected to different enactments based on people of different religions, castes and tribes such as:

- Divorce Act, 1869
- The Indian Christian Marriage Act, 1872
- The Kazis Act, 1180
- The Anand Marriage Act, 1909
- The Indian Succession Act, 1925
- The Parsi Marriage and Divorce Act, 1936
- The Dissolution of Muslim Marriage Act, 1939
- The Special Marriage Act, 1954
- The Hindu Marriage Act, 1955
- The Foreign Marriage Act, 1969
- The Muslim Women (Protection Rights on Divorce) Act, 1986

The marriages among the Scheduled Tribes are regulated by the Special Marriage Act, 1954[71]. This Act provides for special forms of marriages and their registration extending to all of India except the state of Jammu and Kashmir. Persons governed by this Act include the tribal communities belonging to different religious faiths. Thus marriage celebrated under any other form can be registered under The Special Marriage Act, 1954, if it satisfies the requirements of this Act. No doubt effort are being made to codify customary law which arre prevalent among Hindus by enacting the Hindu marriage Act, 1955[72]. But this Act is not applicable to the Scheduled Tribes unless the Central Government notifies in this context by notification in the Official Gazette.

Maintenance

The status of marriage automatically provides the wife the right of maintenance against her husband. Right to maintenance forms a part of the personal laws and extends not only to the wife and dependent children, but also to indigent person and divorced wives irrespective of cast, tribe and communities. Right to maintenance has been provided under Code of Criminal Procedure, 1973 (Amended) Act, 2001 [No. 50 of 2001][73] so as to make this remedy speedier and inexpensive. It is to be noted that divorced wives who had received money payable as maintenance under Cr. P.C, 1973.

The Indian Succession Act, 1925[74] provides for both intestate and testamentary succession. The Indian Succession Act 1925 (Amended) Act, 1991 applies two schemes. One relating to property of persons married under the Special Marriage Act, 1954 and the other relating to succession rights in case of intestate succession only for the Parsi Community.Finally, the Hindu Succession Act, 1956[75] [30 of 1956] extending to the whole of India except the state of Jammu and Kashmir. The remarkable feature of this Act is that now a woman can inherit an intestate equally with men and life estate of female heirs has been abolished. Recently, the Hindu Succession (Amendment) Act, 2005 was passed providing for equal share to a coparcener daughter in a joint family property.

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70 For details see, Constitution of India, 1950.
71 For details see, Special Marriage Act, 1954.
72 For details see, Hindu Marriage Act, 1955.
73 For details see, Criminal Procedure Code, 1973 (Amended) 2001.
74 For details see The Hindu Succession Act, 1925.
75 For details see The Hindu Succession Act, 1956 (Amended) 2005.

7.WELFARE SCHEMES FOR THE SCHEDULED TRIBES

India is a welfare state working on the principal of Rule of Law and Natural Justice. Earlier the Tribal Development Division was under the Ministry of Social Justice and Empowerment but in October 1991 it was separated and made a separate Ministry with the objective of providing more focused approach on the integrated socio-economic development of the Scheduled Tribes (STs). [1]There are various schemes run by the centre government for the upliftment of schedulrd tribes namely

- Pre matric scholarship schemes for ST students.,
- Post matric scholarship schemes for ST students.,
- National overseas scholarship for ST students studying abroad.,
- National fellowship and scholarship for higher education of ST students.,
- Grant-in-aid to voluntary organizations working for welfare of STs.,
- Strengthening Education among ST girls in low literacy districts.,
- Special central assistance to Tribal Sub Schemes (TSS).,
- Grant –in-aid to tribal research institutes.,
- Development of particularly vulnerable tribal groups(PVTGs)
- Support to national/state scheduled tribe finance corporations.,
- Minor forest produce (MFP).,
- Pradhan mantra Van Dhan Yojana (PMVDY).,
- Eklavya Model Residential Schools(EMRS).,
- E-Governance initiative for ST Welfare schemes.,etc

8.CONCLUSION

Despite effective legislation and administration followed by judicial activism in cases related to tribal population in India still we are unable to achieve success in overall development of tribal communities. Major issues which are being noticed related to tribal population is low literacy rate especially among females, lack of awareness regarding their legal rights and welfare schemes, health issues as tribes usually inhabit with their cattles residing in traditional houses making use of stored water for drinking , economically weaker section of society because of less or nil knowledge about new techniques in agriculture and animal husbandary as they are still dependent on traditional methods of cultivation and breeding animals.In this context following suggestion can be made

- There should be harmony between Centre and State sponsored welfare schemes for tribal population for effective implementation .,
- Licensing system should be implemented for making use of forest wood no matter for making furniture or constructing tribal house so that everyone should be equally benefited.,
- NGO,s should come forward for carrying out community programmes for tribal people making them aware of their socio-legal rights. For this purpose legal aid cells should turn up and organize legal aid clinics on regular basis in tribal areas.,
- There should be proper transport facility provided to the tribal areas so that they are not cut from other regions of the state.,
- Household industries should be encouraged in tribal areas followed by establishment of cooperative societies and banks wherein facility for loans at lower rate and longer period of return should be provided.,
- The traditional knowledge and biodiversity of tribal communities of any form must be protected .For that the NGO,s and government must work in coordination.,
- Lastly we should remember that each tribal community is different from other in terms of their heritage and geographical conditions, thus it is mandatory for the state government to understand their needs and provide need based schemes to them.

9. AUTHORS BIOGRAPHY

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HATE CRIMES IN INDIA: NEED FOR A COMPREHENSIVE LEGISLATION

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ABSTRACT

Hate crimes attack the victims not only physically but they and theirfamiliesbegin to question their very own identity causing vulnerable citizens in the country. The hate motivated crimes are not dependent on the behaviour or conduct of a person but are based on his caste, gender, religion, race etc. Hate crimes are on rise in India for the past few decades and if we do not sensitise ourselves with this crime today our future generations cannot live in peace and harmony in this heterogeneous society for very long. These hate crimes may spread beyond the individual victims to a community at large, therefore, there is an utmost need for a legislation with stringent laws and accountability of those responsible for keeping peace in the society.

KEYWORDS: *Hate crimes, Lynching, Hate Speech, Caste-Based and Gender Based Violence*

INTRODUCTION

While the term "Hate Crimes" came into existence before the mid 1980s the legislations were enacted by very few countries to deal with it. Even after the legislations being enacted and punishments being inflicted for such crimes the recent incidents of hate crimes all over the world shows that the legislations are not enough to deal with this crime.

Although the countries like United states of America and India as a matter of fact, have been following the slogans of "Unity in Diversity" or " Diversely United" they are not followed in letter and spirit. Newspapers and cable news programs broadcast a steady stream of stories about murder, hate crimes, genocide, terrorism and the mass killings of civilians—from Paris and Germany, Iraq, Yemen, and the United States. Recent news headlines have highlighted police brutalization of the African American community, and many cases of hate violence mostly on the basis of caste and religion in India.[1]

Recently on 25th May, 2020, a person named George Floyd died in the United States of America. It shows how well the legislation was constructed. One of the Police officers, the so called protectors of the lives of people, pinned down his knee on the neck of George for seven minutes which led to his death.

On 31st May, 2020, in a similar case, four persons allegedly shot dead a DalitDalit boy named Vikas Jatav after refusing him entry in a temple. The accused belonged to an upper caste.

[1]Jamshid A. Marvasti, M.D. and Anton Power,The psychology of hate and hate crimes: The story of those who refused to hate, American journal of forensic psychology, volume 35, issue 1, 2017, p 33.

RECENT CASES OF HATE CRIME IN INDIA

Tabrez Ansari

On 22nd June, 2019 a video went viral in social media where a 24 years old man identified as Tabrez Ansari was beaten for hours in Jharkhand on the pretext of theft. He was married less than two months ago and was the only support of his wife. He was being lynched by the mob and was forced to chant "Jai Shri Ram" and "Jai Hanuman."

Hafeez Mohammed Haldar

A 26 years old teacher who taught in a religious seminary was thrown out of the train in west Bengal. Hafeez Mohammad Haldar was travelling when a mob chanted "Jai Shri Ram" and pushed him out of the train. He managed to escape death with minor injuries.

Faizal Usman Khan

A 25 years old Muslim cab driver was beaten up by a group of men at night in Mumbai and was forced to chant "Jai Shri Ram".

Afrazul Khan

A Bengali-Muslim labourer, Afrazul Khan was lynched in Rajasthan. In a viral video a man is seen hacking Khan to death with a pickaxe. The attacker made the video himself and accused the victim of *love jihad*. He then set Khan on fire.

There are numerous other cases where a Dalit was killed because he entered a temple, or he rode a horse to his wedding, he grew a moustache, he drew water from a local well, for eating in front of upper caste people, for marrying a person from an upper caste, for sitting cross legged in front of upper caste people, for bathing in a lake etc.

Even if we hold numerous rallies of "Black Lives Matter" or "Dalit lives Matter" it will soon be forgotten and gone in vain. In this article we will try to understand the evil of "Hate Crimes" in an elaborate form.

Definition of Hate and Hate Crimes

While "hate crime" would be the term most often used in the United States to describe an attack by a white supremacist against an African American, the act would be known in Germany as "right-wing violence" or "xenophobic violence." In Britain and France, it would be referred to simply as "racial violence."[2]

Hate

- intense hostility and aversion usually deriving from fear, anger, or sense of injury
- extreme dislike or disgust:ANTIPATHY, LOATHING had a great *hate* of hard work
- a systematic and especially politically exploited expression of hatred a crime motivated by bigotry and *hate*.[3]

[2] Mark S. Hamm, "Terrorism, Hate Crimes, and Anti-Government Violence: A Preliminary Review of the Research" (background paper for National Research Council, Commission on Behavioral and Social Sciences and Education, Committee on Law and Justice, March 1996), p 11.
[3] Merriam Webster Dictionary

- The Penguin Dictionary of Psychology defines hate as a "deep, enduring, intense emotion expressing animosity, anger and hostility toward a person, group or object."[4]

Hate Crime

Any of various crimes (such as assault or defacement of property) when motivated by hostility to the victim as a member of a group (such as one based on color, creed, gender, or sexual orientation).[5]

Hate crime, harassment, intimidation, or physical violence that is motivated by a bias against characteristics of the victim considered integral to his social identity, such as his race, ethnicity, or religion. Some relatively broad hate-crime laws also include sexual orientation and mental or physical disability among the characteristics that define a hate crime.[6]

A crime, usually violent, motivated by prejudice or intolerance toward an individual's national origin, ethnicity, color, religion, gender, gender identity, sexual orientation, or disability.[7]

In nutshell, what we have is gender-based violence, biased violence, caste- based violence, honour killings, communal riots, violence and differential treatment against people on the basis of colour and race, xenophobia, witch=hunting, violence towards LGBTQ community, ragging and bullying in schools and colleges, and such other instances,againstwhich we do rallies and candle marches.

Many of these crimes are largely and exclusively committed in India.

Nature and Characteristics of Hate Crime

A hate crimeisnot like any other crime. It has some kind of biases attached to it. It is an extreme form of discrimination in which an individual or a group of individuals with common characteristics are targeted.

Schafer and Navarro wrote about the seven stages of hate crimes as a model to understand what an offender may endure before committing violence. These are:

Stage 1: The Haters Gather.

Stage 2: The Hate Group Defines Itself.

Stage 3: The Hate Group Disparages the Target.

Stage 4: The Hate Group Taunts the Target.

Stage 5: The Hate Group Attacks the Target without Weapons.

Stage 6: The Hate Group Attacks the Target with Weapons.

Stage 7: The Hate Group Destroys the Target. [8]

[4]Reber AS, Reber E: The Penguin Dictionary of Psychology. New York, Penguin Books, 2002
[5]ibid
[6]Encyclopaedia Britannica
[7]www.dictionary.com
[8]Schafer JR, Navarro J: The Seven-Stage Hate Model: the psychopathology of hate groups. FBI Law Enforcement Bulletin, March 2003.

Another aspect in terms of psychology is explained by classifying the offenders in terms of their motivations for committing hate crimes. Levin and McDevitt developed a typology that identified three primary motivations for the commission of hate crime. In extension to their study Glen Kercher, Claire Nolasco and Ling Wu added one more class of offenders by studying various scholars.9

- Thrill seeking offenders
- Defensive offenders
- Mission offenders
- Retaliatory offenders

Thrill seeking offenders are looking for excitement—at someone else's expense—by destroying property and harassing minorities, often through brutal physical attacks. Further, they want to exercise their power to gain status and prestige among their peer groups who encourage hatred.

Defensive offenders commit hate crimes to protect or defend their community or way of life that, in their view, is being threatened, simply by the presence of a different group.

Mission offenders are those who are attached to their prejudice and ideology, which becomes a mission to get rid of all members of a particular group of people, believing them to be evil and subhuman.

Retaliatory offenders commit hate crimes in response to a perceived or actual hate crime. This attack could be motivated by a rumour, before even being verified for accuracy.[10]

If we look at these theories and compare them and fit them in the Indian Context, we will come to a conclusion that all the hate crimes are motivated by either one or more of these together. But most prominent are the defensive and mission offenders.

History of Hate Crimes in India

In India, Hate crime is not a recent or an unfamiliar concept. The only difference between India and other countries is that in India we don't use the word "Hate Crime". Our authorities prefer to keep the word "Hate" segregated from the word "Crime". We have different laws pertaining to different crimes but there is no law which uses the word "Hate crime" as a blanket for all the crimes done in lieu of hatred or bias against a community or a caste or a race or a religion or a gender or an individual.

The concept of bias-motivated violence is not new to India. It is evident from the fact that how the framers of the Constitution of India, at its very inception expressly addressed the issue of untouchability and declared all practices of discrimination based on untouchability as unconstitutional.[11]

[9] McDevitt J, Levin J, Bennett S: Hate crime offenders: an expanded typology. Journal of Social Issues 2002; 58:2:303-317, Kercher G, Nalasco C, Wu L: Hate Crimes. Sam Houston State University, 2008.
[10] Ibid.
[11] Article 17, The Constitution of India, 1950.

In the Indian history, there are no cases of hate crimes because as said earlier they were never considered as crimes committed due to bias towards someone. These crimes are punishable under different legislations. To make a particular offence punishable one must recognise it as a crime first.

Hate crimes are very common in India and had been so since very long but are known by diverse names such as mob lynching, mob violence, public outrage, cow vigilantism, witch-hunting, communal violence, rioting and caste violence against Dalit Dalits etc. If we look into the history of these individual crimes we may probably find many cases.

In India Hindu-Muslim conflicts are primordial. As the Hindus constitute majority of the population in India they try to socially, politically and religiously have dominance over the other minorities. The Hindus feel agitated while talking about how the Indian subcontinent was invaded by the Muslim emperors- Turks, Afghans, and Mughals. All these rulers forced Hindus to Convert to Islam and it did result in mass conversions. Then came the Britishers who divided the people of India on the basis of religion. With the Independence came the partition of India and Pakistan which resulted in the division on the basis of community. It was known as the most enormous mass migration in history leading to extreme violence on and from both sides. Since then there have been numerous instances of inter-community clashes.[12]

The religious tension in India became dangerously high when Babri Masjid was demolished on December 6, 1992, in Ayodhya, Uttar Pradesh, by Karsewaks of Vishwa Hindu Parishad and allied organisations. They contended that this masjid was built by Babur after demolishing a temple of Lord Rama, Ayodhya, being Lord Rama's birthplace.

After ten years, on February 27, 2002, Sabarmati Express train carrying the Hindu pilgrims from Ayodhya to Godhra, Gujarat, was set on fire. Around 59, most of whom were Karsewaks, died.

It was followed by the Gujarat Violence, which was the extreme violence since Independence in which almost 2000 individuals were killed, 1,50,000 displaced and over 800 women and girls raped, mutilated and burnt, accompanied with destruction, arson attacks, demolition of around 132 Mosques and religious tombs. Most of the victims in this case were Muslims.[13]

There have been an increase in the number of cases of communal riots, since then and have been rapidly increasing every year. There are other types of Hate crimes as well some of them are discussed here.

Types of Hate Crimes in India

Racism

Racism means when people are discriminated on the basis of their colour and ethnic backgrounds. Racial discrimination exists in India but is not taken that seriously. Mostly, it is the people from North East who facing this problem. Many of the racism cases go unattended and only the cases like that of Nido[14] receive media and public attention. Government must act

[12]Chandra, B., Mukherjee, M., Mukherjee, A., Mahajan, S., &Panikkar, K. N. (2016). India's struggle for independence. Gurgaon, Haryana, India: Penguin Books.

[13] Introduction, Gujarat Ongoing Genocide, Islamic Human Rights Commission, 2002

[14]Nido was studying in Jalandhar and came to Delhi to meet his friends. At Lajpat Nagar, he asked for the address from a local shopkeeper. But the shopkeeper along with other fellow shopkeepers in the vicinity made mockery of Nido's hair style and colour. Out of rage, Nido broke the glass item worth Rs. 7,000. Nido was then beaten up mercilessly with iron rods and sticks by six people. Police intervened to solve the matter and made Nido pay back Rs. 7,000, which he did. He then went to his room at his sister's home, but the next day was found dead in

in a significant way and come up with stringent laws to stop the racial discrimination.[15] National Human rights commission conducted a study that revealed that 54%people from North-East India do not find New Delhi a safe and secure place to live, in terms of ethnic tolerance. Whereas, 67% people from North-East faced ethnic and racial discrimination in New Delhi. The living and working conditions for North-East Indians in New Delhi and elsewhere in North India are horrible and hostile. The Supreme Court of India (SC) took stringent action and issued guidelines to curb racial discrimination in the case of Karma Dorjee & Others v. Union of India & Others (December 14, 2016) whereby petitioner had alleged that people from north-eastern region, who move out of their states in search of better opportunities in studies and jobs, were subjected to racial taunts, hate crimes and violence on a daily basis due to their physical appearance at the hands of people of their own country. How can India brag about Unity in Diversity when people of the same country are discriminated by their own people? Despite what we may say, India is a racist country in this scenario. We give more importance to a fairer skin and there are even advertisements showing that you won't get a job or a suitable match if your skin colour is not fair. Along with the people of North- East India, the people from South India are also judged on the basis of their colour. We tend to forget that Kerala is the number one state in terms of literacy, Human Development Index and per capita income. The number of violence cases against women and female infanticide cases are far less as compared to North India but we still show our supremacy by the colour or ethnicity.

India is also a signatory to *International Convention on the Elimination of All Forms of Racial Discrimination (ICERD)* which calls for States to prevent and combat racist practices in order to build an international community free from racial segregation. Article5[16] of this convention is recurrently violated in India.

[15]https://www.mapsofindia.com/my-india/society/indians-discriminate-indians-case-of-racial-discrimination-and-death.

[16]Article 5

In compliance with the fundamental obligations laid down in article 2 of this Convention, States Parties undertake to prohibit and to eliminate racial discrimination in all its forms and to guarantee the right of everyone, without distinction as to race, colour, or national or ethnic origin, to equality before the law, notably in the enjoyment of the following rights:
(a) The right to equal treatment before the tribunals and all other organs administering justice;
(b) The right to security of person and protection by the State against violence or bodily harm, whether inflicted by government officials or by any individual group or institution;
(c) Political rights, in particular the right to participate in elections-to vote and to stand for election-on the basis of universal and equal suffrage, to take part in the Government as well as in the conduct of public affairs at any level and to have equal access to public service;
(d) Other civil rights, in particular:
(i) The right to freedom of movement and residence within the border of the State;
(ii) The right to leave any country, including one's own, and to return to one's country;
(iii) The right to nationality
(iv) The right to marriage and choice of spouse;
(v) The right to own property alone as well as in association with others;
(vi) The right to inherit;
(vii) The right to freedom of thought, conscience and religion;
(viii) The right to freedom of opinion and expression;
(ix) The right to freedom of peaceful assembly and association;
(e) Economic, social and cultural rights, in particular:
(i) The rights to work, to free choice of employment, to just and favourable conditions of work, to protection against unemployment, to equal pay for equal work, to just and favourable remuneration;
(ii) The right to form and join trade unions;
(iii) The right to housing;
(iv) The right to public health, medical care, social security and social services;
(v) The right to education and training;
(vi) The right to equal participation in cultural activities;

Hate Speech

The term Hate speech means "a speech that carries no meaning other than an expression of hatred for some group, such as a particular race, especially in circumstances in which the communication is likely to provoke violence."[17]

In a country like India with such a diverse culture, religion, races, languages, caste, it is very difficult to draw a line between freedom of speech and expression and hate speech. Freedom of expression certainly allows a personto give theiropinion, but if that opinion is an attack, theycan instead be a decent person and chose not to give it. Freedom of expression is not equal to being racist, homophobic, sexiest, misogynistic etc. Hate crime and consequently hate speech attacks the victim not only physically but also at the very core of his or her Identity.

Although the term hate speech is nowhere mentioned in any statute the laws pertaining to it are identified in legislations.

Apart from the Constitution of India, there are legislations that neutralize the hate speech in India such as The Indian Penal Code under section 153A[18], 153B[19], 295A[20], 298[21], 501(1)[22], 501(2)[23] declares that the words spoken or written that promotes dissonance, hatred or looks down upon any religion, culture, language, region, caste, race, community, ethnicity etc is punishable by law.

On similar analogy, the Representation of People Act, 1951[24], The Protection of Civil Rights Act, 1955[25], Unlawful Activities (Prevention) Act, 1967[26], The Code of Criminal Procedure, 1973[27], contain provisions for hate speech. However the word Hate speech is nowhere used in these Acts.

There are few instances of Hate speech worth mentioning here. Union Minister Mr. Anurag Thakur and BJP MP Mr. Parvesh Verma received a ban of 72 hours and 96 hours, respectively from campaigning for the Delhi Elections. The reason behind the same was the 'Hate Speech' that they delivered in their respective rallies in Delhi. While Mr. Thakur urged the crowd in a rally to shout "*Goli Maaro* (gun down the traitors)", Mr. Verma claimed in a rally that those who are protesting at Shaheen Bagh against the new Citizenship Law will one day enter the houses and rape our sisters and daughters.[28]

(f) The right of access to any place or service intended for use by the general public, such as transport hotels, restaurants, cafes, theatres and parks.

[17] Black's Law Dictionary, 9th Edition as cited in Pravasi Bhalai Sangathan Vs Union of India,(2014) 11 SCC 477, para 9.

18 See, Section 153A, Indian Penal Code, 1860.

19See, Section 153B, Indian Penal Code, 1860.

20See, Section 295A, Indian Penal Code, 1860.

21 See, Section 298, Indian Penal Code, 1860.

[22]See, Section 501(1), Indian Penal Code, 1860.

[23]See, Section 501(2), Indian Penal Code, 1860.

[24] See Sections 8, 324, 123(3), 123(3A) and 125 of The Representation of the People Act, 1951.

[25] See, Section 7 of The Protection of Civil Rights Act, 1955.

[26] The Unlawful Activities Prevention Act, 1967 has recently imposed a restraint on online speech by banning the internet in Jammu and Kashmir.

[27] See, Section 95, 107 and 144 of The Code of Criminal Procedure, 1973.

[28]https://www.ndtv.com/india-news/minister-anurag-thakur-banned-from-delhi-campaign-for-72-hours-bjp-mp-parvesh-verma-for-96-hours-ove-2172076.

Lynching

Lynching, a form of violence in which a mob, under the pretext of administering justice without trial, executes a presumed offender, often after inflicting torture and corporal mutilation. The term *lynch law* refers to a self-constituted court that imposes sentence on a person without due process of law. [29]

In ***Tehseen S. Poonawala vs. Union of India[30],*** the supreme court of India has defined Lynching as targeted violence which affects the human body and is against private and public property.

Lynching is again a performative act of hate violence. It has become a concern because these acts of mob-lynching are now video graphed and circulated widely through social media and are kind of celebrated as if they are the acts of national heroism. Lynching can be understood in simple terms as an act where a mob kills any person without hearing his part of arguments; the anger of the mob may be due to a rumour, but taking law in their own hands, they carry on with the execution in public.

Even though the Supreme Court highlighted the need for a concrete definition of 'lynching' as a form of vigilantism in July 2018 and directed the state governments to put in place certain preventive, remedial, and punitive measures to combat mob violence, only Rajasthan and Manipur have passed designated legislation. On the other hand, the central government maintains that state governments are competent to enact legislation criminalizing mob lynching. In the absence of any specific laws, these incidents are booked under various legal provisions such as 'rioting', 'unlawful assembly', 'murder', 'criminal intimidation', 'intentional insult with intent to provoke breach of peace' etc., which dilutes the gravity of the offence and renders the statistics inadequate as well as misleading.[31]

Witch Hunting

Even in today's scientific era people still believe in witchcraft and black magic. Calling today's society as progressive when people are still being branded and killed for witchcraft is just hypocrisy.

Witch hunt means "an attempt to find and punish people whose opinions are unpopular and who are said to be a danger to society."[32]

Definition of Witch Hunt

- A searching out for persecution of persons accused of witchcraft
- The searching out and deliberate harassment of those (such as political opponents) with unpopular views.[33]

There have been many instances covered by the media. In 2014, national athlete Debjani Bora, who had won several gold medals in Javelin, was accused of witchcraft in Assam and brutally assaulted by the villagers. As I'm writing this article an elderly couple was burnt to death in their sleep on suspicion of practicing witchcraft while a witch doctor allegedly branded a woman's face with hot iron and forced her to eat pig's excreta to cure her of an ailment in Odisha. In

[29]Encyclopaedia Britannica.
[30](2018) 6 SC 72.
[31]https://amnesty.org.in/news-update/hate-crime-reports-on-an-alarming-rise-reveals-amnesty-international-indias-halt-the-hate/
[32]Cambridge Dictionary(dictionary.cambridge.org/)
[33]The Merriam-Webster Dictionary(https://www.merriam-webster.com/dictionary/witch%20hunt)

Nimapali village of Jajpur district, miscreants set fire to the house of an elderly couple - Shaila and Basanti – Balu late at night when they were sleeping in their home. Villagers suspected the couple of practicing witchcraft after about half a dozen people of Nimapali died due to different causes over the last two weeks. The couple was killed in the blaze.[34]

This evil practice of witch hunting can be resorted if only effective measures and promulgation of laws are done in an efficient manner. There are legislations enacted by some States where this menace is widely practiced. These are as under:

- Prevention of Witch (Dayan) Practices Act, 1999–Bihar;
- Rajasthan Government enacted the Rajasthan Prevention of Witch-hunting Act, 2015;
- Odisha government enacted the Odisha Prevention of Witch-hunting Act, 2013 which became enforceable in February 2014;
- Chhattisgarh government enacted the Chhattisgarh Tonahi Pratadna Nivaran Act, 2005;

These acts have been passed by the respective state legislatures. There is, however, no central law to restrict the practice or its modern forms at the national level.

It is also important to note that modern witch hunting is a result of age-old beliefs or deep-rooted stereotypical notions against females and bias against women. This is definitely one of the crimes which must be put under the definition of Hate Crime.

Cow Vigilantism

The word vigilante has originated from the word vigilant which means to lookout for possible difficulties and danger.The word Vigilante means a person who tries in an unofficial way to preventcrime, or to catch and punish someone who has committed a crime, especially because they do not think that official organizations, such as the police, are controlling crime effectively. Vigilantes usually join together to formgroups.[35]

A member of a volunteer committee organized to suppress and punish crime summarily (as when the processes of law are viewed as inadequate) *broadly*:a self-appointed doer of justice.[36]

Cow vigilantism has sadly become a veil for violence, murders and brutality in the name of cow protection. These cow vigilantes are killing men and women to save the cows. There is no denying the fact that the cow is considered a sacred animal in India but does that mean that one human can kill another human being in the name of its protection. It is high time that our leaders must speak out and speak up in favour of those being slaughtered horrifically in the name of cow protection. The legislators must come up with laws on considering this as a hate crime.

Misogyny/ Gender –Based Violence

Misogyny means "feelings of hating women, or the belief that men are much better than women"[37] India being a patriarchal society, would never think of misogyny as a hate crime because it is the birth right of a male to insult his wife,

[34] Hindustan Times, 20th July, 2020.
[35]https://dictionary.cambridge.org/dictionary/english/vigilante.
[36]https://www.merriam-webster.com/dictionary/vigilante.

mother, daughter or a colleague becauseshe is a female. We can very well understand the plight of a female in India as marital rape is not considered as a crime as the law does not consider sexual intercourse by a man withhis own wife unless she is below 15 years as a rape even if he does it without her consent.

For years we have been conditioned by our society that womenare inferior to men as is being shown in our films these days where the male lead is always glorified. We have made it a part of our upbringing that it's okay to laugh atthe jokes about the wife being dumb, or it's alright if the father comes home drunk and beats his wife. We do not raise our voice if a woman is being disrespected at her workplace because we think it to be normal. Different types of gender-based violence include rape, domestic violence, sexual harassment, virginity test, all forms of physical, emotional, sexual, economic abuses to which women, and not men, are victims.

This treatment needs to be stopped and men can help women achieve their rightful place by acknowledging her worth at home and at work by telling her that her consent matters not only sexually but in everyday life.

Caste Based Violence

This is the oldest form of violence that has existed in India and has still not diminished. India banned caste-based discrimination in 1955. Article 15 of the Constitution of India prohibits discrimination based on caste, and Article 17 declared the practice of untouchability to be illegal. But, this law doesn't deter those who adamantly continue to follow the system. The Human Rights Watch (HRW) notes that India's caste system is perhaps the world's longest surviving social hierarchy.

Recently 13 youngsters brutally assaulted a 32 years old Dalit for allegedly touching the bike of an upper caste. The Dalit was stripped naked and thrashed publically. His family members were also beaten with him when they attempted to save him from the mob.[38]

Three Dalit boys in Jalgaon district's Vakadi village were allegedly stripped, beaten and paraded naked for swimming in a village well. The incident, which took place on June 10, 2020, came to light after a video of it went viral. Maharashtra Minister for Social Justice Dilip Kamble said, "Two persons have already been arrested. An investigation is under way."[39]

On 17 June, 2018, Prashant Solanki, a Dalit man in his late 20s, was on his way to his wedding riding a colourfully decorated horse, as is common practice, when he was ambushed by a group of upper-caste villagers. They insisted that riding a horse was an upper-caste privilege and threatened to attack Mr. Solanki and his family.[40]

These are just few instances of caste- based violence. Every now and then Dalits are being ill- treated, assaulted, and killed, for many trivial matters. It is of grave concern as to when these attacks will be acknowledged as hate crime.

Xenophobia

Xenophobia means "fear and hatred of strangers or foreigners or of anything that is strange or foreign."[41]

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[37]https://dictionary.cambridge.org/us/dictionary/english/misogyny
[38]https://gulfnews.com/world/asia/india/india-dalit-man-allegedly-stripped-and-assaulted-by-13-for-touching-an-upper-caste-mans-bike-1.1595343062332
[39]The Indian Express
[40]BBC News, 19th June, 2018.

"Extreme dislike or fear of foreigners, their customs, their religion, etc."[42]

Xenophobia and Racism are similar yet different terms altogether.

As we all know that we were invaded by the French, Portuguese, Britishers, and Turks etc. from time to time. It is natural to hate or have a fear of foreign invaders but as we have come so far after Independence fear has now cropped up into hatred towards immigrants, sometimes turning hostile towards them. This hatred or fear is there because being a citizen of a country we do not think it proper to dilute our culture or ethnicity by these immigrants or foreigners. Here is when it becomes dangerous when we want to eliminate these outsiders from our country.

There have been number of instances where African and Nigerian students were beaten up in Delhi and Bangaluru. They were accused of cannibalism and selling drugs, mostly. We have read about the agitation that took place because of immigration of Rohingiyas. We believe in the motto of "Atithi Devo Bhava" but we will only allow Bengali-Hindus to immigrate and not Bengali-Muslims.

All cases of Xenophobia are not reported, and if reported we do not have any law which says that xenophobia is a crime so how are we going to punish the perpetrator?

Honour Killings

Honor killing, most often, the murder of a woman or girl by male family members. The killers justify their actions by claiming that the victim has brought dishonor upon the family name or prestige.[43]

In India, the government enacted strict penalties for violence against women during the 1980s. However, honor killings based on inter-caste and inter-religious marriages continued to take place in rural areas, where they were largely unreported to police because of direct or indirect support among village residents. Such murders were often ruled as accidents when reported. A woman beaten, burned, strangled, shot, or stabbed to death could be ruled a suicide, even if there were multiple wounds and there was no possibility the woman could have killed herself.

Honour killing (also known as Shame Killing) results, mostly in the death of a woman as she is supposed to keep the honour of a family. We have read about the famous case of Manoj- Babli where a newlywed couple was killed in 2007. The cases of honour killing are prevalent more in northern regions of India particularly Haryana, Punjab, Rajasthan and Uttar Pradesh.

Honour killings are a severe disregard to the human life and a clear violation of Universal Declaration of Human Rights and the fundamental rights enshrined in the Constitution of India.[44]

Now looking at the various crimes which can be covered under the hate crimes there is a dire need of enacting a comprehensive hate crime law.

[41]https://www.merriam-webster.com/dictionary/xenophobia
[42]https://dictionary.cambridge.org/dictionary/english/xenophobia
[43]https://www.britannica.com/topic/honor-killing
[44]See Article 21, Right to life and personal liberty.

Need for a Legislation

Studies of hate crimes show a steep rise in numbers over the past decade. Amnesty International India's website "Halt the Hate" records the number of hate crimes committed in India as our own National Crime Record Bureau fails to keep an update of the data since 2016. From September, 2015 to June, 2019, Halt the Hate has recorded a total of 902 reported hate crimes in India. A total of 181 incidents of alleged hate crimes were recorded between the months of January and June this year. In 37 reported incidents, the victims were killed. Between January and June 2019, over two-third of the victims suffered harm on account of their Dalit identity followed by their Muslim (40), Adivasi (12), Christian (4) and their actual or perceived sexual orientation or gender identity (6). Some of the alleged hate crimes against Dalits related to denial of access to public property such as roads, water, crematorium, schools etc. Cow-vigilantism related hate crimes and honour killing were reported in 17 cases.[45]

In 2018, Supreme Court directed Central and State Governments to make it widely known that lynching and mob violence would "invite serious consequences under the law".[46]There were only few States who came up with specific legislations to fight lynching and Mob violence.

The Rajasthan Assembly passed two bills in which death penalty have been proposed for hate crimes against couples in the name of honour and tradition and life imprisonment for mob lynching. The Rajasthan Prohibition of Interference with the freedom of Matrimonial Alliances in the name of Honour and Tradition Bill, 2019 and the Rajasthan Protection from Lynching Bill, 2019 were tabled in the assembly by law minister.[47]

The Uttar Pradesh Law Commission took the initiative to recommend a draft of anti-lynching law. It follows the first ever law against lynching passed in the country, introduced by the Manipur Government which is the most significant statute against religious hate crimes in India. Both the Manipur statute and UPLC draft create a new crime which includes dereliction of duty by police officers. It holds the police officer guilty if he or she failed to prevent lynching without reasonable cause and omits to exercise authority given to them under law. It attracts penalty for one to three years and a fine.

The UPLC also makes provision for compensation to the victim of violence within 30 days of the incident.[48]

These are the legislations which were enacted by the particular State but we need legislation enacted by the Central Government which shall be applicable throughout India. Right now we have scattered laws and legislations against hate crimes because we have not put them together under one head. We must learn from the U.S. It took the United Nations Senate 100 years to approve a bill to make lynching a federal crime. Over 200 anti lynching bills were introduced since 1918, but all were rejected until the Justice for Victims of Lynching Act, 2018.

Unfortunately, hate crimes in India are unknown because the law does not recognise it as a separate offence and in the absence of any specific laws these cases are booked under scattered legislations and provisions. All the political leaders have spoken against hate crimes and expressed pain over such incidents but their words are not backed by action. It is high

[45]https://amnesty.org.in/news-update/hate-crime-reports-on-an-alarming-rise-reveals-amnesty-international-indias-halt-the-hate/
[46]Tehseen S. Poonawala vs. Union of India (2018) 6 SC 72.
[47]Hindustan times, August 06, 2019.
[48]https://www.thehindu.com/opinion/lead/in-hate-crime-fight-a-voice-still-feeble/article28775760.ece

time that India acknowledges and punishes hate crimes. We cannot let it pass just as routine incidents. We as citizens also need to wake up and question our laws and its inadequacies.

CONCLUSIONS

We wonder sometimes as to how long the survivors of hate crimes who lost their near and dear ones in India have to wait for a government who will finally recognise their pain. Considering the present state of turmoil in Society, the hate crimes are on a rise. In a heterogeneous culture like India it would be next to impossible to live peacefully with one another. There is definitely a necessity for a separate legislation for Hate crimes and it needs to be strictly implemented. First step that can be taken by the authorities is to ensure that the legislation should be broad enough to include lynching, caste based violence, gender based violence, xenophobia, honour killing, racism, cow vigilantism, witch hunting and hate speech under the purview of Hate Crimes. The hate crimes should be distinguished from ordinary crimes. The collection of data for hate crimes should be done periodically. The trials for the hate crimes must be done in fast track courts so that the victims or their survivors do not suffer a secondary attack. As is proposed by the UPLC, compensation should be provided to the victims and their families.

There is a necessity of a comprehensive legislation in India. It is pertinent to mention that the Parliament must wake up as soon as possible and come up with laws on Hate crimes and set up a benchmark for policemen and administrators to deal with hate crime. It is the duty of the politicians, electronic and print media, and the teachers in schools, colleges and universities to inculcate the virtue of tolerance in people and be responsible citizens of India.

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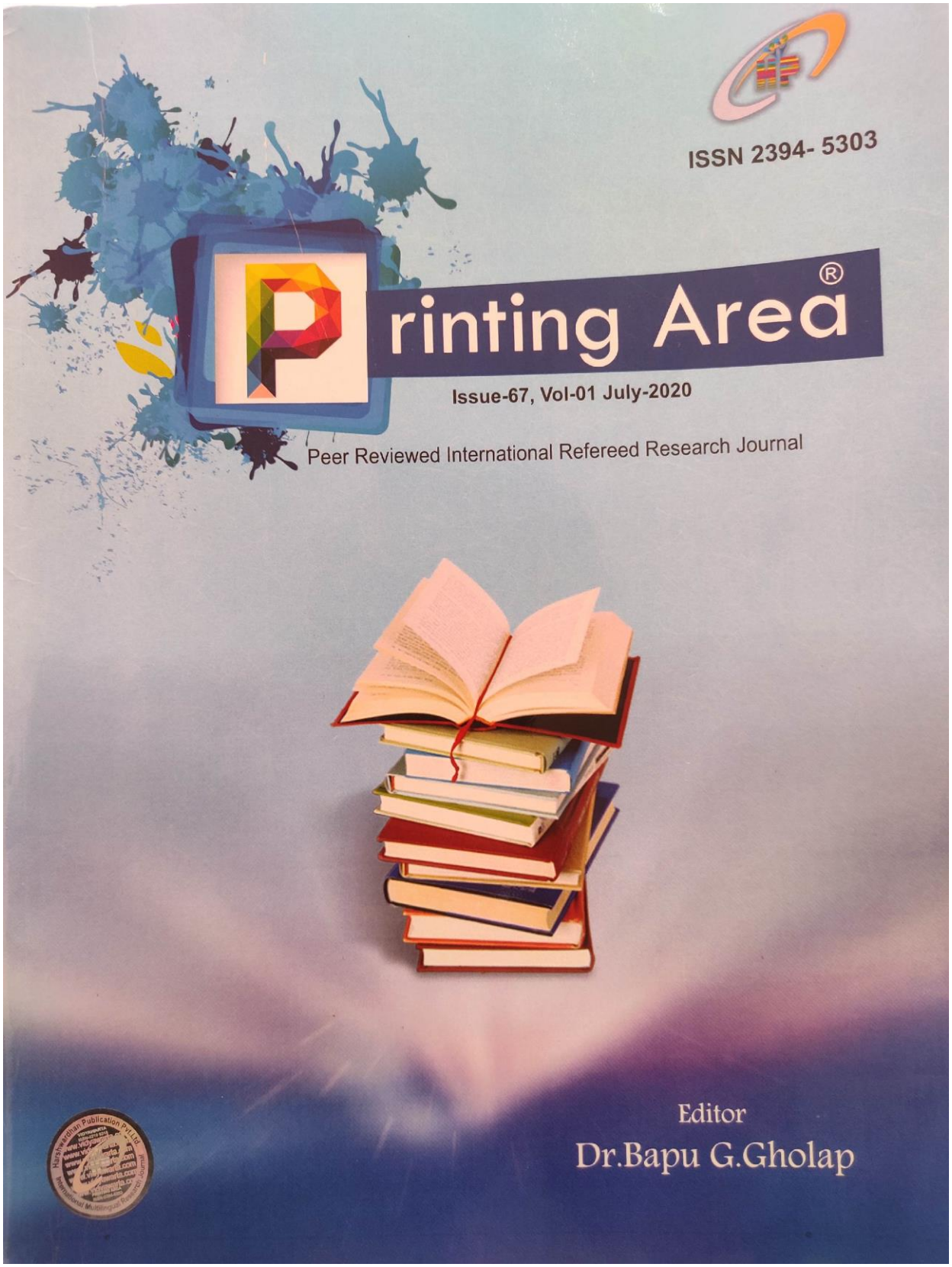
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संस्कृत साहित्य में नारी

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हिमाचल प्रदेश विश्वविद्यालय शिमला

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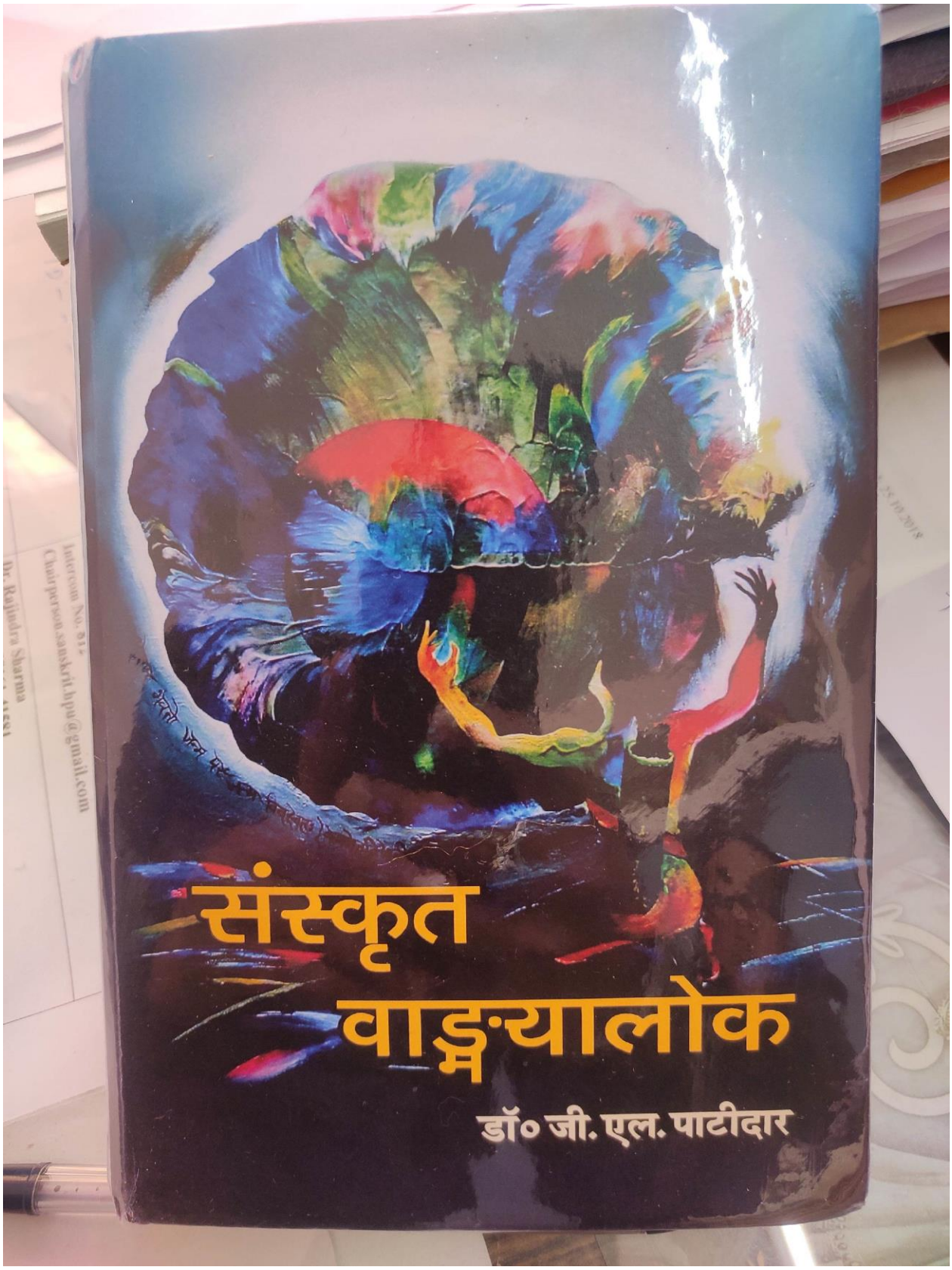
संक्षेपिका

संसार में समस्त प्राणियों में मनुष्य की श्रेष्ठता सर्वोपरि है। वह बुद्धिबल के कारण ही तो अन्य प्राणियों से महान् है। इस मनुष्य जाति के दो रूप है – नर और नारी। वेद में नारी को समाज में मूर्धन्य, सबको धारण करने वाली और तेजस्विनी कहा गया है। किन्हीं लोगों ने स्त्री के लिए 'अबला' शब्द का प्रयोग किया है। परन्तु वेदों में इस प्रकार का कोई शब्द सुनाई नहीं देता। इसके विपरीत वहाँ वीरिणी–वीर पुत्रों को जन्म देने वाली अथवा वीरता के कार्य करने वाली, इत्यादि रूप में नारियों का वर्णन मिलता है।

सर्वप्रथम वैदिक वाङ्मय में नारी, राजनीतिक सन्धिविग्रह, नारी के महत्त्व के विभिन्न स्वरूप, नारी शिक्षा तथा अन्त में निष्कर्ष के ऊपर प्रकाश डाला गया है।

सृष्टि के प्रारम्भ में परमात्मा ने अपने को दो रूपों में विभक्त किया, आधे से वे पुरुष एवं आधे से नारी हो गए। धर्मप्राण भारत में वेद, पुराण, स्मृति आदि ग्रन्थों ने स्त्रियों को पुरुषों की अर्द्धांगिनी माना है। धर्म कार्यों में पत्नी रहित पति का निषेध किया गया है। मानव का नारी के साथ शारीरिक, रागात्मक और धार्मिक सम्बन्ध होने के कारण भी नारी के स्वरूप–भेद हुए और उनके सूचक शब्दों की अलग–अलग सृष्टि हुई। जिस तरह एक छोटे से ओस–बिन्दु में सम्पूर्ण सूर्य–मण्डल प्रतिबिम्बित हो जाता है, उसी तरह नारी–वाचक छोटे से छोटे शब्द में भी उसकी जाति, गुण, क्रिया अथवा इच्छा झलक जाती है।[1]

नारियों की चर्चा के बिना किसी साहित्य की कल्पना नहीं की जा सकती। संस्कृत साहित्य उस परंपरा में विशिष्ट है। वह संस्कृत वाङ्मय ही है जिसमें सीता


संस्कृत
वाङ्न्यालोक
डॉ० जी. एल. पाटीदार

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वाल्मीकि रामायण कालीन भारतीय समाज

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शिमला

संक्षेपिका

राम कथा सम्बन्धी साहित्य की रचना सर्वप्रथम इक्ष्वाकु वंश के सूतों द्वारा आख्यान काव्य के रूप में हुई थी जिन्हें आधार बनाकर वाल्मीकि ने रामायण नामक प्रबन्ध-काव्य की रचना की। इस आदिकाव्य में अयोध्याकांड से लेकर युद्ध कांड तक की कथावस्तु का वर्णन था। इस काव्य में राम को एक आदर्श मानव के रूप में चित्रित किया गया है।

सर्वप्रथम आश्रम व्यवस्था के चारों आश्रमों का उल्लेख किया गया है उसके बाद पारिवारिक-सम्बन्ध, विवाह, खान-पान, वेश-भूषा, आमोद-प्रमोद तथा अन्त में निष्कर्ष को बताया गया है।

व्यवस्था समाज के सदस्य के रूप में व्यक्ति को उसके अधिकारों एवं कर्त्तव्यों का ज्ञान कराती है, आश्रम व्यवस्था व्यक्ति को ऐसा रूप प्रदान करती है, जिससे वह स्वयं को जीवन की विभिन्न अवस्थाओं को तैयार करते हुए, पुरुषार्थ-चतुष्टय की सिद्धि में सफल होता है।

आश्रम व्यवस्था

आश्रम शब्द श्रम् से बना है। जिसका अर्थ उद्योग अथवा प्रयत्न। 'आश्रम्यन्ति अस्मिन् इति आश्रमः' अर्थात् जीवन का ऐसा क्रम, जिसमें मनुष्य पुरुषार्थ चतुष्टय

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शिमला (हि०प्र०)

मानव व्यवहार में शिक्षणाभ्यास की प्रक्रिया का अभूतपूर्व योगदान है, जिसके कारण अनादिकाल से लेकर अद्यतन के विभिन्न दार्शनिकों ने सामाजिक आवश्यकतानुसार शिक्षा-तत्त्वों के विवेचन द्वारा मानव-जीवन में उसकी उपयोगिता पर प्रकाश डाला है। शिक्षा ही जीवन है और जीवन ही शिक्षा है। दोनों के इस अभेद्य सम्बन्ध को नकारा न जाने के कारण ही सा विद्या या विमुक्तये अथवा सा विद्या या ब्रह्मगतिप्रदा के द्वारा विद्या के महत्त्व को पूर्वाचार्यों ने विवेचित किया है, जिसका बोध हमें ज्ञान की उस विधा द्वारा होता है, जिसमें व्यक्ति के वैयक्तिक गुणों की अभिवृद्धि के साथ-साथ उसके सामाजिक, सांस्कृतिक और राष्ट्रीय कर्तव्यों को निश्चित करना रहा है। आधुनिक शिक्षा-शास्त्र पर वैदिक शिक्षण-विधा का प्रभाव है। अथवा आधुनिक शिक्षा-शास्त्र वैदिक शिक्षण परम्परा से अनुप्राणित है या नहीं?

इसके उत्तर में अनेकानेक दृष्टान्तों का अवलोकन करना होगा, तब कहीं जाकर इस निष्कर्ष पर पहुँचा जा सकता है कि आधुनिक शिक्षा-शास्त्र वैदिक शिक्षण परम्परा से अनुप्राणित है। **इष्टप्राप्त्यनिष्टपरिहारयोरलौकिकमुपायं यो ग्रन्थो वेदयति स वेदः**। इस उक्ति द्वारा सायणाचार्य ने इष्ट की प्राप्ति और अनिष्ट

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प्रस्तावना

यास्कप्रणीतस्य निरुक्तस्य सप्तमोऽध्याय दैवतकाण्डनाम्ना ज्ञायते। अस्य दैवतकाण्डस्य द्वितीये पादे आचार्य यास्कः कथयति यत्– ''तिस्रः एव देवताःइति नैरुक्ताः।''[1] अर्थात् निरुक्तानुसारं तिस्रः एव देवता सन्ति।

तिस्रः देवताः इमाः सन्ति– अग्नि, वायु एवं सविता सूर्यो वा एतासां सर्वासाम् देवतानां पृथक् पृथग् ग्रहणं कथं कृतम्? इति जिज्ञासायां निरुक्तकारेण प्रोक्तं यत् ''अग्निः पृथिवीस्थानः वायुर्वेन्द्रो वा अन्तरिक्षस्थानः, सूर्यो द्युस्थानः।'' यतो हि लोका अपि त्रयः सन्ति। पृथिवीलोकः, अन्तरिक्षलोकः, द्युलोकश्च।[2] यद्यपि पौराणिक मान्यतानुसारं एतत् जगत् चतुर्दशभुवनमण्डलात्मकं किन्तु वैदिकमान्यातानुसारं अत्रैव सर्वेषां लोकानां ग्रहणं भवति। अतएव एतेषां सर्वेषां लोकानां नियन्त्रणकर्तारोऽपि देवाः इमे एव त्रयः सन्ति।

एतासां देवतानां महाभाग्यात् एकात्मा बहुधास्तूयते। निरुक्तकारेण उक्तं यथा– ''तासां महाभाग्यात् एकैकस्याः अपि बहूनि नामधेयानि भवन्ति''[3] तासां तिसृणामग्न्यादीनामहाभाग्यात् अर्थात् ऐश्वर्ययोगात्, एकात्मनामनेकधा विकुर्वन्तीनामेकैकस्याः प्रतिविकारं जातवेदाः, वैश्वानरः, वरुणः, रुद्रः, अश्विनौ, उषा इत्येवम् आदीनि, बहूनि नामधेयानि भवन्ति।

तिसृषु देवतासु अग्निदेवस्य प्रथमं स्थानं वर्तते। अग्निदेवस्य अयं लोकः अर्थात् भूलोकः पृथिवीलोक वा। प्रातः सवनम् अग्निदेवस्य कृते भवति। बसन्त ऋतुः, गायत्रीछन्दः, त्रिवृत् स्तोमः स्थन्तरं साम अग्निदेवस्य वर्तते। अग्निदेवता प्रथमेस्थाने पठित देवगणस्य प्रतिनिधि वर्तते। अग्नायी इळा पृथिवीमपि अग्न्यान्तर्गतमेव ज्ञातव्यम्। शरद्ऋतुः, अनुष्टुप्छनदः एकविंशतिस्तोमः तथा वैराजसाम अपि पृथिवीस्थानीय वर्तन्ते।[4]

अग्निदेवस्य प्रमुखं कर्म हविषां वहनं देवतानां आह्वाहनं वर्तते। अर्थात् यच्च किंचिद् दार्ष्टिविषयकम्, अग्निकर्म एव तत्। अग्निः अग्रणीः भवति, अग्रं यज्ञेषु प्रणीयते, अंग नयति संनममानः। यज्ञे सर्वप्रथम अग्नेः आह्वानं भवति। यः कोऽपि अग्नेः आश्रयं नयति तं सः आत्मा धीनं करोति। अक्नोपनः भवति–इति स्थौलाष्ठीविः। न क्नोपयति न स्नेहयति। त्रिभ्य आख्यातेभ्यः जायते इति शाकपूणिः। इतात् अक्तात् दग्धात् वा, नीतात्। स खलु एते अकारम् आदत्ते, गकारम् अनक्तेः वा दहतेः वा नी परः।[5] अतः स अग्नि उच्यते। ऋग्वेदे अग्निविषयको मन्त्रो आयाति–

अग्निमीळे पुरोहितं यज्ञस्य देवमृत्विजम्।
होतारं रत्नधातमम्।।[6]

अर्थात्– यज्ञस्य क्रियमाण देवताद्याराधनकर्मणः पुरोहितम् पुरोहितत्वाद भीष्ट संपादकम्। यद्वा यज्ञस्यपूर्वभागे आहवनीयरूपेण संस्थितम्। अग्निर्वै देवानां होता इति श्रुतेः। देवं दानादिगुणयुक्तम्।। होतारम् होतृनामकमाह्वातारं वा देवानाम्। ऋत्विजम् देवानामृत्विग्भूतम्। रत्नधातमम् यागफलरूपाणां रत्नानां अतिशयेन धारयितारं पोषयितारं वा। अग्निम् तन्नामकं देवम्। ळे स्तौमि। यद्वा यज्ञस्येति पदं ''देव'' मित्यनेनान्वेति। यज्ञस्यप्रकाशकमित्यर्थः।।

वायुः वा इन्द्र अन्तरिक्षस्थानीय देवता वर्तते। तस्याः देवतायाः अन्तरिक्षलोकः वर्तते। माध्यन्दिनं सवनम्, ग्रीष्मऋतुः, त्रिष्टुप्छन्दः, पंचदशस्तोमः, वृहत्साम आदि इन्द्रदेवस्य कृते वर्तते। तथा च ये च देवगणाः समाम्नाताः, मध्यमे स्थाने याश्च स्त्रियः। अथास्य कर्म– रसानुप्रदानं, वृत्रवध, या च का च बलकृतिः इन्द्रकर्म एव तत्। अथ अस्य संस्तविकाः देवाः– अग्नि, सोमः, वरुणः, पूषा, बृहस्पतिः, ब्राह्मणस्पति, पर्वतः, कुत्सः विष्णुः, वायुः।[7] ऋग्वेदे अन्तरिक्षस्थानीय देवस्य कृते अर्थात् इन्द्रस्य वायोः वा विद्युतः कृते मन्त्रः वर्तते यथा–

अभिप्रवन्त समनेव योषाः कल्याण्यः स्मयमानासो अग्निम्।
घृतस्य धाराः समिधो नसन्त ता जषाणो हर्य्यति जातवेदाः।।[8]

गृत्समदो ब्रूते। जनासः जनाः हे असुराः। यो जात एव जायमान एव सन् प्रथमः देवानां प्रधानभूतः मनस्वान् मनस्विनामग्रगण्यः। देवः द्योतमानः सन् क्रतुना वृत्रवधादिलक्षणेन स्वकीयेन कर्मणा देवान् सर्वान यागदेवान पर्यभूषत् रक्षकत्वेन पर्यग्रहीत्। यो जात एव प्रथमो मनस्वी देवो देवान्क्रतुना कर्मणा पर्यभवत्पर्यगृहणात्पर्त्यरक्षदत्यक्रामदिति वा। यस्य बलात् द्यावापृथिव्यावप्यविभीतां नृम्णस्य महना बलस्य महत्त्वेन स जनास इन्द्र। यथा–

यो जात एव प्रथमो मनस्वान, देवो देवान्क्रतुना पर्यभूषत्।
यस्य शुष्माद्रोदसी अभ्यसेतां, नृम्णस्य महना स जनास इन्द्रः।।[9]
हेमन्तऋतुः, पंक्तिछन्दः, त्रिणवःस्तोमः, शाक्वरं साम आदि अन्तरिक्षरथानीयाः वर्तन्ते।[10]

अथ उत अभिधानैः संयुज्य हविश्चोदयति इन्द्राय वृऋने। इन्द्राय वृत्रघ्ने, इन्द्रायांहोमुचे[11] अथ उत कर्मभिः ऋषिः देवताः स्तौति – वृत्रहा; पुरन्दरः इति तानि अपि एके साममनन्ति, भूयांसि तु समाम्नानात्। व्यंजनमात्रं तु तत् तस्याभि धानस्य भवति। यथा ब्राह्मणाय बुभुक्षिताय ओदनं देहि, स्नाताय अनुलेपनं, पिपासते पानीयम् इति।।[12]
निरुक्तानुसारं सूर्यदेवता द्युस्थानीयो देवता। आचार्ययास्कः कथयति यत् आदित्यदेवस्य असौ लोकः अर्थात् द्युलोकः तृतीयसवनम्, वर्षाऋतुः, जगतीछन्दः, सप्तदशस्तोम एवं वैरूपंसाम तथा च शिशिरऋतुः, अतिछन्दः त्रयस्त्रिंशत्स्तोम एवं रैवतसामादिद्युलोकभागिनः सन्ति।[13]
आदित्यदेवस्य कर्म रसादानम् अर्थात् रसस्य आकर्षणम्, रश्मिभिश्च रसधारणम् अर्थात् किरणैः रसधारणम् ग्रहणम् तथा च यंच किंचत् प्रवहिलतम् अर्थात् वनस्पत्यौषधीनां वृद्धिः एवं पुष्टिः तत् सर्वम् आदित्यकर्म वर्तते। आदित्यस्य मन्त्र ऋग्वेदे प्राप्यते। यथा–

वैश्वानरस्य सुमतौ स्याम राजा हि कं भुवनानमभ्श्रीः।
इतो जातोविष्वमिदं वि चष्टे वैश्वानरो यतते सूर्येण।[14]

इतो जातः सर्वमिदमिभिविपश्यति। वैश्वानरः संयतते सूर्येण। राजा यः सर्वेषां भूतानामभिश्रयणीयः तस्य वयं वैश्वानरस्य कल्याण्यां मतौ स्यामिति।।
ऋग्वेदे अनुसारं देवानाम् अनीकम् चित्रम् मित्रस्य वरुणस्य अग्नेः चक्षुः सूर्यः उदगात्। द्यावापृथिवी अन्तरिक्षम् आ अप्रा। जगतः तस्थुषः च आत्मा। यथा–

चित्रं देवानामुदगदनीकं चक्षुर्मित्रस्य वरुणस्याग्नेः।
आप्रा द्यावापृथिवी अन्तरिक्षं सूर्य आत्मा जगतस्तस्थुषश्च।।[15]

अथ आदित्यात् उदीचि प्रथम समावृते आदित्ये कंसं वा मणि वा परिमृज्य प्रतिस्वर यत्र शुष्कगोमयम् असंस्पर्शयन् धारयति तत् प्रदीप्यते। सः अयमेव सम्पद्यते अथापि आह वैश्वानरो यतते सूर्येण इति।।[16]
ऐतरेयब्राह्मणस्य[17] कथनमस्ति यत् ''अग्निः सर्वाः देवताः'' अर्थात् अग्नि एव सर्वेषु देवेषु मुख्यो वर्तते। अथवा अग्नेः कथनेन एव अन्येषां ग्रहणं भवति। ऋग्वेदस्य एका ऋचा अस्य ब्राह्मणवचनस्य अधिकं समर्थनार्थं प्रमाणरूपेण दत्ता वर्तते। यथा–

इन्द्रं मित्रं वरुणमग्निमाहुरथो दिव्यः स सुपर्णो गरुत्मान्।
एकं सद्विप्रा बहुधा वदन्त्यग्निं यमं मातरिष्वानमाहुः।।[18]

यत् अग्निरेव इन्द्रं मित्रं वरुणमादिनामभिः ज्ञायते। तथा अग्निरेव दिव्यदिविज अर्थात् द्युलोकवासी, सुपर्ण अर्थात् पतनशीलः, गरुत्मान् अर्थात् स्तुतियुक्त अथवा रसान् यः आकर्षयति स आदित्य अपि प्रसिद्धाग्निरेवाऽस्ति। अयमेकमग्निमेव मेधावी तथा आत्मज्ञानी जनाः अनेकैः नामभिः आह्वयन्ति। यथा यम तथा मातरिश्वादि देवाः।
पश्चात् कथितं वर्तते यत् निस्सन्देहेन अनेकानां नामानि अग्निः वर्तते। यथा– विद्युत, आदित्यादि अपि अग्नि अस्ति, किन्तु गौणरूपेण। गौणीवृत्या एते अग्निनाम्ना व्यवहृताः सन्ति। किन्तु वास्तवरूपेण एषः पार्थिवाग्निरेव अग्निरस्ति।
अथ असौ आदित्यः– इति पूर्वे याज्ञिकाः। एषा लोकानां रोहेण, सवनानां रोहः आग्नातः। रोहात्प्रत्यवरोहः चिकीर्षितः ताम् अनुकृति होता अग्निमारुते शस्त्रे, वैश्वानरीयेण सूक्तेन[19] तथा वर्षाकर्मणा वैश्वानरस्य स्तुतिः कृता वर्तते, अत एषः मध्यमाग्नि अर्थात् विद्युत् अस्ति तदपि उचित नास्ति। कारणं अस्मिन पार्थिवाग्नौ एव सर्वम् उपपद्यते। अग्रिमे मन्त्रे वर्णितमस्ति। यथा–

समानमेतदुदकमुच्चैत्यव चाहभिः।
भूमि पर्जन्या जिन्वन्ति दिव जिन्वन्त्यग्नयः।[20]

समानम्– एकमेवेदम्, उदकम्–उदकत्वेनाविशिष्टम् उच्चैत्यवचाहभिः। उत् एति च ऊद्वघ्वं चैति। अहोभिर्निमित्तभूतैः पुनश्च अहोभिरेव अवाम् एति नीचैरागच्छति। भूमिं पर्जन्या माध्यमिका देवगणा जिन्वन्ति–तर्प्यन्ति, ओषधयुत्पत्तये एवं तावदवाम् एति। यथैवामुतो वर्षेणेमां पर्जन्या जिन्वन्ति तथैवाहुति प्रभावेण वर्षेण दिवं जिन्वन्त्यग्नयः आहुतयो हयग्नौ प्रक्षिप्ताः पुनर्वर्षं प्रकल्पयन्ति।
आग्नेयेषु एव हि सूक्तेषु वैश्वानरीयाः प्रवादाः भवन्ति अग्निकर्मणा च एनं स्तौति। इति दहसि, इति वहसि, इति पचसि इति यथो एतत्–वर्षकर्मणा हि एनं स्तौति ''इति अस्मिन् अपि एतत् उपपद्यते।[21]
सर्वे देवाः अग्नौ एव सन्निहिताः सन्ति। द्युलोके यः अग्नि अस्ति सः सौराग्निरस्ति। अन्तरिक्षलोके य अग्निरस्ति सः विद्युताग्नि अस्ति। वृक्षेस्थित अग्निः दावाग्निः वर्तते, जलेस्थित अग्निः वडवानलाग्निरूपेण व्यवह्रियते तथा शरीरेस्थित अग्निः जठराग्निरूपेण ज्ञायते। अतः वक्तुं यत् ''अग्निरेव सर्वाः देवताः।''

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Abstract

Training is a continuous process in improving the caliber and skills of employees at the workplace. It is an attempt to improve their current and future performance but the organization should keep a track on their performance after imparting them training it means training needs assessment (Janice A. Miller, 2002) it is a systematic process of altering the behavior of employees in a direction to achieve the organization's goals. The aim of any training program is to provide instruction and experience to new employees to help them reach the required level of performance in their jobs quickly and economically. In order to meet the ever-growing and challenging needs of business and household banking has to become dynamic and updated in modern scenario and also to take up this industry to the heights of international excellence requires best combination of new technology and skillful and talented manpower. The objective is to examine the effectiveness of training programmes for employees in fulfillment of their duties. Present research paper is of descriptive type and based on primary data collected through questionnaire filled by the bank employees. The present paper explained some suggestions to enhance training strategies in the banking sector, and to cope up with the existing challenges in the wake of severe competition in the training and development. The findings of the study suggest that training is inevitable and unavoidable in any sector.

Keywords: Training, Banks, State Bank of India, Human Resource Management, Employees.

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WORK LIFE BALANCING IN BANKING SECTOR: PERCEIVED GENDER DISCRIMINATION

Dr. ArtiPanditDhawan* Anu Maher**
** Associate Professor, Centre for Evening Studies, H.P. University, Shimla.*
*** Research Scholar, H.P. University, Shimla.*

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In India, it is assumed that activities related to earning of living are solely the entitlement of males while domestic work, child bearing and child rearing are the lone employments of women. Traditionally, women in India have not enjoyed a good standing in workplace settings whether in administrative or operational roles. Women have been loaded with work of all sorts all through their lives. Among fast growing developing countries, India is characterized for the role of the service sector. Going by the same theme, this study has been undertaken focusing on women employees of service sector. The idea was simply to examine if gender based perceived discrimination takes place when it comes to work life balancing. A sample of 410 employees working in banking sector was selected including 197 male and 213 female respondents. Their responses on various aspects of work life balancing were collected and tested for discrimination with the help of chi square test. Results have indicated a clear discrimination with some of the aspects of work life balancing like Job Autonomy, Job Demands, Job Time, Job Security, Job Stress, Personal Financial Strain, and Organization Commitment.

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Introduction

The balance between private and professional life is one of the essential ingredients of well-being and job satisfaction. Nevertheless, this balance is sometimes difficult to find. An important aspect of the balance between work and private life is the time spent at work. Data shows that heavy schedules can affect the health, jeopardize the safety and increase stress. At nearly 13%, the average number of employees working 50 hours or more per week is not very high in all of the OECD. Turkey is by far the country where the percentage of employees working very long hours, with 39%, the highest; It is followed by Mexico, with nearly 28%, and Israel, with one sixth of employees. Overall, there are more men working very long hours than women, and the percentage of employees working very long hours in the OECD countries reached 17% among men, against 8% in women[1].In addition, more a person works, the less it spends time in other activities, whether leisure or time for oneself. The amount and quality of leisure time are important factors of general well-being of an individual and can provide additional benefits in terms of physical and mental health. Devoting fewer hours in paid work does not necessarily mean for women they have more leisure, because men and women devote approximately the same time in twenty OECD countries studied[2].

Among the difficulties encountered by employees, balancing work and personal life regularly comes first. The social surveys and barometers carried out by the employers are unanimous on this point and, obviously, the days of RTT (Reduction in Total Work Time) are not always enough to find a good balance. While working time has been on an upward trend for more than a century, the Indian worker's sleeping time is also shrinking, as is the number of children in couples, how is it that the equilibrium between work and personal life is particularly problematic today? First of all, the official working time does not always correspond to the actual working time. Even when the latter is precisely measured, an employee cannot badge if he carries work at home at night or on weekends. In addition, some say they do not have time to take all their days off and RTT.

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Particularly in case of women employees, we should not forget the effect of family changes. To this must be added the social pressure which demands, for example, that a woman be both an excellent mother with her children, an excellent wife with her spouse, an excellent daughter with her parents, an excellent employee, an excellent friend etc.The growth of divorces, single-parent families and blended families generally makes it even more difficult to balance work and personal life. Moreover, this conciliation is complex, because our ambition is extremely high: we want everything right away.

Problem Definition: This study has been organized and designed with the specific objective of how male and female employees in banking sector perceive various aspects of work life balancing. An effort has been made to examine if male and female employees differ on their perceptions related to aspects of work life balancing.

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Dr. ArtiPanditDhawan* **Anu Maher****
**Associate Professor, Centre for Evening Studies, H.P. University, Shimla.*
***Research Scholar, H.P. University, Shimla.*

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Training as Human Resource Development (HRD) Mechanism in H.P. Police

Dr. Arti Pandit Dhawan
Associate Professor (Commerce)

HPUCES, The Mall, Shimla,
Himachal Pradesh.

Abstract:

Police service is a part of public service in India. But the nature of the services somewhat different forms other categories of public services, as it is entrusted with the tasks of maintaining law and order. This task makes the policeman and agent of enforcing law & order who also has to play a role in protecting and defending the rights and liberty of citizens. Of late the policeman has also become an agent of social change by executing various social legislation. Since the job of a policeman is, in general, rough and tough, it requires the particular type of training in order to deal with situations rising from peculiar problems such as combating terrorism, drug peddling, heinous crimes, smuggling and communal riots. These problems demand a policeman to be physically fit and mentally alert. All these techniques cannot simply be learned by trial and error and hence it requires a particular type of training needed for policeman. Training to policeman has to bring greater efficiency and effectiveness, in his job. The police job entails the handling of critical and essential situations including decision making, therefore, problem solving training should be providing on continuous basis so that they develop proficiency in their skill, modify their behaviour and attune themselves to the tasks challenging them from time to time. Training has to prepare them for leadership because a lot depends upon the way the leader leads and his subordinate's behave. Training helps in bridging the gap between the existing performance ability and desired performance. Training generally aims at improved individual performance, improved job satisfaction and improved organizational effectiveness. The purpose of training according to the modern approach is the continuous development of individuals towards their full and unique potential through their life span and thus the continuous development of human resources. In this paper an attempt has been made to study training as HRD mechanism in H.P .Police.

***

Defining Training and Development

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A Study on Effectiveness of Training in Banks (With special reference toState Bank of India in Panchkula and Ambala)

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****RuchiVerma**
Research Scholar,
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WORK LIFE CONFLICT: AN ANALYTICAL STUDY OF WORK SPILL OVER AND LIFE SATISFACTION OF WOMEN EMPLOYEES IN BANKING SECTOR

Dr.Arti Pandit Dhawan
Associate Professor

H.P.U.C.E.S

Anu Maher
Research Scholar

Abstract
The role of work has changed throughout the world due to economic conditions and social demands. Originally, work was a matter of necessity and survival. Throughout the years, the role of "work" has evolved and the composition of the workforce has changed. Changes in the social, political and economic fabric of societies have influenced and continue to influence both the nature of employment and its relationship to life outside work. Today work still is a necessity but it should be a source of personal satisfaction as well. One of the vehicles to provide attainment of personal and professional goals is work life benefits and programmes Work life balance has always been a concern of those interested in the quality of working life and its relation to broader quality of life (Noor,2011). Work-personal life conflict occur when the burden, responsibilities and liabilities of work and family roles become incompatible or irreconcilable. There occurs conflict between life inside and work outside. In the context of work life balance, spill over refers to positive or negative effects of an individual's working life on their personal life or family life and vice versa. Life satisfaction is a measure of well-being and may be assessed in terms of mood, satisfaction with relations with others and with achieved goals, self-concepts, and self-perceived ability to cope with daily life. Lack of work flexibility, work burden and longer working hours are stressing out many women employees. In this paper an attempt has been made to analyse the sensitivity of women employees in banking sector regarding work spill over and life satisfaction.
Keywords: *Perception, Spill over, Life satisfaction.*

Introduction

In India, it is taken for granted that economic activities are exclusively the prerogative of males while domestic work, child bearing and child rearing

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Among the difficulties encountered by employees, balancing work and personal life regularly comes first. The social surveys and barometers carried out by the employers are unanimous on this point and, obviously, the days of RTT (Reduction in Total Work Time) are not always enough to find a good balance. While working time has been on an upward trend for more than a century, the Indian worker's sleeping time is also shrinking, as is the number of children in couples, how is it that the equilibrium between work and personal life is particularly problematic today? First of all, the official working time does not always correspond to the actual working time. Even when the latter is precisely measured, an employee cannot badge if he carries work at home at night or on weekends. In addition, some say they do not have time to take all their days off and RTT.

Then, work has intensified since the 1990s due to productivity imperatives, pressure from customers who are increasingly impatient, the need to be hyper-reactive to market changes and, finally, new technologies. Thus, time seems to be accelerating. There is less and less "time out" since employees can now, for the most part, work everywhere and all the time.Finally, the share of the labor force working at non-standard working hours is steadily increasing.

Particularly in case of women employees, we should not forget the effect of family changes. To this must be added the social pressure which demands, for example, that a woman be both an excellent mother with her children, an excellent wife with her spouse, an excellent daughter with her parents, an excellent employee, an excellent friend etc.The growth of divorces, single-parent families and blended families generally makes it even more difficult to balance work and personal life. Moreover, this conciliation is complex, because our ambition is extremely high: we want everything right away.

Problem Definition: This study has been organized and designed with the specific objective of how male and female employees in banking sector perceive various aspects of work life balancing. An effort has been made to examine if male and female employees differ on their perceptions related to aspects of work life balancing.

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[1] *Compiled from OECD surveys on Global Level. Available at http://www.oecdbetterlifeindex.org*
[2] *Countrywide reports of OECD are available at http://www.oecdbetterlifeindex.org/countries*

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HUMAN RESOURCE DEVELOPMENT (HRD) PRACTICES IN DISTRICT CIVIL ADMINISTRATION

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Abstract
The present form of district is a mixed creation of Mughal and British but as a unit of administration it existed in India much before the beginning of Christian era. District has been the nodal point of the administrative system in India for about two hundred years. Administrative Reforms Commission has stated that "Need for changes in the machinery of government and its personnel have been felt to be compelling. It is equally clear that adhoc or peripheral administrative improvisations are doomed to be inconsequential and even futile and what is needed are the basic changes in the system and spirit of government as inherited from the British. Proper attitudes are to be cultivated by the country's bureaucracy and government in power. This should synchronize with re-determination of government hierarchies as well as of business methods. In addition to the structure and processes, the contents of administration require to be determined much more rationally." Human Resource Development (HRD) practices do make a difference in many ways. These practices enhance the internal capabilities of an organization to deal with current and future challenges faced by an organization.

Keywords: Human Resource Development, District Administration, Future Challenges.

Introduction

According to the introductory prologue to the "The Administrative Reforms Commission, compilation by Dr. S.R. Maheshwari , administration is a mechanism which the society, through its agency, government has designed and brought into existence to translate its volitions into fulfillment, when there is a conglomeration of resolutions continuing seeking almost simultaneously realization, this mechanism acquires an obvious and increasing influence, even urgency in the smooth functioning of the social order. Volume, nature and variety of desires released at a given time depend essentially on the stage of political development and maturity reached in the society. Society speaks through the government and the government activates itself through public administration".

Administrative Reforms Commission has further stated that "need for changes in the machinery of government and its personnel and its personnel have been felt to be compelling. It is equally clear that adhoc or peripheral administrative improvisations are doomed to be inconsequential ,even futile and what is needed are basic changes in the system and spirit of government as inherited from the British. Proper attitudes are to be cultivated by the country's bureaucracy. This should synchronize with re-determination of government hierarchies as well as of business methods. In addition to the structure and processes, the contents of administration require to be determined much more rationally."

Review of Literature

In the context of the present study it is important to take cognizance of the studies related to research problem under study.

Shastri (1957) has analysed that collector of the district occupies cardinal position in the administration. He is the local representative of the government. He is the head of the revenue department in the district; he is the executive district magistrate and keeps in general touch with the working of all the departments in the district.

Khera (1964) has studied that the district in India is in many ways the most important unit of field administration in the country. It in a convenient geographical unit, where there can be concentrated the total apparatus of public administration it provides a practical method for management of public affairs in a country like India. It is many ways the result of history. It has stood the test of time and time provides some very severe tests for all forms of organisations everywhere. Shukla (1976) has enumerated a comparative study of variations in administration setup in different states and their implication have also been noted and compared.

Pareek and Rao (1981) have emphasized that human resource system requires a different type of emphasis on analysis of the roles, (key performance areas and critical attributes), matching to the role of person (recruitment placement and promotions) developing the person in the role (performance appraisals, feedback and counseling and training), potential appraisals, carrier development and planning, developing a role for a person(job rotation, job enrichment , job design and redesigning) and role of effectiveness etc.

Sharma (1992) has studied that development being an ideology has to be pursued vigorously in order to fulfill pledges and commitments made to the toiling millions by our national leaders. Ashwa Thapa (2000) has provided a refreshing and awarding in sight into the management of human resources and focuses on the strategic human resource management, human resource planning training and development.

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HRD CLIMATE AND OCTAPACE CULTURE: CHANGE AGENTS FACILITATING GOOD GOVERNANCE

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Abstract

Good governance is possible by managing people through human approach and touch. The concept of good governance is not static but a dynamic one, as it keeps changing due to overall societal changes. Good governance implies utmost concern for people's welfare wherein the government and its bureaucracy follow policies and discharge their duties with the deep sense of commitment, respecting the rule of law in a manner which is transparent, ensuring human rights and dignity and public accountability. HRD Climate can be defined as the employee's perception about the environment of their organization. Various HRD instruments create a climate conducive to achieve organizational effectiveness HRD Climate is an integral part of organizational climate. Good governance process should be efficient, effective, economical, ethical, equitable, reasonable, fare and people caring. It implies gearing up the government machinery to provide a responsive, transparent, clean and people friendly administration. For good governance, there has to be openness and transparency, de-bureaucratization by changing the mind set of functionaries, improved skills, enhanced capabilities, better performance, free from corruption, de-centralized management, better budgeting, accounting and auditing, efficiency and accountability. In view of above it can be concluded that HRD climate consisting of OCTAPACE culture is a facilitator for good governance.

Key words: Good Governance, HRD Climate, OCTAPACE Culture.

Introduction

According to H.K. Asmeron et al, "Good Governance is associated with efficient and effective administration in a democratic framework". Good Governance is said to have following eight characteristics: it is participatory, consensus-oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law.

The World Bank, for the first time in 1989, highlighted the concept of good governance. By good Governance, it meant sound public management, and in this context identified four dimensions:

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Training as Human Resource Development (HRD) Mechanism in H.P. Police

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Abstract:

Police service is a part of public service in India. But the nature of the services somewhat different forms other categories of public services, as it is entrusted with the tasks of maintaining law and order. This task makes the policeman and agent of enforcing law & order who also has to play a role in protecting and defending the rights and liberty of citizens. Of late the policeman has also become an agent of social change by executing various social legislation. Since the job of a policeman is, in general, rough and tough, it requires the particular type of training in order to deal with situations rising from peculiar problems such as combating terrorism, drug peddling, heinous crimes, smuggling and communal riots. These problems demand a policeman to be physically fit and mentally alert. All these techniques cannot simply be learned by trial and error and hence it requires a particular type of training needed for policeman. Training to policeman has to bring greater efficiency and effectiveness, in his job. The police job entails the handling of critical and essential situations including decision making, therefore, problem solving training should be providing on continuous basis so that they develop proficiency in their skill, modify their behaviour and attune themselves to the tasks challenging them from time to time. Training has to prepare them for leadership because a lot depends upon the way the leader leads and his subordinate's behave. Training helps in bridging the gap between the existing performance ability and desired performance. Training generally aims at improved individual performance, improved job satisfaction and improved organizational effectiveness. The purpose of training according to the modern approach is the continuous development of individuals towards their full and unique potential through their life span and thus the continuous development of human resources. In this paper an attempt has been made to study training as HRD mechanism in H.P .Police.

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Defining Training and Development

Training is the act of increasing the knowledge and skills of an employee for doing a particular job. The major outcome of training is learning. A trainee learns new

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Role of NGOS in Rural Development of Himachal Pradesh

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ABSTRACT - Rural development generally refers to the process of improving the quality of life and economic well-being of people living in relatively isolated and sparsely populated areas. Rural development has traditionally centred on the exploitation of land-intensive natural resources such as agriculture and forestry. Rural development actions are mainly and mostly to development aim for the social and economic development of the rural areas.Rural development programs are usually top-down from the local or regional authorities, regional development agencies, NGOs, national governments or international development organizations. India is a land of villages and the Government of India has been implementing numerous rural development programmes for the upliftment of rural Communities. A number of NGOs have been playing a vital role in rural community development, besides government interventions. Realizing that the government alone was not able to meet the challenges of the massive enormous tasks in the process of rural development, the non-profit, voluntary and non-governmental organizations had to be involved in different phases and activities at the global, regional and local levels. The NGO sector effectively works towards uplifting the socio-economic status of the poor.

KEYWORDS: Rural Development, government, NGO, rural development. Schemes.

I. INTRODUCTION

India is rightly regarded as the land of villages. In a country where 75% of the population lives in villages, the importance of rural development is self-evident. Rural development programmes are designed to facilitate a multi-faceted growth of the rural poor by providing the benefits of development to them and the improvement of their living standards. After independence and particularly after the constitution came into force the government has initiated a number of programmes to solve the chronic problems facing villages in India. Soon after independence, in the early stages, efforts were made through Community development programme, democratic decentralization and Panchayati raj were made to eradicate poverty and hunger from the rural India and to usher in all round development of rural masses. It should be noted that all these rural development programmes were synonymous with agricultural development. This followed the worldwide thinking and India's excessive concern, especially till the Green Revolution in the late 1960s, with the food self-sufficiency. Later on it was realised that rural development is much broader in scope than merely agriculture development. Therefore, if the strategy for rural development had to be made effective, a multi – pronged approach to rural problems was imperative. The Panchayati raj institutions did not help much the weaker sections of the society due to domination and control of higher castes in these bodies, therefore, after the evaluation of earlier programmes, a number of special programmes were taken up for poverty alleviation in the hope that benefits of these programmes may reach the people living below poverty line.

1.2.1.1 RURAL DEVELOPMENT PROGRAMMES

Special Development programmes which were directly or indirectly designed for the uplift of socio-economic conditions of the rural people. Broadly, these programmes fall under the following three categories-

1. Area based programmes to counter endemic poverty due to hostile Argo climatic conditions and degeneration of ecosystems, such as Drought prone Areas Programme, Desert Development Programme and Hill Area Development programme come under this category.
2. Targeted group of individual house-hold and poverty group-oriented programmes of income generation through assets and skills endowment. The Integrated Rural Development programme, The national Rural Employment Guarantee Programme, Rural landless Employment Guarantee programme and Jawahar Rozgar Yojana being run by the Ministry of Rural Areas and Employment belong to this category.
3. The Minimum Needs programme to support the poverty groups by providing for sufficient consumption and social services to improve the quality of life and to

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provide infrastructural support to the programme of poverty alleviation.

1.2.1.2 IMPLEMENTATION AGENCIES

Implementation of programmes, plans, reforms, policies etc. is a serious problem. The success of public administration for development can be measured only in relation to the implementation of programmes etc. Thus, implementation is the key to the success of government. Implementation is the phase between a decision and operation. It seeks to determine whether an organization is able to carry out and achieve its stated objectives. Thus, implementation, as putting programmes into action, is difficult exercise.

The main agencies which are implementing the Integrated rural development programme are-

- Central Government
- State Government
- District Level
- Block Level
- Panchayati Raj Institutions
- **Voluntary Agencies.**

Today the voluntary agencies are playing an important role in rural development. Such voluntary agencies should be strengthened and encouraged at the village level, block and district levels. In 1991, there were 44 agencies that were involved in the process of rural development. The examples of some of them are The farmers Service Societies, The Council for Advancement of People's Action and Rural Technology, etc.

The voluntary agencies have emerged as a main instrument for awareness generation among masses and as a an instrument for the implementation of the government policies. Therefore, it becomes imperative to study these voluntary agencies/NGOs at Global, national and regional level and their roles which they play in various areas so that the working of these agencies can be further strengthened. The present study focuses on the role of these voluntary agencies in the rural development especially in Himachal Pradesh where most the people lives in rural areas.

II. DEFINITON OF NGO

A **non-governmental organization** (**NGO**) is an organization that is neither a part of a government nor a conventional for-profit business, usually set up by ordinary citizens, NGOs may be funded by governments, foundations, businesses, or private persons. Some avoid formal funding altogether and are run primarily by volunteers. NGOs are highly diverse groups of organizations engaged in a wide range of activities, and take different forms in different parts of the world. Some may have charitable status, while others may be registered for tax exemption based on recognition of social purposes. Others may be fronts for political, religious or other interest groups.

Recognition of the Role of NGOs by the Government

Since Independence in 1947 until the Sixth Five Year Plan (1980-85), there was little effort on the part of the Government to define the role of a voluntary agency or to recognise the importance of NGOs in the development process. The tendency until now was to equate the work of the voluntary agencies with only welfare activities and charity work.

Realising the importance of participatory development, the Sixth Five Year Plan Document, emphasised the importance of non-governmental organisations, formal and informal in nature, as new actors, which could motivate and mobilize people in specific or general developmental tasks and meet the new demands of the growing sphere of developmental activities. The new areas where awareness and conscious participation of the people is critical for success were identified as:

(a) optimal utilisation and development of renewable source of energy, including forestry through the formation of renewable energy associations at the block level
(b) family welfare, health and nutrition education and relevant community programmes in this field
(c) 'Health for all' programmes
(d) water management and soil conservation
(e) social welfare programmes for weaker sections
(f) implementation of minimum needs programme
(g) disaster preparedness and management (floods, cyclones, etc.)
(h) promotion of ecology and tribal development
(i) environmental protection and education

The new actors sought to be associated with these tasks were

(i) youth and women's organisations at different spatial levels, particularly for promoting eco-development and environmental protection
(ii) Voluntary organisations of specific beneficiary or interest groups like, self-employed women, or farmers or of people who have common economic interest such as marketing
(iii) Voluntary organisations engaged in general developmental work, in an area or a specific activity
(iv) Organisation of the farmers living in command area of irrigation projects, catchment area in the hills and watershed areas in un-irrigated regions into cooperatives for improving land and water management without affecting the individuality of holdings

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(v) Religious, social or cultural organisations or clubs (Rotary, Jaycees, Lions etc.) which often undertake developmental activities in selected areas

(vi) Professional organisations or educational institutions which take up study, research and social action programmes as part of their professional or social commitments.

Today India has a vibrant NGO sector. Although there has been no complete census of NGOs, their total number is roughly estimated at about 1,00,000 of which only 25,000 to 30,000 are active. The largest number of such organisations listed at one place is 12,313 NGOs registered with the Ministry of Home Affairs, Government of India under the Foreign Contribution (Regulation) Act (FCRA) 1976, as of 31st December, 1989, besides 726 unregistered NGOs under the 'prior permission category'. There has been astronomical increase in the number of NGOs during the past ten-fifteen years due to rising awareness and social concern, widespread poverty and deprivation, weakening governmental delivery mechanism, democratic spirit and increased funding.

The Seventh Plan (1985-90) envisaged a more active role for the voluntary organisations so as to make communities as self- reliant as possible. These were expected to show how village and indigenous resources could be used and how human resources, rural skills and local knowledge, grossly underutilised at present could be used for their own development. Further these were to be utilised to demystify technology and bring it in a simpler' form lo the rural poor, to train a cadre of grass-root workers who believe in professionalizing voluntarism, to mobilise financial resources from within the community and to mobilise and organise the poor and generate awareness to demand quality service and impose a community system, of accountability on the performance of village level government functionaries.

Role of NGOs in Rural Development

Voluntary organisations can play a crucial role in rural development by supplementing government efforts as they are close to the minds and hearts of the rural people. They have their roots in the people and can respond to the needs and aspirations of the community. They face problems in terms of funding, recruitment and retention of trained and qualified staff, leadership crisis, poor maintenance of records, apathy of bureaucracy and the tendency of politicians and others to use them for personal or political gains. Voluntary action and state are the two sides of the same coin of rural development administration and they must recognise their interdependence. In a country like India the voluntary organisations can provide only a starting point and impetus. The voluntary organisations and government should come to the negotiating table; and with mutual respect and maturity discuss on development issues as they both are to be viewed as partners in rural development

III. REVIEW OF LITERATURE

The seventh five year plan document (1985-90) envisaged a greater role of the voluntary agencies and the NGOs in the implementation of development. The seventh plan has given special importance to the role of NGOs in rural development. For the first time an amount of Rs. 50 crores has been allocated as financial assistance to voluntary agencies in their endeavour to uplift the rural poor. The Government of India has also encouraged the involvement of international voluntary agencies through coordinating agencies. The eighth five year plan document (1992-97) emphasized on the role ofvoluntary organizations in rural development. The plan document states that a nation-wide network of NGOs will be created. In order to facilitate the working of this network, three schemes relating to the creation, replication, multiplication and consultancy development have been worked out by planning commission. Further efforts will be made to evolve a system of providing one window service to the NGOs working in the area of integrated development.

Suresh Kumar Bhaker (2014) in his paper published in the journal of business and policy economics highlighted the role of NGOs in rural development of India. He studied the performance of 8 NGOs engaged in health, hygiene and sanitation field in Uttar Pradesh in India. The paper highlighted the performance evaluation h People's Participation. He concluded that there is a casual relationship between NGOs and rural development. Although there is not much change in the health indicators as result of NGOs efforts. But the health indicators are not only instruments to measure the work of NGOs. What the knowledge and views of villagers have been broadened towards health, hygiene and sanitation that can't be described in words. Moreover the positive efforts of these activities cannot be measured in a short span of time, but a lifelong effect on human body and personal life of the villagers. If the knowledge of health, hygiene and sanitation is strong and wide that will certainly develop the social and economic life of the villagers. If the rural areas are well developed that will make the country more developed. Thus the role of these NGOs cannot be assessed only through impact indicators or the services they provide, but should be assessed in a long and wide view for overall development.

D.S Jadhav (2015) studied the role of NGOs in rural development in India. According to him In India, the scope of development is not narrow but very wide, as it includes not just the economic development but the growth on social front, quality of life, empowerment, women and child development, education and awareness of its citizens. To achieve this, a holistic vision and collaborative efforts involving various departments, agencies and even NGOs is required. NGOs or Non-Governmental Organizations have

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more benefits of working in rural areas as compared to governmental organizations because NGOs are more flexible, NGOs are specific to a particular locality and moreover these are committed towards serving the public and community as a whole. Further he highlighted the main role of NGOs in rural development with economic reforms and liberalization. He reveals that as economic reform and liberalization saw the Government vacating several areas to let private sector entrepreneurship flourish and contribute to the high growth rate of the economy in recent years, a similar paradigm shift is needed to transform NGOs from their dependence on aid and grants from within and outside for transforming the rural scenario in the country. This is sought to be achieved for the NGOs through engaging them in micro-finance, micro insurance, and micro-entrepreneurship activities for the overall development of the rural areas and to promote the welfare of the people of rural India, The NGOs have taking active participation in rural development. The rural poor and socially depressed classes are mainly depending upon the operations of NGOs. No particular job is particularly meant for the NGOs. Thus, there is a huge competition among the NGOs to extend the services for the benefit of the poor. At the same time we should not forget the mushrooming of the NGOs for their welfare. The following are the important activities should take up for the development of the poor.

1. Agricultural related programs: Numerous activities can be undertaken under agriculture sector. The jobs/projects like distributing planting materials, cattle, poultry, minor irrigation, free medical care for cattle's, safe drinking water for animals etc.

2. Health programmes for human and non-human beings: The works like pit drainage, housing, creation of smokeless environment, good drinking water for animals and human beings, regular health check-up camps etc. will improve the health conditions of the human and non-human beings.

3. Community development programs: The community development programs like adoption of villages for development, moral support during flood and famine period, supply of food and drinking water during flood, common well, training programs for the rural youths, housing projects, repair and renovation of houses etc will satisfy the basic necessities. The important program like training programs for the rural poor will hold the youths from rural exodus. Even this type of training programs may also be extended for the rural women, so that we can expect self-sustenance among this community.

4. Human Resource Development programs: The personality development programs, skill development programs, educational programs, integrated development projects etc will enable the rural poor to earn bread and butter.

5. Trade and industrial promotion: The important problem in the present context is availability of the market for the products of rural enterprises. Therefore, an NGO has a direct link with the government for marketing of the goods. Apart from this, NGO can also go for training the rural youths in fabrication works, wood works, beedi rolling, agarbathi manufacturing, printing press etc.

R. Singhal (2015) in his paper discussed the effectiveness of non-governmental organizations (NGOs) and various models of organizational effectiveness (OE) that have been applied in NGOs. Furthermore, different viewpoints that emerged from research over the past four decades are synthesized. The review of models and research studies revealed little agreement among the academic community to conceptualize NGO effectiveness. While early studies focused on the assessment of NGO effectiveness highlighted organizational goals, contemporary studies focused on the processes that contribute to NGO effectiveness. Most of the studies found the governing board as a common dimension of NGO effectiveness. The paper conceptualized NGO effectiveness as a multi-dimensional social construct with an ability to achieve an organizational mission through a competent governing board, strong NGO-employee relationship, and efficient financial measures. The paper concluded that it is difficult to develop a universal standard definition of NGO effectiveness because NGOs work on diverse themes, issues, scales, and approaches. On the basis of the analysis, it is suggested that future research on NGO effectiveness should focus on specific cultures, focus, and scale of NGOs.

Uma Sarmistha (2015) conducted a research at Rural Handloom Textile **In**dustry in Bihar. He pointed out that the functioning of rural handloom sector will not be able to fit in the new- classical framework of labour Market and development studies. Thus, taking the point what Granovetter explain in his theory of embeddedness of middle path between over and under Socialisation, may help these societies move towards a better future. The Middle path can come with government initiatives in the region. He concluded that the Government can come up with some policy. Solutions such as creation of Some kiosks to distribute and collect the finished product and provide equal Remuneration to all weavers; (ii) strengthen the rural employment guarantee Programme to provide more jobs in rural areas; (iii) upscale technology in the weaving; and (iv) provide health care and other facilities in the village. This kind of middle path can give society a balanced path way to development, which would recognise.

P. Raghupathi (March 2016) studied the impact of rural Development programmes on Landless Dalits. The study found that there is large- scale arbitrariness, nepotism and manipulations in the selection of beneficiaries. According to the selection guidelines , the beneficiaries have to be selected from the actual BPL families but in reality the

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actual BPL family but in reality, the panchayat member and sarpanch arbitrarily select the beneficiaries. In a number of cases, the BPL list is manipulated. Therefore the BPL list must be prioritized according the level of income and landholding criterion or any other specified measure. The middleman who manipulate must be dealt with stringently in order to ensure fair selection of the beneficiaries. Thus a greater degree of transparency and accountability from the implementing authorities and better awareness and proper utilization of the benefits by the eligible beneficiaries would ensure better results.

IV. RESARCH DESIGN

NEED OF THE STUDY

In India, the scope of development is not narrow but very wide, as it includes not just the economic development but the growth on social front, quality of life, empowerment, women and child development, education and awareness of its citizens. The task of development is so huge and complicated that just implementing government plans is not sufficient to fix the problem. To achieve this, a holistic vision and collaborative efforts involving various departments, agencies and even NGOs is required. Owing to such a great need, the number of NGOs in India is increasing rapidly and, at present, there are about 25,000 to 30,000 active NGOs in India.

Superficially, rural development seems to be a simple task but, in reality, it is not. Post-Independence era has seen many rural development programs through different five-years plans. Alleviating poverty, employment generation, more opportunities for generating income, and infrastructure facilities are emphasized through the policies and programs of the government. Along with this, the panchayat raj institutions have also been initiated by the government to strengthen the democracy at grass roots level. But in spite of all the efforts rural poverty, unemployment rate, low production still exists. The fight is still on for the basic facilities such as livelihood security, sanitation problem, education, medical facilities, roads, etc. Still there is a huge gap in terms of infrastructure that is available in urban and rural areas. The basic rural development should include all these apart from employment, proper water supply and other basic facilities.

NGOs or Non-Government Organizations have more benefits of working in rural areas as compared to governmental organizations because NGOs are more flexible, NGOs are specific to a particular locality and moreover these are committed towards serving the public and community as a whole. As the task of development is massive, many NGOs are playing vital role in the rural development of India in collaboration with the government. The Government openly welcomed and encourages participation of the NGO's in development process. Now international agencies like World Bank, which was earlier working exclusively through national government prefers to work through the NGOs for the implementation of their projects. This makes clear that NGOs have gained prominence in the present times. So, it becomes essential to see the extent of the role played by the state NGOs in the development of Himachal Pradesh.

SCOPE OF THE STUDY

The present study has been conducted in three districts of Himachal Pradesh. i.e. Chamba, Kangra and Solan. The present study has undertaken to look into the performance of the NGOs and their relevance in development of the rural areas of state. The main purpose of the study is to discuss the role of the NGOs in rural development of Himachal Pradesh. The present study also provides an in depth background, analysis and interpretation of the performance of the NGOs the different areas of rural development in Himachal Pradesh.

OBJECTIVES OF THE STUDY

The present exercise attempts to attain the following objectives during the course of research.

OBJECTIVES

1. To examine the role and relevance of NGOs in the rural development of Himachal Pradesh.
2. To examine the role of NGOs in creating awareness among rural masses regarding government schemes and programmes for rural development

V. RESEARCH METHODOLOGY

In the present study both primary and secondary sources of data have been used to fulfil the various objectives of the study.

Primary Data

Primary data was collected with the help of questionnaires, discussions, interviews and observation methods.

Questionnaires

A single set of questionnaire was framed to collect data from beneficiaries of NGOs in three district of Himachal Pradesh. While framing the questionnaires an attempt has been made to cover all the aspects related to NGOs.

First of all, preliminary preparation was done for finding out the scope for conducting the present study. Deskwork in various libraries such as Himachal Pradesh University, Indian institute of Himalayan Studies, Himachal Pradesh University, Himachal Pradesh Secretariat, Department of Registrar of Cooperative Society, Shimla and various literatures from office of NGOs was done to review the necessary literature. Various dissertations, Ph.D. Thesis, reports, Newspaper and websites have been consulted to obtain secondary data for the purpose of study. The Ministry of rural development, The Ministry of Social Justice and Empowerment, Department of Planning

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Commission, Family Welfare were also visited to collect information on the present study.

A sample of 450 beneficiaries from the selected volunteer organizations was selected through proportionate random sampling procedure. The respondents from different categories of caste, age group, sex, education level, family background, status and size of income were selected. Further based on discussion with the implementing officials and authorities of NGOs, the major programmes three NGOs were listed for research work and the programmes of these NGOs in Rural Development were identified.

TOOLS USED FOR ANALYSIS AND INTERPRETATION OF DATA

In the analysis of the collected data the Statistical package for social sciences (SPSS, Version 20) was used. Keeping in view of the study, the data collected was coded, scored, and tabulated, analysed and research report was prepared on that basis. The following tools were used in the analysis of the data.

I) Mathematical Tools

II) Statistical tools

The following statistical methods have been used in this Work for the analysis of the data.

1. Arithmetic Mean:

The arithmetic mean has been applied to study the opinion of the NGO beneficiaries on close ended questions and 5 - point likert scale for different rural development indicators and also for the questions related to health, education and social welfare etc of the beneficiaries. The arithmetic mean has been calculated by assigning numerical values to the qualitative indicators. These values have been assigned to qualitative responses as per the below details-

- Five for strongly agree
- four for agree,
- three for indifferent,
- two for disagree
- One for strongly disagree.

(ii) Co-efiicient of Skewness:

The co-efficient of skewness, as a statistical tool, helps in the study of degree and direction of variation from the central value. It also shows that a particular distribution is symmetrical or positively skewed or negatively skewed.

(iii) Chi-Square Test:

The -^ test as a test of goodness of fit has been used to analyze the magnitude of difference in opinion of the NGO beneficiaries between observed distributions under the assumption that it is equally distributed on the 5- point scale percent or lower level of significance.

VI. ANALYSIS AND INTERPRETATION

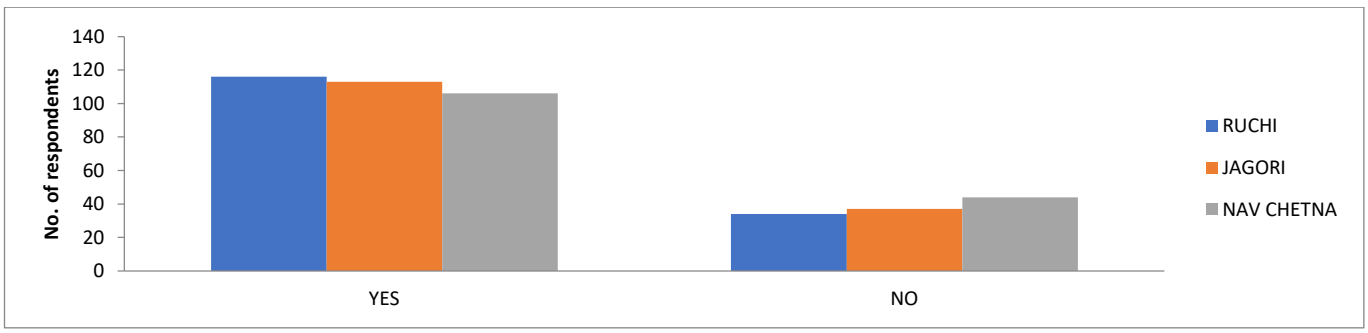
1. NGOS AND RURAL DEVELOPMENT

Table 1.1shows the classification of beneficiaries on the basis of their views regarding the role of NGOs in the rural development. It is clear from the table that NGOs are a very important role in the development their area. Further when we asked particularly about the work of selected NGOs in the rural area majority of the people were in the favour of the selected NGOS and their role in the rural development. When asked about the role of NGOS in rural development, 335(74 %) of the beneficiaries responded in the favour of role of NGOs in the rural development whereas 115 (25.6%) of the beneficiaries responded that NGOs are working in the field of social welfare and rural development.

TABLE 1

RESPONSE		RUCHI	JAGORI	NAV CHETNA	TOTAL
	YES	116	113	106	335(74.4)
	NO	34	37	44	115 (25.6)
	TOTAL	**150**	**150**	**150**	**450 (100%)**

NGOS AND RURAL DEVELOPMENT



Source: data collected through questionnaires

Hence it can be concluded from the above table and discussion that NGOs in the State are playing a very important role in the Rural development and now they have become a wheel of development in rural areas of Himachal Pradesh. Further analysis of some of the important variable was done to develop a vast understanding of role of NGOs in rural Development. Some of the important components of rural development are as follows.

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1.1 Construction of Link Roads

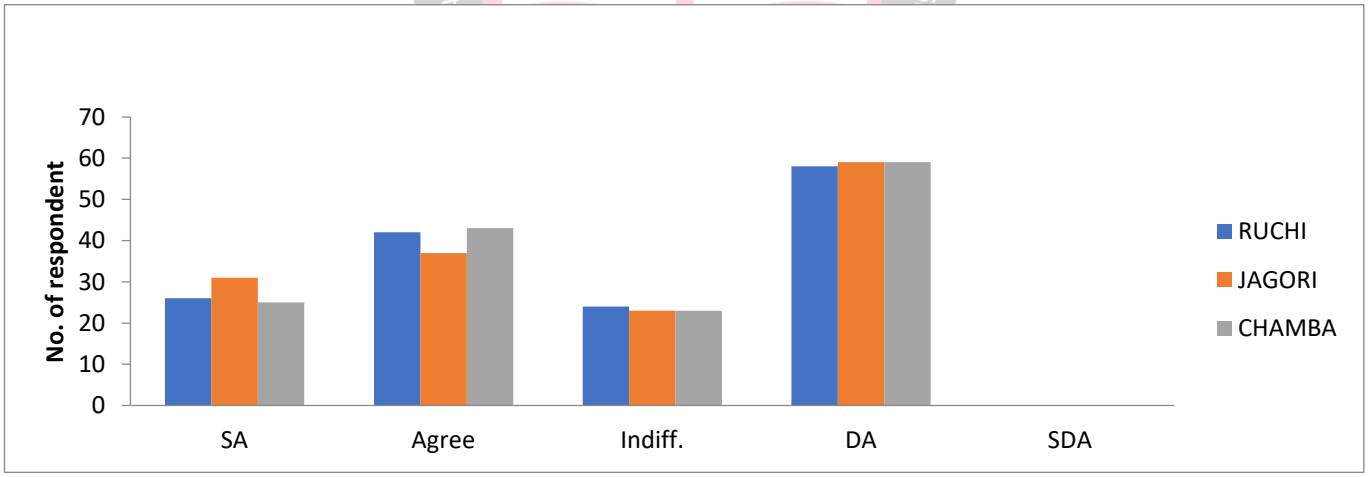
The perception of the beneficiaries of three district NGOs about the role of NGOs in construction of link roads is given in table 1.1. It can be observed from the table that NGOs have made little efforts to provide such help to beneficiaries. It is evident from the table that out of total 450 beneficiaries 176 (39.3%) were disagree, 82 (18.2%) were strongly agree, 122 (27.1%) agree while 70 (15.3%) were indifferent in their views regarding the role of NGOs in the construction of link roads. The mean scores (3.24) of the overall response of the beneficiaries indicates that NGOs play a little role in the construction of link roads in the rural areas as the combined data for agree and strongly agree is 204 whereas the combined data for disagree and indifferent is 246. Hence we cannot fully ignore the role of NGOs in the construction of link roads so we can say NGOs play a little role in the construction f link roads in the rural areas.. The low value of skewness (0.229) also supports this fact that the opinion of beneficiaries is concentrated towards higher side of the overall mean score. The x^ values for goodness of fit are also highly significant. It statistically supports the findings that the majority of beneficiaries of three selected NGOs are agree that NGOs play a moderate role in construction of link roads.

TABLE 1.1 Construction of Link Roads

Name of Organi-zation	SA	Agree	Indiff.	DA	SDA	Total	Mean	Std. Dev.	Skew.	Chi Sq.	PValue
RUCHI	26 (17.3%)	42 (28.0%)	24 (16%)	58 (38.7%)	0	150 (100%)	3.24	1.145	223	84.463	.000
JAGORI	31 (20.7%)	37 (24.7)	23 (15.3)	59 (39.3%)	0	150	3.27	1.185	227	150.00	.000
NAV CHETNA	25 (16.7%)	43 (28.7%)	23 (15.3%	59 (39.3%)	0	150	3.23	1.142	229	107.738	.000
TOTAL	82 (18.2%)	122 (27.1%)	70 (15.3%)	176 (39.3%)	0	450	3.24	1.156	229	337.341	.000

Source: data collected through questionnaires

***Figure 1.1*Construction of Link Roads**



Source: data collected through questionnaires

NGO-wise break-up of the responses of the beneficiaries also show the similar pattern. The moderate role in the construction of link road is played by all the three selected NGOs. The mean score of this NGO is 3.24 and 3.27 respectively and the value of skewness is .223 and .227 respectively. Further the chi square values are highly significant in all NGOs. This also supports statistically the above findings. Thus, it makes clear that mostly the beneficiaries in these NGOs have received moderate help when it comes to construction of link roads.. Thus, it is clear from the statistical analysis that the NGOs have been playing a moderate role in construction of link roads in the rural areas.

1.2. NGOs help in providing Water facilities

The perception of respondents with regard to role of NGOs in providing water facilities to its beneficiaries has been exhibited in table 1.2. The opinions of the beneficiaries' falls between agree and strongly agree. The overall mean score being 3.68

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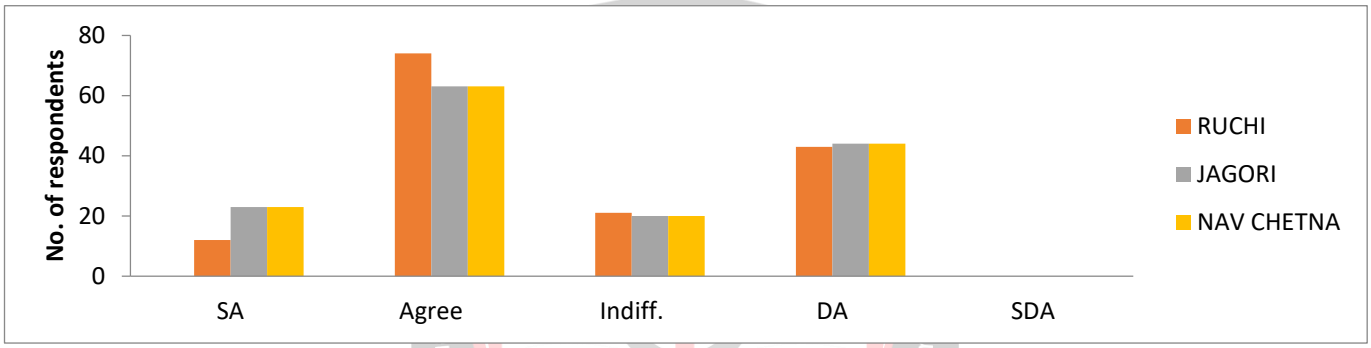
indicates that majority of beneficiaries agree with this development indicator. The negative value of skewness (-.215) indicating concentration of more opinion towards higher side of mean score. The highly significant chi square value also supports that there is found significant relationship among the responses of the respondents that NGOs help in providing water facilities in the rural areas.

TABLE 1.2 NGOs AND WATER FACILITIES

Name of Organization	SA	Agree	Indiff.	DA	SDA	Total	Mean	Std. Dev.	Skew.	Chi Sq.	P Value
RUCHI	12 (8.0%)	74 (49.3%)	21 (14.0%)	43 (28.7%)	0	150 (100%)	3.37	.986	-.282	84.353	.000
JAGORI	23 (16.7%)	63 (28.7%)	20 (15.3%)	44 (39.3%)	0	150	3.43	1.071	-.173	132.951	.000
NAV CHETNA	23 (16.7%)	63 (28.7%)	20 (15.3%)	44 (39.3%)	0	150	3.43	1.071	-.173	132.951	.000
TOTAL	**51 (18.2%)**	**207 (27.1%)**	**61 (15.3%)**	**131 (39.3%)**	**0**	**450**	**3.68**	**1.024**	**-.215**	**335.964**	**.000**

Source: data collected through questionnaires

Figure 1.2 NGOs AND WATER FACILITIES



Source: data collected through questionnaires

NGO-wise analysis shows that the mean scores of all NGOs fall between agree and strongly agree. It shows that beneficiaries in every NGO find that these NGOs are playing a major role in providing water facilities. The negative value of skewness also indicate that majority of opinion of beneficiaries is concentrated towards the higher side of mean. Thus, majority of beneficiaries in these NGOs agree to this statement. The chi-square test of goodness fit also shows that there is significant relationship among the opinion of the beneficiaries. It is concentrated towards higher side as indicated by value of mean score and negative value of skewness. To sum up, the majority of the beneficiaries in the rural areas of Himachal Pradesh claimed that NGOS play an effective role in providing water facilities in the rural areas. Further during the survey researcher came to know that NGOs are working with IPH department to provide water facilities in the rural areas. NGOs also helping in creating awareness about water purification and use of clean water for drinking purpose in order to avoid all health hazard.

1.3 NGO help in Watershed development

The opinion of respondents with regard to role of NGOs in watershed development to its beneficiaries has been shown in table 1.3. It can be observed from the table that the majority of the beneficiaries in each NGO have responded positively to this indicator. The opinion of the beneficiaries falls between agree and strongly agree. As per the table out of 450 beneficiaries 159(35.33%) are strongly agree, 120 (26.66%) of the respondents are agree whereas 81(18%) were disagree while 66(14.66%) of the beneficiaries were indifferent with the statement. The overall mean score being 3.46 and it indicates that majority of the beneficiaries agreed with this indicator. The negative value of skewness (-3.85) is also supporting the study from the higher side of mean value. The x^ values for the test of goodness of fit in all these NGOs are highly significant. This also supports statistically the above findings. The value of chi square is 159.80 and the table value is 5.991 which is less than the calculated value at 5 percent level of significance and there is found a significant relationship among the responses of the respondents that NGOs help in watershed development in the rural areas of Himachal Pradesh.

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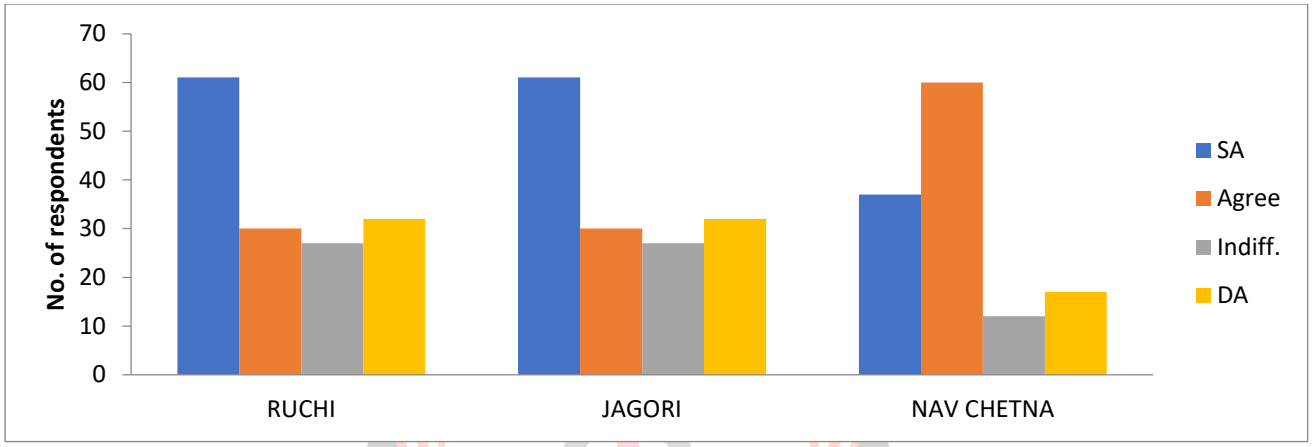
Table 1.3 NGOs AND WATERSHED DEVELOPMENT

Name of Organization	SA	Agree	Indiff.	DA	SDA	Total	Mean	Std. Dev.	Skew.	Chi Sq.	P Value
RUCHI	61 (40.66%)	30 (20%)	27 (18%)	32 (21.33%)	0	150 (100%)	3.80	1.187	-,385	97.492	.000
JAGORI	61 (40.66%)	30 (20%)	27 (18%)	32 (21.33%)	0	150	3.80	1.187	-.385	132.951	.000
NAV CHETNA	37	60 (28.7%)	12 (15.3%)	17 (39.3%)	24	150	3.46	1.393	-.671		.000
TOTAL	**159 (35.33%)**	**120 (26.66%)**	**66 (14.66%)**	**81 (18%)**	**24 (5.33%)**	**450 (100%)**	**3.46**	**1.393**	**-.385**	**159.809**	**.000**

Source: data collected through questionnaires

Figure 1.3



Source: data collected through questionnaires

NGO-wise analysis shows that the majority of the beneficiaries in all the three NGOs also indicate similar pattern of responses. The negative value of skewness also indicates that opinion of the beneficiaries is concentrated towards the higher side of mean value. The value of skewness in these NGOS ranges supports that majority of the beneficiaries in each NGO favour the indicator of watershed development. To sum up, the majority of the beneficiaries of Himachal Pradesh claimed that NGOS play an effective role in watershed development in rural areas. Further when researcher visited these areas for survey then we came to know from local people especially in Solan district even at the time of survey, RUCHI in Solan district was running such project.

1.4 NGOs played a role in the improvement in Social status of the rural people.

The perception of respondents with regard to the role of NGOs in improving social status of its beneficiaries has been exhibited in table 1.4. The opinion of the beneficiaries falls between agree and strongly agree. The overall high mean score being 3.85 indicates that majority of beneficiaries agree with this social development indicator. The negative value of skewness (-.527) is also indicating concentration of more opinion towards higher side of mean score. The chi square test of goodness fit also shows significant difference in the district of opinion of beneficiaries which also supports the above findings.

TABLE 1.4 NGOs AND SOCIAL STATUS OF RURAL PEOPLE

Name of Organization	SA	Agree	Indiff.	DA	SDA	Total	Mean	Std. Dev.	Skew.	Chi Sq.	P Value
RUCHI	60 (40%)	40 (26.67%)	23 (15.33%)	27 (18%)	0	150	3.89	1.126	-.545	90.879	.000
JAGORI	69 (46%)	31 (20.67%)	26 (17.33%)	24 (16%)	0	150	3.97	1.132	-.610	134.879	.000
NAV CHETNA	52 (34.67%)	39 (26%)	25 (16.67%)	31 (20.67%)	3 (2%)	150	3.71	1.201	-.427	116.762	.000
TOTAL	**181 (40.22%)**	**110 (24.44%)**	**74 (16.44%)**	**82 (18.22%)**	**3 (.66%)**	**450**	**3.85**	**1.156**	**-.527**	**333.728**	**.000**

Source: data collected through questionnaires

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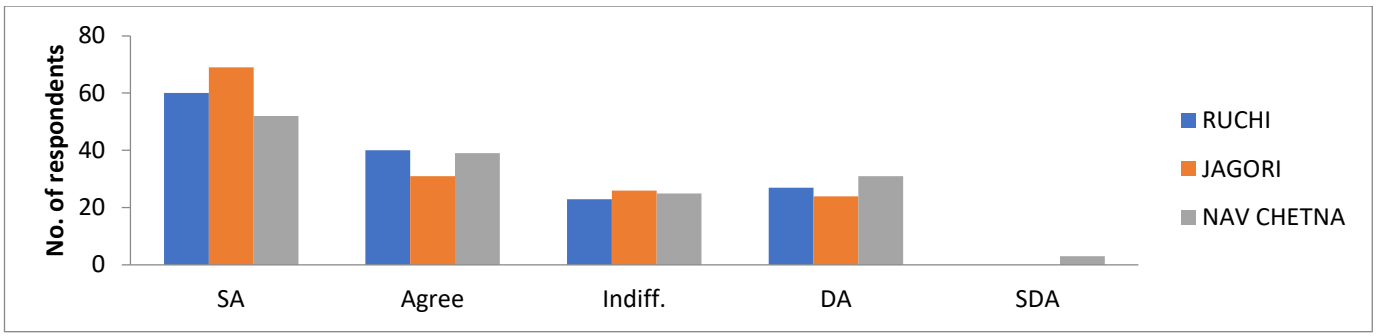
Figure 1.4



Source: data collected through questionnaires

NGO-wise analysis also shows the similar pattern of responses of beneficiaries. The majority of the beneficiaries in all the districts are agree that respective NGOs play a very important role in the upliftment of the social status of the rural masses. The negative value of skewness also indicates that majority of opinion of beneficiaries is concentrated towards the higher side of mean. Through personal observations it came to light that RUCHI and JAGORI in Solan and Kangra district respectively have been most effective in increasing social status of the beneficiaries. These organizations have opened sewing and knitting centres and computer training centres for rural women and children and has trained them in stitching work. Rural women have definitely increased their status as they have started earning on their own. These organisations have also started skill development courses for the rural youth under skill development schemes started by Government of India. This has led to increase in their social status. Hence, the organization has achieved a tremendous success in this field. In contrast to RUCHI and JAGORI, NAV CHETNA has registered far less success but still they are doing well in increasing the social status of the rural masses by helping them in other ways such as women and children issues, creation of Self Help Groups and the like. NAV CHETNA is running skill development courses for educated youth in the rural areas of Chamba district. To sum up, the majority of beneficiaries of Himachal Pradesh claimed that NGOs play an effective role improving their social status.

VII. CONCLUSION

ROLE OF NGOs IN RURAL DEVEOPMENT OF HIMACHAL PRADESH

From the chapter on 'Role of NGOs in Development of Himachal Pradesh', it can be concluded that today the role of NGOs in the field of rural development is wide. It covers not only the rural infrastructure but also covers health, education, social welfare, environment protection etc. The process of growth and development as initiated by NGOs has made a significant improvement in the social, economic, health and educational facilities in rural and remote villages of the three districts of Himachal Pradesh. It has resulted in an increase in the awareness level of beneficiaries in terms of health, hygiene, education and environment. However, these NGOs still lag behind in building physical infrastructures for the beneficiaries.

To be specific the survey shows that most of the beneficiaries are sure about the NGO services in construction of link roads, in providing water facilities, watershed development projects, development of cash crops, development of sericulture units, awareness about irrigation techniques and preservation of natural resources of water and modern technologies in cultivation and harvesting , various government schemes, vocational institutes, mobile schools, adult education, functioning of school committees, maintenance of school libraries, awareness about scholarships, bio-diversity, measurement of air pollution and environment education. Further, the research shows that by and large NGOs have done well in many other fields such as plantation of medicinal plants, formation of village committees, awareness about sanitation, implementation of govt. programmes like NRHM, Swachch Bharat Mission etc, awareness about family planning, organization of health camps, AIDS, adolescent health and Rogi Kalyan Samities, in dealing with disability, a)airvedic home remedies, educational institutes, schools for special children, awareness about right to education more specifically girls education through SSA programmes, forest maintenance and plantation, encouraging entrepreneurship through forest produce, solving sanitation problems and awareness about solid waste management. Moreover, government has been involving NGOs extensively in implementation of various social development projects. This clears the picture that NGOs do have a stake at grass-root level and the strength of NGOs is well recognized by the government.

The roles that the NGOs perform today in rural development of Himachal Pradesh are numerous. They are advocates, educators, catalysts, monitors, whistle blowers, mediators, activists, mobilizers (of both men and resources), protectors of human rights, conscientizes, animators, and conciliators. NGOs are playing a promising interlocutors role in all development activities in existing academic as well as development studies. In recent times, responding to Grass-roots level initiative and voluntary

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action became necessary to develop the rural areas. The increasing demands for the NGOs are itself a response to recent trends relating to socio-economic issues and their corresponding development interventions in academic and policy-oriented research. Today NGOs are playing a dominating role in the implementation of child care, women development, anti-poverty and minimum needs programmes. Further NGOs are also supporting many other economically and social vulnerable groups like small and marginal farmers, agricultural labours, scheduled castes and tribes, bonded labours, rural artisans, rural women, etc., who also need to be brought in the mainstream of development process.

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शोध-आलेख सार

सर्जक, सृजन एवं सहृदय भावक-ऐसे तीन प्रमुख बिन्दु हैं जिन्हें केन्द्र में रखकर पठनीयता के परिदृश्य का ईमानदार विश्लेषण किया जा सकता है। इस शोध पत्र में हिन्दी के मध्यकालिक कवि भूषण त्रिपाठी के बहाने उपर्युक्त समस्या को मात्र सर्जक के पक्ष से समझने तथा उसके निराकरण के उपायों की दिशा में आगे बढ़ने का उपक्रम किया गया है।

मुख्य-शब्द : विश्वबोध, सौमनस्य, सृजनधर्मी, महाक्रान्ति, निर्वैयक्तिक ।

साहित्य के महादेश भारतवर्ष का जनजीवन सदैव साहित्य की शक्ति से प्रेरित और प्रभावित रहा है। साहित्य की केन्द्रीय भूमिका के कारण यहाँ के स्वतंत्रचेता कवियों ने समय-समय पर बद्धमूल व्यवस्था में सार्थक हस्तक्षेप कर लोक को नेतृत्व प्रदान किया है। लोक में कवियों की सहज स्वीकार्यता का कारण उनके द्वारा की गई सामाजिकता की साधना है।

किन्तु, बड़े खेद का विषय है कि आज के दौर में- जहाँ विजिगीषु प्रतिगामी शक्तियाँ नागरिक का व्यक्तित्वान्तरण कर उसे उपभोक्ता बनने पर विवश कर रही है, हमारी ऐतिह्य स्मृतियाँ, परम्पराबोध, श्रद्धा-विश्वास और आस्था जैसे मूलाधार बलात् अपदस्थ किए जा रहे हैं- रचनाकार और भावक के बीच सहज सौमनस्य की डोर लगातार तनती जा रही है। हिन्दी तथा कुछेक अन्य भारतीय भाषाओं में घटती पाठकीयता की समस्या को बहुत गहरे महसूस किया जा रहा है।

यह वाकया[1] तब का है जब शाहजहाँ के शासन का अवसान हो चुका था और कवि-कर्म की प्रतिष्ठा का निरन्तर ह्रास हो रहा था। राज्याश्रयी कविगण किसी तरह बड़ी मुश्किल से अपनी वृत्तियाँ वसूल पाते थे। ऐसे में कवि भूषण त्रिपाठी आजीविका के सिलसिले में औरंगजेब के शाही दरबार में पहुँचे। औरंगजेब की खासियत यह थी कि वह अपने पुरखों की तरह विलासप्रिय न था। भले ही मूल्यविहीन राजनीति तथा कपटपूर्ण आचरण के कारण वह कालान्तर में निकृष्ट श्रेणी का शासक सिद्ध हुआ तथापि उसका व्यक्तित्व पराक्रमोन्मुखी था। खैर, समयानुसार कवि भूषण को दरबार में पेश किया गया। भूषण त्रिपाठी वीर रस के सिद्ध कवि थे। औरंगजेब को उनकी वीर-रसीली कविता बेहद पसंद आई। उसने कहा, 'और सुनाओ।' भूषण ने जवाब दिया कि हुजूर का हाथ शृंगार-कविता सुनते-सुनते कुठौर में लगा होगा, इसे धो लें तो कविता सुनाई जाए क्योंकि मेरी वीररस की कविता सुनकर हुजूर का हाथ मूँछों पर चला जाएगा।

औरंगजेब युवा कवि के इस आत्मविश्वास से स्तब्ध रह गया। तनिक सोचकर उसने यह कहते हुए हाथ धो लिए कि यदि मूँछों पर हाथ न गया तो सिर उतरवा लूँगा। फिर क्या, जो होना था सो हुआ। आख़िरकार कविता के प्रभाव में आकर औरंगजेब अनायास ही मूँछों पर ताव देने लगा! कवि और कविता की आन विजयी हुई, भूषण त्रिपाठी दरबार में जम गए।

आज साहित्य का लगभग हर तबका अहर्निश घटती पाठकीयता का राग अलाप रहा है। समकालीन लेखकों के समक्ष, उनकी स्वयं की इयत्ता सिद्ध करने की चुनौतियाँ सिर उठा रही है। उपयोगितावाद के आभोग में हाशिए की ओर खिसकता रचनाकार अपनी अस्मिता के लिए छटपटाता नजर आ रहा है। ऐसी स्थिति के उत्तरदायी सम्भावित कारणों में से एक बड़ा कारण यह हो सकता है कि रचनाकार में 'सिर उतरवाने की चुनौती'

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Effects of Temperature Dependent Viscosity and Magnetic Field on the Oscillations in Triply Diffusive Convection

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Abstract:*The stability of the triply diffusive convective layer of fluid is studied to analyze the effects of temperature dependent viscosity and uniform magnetic field on the growth rate of oscillations. A condition for the stability and consequently for the existence ofoscillatory motions of growing amplitude are derived, using some nontrivial integral estimates obtained from the eigenvalue equations. The upper bounds for the complex growth rate of oscillatory modes are prescribed, which yields that the oscillations can be controlled by an appropriate choice of the parameters of the problem. It is observed that both the temperature dependent viscosity and the magnetic field have the stabilizing effect on the oscillatory instability i.e. both postpone the onset of oscillatory motions in triply diffusive convection. Some consequences of the derived results are also deduced, which are also uniformly valid for the quite general nature of bounding surfaces.*

Keywords: *Triply-diffusive convection; linear stability; Growth rate; Magnetic field; Temperature dependent Viscosity, Oscillatory motions.*

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I. Introduction

A natural convection flow in a gravity field is termed as Thermohaline convection/ Double-diffusive convection, if both thermal and concentration gradients are affecting the density of the fluid. In the context of the thermohaline instability problem, two fundamental configurations have been studied by Stern [1]/ Veronis [2], wherein the temperature gradient is stabilizing/ destabilizing and the concentration gradient is destabilizing/stabilizing. Gupta *et. al.* [3] studied the stability of Veronis and Stern type's configurations in horizontal layer geometry and derived the sufficient conditions for the stability of an initially top-heavy or an initially bottom-heavy configuration by controlling the growth rate of the oscillatory motions of neutral or growing amplitude. For a broad view of the subject one may be referred to Brandt and Fernando [4].

The influence of magnetic field on an electrically conducting fluid contribute to two kinds of effects: first, by the motion of electrically conducting fluid across the magnetic lines of force, electric currents are generated and the associated magnetic field contribute to change in the existing fields and second, the fluid elements carrying currents transverse magnetic lines of force contributes to additional forces like Lorentz Force acting on the fluid elements. The effect of magnetic field on the stability of thermal convection problem has been thoroughly investigated by Chandrasekhar [5].

Straughan [6] has pointed that the viscosity of a fluid is one of the properties which are most sensitive to temperature. Torrance & Turcotte [7] observed that the viscosity of the liquids decreases with increasing temperature, while the reverse trend is observed in gases. Therefore, the type of fluid and the range of operating temperatures are very crucial parameters in the study of fluid dynamics. Authors have considered the viscosity of the fluid to be constant in most of the studies pertaining to single or double-diffusive convection. Because, additional mathematical complexities arises in convective instability problems, when the viscosity of the fluid is varying with temperature. Some authors, including Stengel *et al.* [8] and Dhiman and Kumar [9] have studied the stability of thermal convection problem by taking into account the variations in viscosity. Dhiman and Kumar [10] studied the thermohaline convection problems under the influence of temperature dependent viscosity and derived some general qualitative and quantitative results for each combination of rigid and dynamically free boundary conditions.

The problem of multi diffusive-convection (when temperature and two or more component agencies, or three different salts are present) becomes more interesting than double-diffusive convection problem. Triple-diffusive convection is of great importance because of its usefulness in describing so many natural phenomena such as acid rain effects, underground water flow, warming of stratosphere etc. Griffiths [11], Pearlstein *et. al.* [12] have studied theoretically the onset of convection in a horizontally fine layer of a triply-diffusive fluid (in which the density depends on three independently diffusing components having different diffusivities) and derived some general results. Many applications of triply-diffusive convection have been discussed by

Pearlstein *et. al.*and they predicted that the onset of convection in triply-diffusive fluid might occur via a quasi-periodic bifurcation from the motionless basic state. For further details in the discipline of multi component diffusion one may be referred to Lopez *et. al.* [13].

This paper is aimed precisely in the direction to include the effects of viscosity variation and magnetic field (acting opposite to the gravity) in triply-diffusive convection problem. Following linear stability theory, a sufficient condition for the stability of oscillatory motions for this general problem is derived, using some integral estimates obtained from the non-dimensional linearized perturbations equations governing the problem and hence the bounds for the complex growth rate for arbitrary neutral or unstable oscillatory modes (when it exist) are prescribed. The obtained results are uniformly valid for all cases of boundary conditions. Some consequences for the triply-diffusive convection problem and double-diffusive convection problems are also worked out.

II. Physical Configuration and Basic Equations

A horizontal layer of viscous incompressible fluid of infinite horizontal extension and finite vertical depth is statically confined between two horizontal boundaries $z = 0$ and $z = d$, which are respectively maintained at uniform temperatures$T_0$and $T_1(< T_0)$ and uniform solute concentrationsS_{a0} , $S_{b0}$and$S_{a1}(< S_{a0})$, $S_{b1}(< S_{b0})$. This layer of fluid is kept under the influence of uniform vertical magnetic field. Let the viscosity of the fluid depend upon temperature. Let the origin be taken on the lower boundary $z = 0$ with z-axis perpendicular to it. It is further assumed that cross diffusion effects are neglected.

Following the usual steps of linear stability theory, the non-dimensional linearized perturbation equations for triply-diffusive convection problem with magnetic field and temperature dependent viscosity can be put in the following form (*c.f.* Gupta *et. al.* [3] and Dhiman and Kumar [10]);

$$f(D^2 - a^2)^2 w - \frac{p}{\sigma}(D^2 - a^2)w + 2(Df)D(D^2 - a^2)w + D^2 f(D^2 + a^2)w$$
$$= R_T a^2 \theta - R_S a^2 \phi_1 - R_S' a^2 \phi_2 - QD(D^2 - a^2)h_z \quad (1)$$
$$(D^2 - a^2 - p)\theta = -w \quad (2)$$
$$\left(D^2 - a^2 - \frac{p}{\tau_1}\right)\phi_1 = -\frac{w}{\tau_1} \quad (3)$$
$$\left(D^2 - a^2 - \frac{p}{\tau_2}\right)\phi_2 = -\frac{w}{\tau_2} \quad (4)$$
$$\left(D^2 - a^2 - \frac{p\sigma_1}{\sigma}\right)h_z = -Dw \quad (5)$$

together with following boundary conditions

$$w = 0 = \theta = \phi_1 = \phi_2 = h_z \ \ at\ z = 0\ and\ z = 1; \quad (6)$$

and the bounding surface is dynamically free or rigid according as $D^2 w = 0\ or\ Dw = 0$ on the lower/upper boundary *i.e.*at $z = 0$and $z = 1$.

In the foregoing equations, $z$is the real independent variable, $D = d/dz$ is the differentiation with respect to z, $a^2$is the square of the wave number, $\sigma$is the thermal Prandtl number, $\sigma_1$is the magnetic Prandtl number,$\tau_1, \tau_2$are the Lewis numbers for the two concentrationsS_a and $S_b$respectively, $R_T$is the thermal Rayleigh number, $R_S$and $R_S'$are the concentration Rayleigh numbers for the two concentration components, Q is the Chandrasekhar number, $p(= p_r + ip_i)$ is the complex growth rate, w, θ, h_z are the perturbations in the vertical velocity, temperature, magnetic field respectively, ϕ_1, $\phi_2$are the perturbations in the respective concentrations of the two components and $\mu[= \mu_0 f(T)]$is the viscosity of the fluid; μ_0 is the viscosity at the lower boundary and $f(T)$ is an arbitrary function of vertical coordinate z.

We have also followed the assumptions of Stengel*et. al.*[8] (regarding the small ratio of the viscosities at the top to the bottom boundaries), in deriving the above equations.

System of equations (1) – (5) together with either of the boundary conditions (6) governing triple diffusive convection problem with temperature dependent viscosity in the presence of magnetic field constitutes an eigen value problem for$R_T$for given values of the other parameters. Further, a given state of system is stable, neutral or unstableaccording as p_r is negative, zero or positive. Further if $p_r = 0$ implies $p_i = 0$ for every wave number$a$ then the *principle of the exchange of stabilities* (PES) is valid, otherwise we shall have *overstability* at least when instability sets in as certain modes.

III. Stability of the oscillatory modes

We shall investigate the character of the oscillatory modes. Let us suppose that$p_i \neq 0$, *i.e*. PES is not valid and instability is through oscillations.

Multiplying equation (1) by w^*(the complex conjugate of w) and integrating the resulting equation by parts a suitable number of times and using the relevant boundary conditions (6) and equations (2)-(5), we have

$$\int_0^1 f(|D^2 w|^2 + 2a^2|Dw|^2 + a^4|w|^2)dz + \frac{p}{\sigma}\int_0^1(|Dw|^2 + a^2|w|^2)dz + \int_0^1(D^2 f)|w|^2 dz$$

$$= R_T a^2 \int_0^1 (|D\theta|^2 + a^2|\theta|^2)dz - R_S a^2 \tau_1 \int_0^1 (|D\phi_1|^2 + a^2|\phi_1|^2)dz$$
$$-R_S' a^2 \tau_2 \int_0^1 (|D\phi_2|^2 + a^2|\phi_2|^2)dz - Q \int_0^1 (|D^2 h_z|^2 + 2a^2|Dh_z|^2 + a^4|h_z|^2)dz$$
$$+a^2 p^* \left[R_T \int_0^1 |\theta|^2 dz - R_S \int_0^1 |\phi_1|^2 dz - R_S' \int_0^1 |\phi_2|^2 dz - \frac{Q\sigma_1}{\sigma} \int_0^1 (|Dh_z|^2 + a^2|h_z|^2)dz\right] \quad (7)$$

Subsequently, for convenience, we will omit the limits of integration from the integral sign and dz from the integrand.Now, equating the real and imaginary parts of both sides of equation (7) and cancelling $p_i (\neq 0)$ throughout from the imaginary part, we have

$$\int f(|D^2 w|^2 + 2a^2|Dw|^2 + a^4|w|^2) + \frac{p_r}{\sigma}\int (|Dw|^2 + a^2|w|^2) + a^2 \int (D^2 f)|w|^2 - R_T a^2 \int (|D\theta|^2 + a^2|\theta|^2)$$
$$-R_S a^2 \tau_1 \int (|D\phi_1|^2 + a^2|\phi_1|^2) - R_S' a^2 \tau_2 \int (|D\phi_2|^2 + a^2|\phi_2|^2) + Q \int (|D^2 h_z|^2 + 2a^2|Dh_z|^2 + a^4|h_z|^2)$$
$$= a^2 p_r \left[R_T \int |\theta|^2 - R_S \int |\phi_1|^2 - R_S' \int |\phi_2|^2 - \frac{Q\sigma_1}{\sigma} \int (|Dh_z|^2 + a^2|h_z|^2)\right] \quad (8)$$

$$\frac{1}{\sigma} \int (|Dw|^2 + a^2|w|^2) + R_T a^2 \int |\theta|^2 - R_S a^2 \int |\phi_1|^2 - R_S' a^2 \int |\phi_2|^2$$
$$- \frac{Q\sigma_1}{\sigma} a^2 \int (|Dh_z|^2 + a^2|h_z|^2) = 0 \quad (9)$$

From equation (9), it follows that

$$R_S a^2 \int |\phi_1|^2 > \frac{1}{\sigma} \int (|Dw|^2 + a^2|w|^2) - R_S' a^2 \int |\phi_2|^2 - \frac{Q\sigma_1}{\sigma} a^2 \int (|Dh_z|^2 + a^2|h_z|^2) \quad (10)$$

Since$w = 0 = \theta = \phi_1 = \phi_2 = h_z \ \ at\ z = 0$ and $z = 1$; therefore, Rayleigh-Ritz inequality [14] yields that

$$\int |D\psi|^2 \geq \pi^2 \int |\psi|^2 \quad (11)$$

where $\psi = \{w, \theta, \ \phi_1, \ \phi_2, \ h_z\}$.

Now, using *Schwartz* inequality, we can have

$$\int |D\theta|^2 = |-\int \theta^* D^2 \theta| \leq \int |\theta^* D^2 \theta| = \int |\theta||D^2 \theta| \leq (\int |\theta|^2)^{\frac{1}{2}} (\int |D^2 \theta|^2)^{\frac{1}{2}} \quad (12)$$

Which upon utilizing inequality (11)$(with\ \psi = \theta)$ gives

$$\int |D^2 \theta|^2 \geq \pi^4 \int |\theta|^2 \quad (13)$$

Now, combining inequality (13)and inequality (11)$(with\ \psi = \theta)$, we have

$$\int (|D^2 \theta|^2 + 2a^2|D\theta|^2 + a^4|\theta|^2) \geq (\pi^2 + a^2)^2 \int |\theta|^2 \quad (14)$$

Proceeding analogously as in the derivation of the inequality (14), we have following inequalities

$$\int f(|D^2 w|^2 + 2a^2|Dw|^2 + a^4|w|^2) \geq f_{min.} (\pi^2 + a^2)^2 \int |w|^2 \quad (15)$$

$$\int (|D^2 h_z|^2 + 2a^2|Dh_z|^2 + a^4|h_z|^2) \geq (\pi^2 + a^2) \int (|Dh_z|^2 + a^2|h_z|^2) \quad (16)$$

Here, $f_{min.}$is the minimum value of $f(z)$ in closed interval$[0, 1]$.

Again, using *Schwartz* inequality, we can have

$$\int (|D\theta|^2 + a^2|\theta|^2) = |-\int \theta^* (D^2 - a^2)\theta| \leq \int |\theta^* (D^2 - a^2)\theta| = \int |\theta||(D^2 - a^2)\theta|$$
$$\leq (\int |\theta|^2)^{\frac{1}{2}} (\int |(D^2 - a^2)\theta|^2)^{\frac{1}{2}} \quad (17)$$

Further, multiplying equation (2) by its complex conjugate and integrating the various terms on left hand side of the resulting equation by parts for an appropriate number of times and making use of boundary condition (6), we obtain

$$\int (|D^2 \theta|^2 + 2a^2|D\theta|^2 + a^4|\theta|^2) + 2p_r \int (|D\theta|^2 + a^2|\theta|^2) + |p|^2 \int |\theta|^2 = \int |w|^2 \quad (18)$$

If permissible, let$p_r \geq 0$. In view of this equation (18) implies that

$$\int |(D^2 - a^2)\theta|^2 = \int (|D^2 \theta|^2 + 2a^2|D\theta|^2 + a^4|\theta|^2) < \int |w|^2 \quad (19)$$

Inequality (17) together with inequalities (14) and (19), yields

$$\int (|D\theta|^2 + a^2|\theta|^2) < \frac{1}{\pi^2 + a^2} \int |w|^2 \quad (20)$$

Now, inequality (10) upon using inequality (11)$(with\ \psi = w)$, yields either of the inequalities

$$R_S a^2 \int |\phi_1|^2 > \frac{\pi^2 + a^2}{\sigma} \int |w|^2 - R_S' a^2 \int |\phi_2|^2 - \frac{Q\sigma_1}{\sigma} a^2 \int (|Dh_z|^2 + a^2|h_z|^2) \quad (21)$$

$$R_S' a^2 \int |\phi_2|^2 > \frac{\pi^2 + a^2}{\sigma} \int |w|^2 - R_S a^2 \int |\phi_1|^2 - \frac{Q\sigma_1}{\sigma} a^2 \int (|Dh_z|^2 + a^2|h_z|^2) \quad (22)$$

$$Q \int (|Dh_z|^2 + a^2|h_z|^2) > \frac{\pi^2 + a^2}{\sigma_1} \int |w|^2 - \frac{R_S a^2 \sigma}{\sigma_1} \int |\phi_1|^2 - \frac{R_S' a^2 \sigma}{\sigma_1} \int |\phi_2|^2 \quad (23)$$

Now, multiplying equation (9) by p_r and adding the resulting equation to equation (8), we have

$$\int f(|D^2 w|^2 + 2a^2|Dw|^2 + a^4|w|^2) + \frac{2p_r}{\sigma} \int (|Dw|^2 + a^2|w|^2) + a^2 \int (D^2 f)|w|^2$$
$$-R_T a^2 \int (|D\theta|^2 + a^2|\theta|^2) - R_S a^2 \tau_1 \int (|D\phi_1|^2 + a^2|\phi_1|^2) - R_S' a^2 \tau_2 \int (|D\phi_2|^2 + a^2|\phi_2|^2)$$
$$-Q \int (|D^2 h_z|^2 + 2a^2|Dh_z|^2 + a^4|h_z|^2) = 0 \quad (24)$$

For $D^2 f \geq 0$ (which is true for the most of the temperature dependent viscosity variation laws), and$p_r \geq 0$, equation (24) yields:

$$\int f(|D^2 w|^2 + 2a^2|Dw|^2 + a^4|w|^2) + R_S a^2 \tau_1 \int (|D\phi_1|^2 + a^2|\phi_1|^2)$$
$$+R_S' a^2 \tau_2 \int (|D\phi_2|^2 + a^2|\phi_2|^2) + Q \int (|D^2 h_z|^2 + 2a^2|Dh_z|^2 + a^4|h_z|^2)$$
$$< R_T a^2 \int (|D\theta|^2 + a^2|\theta|^2) \quad (25)$$

Now, using inequality (11)($with\ \psi = \phi_1\ and \phi_2$), inequalities (15), (16), (20) and using inequalities (21) – (23) successivelyin inequality (25), we haveeither of the following inequalities

$$\frac{(\pi^2+a^2)^3}{a^2\sigma}(\sigma f_{min.} + \tau_1) \int |w|^2 + (\pi^2 + a^2)^2 R_S' a^2 (\tau_2 - \tau_1) \int |\phi_2|^2$$
$$+ \frac{(\pi^2+a^2)^2}{a^2\sigma} Q\sigma_1 \left(\frac{\sigma}{\sigma_1} - \tau_1\right) \int (|Dh_z|^2 + a^2|h_z|^2) < R_T \int |w|^2 \quad (26)$$

$$\frac{(\pi^2+a^2)^3}{a^2\sigma}(\sigma f_{min.} + \tau_2) \int |w|^2 + (\pi^2 + a^2)^2 R_S a^2 (\tau_1 - \tau_2) \int |\phi_1|^2$$
$$+ \frac{(\pi^2+a^2)^2}{a^2\sigma} Q\sigma_1 \left(\frac{\sigma}{\sigma_1} - \tau_2\right) \int (|Dh_z|^2 + a^2|h_z|^2) < R_T \int |w|^2 \quad (27)$$

$$\frac{(\pi^2+a^2)^3}{a^2\sigma}\left(\sigma f_{min.} + \frac{\sigma}{\sigma_1}\right) \int |w|^2 + (\pi^2 + a^2)^2 R_S a^2 \left(\tau_1 - \frac{\sigma}{\sigma_1}\right) \int |\phi_1|^2$$
$$+ (\pi^2 + a^2)^2 R_S' a^2 \left(\tau_2 - \frac{\sigma}{\sigma_1}\right) \int |\phi_2|^2 < R_T \int |w|^2 \quad (28)$$

Taking$\Gamma = min.\{\tau_1\ ,\ \tau_2\ ,\ \sigma/\sigma_1\}$, inequalities (26) - (28) can be written as follows

$$\frac{(\pi^2+a^2)^3}{a^2\sigma}(\sigma f_{min.} + \Gamma) \int |w|^2 < R_T \int |w|^2. \quad (29)$$

Since, minimum value of$(\pi^2 + a^2)^3/a^2$ with respect to $a^2$is $27\pi^4/4$, therefore (29) yields

$$\left[\frac{27\pi^4}{4\sigma}(\sigma f_{min.} + \Gamma) - R_T\right] \int |w|^2 < 0.$$

From the above inequality, it is clear that if$R_T < 27\pi^4(\sigma f_{min.} + \Gamma)/4\sigma$, then we have a contradiction. Hence, we must have $p_r < 0$.

Thus, when $D^2 f \geq 0$and$R_T < 27\pi^4(\sigma f_{min.} + \Gamma)/4\sigma$, $\Gamma = min.\{\tau_1\ ,\ \tau_2\ ,\ \sigma/\sigma_1\}$, the oscillatory modes of the system are stable, *i.e.*the oscillatory modes of growing amplitude are not allowed for triply-diffusiveconvection problem with magnetic field and temperature dependent viscosity.

It is remarkable to note that, when we consider the compliment of the above sufficient condition for the stability of the oscillatory motions, *i.e.* when$R_T \geq 27\pi^4(\sigma f_{min.} + \Gamma)/4\sigma$, the oscillatory modes of growing amplitude may exist. Hence it becomes important to prescribe the bounds for the growth rate of these motions.

IV. Bounds for complex growth rate

In following analysis, we have derived the bounds, which arrest the complex growth rate of the arbitrary neutral or unstable $(p_r \geq 0)$ oscillatory motions $(p_i \neq 0)$for thepresent problem.

We now, prove the following theorem.

Theorem 1. If$(p,\ w, \theta, \phi_1, \phi_2, h_z), p = p_r + ip_i\ , p_i \neq 0, p_r \geq 0,\ D^2 f \geq 0$ is a solution of equations (1)-(5) together with either of boundary conditions (6)and$R_T > 0, R_S > 0, R_S' > 0, R_T > 27\pi^4(\sigma f_{min.} + \Gamma)/4\sigma$, then$|p| < \sigma R_T\sqrt{\Omega^2 - 1}/27\pi^4(\sigma f_{min.} + \Gamma)$,where$\Omega = 4\sigma R_T/27\pi^4(\sigma f_{min.} + \Gamma)$ and$\Gamma = min.\{\tau_1\ , \tau_2\ , \sigma/\sigma_1\}$.

Proof. Taking $p_r \geq 0$ in the equation (18), we have

$$\int (|D^2\theta|^2 + 2a^2|D\theta|^2 + a^4|\theta|^2) + |p|^2 \int |\theta|^2 < \int |w|^2$$

Now, using inequality (14), above inequality yields

$$\int |\theta|^2 < \frac{1}{[(\pi^2+a^2)^2 + |p|^2]} \int |w|^2. \quad (30)$$

Now, using inequalities (19) and (30) in inequality (17), we have

$$\int (|D\theta|^2 + a^2|\theta|^2) < \frac{1}{(\pi^2+a^2)\left[1 + \frac{|p|^2}{(\pi^2+a^2)^2}\right]^{1/2}} \int |w|^2. \quad (31)$$

Now, using inequality (11)($with\ \psi = \phi_1\ and \phi_2$), inequalities (15), (16), (31) and using inequalities (21) – (23) successivelyin inequality (25), we haveeither of the following inequalities

$$\frac{(\pi^2 + a^2)^3}{a^2\sigma}(\sigma f_{min.} + \tau_1) \int |w|^2 + \frac{(\pi^2 + a^2)^2}{a^2\sigma} Q\sigma_1 \left(\frac{\sigma}{\sigma_1} - \tau_1\right) \int (|Dh_z|^2 + a^2|h_z|^2)$$
$$+ (\pi^2 + a^2)^2 R_S' a^2 (\tau_2 - \tau_1) \int |\phi_2|^2 < R_T \left[1 + \frac{|p|^2}{(\pi^2+a^2)^2}\right]^{-1/2} \int |w|^2. \quad (32)$$

$$\frac{(\pi^2 + a^2)^3}{a^2\sigma}(\sigma f_{min.} + \tau_2) \int |w|^2 + \frac{(\pi^2 + a^2)^2}{a^2\sigma} Q\sigma_1 \left(\frac{\sigma}{\sigma_1} - \tau_2\right) \int (|Dh_z|^2 + a^2|h_z|^2)$$

$$+(\pi^2+a^2)^2 R_S a^2(\tau_1-\tau_2)\int|\phi_1|^2 < R_T\left[1+\frac{|p|^2}{(\pi^2+a^2)^2}\right]^{-1/2}\int|w|^2. \quad (33)$$

$$\frac{(\pi^2+a^2)^3}{a^2\sigma}\left(\sigma f_{min.}+\frac{\sigma}{\sigma_1}\right)\int|w|^2+(\pi^2+a^2)^2 R_S a^2\left(\tau_1-\frac{\sigma}{\sigma_1}\right)\int|\phi_1|^2$$

$$+(\pi^2+a^2)^2 R_S' a^2\left(\tau_2-\frac{\sigma}{\sigma_1}\right)\int|\phi_1|^2 < R_T\left[1+\frac{|p|^2}{(\pi^2+a^2)^2}\right]^{-1/2}\int|w|^2. \quad (34)$$

Taking$\Gamma = min.\{\tau_1\ ,\ \tau_2\ ,\ \sigma/\sigma_1\}$, inequalities (32) - (34) can be written as follows

$$\frac{(\pi^2+a^2)^3}{a^2\sigma}(\sigma f_{min.}+\Gamma)\int|w|^2 < R_T\left[1+\frac{|p|^2}{(\pi^2+a^2)^2}\right]^{-1/2}\int|w|^2. \quad (35)$$

Since, minimum value of$(\pi^2+a^2)^3/a^2$ with respect to a^2 is $27\pi^4/4$, therefore (35) yields

$$\left[\frac{27\pi^4}{4\sigma}(\sigma f_{min.}+\Gamma)-R_T\left\{1+\frac{|p|^2}{(\pi^2+a^2)^2}\right\}^{-1/2}\right]\int|w|^2<0. \quad (36)$$

Inequality (36), clearly implies that

$$|p| < (\pi^2+a^2)\sqrt{\Omega^2-1} \quad (37)$$

Where$\Omega = 4\sigma R_T/27\pi^4(\sigma f_{min.}+\Gamma)$.

Also, from inequality (29), we have

$$\frac{(\pi^2+a^2)^3}{a^2\sigma}(\sigma f_{min.}+\Gamma) < R_T. \quad (38)$$

Since, minimum value of$(\pi^2+a^2)^2/a^2$ with respect to a^2 is $4\pi^2$, therefore (38) yields

$$\pi^2+a^2 < \frac{\sigma R_T}{4\pi^2(\sigma f_{min.}+\Gamma)}. \quad (39)$$

Now, using inequality (39) in inequality (37), we get

$|p| < \sigma R_T\sqrt{\Omega^2-1}/4\pi^2(\sigma f_{min.}+\Gamma)$.

Theorem 2. If $(p,\ w,\theta,\phi_1,\phi_2,h_z), p = p_r+ip_i\ , p_i\neq 0, p_r\geq 0,\ D^2 f\geq 0$ is a solution of equations (1)-(5) together with either of boundary conditions (6)-(7) and $R_T>0, R_S>0, R_S'>0, R_T > \frac{27\pi^4\left(f_{min.}+\frac{\tau_1+\tau_2}{\sigma}\right)}{4}$, then$|p| < \frac{\sigma R_T\sqrt{\mathrm{M}^2-1}}{27\pi^4[\sigma f_{min.}+(\tau_1+\tau_2)]}$, where,$\mathrm{M} = 4\sigma R_T/27\pi^4[\sigma f_{min.}+(\tau_1+\tau_2)]$.

Proof. Proceeding as in the derivation of the above Theorem, considering the other forms of inequality (10) derived from equation (9) and making use of these inequalities together with inequality (11)($with\ \psi = \phi 1\ and \phi 2$, inequalities (15), (16), (20), in inequality (25) and following the analogous steps used there in the derivation of the Theorem 1, we can easily prove the theorem.

V. Results and Discussion

In terminology of hydrodynamic stability theory, the above result can be stated as, '*the complex growth rate* $p(=p_r+ip_i)$ *of an arbitrary oscillatory*$(p_i\neq 0)$ *perturbation of growing amplitude* $(p_r\geq 0)$*, in triply-diffusive convection problem with magnetic field and temperature dependent viscosity, when,* $D^2 f\geq 0$ *and*$\Omega > 1$*, lies inside a semicircle in the right half of the* $p_i p_r-$*plane, whose center is at the origin and radius is* $\sigma R_T\sqrt{\Omega^2-1}/27\pi^4(\sigma f_{min.}+\Gamma)$'. From the analysis, we observed that the radius of growth rate of oscillations for an arbitrary oscillatory perturbation decreases under the effects of diffusion ratios (Lewis numbers for the two concentrations), the thermal Prandtl number, the magnetic Prandtl number and the viscosity variation parameter.

The obtained result is uniformly valid for all combinations of rigid and dynamically free boundary conditions.Also, Theorem 1 implies that when $R_T < 27\pi^4(\sigma f_{min.}+\Gamma)/4\sigma$, the oscillatory motions of growing amplitude are not allowed.

Further, from the expression for the growth rate given in Theorem 1, we can see that for Triply-diffusive convection problem with magnetic field and temperature dependent viscosity, one can control the radius of arbitrary oscillatory perturbation by appropriate choice of diffusion ratio's(Lewis numbers for the two concentrations)τ_1 , τ_2,thermal Prandtl number (σ), magnetic Prandtl number(σ_1) and viscosity of the fluid$(f_{min.})$ and hence by modulating the viscosity through temperature, one can control the oscillations of the growth rate.In particular, when the viscosity is a linear, quadratic or exponential function of the temperature, the condition on viscosity *i.e.* $D^2 f\geq 0$is automatically satisfied and$f_{min.}=1$.

From the point of view of hydrodynamic stability theory, following consequences arededuced form Theorem 1.

The complex growth rate $p(=p_r+ip_i)$ of an arbitrary oscillatory$(p_i\neq 0)$ perturbation of growing amplitude$(p_r\geq 0)$lies inside a semicircle in the right half of the $p_i p_r-$plane, whose center is at the origin and radius is as given below, for the following convection problems;

1. For*HydromagneticTriply-diffusive convection problem*with*constant viscosity*$\left(f_{\min.}=1\right)$, the radius is given by $\sigma R_T\sqrt{\mathrm{N}^2-1}/4\pi^2(\sigma+\Gamma)$, where$\mathrm{N}=\frac{4\sigma R_T}{27\pi^4(\sigma+\Gamma)}and\Gamma=min.\{\tau_1\ ,\ \tau_2\ ,\ \sigma/\sigma_1\}$.
2. For*Triply-diffusive convection problem*with *constant viscosity*$(Q=0, f_{min.}=1)$,the radius is given by $\sigma R_T\sqrt{\mathrm{P}^2-1}/4\pi^2(\sigma+\Gamma_1)$, where$\mathrm{P}=4\sigma R_T/27\pi^4(\sigma+\Gamma_1)$ and $\Gamma_1=min.\{\tau_1\ ,\ \tau_2\}$.
3. For*Hydromagnetic Double-diffusive convection* with *temperature dependent viscosity*$(\tau_1=\tau\ ,\tau_2=0)$, the radius is given by $\sigma R_T\sqrt{\mathrm{L}^2-1}/4\pi^2(\sigma f_{min.}+\Gamma_2)$,where$\mathrm{L}=4\sigma R_T/27\pi^4(\sigma f_{min.}+\Gamma_2)and\Gamma_2=min.\{\tau\ ,\ \sigma/\sigma_1\}$.
4. For*Hydromagnetic Double-diffusive convection* with *constant viscosity*$(\tau_1=\tau\ ,\tau_2=0,\ f_{min.}=1)$, the radius is given by $\sigma R_T\sqrt{\mathrm{S}^2-1}/4\pi^2(\sigma+\Gamma_3)$, where $\mathrm{S}=4\sigma R_T/27\pi^4(\sigma+\Gamma_3)$ and $\Gamma_3=min.\{\tau\ ,\ \sigma/\sigma_1\}$.
5. For*Double-diffusive convection* with *temperature dependent viscosity*$(\tau_1=\tau\ ,\tau_2=0,\ Q=0)$, the radius is given by $\sigma R_T\sqrt{\mathrm{X}^2-1}/4\pi^2(\sigma f_{min.}+\tau)$, where$\mathrm{X}=4\sigma R_T/27\pi^4(\sigma f_{min.}+\tau)$.This is the same result as obtained by Dhiman and Kumar [18].
6. For*Double-diffusive convection* with *constant viscosity*$(\tau_1=\tau\ ,\tau_2=0,\ Q=0, f_{min.}=1)$, the radius is given by $\sigma R_T\sqrt{\mathrm{Y}^2-1}/4\pi^2(\sigma+\tau)$, where $\mathrm{Y}=4\sigma R_T/27\pi^4(\sigma+\tau)$.This is the same result as obtained by Gupta *et. al.* [3].

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FLUID MECHANICS

EFFECT OF TEMPERATURE DEPENDENT VISCOSITY ON THERMAL CONVECTION IN FERROFLUID LAYER

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ABSTRACT: A linear stability analysis of onset of thermal convection in ferromagnetic fluid layer heated from below with temperature-dependent viscosity is investigated for general bounding surfaces. The eigenvalue problem is solved using a single term Galerkin technique and the values of critical Rayleigh numbers for different combinations of stress free and no-slip boundary conditions are computed for linear and exponential temperature dependent viscosity variations. The effects of temperature dependent viscosity parameter, magnetic Rayleigh number and the magnetization parameter on the onset of stationary convection are investigated numerically. It is found that increase in temperature dependent viscosity and decrease in magnetic number delay the onset of ferroconvection, while the nonlinearity of fluid magnetization has marginal influence on the stability of the system.

KEY WORDS: thermal convection, temperature dependent viscosity, ferrofluids, Galerkin method, Rayleigh number, magnetic Rayleigh number.

1 INTRODUCTION

Due to some physical properties of ferrofluids and its important applications in different fields of industry and medicine, the study of thermal convection in ferrofluids has gained much attention in the recent past. Ferrohydrodynamics, in contrast to the magnetohydrodynamics of ordinary fluids, is of special interest, since the flow here occurs without the imposition of electrical currents and thus in the absence of corresponding *Lorentz* forces. Ferrofluids are very important and useful tool in variety of applications in the fields of technology and biomedical sciences. Rosensweig [1] provided a detailed introduction to the subject of ferrofluids and its properties in his monograph and described the ferrofluids as stable colloidal suspensions consisting of single-domain magnetic particles coated with surfactant and immersed in a carrier fluid. The particles are commonly magnetite and of order 10 nm. in diameter, while the carrier liquid is typically an oil or water base. He observed that magnetization is a function of magnetic field, temperature and density of the fluid in general, and

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any variation in these properties impart change in the body force distribution in the fluid, which eventually give rise to convection in ferrofluids in the presence of a gradient of magnetic field and the phenomenon is known as ferroconvection, analogous to classical thermal convection (Chandrasekhar [2]).

Finlayson [3] studied the convective instability of a ferromagnetic fluid layer heated from below in the presence of a uniform vertical magnetic field and concluded from the characteristic equation, under the approximation namely; magnetic parameter M_2 very small ($M_2 \approx 0$), that the oscillatory motions of growing amplitude are not allowed and hence the stationary convection is the only mode of instability. Further, he derived an expression for the Rayleigh number for the case of stationary convection from the exact solution of the problem for the case of both free boundaries. He also obtained the numerical values of the critical magnetic Rayleigh number from an approximate solution for the case of both rigid boundaries using Galerkin method. Since then many authors including: Curtis [4], Lalas and Carmi [5], Shliomis [6] and Schwab *et al.* [7] have studied the convective instability in ferrofluids under varying assumptions of ferrohydrodynamics.

One of the well-known phenomena generated by the influence of magnetic field on the ferrofluids is the change of their viscosity. Rosensweig *et al.* [8] in the study of concentrated magnetite ferrofluids revealed that the increasing magnetic field strength increases the viscosity of ferrofluids. Shliomis [6] investigated the effect of a homogeneous magnetic field on the viscosity of a fluid with solid particles possessing intrinsic magnetic moments. The effect of magnetic field dependent (MFD) viscosity on the onset of ferroconvection in a rotating medium has been investigated by Vaidyanathan *et al.* [9]. Nanjundappa *et al.* [10] have also studied the effect of magnetic field dependent (MFD) viscosity on the onset of ferroconvection.

Review of the literature has revealed that for most of the fluids, viscosity is temperature dependent and shows a significant variation with respect to temperature. Torrance and Turcotte [11] found that the viscosity of liquids decreases with increasing temperature, while reverse trend is observed in gases. Early studies related to convection in fluids are by Palm [12] and Stengel *et al.* [13], who respectively considered the *linear* and *exponential* variations of temperature dependent viscosity. Jenkins [14] compared the *linear* and *exponential* viscosity variations with temperature and revealed that the linear dependence is realistic for fluids with small values of viscosity, while exponential dependence is more realistic for fluids with high viscosity. Dhiman and Kumar [15] and Dhiman and Sharma [16, 17] investigated the effect of temperature-dependent viscosity on the Rayleigh-Bénard convection problem in classical fluid, nanofluid and ferrofluid layers, respectively for different cases of boundary conditions.

A critical review of the above studies reveals that the ferrofluid motions have shown strong dependence upon some physical parameters (temperature, magnetic

field and density), therefore, it seems that the temperature-dependent viscosity may be one of the rheological properties that influence the convective motions of the ferrofluids. The present study is motivated by the above point and thus deals with the study of the effect of temperature dependent viscosity on the onset of convection in a ferromagnetic fluid layer in the presence of a uniform vertical magnetic field for different combinations of boundary conditions. The eigenvalue problem is solved using the Galerkin technique for different possible cases of combination of *dynamically free* and *rigid* boundary conditions. The effects of temperature dependent viscosity parameter, magnetic Rayleigh number and the nonlinear fluid magnetization parameter on the onset of stationary convection are discussed.

2 Physical Configuration and Eigenvalue Problem

Let an infinite horizontal layer of ferromagnetic fluid of thickness 'd' is confined between two horizontal boundaries $z = 0$ and $z = d$ in the force field of gravity $\vec{g}(0, 0, -g)$. The lower and upper boundaries are respectively maintained at uniform temperature T_0 and T_1 $(T_0 > T_1)$, thus maintaining a uniform adverse temperature gradient (β) having tendency to increase the density of the fluid in vertical direction z. The fluid is taken to be electrically non-conducting and is also permeated with a uniform vertical magnetic field $\vec{H}(0, 0, H_0)$. Here, it is also assumed that magnetic field $\vec{H}$ and magnetic induction $\vec{B}$ act parallel to each other. The fluid is assumed to be incompressible (Boussinesq) and the viscosity is temperature dependent given by; $\mu = \mu_0 f(T)$.

Following the usual steps of linear stability theory, the non-dimensional linearized perturbation equations and boundary conditions governing the above physical problem are derived in Appendix A; equations (A.22)–(A.26).

System of equations (A.22)–(A.24) and boundary conditions (A.25)–(A.26) constitutes an *eigenvalue problem* for complex growth rate $(p = p_r + ip_i)$ for the given values of other parameters. If $p_r \geq 0$ implies $p_i = 0$ (or *equivalently*, $p_i \neq 0$ implies $p_r < 0$) for all wave number a^2, then for neutral instability $(p_r = 0)$, we have $p = 0$. This situation in hydrodynamic stability theory is termed as *principle of exchange of stabilities* (PES), which means that instability sets in as stationary convection. Proving the validity of PES for any problem results in the elimination of the unsteady terms form the governing equations of the stability problems and thus the transition from stability to instability occurs via a marginal stationary state characterized by $p = 0$. Thus, putting $p = 0$ in governing perturbations, we obtain an eigenvalue problem for Rayleigh number.

The problem of thermal convection in ferrofluids [3] with temperature dependent viscosity was recently studied by Dhiman and Sharma [17] for general cases boundary conditions and proved the validity of the *principle of exchange of stabili-*

ties (PES) using Pellew and Southwell method of conjugate eigenfunctions for this problem governed by equations (A.22)–(A.26), when the magnetic parameter M_2 is very small ($M_2 \approx 0$). This yields that convective instability in ferromagnetic fluids sets in as stationary convection, which also validates the claim of Finlayson [3] regarding the nonexistence of oscillatory motions (for constant viscosity) for the cases of both free and both rigid boundary conditions. Since the typical value of M_2 for magnetic fluids is of the order of 10^{-6}, hence its effect can be neglected as compared to unity in the eigenvalue problem governed by these equations.

In view of the above discussion, the eigenvalue problem for Rayleigh number can be obtained by taking $p = 0$. Hence, equations (A.22)–(A.24) together with the combinations of the *rigid* and *dynamically free* boundary conditions (A.25)–(A.26) for stationary convection with $p = 0$ at $M_2 = 0$, assume the following form:

$$(1) \quad f(D^2 - a^2)^2 w + 2(Df)D(D^2 - a^2)w + D^2 f(D^2 + a^2)w = Ra^2[(1 + M_1)\theta - M_1 D\varphi] \,,$$

$$(2) \quad (D^2 - a^2)\theta = -w \,,$$

$$(3) \quad (D^2 - a^2 M_3)\varphi = D\theta \,,$$

subject to either of the following cases of boundary conditions:

Case 1: *Both boundaries dynamically free*

$$(4) \qquad w = 0 = \theta = D\varphi = D^2 w \quad \text{at} \;\; z = 0 \;\; \text{and} \;\; z = 1 \,.$$

Case 2: *Both boundaries rigid*

$$(5) \qquad w = 0 = \theta = D\varphi = Dw \quad \text{at} \;\; z = 0 \;\; \text{and} \;\; z = 1 \,.$$

Case 3: *One rigid and other free boundary*

$$(6) \qquad \begin{cases} w = 0 = \theta = D\varphi = Dw & \text{at} \;\; z = 0 \;\; (\text{or} \;\; z = 1) \\ w = 0 = \theta = D\varphi = D^2 w & \text{at} \;\; z = 1 \;\; (\text{or} \;\; z = 0) \,. \end{cases}$$

3 Stability Analysis

We shall now use the Galerkin method to solve the above eigenvalue problem. For this, we shall use a single term Galerkin method (*cf.* [3, 15] and [16]) to find the values of Rayleigh numbers for each case of boundary conditions (4)–(6). Let us take a single-term in the expansions of w, θ and φ as

$$(7) \qquad w = Aw_1(z) \,, \quad \theta = B\theta_1(z) \,, \quad \varphi = C\varphi_1(z) \,,$$

where w_1, θ_1 and φ_1 are suitably chosen trial functions which satisfy the respective boundary conditions (4)–(6) and A, B and C are constants.

Substituting the above values of w, θ and φ in equations (1)–(3), multiplying each of the resulting equations (the residuals) by w_1, θ_1 and φ_1, integrating these equations by parts suitable number of times using the relevant boundary conditions (4)–(6), we obtain three homogeneous algebraic equations in A, B and C having its coefficients as definite integrals. For the existence of the nontrivial solution, the determinant of the coefficients must vanish, which yields the following eigenvalue equation involving the relation between Rayleigh number R and wave number a (*the cell size*), as a first order

$$R = \frac{(I_1 + a^2 I_2) I_3}{a^2 I_4 \Big\{ (1 + M_1) I_4 + \dfrac{I_5 (M_1 I_6)}{I_7} \Big\}} \,. \tag{8}$$

Here

$$I_1 = \int_0^1 f \left((D^2 w_1)^2 + 2a^2 (D w_1)^2 + a^4 (w_1)^2 \right) dz \,, \quad I_2 = a^2 \int_0^1 (D^2 f)(w_1)^2 dz \,,$$
$$I_3 = \int_0^1 \left((D\theta_1)^2 + a^2 (\theta_1)^2 \right) dz \,, \quad I_4 = \int_0^1 \theta_1 w_1 dz \,, \quad I_5 = \int_0^1 D\theta_1 \varphi_1 dz \,,$$
$$I_6 = \int_0^1 D\varphi_1 w_1 dz \,, \quad I_7 = \int_0^1 \left((D\varphi_1)^2 + a^2 M_3 (\varphi_1)^2 \right) dz \,.$$

From the above expression (8), we shall compute the minimum of the eigenvalues; *i.e.* the critical Rayleigh number R_c, at which the onset of stationary instability occurs for each case of boundary conditions for both *exponential* and *linear* temperature dependent viscosity variations. For this, we consider following non-dimensional *exponential* and *linear* viscosity variation laws (*cf.* [15] and [16]):

$$f = e^{\delta z} \quad \text{and} \quad f = (1 + \delta z) \,, \tag{9}$$

where $\delta = \gamma \beta d$ is the viscosity variation parameter.

We shall now calculate the values of *critical* Rayleigh numbers for both *exponential* and *linear* variation of viscosity numerically, for each case of boundary conditions, separately.

Case 1: Both boundaries dynamically free. For the present case, let us choose the following suitable polynomial trial functions satisfying the boundary conditions (4)

$$w = z^4 - 2z^3 + z \,, \quad \theta = z(z-1) \quad \text{and} \quad \varphi = \frac{z^2}{2} - \frac{z^3}{3} \,. \tag{10}$$

Using the trial functions (10) and *linear* viscosity variation law (9) in the integrals I_1 to I_7 above, computing each of it numerically and finally using the values in expression (8), we obtain the following Rayleigh number for *linear* viscosity variation:

$$R_{\text{ff}}^{\text{lin}} = \frac{14(42+13a^2M_3)}{867a^2(42+13a^2(1+M_1)M_3)} \times (10+a^2)(31a^4+612a^2+3024)(2+\delta)\,. \tag{11}$$

Similarly using the numerical values of integrals I_1 to I_7 calculated using the *exponential* viscosity law (9) in expression (8), we obtain the following expression for Rayleigh number for the case of *exponential* viscosity variation:

$$\begin{aligned} R_{\text{ff}}^{\text{exp}} = {} & \frac{(42+13a^2M_3)}{a^2(42+13a^2(1+M_1)M_3)}\,\frac{11760}{289\delta^9}\Big[(10+a^2)\Big\{144\delta^4\big(-12-6\delta \\ & -\delta^2+e^{\delta}(12-6\delta+\delta^2)\big)+a^4\big(-20160-1080\delta-1440\delta^2+120\delta^3 \\ & +48\delta^4-\delta^6+e^{\delta}(20160-10080\delta+1440\delta^2+120\delta^3-48\delta^4+\delta^6)\big) \\ & +2a^2\delta^2\big(-15840-7290\delta-1152\delta^2+84\delta^3+36\delta^4-\delta^6 \\ & +e^{\delta}(15840-7290\delta+1152\delta^2+84\delta^3-36\delta^4+\delta^6)\big)\Big\}\Big]\,. \end{aligned} \tag{12}$$

Now, from expression (11) for the case of *linear* viscosity variation, the critical value of the wave number (the *critical cell size*) is determined from the condition, $d(R_{\text{ff}}^{\text{lin}})/da = 0$, which yields the following algebraic equation, whose positive root gives the critical wave number (a_c) depending upon M_1 and M_3:

$$C_1a^{10}+C_2a^8+C_3a^6+C_4a^4+C_5a^2+C_6=0\,. \tag{13}$$

Here

$$\begin{aligned} C_1 &= \left(5239\,(1+M_1)\,M_3^2\right)\,, \\ C_2 &= \left(77909\,(1+M_1)\,M_3^2+(8463M_1+33852)M_3\right)\,, \\ C_3 &= (503412M_3+54684)\,, \\ C_4 &= \left(-2555280\,(1+M_1)\,M_3^2+2496312M_1M_3+813204\right)\,, \\ C_5 &= (-16511040\,(1+M_1)\,M_3)\,, \\ C_6 &= -26671680\,. \end{aligned}$$

Note that equation (13) is a 5th degree algebraic equation in a^2 with coefficients involving M_1 and M_3 implicitly and it is cumbersome to solve analytically equation (13) for any positive root. Hence, in the present investigation, equation (13)

is solved numerically (using *Mathematica*® software) and the values of the critical wave numbers a_c for particular set of values of δ, M_1 and M_3 are obtained and consequently using these values of a_c, the values of *critical* Rayleigh numbers $(R_{ff}^{lin})_c$ are obtained. The results so obtained are also presented in Tables 1 and 2 for the case of *linear viscosity* variation.

Now, for the case of *ordinary fluid*, *i.e.* in the absence of magnetic parameters when $M_1 = 0 = M_3$, equation (13) reduces to the following equation:

$$31a^6 + 461a^4 - 15120 = 0\,, \tag{14}$$

and the only positive root of this equation is given by $a_c = 2.22$.

Thus, the minimum (*critical*) value of Rayleigh number $(R_{\text{ff}}^{\text{lin}})$ given by equation (11), using $a_c = 2.22$, is given by

$$(R_{\text{ff}}^{\text{lin}})_c \approx 332.267(2+\delta) \quad \text{at} \quad a_c = 2.22\,, \tag{15}$$

which is the same value as obtained by Dhiman and Kumar [15] for the thermal convection problem for ordinary fluid (*Newtonian fluid*) with temperature dependent viscosity.

Further, for the case of *constant viscosity* $(\delta \to 0)$, the expression (15) yields

$$R_c = 664.526 \quad \text{at} \quad a_c = 2.22\,, \tag{16}$$

which is about 6.5% higher than the value $R_c = 657.51$ as obtained by Chandrasekhar [2] using full numerical solution, in comparison to the present first approximation solution.

Also, for the case of *constant viscosity*, the expressions (11) and (12) in view the values of the integrals I_1 to I_7, yield the following same expression for Rayleigh number using *exponential* and *linear* variations of viscosity laws:

$$R_{\text{ff}} = \frac{28(10+a^2)(3024+612a^2+31a^4)(42+13M_3a^2)}{867a^2(42+13a^2(1+M_1)M_3)}\,. \tag{17}$$

The minimum value of the R_{ff} given in (17) can be calculated numerically using the critical values of wave number a_c computed from equation (13) for any positive root.

Finlayson [3] in his analysis of ferroconvection (with *constant* viscosity) obtained the following expression for Rayleigh number for the case of both *free boundaries*:

$$R = \frac{(\pi^2+a^2)^3(\pi^2+M_3a^2)}{a^2(\pi^2+a^2(1+M_1)M_3)}\,, \tag{18}$$

and the *critical* value of this Rayleigh number (R) denoted as R_c can computed using critical wave number a_c, which can be obtained from the following equation obtained analogous to equation (13) above:

$$D_1 a^{10} + D_2 a^8 + D_3 a^6 + D_4 a^4 + D_5 a^2 + D_6 = 0\,, \tag{19}$$

where

$$\begin{aligned} D_1 &= 2(1+M_1)M_3^2\,, & D_2 &= ((4+3M_1)\,M_3 + M_1 + 4))M_3\pi^4\,,\\ D_3 &= 2((1+3M_1)\,M_3^2 + 3M_3 + 1)\pi^4\,, & D_4 &= (-(3+M_3)\,M_1 M_3 + 3)\,\pi^6\,,\\ D_5 &= (-2\,(1+M_1)\,M_3)\pi^8\,, & D_6 &= -\pi^{10}\,. \end{aligned}$$

Now, the values of critical wave numbers (a_c^2) computed from expressions (13) and (19) respectively, we obtain the following values of critical Rayleigh numbers $(R_{\rm ff})_c$ and R_c from expressions (17) and (18): $(R_{\rm ff})_c = 342.52$ and $(R)_c = 357.235$, for $a_c^2 = 5.174$ (with $M_1 = 1$ and $M_3 = 10$); $(R_{\rm ff})_c = 65.973$ and $(R)_c = 75.139$, for $a_c^2 = 5.352$ (with $M_1 = 10$ and $M_3 = 6$).

It is clear from the above set of values that the critical Rayleigh numbers computed using (present) *Galerkin first approximation* solution method for the case of *constant viscosity* are in close agreement with the respective values obtained by Finlayson [3] in his analysis for this problem.

Further, using Finlayson [3] analysis, we have following expressions for N (the *magnetic Rayleigh number*) for very large values of M_1, obtained from expressions (11) and (12) respectively for *linear* and *exponential* variations of viscosity

$$(N_{\rm ff}^{\rm lin}) = (R_{\rm ff}^{\rm lin} M_1) = \frac{14(2+\delta)(30240+9144a^2+922a^4+31a^6)(42+13a^2M_3)}{11271a^4M_3} \tag{20}$$

$$\begin{aligned} (N_{\rm ff}^{\rm exp}) = (R_{\rm ff}^{\rm exp} M_1) &= \frac{11760(10+a^2)(42+13a^2M_3)}{3757\delta^9 a^4 M_3}\\ &\times \Big[\Big\{144\delta^4(-12-6\delta-\delta^2+e^\delta(12-6\delta+\delta^2))\\ &+ a^4\big(-20160-10080\delta-1440\delta^2+120\delta^3+48\delta^4-\delta^6\\ &+ e^\delta(20160-10080\delta+1440\delta^2+120\delta^3-48\delta^4+\delta^6)\big)\\ &+ 2a^2\delta^2\big(-15840-7290\delta-1152\delta^2+84\delta^3+36\delta^4-\delta^6\\ &+ e^\delta(15840-7290\delta+1152\delta^2+84\delta^3-36\delta^4+\delta^6)\big)\Big\}\Big]\,, \end{aligned} \tag{21}$$

which represent the magnetic mechanism operating in the absence of buoyancy effects.

Following the above analysis, the numerical values of critical wave numbers a_c at which the minimum (*critical*) values $(N_{\text{ff}}^{\text{exp}})_c$ and $(N_{\text{ff}}^{\text{lin}})_c$ of N_{ff} (for both *exponential* and *linear* cases) exist can be computed analogously. The values so obtained for *linear* case of viscosity variations are presented in Table 3.

Now, proceeding as in Case 1 of boundary conditions above, we can obtain the analogous expressions for Rayleigh numbers for other two cases of boundary conditions (Case 2 and Case 3), also.

Case 2: Both boundaries rigid. The suitable polynomial trial functions satisfying the boundary conditions (5) chosen are

$$w = z^4 - 2z^3 + z^2\,, \quad \theta = z(z-1) \quad \text{and} \quad \varphi = \frac{z^2}{2} - \frac{z^3}{3}\,.$$

Using these trial functions and the viscosity variation laws (9) in expression (8) and proceeding as in Case 1 above, we obtain following expressions for Rayleigh numbers respectively for *linear* and *exponential* variation of viscosity:

$$(R_{\text{rr}}^{\text{lin}}) = \frac{14(2520(4+744\delta)+(744a^2+34a^4+a^6)(2+\delta)(42+13a^2M_3)}{27a^2(42+13a^2(1+M_1)M_3)}\,, \tag{22}$$

$$\begin{aligned}(R_{\text{rr}}^{\text{exp}}) = {} & \frac{7840(10+a^2)[42+13a^2M_3]}{3a^2\delta^9[42+13a^2M_3+13a^2M_1M_3]}\Big[\Big\{6a^4\big(-1680-840\delta \\ & -180\delta^2-20\delta^3-\delta^4+e^{\delta}(1680-840\delta-180\delta^2-20\delta^3-\delta^4)\big) \\ & +\delta^4\big(-864-432\delta-96\delta^2-12\delta^3-\delta^4+e^{\delta}(864-432\delta+96\delta^2 \\ & -12\delta^3+\delta^4)\big)+2a^2\delta^2\big(-7920-3960\delta-852\delta^2-96\delta^3-5\delta^4 \\ & +e^{\delta}(7920-3960\delta+852\delta^2-96\delta^3+5\delta^4)\big)\Big\}\Big].\end{aligned} \tag{23}$$

Case 3: Lower rigid and upper free boundaries. Let us choose following suitable polynomial trial functions satisfying the either of boundary conditions (6)

$$w = 2z^4 - 5z^3 + 3z^2\,, \quad \theta = z(z-1) \quad \text{and} \quad \varphi = \frac{z^2}{2} - \frac{z^3}{3}\,,$$

and proceeding analogously as in other two cases of boundary conditions above, upon using these trial functions and the viscosity variation laws given in (9) in expression (8), we obtain following expressions for Rayleigh numbers for *linear* and *exponential* variation of viscosity, respectively:

$$(R_{\text{rf}}^{\text{lin}}) = \frac{7(42+13a^2M_3)(10+a^2)(1512(12+5\delta)+216a^2(8+5\delta)+a^4(76+43\delta))}{507a^2(42+13a^2(1+M_1)M_3)} \tag{24}$$

$$(R_{\rm rf}^{\rm exp}) = \frac{11760(10+a^2)[42+13a^2M_3]}{169a^2\delta^9[42+13a^2M_3+13a^2M_1M_3]}\Big[\Big\{18\delta^4\big(-384 - 240\delta - 66\delta^2 - 10\delta^3 - \delta^4 - 6e^{\delta}(64-24\delta+3\delta^2)\big) + a^4\big(-36(2240+1400\delta+370\delta^2+50\delta^3+3\delta^4) + e^{\delta}(80640-30240\delta+3240\delta^2+240\delta^3-72\delta^4+\delta^6)\big) + 2a^2\delta^2\big(-18(3520+2200\delta+584\delta^2+80\delta^3+5\delta^4 + e^{\delta}(63360-23760\delta+2592\delta^2+168\delta^3-54\delta^4+\delta^6)\big)\Big\}\Big]. \tag{25}$$

It is to mention here that using the following trial functions, which satisfy the other set of boundary conditions (6); *i.e. upper rigid and lower free boundary*

$$w = 2z^4 - 3z^3 + z\,, \quad \theta = z(z-1) \quad \text{and} \quad \varphi = \frac{z^2}{2} - \frac{z^3}{3}\,,$$

we have obtained the expressions analogous to (24) and (25), which yield almost same numerical values for Rayleigh numbers and hence are omitted here for the sake of compactness.

4 Results and Discussion

In the present analysis, we have investigated the effects of *linear* and *exponential* temperature-dependent viscosity on the onset of thermal convection in ferrofluids. As reported earlier that the *principle of exchange of stabilities* (PES) is valid for the problem with variable viscosity [17], when the values of the magnetic parameter ($M_2 \approx 0$) are very small, which yields that the onset of instability is through stationary modes only. Therefore, the expressions for Rayleigh numbers for stationary convection (for both *linear* and *exponential* cases of viscosity variations) for different cases of boundary conditions are derived using a single-term *Galerkin method* and the values of critical wave numbers and Rayleigh numbers are computed numerically from these eigenvalues.

In Table 1, the values of critical wave numbers a_c^2 computed numerically from expressions (13) for *linear* temperature-dependent viscosity with $\delta = 0.0, 0.2, 0.5, 0.7, 0.9$, $M_1 = 1, 5$ and fixed $M_3 = 10$ are presented, for the case of *both free boundaries.* Using these values of a_c^2 in expression (11), the values of the critical Rayleigh number $(R_{\rm ff})_c$ are computed and are shown in Table 1. Similarly, the values of a_c^2 and Rayleigh numbers; $(R_{\rm rr})_c$ and $(R_{\rm rf})_c$ for both rigid and one rigid one free cases of boundary conditions are computed from expressions (22) and (24) respectively and are also presented in Table 1.

Also, for *linear* viscosity variation, the values of a_c^2 and analogous $(R_{\rm ff})_c$, $(R_{\rm rr})_c$ and $(R_{\rm rf})_c$ which are computed from these expressions for the same set of values δ

Table 1: Values of critical wave number a_c^2 and Rayleigh numbers R with δ, M_1 and fixed M_3

$M_3 = 10$		Linear viscosity variation					
M_1	δ	a_c^2	$(R_{\text{ff}})_c$	a_c^2	$(R_{\text{rr}})_c$	a_c^2	$(R_{\text{rf}})_c$
1	0.0	5.174	342.52	9.921	889.15	7.336	581.78
	0.2	5.174	376.78	9.921	978.06	7.237	641.06
	0.5	5.174	428.16	9.921	1111.4	7.120	729.84
	0.7	5.174	462.41	9.921	1200.3	7.058	788.97
	0.9	5.174	496.79	9.921	1289.2	7.004	848.05
5	0.0	5.319	116.49	10.06	299.56	7.476	196.72
	0.2	5.319	128.14	10.06	329.51	7.378	216.81
	0.5	5.319	145.62	10.06	374.45	7.262	246.89
	0.7	5.319	157.26	10.06	404.40	7.199	266.93
	0.9	5.319	168.92	10.06	434.36	7.146	286.95

with $M_3 = 2$, 6 and fixed $M_1 = 1000$ are presented in Table 2. Further, in Table 3, the values of a_c^2 and analogous $(N_{\text{ff}})_c$, $(N_{\text{rr}})_c$ and $(N_{\text{rf}})_c$ are presented, which are computed from expression (20) and from analogous expressions for the same set of values of parameters. Figs. (1a)–(1f) depict the variations of Rayleigh number and *magnetic* Rayleigh number (R_{ff} and N_{ff}) *versus* the square of the wave number a^2 for

Table 2: Values of critical wave number a_c^2 and Rayleigh numbers R with δ, M_3 and fixed M_1

$M_1 = 1000$		Linear viscosity variation					
M_3	δ	a_c^2	$(R_{\text{ff}})_c$	a_c^2	$(R_{\text{rr}})_c$	a_c^2	$(R_{\text{rf}})_c$
2	0.0	6.582	0.849	11.443	2.014	8.792	1.368
	0.2	6.582	0.934	11.443	2.033	8.695	1.510
	0.5	6.582	1.062	11.443	2.518	8.581	1.723
	0.7	6.582	1.146	11.443	2.719	8.519	1.865
	0.9	6.582	1.231	11.443	2.933	8.467	2.00
6	0.0	5.366	0.731	10.383	1.84	7.793	1.219
	0.2	5.366	0.804	10.383	2.023	7.695	1.344
	0.5	5.366	0.914	10.383	2.302	7.580	1.531
	0.7	5.366	0.987	10.383	2.486	7.519	1.656
	0.9	5.366	1.061	10.383	2.671	7.466	1.781

Table 3: Values of critical wave number a_c^2 and magnetic Rayleigh numbers N with δ, M_3 and fixed M_1

$M_1 = 1000$		Linear viscosity variation					
M_3	δ	a_c^2	$(N_{\text{ff}})_c$	a_c^2	$(N_{\text{rr}})_c$	a_c^2	$(N_{\text{rf}})_c$
2	0.0	6.584	850.679	11.445	2017.1	8.794	1369.7
	0.2	6.584	935.747	11.445	2035.8	8.697	1512.0
	0.5	6.584	1063.35	11.445	2521.3	8.523	1725.2
	0.7	6.584	1148.42	11.445	2723.0	8.521	1867.2
	0.9	6.584	1233.48	11.445	2924.8	8.469	2009.2
6	0.0	5.637	732.049	10.383	1843.7	7.793	1220.8
	0.2	5.637	805.254	10.383	2028.1	7.696	1346.0
	0.5	5.637	915.061	10.383	2304.6	7.581	1533.6
	0.7	5.637	988.266	10.383	2489.0	7.519	1658.5
	0.9	5.637	1061.47	10.383	2673.4	7.466	1783.3

exponential viscosity variations (for the case of *both free boundaries*) with different values of δ and fixed values of M_1 and M_3.

It is found from the values presented in Tables 1–3 for the case of *linear* viscosity variation that the critical wave number (the cell size) is independent of temperature-dependent viscosity δ, but depend upon the *magnetic* parameters M_1 and M_3. It is observed that the values of the critical Rayleigh numbers increase for increasing values of δ for all cases of boundary conditions, which yields that the temperature-dependent viscosity has stabilizing effect on the onset of stationary convection in ferrofluid.

We observed that for increasing values of magnetic number (M_1), the values of critical Rayleigh numbers decrease, which implies that M_1 has destabilizing effect on the onset of stationary convection in ferrofluid layer. This behavior of the system may be due to the increase in the destabilizing magnetic force, as heat is transported more efficiently in magnetic fluids as compared to ordinary fluids. A similar behaviour of Rayleigh numbers plotted in Figs. (1a)–(1b) *versus* a^2 for *exponential* case of viscosity variation with different values of M_1 is also observed.

From Table 2, we observed that the values of Rayleigh numbers decrease with increasing values of M_3 (the measure of *nonlinearity of magnetization*) which yields that M_3 has a destabilizing effect on the onset of stationary convection for all cases of boundary conditions. This may be due to the large *pyromagnetic* coefficient or large *temperature gradient*. However, the destabilizing effect of nonlinearity of the fluid magnetization observed in the present analysis is marginal. Similar effect of M_3 on

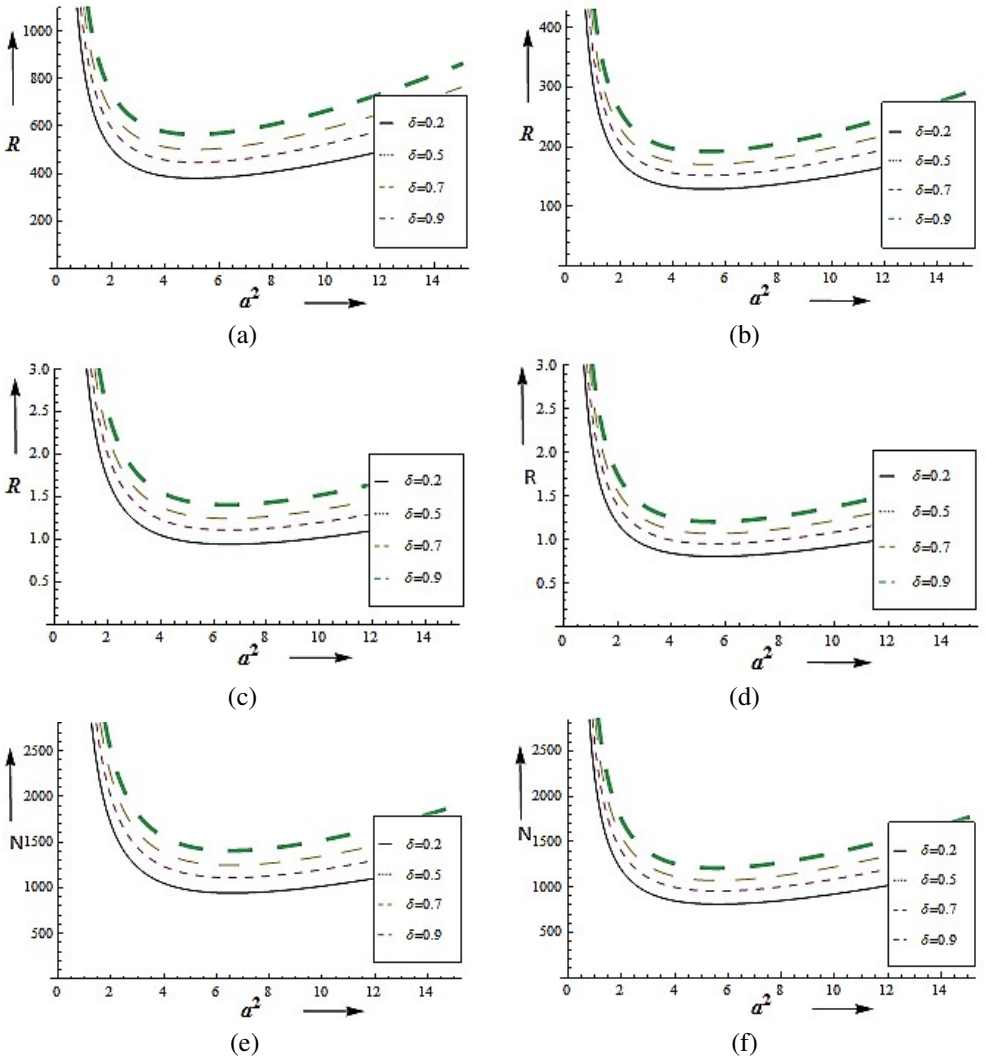

Fig. 1: Plots showing variations of Rayleigh numbers vs. wave number for exponential viscosity variations: Case of both free boundaries: (a) & (b) – variations of R vs. a^2 respectively for $M_1 = 1$ and 5 with fixed $M_3 = 10$; (c) & (d) – variation of R vs. a^2 respectively for $M_3 = 2$ and 6 with fixed $M_1 = 1000$; (e) & (f) – variation of N vs. a^2 respectively for $M_3 = 2$ and 6 with fixed $M_1 = 1000$.

Rayleigh number for *exponential* viscosity variation is also observed from Figs. (1c) & (1d). From Table 3, we observed that the values of critical *magnetic* Rayleigh number also decrease with the increasing values of M_3, for all cases of boundary

conditions. Further, it is evident form Tables 2 and 3 that the values of critical *magnetic* Rayleigh numbers (N_c) are greater than the critical Rayleigh numbers (R_c) yielding that the system is more stable when magnetic mechanism is alone present (in the absence of *buoyancy forces*). From Figs. (1e) & (1f), we observed that the *magnetic* Rayleigh number admits the same behaviour with M_3, for *exponential* case of viscosity variation, also.

In general, it is evident from the computed values that values of critical wave numbers decrease slightly for increasing values of δ for each case of boundary conditions, however the values of critical Rayleigh numbers increase with the increasing δ. We also conclude from the comparison of the numerical values presented here that the *exponential* temperature-dependent viscosity is more stabilizing than the *linear* case of viscosity variation.

From the analysis of the values computed for Rayleigh numbers for *exponential* viscosity variation, we found that it follows analogous trends and variations with respect to the parameters as shown in the case of *linear* viscosity variation in Tables 1–3, hence the tables of values for *exponential* case are omitted here for the sake of compactness. Further, we have observed the same trends of variations of Rayleigh numbers for *linear* and *exponential* cases of viscosity variation, hence the graphs for the *linear* case of viscosity variations and for other two case of boundary conditions for the case of *exponential* viscosity variation are also omitted here.

Appendix A Derivation of Eigenvalue Problem

The basic hydrodynamic equations for thermal convection in ferrofluid in the presence of vertical magnetic field are given in Finlayson [3]. These equations can be rewritten for the case when the viscosity is temperature dependent following Chandrasekhar [2]. Thus, the system of basic equations governing the physical configuration (Section 2) under Boussinesq approximation are given by

$$\nabla \cdot \vec{q} = 0\,, \tag{A.1}$$

$$\rho_0 \frac{D\vec{q}}{Dt} = -\nabla P - \rho g \hat{k} + \frac{\partial}{\partial x_j}\Big[\mu\Big(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\Big)\Big] + 2\frac{\partial \mu}{\partial z}\nabla(\vec{q}\cdot\hat{k}) + \nabla\cdot(\vec{H}\vec{B}), \tag{A.2}$$

$$\Big[\rho_0 C_{V,H} - \eta_0 \vec{H}\cdot\big(\frac{\partial \vec{M}}{\partial T}\big)_{V,H}\Big]\frac{DT}{Dt} + \eta_0 T\big(\frac{\partial \vec{M}}{\partial T}\big)_{V,H}\cdot\frac{D\vec{H}}{Dt} = k_1\nabla^2 T\,, \tag{A.3}$$

$$\rho = \rho_0[1-\alpha(T-T_0)]\,. \tag{A.4}$$

The above equations have been casted in a Cartesian coordinate system (x, y, z) with origin at the bottom layer and z-axis is considered vertically upward. In these

equations: $\vec{q} = (u, v, w)$ is the velocity vector, T is the temperature, P is the pressure, g is the gravity, $\hat{k}$ is the unit vector in the z-direction, $\vec{H} = (H_x, H_y, H_z)$ is the magnetic field intensity, $\vec{B} = (B_x, B_y, B_z)$ is the magnetic induction, $\vec{M} = (M_x, M_y, M_z)$ is the magnetization. Also, $\dfrac{D}{Dt} \equiv \left(\dfrac{\partial}{\partial t} + \vec{q}\cdot\nabla\right)$ is the material derivative, $\mu = \mu_0 f(T)$ is the temperature dependent viscosity, $C_{V,H}$ is the specific heat at constant volume and magnetic field, k_1 is the thermal conductivity and α is the coefficient of thermal expansion. Further, ρ_0, η_0 and μ_0 are the density, magnetic permeability and viscosity at the reference temperature T_0.

Equation (A.1) represents the continuity equation, (A.2) is the momentum equation, (A.3) is the energy equation, and (A.4) is the equation of state. Further, the Maxwell's equations for a non-conducting ferromagnetic fluid with no displacement current are given as (Finlayson [3])

$$\nabla \cdot \vec{B} = 0\,, \quad \nabla \times \vec{H} = 0\,, \quad \vec{H} = \nabla \cdot \varphi\,, \tag{A.5}$$

where φ is the magnetic scalar potential. Further, in the Chu formation (see [3]) the magnetic field $\vec{H}$ and magnetization $\vec{M}$ are related to magnetic induction $\vec{B}$ as

$$\vec{B} = \eta_0(\vec{H} + \vec{M})\,. \tag{A.6}$$

First of the equations (A.5), *i.e.* $\nabla \cdot \vec{B} = 0$, upon using equation (A.6), yields

$$\eta_0\big(\nabla \cdot (\vec{H} + \vec{M})\big) = 0\,. \tag{A.7}$$

Since the magnetization is assumed to be aligned with the magnetic field and is a function of temperature and magnetic field, we have

$$\vec{M} = \frac{\vec{H}}{H} M(H, T)\,. \tag{A.8}$$

In addition to the above equations, the magnetic equation of state is given by

$$M = M_0 + \chi(H - H_0) - K_2(T - T_0)\,. \tag{A.9}$$

Here, the magnetic equation is linearized about the magnetic field H_0 and the average temperature T_0. In the above equations; M_0 is the reference magnetization at $H = H_0$ and $T = T_0$, $\chi = \left(\dfrac{\partial M}{\partial H}\right)_{H_0,T_0}$ is the magnetic susceptibility, $K_2 = \left(\dfrac{\partial M}{\partial T}\right)_{H_0,T_0}$ is the pyromagnetic co-efficient and H_0 is the uniform magnetic field of the fluid layer when placed in an *external* magnetic field $\vec{H} = H_0^{\text{ext}}$.

To investigate the instability of equilibrium system, let us add small perturbations to the initial state solution and the perturbed quantities are denoted as

$$\begin{aligned} &\vec{q} = \vec{q}_b(0,0,0) + \vec{V}\,; \quad P = P_b(z) + \delta p\,; \\ &T = T_b(z) + \theta\,; \qquad \rho = \rho_0(1 - \alpha(T_b(z) + \theta - T_0))\,; \\ &\vec{H} = \vec{H}_b(z) + \vec{H}'\,; \qquad \vec{M} = \vec{M}_b(z) + \vec{M}'\,, \end{aligned} \tag{A.10}$$

where $\vec{V}(u,v,w)$, δp, θ, $\vec{H}'$ and $\vec{M}'$ are the respective perturbations in the initial velocity, pressure p temperature T, magnetic field and magnetization and $\vec{q}_b$, $P_b(z)$, $T_b(z)$ and $\vec{H}_b(z)$ are the basic state solutions. Also, $\kappa = \dfrac{k_1}{\rho_0 C_1}$ is the effective thermal diffusivity, $\beta = \dfrac{T - T_0}{d}$ is maintained uniform temperature gradient.

Now following the usual steps of linear stability (Chandrasekhar [2], Finlayson [3]), substituting the perturbed quantities (A.10) in equations (A.1)–(A.3) and (A.7), we obtain the following linearized perturbation equations:

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0\,, \tag{A.11}$$

$$\begin{aligned} \rho_0 \frac{\partial u}{\partial t} = &-\frac{\partial \delta p}{\partial x} + \mu_0 f(T)\nabla^2 u + \mu_0 \frac{\partial f(T)}{\partial z}\Big(\frac{\partial u}{\partial z} + \frac{\partial w}{\partial x}\Big) \\ &+ \eta_0(H_0 + M_0)\frac{\partial H_1(z)}{\partial z}\,, \end{aligned} \tag{A.12}$$

$$\begin{aligned} \rho_0 \frac{\partial v}{\partial t} = &-\frac{\partial \delta p}{\partial y} + \mu_0 f(T)\nabla^2 v + \mu_0 \frac{\partial f(T)}{\partial z}\Big(\frac{\partial v}{\partial z} + \frac{\partial w}{\partial y}\Big) \\ &+ \eta_0(H_0 + M_0)\frac{\partial H_2(z)}{\partial z}\,, \end{aligned} \tag{A.13}$$

$$\begin{aligned} \rho_0 \frac{\partial w}{\partial t} = &-\frac{\partial \delta p}{\partial z} + \mu_0 f(T)\nabla^2 w + 2\mu_0 \frac{\partial f(T)}{\partial z}\frac{\partial w}{\partial z} + g\alpha\theta\rho_0 \\ &+ \eta_0(H_0 + M_0)\frac{\partial H_3(z)}{\partial z} + \eta_0(M_3 + H_3)\frac{\partial}{\partial z}\Big(H_0 - \frac{K_2\beta z}{1+\chi}\Big)\,, \end{aligned} \tag{A.14}$$

$$\rho_0 C_1 \frac{\partial \theta}{\partial t} - \eta_0 T_0 K_2 \frac{\partial}{\partial t}\Big(\frac{\partial \varphi}{\partial z}\Big) = k_1 \nabla^2 \theta + (\rho_0 C_1 - \frac{\eta_0 T_0 K_2^2}{1+\chi})\beta w\,, \tag{A.15}$$

$$\frac{\partial}{\partial x}(H_1 + M_1) + \frac{\partial}{\partial y}(H_2 + M_2) + \frac{\partial}{\partial z}(H_3 + M_3) = 0\,. \tag{A.16}$$

Here φ is the perturbed magnetic potential and $\rho_0 C_1 = \rho_0 C_{V,H} + K_2 H_0 \eta_0$.

Now, substituting (A.10) in equations (A.8) and (A.9) and taking $K_2\beta d \ll (1+\chi)H_0$, we have

$$H_i + M_i = \begin{cases} (1+M_0/H_0)H_i & \text{for } i=1,2\,, \\ (1+\chi)H_i - K_2\theta & \text{for } i=3\,. \end{cases} \tag{A.17}$$

Upon using equations $\vec{H} = \nabla\cdot\varphi$ and (A.17), equations (A.14) and (A.16) yield

$$\rho_0\frac{\partial w}{\partial t} = -\frac{\partial \delta p}{\partial z} + \mu_0 f(T)\nabla^2 w + 2\mu_0\frac{\partial f(T)}{\partial z}\frac{\partial w}{\partial z} + g\rho_0\alpha\theta + \eta_0(H_0+M_0)\frac{\partial^2\varphi}{\partial z^2} - \eta_0 K_2\beta H_3 + \frac{\eta_0 K_2^2\beta}{1+\chi}\theta\,, \tag{A.18}$$

$$\Big(1+\frac{M_0}{H_0}\Big)\Big(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\Big)\varphi + (1+\chi)\frac{\partial^2\varphi}{\partial z^2} - K_2\frac{\partial\theta}{\partial z} = 0\,. \tag{A.19}$$

Now, eliminating δp amongst the equation (A.11)–(A.13) and (A.18), we have

$$\rho_0\frac{\partial}{\partial t}\nabla^2 w = \rho_0 g\alpha\Big(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\Big)\theta + \mu_0 f(T)\nabla^4 w + 2\mu_0\frac{df(T)}{dz}\nabla^2\Big(\frac{\partial w}{\partial z}\Big) - \mu_0\frac{d^2 f(T)}{dz^2}\Big(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}-\frac{d^2}{dz^2}\Big)w - \eta_0 K_2\beta\Big(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\Big)\frac{\partial\varphi}{\partial z} + \frac{\eta_0 K_2^2\beta}{1+\chi}\Big(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\Big)\theta\,. \tag{A.20}$$

Finally, using the *normal mode analysis* by assuming the time dependence periodic solution in horizontal plane of the form

$$(u, v, w, \delta p, \theta) = F^*(z)\exp[i(k_x x + k_y y) + nt] \tag{A.21}$$

we obtain the following system of non-dimensional linearized perturbation equations, after some algebraic manipulations

$$f(T)(D^2-a^2)^2 w - \frac{p}{\sigma}(D^2-a^2)w + 2Df(T)D(D^2-a^2)w + D^2 f(T)(D^2+a^2)w = Ra^2[(1+M_1)\theta - M_1 D\varphi]\,, \tag{A.22}$$

$$(D^2-a^2-p)\theta + pM_2 D\varphi = -(1-M_2)w\,, \tag{A.23}$$

$$(D^2 - a^2 M_3)\varphi = D\theta\,. \tag{A.24}$$

The above equations have been recasted into the non-dimensional forms by using the following non-dimensional quantities:

$$\hat{z} = \frac{z}{d}\,, \quad \hat{a} = kd\,, \quad \hat{D} = d\frac{d}{dz}\,, \quad \hat{p} = \frac{nd^2}{\kappa}\,, \quad \hat{w} = \frac{dw^*}{\nu}\,,$$
$$\hat{\theta} = \frac{\kappa\theta^*}{\beta\nu d}\,, \quad \hat{\varphi} = \frac{(1+\chi)\kappa\varphi^*}{K_2\beta\nu d^2}\,, \quad \sigma = \frac{\nu}{\kappa}\,, \quad \nu = \frac{\mu_0}{\rho_0}\,.$$

In the above equations; $R = \dfrac{g\alpha\beta d^4}{\kappa\nu}$ is Rayleigh number, a is wave number, p is complex *growth rate*, σ is the Prandtl number, $M_1 = \eta_0 K_2^2\beta/\rho_0 g\alpha(1+\chi)$ is the magnetic number, $M_2 = \eta_0 K_2^2 T_0/\rho_0 C_1(1+\chi)$ is the magnetic parameter and $M_3 = \left(1 + \dfrac{M_0}{H_0}\right)/(1+\chi)$ is the measure of nonlinearity of magnetization. Further, the caps have been dropping in the above equations for convenience in writing.

The equations (A.22)–(A.24) must seek solutions subject to certain boundary conditions based upon the nature of the bounding surfaces. The boundary surfaces shall be either rigid (with no slip condition) or dynamically free (where the tangential stresses vanish). Hence, the relevant non-dimensional boundary conditions (for $\chi \to \infty$, *i.e.* for very large magnetic susceptibility) considered here are (*cf.* [3])

(A.25) $\qquad w = 0 = \theta = D\varphi = D^2 w \quad$ on dynamically free surfaces,

(A.26) $\qquad w = 0 = \theta = D\varphi = Dw \quad$ on rigid surfaces.

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Inequalities for central moments and spreads of matrices

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Abstract

We derive some inequalities involving first four central moments of discrete and continuous distributions. Bounds for the eigenvalues and spread of a matrix are obtained when all its eigenvalues are real. Likewise, we discuss bounds for the roots and span of a polynomial equation.

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A NOTE ON VARIANCE BOUNDS AND LOCATION OF EIGENVALUES

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Abstract. We discuss some extensions and refinements of the variance bounds for both real and complex numbers. The related bounds for the eigenvalues and spread of a matrix are also derived here.

1. Introduction

Let $z_1, z_2, \ldots, z_n$ denote n complex numbers. Their arithmetic mean is the number

$$\frac{1}{n}\sum_{i=1}^{n} z_i = \widetilde{z}. \tag{1.1}$$

In literature, the number

$$\frac{1}{n}\sum_{i=1}^{n} |z_i - \widetilde{z}|^2 = S_z^2 \tag{1.2}$$

or its equivalent expressions have been studied in several different contexts and notations and is termed as the variance of complex numbers at many places. For example, see Audenaert [2], Bhatia and Sharma [4,5], Merikoski and Kumar [13], and Park [17].

The number

$$\frac{1}{n}\sum_{i=1}^{n} (z_i - \widetilde{z})^2 = S^2 \tag{1.3}$$

is also important in this context. If z_i's are all real we denote them by x_i's with $a = \min x_i$ and $b = \max x_i$. The arithmetic mean by $\overline{x}$ and variance by the lower case letter s^2. In this case $S_z = |S| = S = s$ but in general S_z rather than $|S|$ is more consistent with s. For instance, $s = 0$ $(S_z = 0)$ if and only if all the x_i's $(z_i$'s$)$ are equal. This is not the case with $|S|$; for example, for three distinct complex numbers 0, $\pm\frac{1}{2} + i\frac{\sqrt{3}}{2}$ we have $S = 0$. It however turns out that for some purposes s^2 is more consistent with

$$\sigma_z^2 = \frac{|S^2| + S_z^2}{2} \tag{1.4}$$

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than S_z^2. Note that the analogue of the Popoviciu inequality [18]

$$s^2 \leqslant \frac{(b-a)^2}{4} \tag{1.5}$$

for the complex numbers says that

$$\sigma_z^2 \leqslant \max_{i,j} \frac{\left|z_i - z_j\right|^2}{4}. \tag{1.6}$$

But it is not always true that $S_z^2 \leqslant \max\limits_{i,j} \frac{\left|z_i - z_j\right|^2}{4}$. For example, for $z_1 = -\frac{1}{2} + i\frac{\sqrt{3}}{2}$, $z_2 = 0$ and $z_3 = \frac{1}{2} + i\frac{\sqrt{3}}{2}$, $S_z^2 = \frac{1}{3}$ and $\max\limits_{i,j} \left|z_i - z_j\right| = 1$.

The corresponding inequality for S_z^2 is

$$S_z^2 \leqslant r_z^2 \leqslant \max_{i,j} \frac{\left|z_i - z_j\right|^2}{3}, \tag{1.7}$$

where r_z is the radius of the smallest disk containing all the numbers z_i's, see [4, 5].

A classical theorem of Jung [9] says that the complex numbers z_i's in a plane can be contained in a closed disk of radius $\max\limits_{i,j} \frac{\left|z_i - z_j\right|}{\sqrt{3}}$. We thus have

$$\max_{i,j} \frac{\left|z_i - z_j\right|}{2} \leqslant r_z \leqslant \max_{i,j} \frac{\left|z_i - z_j\right|}{\sqrt{3}}.$$

In this context it is interesting to note a case when the given complex numbers lie on the boundary of the smallest disk containing them. We here show that if the complex numbers lie on a circle with centre at their arithmetic mean then this circle is the smallest circle enclosing these points, (see Theorem 2.1 & 3.1 below). A necessary and sufficient condition is given for which the numbers σ_z, S_z and $|S|$ are all equal, (Theorem 2.2). We obtain a complex analogue of the inequality, Mallows and Richter [11],

$$s^2 \geqslant \frac{r}{n-r} (\alpha_r - \overline{x})^2, \tag{1.8}$$

where α_r is the arithmetic mean of any subset of r numbers chosen from the real numbers $x_1, x_2, \ldots, x_n$, (Theorem 2.3).

On the other hand we find in literature that the inequality (1.5) and its complementary Nagy's inequality [13],

$$s^2 \geqslant \frac{(b-a)^2}{2n} \tag{1.9}$$

also provide bounds for the spread of a complex $n \times n$ matrix A when the eigenvalues $\lambda_i(A)$ of A are all real. The spread of a matrix A is the maximum distance between two eigenvalues of a matrix, $\mathrm{Spd}(A) = \lambda_{\max}(A) - \lambda_{\min}(A)$. We have,

$$\frac{4}{n} \mathrm{tr} B^2 \leqslant \mathrm{Spd}(A)^2 \leqslant 2\mathrm{tr} B^2, \tag{1.10}$$

where $B = A - \frac{\mathrm{tr}A}{n} I$ and $\mathrm{tr}A$ denotes the trace of A, see [6, 23].

We show that the inequalities, [3, 21],

$$\frac{(b-a)^2}{2n} + \frac{2}{n-2}\left(\overline{x} - \frac{a+b}{2}\right)^2 \leqslant s^2 \leqslant (b-\overline{x})(\overline{x}-a), \tag{1.11}$$

provide some further refinements of the inequalities (1.5) and (1.9) and consequently we get better bounds for the spread of a matrix for some special cases, (Theorem 2.4, 2.5, 3.2). A refinement of the inequality (1.5) is obtained for Leptokurtic and Mesokurtic distributions, (Theorem 2.6). It is shown that better estimates can be obtained from the existing bounds for the eigenvalues and spread of a matrix when any one of its eigenvalue is known in advance, (Theorem 3.3, 3.4). Likewise, the bounds for the span of a polynomial are given, (Theorem 3.5).

2. Main results

THEOREM 2.1. *If the complex numbers z_i's in the complex plane lie on a circle with centre $\widetilde{z}$ and radius r_z, then r_z is the radius of the smallest disk containing all the points z_i's.*

Proof. For any complex number c, we can write (1.2) in the form

$$S_z^2 = \frac{1}{n}\sum_{i=1}^{n} |z_i - c + c - \widetilde{z}|^2 = \frac{1}{n}\sum_{i=1}^{n} |z_i - c|^2 - |\widetilde{z} - c|^2. \tag{2.1}$$

If all the complex numbers z_i's lie on the circle $|z-c| = r_z$, then

$$\frac{1}{n}\sum_{i=1}^{n} |z_i - c|^2 = r_z^2. \tag{2.2}$$

Combining (2.1) and (2.2), we get that

$$S_z^2 + |\widetilde{z} - c|^2 = r_z^2. \tag{2.3}$$

From the first inequality (1.7), $r_z \geqslant S_z$. So the minimum value of r_z is S_z. This implies that if $r_z = S_z$ then r_z is the radius of the smallest disk containing the points z_i's. For $\widetilde{z} = c$, (2.3) gives $r_z = S_z$. This proves the theorem. □

THEOREM 2.2. *Let $z_1, z_2, \ldots, z_n$ be the points in the finite complex plane and let S_z, S and σ_z be defined as in (1.2), (1.3) and (1.4), respectively. Then, $S_z = |S| = \sigma_z$ if and only if all the points $z_1, z_2, \ldots, z_n$ lie on a straight line.*

Proof. In the complex plane the convex combination of complex numbers lie in the convex hull of these numbers. It follows that if the points z_i's are collinear then $\widetilde{z}$ also lies on the straight line passing through z_i's.

From (1.2)–(1.4), we see that $S_z = |S| = \sigma_z$ if and only if

$$\left|\sum_{i=1}^{n} (z_i - \widetilde{z})^2\right| = \sum_{i=1}^{n} |z_i - \widetilde{z}|^2 \ . \tag{2.4}$$

The equality occurs in triangle inequality

$$\left|\sum_{i=1}^{n} a_i\right| \leqslant \sum_{i=1}^{n} |a_i|$$

if and only if the ratio of any two non-zero terms is positive that is $\frac{a_i}{a_j} > 0, \quad i,j = 1,2,\ldots,n,$ see Ahlfors [1]. This means (2.4) holds true if and only if the ratio of any two non zero terms in (2.4) is positive, that is

$$\left(\frac{z_i - \widetilde{z}}{z_j - \widetilde{z}}\right)^2 > 0. \tag{2.5}$$

The square of a complex number z is positive if and only if z is real and therefore (2.5) implies that $\frac{z_i-\widetilde{z}}{z_j-\widetilde{z}}$ is real. Also, $\frac{z_i-\widetilde{z}}{z_j-\widetilde{z}}$ is real if and only if z_i lies on the straight line passing through z_j and $\widetilde{z}$. If $z_k - \widetilde{z} = 0$ for some k then $z_k = \widetilde{z}$ and so z_k lies on the straight line passing through z_j and $\widetilde{z}$. □

We need following lemma to extend the inequality (1.8) for complex numbers.

LEMMA 2.1. *Let $Z_1 = \{z_1, z_2, \ldots, z_{n_1}\}$ and $Z_2 = \{z_{n_1+1}, z_{n_1+2}, \ldots, z_{n_1+n_2}\}$ be two sets of complex numbers. Denote by $\widetilde{Z}_i$ and $S^2_{Z_i}$ the arithmetic mean and variance of Z_i's, $i = 1,2$, respectively. Then the combined variance $S^2_{Z_1 \cup Z_2}$ of the set $Z_1 \cup Z_2$ is given by*

$$S^2_{Z_1 \cup Z_2} = \frac{n_1}{n_1+n_2} S^2_{Z_1} + \frac{n_2}{n_1+n_2} S^2_{Z_2} + \frac{n_1 n_2}{(n_1+n_2)^2} \left|\widetilde{Z}_1 - \widetilde{Z}_2\right|^2. \tag{2.6}$$

Proof. The combined variance of the set $Z_1 \cup Z_2$ of $n_1 + n_2$ numbers can be written as

$$S^2_{Z_1 \cup Z_2} = \frac{1}{n_1+n_2} \left(\sum_{j=1}^{n_1} \left|z_j - \widetilde{a}\right|^2 + \sum_{j=n_1+1}^{n_1+n_2} \left|z_j - \widetilde{a}\right|^2 \right), \tag{2.7}$$

where

$$\widetilde{a} = \frac{1}{n_1+n_2} \sum_{j=1}^{n_1+n_2} z_j.$$

We note that

$$\begin{aligned} \left|z_j - \widetilde{a}\right|^2 &= \left|z_j - \widetilde{Z}_1 + \widetilde{Z}_1 - \widetilde{a}\right|^2 \\ &= \left|z_j - \widetilde{Z}_1\right|^2 + \left|\widetilde{Z}_1 - \widetilde{a}\right|^2 + 2\mathrm{Re}\,\overline{\left(\widetilde{Z}_1 - \widetilde{a}\right)} \left(z_j - \widetilde{Z}_1\right), \end{aligned}$$

$$\sum_{j=1}^{n_1} \left(z_j - \widetilde{Z}_1\right) = 0 \text{ and } \left|\widetilde{Z}_1 - \widetilde{a}\right| = \frac{n_2}{n_1+n_2} \left|\widetilde{Z}_1 - \widetilde{Z}_2\right|.$$

Therefore,

$$\sum_{j=1}^{n_1} \left|z_j - \widetilde{a}\right|^2 = \sum_{j=1}^{n_1} \left|z_j - \widetilde{Z}_1\right|^2 + \frac{n_1 n_2^2}{(n_1+n_2)^2} \left|\widetilde{Z}_1 - \widetilde{Z}_2\right|^2. \tag{2.8}$$

On using similar arguments, we have

$$\sum_{j=n_1+1}^{n_1+n_2} \left|z_j-\widetilde{a}\right|^2 = \sum_{j=n_1+1}^{n_1+n_2} \left|z_j-\widetilde{Z}_2\right|^2 + \frac{n_1^2 n_2}{(n_1+n_2)^2}\left|\widetilde{Z}_1-\widetilde{Z}_2\right|^2. \tag{2.9}$$

The assertions of the theorem now follow on using (2.8) and (2.9) in (2.7). □

THEOREM 2.3. *Let γ_r be the arithmetic mean of any subset of r numbers chosen from the set of n complex numbers $z_1, z_2, \ldots, z_n$ and let σ_z^2 be defined as in (1.4). Then the inequality*

$$|\gamma_r - \widetilde{z}|^2 \leqslant \frac{n-r}{r}\sigma_z^2 \tag{2.10}$$

holds true for $1 \leqslant r \leqslant n$.

Proof. Let Z_1 and Z_2 be the disjoint sets of r and $n-r$ numbers chosen from the numbers $z_1, z_2, \ldots, z_n$, respectively. Denote by $S_{z(r)}^2$ and $S_{z(n-r)}^2$ the variance of Z_1 and Z_2, respectively. We now apply Lemma 2.1 and find that

$$S_z^2 = \frac{r}{n}S_{z(r)}^2 + \frac{n-r}{n}S_{z(n-r)}^2 + \frac{r(n-r)}{n^2}|\gamma_r - \gamma_{n-r}|^2 \ . \tag{2.11}$$

Further,

$$|\gamma_r - \gamma_{n-r}| = \left|\gamma_r - \frac{1}{n-r}\left(\sum_{i=1}^{n} z_i - \sum_{i=1}^{r} z_i\right)\right| = \left|\frac{n}{n-r}(\gamma_r - \widetilde{z})\right|$$

and therefore (2.11) can be written as

$$S_z^2 = \frac{r}{n}S_{z(r)}^2 + \frac{n-r}{n}S_{z(n-r)}^2 + \frac{r}{n-r}|\gamma_r - \widetilde{z}|^2 \ . \tag{2.12}$$

On using similar arguments, we have

$$S^2 = \frac{r}{n}S_r^2 + \frac{n-r}{n}S_{n-r}^2 + \frac{r}{n-r}(\gamma_r - \widetilde{z})^2 \ . \tag{2.13}$$

On applying triangle inequality we find from (2.13) that

$$\left|S^2\right| \geqslant \frac{r}{n-r}|\gamma_r - \widetilde{z}|^2 - \left|\frac{r}{n}S_r^2 + \frac{n-r}{n}S_{n-r}^2\right|. \tag{2.14}$$

From (2.12) and (2.14), we get that

$$\left|S^2\right| + S_z^2 \geqslant \frac{2r}{n-r}|\gamma_r - \widetilde{z}|^2 + \frac{r}{n}S_{z(r)}^2 + \frac{n-r}{n}S_{z(n-r)}^2 - \left|\frac{r}{n}S_r^2 + \frac{n-r}{n}S_{n-r}^2\right| \ . \tag{2.15}$$

Again by triangle inequality, $S_{z(r)}^2 \geqslant \left|S_r^2\right|$, $S_{z(n-r)}^2 \geqslant \left|S_{n-r}^2\right|$ and therefore

$$\frac{r}{n}S_{z(r)}^2 + \frac{n-r}{n}S_{z(n-r)}^2 \geqslant \frac{r}{n}\left|S_r^2\right| + \frac{n-r}{n}\left|S_{n-r}^2\right| \geqslant \left|\frac{r}{n}S_r^2 + \frac{n-r}{n}S_{n-r}^2\right|. \tag{2.16}$$

The inequality (2.10) now follows from (2.15) and (2.16). □

The inequality (2.10) is an extension of Mallows and Richter inequality [11]. For $r = 1$, we obtain the generalisation of the well known Samuelson's inequality [20],

$$\sigma_z^2 \geqslant \frac{1}{n-1}\left|z_j - \widetilde{z}\right|^2.$$

Likewise, we can prove the following extension of Nagy's inequality [13],

$$\sigma_z^2 \geqslant \frac{1}{2n}\max_{j,k}\left|z_j - z_k\right|^2, \quad j,k = 1,2,\ldots,n. \tag{2.17}$$

Note that for $r = 1$, $S_1 = 0$ and therefore from (2.13) on using triangle inequality we get that

$$\left|S_{n-1}^2\right| \leqslant \frac{n}{n-1}\left|S^2\right| + \frac{n}{(n-1)^2}\left|\widetilde{z} - z_j\right|^2.$$

Similarly, from (2.12), we have

$$S_{z(n-1)}^2 = \frac{n}{n-1}S_z^2 - \frac{n}{(n-1)^2}\left|\widetilde{z} - z_j\right|^2$$

and by addition we obtain the inequality

$$\sigma_{z(n-1)}^2 = \frac{|S_{n-1}|^2 + S_{z(n-1)}^2}{2} \leqslant \frac{n}{n-1}\sigma_z^2.$$

It then follows inductively that the inequality

$$\sigma_{z(m)}^2 \leqslant \frac{n}{m}\sigma_z^2,$$

holds true for $m = 1,2,\ldots,n$ and therefore for $m = 2$, we have

$$\sigma_z^2 \geqslant \frac{2}{n}\sigma_{z(2)}^2 = \frac{1}{2n}\left|z_i - z_j\right|^2 \tag{2.18}$$

for all $i,j = 1,2,\ldots,n$, $i \neq j$. The inequality (2.18) implies (2.17). Also, see [24].

THEOREM 2.4. *For* $0 \leqslant a < \overline{x} \leqslant s$, *we have*

$$s^2 + \left(\frac{s^2 - \overline{x}^2}{2\overline{x}}\right)^2 \leqslant \frac{(b-a)^2}{4} \tag{2.19}$$

and with $n \geqslant 3$

$$s^2 - \frac{2}{n-2}\left(\frac{s^2 - \overline{x}^2}{2\overline{x}}\right)^2 \geqslant \frac{(b-a)^2}{2n}. \tag{2.20}$$

Proof. The second inequality (1.11) implies that

$$\overline{x}^2 \leqslant (a+b)\overline{x} - ab - s^2,$$

and therefore for $0 \leqslant a < \overline{x}$, we can write

$$\overline{x} \leqslant \frac{a+b}{2} - \frac{s^2 - \overline{x}^2 + ab}{2\overline{x}} \leqslant \frac{a+b}{2} - \frac{s^2 - \overline{x}^2}{2\overline{x}} = \alpha \text{ (say)}. \tag{2.21}$$

It is clear that $\alpha \leqslant \frac{a+b}{2}$ and since $f(x) = (x-a)(b-x)$ increases in the interval $\left[a, \frac{a+b}{2}\right], a < b$, we find that

$$(\overline{x}-a)(b-\overline{x}) \leqslant (\alpha - a)(b-\alpha) = \frac{(b-a)^2}{4} - \left(\frac{s^2-\overline{x}^2}{2\overline{x}}\right)^2. \tag{2.22}$$

Combining (2.22) and the second inequality (1.11); we immediately get (2.19).

Further, it follows from (2.21) that for $0 < \overline{x} \leqslant s$,

$$\left(\frac{a+b}{2} - \overline{x}\right)^2 \geqslant \left(\frac{s^2-\overline{x}^2}{2\overline{x}}\right)^2. \tag{2.23}$$

Combining (2.23) with the first inequality (1.11); a little computation leads to (2.20). □

It may be noted here that the inequality (2.19) can equivalently be written as

$$\frac{m_2'}{\overline{x}} \leqslant b - a, \tag{2.24}$$

where $m_2' = s^2 + \overline{x}^2$.

We mention an alternative proof of (2.24). From the second inequality (1.11),

$$\frac{m_2'}{\overline{x}} \leqslant \frac{(a+b)\overline{x} - ab}{\overline{x}}, \ \overline{x} > 0. \tag{2.25}$$

Also, for $0 \leqslant a < \overline{x} \leqslant s$, from the inequality (1.5), we have $\overline{x} \leqslant s \leqslant \frac{b-a}{2} \leqslant \frac{b}{2}$ and for $\overline{x} \leqslant \frac{b}{2}$,

$$\frac{(a+b)\overline{x} - ab}{\overline{x}} \leqslant b - a. \tag{2.26}$$

The inequality (2.24) follows from (2.25) and (2.26).

THEOREM 2.5. *For $a < 0$ and $\overline{x} \geqslant \sqrt{\frac{n}{2}}s$, we have*

$$s^2 + \left(\frac{\overline{x}^2 - \frac{n}{2}s^2}{2\overline{x}}\right)^2 \leqslant \frac{(b-a)^2}{4} \tag{2.27}$$

and with $n \geqslant 3$,

$$s^2 - \frac{2}{n-2}\left(\frac{\overline{x}^2 - \frac{n}{2}s^2}{2\overline{x}}\right)^2 \geqslant \frac{(b-a)^2}{2n}. \tag{2.28}$$

Proof. We write (1.9) in the form

$$s^2 \geqslant \frac{(b-\overline{x}+\overline{x}-a)^2}{2n} = \frac{(b-\overline{x})^2+(\overline{x}-a)^2+2(b-\overline{x})(\overline{x}-a)}{2n}. \tag{2.29}$$

Using arithmetic mean - geometric mean inequality,

$$(b-\overline{x})^2+(\overline{x}-a)^2 \geqslant 2(b-\overline{x})(\overline{x}-a). \tag{2.30}$$

Thus, from (2.29) and (2.30),

$$s^2 \geqslant \frac{2}{n}(b-\overline{x})(\overline{x}-a). \tag{2.31}$$

It follows from (2.31) that

$$\overline{x}^2 \geqslant (a+b)\overline{x} - \frac{n}{2}s^2 - ab$$

and consequently, for $a<0$ and $\overline{x}>0$, we have

$$\overline{x} \geqslant \frac{a+b}{2} + \frac{1}{2\overline{x}}\left(\overline{x}^2 - \frac{n}{2}s^2 - ab\right) \geqslant \frac{a+b}{2} + \frac{1}{2\overline{x}}\left(\overline{x}^2 - \frac{n}{2}s^2\right) = \beta \text{ (say)}. \tag{2.32}$$

It is clear that $\beta \geqslant \frac{a+b}{2}$ for $\overline{x} \geqslant \sqrt{\frac{n}{2}}s$ and since $f(x)=(\overline{x}-a)(b-\overline{x})$ decreases in the interval $\left[\frac{a+b}{2}, b\right], a<b$, we find that

$$(b-\overline{x})(\overline{x}-a) \leqslant \left(\frac{b-a}{2}\right)^2 - \left(\frac{\overline{x}^2 - \frac{n}{2}s^2}{2\overline{x}}\right)^2. \tag{2.33}$$

Combining (2.33) with the second inequality (1.11); we immediately get (2.27).

From (2.33), we also have

$$\left(\overline{x} - \frac{a+b}{2}\right)^2 \geqslant \left(\frac{\overline{x}^2 - \frac{n}{2}s^2}{2\overline{x}}\right)^2. \tag{2.34}$$

The inequality (2.28) follows from (2.34) and the first inequality (1.11). □

Sharma et al. [22] have proved that

$$m_4 + 3m_2^2 \leqslant (b-a)^2(\overline{x}-a)(b-\overline{x}), \tag{2.35}$$

where $m_2 = s^2$ and $m_4 = \frac{1}{n}\sum_{i=1}^{n}(x_i-\overline{x})^4$.

If the distribution is Leptokurtic or Mesokurtic, we have, see [10],

$$\frac{m_4}{m_2^2} \geqslant 3. \tag{2.36}$$

We prove a refinement of the inequality (1.5) in the following theorem.

THEOREM 2.6. *For a Leptokurtic and Mesokurtic distribution, we have*

$$s^2 \leqslant (b-a)\sqrt{\frac{(\overline{x}-a)(b-\overline{x})}{6}} \leqslant \frac{(b-a)^2}{2\sqrt{6}}. \tag{2.37}$$

Proof. Under the assumptions of the theorem the inequalities (2.35) and (2.36) hold true. By (2.36), $3s^4 \leqslant m_4$ and we obtain from (2.35) that

$$6s^4 \leqslant (b-a)^2(\overline{x}-a)(b-\overline{x}). \tag{2.38}$$

This gives the first inequality (2.37). The second inequality (2.37) follows from (2.38) on using arithmetic mean - geometric mean inequality, $(\overline{x}-a)(b-\overline{x}) \leqslant \frac{(b-a)^2}{4}$. □

We remark that the inequalities (2.37) also hold true for both discrete and continuous distributions.

3. Bounds for eigenvalues

Let $\mathbb{M}(n)$ denote the algebra of all complex $n \times n$ matrices. We assume that the eigenvalues $\lambda_i(A)$ of $A = (a_{ij}) \in \mathbb{M}(n)$ are all real, and may respectively define their arithmetic mean and variance to be

$$\overline{\lambda}(A) = \frac{1}{n}\sum_{i=1}^{n}\lambda_i(A) = \frac{\mathrm{tr}A}{n} \tag{3.1}$$

and

$$s_\lambda^2 = \frac{1}{n}\sum_{i=1}^{n}\left(\lambda_i(A) - \overline{\lambda}(A)\right)^2 = \frac{\mathrm{tr}A^2}{n} - \left(\frac{\mathrm{tr}A}{n}\right)^2 = \frac{\mathrm{tr}B^2}{n}, \tag{3.2}$$

where $B = A - \frac{\mathrm{tr}A}{n}I$.

The spread of a matrix is the greatest distance between its eigenvalues. The notion of the spread was introduced by Mirsky [14, 15] and several authors have studied bounds for the spread of a matrix, see [6, 8, 13, 24].

THEOREM 3.1. *If trace of a unitary matrix $U \in \mathbb{M}(n)$ is zero then the unit circle is the smallest circle enclosing the eigenvalues of U, and greatest lower bound on the $Spd(U)$ is $\sqrt{3}$.*

Proof. The eigenvalues of a unitary matrix U all lie on the unit circle and by assumption of the theorem $\mathrm{tr}U = 0$. So, the eigenvalues $\lambda_i(U)$'s satisfy the conditions of the Theorem 2.1 and hence the unit circle is the smallest circle containing $\lambda_i(U)$'s. It also follows from the second inequality (1.7) that $\mathrm{Spd}(U) \geqslant \sqrt{3}$. □

EXAMPLE 1. The basic circulant matrix C with first row $(0,1,0\ldots,0)$ is a unitary matrix and its trace is zero. By Theorem 3.1 the unit disk is the smallest disk containing eigenvalues of C and $\mathrm{Spd}C \geqslant \sqrt{3}$. Also, for $n = 3$ we have $\mathrm{Spd}C = \sqrt{3}$.

The following theorem is a consequence of Theorem 2.4 and provides refinements of the inequalities (1.10).

THEOREM 3.2. *Let the eigenvalues of an element $A \in \mathbb{M}(n)$ be all non negative and let $0 < \mathrm{tr}A \leqslant \left(n\mathrm{tr}B^2\right)^{\frac{1}{2}}$. Then*

$$\mathrm{Spd}(A) \geqslant \frac{\mathrm{tr}A^2}{\mathrm{tr}A} \tag{3.3}$$

and with $n \geqslant 3$,

$$\mathrm{Spd}(A) \leqslant \frac{1}{\mathrm{tr}A}\left(2\mathrm{tr}B^2(\mathrm{tr}A)^2 - \frac{\left(n\mathrm{tr}B^2 - (\mathrm{tr}A)^2\right)^2}{n(n-2)}\right)^{\frac{1}{2}}. \tag{3.4}$$

Proof. Under the condition $\mathrm{tr}A \leqslant \left(n\mathrm{tr}B^2\right)^{\frac{1}{2}}$, we have

$$\overline{\lambda}(A) = \frac{\mathrm{tr}A}{n} \leqslant \left(\frac{1}{n}\mathrm{tr}B^2\right)^{\frac{1}{2}} = \left(\frac{\mathrm{tr}A^2}{n} - \left(\frac{\mathrm{tr}A}{n}\right)^2\right)^{\frac{1}{2}} = s_\lambda. \tag{3.5}$$

Further, the eigenvalues of A are all non-negative, therefore $0 < \lambda_{\min}(A) \leqslant \overline{\lambda}(A) \leqslant s_\lambda$ and $\mathrm{Spd}(A) = \lambda_{\max}(A) - \lambda_{\min}(A)$. So we can apply Theorem 2.4, the inequalities (3.3) and (3.4) follow on using (3.1) and (3.2) in (2.19) and (2.20), respectively. □

EXAMPLE 2. Let

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 4 & 1 & 1 \\ 1 & 1 & 16 & 1 \\ 1 & 1 & 1 & 100 \end{bmatrix}.$$

From (1.10), $81.393 \leqslant \mathrm{Spd}(A) \leqslant 115.11$. The matrix A is positive definite and $\mathrm{tr}A \leqslant \left(n\mathrm{tr}B^2\right)^{\frac{1}{2}}$. So, from our bounds (3.3) and (3.4) we have better estimate $85 \leqslant \mathrm{Spd}(A) \leqslant 104.90$.

Likewise, we can obtain another refinement of the inequality (1.10) on applying Theorem 2.5. If $\lambda_{\min}(A) < 0$ and $0 < 2(\mathrm{tr}A)^2 \geqslant n^2\mathrm{tr}B^2$, then

$$\mathrm{Spd}(A) \geqslant \frac{1}{2n\mathrm{tr}A}\left(16n\mathrm{tr}B^2(\mathrm{tr}A)^2 + \left(2(\mathrm{tr}A)^2 - n^2\mathrm{tr}B^2\right)^2\right)^{\frac{1}{2}} \tag{3.6}$$

and for $n \geqslant 3$,

$$\mathrm{Spd}(A) \leqslant \frac{1}{\mathrm{tr}A}\left(2\mathrm{tr}B^2(\mathrm{tr}A)^2 - \frac{\left(2(\mathrm{tr}A)^2 - n^2\mathrm{tr}B^2\right)^2}{4n(n-2)}\right)^{\frac{1}{2}}. \tag{3.7}$$

Further, Wolkowicz and Styan [23] have shown that if the eigenvalues of $A \in \mathbb{M}(n)$ are all real and $\lambda_1(A) \leqslant \lambda_i(A) \leqslant \lambda_n(A)$, $i = 1, 2, \ldots, n$, then

$$\frac{\mathrm{tr}A}{n} - \sqrt{\frac{n-1}{n}\mathrm{tr}B^2} \leqslant \lambda_1(A) \leqslant \frac{\mathrm{tr}A}{n} - \sqrt{\frac{1}{n(n-1)}\mathrm{tr}B^2} \tag{3.8}$$

and

$$\frac{\mathrm{tr}A}{n}+\sqrt{\frac{1}{n(n-1)}\mathrm{tr}B^2}\leqslant\lambda_n(A)\leqslant\frac{\mathrm{tr}A}{n}+\sqrt{\frac{n-1}{n}\mathrm{tr}B^2}. \tag{3.9}$$

The inequalities (3.8) and (3.9) follow respectively from the inequalities, [7, 20],

$$\overline{x}-\sqrt{n-1}s\leqslant\min_i x_i\leqslant\overline{x}-\frac{s}{\sqrt{n-1}} \tag{3.10}$$

and

$$\overline{x}+\frac{s}{\sqrt{n-1}}\leqslant\max_i x_i\leqslant\overline{x}+\sqrt{n-1}s. \tag{3.11}$$

We now discuss extensions of these inequalities for the case when any one eigenvalue of A is known as in case of stochastic and singular matrices.

It is clear from Lemma 2.1 that if s_{n-1}^2 is the variance of $n-1$ numbers obtained by excluding a number x_j from the real numbers $x_1,x_2,\ldots,x_n$, then

$$s_{n-1}^2=\frac{n}{n-1}s^2-\frac{n}{(n-1)^2}\left(\overline{x}-x_j\right)^2. \tag{3.12}$$

THEOREM 3.3. *Let the eigenvalues of $A\in\mathbb{M}(n)$ be all real. Let $\nu(A)$ be an eigenvalue of A and denote the remaining eigenvalues by $\nu_i(A)$, $\nu_1(A)\leqslant\nu_i(A)\leqslant\nu_{n-1}(A)$, $i=1,2,\ldots,n-1$. Then, for $n\geqslant 3$,*

$$\frac{\mathrm{tr}A-\nu(A)}{n-1}-\sqrt{n-2}s_\nu\leqslant\nu_1(A)\leqslant\frac{\mathrm{tr}A-\nu(A)}{n-1}-\frac{s_\nu}{\sqrt{n-2}} \tag{3.13}$$

and

$$\frac{\mathrm{tr}A-\nu(A)}{n-1}+\frac{s_\nu}{\sqrt{n-2}}\leqslant\nu_n(A)\leqslant\frac{\mathrm{tr}A-\nu(A)}{n-1}+\sqrt{n-2}s_\nu. \tag{3.14}$$

Proof. The arithmetic mean $\overline{\nu}(A)$ of $n-1$ eigenvalues $\nu_i(A)$ can be written as

$$\overline{\nu}(A)=\frac{1}{n-1}\sum_{i=1}^{n-1}\nu_i(A)=\frac{\mathrm{tr}A-\nu(A)}{n-1}. \tag{3.15}$$

By the use of (3.12) the variance of these eigenvalues is

$$\begin{aligned}s_\nu^2&=\frac{1}{n-1}\sum_{i=1}^{n-1}\left(\nu_i(A)-\overline{\nu}(A)\right)^2=\frac{n}{n-1}s_\lambda^2-\frac{n}{(n-1)^2}\left(\overline{\lambda}(A)-\nu(A)\right)^2\\&=\frac{\mathrm{tr}B^2}{n-1}-\frac{n}{(n-1)^2}\left(\frac{\mathrm{tr}A}{n}-\nu(A)\right)^2.\end{aligned} \tag{3.16}$$

On applying (3.10) to $n-1$ numbers $\nu_1(A),\nu_2(A),\ldots,\nu_{n-1}(A)$ and using (3.15) and (3.16); we immediately get (3.13). Likewise, (3.14) follows from (3.11). □

THEOREM 3.4. *Under the conditions of Theorem 3.3., we have*

$$\max_{i,j} \left| \nu_i(A) - \nu_j(A) \right|^2 \leqslant 2 \left(\mathrm{tr}B^2 - \frac{n}{n-1} \left(\frac{\mathrm{tr}A}{n} - \nu(A) \right)^2 \right) \tag{3.17}$$

and

$$\max_{i,j} \left| \nu_i(A) - \nu_j(A) \right|^2 \geqslant \frac{4}{n-1} \left(\mathrm{tr}B^2 - \frac{n}{n-1} \left(\frac{\mathrm{tr}A}{n} - \nu(A) \right)^2 \right). \tag{3.18}$$

Proof. On using the inequalities (1.5) and (1.9), for $n-1$ numbers $\nu_1(A), \nu_2(A), \ldots, \nu_{n-1}(A)$, we have

$$4s_\nu^2 \leqslant \max_{i,j} \left| \nu_i(A) - \nu_j(A) \right|^2 \leqslant 2(n-1)s_\nu^2. \tag{3.19}$$

Inserting (3.16) in (3.19), we immediately get (3.17) and (3.18) on simplifications. □

EXAMPLE 3. Let

$$A = \begin{bmatrix} 1 & 2 & 9 & 4 \\ 2 & 10 & 0 & 4 \\ 9 & 0 & 5 & 2 \\ 4 & 4 & 2 & 6 \end{bmatrix}.$$

From the inequalities (3.8), we have $-9.0688 \leqslant \lambda_1(A) \leqslant .644$. The largest eigenvalue of A is 16 as all its row sums are 16 and A is a symmetric matrix. From (3.13) we have better estimate for the smallest root, $-7.521 \leqslant \lambda_1(A) \leqslant -2.7610$. The actual value of $\lambda_1(A)$ to four decimal places is -6.5788.

We now consider polynomials with real zeros. Let f be a monic polynomial

$$f(x) = x^n + a_1 x^{n-1} + a_2 x^{n-2} + \ldots + a_n \tag{3.20}$$

with only real zeros. Then the length $b-a$ of the smallest interval $[a,b]$ containing all the zeros of f is called span of f, see [12, 19]. Denote by D_n the span of f then

$$\frac{2}{n}\sqrt{(n-1)a_1^2 - 2na_2} \leqslant D_n \leqslant \sqrt{2\frac{n-1}{n}a_1^2 - 4a_2}. \tag{3.21}$$

See Corollary 6.1.4 and Theorem 6.1.6 in [19].

We prove a refinement of (3.21) in the following theorem.

THEOREM 3.5. *Let the zeros of the polynomial (3.20) be all non-negative and let* $2na_2 \leqslant (n-2)a_1^2$. *Then*

$$D_n \geqslant \frac{2a_2 - a_1^2}{a_1} \tag{3.22}$$

and with $n \geqslant 3$,

$$D_n \leqslant \sqrt{\frac{2}{n}\left((n-1)a_1^2 - 2na_2\right) - \frac{1}{n(n-2)}\left(\frac{2na_2 - (n-2)a_1^2}{a_1}\right)^2}. \tag{3.23}$$

Proof. Let $x_1, x_2, \ldots, x_n$ be the roots of the polynomial (3.20). Then, on using relation between roots and coefficient of polynomial, we have

$$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i = \frac{-a_1}{n}$$

and

$$\begin{aligned} s^2 &= \frac{1}{n}\sum_{i=1}^{n} x_i^2 - \overline{x}^2 = \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2 - \frac{2}{n}\sum_{i<j}^{n} x_i x_j - \overline{x}^2 \\ &= \frac{(n-1)a_1^2 - 2na_2}{n^2}. \end{aligned}$$

The assertions of the theorem now follow on applying Theorem 2.4. □

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Indian Journal of Pure and Applied Mathematics: A Bibliometric Survey, 1998-2017

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Abstract

The study describes and analyses key bibliometric patterns of 20370 citations appended to 1561 research articles published in Indian Journal of Pure and Applied Mathematics during 1998-2017.A demographic analysis is done to comprehend the chronological growth and authorship pattern ofIndian and foreign contributors associated with different educational and research institutes of the world. Further geographical distribution (nationally and internationally) of contributions along with their pagination is carried out. We have usedtraditional manual data analysis technique to reach at the conclusions.

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ENTROPY GENERATION EFFECT IN MHD FLOW THROUGH A POROUS HORIZONTAL CHANNEL IN THE PRESENCE OF SLIP BOUNDARY CONDITIONS AND POROUS MEDIA

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Abstract: In the present paper, combined effect of magnetic field, porous media and slip flow conditions on the entropy generation in the flow of an incompressible and electrically conducting fluid in an infinite horizontal porous channel under a constant pressure gradient have been carried out. The dimensional ordinary differential equations of motion and energy are transformed to non-dimensional form by using the relevant non-dimensional variables. The exact solutions of governing equations and its numerical calculations have been done by using Matlab function 'bvp4c'. The effect of different governing parameters on velocity, temperature, entropy generation are elaborated with the help of tables and graphs. It is concluded from this study that for increase in the magnetic parameter, slip parameters, group parameter, Brinkmann number, Peclet number and Darcy number, the entropy generation N_s increase near the lower plate whereas the entropy generation decreases with the increase in the Reynold's number.

Keywords: Entropy generation number; Bejan number; Brinkmann number; Peclet number; Reynold's number; Magnetic parameter.

Mathematics Subject Classification: 76D05, 65P99

1. Introduction

The second law of thermodynamics analysis is the basis in the area of heat transfer along with thermal design and the structure given by it correlates the hypothesis of entropy generation minimization. The Clasius and Kelvin studied the aspects of irreversibility of the Second law of Thermodynamics and initiated the knowledge of entropy production [1,8,10]. Bejan [2,7] noticed the sources of entropy generation in the process of conventional heat transfer problem. The author entrenched that during the process of flowing of fluid, the production of entropy was ascribed to the finite differences in velocity gradient and the temperature. In fluid dynamics, due to abnormal accord with the results in

the experiment for a century, the studies fail to mention that no slip condition remains a supposition. However, another approach assumed that fluid can slide over a solid surface. Navier [24] presented the slip of fluid at the solid boundary with the help of general boundary conditions. He gave the proposal that at the solid surface, the velocity is proportional to the shear stress. The concept of slip occurrence has been exhibited by many theoretical and experimental studies like Gbadeyan et al. [14], Mahmoud and Waheed [18], Martin and Boyd [21], Mehmood [22]. They examined that rise in the slip parameter slows down the process of flow of fluid. In a channel with permeable boundaries, the effect of slip conditions on hydromagnetic steady flow in a channel with permeable boundaries were given by Khalid and Wafai [17] and Makinde and Osalusi [19] obtained the solution in closed form for steady periodic and transient velocity field with slip conditions. To look into the irreversibilities in terms of the rate of entropy generation, the second law of thermodynamics is applicable. Bejan [9] worked into the second law of thermodynamics by virtue of entropy generation minimization specifically in the area of thermal science, heat transfer, storage and thermal power conversion. The entropy generation minimization studies has procured significant attention in many energy involving problems including thermal energy, cooling of the modern electronic system, geothermal energy system and solar power collectors. In any thermal process, the study of entropy generation gives a useful technique for determining the irreversibility in any thermal process.

The irreversibility occurrence for a microfluidic flow is due to heat and mass transfer, friction dissipation or chemical reaction. Makinde [20] discussed the Entropy analysis for MHD boundary layer flow and heat transfer over a flat plate with a convective surface boundary condition. Akbar [5] investigated the entropy generation and energy conversion rate for the peristaltic flow in a tube with magnetic field. Different aspects of magnetohydrodynamic flow and thermal conductance phenomena have been carried out by various researchers, for details see [4,6]. Jian [16] studied the MHD flow and entropy generation in microchannel with electroosmotic effects. The analysis of the effects of mixed convection and entropy generation on an MHD nanofluid flow is done by Fersadou et al. [13]. Ibanez et al. [15] assessed the impact of magnetic field and entropy generation on nanofluid flow towards a micro-channel. Nasiri et al. [23] investigated the consequences of the magnetic field on entropy generation towards a microchannel. Shi and Dong [26] have reviewed the entropy generation and heat transfer flow through a microchannel.

The primary objective of the present analysis is to examine the combined effects of magnetic field, suction / injection and Navier slips on entropy generation in a MHD flow through a porous channel under a constant pressure gradient. The solutions in closed form have been obtained for the velocity and temperature of the fluid. The various plots have been displayed which have been obtained with the help of Matlab function ‘bvp4c’ of the solution of given boundary value problem. The effect of different parameters involving in the governing equations of the problem on velocity flow, temperature flow, entropy generation and Bejan number have been studied.

2. Mathematical Formulation of the problem

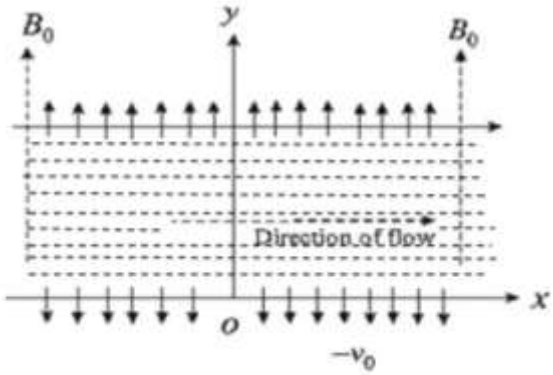

Fig A. Geometrical configuration of the problem

Let us have a viscous incompressible electrically conducting fluid enclosed between two infinite horizontal parallel porous plates at a distance 'h' apart. Let us have x-axis along the lower stationery plate which is also the direction of flow of fluid and y-axis perpendicular to the plates in the cartesian coordinate system. The uniform transverse magnetic field B_0 is in the direction perpendicular to the plates of the channel. Due to the infinite length of the plates, all physical variables excluding pressure are dependant only upon y.

The basic fundamental equations of fluid dynamics then become:

Equation of Continuity:

$v = -v_0$ where $v_0$is the suction velocity at the plates

Equation of Motion:

$$-v_0 \frac{du}{dy} = -\frac{1}{\rho}\frac{\partial \rho}{\partial x} + \upsilon \frac{d^2u}{dy^2} - \sigma \frac{B_0^2}{\rho} u - \frac{\upsilon u}{k} \tag{1}$$

Equation of Energy:

$$-v_0 \frac{dT}{dy} = \frac{k}{\rho C_p}\frac{d^2T}{dy^2} + \frac{\mu}{\rho C_p}\left(\frac{du}{dy}\right)^2 + \lambda \frac{\sigma B_0^2}{\rho C_p} u^2 \tag{2}$$

where μ is the fluid velocity at x-axis, ρ is the fluid density, ν the kinematic viscosity, σ the electrical conductivity of the fluid and p is the fluid pressure, μ is the coefficient of viscosity, k the thermal conductivity, C_p the specific heat at constant pressure, the index λ in the equation (2) is taken equal to 1 for including Joule dissipation.

The relevant boundary conditions are as follows:

$$\mu = \gamma_1 \frac{du}{dy}, T = T_0 \; at \; y = 0$$

$$\mu = \gamma_2 \frac{du}{dy}, T = T_h \; at \; y = h \tag{3}$$

where T is the temperature of the fluid, T_h is the upper plate temperature,T_0 is the lower plate temperature and γ_1 and $\gamma_2$are the slip coefficients.

Non-dimensionalising the equations, we introduce the non-dimensional variables as-

$$\eta = \frac{y}{h}, w_1 = \frac{u}{v_0}, \varphi = \frac{T-T_0}{T_h-T_0} \tag{4}$$

From Eqs. (1) and (2), we then have

$$\frac{d^2w_1}{d\eta^2} + Re\frac{dw_1}{d\eta} - \left(M^2 + \frac{1}{D_a}\right)w_1 = -P \tag{5}$$

$$\frac{d^2\varphi}{d\eta^2} + Pe\frac{d\varphi}{d\eta} + Br\left[\left(\frac{dw_1}{d\eta}\right)^2 + \lambda M^2 w_1^2\right] = 0 \tag{6}$$

here $M^2 = \frac{\sigma B^2 h^2}{\rho v}$ is the magnetic parameter, $Br = \frac{\mu v_0^2}{k(T_h - T_0)}$ the Brinkmann number, $Pe = \frac{v_0 h \rho C_p}{k}$ the Peclet number, $Re = \frac{v_o\ h}{\nu}$ the Reynold's number, $D_a = \frac{k}{h^2}$ is the Darcy number and $P = \frac{h^2}{\rho v v_0}\left(-\frac{\partial p}{\partial x}\right)$ is the non-dimensional pressure gradient.

The boundary conditions for the above problem is:

$$w_1 = \alpha_1 \frac{dw_1}{d\eta}, \varphi = 0\ at\ \eta = 0$$

$$w_1 = \alpha_2 \frac{dw_1}{d\eta}, \varphi = 1\ at\ \eta = 1 \tag{7}$$

where $\alpha_1 = \frac{\gamma_1}{h}$ and $\alpha_2 = \frac{\gamma_2}{h}$ are the slip parameters.

The solutions of the equations subject to these boundary conditions are given by -

$$w_1(\eta) = \frac{P}{(M^2 + \frac{1}{D_a})} + (A\cosh n\eta + B\sinh n\eta)e^{\frac{-Re}{2}\eta} \tag{8}$$

where $n = \frac{[Re^2 + 4(M^2 + \frac{1}{D_a})]^{1/2}}{2}$

The solution given by the Eq. (8) is applied for both Re< 0 (for the blowing at the plates $v_0 < 0$) and $Re > 0$ (for the suction at the plates $v_0 > 0$).

By solving equation (8), equation (6) becomes

$$\frac{d^2\varphi}{d\eta^2} + Pe\ \frac{d\varphi}{d\eta} = -Br[e^{-Re\eta}\{A_1 + \frac{1}{2}(A_4\cosh 2n\eta + A_5\sinh 2n\eta)\} + \frac{2\lambda P}{\left(1+\frac{1}{D_a M^2}\right)}e^{\frac{-Re}{2}\eta}(A\cosh n\eta + B\sinh n\eta) + \frac{\lambda P^2}{(1+\frac{1}{D_a M^2})^2}] \tag{9}$$

Solution of the equation (11) subject to the boundary conditions is -

$$\varphi(\eta) = c_1 + c_2 e^{-Pe\eta} - Br\left[e^{-Re\eta}\left\{A_8 + \frac{1}{2}(A_4\cosh 2n\eta + A_5\sinh 2n\eta) + \frac{\lambda P e^{\frac{-Re}{2}\eta}}{(1+\frac{1}{D_a M^2})}(A_6\cosh n\eta + A_7\sinh n\eta) - \frac{\lambda P^2}{Pe(1+\frac{1}{D_a M^2})}\eta\right\}\right] \tag{10}$$

3. Discussion of the results

The rate of heat transfer at the plates $\eta = 0$ and $\eta = 1$ are procured as -

$$\varphi'(0) = -c_2 \mathrm{Pe} + \mathrm{Br}\left[\left\{\mathrm{ReA}_8 + \left(\mathrm{Re}\frac{\mathrm{A}_4}{2} + 2\mathrm{n}\frac{\mathrm{A}_5}{2}\right)\right\} + \frac{\lambda \mathrm{P}}{\left(1+\frac{1}{\mathrm{D_a M^2}}\right)}\left(\mathrm{nA}_7 - \frac{\mathrm{Re}}{2}\mathrm{A}_6\right) + \frac{\lambda \mathrm{P}^2}{\mathrm{Pe}\left(1+\frac{1}{\mathrm{D_a M^2}}\right)^2}\right] \quad (11)$$

$$\varphi'(1) = -c_2 Pe\, e^{-Pe} + Br\left[e^{-Re}\left\{ReA_8 + \left(Re\frac{A_4}{2} + 2n\frac{A_5}{2}\right)\cosh 2n + \left(Re\frac{A_5}{2} + 2n\frac{A_4}{2}\right)\sinh 2n\right\} - \frac{\lambda Pe^{\frac{-Re}{2}}}{\left(1+\frac{1}{D_a M^2}\right)}\left\{\left(\frac{1}{2}ReA_6 + nA_7\right)\cosh n + \left(\frac{1}{2}ReA_7 + nA_6\right)\sinh n\right\} + \frac{\lambda P^2}{Pe\,(1+\frac{1}{D_a M^2})}\right] \quad (12)$$

All the constants used above have been given in the appendix.

Table 1 :-Rate of heat transfer at the plates $\eta = 0$ and $\eta = 1$ when $Br = 2, \alpha_1 = 0.1, \alpha_2 = 0.1, Pe = 3$ and $D_a = 0.2$

R/M^2	$\varphi'(0)$				$\varphi'(1)$			
	5	10	15	20	5	10	15	20
0.5	3.3462	3.2283	3.2166	5.2289	-0.1115	-0.0168	-0.0992	-12.5320
1.0	3.3376	3.2232	3.2072	5.0843	-0.0752	-0.0074	-0.0475	-11.6497
1.5	3.3297	3.2190	3.2002	3.6512	-0.0446	0.0272	-0.0098	-2.7874
2.0	3.3222	3.2154	3.1949	3.3828	-0.0188	0.0435	0.0185	-1.1486

Table 2 :-Rate of heat transfer at the plates $\eta = 0$ and $\eta = 1$ when $Re = 2, \alpha_1 = 0.1, \alpha_2 = 0.1, M^2 = 5$ and $D_a = 0.2$

Br/Pe	$\varphi'(0)$				$\varphi'(1)$			
	4	6	8	10	4	6	8	10
0.2	4.1354	6.1657	8.2875	10.4639	0.0428	-0.0426	-0.0829	-0.1149
0.4	4.1962	6.3166	8.5724	10.9274	0.0110	-0.1001	-0.1685	-0.2302
0.6	4.2570	6.4674	8.8572	11.3908	-0.0209	-0.1577	-0.2540	-0.3455
0.8	4.3177	776.6182	9.1421	11.8543	-0.0527	-0.2152	-0.3396	-0.4608

Table 3:-Rate of Heat transfer at the plates $\eta = 0$ and $\eta = 1$ when $Re = 2, Pe = 3, Br = 1, M^2 = 5$ and $D_a = 0.2$

α_1/α_2	$\varphi'(0)$				$\varphi'(1)$			
	0.2	**0.5**	**0.8**	**1.1**	**0.2**	**0.5**	**0.8**	**1.1**
0.3	3.3453	5.2264	3.6816	3.5594	-0.0810	-2.2341	-0.2162	-0.0814
0.5	3.3523	5.2354	3.6852	3.5632	-0.0835	-2.2588	-0.2194	-0.0836
0.7	3.3576	5.2462	3.6903	3.5682	-0.0850	-2.2730	-0.2214	-0.0850
0.9	3.3616	5.2533	3.6949	3.5725	-0.0860	-2.2823	-0.2227	-0.0859

The rate of heat transfer $\varphi'(0)$ and $\varphi'(1)$ is displayed in Tables 1 to 3 numerically for various values of different parameters such as M^2, Re, Br, Pe, D_a, α_1 and α_2. From Table 1, it is noticed that the rate of heat transfer $\varphi'(0)$ decreases with an increase in Reynold's number Re while for increase in magnetic parameter M^2, it decreases near the surface and it increases away from the surface. Also, it can be seen that the rate of heat transfer $\varphi'(1)$ at the plate $\eta = 1$ increases as the Reynold's number Re increases and decreases as the magnetic parameter M^2 decreases. From Table 2, we find that the rate of heat transfer increases for increase in the both Brinkmann number (Br) and the Peclet number(Pe) at the plates η=0. On the other hand, at the plates η=1, the rate of heat transfer decreases for the increase in Brinkmann number(Br) as well as the Peclet number Pe. From Table 3, it is expressed that the rate of heat transfer at the plate η=0 increases with an increase in slip parameter α_1 whereas for the slip parameter α_2, the rate of heat transfer increases near the plate and decreases away from the plate. The rate of heat transfer $\varphi'(1)$ at the plate η=1 shows a decrease with the increase in the slip parameter α_1 and for the increase in the slip parameter α_2, it decreases near the plate and increases away from the plate.

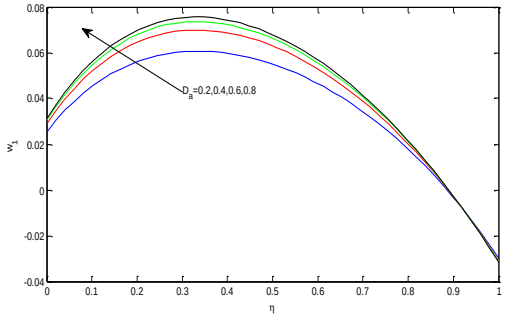

Figure 1 Velocity profiles for different D_a when $M^2 = 5$, $\alpha_1 = 0.1$,$\alpha_2 = 0.1$, $Re = 2$ and $D_a = 0.2$

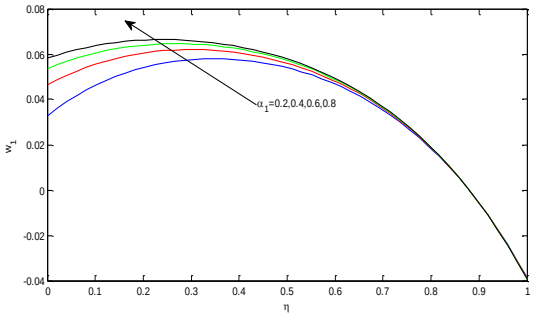

Figure 2 Velocity profiles for different α_1 when $M^2 = 5$, $\alpha_2 = 0.1$, $Re = 0.5$ and $D_a = 0.2$

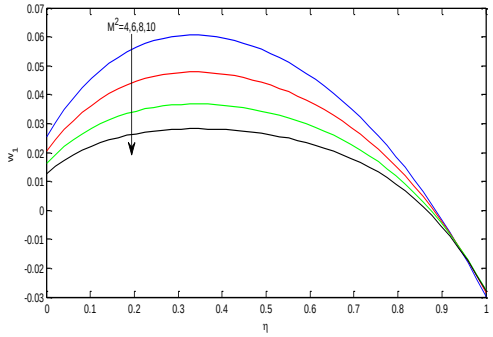

Figure 3 Velocity profiles for different M^2 when $Re = 2, \alpha_1 = 0.1$,$\alpha_2 = 0.1$ and $D_a = 0.2$

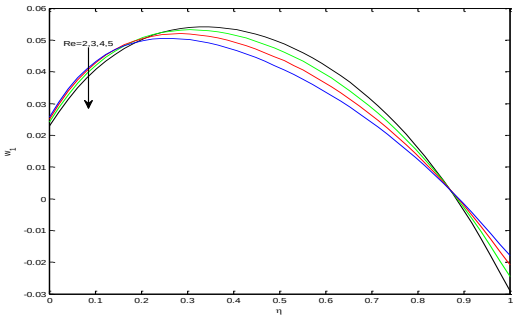

Figure 4 Velocity profiles for different Re when $M^2 = 5$, $\alpha_1 = 0.1$,$\alpha_2 = 0.1$ and $D_a = 0.2$

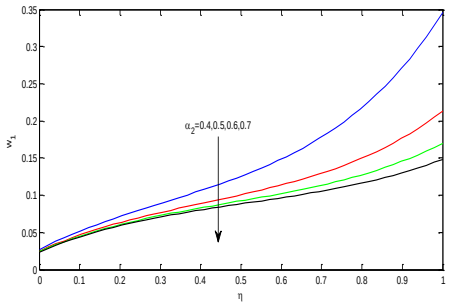

Figure 5 Velocity profiles for different α_2 when $M^2 = 5$, $\alpha_1 = 0.1, Re = 0.1$ and $D_a = 0.2$

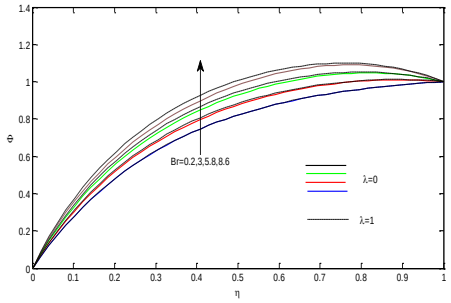

Figure 6 Temperature profiles for different Br when $Re = 2, D_a = 0.2$ and $Pe = 3$

The non-dimensional velocity w_1 has been plotted against η the space coordinate for studying the effects of magnetic field and Reynold's number on the velocity. It is seen from figures (1 to 5) that the velocity of the fluid shows an increase with the increase in the Darcy number (D_a) and slip parameter(α_1) while for the magnetic parameter (M^2), Reynold's number(Re) and slip parameter (α_2), it diminishes. The Lorentz force causes the resistance to the flow of the fluid resulting in the decrease in the fluid velocity. The larger is the value of the Reynold's number, the higher is the strength of suction/injection showing a decrease in the velocity of the fluid as represented in Figure 2.

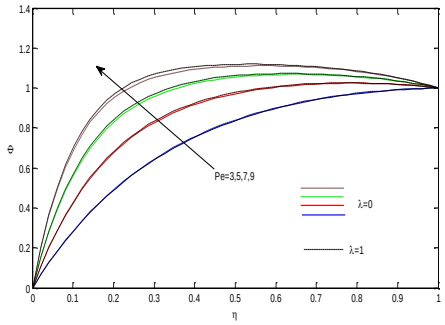

Figure 7 Temperature profiles for different Pe when $Br = 1, D_a = 0.2$ and $Re = 2$

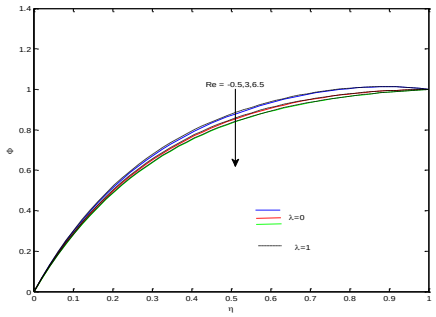

Figure 8 Temperature profiles for different Re when $Br = 1, Pe = 3$ and $D_a = 0.2$

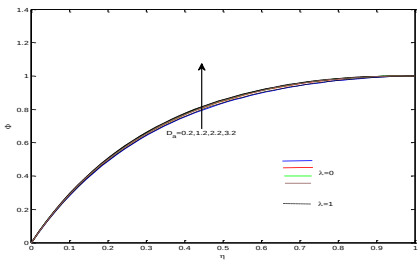

Figure 9 Temperature profiles for different D_a when $Br = 1, Pe = 3$ and $Re = 2$

In case of the temperature profiles, the temperature of the fluid has been displayed in the figures(6 to 9). From the graphs, it is evident that the temperature of the fluid increases with the increase in the Brinkmann number(Br) and Peclet number(Pe) whereas the temperature decreases with the decrease in the Reynold's number (Re). Darcy number(D_a) don't have any significant effect on the temperature field as illustrated in Figure 9.

5. Entropy Generation

Physically, entropy is the disorder of a system and the surrounding.In microscopic level, it occurs when heat transfer occurs because heat is a energy, when it moves some additional movement happens eg molecular friction, molecular vibration, internal displacement of molecule, spin moment, kinetic energy etc. which make loses useful heat, thus heat can't be transformed fully into work. This additional movements create chaos in the system and the surroundings, that's why sometimes entropy is called the measure of the chaos. For this, microscopic chaos results in macroscopic level which occurs because some unnecessary irreversibilities eg friction, mixing of fluids, electric resistance, inelastic deformation of solids, chemical reaction and unnecessary heat transfer in finite temperature difference. Noting that such kind of energy loss can't be regained so system and surrounding can't come to its initial state without extra work done on it. Therefore, Entropy is called the measure of irreversibilities.For this cause, heat can't be transformed fully into work. In real life, all sort of process has this kind of macroscopic and microscopic loss. So in reality each and every thermodynmanic process is an irreversible process. So in reality each and every thermodynamic process is an irreversible process.

Entropy generation occurs due to irreversiblity of process or in simple terms due to irreversibility of process or in simple terms due to friction associated during the process. Entropy generation is zero for reversible process. Woods[27] has indicated the local volumetric rate of entropy generation for a viscous incompressible conducting fluid in the presence of magnetic field as:

$$E_G = \frac{k}{{T_0}^2}\left(\frac{dT}{dy}\right)^2 + \frac{\mu}{T_0}\left(\frac{du}{dy}\right)^2 + \lambda\frac{\sigma B_0^2}{T_0}u^2 \tag{13}$$

The entropy generation above comprises of three terms, the first one is the irreversibility due to the heat transfer, the second one is the entropy generation due to viscous dissipation and the last one is local entropy generation due to the effect of magnetic field. (Joule heating or Ohmic heating)

The entropy generation number in dimensionless form is given as:

$$N_s = \frac{T_0^2 h^2 E_G}{k(T_h - T_{0)}} \tag{14}$$

For velocity and temperature without dimensions, the entropy generation number is given as:

$$N_s = \left(\frac{d\varphi}{dy}\right)^2 + \frac{Br}{\Omega}\left[\left(\frac{dw_1}{d\eta}\right)^2 + \lambda M^2 w_1^2\right]$$

where $Br = \frac{\mu v_0^2}{k(T_h - T_0)}$ is the Brinkmann number and $\Omega = \frac{T_h - T_0}{T_o}$, the non dimensional temperature difference.

The entropy generation number is written as a combination of the entropy generation due to heat transfer given by N_1 and the entropy generation due to fluid friction with magnetic field denoted by N_2 given as,

$$N_1 = \left(\frac{d\varphi}{d\eta}\right)^2, N_2 = \frac{Br}{\Omega}\left[\left(\frac{dw_1}{d\eta}\right)^2 + \lambda M^2 w_1^2\right]$$

Paoletti et al[25] introduced an alternative irreversibility distribution parameter in terms of Bejan number(Be) which is given as:

Be $= \frac{N_1}{N_s} = \frac{1}{1+\epsilon}$

where $\epsilon = \frac{N_2}{N_1}$ is the irreversibility ratio.

When $0 \leq \epsilon < 1$, heat transfer is prepotent while for $\epsilon > 1$, fluid friction with magnetic effects is ascendant. Heat transfer and fluid friction both have influence of same magnitude to entropy generation for $\epsilon = 1$. From [12], it is clear that the Bejan number (Be) has its values lying between 0 and 1. It approaches zero when the entropy generation due to the combined effects of fluid friction and magnetic field is dominant. Similarly, Be = 0.5 indicates that the irreversibility due to heat transfer dominates with Be=1 as the limit at which the irreversibility is solely due to heat transfer.

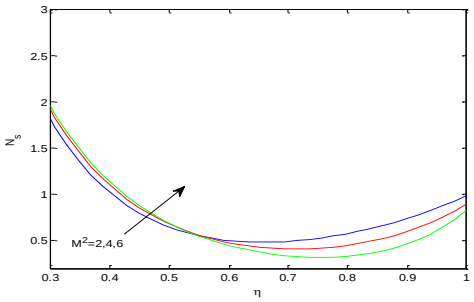

Figure10 N_s for different $M^2$when $Pe = 3, \alpha_1 = 0.1, \alpha_2 = 0.1, Br = 1, Br\Omega^{-1} = 1, Re = 2$ and $D_a = 0.4$

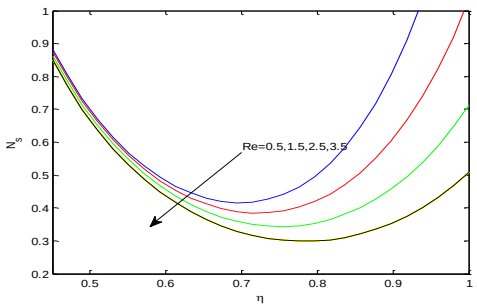

Figure11 N_s for different Re when $Pe = 2, \alpha_1 = 0.1, \alpha_2 = 0.1, Br = 1, Br\Omega^{-1} = 1, M^2 = 5$ and $D_a = 0$.

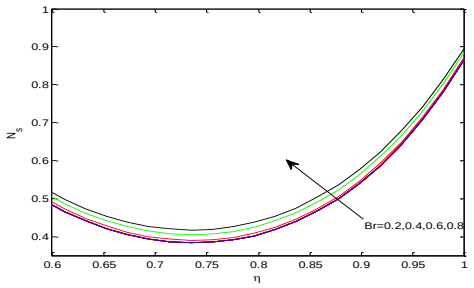

Figure12 N_s for different Br when $Pe = 2, \alpha_1 = 0.1, \alpha_2 = 0.1, Re = 2, Br\Omega^{-1} = 1, M^2 = 5$ and $D_a = 0$

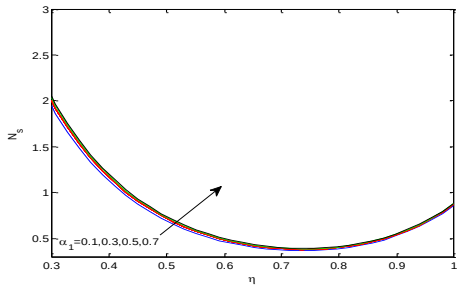

Figure13 N_s for different α_1 when $Pe = 3, Re = 2, \alpha_2 = 0.1, Br = 1, Br\Omega^{-1} = 1, M^2 = 5$ and $D_a = 0.4$

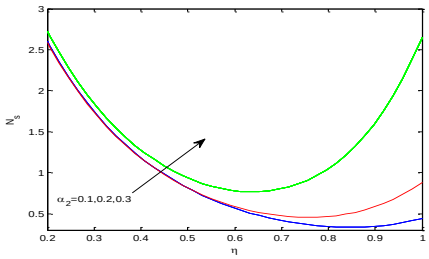

Figure 14 N_s for different α_2 when $Pe = 3, Re = 2, \alpha_1 = 0.1, Br = 1, Br\Omega^{-1} = 1, M^2 = 5$ and $D_a = 0.4$

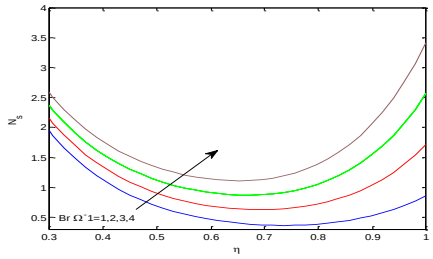

Figure 15 N_s for different $Br\Omega^{-1}$ when $Pe = 3, Re = 2, \alpha_1 = 0.1, \alpha_2 = 0.1, Br = 1, M^2 = 5$ and $D_a = 0.4$

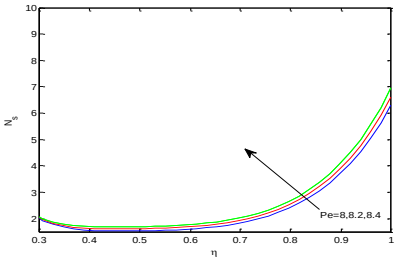

Figure 16 N_s for different Pe when $Re = 2, \alpha_1 = 0.1, \alpha_2 = 0.1, Br = 1, Br\Omega^{-1} = 1, M^2 = 5$ and $D_a = 0.4$

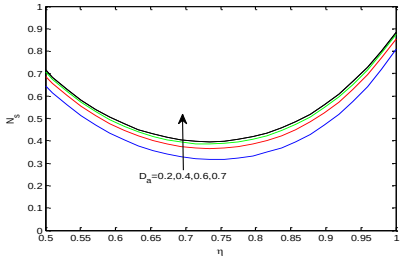

Figure 17 N_s for different D_a when $Re = 2, \alpha_1 = 0.1, \alpha_2 = 0.1, Pe = 3, Br = 1, Br\Omega^{-1} = 1$ and $M^2 = 5$

The impact of various controlling parameters on the entropy generation is given in the figures (10 to 17). Figure 10 shows that the entropy generation N_s increases near the lower plate of the channel and far away from it the reverse trend is exhibited. Figure 11 shows that the increase in the Reynold's number leads to the decrease in the entropy generation rate. From figure (12 to 17), it is found that the entropy generation number increases with the increase in Brinkmann number(Br), slip parameter (α_1) and (α_2), group parameter $(Br\Omega^{-1})$, Peclet number(Pe) and Darcy number(D_a).The temperature gradient within the channel has an increase in its value due to increase in the temperature of the fluid, as a result the entropy generation number has a rise in its value. The enhancement in the values of entropy generation number with an increase in group parameter $Br\Omega^{-1}$ is observed due to increase in the irreversibility of the fluid friction.

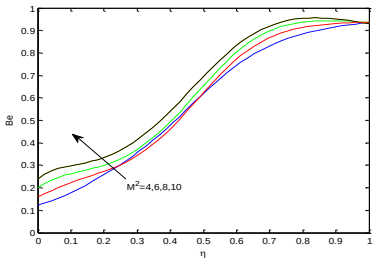

Figure18 Bejan number for different M^2 when $Re = 2, \alpha_1 = 0.1, \alpha_2 = 0.1, Br = 1, Br\Omega^{-1} = 1, D_a = 0.4$ and $Pe = 3$

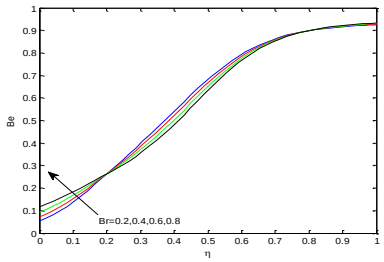

Figure 19 Bejan number for different Br when $M^2 = 5, Re = 2, \alpha_1 = 0.1, \alpha_2 = 0.1, Br\Omega^{-1} = 1, D_a = 0.4$ and $Pe = 3$

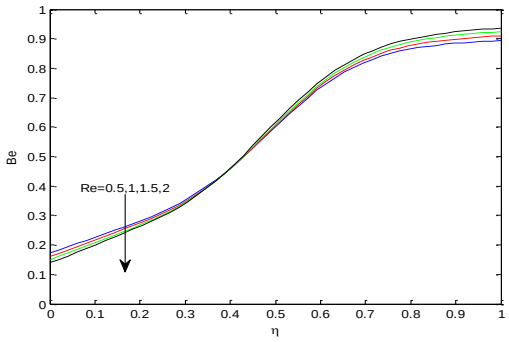

Figure 20 Bejan number for different Re when $M^2 = 5$, $Br = 1$,$\alpha_1 = 0.1, \alpha_2 = 0.1, Br\Omega^{-1} = 1, D_a = 0.4$ and $Pe = 3$

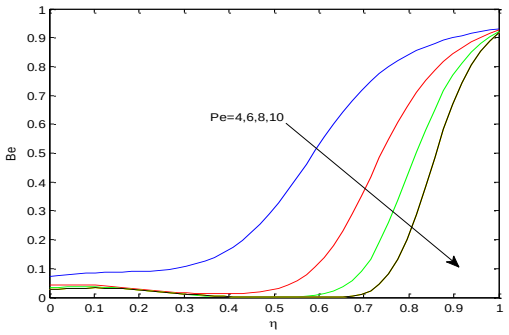

Figure 21 Bejan number for different Pe when $M^2 = 5$, $Br = 1$,$\alpha_1 = 0.1, \alpha_2 = 0.1, Br\Omega^{-1} = 1, D_a = 0.4$ and $Re = 2$

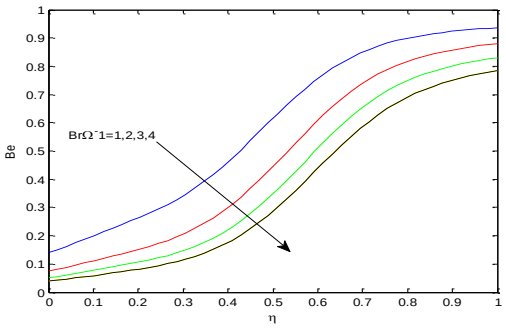

Figure 22 Bejan number for different $Br\Omega^{-1}$ when $M^2 = 5$, $Br = 1$,$\alpha_1 = 0.1, \alpha_2 = 0.1, Pe = 3, D_a = 0.4$ and $Re = 2$

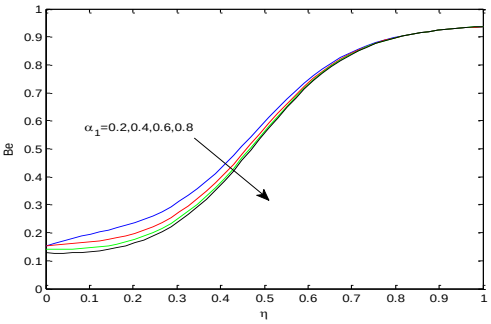

Figure 23 Bejan number for different α_1 when $M^2 = 5$, $Br = 1, \alpha_2 = 0.1, Pe = 3, D_a = 0.4, Br\Omega^{-1} = 1$ and $Re = 2$

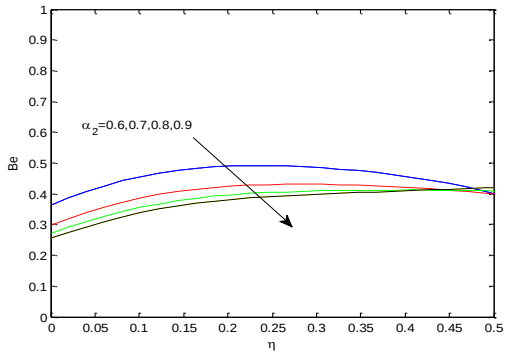

Figure 24 Bejan number for different α_2 when $M^2 = 5$, $Br = 1, \alpha_1 = 0.1, Pe = 3, D_a = 0.4, Br\Omega^{-1} = 1$ and $Re = 2$

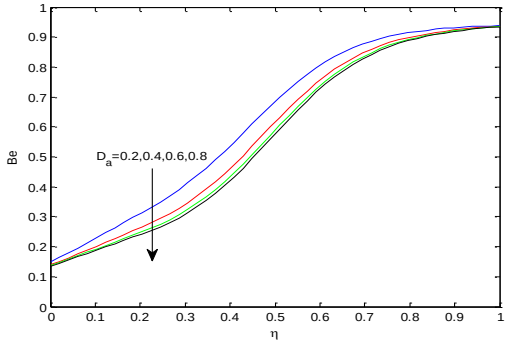

Figure 25 Bejan number for different D_a when $M^2 = 5$, $Br = 1, \alpha_1 = 0.1,\ \alpha_2 = 0.1, Pe = 3, Br\Omega^{-1} = 1$ and $Re = 2$

Now the effect of various parameters on Bejan number(Be) is shown in the figures (17 to 24).It is clear from these figures that the Bejan number(Be) shows an increase with the increasing Magnetic parameter(M^2) and Brinkmann number(Br).On the other hand ,it

reduces with the increasing parameters Reynold's number(Re),Peclet number(Pe),group parameter($\mathrm{Br}\Omega^{-1}$),slip parameter (α_1) and (α_2) and Darcy number(D_a).Group parameter plays an important role in analyzing the irreversibility. The viscous effects to that of temperature gradient entropy generation are governed by this number. It is observed from the figures that the Bejan number(Be) shows a decrease near the lower plate $\eta = 0$ while it increases near the upper plate $\eta = 1$ with the increase in the Reynold's number(Re).

6. Closing Remarks

The combined effect of viscous dissipation, magnetic field, porous media, suction/ injection and slip conditions on entropy generation in a fluid through horizontal porous channels have been investigated. To obtain the entropy production, the analytical results obtained for the velocity and temperature profiles have been used. The velocity and temperature profiles have been plotted by solving equations (5) & (6) with the help of 'bvp4c' function in Matlab software[see(3)]. The non-dimensional entropy generation number and Bejan number have been resolved. The effects of various parameters on the entropy generation number and the rate of heat transfer have been discussed. It is observed that:

1. Velocity of the fluid increases with the increase in the Darcy number and slip parameter α_1 while for magnetic parameter, Reynold's number and slip parameter α_2, it decreases.
2. Temperature of the fluid increases with the increase in the Peclet number and Brinkmann number whereas the temperature decreases with the increase in the Reynold's number. Also, Darcy number don't have much effect on the temperature of the fluid.
3. For increase in the magnetic parameter, the entropy generation N_s increase near the lower plate of the channel and far away from it, it decreases. Alongwith, the entropy generation decreases with the increase in the Reynold's number while it shows an increase with Brinkmann number, slip parameters α_1 and α_2,group parameter, Peclet number and Darcy number.
4. Bejan number shows an increase with the increase in magnetic parameter and Brinkmann number and reduces with the increase in Reynold's number, Peclet number, group parameter, slip parameters α_1 and α_2 and Darcy number.

The entropy generation optimization is helpful to engineer and scientists for designing thermal systems with lesser loss of energy as a result there is availability of maximum possible energy.

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APPENDIX

$$A = \frac{-\frac{P}{\left(M^2+\frac{1}{D_a}\right)}\left[n\alpha_1 e^{\frac{-Re}{2}}+\sinh n-\alpha_2\left(n\cosh n-\frac{Re}{2}\sinh n\right)\right]}{\left\{n(\alpha_1-\alpha_2)\cosh n+\sinh n\left[1+\alpha_1.\alpha_2\left(\frac{Re^2}{4}-n^2\right)+\frac{Re}{2}(\alpha_1+\alpha_2)\right]\right\}}$$

$$B = \frac{P}{n\alpha_1\left(M^2+\frac{1}{D_a}\right)}+\frac{A}{n}\left(\frac{1}{\alpha_1}+\frac{1}{2}\,Re\right)$$

$$A_1 = \frac{1}{8}\{(A^2\text{-}B^2)Re^2 - 4n^2(A^2-B^2) + \frac{\lambda M^2}{2}(A^2-B^2)\}$$

$$A_2 = \frac{1}{4}(Re^2+4n^2)(A^2+B^2) - 8nAB\,Re + \lambda M^2(A^2+B^2)$$

$$A_3 = \frac{1}{2}(-ARe+2nB)(-BRe+2An) + \lambda M^2 AB$$

$$A_4 = \frac{A_2}{(Re^2-RePe)}$$

$$A_5 = \frac{A_3}{(Re^2-RePe)}$$

$$A_6 = \frac{8A}{(Re^2-2RePe)}$$

$$A_7 = \frac{8B}{(Re^2-2Re\,Pe)}$$

$$A_8 = \frac{A_1}{(Re^2-Re\,Pe)}$$

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Trace of the positive integral powers of three and five dimensional rhotrices *

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Abstract The traces of powers of matrices frequently arise in several fields of mathematics. Rhotrices are a new paradigm of matrices which are represented as coupled matrices. The main aim of this paper is to find the trace of positive integral powers of three and five dimensional rhotrices. Further, the trace of positive integral powers of special type of circulant rhotrix is also discussed.

Key words Rhotrix, trace of a rhotrix, determinant, circulant rhotrix.

2020 Mathematics Subject Classification 15A09, 20H30, 11T71.

1 Introduction

The trace of a positive integer power of a matrix needs to be evaluated in various problems in Network Analysis, Number Theory, Matrix Theory, Dynamical Systems and Differential Equations. To study a complex network, we need to compute the total number of triangles of a connected simple graph. The trace of integral powers of square matrices was discussed by Michiel [6] and Pahade and Jha [7]. Cisneros et al. [4] and Cisneros [5] discussed a formula for the trace of symmetric powers of a matrix. Also, Brezinski et al. [3] estimated the trace of powers of self adjoint operators. Zareula [14] discussed the congruences for the trace of powers of some matrices.
Rhotrix is a new paradigm in the study of matrix theory. Rhotrix is represented as coupled matrix. Ajibade [2] defined a 3–dimensional rhotrix, which is, in some way, between 2×2–dimensional and 3×3–dimensional matrices as

$$R_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle,$$

where a, b, c, d, e are real numbers and $h(R_3) = c$ is called the heart of rhotrix R_3.

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Let $Q_3 = \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle$, be another 3-dimensional rhotrix, then the addition of two rhotrices is defined as

$$R_3 + Q_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle + \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle = \left\langle \begin{array}{ccc} & a+f & \\ b+g & c+h & d+j \\ & e+k & \end{array} \right\rangle,$$

and for any real number α, the scalar multiplication of a rhotrix R_3 by α is defined as

$$\alpha\, R_3 = \alpha \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle = \left\langle \begin{array}{ccc} & \alpha\, a & \\ \alpha\, b & \alpha\, c & \alpha\, d \\ & \alpha\, e & \end{array} \right\rangle.$$

Two types of multiplications of rhotrices are discussed in the literature of rhotrices, namely, the heart oriented multiplication and the row-column multiplication. Ajibade [2] discussed the heart oriented multiplication of 3-dimensional rhotrices as given below:

Let $Q_3 = \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle$,be another 3-dimensional rhotrix, then the multiplication of two rhotrices is defined as

$$R_3\, o\; Q_3 = \left\langle \begin{array}{ccc} & ah+fc & \\ bh+gc & ch & dh+jc \\ & eh+kc & \end{array} \right\rangle.$$

Further, Absalom et al. [1] generalized the heart oriented multiplication of 3-dimensional rhotrices to n-dimensional rhotrices. The row column multiplication of 3-dimensional rhotrices is defined by Sani [8] as

$$R_3\, o\, Q_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle = \left\langle \begin{array}{ccc} & af+dg & \\ bf+eg & ch & aj+dk \\ & bj+ek & \end{array} \right\rangle.$$

Sani [9] also discussed the row-column multiplication of high dimension rhotrices as follows: Consider an n-dimensional rhotrix

$$P_n = \left\langle \begin{array}{ccccccc} & & & a_{11} & & & \\ & & a_{21} & c_{11} & a_{12} & & \\ & a_{31} & c_{21} & a_{22} & c_{12} & a_{13} & \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ a_{t1} & \cdots & \cdots & \cdots & \cdots & \cdots & a_{1t} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ & a_{tt-2} & c_{t-1t-2} & a_{t-1t-1} & c_{t-2t-1} & a_{t-2t} & \\ & & a_{tt-1} & c_{t-1t-1} & a_{t-1t} & & \\ & & & a_{tt} & & & \end{array} \right\rangle,$$

where $t = (n+1)/2$. Sani [10] represented rhotrix as a coupled matrix and denoted it as $P_n = \langle a_{ij},\ c_{lk} \rangle = \langle A, C \rangle$ with $i, j = 1, 2, ..., t$ and $l, k = 1, 2, ..., t-1$. The multiplication of two rhotrices P_n and Q_n defined by Sani [9] is as follows:

$$P_n\, o\, Q_n = \langle a_{i_1 j_1},\, c_{l_1 k_1} \rangle\; o\; \langle b_{i_2 j_2},\, d_{l_2 k_2} \rangle = \left\langle \sum_{i_2 j_1 = 1}^{t} (a_{i_1 j_1}\, b_{i_2 j_2}),\ \sum_{l_2 k_1 = 1}^{t-1} (c_{l_1 k_1}\, d_{l_2 k_2}) \right\rangle.$$

Sharma and Kanwar [11, 12] defined the trace of a rhotrix and discussed its properties. Sharma et al. [13] introduced circulant rhotrices in the literature of rhotrices.

Definition 1.1. [11] Let

$$R_n = \left\langle \begin{array}{ccccccccc} & & & & a_{11} & & & & \\ & & & a_{21} & c_{11} & a_{12} & & & \\ & & a_{31} & c_{21} & a_{22} & c_{12} & a_{13} & & \\ & .. & .. & .. & .. & .. & .. & .. & \\ a_{t1} & c_{t-11} & .. & .. & .. & .. & .. & c_{1t-1} & a_{1t} \\ & .. & .. & .. & .. & .. & .. & .. & \\ & & a_{t\,t-2} & c_{t-1t-2} & a_{t-1t-1} & c_{t-2t-1} & a_{t-2t} & & \\ & & & a_{t\,t-1} & c_{t-1t-1} & a_{t-1t} & & & \\ & & & & a_{tt} & & & & \end{array} \right\rangle$$

$$= \langle a_{i\,j},\ c_{l\,k} \rangle = \langle A,\ C \rangle\ ,$$

be a rhotrix, where $a_{i\,j},\ c_{l\,k} \in \mathbb{R}$, $1 \leq i, j \leq t$, $1 \leq l, k \leq t-1$ and $t = \frac{n+1}{2}$.
The trace of R_n is defined as

$$\begin{aligned} Tr\ R_n &= \sum_{i=1}^{t} a_{ii} + \sum_{i=1}^{t-1} c_{ii} \\ &= Tr\ A + Tr\ C \\ &= \sum_{r=1}^{t} x_{rs} \end{aligned}$$

That is, the trace of a rhotrix R_n, which is the sum of all its elements of the vertical diagonal, where $R_n = \langle x_{r\,s} \rangle$ is the general representation to the n–dimensional rhotrix. The elements $x_{r\,s}$ for $r = s\,(r \neq s)$ represent the vertical (non–vertical) diagonal entries of the rhotrix R_n.

2 Trace of positive integral powers of a three dimensional rhotrix

In this section, we put forward a result to evaluate the trace of any positive integral power of a three dimensional rhotrix.

Theorem 2.1. *Let $R_3 =< A, B >$ be a three dimensional rhotrix whose coupled matrices are $A = (a_{ij})_{2\times 2}$ and $B = (c)_{1\times 1}$. Then, the trace of R_3^n, where n is positive even integer, is given by:*

$$TrR_3^n = (TrA)^n - n.|A|.(TrA)^{n-2} + \frac{n\,(n-3)}{2!}.|A|^2.(TrA)^{n-4} - \frac{n\,(n-4)\,(n-5)}{3!}.|A|^3.(TrA)^{n-6} +$$
$$\ldots + (-1)^{\frac{n}{2}} \frac{n\left(n-\frac{n}{2}-1\right)\left(n-\frac{n}{2}-2\right)\ldots . up\ to\ \frac{n}{2}\ terms}{\left(\frac{n}{2}\right)!}.|A|^{\frac{n}{2}}\,(TrA)^{n-2\cdot\frac{n}{2}} + (TrB)^n.$$

Proof. Consider a three dimensional rhotrix

$$R_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle,$$

where a, b, c, d, e are real numbers and the coupled matrices are given as $A = \begin{bmatrix} a & d \\ b & e \end{bmatrix}$ and $B = [c]$.
Then, $|A| = ae - bd$ and $Tr\ A = a + e$.

$$A^2 = \begin{bmatrix} a^2 + bd & d(a+e) \\ b(a+e) & bd + e^2 \end{bmatrix}$$

and

$$\begin{aligned} Tr\ A^2 &= a^2 + 2bd + e^2 = a^2 + 2ae + e^2 - 2ae + 2bd \\ &= (a+e)^2 - 2(ae - bd) \end{aligned}$$

or,

$$TrA^2 = (TrA)^2 - 2.\,|A|\,. \tag{2.1}$$

Similarly,

$$A^3 = \begin{bmatrix} a^3 + abd + bd(a+e) & a^2d + d^2b + ed(a+e) \\ ab\,(a+e) + b^2d + e^2b & bd\,(a+e) + dbe + e^3 \end{bmatrix}$$

and

$$Tr\ A^3 = a^3 + e^3 + 3bd(a+e) = (a+e)^3 - 3(a+e)(ae - bd)$$

or,

$$TrA^3 = (TrA)^3 - 3.\,|A|\,.\,Tr\ A. \tag{2.2}$$

Replacing A by A^2 in (2.1), we get

$$Tr\ (A^2)^2 = \left(TrA^2\right)^2 - 2.\,|A^2|$$
$$= ((TrA)^2 - 2.\,|A|)^2 - 2(|A|)^2$$

or,

$$TrA^4 = (TrA)^4 - 4.\,|A|\,.(TrA)^2 + \frac{4(4-3)}{2!}.|A|^2.(TrA)^{4-2.\frac{4}{2}}$$

Also, replacing A by A^2 in (2.2), we get

$$Tr\ A^6 = Tr\ (A^2)^3 = \left(TrA^2\right)^3 - 3.\,|A^2|\,.\,TrA^2$$

$$= ((TrA)^2 - 2.\,|A|)^3 - 3.(|A|)^2((Tr\ A)^2 - 2.\,|A|)$$
$$= (TrA)^6 - 8.|A|^3 - 6.\,|A|\,.(TrA)^4 + 12|A|^2.\ (TrA)^2 - 3.(|A|)^2(Tr\ A)^2 + 6.(|A|)^3$$
$$TrA^6 = (TrA)^6 - 6.\,|A|\,.(TrA)^4 + \frac{6\,(6-3)}{2!}.|A|^2.\ (TrA)^2 - \frac{6\,(6-4)\,(6-5)}{3!}.|A|^3.\ (TrA)^{6-2.\frac{6}{2}}.$$

Thus, when n is an even integer, then

$$TrA^n = (TrA)^n - n.|A|.(TrA)^{n-2} + \frac{n\,(n-3)}{2!}.|A|^2.(TrA)^{n-4} - \frac{n\,(n-4)\,(n-5)}{3!}.|A|^3.(TrA)^{n-6} +$$
$$\ldots + (-1)^{\frac{n}{2}}\frac{n\left(n-\frac{n}{2}-1\right)\left(n-\frac{n}{2}-2\right)\ldots \text{up to } \frac{n}{2} \text{ terms}}{\left(\frac{n}{2}\right)!}.|A|^{\frac{n}{2}}(TrA)^{n-2.\frac{n}{2}}.$$

Also,

$$Tr\ B^n = c^n$$

By Definition 1.1 we know that

$$Tr\ R_3 = Tr\ A + Tr\ B.$$

Therefore,

$$TrR_3^n = Tr\ A^n + Tr\ B^n.$$

Hence,

$$TrR_3^n = \sum\nolimits_{k=0}^{n/2} \frac{(-1)^k}{k!} \cdot (n(n-k-1)(n-k-2)\ldots \text{up to } k \text{ terms}) \cdot |A|^k (TrA)^{(n-2k)} + c^n$$

where n is an even integer.

□

Example 2.2. Let

$$R_3 = \left\langle \begin{matrix} & 1 & \\ 2 & 1 & -1 \\ & 2 & \end{matrix} \right\rangle$$

be a three dimensional rhotrix such that its coupled matrices are $A = \begin{bmatrix} 1 & -1 \\ 2 & 2 \end{bmatrix}$ and $B = [1]$. Then, $Tr\ A = 3$ and $|A| = 4$ and $Tr\ B = 1$. Now,

$$Tr\ A^{10} = \sum_{k=0}^{5} \frac{(-1)^k}{k!}(n\,(n-k-1)\,(n-k-2)\ldots \text{up to } k \text{ terms}).|A|^k (TrA)^{n-2k}$$

$$= (TrA)^{10} - 10.|A|.(TrA)^8 + \frac{10.7}{2!}.|A|^2.(TrA)^6 - \frac{10.6.5}{3!}.|A|^3(TrA)^4 + \frac{10.5.4.3}{4!}.|A|^4(TrA)^2 - \frac{10.4.3.2.1}{5!}.|A|^5$$

$$= (3)^{10} - 10.4.(3)^8 + 35.(4)^2.(3)^6 - 50.(4)^3.(3)^4 + 25.(4)^4.(3)^2 - 2(4)^5 = 1201$$

and $Tr\ B^{10} = 1$. Therefore, ${R_3}^{10} = 1201 + 1 = 1202$.

Theorem 2.3. *Let $R_3 =< A, B >$ be a three dimensional rhotrix whose coupled matrices are $A = (a_{ij})_{2\times 2}$ and $B = (c)_{1\times 1}$ .Then, the trace of R_3^n where, n is a positive odd integer, is given by*

$$TrR_3^n = \sum_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n(n-k-1)(n-k-2)\dots \text{up to } k \text{ terms}) \cdot |A|^k \cdot (TrA)^{n-2k} + (TrB)^n$$

where $|A| = \det A$.

Proof. Consider a three dimensional rhotrix

$$R_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle$$

where a, b, c, d, e are real numbers and the coupled matrices are given by $A = \begin{bmatrix} a & d \\ b & e \end{bmatrix}$ and $B = [c]$.

Then, from the Theorem 2.1 TrA^3 is given by

$$TrA^3 = (TrA)^3 - 3.|A|.Tr\ A$$

$$= (TrA)^{3-2.0} + \frac{(-1)^1}{1!}.|A|^1.(Tr\ A)^{3-2.1}.$$

Similarly,

$$A^5 = A^3.A^2$$

$$= \begin{bmatrix} a^3 + abd + bd(a+e) & a^2d + d^2b + ed(a+e) \\ ab(a+e) + b^2d + e^2b & bd(a+e) + dbe + e^3 \end{bmatrix} \begin{bmatrix} a^2 + bd & d(a+e) \\ b(a+e) & bd + e^2 \end{bmatrix}$$

Now,

$$TrA^5 = a^5 + a^3bd + 2a^2bd(a+e) + a^3bd + ab^2d^2 + 4b^2d^2(a+e) + ebd(a+e)^2$$
$$+ abd(a+e)^2 + 2e^2bd(a+e) + eb^2d^2 + 2e^3bd$$
$$= (a+e)^5 - 5.(ae-bd).(a+e)^3 + 5(ae-bd)^2.(a+e)$$
$$= (TrA)^5 - 5.|A|.(TrA)^3 + \frac{5(5-3)}{2!}.|A|^2.(Tr\ A)$$
$$= (TrA)^{5-2.0} + \frac{(-1)^1}{1!}.5.|A|^1.(TrA)^{5-2.1} + \frac{(-1)^2}{2!}5(5-3).|A|^2.(Tr\ A)^{5-2.2}$$

Thus, when n is an odd integer, then

$$TrA^n = \sum_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n(n-k-1)(n-k-2)\dots \text{ up to } k \text{ terms}) \cdot |A|^k (TrA)^{n-2k}.$$

Also,

$$Tr\ B^n = c^n.$$

Sharma and Kanwar [11] showed that the trace of a rhotrix is given by,

$$Tr\ R_3 = Tr\ A + Tr\ B.$$

Therefore,

$$TrR_3^n = Tr\ A^n + Tr\ B^n.$$

Hence,

$$TrR_3^n = \sum_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n(n-k-1)(n-k-2)\dots \text{up to } k \text{ terms}) \cdot |A|^k (TrA)^{n-2k} + c^n$$

where n is an odd positive integer.

□

Example 2.4. Let

$$R_3 = \left\langle \begin{array}{ccc} & 1 & \\ 2 & 1 & -1 \\ & 2 & \end{array} \right\rangle$$

be a three dimensional rhotrix such that its coupled matrices are $A = \begin{bmatrix} 1 & -1 \\ 2 & 2 \end{bmatrix}$ and $B = [1]$. Then, $Tr\ A = 3$ and $|A| = 4$ and $Tr\ B = 1$. Now,

$$Tr\ A^9 = \sum_{k=0}^{4} \frac{(-1)^k}{k!} \cdot (n\,(n-k-1)\,(n-k-2)\ldots \text{up to } k \text{ terms}) \cdot |A|^k (TrA)^{n-2k}$$

$$= (TrA)^9 - 9.\,|A|\,.\,(TrA)^7 + \frac{9.7}{2!}.|A|^2.(TrA)^5 - \frac{9.5.4}{3!}.\,|A|^3(TrA)^3 + \frac{9.4.3}{4!}.|A|^4\ .TrA$$

$$= (3)^9 - 9.4.\ (3)^7 + \frac{63}{2}.\,(4)^2.\ (3)^5 - 30.(4)^3.\,(3)^3 + \frac{9}{2}.\ (4)^4.3 = 15039$$

and $Tr\ B^{10} = 1$. Therefore,

$$Tr\ {R_3}^{10} = 15039 + 1 = 15040.$$

3 Trace of positive integral powers of a five dimensional rhotrix

In this section, we put forward a result to evaluate the trace of any positive power of a five dimensional rhotrix.

Theorem 3.1. *Let $R_5 =< A, B >$ be a five dimensional rhotrix whose coupled matrices are $A = (a_{ij})_{3\times 3}$ and $B = (b_{ij})_{2\times 2}$. Then, the trace of R_5^n where n is a positive even integer is given by*

$$Tr\ R_5^n$$
$$= \sum\nolimits_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum\nolimits_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} [n\,(n-r_0-2r_1-1)\,(n-r_0-2r_1-2)\ldots(n-2r_0-3r_1+1)] \times \right.$$
$$\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} + \sum\nolimits_{k=0}^{\frac{n}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n-k-1)\,(n-k-2)\ldots(up\ to\ k\ terms)) \times$$
$$|B|^k (TrB)^{n-2k}$$

and the trace of R_5^n when n is positive odd integer, is given by

$$Tr\ R_5^n$$
$$= \sum\nolimits_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum\nolimits_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} [n\,(n-r_0-2r_1-1)\,(n-r_0-2r_1-2)\ldots(n-2r_0-3r_1+1)] \times \right.$$
$$\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} + \sum\nolimits_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n-k-1)\,(n-k-2)\ldots(up\ to\ k\ terms)) \times$$
$$|B|^k (TrB)^{n-2k}$$

where A_2 is the sum of all principal minors of order 2 in A, r_0 is the number of principal minor of order 1, r_1 is the number of principal minors of order 2, $\lfloor x \rfloor$ is the floor function, $|A| = \det A$ and $|B| = \det B$.

Proof. Let $R_5 = \left\langle \begin{array}{ccccc} & & a & & \\ & d & p & b & \\ g & r & e & q & c \\ & h & s & f & \\ & & i & & \end{array} \right\rangle$ be a five dimensional rhotrix whose coupled matrices are

$A = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$ and $B = \begin{bmatrix} p & q \\ r & s \end{bmatrix}$. As stated earlier, $TrR_5 = TrA + TrB$ and $TrR_5^n = TrA^n + TrB^n$. Since of B is a matrix order 2×2, therefore, the trace of B^n can be written directly from the

Theorem 2.1 and the Theorem 2.3. To get the trace of R_5^n, we need to evaluate the trace of A^n. Now, as

$$|A| = a\,(ei - hf) - b\,(di - gf) + +c\,(dh - eg)$$

and $Tr\ A = a + e + i$, therefore,

$$TrA^2 = (a + e + i)^2 - 2\,(ae - bd + ei - fh + ai - cg)$$
$$= (TrA)^2 - 2\sum_{i=1}^{3} |A_{ii}|,$$

where $|A_{ii}|$ are the principal minors of order 2 given as $|A_{11}| = \begin{vmatrix} a & b \\ d & e \end{vmatrix}$, $|A_{22}| = \begin{vmatrix} e & f \\ g & h \end{vmatrix}$, $|A_{33}| = \begin{vmatrix} a & c \\ g & i \end{vmatrix}$.

Therefore, if we put

$$A_2 = \sum_{i=1}^{3} |A_{ii}|$$

then

$$TrA^2 = (TrA)^2 - 2A_2.$$

Also,

$$\begin{aligned} TrA^4 &= a^4 + 2b^2d^2 + e^4 + 2c^2g^2 + 4a^2\,(bd + cg) + 4cdeh + 4e^2fh + 4cfgh \\ &\quad + 2f^2h^2 + cdhi + 4efhi + 4cgi^2 + 4fhi^2 + i^4 + 4a\,(bde + bfg + cdh + cgi) \\ &\quad + 4b\,\left(d\left(e^2 + cg + fh\right) + fg(e + i)\right) \\ &= (a + e + i)^4 - 4(a + e + i)^2\,(-bd + ae - cg - fh + ai + ei) \\ &\qquad + 2(-bd + ae - cg - fh + ai + ei)^2 \\ &\qquad + 4(a + e + i)(-ceg + bfg + cdh - afh - bdi + aei) \\ &= (TrA)^4 - 4\sum_{i=1}^{3} |A_{ii}|.TrA + 2(\sum_{i=1}^{3} |A_{ii}|)^{\ 2} + 4.TrA.\ |A| \\ &= (TrA)^4 - 4A_2.TrA + 2(A_2)^2 + 4.TrA.\ |A|\,. \end{aligned}$$

Similarly,

$$TrA^5 = (TrA)^5 - 5A_2.(TrA)^3 + 5\ TrA.(A_2)^2 + 5\ (TrA)^2.\ |A| - 5.A_2.\,|A|\,.$$

Therefore, TrA^n can be generalized as

$$\begin{aligned} &Tr\ A^n \\ &= \sum\nolimits_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum\nolimits_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} \left[n\,(n - r_0 - 2r_1 - 1)\,(n - r_0 - 2r_1 - 2)\ldots(n - 2r_0 - 3r_1 + 1)\right] \times \right. \\ &\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} \end{aligned}$$

For even positive integer n and using Theorem 2.1, we have

$$Tr\ B^n = \sum\nolimits_{k=0}^{\frac{n}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n - k - 1)\,(n - k - 2)\ldots(\text{up to } k \text{ terms})) \cdot |B|^k (TrB)^{n-2k}$$

Therefore, $TrR_5^n = Tr\ A^n + Tr\ B^n$. Now,

$$\begin{aligned} &Tr\ R_5^n \\ &= \sum\nolimits_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum\nolimits_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} \left[n\,(n - r_0 - 2r_1 - 1)\,(n - r_0 - 2r_1 - 2)\ldots(n - 2r_0 - 3r_1 + 1)\right] \times \right. \\ &\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} + \sum\nolimits_{k=0}^{\frac{n}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n - k - 1)\,(n - k - 2)\ldots(\text{up to } k \text{ terms})) \times \\ &|B|^k (TrB)^{n-2k} \end{aligned}$$

Also, $R_5^n = Tr\ A^n + Tr\ B^n$, for odd n, this gives

$$Tr\ R_5^n$$
$$= \sum_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} \left[n\,(n-r_0-2r_1-1)\,(n-r_0-2r_1-2)\ldots(n-2r_0-3r_1+1) \right] \times \right.$$
$$\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} + \sum_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n-k-1)\,(n-k-2)\ldots(\text{up to } k \text{ terms})) \times$$
$$|B|^k (TrB)^{n-2k}$$

□

4 Trace of a special type of n-dimensional circulant rhotrix

Now we prove below a theorem for the trace of a special type of n-dimensional circulant rhotrix.

Theorem 4.1. *Let $R_n = \langle A_t, B_{t-1} \rangle$ be an $n-$dimensional special circulant rhotrix whose diagonal entries are zero and all other entries are one. A_t, B_{t-1} are the coupled matrices of R_n, where $t = \frac{n+1}{2}, A_t = (a_{ij})$, $1 \leq i,j \leq t$ and $B_{t-1} = (b_{ij})$, $1 \leq i,j \leq t-1$ such that $a_{ij} = \begin{cases} 0, & \text{if } i=j \\ 1, & \text{if } i \neq j \end{cases}$ and $b_{ij} = \begin{cases} 0, & \text{if } i=j \\ 1, & \text{if } i \neq j \end{cases}$. Then, the trace of positive powers of R_n, when r is a positive even integer, is given by*

$$Tr\ R_n^r = \sum_{m=1}^{\frac{r}{2}} N(t,m) t(t-1)^m (t-2)^{r-2m} + \sum_{m=1}^{\frac{r}{2}} N(t-1,m)\,(t-1)\,(t-2)^m (t-3)^{r-2m},$$

and the trace of positive powers of R_n, when r is a positive odd integer, is given by

$$Tr\ R_n^r = \sum_{m=1}^{\frac{r-1}{2}} N(t,m) t(t-1)^m (t-2)^{r-2m} + \sum_{m=1}^{\frac{r-1}{2}} N(t-1,m)\,(t-1)\,(t-2)^m (t-3)^{r-2m},$$

where, $N(k,1) = 1$, $N\left(k, \frac{k}{2}\right) = 1$, $N\left(k, \frac{k-1}{2}\right) = \frac{k-1}{2}$ and $N(k,\ r) = N(k-1,\ r) + N(k-2,\ r-1)$.

Proof. The rhotrix R_n is given by

$$R_n = \left\langle \begin{array}{ccccccc} & & & 0 & & & \\ & & 1 & 0 & 1 & & \\ & & & 1 & 0 & 1 & \ddots \\ 1 & \ldots & 1 & 0 & 1 & \ldots & 1 \\ & & \vdots & \vdots & \vdots & \vdots & \vdots \\ & & & 1 & 0 & 1 & \\ & & & & 0 & & \end{array} \right\rangle$$

whose coupled matrices for $t = \frac{n+1}{2}$ are A_t and B_{t-1} given as below:

$$A_t^2 = (a_{ij}) = \begin{cases} t-1, \text{ if } i=j \\ t-2, \text{ if } i \neq j \end{cases} \quad \text{and} \quad B_{t-1}^2 = (b_{ij}) = \begin{cases} t-2, \text{ if } i=j \\ t-3, \text{ if } i \neq j. \end{cases}$$

Therefore,

$$Tr\ A_t^2 = t(t-1) \ \text{ and } \ Tr\ B_{t-1}^2 = (t-1)\,(t-2)\,. \tag{4.1}$$

That is,

$$Tr\ A_t^2 = \sum_{m=1}^{\frac{r}{2}=1} N\,(2,1)\,t(t-1) \ \text{ and } \ B_{t-1}^2 = \sum_{m=1}^{\frac{r}{2}=1} N\,(2,1)\,(t-1)(t-2).$$

Hence,

$$Tr\ R_n^2 = Tr\ A_t^2 + Tr\ B_{t-1}^2 = \sum_{m=1}^{\frac{r}{2}=1} N(2,m)\, t(t-1) + \sum_{m=1}^{\frac{r}{2}=1} N(2,m)\,(t-1)(t-2).$$

Similarly,

$$A_t^3 = (a_{ij}) = \begin{cases} (t-1)(t-2), \text{ if } i=j \\ (t-1)+(t-2)^2, \text{ if } i\neq j \end{cases} \quad \text{and} \quad B_{t-1}^3 = (b_{ij}) = \begin{cases} (t-2)(t-3), \text{ if } i=j \\ (t-2)+(t-3)^2, \text{ if } i\neq j, \end{cases}$$

which gives,

$$Tr\ A_t^3 = t(t-1)(t-2) \ \text{ and } \ Tr\ B_{t-1}^3 = (t-1)\,(t-2)\,(t-3). \tag{4.2}$$

That is,

$$TrA_t^3 = \sum\nolimits_{m=1}^{\frac{r-1}{2}=1} N(3,m)\, t(t-1)(t-2) \quad \text{and} \quad TrB_{t-1}^3 = \sum\nolimits_{m=1}^{\frac{r-1}{2}=1} N(3,m)\,(t-1)(t-2)(t-3),$$

which gives,

$$Tr\ R_n^3 = Tr\ A_t^3 + Tr\ B_{t-1}^3 \ = \sum_{m=1}^{\frac{r-1}{2}=1} N(3,m)\, t(t-1)(t-2) + \sum_{m=1}^{\frac{r-1}{2}=1} N(3,m)\,(t-1)(t-2)(t-3).$$

Now,

$$A_t^4 = (a_{ij}) = \begin{cases} (t-1)\ \ [(t-1)+(t-2)^2], \ \text{ if } \ i=j \\ (t-1)\,(t-2)+(t-2)\,[(t-1)+(t-2)^2], \ \text{ if } \ i\neq j \end{cases}$$

and

$$B_{t-1}^4 = (b_{ij}) = \begin{cases} (t-2)\ \ [(t-2)+(t-3)^2], \ \text{ if } \ i=j \\ (t-2)\,(t-3)+(t-3)\,[(t-2)+(t-3)^2], \ \text{ if } \ i\neq j \end{cases}$$

which lends

$$Tr\ A_t^4 = t(t-1)^2 + t(t-1)(t-2)^2 \quad \text{and} \quad Tr\ B_{t-1}^4 = (t-1)(t-2)^2 + (t-1)(t-2)(t-3)^2. \tag{4.3}$$

That is,

$$TrA_t^4 = \sum_{m=1}^{\frac{r}{2}=2} N(4,m)\, t(t-1)^m (t-2)^{4-2m} \quad \text{and} \quad TrB_t^4 = \sum_{m=1}^{\frac{r}{2}=2} N(4,m)\,(t-1)\,(t-2)^m (t-3)^{4-2m}$$

which gives,

$$Tr\ R_n^4 = Tr\ A_t^4 + Tr\ B_{t-1}^4 \ = \sum_{m=1}^{\frac{r}{2}=2} N(4,m)\, t(t-1)^m (t-2)^{4-2m} + \sum_{m=1}^{\frac{r}{2}=2} N(4,m)\,(t-1)(t-2)^m (t-3)^{4-2m}.$$

Now,

$$A_t^5 = (a_{ij}) = \begin{cases} 2(t-1)^2\,(t-2) + (t-1)(t-2)^3, \ \text{ if } \ i=j \\ (t-1)^2 + 3\,(t-1)\,(t-2)^2 + (t-2)^4], \ \text{ if } \ i\neq j \end{cases}$$

and

$$B_{t-1}^5 = (b_{ij}) = \begin{cases} 2(t-2)^2\,(t-3) + (t-2)(t-3)^3, \ \text{ if } \ i=j \\ (t-2)^2 + 3\,(t-2)\,(t-3)^2 + (t-3)^4], \ \text{ if } \ i\neq j, \end{cases}$$

which gives,

$$Tr\ A_t^5 = 2t(t-1)^2(t-2) + t(t-1)(t-2)^3 \quad \text{and} \quad Tr\ B_{t-1}^5 = 2\,(t-1)\,(t-2)^2\,(t-3) + (t-1)(t-2)(t-3)^3. \tag{4.4}$$

That is,

$$TrA_t^5 = \sum_{m=1}^{\frac{r}{2}=2} N(5,m)\, t(t-1)^m (t-2)^{5-2m} \quad \text{and} \quad TrB_{t-1}^5 = \sum_{m=1}^{\frac{r}{2}=2} N(5,m)\,(t-1)(t-2)^m (t-3)^{5-2m}$$

from where follows that

$$Tr\ R_n^5 = Tr\ A_t^5 + Tr\ B_{t-1}^5 = \sum_{m=1}^{\frac{r}{2}=2} N\,(5,m)\,t(t-1)^m(t-2)^{5-2m} + \sum_{m=1}^{\frac{r}{2}=2} N\,(5,m)\,(t-1)(t-2)^m(t-3)^{5-2m}.$$

Thus, by induction, we conclude that

$$Tr\ R_n^r = \sum_{m=1}^{\frac{r}{2}} N(t,m)t(t-1)^m(t-2)^{r-2m} + \sum_{m=1}^{\frac{r}{2}} N(t-1,m)\,(t-1)\,(t-\ \ 2)^m(t-3)^{r-2m}$$

where, r is a positive even integer and

$$Tr\ R_n^r = \sum_{m=1}^{\frac{r-1}{2}} N(t,m)t(t-1)^m(t-2)^{r-2m} + \sum_{m=1}^{\frac{r-1}{2}} N(t-1,m)\,(t-1)\,(t-2)^m(t-3)^{r-2m}$$

where, r is a positive odd integer.

□

5 Conclusion

In this paper, we find the trace of positive integral powers of three and five dimensional rhotrices. Also, a result to find the traces of positive integral power of a special type of circulant rhotrix is derived.

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On the characteristic roots and heart of a class of rhotrices over a finite field *

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Abstract Matrices play an important role in various branches of mathematics such as coding theory, combinatorics and cryptography. Rhotrices are represented by coupled matrices. The use of rhotrices in cryptography doubles the security of messages which travel over insecure channels. We consider rhotrices of 3-dimension and derive some properties related to their characteristic roots. Further, we take a special class of rhotrices of n-dimension and discuss its properties.

Key words Rhotrix, Finite field, Coupled matrix, Eigen values.

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1 Introduction

The concept of rhotrix was introduced by Ajibade [2] in 2003. A rhotrix is defined as a mathematical array, which is in some way, between (2×2)-dimension

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

and (3×3)-dimension

$$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$$

matrices. The rhotrix of dimension three is defined by

$$R_3 = \left\{ \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle : a,\ b,\ c,\ d,\ e \in \Re \right\} \tag{1.1}$$

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Here, $h(R_3)= c$ is the heart of rhotrix and all the entries of rhotrix are real numbers. Ajibade [2] also discussed the following operations of addition and scalar multiplication.

Let $R_5 = \left\langle \begin{array}{ccccc} & & a & & \\ & b & c & d & \\ e & f & h(R_5) & h & i \\ & j & k & l & \\ & & m & & \end{array} \right\rangle$ and $Q_5 = \left\langle \begin{array}{ccccc} & & n & & \\ & o & p & q & \\ r & s & h(Q_5) & u & v \\ & w & x & y & \\ & & z & & \end{array} \right\rangle$ be 5-dimensional rhotrices,

then the addition of these rhotrices is defined as

$$R_5 + Q_5 = \left\langle \begin{array}{ccccc} & & a & & \\ & b & c & d & \\ e & f & h(R_5) & h & i \\ & j & k & l & \\ & & m & & \end{array} \right\rangle + \left\langle \begin{array}{ccccc} & & n & & \\ & o & p & q & \\ r & s & h(Q_5) & u & v \\ & w & x & y & \\ & & z & & \end{array} \right\rangle$$

$$= \left\langle \begin{array}{ccccc} & & a+n & & \\ & b+o & c+p & d+q & \\ e+r & f+s & h(R_5)+h(Q_5) & h+u & i+v \\ & j+w & k+x & l+y & \\ & & m+z & & \end{array} \right\rangle. \tag{1.2}$$

The scalar multiplication $\alpha\, R_5$ for the real scalar α is defined as

$$\alpha\, R_5 = \alpha \left\langle \begin{array}{ccccc} & & a & & \\ & b & c & d & \\ e & f & h(R_5) & h & i \\ & j & k & l & \\ & & m & & \end{array} \right\rangle = \left\langle \begin{array}{ccccc} & & \alpha a & & \\ & \alpha b & \alpha c & \alpha d & \\ \alpha e & \alpha f & \alpha h(R_5) & \alpha h & \alpha i \\ & \alpha j & \alpha k & \alpha l & \\ & & \alpha m & & \end{array} \right\rangle. \tag{1.3}$$

The row-column multiplication of rhotrices is discussed in [6] as follows:

For $R_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle$ and $Q_3 = \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle$,

$$R_3\, o\, Q_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle = \left\langle \begin{array}{ccc} & af+dg & \\ bf+eg & ch & aj+dk \\ & bj+ek & \end{array} \right\rangle.$$

A method of converting a rhotrix to a coupled matrix is discussed in [8]. Various problems involving the $m \times m$ and the $(m-1) \times (m-1)$ matrices can be easily solved by coupled matrix simultaneously, see [4, 15]. The heart-oriented multiplication is discussed in [1, 5].

The row-column multiplication of n-dimensional rhotrices is discussed by Sani [7]. The rhotrix of n-dimension is given by

$$R_n = \left\langle \begin{array}{ccccccccc} & & & & a_{11} & & & & \\ & & & a_{21} & c_{11} & a_{12} & & & \\ & & a_{31} & c_{21} & a_{22} & c_{12} & a_{13} & & \\ & & .. & .. & .. & .. & .. & & \\ & & .. & .. & .. & .. & .. & & \\ & & .. & .. & .. & .. & .. & & \\ a_{n1} & & a_{n\,n-2} & c_{n-1\,n-2} & a_{n-1\,n-1} & c_{n-2\,n-1} & a_{n-2\,n} & & a_{1n} \\ & & & a_{n\,n-1} & c_{n-1\,n-1} & a_{n-1\,n} & & & \\ & & & & a_{nn} & & & & \end{array} \right\rangle = \langle a_{ij},\, c_{lk} \rangle\,,$$

The total number of elements in R_n (n is always an odd number ≥ 3) is given by $|R_n| = \frac{n^2+1}{2}$, where $R_n = \langle a_{ij},\, c_{lk} \rangle$is the coupled matrix with $i,\, j = 1,\ 2,\ ...,t;\ l,\ k = 1,\ 2,\ ...,t-1$ for $t = \frac{n+1}{2}$.

Further, for two coupled rhotrices $R_n{=}\langle a_{i_1j_1},\ c_{l_1k_1}\rangle$ and $Q_n{=}\langle b_{i_2j_2},\ d_{l_2k_2}\rangle$, the multiplication is defined as

$$R_n\, o\, Q_n = \langle a_{i_1j_1},\ c_{l_1k_1}\rangle\ o\ \langle b_{i_2j_2},\ d_{l_2k_2}\rangle = \left\langle \sum_{i_2j_1=1}^{t} (a_{i_1j_1}\, b_{i_2j_2})\ ,\ \sum_{l_2k_1=1}^{t-1} (c_{l_1k_1}\, d_{l_2k_2}) \right\rangle. \tag{1.4}$$

The inverse of the rhotrix

$$R_3 = \left\langle \begin{array}{ccc} & a & \\ b & e & d \\ & c & \end{array} \right\rangle$$

is defined as

$$R_3^{-1} = \left\langle \begin{array}{ccc} & \frac{c}{ac-bd} & \\ -\frac{b}{bd-ac} & \frac{1}{e} & -\frac{d}{bd-ac} \\ & \frac{a}{ac-bd} & \end{array} \right\rangle. \tag{1.5}$$

Matrices are important in cryptography. Some cryptosystems are based on matrices, such as Hill cipher, see [3]. The rhotrices are represented as coupled matrices. Therefore, the use of rhotrix in cryptography means the use of the double matrices which increase the security of the cipher. The properties of rhotrices are discussed in [9–14, 16].
We discuss some properties of rhotrices $R_n = \langle a_{ij},\ c_{lk}\rangle$ over a finite field $\mathbb{F}_2$ which satisfies the following condition:

$$\mathbf{P}\ : \alpha_{ij} = \begin{cases} 1 & \text{if } i+j = \text{even}, \\ 0 & \text{if } i+j = \text{odd}. \end{cases} \tag{1.6}$$

2 The main results

Theorem 2.1. *Let R be a rhotrix of 3-dimension which satisfies the condition* $\mathbf{P}$ *of (1.6) and $\lambda_1,\ \lambda_2,\ \lambda_3$ be the characteristic roots of R. Then $\lambda_1^2,\ \lambda_2^2,\ \lambda_3^2$ are the characteristic roots of R^2 over the finite field $\mathbb{F}_2$.*

Proof. Let

$$R = \left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle \tag{2.1}$$

be the rhotrix satisfying the condition $\mathbf{P}$ of (1.6). Now, the characteristic roots of R are given by

$$|R - \lambda I| = 0,$$

That is,

$$\begin{vmatrix} & a_{11}-\lambda & \\ 0 & c_{11}-\lambda & 0 \\ & a_{22}-\lambda & \end{vmatrix} = 0.$$

This gives

$$\lambda^3 + (a_{11}+a_{22}+c_{11})\,\lambda^2 + (a_{11}c_{11}+a_{22}c_{11}+a_{22}a_{11})\,\lambda + (a_{11}a_{22}c_{11}) = 0. \tag{2.2}$$

Since, $\lambda_1, \lambda_2, \lambda_3$ are the characteristic roots of R, therefore, there exists a non-zero vector X such that

$$RX = \lambda X,$$

where, $X = (x_1, x_2, x_3)$ is a non-zero vector corresponding to the characteristic roots $\lambda_1, \lambda_2, \lambda_3$.
Thus, we get

$$\left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \tag{2.3}$$

Multiplying both sides by R, we get

$$\left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle \left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix},$$

that is,

$$\left\langle \begin{array}{ccc} & a_{11}a_{11} & \\ 0 & c_{11}c_{11} & 0 \\ & a_{22}a_{22} & \end{array} \right\rangle \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{bmatrix} \tag{2.4}$$

Using (2.3) in (2.4), we get

$$\left\langle \begin{array}{ccc} & a_{11}a_{11} & \\ 0 & c_{11}c_{11} & 0 \\ & a_{22}a_{22} & \end{array} \right\rangle \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{bmatrix} \left(\begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \right),$$

$$= \left(\begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{bmatrix} \right)^2 \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix},$$

$$= \left(\begin{bmatrix} \lambda_1^2 \\ \lambda_2^2 \\ \lambda_3^2 \end{bmatrix} \right) \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}. \tag{2.5}$$

Since, $x = (x_1, x_2, x_3)$ is a non-zero vector, therefore, it is clear from the above equation that $\lambda_1^2, \lambda_2^2, \lambda_3^2$ are the characteristic roots of the rhotrix R^2. □

Theorem 2.2. *Let R be a rhotrix of 3-dimension satisfying the condition* **P** *of (1.6). Then there exists an invertible rhotrix S, such that $S^{-1}RS$ and R have the same characteristic roots (eigenvalues).*

Proof. Let the rhotrix be

$$R = \left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle.$$

Let $\lambda_1,\ \lambda_2,\ \lambda_3$ be its characteristic roots. Therefore,

$$\lambda^3 + (a_{11} + a_{22} + c_{11})\lambda^2 + (a_{11}c_{11} + a_{22}c_{11} + a_{22}a_{11})\lambda + (a_{11}a_{22}c_{11}) = 0.$$

Let the rhotrix

$$S = \left\langle \begin{array}{ccc} & b_{11} & \\ 0 & d_{11} & 0 \\ & b_{22} & \end{array} \right\rangle$$

be non-singular.
Therefore, the inverse of S rhotrix is given by

$$S^{-1} = \left\langle \begin{array}{ccc} & \frac{1}{b_{11}} & \\ 0 & \frac{1}{d_{11}} & 0 \\ & \frac{1}{b_{22}} & \end{array} \right\rangle. \tag{2.6}$$

Now,

$$S^{-1}RS = \left\langle \begin{array}{ccc} & \frac{1}{b_{11}} & \\ 0 & \frac{1}{d_{11}} & 0 \\ & \frac{1}{b_{22}} & \end{array} \right\rangle \left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle \left\langle \begin{array}{ccc} & b_{11} & \\ 0 & d_{11} & 0 \\ & b_{22} & \end{array} \right\rangle,$$

$$= \left\langle \begin{array}{ccc} & \frac{1}{b_{11}} & \\ 0 & \frac{1}{d_{11}} & 0 \\ & \frac{1}{b_{22}} & \end{array} \right\rangle \left\langle \begin{array}{ccc} & a_{11}b_{11} & \\ 0 & c_{11}d_{11} & 0 \\ & a_{22}b_{22} & \end{array} \right\rangle,$$

$$= \left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle. \tag{2.7}$$

Therefore, the characteristic equation of $S^{-1}RS$ is given by

$$\left| S^{-1}RS - \lambda \right| = 0,$$

i.e.,

$$\begin{vmatrix} & a_{11}-\lambda & \\ 0 & c_{11}-\lambda & 0 \\ & a_{22}-\lambda & \end{vmatrix} = 0,$$

which gives

$$\lambda^3 + (a_{11}+a_{22}+c_{11})\lambda^2 + (a_{11}c_{11}+a_{22}c_{11}+a_{22}a_{11})\lambda + (a_{11}a_{22}c_{11}) = 0. \tag{2.8}$$

It is clear from (2.2) and (2.8) that the characteristic roots of R and $S^{-1}RS$ are the same. □

Theorem 2.3. *Let R be a rhotrix of 3-dimension satisfying the condition* **P** *of (1.6). Also $\lambda = \{\lambda_1, \lambda_2, \lambda_3\}$ be the set of characteristic roots of the rhotrix R over the finite field $\mathbb{F}_2$. Then $\frac{|R|}{\lambda_i}$ (for some $i = 1, 2, 3$) is the characteristic root of the rhotrix R.*

Proof. Let $\lambda = \{\lambda_1, \lambda_2, \lambda_3\}$ be the set of characteristic roots of rhotrix

$$R = \left\langle \begin{array}{ccc} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{array} \right\rangle.$$

The determinant of the rhotrix R is given by

$$|R| = \begin{vmatrix} & a_{11} & \\ 0 & c_{11} & 0 \\ & a_{22} & \end{vmatrix}$$

$$= (a_{11}a_{22}c_{11}) \tag{2.9}$$

Therefore,

$$\frac{|R|}{\lambda_i} = \frac{(a_{11}a_{22}c_{11})}{\lambda_i}. \tag{2.10}$$

Since c_{11} is one of the characteristic roots of R among $\{\lambda_1, \lambda_2, \lambda_3\}$, thus taking $\lambda_i = c_{11}$ and putting in (2.10), we get

$$\frac{|R|}{\lambda_i} = \frac{(a_{11}a_{22}c_{11})}{c_{11}}$$

$$= a_{11}a_{22}. \tag{2.11}$$

Putting the value of $\frac{|R|}{\lambda_i}$ from (2.11) in the characteristic equation of R given in (2.2), we get

$$(a_{11}a_{22})^3 + (a_{11}+a_{22}+c_{11})(a_{11}a_{22})^2 + (a_{11}c_{11}+a_{22}c_{11}+a_{22}a_{11})(a_{11}a_{22}) + (a_{11}a_{22}c_{11}) = 0. \tag{2.12}$$

Therefore, it is clear from (2.12) that $\frac{|R|}{\lambda_i}$ satisfies the equation (2.2). This implies that $\frac{|R|}{\lambda_i}$ is the characteristic root of R. □

Theorem 2.4. *Let R_n be a rhotrix over finite field $\mathbb{F}_2$, satisfying the condition* **P** *of (1.6). Then,* $\mathrm{H}(R_n^2) = 1$.

Proof. Let the rhotrix R_n be given by

$$R_n = \left\langle \begin{array}{ccccccc} & & & & a_{11} & & \\ & & & a_{21} & c_{11} & & \\ & & a_{31} & c_{21} & a_{22} & & \\ & \cdots & \cdots & \cdots & \cdots & & \\ & a_{(n-1)1} & \cdots & \cdots & \cdots & \sum a_{\frac{(n-1)}{2}\ \frac{(n-1)}{2}} & \\ a_{n1} & c_{(n-1)1} & \cdots & \cdots & \sum a_{\frac{(n+1)}{2}\ \frac{(n-1)}{2}} & \sum c_{\frac{(n-1)}{2}\ \frac{(n-1)}{2}} & \\ & a_{n2} & \cdots & \cdots & \cdots & \sum a_{\frac{(n+1)}{2}\ \frac{(n+1)}{2}} & \\ & \cdots & \cdots & \cdots & \cdots & \cdots & \\ & & a_{n(n-2)} & c_{n(n-1)} & a_{(n-1)(n-1)} & & \\ & & & a_{n(n-1)} & c_{(n-1)(n-1)} & & \\ & & & & a_{nn} & & \end{array} \right\rangle$$

$$\left\langle \begin{matrix} a_{12} \\ c_{12} \\ \cdots \\ \cdots \\ \sum a_{\frac{(n-1)}{2}\ \frac{(n+1)}{2}} \\ \cdots \\ \cdots \\ c_{(n-1)n} \\ a_{(n-1)n} \end{matrix} \quad \begin{matrix} a_{13} \\ \cdots \\ \cdots \\ \cdots \\ \cdots \\ \cdots \\ a_{(n-2)n} \end{matrix} \quad \begin{matrix} \cdots \\ \cdots \\ \cdots \\ \cdots \\ \cdots \end{matrix} \quad \begin{matrix} a_{1(n-1)} \\ c_{1(n-1)} \\ a_{2n} \end{matrix} \quad a_{1n} \right\rangle .$$

Since the rhotrix R_n satisfies the condition **P** of (1.6), therefore R_n becomes

$$R_n = \left\langle \begin{matrix} & & & & & 1 & & & & \\ & & & 0 & & 1 & & 0 & & \\ & & 1 & 0 & & 1 & & 0 & 1 & \\ \cdots & \cdots & \cdots & \cdots & & \cdots & & \cdots & \cdots & \cdots \\ 0 & \cdots & \cdots & \cdots & & \sum a_{\frac{(n-1)}{2}\ \frac{(n-1)}{2}} & & \cdots & \cdots & \cdots & 0 \\ 0 & \cdots & \cdots & 0 & & \sum c_{\frac{(n-1)}{2}\ \frac{(n-1)}{2}} & & 0 & \cdots & \cdots & 0 \\ 0 & \cdots & \cdots & \cdots & & \sum a_{\frac{(n+1)}{2}\ \frac{(n+1)}{2}} & & \cdots & \cdots & \cdots & 0 \\ \cdots & \cdots & \cdots & \cdots & & \cdots & & \cdots & \cdots & \cdots & \\ & a_{n(n-2)} & & 0 & & a_{(n-1)(n-1)} & & 0 & a_{(n-2)n} & & \\ & & & 0 & & c_{(n-1)(n-1)} & & 0 & & & \\ & & & & & a_{nn} & & & & & \end{matrix} \right\rangle \quad a_{n1} \quad a_{1n} \quad , \qquad (2.13)$$

where $a_{11}, c_{11}, a_{21}, a_{12}, c_{21}, c_{21}, \ldots, c_{(n-1)(n-1)}, a_{nn} \in \mathbb{F}_2$ and $c_{\frac{(n-1)}{2}\ \frac{(n-1)}{2}}$ is the heart of the rhotrix R_n, that is, $H(R_n)$.
Since, $R_n^2 = R_n R_n$, therefore,

$$R_n^2 = \left\langle \begin{matrix} & & & & & & & & & & \sum_{i,j=1}^{n} a_{ij}a_{ji} \\ & & & & & & & & & 0 & \sum_{i,j=1}^{n} c_{ij}c_{ji} \\ & & & & & & & \sum_{i=3,j=1}^{n} a_{ij}a_{ji} & & 0 & \sum_{i,j=2}^{n} a_{ij}a_{ji} \\ & & & & & & 0 & \sum_{i=3,j=1}^{n} c_{ij}c_{ji} & & 0 & \sum_{i,j=2}^{n} c_{ij}c_{ji} \\ & & & & & & \cdots & \cdots & & \cdots & \cdots \\ & & & & & \cdots & \cdots & \cdots & & \cdots & \cdots \\ & & & & \cdots & \cdots & \cdots & \cdots & & \cdots & \cdots \\ 0 & \cdots & \cdots & \cdots & \cdots & \cdots & & \cdots & & \cdots & \sum_{i,j=1}^{n} a_{\frac{(n-1)}{2}\ i}\, a_{j\ \frac{(n-1)}{2}} \\ 0 & \cdots & \cdots & \cdots & \cdots & \cdots & & \cdots & & 0 & \sum_{i,j=1}^{n} c_{\frac{(n-1)}{2}\ i}\, c_{j\ \frac{(n-1)}{2}} \\ 0 & & \cdots & \cdots & \cdots & \cdots & & \cdots & & \cdots & \sum_{i,j=1}^{n} a_{\frac{(n+1)}{2}\ i}\, a_{j\ \frac{(n+1)}{2}} \\ & & & & \cdots & \cdots & & \cdots & & \cdots & \cdots \\ & & & & & \cdots & & \cdots & & \cdots & \cdots \\ & & & & & 0 & & \cdots & & \cdots & \cdots \\ & & & & & & & \cdots & & \cdots & \cdots \\ & & & & & & \sum_{i=n}^{n}\sum_{j=3}^{n} a_{ij}a_{(j-2)i} & & 0 & \sum_{i,j=3}^{n} a_{(i-1)j}a_{(j-1)i} \\ & & & & & & & & 0 & \sum_{i,j=2}^{n} c_{(i-1)j}c_{(j-1)i} \\ & & & & & & & & & \sum_{i=1}^{n} a_{ii}a_{ii} \end{matrix} \right\rangle$$

$$
\begin{array}{ccccccccccccc}
0 & & & & & & & & & & & & \\
0 & \sum\limits_{i=1,j=3}^{n} a_{ij}a_{ji} & & & & & & & & & & & \\
0 & \sum\limits_{i=1,j=3}^{n} c_{ij}c_{ji} & 0 & & & & & & & & & & \\
\cdots & \cdots & \cdots & \cdots & & & & & & & & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & & & & & & & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots & & & & & & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & 0 & & & & \\
0 & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & 0 & \sum\limits_{j=n}^{n}\sum\limits_{i=1}^{n} a_{ij}a_{ji} & \Big\rangle & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & 0 & & & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & & & & & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & & & & & & & & \\
\cdots & \cdots & \cdots & \cdots & & & & & & & & & \\
\cdots & \cdots & 0 & & & & & & & & & & \\
0 & \sum\limits_{j=n}^{n}\sum\limits_{i=3}^{n} a_{(i-2)j}a_{ji} & & & & & & & & & & & \\
0 & & & & & & & & & & & &
\end{array}
\tag{2.14}
$$

Obviously, the heart of the rhotrix R_n^2 is

$$
H\left(R_n^2\right) = \sum_{i,j=1}^{n} c_{\frac{(n-1)}{2}\,i}\, c_{j\,\frac{(n-1)}{2}}\,, \tag{2.15}
$$

where $\frac{(n-1)}{2}$ is always even.
Therefore,

$$
\begin{aligned}
\sum_{i,j=1}^{n} c_{\frac{(n-1)}{2}\,i}\, c_{j\,\frac{(n-1)}{2}} &= c_{1i}c_{j1} + c_{2i}c_{j2} + c_{3i}c_{j3} + \ .\ .\ .\ + c_{\frac{(n-1)}{2}\,i}\, c_{j\,\frac{(n-1)}{2}}\,, \\
&= c_{11}c_{11} + c_{13}c_{31} + c_{15}c_{51} + c_{21}c_{12} + \ .\ .\ .\ + c_{\frac{(n-1)}{2}\,n}\, c_{n\,\frac{(n-1)}{2}}\,.
\end{aligned} \tag{2.16}
$$

By using the condition **P** of (1.6) in (2.16) the terms like $c_{12}c_{21}$ become zero. Similarly, all the terms with $i+j =$ an odd number are zero and only the terms for which $i+j =$ an even number survive. Since these terms are always odd in number, therefore, it is clear form (2.16) that sum of all these terms is equal to 1 over the finite field $\mathbb{F}_2$. Hence, we conclude that heart of rhotrix R_n^2 is always equal to 1. □

Theorem 2.5. *Let R_n be a rhotrix satisfying the condition* **P** *of* (1.6). *Then, there exist a sub-rhotrix*

$$
\begin{cases}
\left\langle \begin{array}{ccc} & 0 & \\ 0 & 1 & 0 \\ & 0 & \end{array} \right\rangle, \text{ for } n = 4k_1 \pm 1, \text{ where } k_1 \text{ is an even number,} \\
\left\langle \begin{array}{ccc} & 1 & \\ 0 & 1 & 0 \\ & 1 & \end{array} \right\rangle, \text{ for } n = 4k_2 \pm 1, \text{ where } k_2 \text{ is an odd number,}
\end{cases} \tag{2.17}
$$

of R_n^2 over the finite field $\mathbb{F}_2$.

Proof. Let the rhotrix R_n be

$$R_n = \left\langle \begin{array}{ccccccccccccc} & & & & & & 1 & & & & & & \\ & & & & & 0 & 1 & 0 & & & & & \\ & & & & 1 & 0 & 1 & 0 & 1 & & & & \\ & & .. & & .. & .. & .. & .. & .. & .. & & & \\ & 0 & .. & & .. & .. & .. & .. & .. & .. & 0 & & \\ a_{n1} & 0 & .. & & .. & .. & .. & .. & .. & .. & 0 & a_{1n} & \\ & 0 & .. & & .. & .. & .. & .. & .. & .. & 0 & & \\ & & .. & & .. & .. & .. & .. & .. & & & & \\ & & & a_{n(n-2)} & 0 & a_{(n-1)(n-1)} & 0 & a_{(n-2)n} & & & & & \\ & & & & 0 & c_{(n-1)(n-1)} & 0 & & & & & & \\ & & & & & a_{nn} & & & & & & & \end{array} \right\rangle,$$

Since, $R_n^2 = R_n R_n$, therefore,

$$R_n^2 = \left\langle \begin{array}{ccccccccccccc} & & & & & & & & & & & & \sum_{i,j=1}^{n} a_{ij}a_{ji} \\ & & & & & & & & & & & & \sum_{i,j=1}^{n} c_{ij}c_{ji} \\ & & & & & & & \sum_{i=3,j=1}^{n} a_{ij}a_{ji} & & & 0 & & \sum_{i,j=2}^{n} a_{ij}a_{ji} \\ & & & & & & 0 & \sum_{i=3,j=1}^{n} c_{ij}c_{ji} & & & 0 & & \sum_{i,j=2}^{n} c_{ij}c_{ji} \\ & & & & & & \cdots & \cdots & & & \cdots & & \cdots \\ & & & & & \cdots & \cdots & \cdots & & & \cdots & & \cdots \\ & & & & \cdots & \cdots & \cdots & \cdots & & & \cdots & & \sum_{i,j=1}^{n} c_{\frac{(n-3)}{2}\,i}\, c_{j\,\frac{(n-3)}{2}} \\ & & 0 & \cdots & \cdots & \cdots & \cdots & \cdots & & & \cdots & & 0 & & \sum_{i,j=1}^{n} a_{\frac{(n-1)}{2}\,i}\, a_{j\,\frac{(n-1)}{2}} \\ \sum_{i=n}\sum_{j=1}^{n} a_{ij}a_{ji} & & 0 & \cdots & \cdots & \cdots & \cdots & \cdots & \sum_{i,j=1}^{n} c_{\frac{(n+1)}{2}\,i}\, c_{j\,\frac{(n-3)}{2}} & & & & 0 & & \sum_{i,j=1}^{n} c_{\frac{(n-1)}{2}\,i}\, c_{j\,\frac{(n-1)}{2}} \\ & & 0 & & \cdots & \cdots & \cdots & \cdots & & & \cdots & & 0 & & \sum_{i,j=1}^{n} a_{\frac{(n+1)}{2}\,i}\, a_{j\,\frac{(n+1)}{2}} \\ & & & & & & \cdots & \cdots & & & \cdots & & \cdots & & \sum_{i,j=1}^{n} c_{\frac{(n+1)}{2}\,i}\, c_{j\,\frac{(n+1)}{2}} \\ & & & & & & \cdots & \cdots & & & \cdots & & \cdots & & \cdots \\ & & & & & & \cdots & \cdots & & & \cdots & & \cdots & & \cdots \\ & & & & & & & \cdots & & & \cdots & & \cdots & & \cdots \\ & & & & & & & \sum_{i=n}\sum_{j=3}^{n} a_{ij}a_{(j-2)i} & & & 0 & & \sum_{i,j=2}^{n} a_{(i-1)j}a_{(j-1)i} \\ & & & & & & & & & & 0 & & \sum_{i,j=2}^{n} c_{(i-1)j}c_{(j-1)i} \\ & & & & & & & & & & & & \sum_{i=1}^{n} a_{ii}a_{ii} \end{array} \right\rangle$$

$$\begin{array}{cccccccccccc}
0 & & & & & & & & & & & \\
0 & \sum_{i=1,j=3}^{n} a_{ij}a_{ji} & & & & & & & & & & \\
0 & \sum_{i=1,j=3}^{n} a_{ij}a_{ji} & 0 & & & & & & & & & \\
\cdots & \cdots & \cdots & \cdots & & & & & & & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & & & & & & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots & & & & & & \\
0 & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & 0 & & & \\
0 & \sum_{i,j=1}^{n} a_{\frac{(n-3)}{2}i}a_{j\frac{(n+1)}{2}} & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & 0 & \sum_{j=n}^{n}\sum_{i=1}^{n} a_{ij}a_{ji} & & \\
0 & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & 0 & & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & & & & & \\
\cdots & \cdots & \cdots & \cdots & \cdots & & & & & & & \\
\cdots & \cdots & \cdots & \cdots & & & & & & & & \\
\cdots & \cdots & 0 & & & & & & & & & \\
0 & \sum_{j=n}^{n}\sum_{i=3}^{n} a_{(i-2)j}a_{ji} & & & & & & & & & & \\
0 & & & & & & & & & & &
\end{array} \Bigg\rangle \tag{2.18}$$

For $n = 5$, the entries of R_n^2 are as follows:

$$\begin{aligned}
\sum_{n=5}\sum_{i,j=1}^{3} a_{\frac{(n-1)}{2}i}a_{j\frac{(n-1)}{2}} &= a_{21}a_{12} + a_{22}a_{22} + a_{23}a_{32} \\
&= 0 + 1 + 0 \\
&= 1,
\end{aligned}$$

$$\begin{aligned}
\sum_{n=5}\sum_{i,j=1}^{2} c_{\frac{(n-1)}{2}i}c_{j\frac{(n-1)}{2}} &= c_{21}c_{12} + c_{22}c_{22} \\
&= 1 + 0 \\
&= 1,
\end{aligned}$$

$$\begin{aligned}
\sum_{n=5}\sum_{i,j=1}^{2} c_{\frac{(n-3)}{2}i}c_{j\frac{(n-3)}{2}} &= c_{11}c_{11} + c_{12}c_{21} \\
&= 0 + 1 \\
&= 1,
\end{aligned}$$

$$\begin{aligned}
\sum_{n=5}\sum_{i,j=1}^{2} c_{\frac{(n-1)}{2}i}c_{j\frac{(n-3)}{2}} &= c_{11}c_{12} + c_{12}c_{22} \\
&= 0 + 0 \\
&= 0
\end{aligned}$$

and $\sum_{n=5}\sum_{i,j=1}^{2} c_{\frac{(n-3)}{2}i}c_{j\frac{(n-1)}{2}} = c_{21}c_{11} + c_{22}c_{21}$

$$\begin{aligned}
&= 0 + 0 \\
&= 0.
\end{aligned}$$

Clearly, $\left\langle \begin{array}{ccc} & 1 & \\ 0 & 1 & 0 \\ & 1 & \end{array} \right\rangle$ is a sub-rhotrix of R_n^2 over the finite field $\mathbb{F}_2$.

Similarly, for $n = 7$, the entries of R_n^2 are as follows:

$$\sum_{n=7}\sum_{i,j=1}^{3} c_{\frac{(n-3)}{2}i}c_{j\frac{(n-3)}{2}} = c_{21}c_{12} + c_{22}c_{22} + c_{23}c_{32}$$

$$= 0 + 1 + 0$$
$$= 1,$$

$$\sum_{n\,=\,7}\ \sum_{i\,,j=1}^{4} a_{\frac{(n-1)}{2}\,i}\, a_{j\,\frac{(n-1)}{2}} = a_{31}a_{13} + a_{32}a_{23} + a_{33}a_{33} + a_{34}a_{43}$$
$$= 1 + 0 + 1 + 0$$
$$= 0,$$

$$\sum_{n\,=\,7}\ \sum_{i\,,j=1}^{4} a_{\frac{(n-3)}{2}\,i}\, a_{j\,\frac{(n-3)}{2}} = a_{21}a_{12} + a_{22}a_{22} + a_{23}a_{32} + a_{24}a_{42}$$
$$= 0 + 1 + 0 + 1$$
$$= 0,$$

$$\sum_{n\,=\,7}\ \sum_{i\,,j=1}^{4} a_{\frac{(n-1)}{2}\,i}\, a_{j\,\frac{(n-3)}{2}} = a_{31}a_{12} + a_{32}a_{22} + a_{33}a_{32} + a_{34}a_{42}$$
$$= 0 + 0 + 0 + 0$$
$$= 0,$$

and $\sum_{n\,=\,7}\ \sum_{i\,,j=1}^{4} a_{\frac{(n-3)}{2}\,i}\, a_{j\,\frac{(n-1)}{2}} = a_{21}a_{13} + a_{22}a_{23} + a_{23}a_{33} + a_{24}a_{43}$

$$= 0 + 0 + 0 + 0$$
$$= 0,$$

Clearly, $\left\langle \begin{array}{ccc} & 0 & \\ 0 & 1 & 0 \\ & 0 & \end{array} \right\rangle$ is a sub-rhotrix of R_n^2 over the finite field $\mathbb{F}_2$.

Therefore, in the same way for other values of n, we conclude the desired result of (2.17) for R_n^2 rhotrix. □

3 Illustrations

Here, we illustrate some results given in section 2 with the help of examples.

Example 3.1. Let R_5 be a rhotrix satisfying the condition **P** of (1.6) and let it given by

$$R_5 = \left\langle \begin{array}{ccccc} & & 1 & & \\ & 0 & 1 & 0 & \\ 1 & 0 & 1 & 0 & 1 \\ & 0 & 1 & 0 & \\ & & 1 & & \end{array} \right\rangle.$$

Now, $R_5^2 = R_5 R_5$

$$= \left\langle \begin{array}{ccccc} & & 1 & & \\ & 0 & 1 & 0 & \\ 1 & 0 & 1 & 0 & 1 \\ & 0 & 1 & 0 & \\ & & 1 & & \end{array} \right\rangle \left\langle \begin{array}{ccccc} & & 1 & & \\ & 0 & 1 & 0 & \\ 1 & 0 & 1 & 0 & 1 \\ & 0 & 1 & 0 & \\ & & 1 & & \end{array} \right\rangle,$$

$$= \left\langle \begin{array}{ccccc} & & 2 & & \\ & 0 & 1 & 0 & \\ 2 & 0 & 1 & 0 & 2 \\ & 0 & 1 & 0 & \\ & & 2 & & \end{array} \right\rangle.$$

Since, all the entries of above rhotrix belong to the finite field $\mathbb{F}_2$, therefore, we get

$$R_5^2 = \left\langle \begin{array}{ccccc} & & 0 & & \\ & 0 & 1 & 0 & \\ 0 & 0 & 1 & 0 & 0 \\ & 0 & 1 & 0 & \\ & & 0 & & \end{array} \right\rangle. \tag{3.1}$$

Clearly, the heart of matrix R_5^2 over the finite field $\mathbb{F}_2$ is 1. Further, from (3.1) it is concluded that, there is a sub-rhotrix of R_5^2 of the form $\left\langle \begin{array}{ccc} & 1 & \\ 0 & 1 & 0 \\ & 1 & \end{array} \right\rangle$.

Example 3.2. Let R be a rhotrix of 7-dimensions satisfying the condition **P** of (1.6) and suppose it is given by

$$R_7 = \left\langle \begin{array}{ccccccc} & & & 1 & & & \\ & & 0 & 1 & 0 & & \\ & 1 & 0 & 1 & 0 & 1 & \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ & 1 & 0 & 1 & 0 & 1 & \\ & & 0 & 1 & 0 & & \\ & & & 1 & & & \end{array} \right\rangle.$$

Now,

$$R_7^2 = \left\langle \begin{array}{ccccccccc} & & & 1 & & & & & \\ & & 0 & 1 & 0 & & & & \\ & 1 & 0 & 1 & 0 & 1 & & & \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & & \\ & 1 & 0 & 1 & 0 & 1 & & & \\ & & 0 & 1 & 0 & & & & \\ & & & 1 & & & & & \end{array} \right\rangle \left\langle \begin{array}{ccccccccc} & & & 1 & & & & & \\ & & 0 & 1 & 0 & & & & \\ & 1 & 0 & 1 & 0 & 1 & & & \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & & \\ & 1 & 0 & 1 & 0 & 1 & & & \\ & & 0 & 1 & 0 & & & & \\ & & & 1 & & & & & \end{array} \right\rangle,$$

$$= \left\langle \begin{array}{ccccccccc} & & & 2 & & & & & \\ & & 0 & 2 & 0 & & & & \\ & 2 & 0 & 2 & 0 & 2 & & & \\ 0 & 2 & 0 & 1 & 0 & 2 & 0 & & \\ & 2 & 0 & 2 & 0 & 2 & & & \\ & & 0 & 2 & 0 & & & & \\ & & & 2 & & & & & \end{array} \right\rangle.$$

After reducing all the entries over the finite field $\mathbb{F}_2$, we get

$$R_7^2 = \left\langle \begin{array}{ccccccccc} & & & 0 & & & & & \\ & & 0 & 0 & 0 & & & & \\ & 0 & 0 & 0 & 0 & 0 & & & \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & & \\ & 0 & 0 & 0 & 0 & 0 & & & \\ & & 0 & 0 & 0 & & & & \\ & & & 0 & & & & & \end{array} \right\rangle. \tag{3.2}$$

Therefore, it is clear from (3.2) that there exist a sub-rhotrix of R_7^2 which is of the form $\left\langle \begin{array}{ccc} & 0 & \\ 0 & 1 & 0 \\ & 0 & \end{array} \right\rangle$.

4 Conclusion

We considered the rhotrices of 3-dimensions and derived some properties related to their characteristic roots. Further, we discussed results related to the heart and sub-rhotrix of n-dimensional rhotrices.

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Research Article

Recursive construction of normal polynomials over finite fields

P. L. Sharma, Ashima & Arun Kumar Sharma

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Abstract

Recently, Kim and Son [9] have obtained an infinite sequence of irreducible polynomials over the finite field F_q of characteristic p by using the transformation $x \to \frac{x^p - x^{p-1} + 1}{-x^{p-1} + 1}$. Here, it is shown that one can also build this infinite sequence of irreducible polynomials over the field F_q of characteristic p by using a different transformation $x \to \frac{x^p - x^{p-1} + 1}{x^p}$. Moreover, this transformation is helpful to establish the sequence of normal polynomials $(F_r(x))_{r \geq 0}$ of degree np^r in $F_q[x]$ by using an appropriate initial normal polynomial of degree n.

Subject Classification: 12E05 12E10 12E20

Keywords: Finite field Irreducible polynomial Normal polynomial Self -reciprocal polynomial

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ON ARRESTING THE COMPLEX GROWTH RATE OF A PERTURBATION IN FERROTHERMOSOLUTAL CONVECTION IN A POROUS MEDIUM: DARCY MODEL

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Abstract: In the present paper upper bounds for the complex growth rate of a disturbance in ferrothermosolutal convection in a porous medium have been obtained by using Darcy model. It is proved that the complex growth rate $\sigma = \sigma_r + i\sigma_i$($\sigma_r$ and σ_i are respectively the real and imaginary parts of σ) of an arbitrary oscillatory perturbation of growing amplitude in ferrothermosolutal convection in a densely packed porous medium, for the case of free boundaries, lies inside a semicircle in the right half of the $\sigma_r\sigma_i$-plane whose center is at the origin and radius $= \sqrt{\frac{\varepsilon R_s\left[1-M_1'\left(1-\frac{1}{M_5}\right)\right]}{P_s}}$, where R_s is the solutal Rayleigh number, ε is the porosity of the medium, P_s is the solutal Prandtl number, M_1' is the ratio of magnetic flux due to concentration fluctuation to the gravitational force and M_5 is the ratio of concentration effect on magnetic field to pyromagnetic coefficient. Further, the case of deriving upper bounds for rigid boundaries is also dealt separately.

Keywords: Ferrofluid, Ferrothermosolutal Convection, Porous Medium, Darcy Model.

1. Introduction

A ferrofluid also known as magnetic Nano fluid is composed of small particles (dimensions of 3-15 nm) of solid, magnetic particles coated with some surfactant to prevent their aggregation and dispersed in a liquid carrier such as water, kerosene or ester. A ferrofluid does not exist in nature but are synthesized. Being highly interdisciplinary in nature, the ferrofluid researches has brought engineers, applied Mathematicians, Chemists, Physicians, theoretical and experimental Physicist together which ultimately resulted into wide range of practical applications e. g. energy conversion devices,noiseless jet printing system, high speed silent printers, liquid cooled loudspeakers, sealing of computer hard disc drives, the treatment of ulcers and brain tumours, destroying cancer cells, contrast enhancement of magnetic resonance imaging (MRI) etc. (Rosensweig [18], Odenbach [7-8]).

The concept of thermal convection in ferrofluids in the presence of magnetic field is similar to Bénard convection. These manifold practical applications of ferrofluids have attracted many scientists towards the study of thermal convection in ferrofluids in porous/non-porous media. In a fundamental paper Finlayson [4] studied the convective instability of ferromagnetic fluids and explained the concept of thermomechanical interactions in ferrofluids. Lalas and Carmi [6] investigated the thermoconvective stability of ferrofluids without considering buoyancy effects. Rosensweig et al. [19] investigated experimentally the penetration of ferrofluids in a Hele-Shaw cell. Gupta and Gupta [5] studied the effect of rotation on the convective instability of a layer of a ferromagnetic fluid. The effect of magnetic field dependent (MFD) viscosity on the thermal convection in a ferrofluid layer saturating a sparsely distributed porous medium has been studied by Prakash et al. [14].

For a broad view of the study of ferroconvection with heat as a single diffusive component one may be referred to Rahman and Suslov [16], Sekar and Vaidyanathan [22], Prakash [12], Prakash et al.[14], Ekaterina and Ekaterina [3], Prakasha [15], Ram et al. [17].

Moreover, since ferrofluids are mostly organic solvent carriers having suspensions of ferromagnetic salts acting as solute, it is also important to study the convective instability in ferrofluid layer having two diffusive components (also known as ferrothermosolutal convection). Several researchers have contributed in the development of ferrothermosolutal convection problem in porous/non-porous media. Vaidyanathan et al. [26] have studied the effect of a concentration gradient on double diffusive ferrofluid layer saturating a porous medium heated from below and salted from above for fixed particle suspensions causing various porosities. Sekar and Raju [21] investigated the effect of sparse distribution pores in thermohaline convection in a micropolar ferromagnetic fluid. Sekar and Murugan [25] studied the linear stability effect of densely distributed porous medium and coriolis force on Soret driven ferrothermohaline convection.For more studies one may be referred to Sekar et al. [23-24].

Since for a double diffusive ferroconvection problem the exact solutions in closed form are not possible for the cases where both the boundaries are not free, therefore the problem of obtaining the upper bounds for the complex growth rate of an arbitrary disturbance has its own importance[1]. Recently, Prakash [9-10] has derived upper bounds for the complex growth rates in some ferromagnetic convection problems in porous/non-porous medium. Prakash and Gupta [11] have extended his work to include the effect of rotation and magnetic field dependent viscosity on ferromagnetic convection. Recently, Prakash and Bala [13] also derived the upper bounds for complex growth rates in ferromagnetic convection with magnetic field dependent viscosity in a rotating sparsely distributed porous medium. To the best of our knowledge no attempt has been made, so far, to find such bounds for the case of ferrothermosolutal convection configurations.

Thus as a further step, we have derived the upper bounds for the complex growth rates in ferrothermosolutal convection in a densely packed porous medium in the presence of a uniform vertical magnetic field for the cases of free and rigid boundaries separately. The

present work will definitely pave the way for further theoretical and experimental investigations in this field of enquiry.

2. Mathematical Formulation

Consider a ferromagnetic Boussinesq fluid layer of infinite horizontal extension and finite vertical thickness d, saturating a densely packed porous medium heated and salted from below. The fluid layer is statically confined between the horizontal boundaries $z = 0$ and $z = d$ which are respectively maintained at uniform temperatures T_0 and $T_1(< T_0)$ and concentrations S_0 and $S_1(< S_0)$ under the action of a uniform vertical magnetic field $\boldsymbol{H}$ (see Fig.1). Darcy model has been used to analyze this problem.

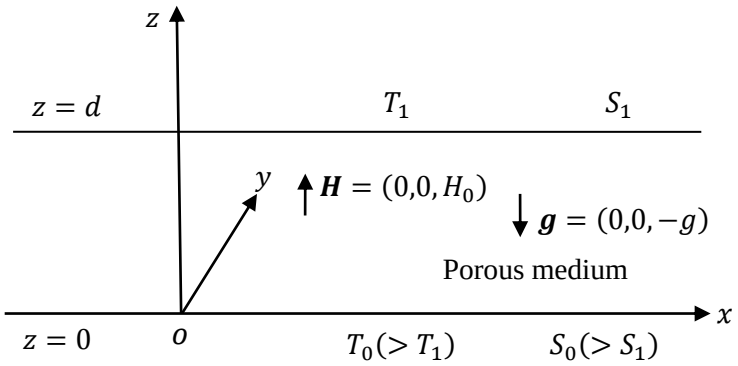

Fig 1 Geometrical configuration of the problem.

The Basic hydrodynamic equations governing the flow of the ferromagnetic fluid for the above model are given by (Finlayson [4] Divya et al. [2])

$$\nabla . \boldsymbol{q} = 0, \tag{1}$$

$$\frac{\rho_0}{\varepsilon}\left[\frac{\partial}{\partial t} + \frac{1}{\varepsilon}(\boldsymbol{q}.\nabla)\right]\boldsymbol{q} = -\nabla p + \rho \boldsymbol{g} + \nabla.(\boldsymbol{HB}) - \frac{\mu}{k_1}\boldsymbol{q}, \tag{2}$$

$$\varepsilon\left[\rho_0 C_{V,H} - \mu_0 \boldsymbol{H}.\left(\frac{\partial \boldsymbol{M}}{\partial T}\right)_{V,H}\right]\frac{DT}{Dt} + (1-\varepsilon)\rho_s C_s \frac{\partial T}{\partial t} + \mu_0 T\left(\frac{\partial \boldsymbol{M}}{\partial T}\right)_{V,H}.\frac{D\boldsymbol{H}}{Dt} = K_1 \nabla^2 T + \Phi_T, \tag{3}$$

$$\varepsilon\left[\rho_0 C_{V,H} - \mu_0 \boldsymbol{H}.\left(\frac{\partial \boldsymbol{M}}{\partial S}\right)_{V,H}\right]\frac{DS}{Dt} + (1-\varepsilon)\rho_s C_s \frac{\partial S}{\partial t} + \mu_0 S\left(\frac{\partial \boldsymbol{M}}{\partial S}\right)_{V,H}.\frac{D\boldsymbol{H}}{Dt} = K_1' \nabla^2 S + \Phi_S, \tag{4}$$

where $\boldsymbol{q}, \varepsilon, t, p, \boldsymbol{H}, \boldsymbol{B}, \mu, \boldsymbol{g}(0,0-g), k_1, C_{V,H}, \mu_0, T, S, \boldsymbol{M}, K_1, K_1', \Phi_T$and Φ_S denote respectively the velocity, porosity of the medium, time, pressure, magnetic field, magnetic induction, variable viscosity, acceleration due to gravity, permeability of the porous medium, heat capacity at constant volume and magnetic field, magnetic permeability, temperature, concentration, magnetization, thermal conductivity, solute conductivity, viscous dissipation function containing second order terms in velocity gradient and viscous dissipation function analogous to Φ_T but corresponding to solute.

The equation of state is given by

$$\rho = \rho_0[1 - \alpha(T - T_0) + \alpha'(S - S_0)], \tag{5}$$

where ρ is the fluid density, ρ_0 is the reference density, α is the coefficient of volume expansion, α' is an analogous solvent coefficient of expansion, T_0 is the temperature and S_0 is the concentration at the lower boundary.

Maxwell's equations for non-conducting fluid with no displacement current given by Finlayson (1970) as

$$\nabla . \boldsymbol{B} = 0, \nabla \times \boldsymbol{H} = \boldsymbol{0}. \tag{6a,b}$$

Further, the relation between $\boldsymbol{B}$and$\boldsymbol{H}$is expressed by

$$\boldsymbol{B} = \mu_0(\boldsymbol{H} + \boldsymbol{M}). \tag{7}$$

It is assumed that the magnetization is aligned with the magnetic field intensity and depends on the magnitude of magnetic field, temperature and salinity (Finlayson [4]), so that

$$\boldsymbol{M} = \frac{\boldsymbol{H}}{H} M(H, T, S). \tag{8}$$

Finally, the linearized magnetic equation of state is given by

$$M = M_o + \chi(H - H_0) - K_2(T - T_0) + K_3\,(S - S_0). \tag{9}$$

In the above equation $M_0 = M(H_0, T_0, S_0)$ is the magnetization when magnetic field is H_0, temperature is T_0 and concentration is S_0, $\chi = \left(\frac{\partial M}{\partial H}\right)_{H_0,T_0}$ is magnetic susceptibility, $K_2 = -\left(\frac{\partial M}{\partial T}\right)_{H_0,T_0}$ is the pyromagnetic coefficient, $K_3 = \left(\frac{\partial M}{\partial S}\right)_{H_0,S_0}$ is the salinity magnetic coefficient, H is the magnitude of $\boldsymbol{H}$, M is the magnitude of $\boldsymbol{M}$.

Now following Finlayson [4] and Divya et al. [2] using linear stability theory, we obtain the following set of non-dimensional equations

$$\left(\frac{\sigma}{\varepsilon} + \frac{1}{k_1}\right)(D^2 - a^2)w = a\,{R_a}^{1/2}\left[(M_1 - M_4)D\Phi_1 - (1 + M_1 - M_4)\theta\right] + a\,{R_s}^{1/2}[(M_1' - M_4')D\Phi_2 + (1 - M_1' + M_4')\phi], \tag{10}$$

$$(D^2 - a^2 - \sigma P_r)\theta = -(1 - M_2)a{R_a}^{1/2}w - P_r'\,M_2\sigma D\Phi_1, \tag{11}$$

$$(D^2 - a^2 - \sigma P_s)\phi = -(1 - M_2')a{R_s}^{1/2}w - P_s'M_2'\sigma D\Phi_2, \tag{12}$$

$$(D^2 - a^2M_3)\Phi_1 = D\theta, \tag{13}$$

$$(D^2 - a^2M_3)\Phi_2 = D\phi, \tag{14}$$

where z is the real independent variable such that $0 \le z \le 1$, D is differentiation with respect to z, a^2 is square of the wave number, $P_r = \frac{\nu\rho C_1}{K_1} > 0$ is the thermal Prandtl

number,$P_s = \frac{\nu\rho C_1'}{K_1'} > 0$ is the solutal Prandtl number,, $\sigma = \frac{nd^2}{\nu}$ is the complex growth rate, $R_a = \frac{g\alpha\beta d^4\rho C_2}{K_1\nu} > 0$ is the thermal Rayleigh number, $R_s = \frac{g\alpha'\beta' d^4\rho C_2'}{K_1'\nu} > 0$ is the concentration Rayleigh number,$M_1 = \frac{\mu_0 K_2^2\,\beta}{(1+\chi)\alpha\rho_0 g} > 0$ is the ratio of magnetic force due to temperature fluctuation to the gravitational force, $M_2 = \frac{\mu_0 T_0 K_2^2}{(1+\chi)\rho C_2} > 0$ is the ratio of thermal flux due to magnetization to magnetic flux, $M_1' = \frac{\mu_0 K_3^2\beta'}{(1+\chi)\alpha'\rho_0 g} > 0$ is the ratio of magnetic flux due to concentration fluctuation to the gravitational force, $M_2' = \frac{\mu_0 S_0 K_3^2}{(1+\chi)\rho C_2'} > 0$ is the ratio of mass flux due to magnetization to magnetic flux, $M_4 = \frac{\mu_0 K_2 K_3\beta'}{(1+\chi)\alpha\,\rho_0 g} > 0$ and $M_4' = \frac{\mu_0 K_2 K_3\,\beta}{(1+\chi)\alpha'\rho_0 g} > 0$ are nondimentional parameters, , $M_5 = \frac{M_4}{M_1} = \frac{M_1'}{M_4'} = \frac{K_3\beta'}{K_2\beta} > 0$ is the ratio of concentration effect on magnetic field to pyromagnetic coefficient, $M_3 = \frac{1+\frac{M_0}{H_0}}{(1+\chi)} > 0$ is the measure of the nonlinearity of magnetization, $\sigma = \sigma_r + i\sigma_i$ is a complex constant in general such that σ_r and σ_i are real constants and as a consequence the dependent variables $w(z) = w_r(z) + i\,w_i(z)$, $\theta(z) = \theta_r(z) + i\,\theta_i(z)$, $\phi(z) = \phi_r(z) + i\,\phi_i(z), \Phi_1(z) = \Phi_{1r}(z) + i\,\Phi_{1i}(z)$, $\Phi_2(z) = \Phi_{2r}(z) + i\,\Phi_{2i}(z)$ and are complex valued functions of the real variable z such that $w_r(z)$, $w_i(z)$, $\theta_r(z)$, $\theta_i(z)$, $\phi_r(z), \phi_i(z), \Phi_{1r}(z)$, $\Phi_{1i}(z), \Phi_{2r}(z)and\Phi_{2i}(z)$ are real valued functions of the real variable z.

Since, M_2 and M_2' are of very small order (Finlayson [4]), they are neglected in the subsequent analysis and thus Eqs. (11) and (12) takes the forms

$$(D^2 - a^2 - \sigma P_r)\theta = -aR_a{}^{1/2}w, \tag{15}$$

$$(D^2 - a^2 - \sigma P_s)\phi = -aR_s{}^{1/2}w, \tag{16}$$

respectively.

The bounding surfaces are considered to be either free or rigid. Hence the boundary conditions are given by

$$w = 0 = \theta = \phi = D\Phi_1 = D\Phi_2 \text{ at } z = 0 \text{ and } z = 1, \tag{17}$$

(both the boundaries are free)

$$\text{or } w = 0 = \theta = \phi = Dw = \Phi_1 = \Phi_2 \text{ at } z = 0 \text{ and } z = 1. \tag{18}$$

(both the boundaries are rigid)

It may further be noted that Eqs. (10) and (13) - (18) describe an eigenvalue problem for σ and govern ferrothermosolutal convection in densely packed porous medium heated and salted from below.

3. Mathematical Analysis

We now derive upper bounds for the complex growth rate of the arbitrary oscillatory perturbations of neutral or growing amplitude for the present configuration. The cases of free and rigid boundaries are studied separately. We prove the following theorems:

Theorem1: If $R_a > 0, R_s > 0, \quad M_1' > 0, 1 - M_5 > 0, P_s > 0, \sigma_r \geq 0, \delta > 0$ and $\sigma_i \, (\neq 0)$, then a necessary condition for the existence of a nontrivial solution $(w, \theta, \phi, \Phi_1, \Phi_2, \sigma)$ of the equations (10) and (13) - (18) together with the boundary conditions (17) is that $|\sigma| < \sqrt{\frac{\varepsilon R_s\left[1-M_1'\left(1-\frac{1}{M_5}\right)\right]}{P_s}}$.

Proof: Multiplying Eq. (10) by w^* (the superscript * henceforth represents the complex conjugation) throughout and integrating the resulting equation over the interval [0,1] and using the boundary conditions (17), we obtain

$$\left(\frac{\sigma}{\varepsilon}+\frac{1}{k_1}\right)\int_0^1 w^*(D^2-a^2)w\,dz = aR_a^{1/2}(M_1-M_4)\int_0^1 w^* D\Phi_1\,dz - aR_a^{1/2}(1+M_1-M_4)\int_0^1 w^*\theta\,dz + aR_s^{1/2}(M_1'-M_4')\int_0^1 w^* D\Phi_2\,dz + aR_s^{1/2}(1-M_1'+M_4')\int_0^1 w^*\phi\,dz. \tag{19}$$

Using Eqs. (13) - (16) and boundary conditions Eq. (17), the various terms of right hand side of Eq. (19) can respectively be written as

$$aR_a^{1/2}(M_1-M_4)\int_0^1 w^* D\Phi_1\,dz = -M_1(1-M_5)\int_0^1 D\Phi_1(D^2-a^2-\sigma^* P_r)\theta^*\,dz$$

$$= -M_1(1-M_5)\int_0^1 D\Phi_1 D^2\,\theta^* dz + M_1(1-M_5)(a^2+\sigma^* P_r)\int_0^1 \theta^*\, D\Phi_1 dz$$

$$= M_1(1-M_5)\int_0^1 D^2\Phi_1 D\theta^* dz - M_1(1-M_5)(a^2+\sigma^* P_r)\int_0^1 \Phi_1 D\theta^* dz$$

$$= M_1(1-M_5)\int_0^1 D^2\Phi_1(D^2-a^2M_3)\Phi_1^* dz - M_1(1-M_5)(a^2+\sigma^* P_r)\int_0^1 \Phi_1\,(D^2-a^2M_3)\Phi_1^* dz, \text{ (utilizing Eq. (13))} \tag{20}$$

$$aR_a^{1/2}(1+M_1-M_4)\int_0^1 w^*\theta\,dz = -[1+M_1(1-M_5)]\int_0^1 \theta(D^2-a^2-\sigma^* P_r)\theta^* dz. \tag{21}$$

Following the same procedure as is used to obtain Eq. (20), we have on utilizing Eq. (14) that

$$aR_s^{1/2}(M_1'-M_4')\int_0^1 w^*\, D\Phi_2 dz =$$

$$-M_4'(1-M_5)\int_0^1 D^2\Phi_2\,(D^2-a^2\,M_3)\Phi_2{}^* dz + M_4'(1-M_5)(a^2+\sigma^* P_s)\int_0^1 \Phi_2\,(D^2-a^2\,M_3)\Phi_2{}^* dz. \tag{22}$$

Further, on using (16), we have

$$aR_s^{1/2}(1-M_1'+M_4')\int_0^1 w^*\phi\,dz = -\left[1-M_1'\left(1-\frac{1}{M_5}\right)\right]\int_0^1 \phi\,(D^2-a^2-\sigma^*P_s)\phi^*dz. \tag{23}$$

Combining Eqs. (19) - (23), we obtain

$$\left(\frac{\sigma}{\varepsilon}+\frac{1}{k_1}\right)\int_0^1 w^*\,(D^2-a^2)wdz = M_1(1-\ M_5\,)\int_0^1 D^2\Phi_1(D^2-a^2M_3)\Phi_1^*dz - M_1(1-\ M_5\,)(a^2+\sigma^*P_r)\int_0^1 \Phi_1\,(D^2-a^2M_3)\Phi_1^*dz + [1+M_1(1-M_5\,)]\int_0^1 \theta(D^2-a^2-\sigma^*P_r)\theta^*dz - M_4'(1-\ M_5\,)\int_0^1 D^2\Phi_2(D^2-a^2M_3)\Phi_2^*dz + M_4'(1-\ M_5\,)(a^2+\sigma^*P_s)\int_0^1 \Phi_2\,(D^2-a^2M_3)\Phi_2^*dz - \left[1-M_1'\left(1-\tfrac{1}{M_5}\right)\right]\int_0^1 \phi\,(D^2-a^2-\sigma^*P_s)\phi^*dz. \tag{24}$$

Integrating the various terms of Eq. (24), by parts, for a suitable number of times with the help of the boundary conditions (17) and the equality

$$\int_0^1 \psi^*\,D^{2n}\psi dz\ = (-1)^n\int_0^1 |D^n\psi|^2dz, \tag{25}$$

where $\psi = w, \theta, \phi, \Phi_1, \Phi_2 (n = 1\,)$,

we get

$$\left(\frac{\sigma}{\varepsilon}+\frac{1}{k_1}\right)\int_0^1(|Dw|^2+a^2|w|^2)\,dz = -M_1(1-\ M_5\,)\int_0^1(|\,D^2\Phi_1|^2+a^2M_3|D\Phi_1|^2)dz - M_1(1-\ M_5\,)(a^2+\sigma^*P_r)\int_0^1(|D\Phi_1|^2+a^2M_3|\Phi_1|^2)\,dz + [1+M_1(1-M_5\,)]\int_0^1(|D\theta|^2+(a^2+\sigma^*P_r)|\theta|^2)\,dz + M_4'(1-\ M_5\,)\int_0^1(|\,D^2\Phi_2|^2+a^2M_3|D\Phi_2|^2)dz + M_4'(1-\ M_5\,)(a^2+\sigma^*P_s)\int_0^1(|D\Phi_2|^2+a^2M_3|\Phi_2|^2)\,dz - \left[1-M_1'\left(1-\tfrac{1}{M_5}\right)\right]\int_0^1(|D\phi|^2+(a^2+\sigma^*P_s)|\phi|^2)dz. \tag{26}$$

Equating imaginary parts of both sides of Eq. (26) and cancelling $\sigma_i(\neq 0)$, we obtain

$$\frac{1}{\varepsilon}\int_0^1(|Dw|^2+a^2|w|^2)\,dz = M_1(1-\ M_5\,)P_r\int_0^1(|D\Phi_1|^2+a^2M_3|\Phi_1|^2)\,dz - [1+M_1(1-M_5\,)]P_r\int_0^1|\theta|^2dz - M_4'(1-\ M_5\,)P_s\int_0^1(|D\Phi_2|^2+a^2M_3|\Phi_2|^2)\,dz + \left[1-M_1'\left(1-\tfrac{1}{M_5}\right)\right]P_s\int_0^1|\phi|^2dz. \tag{27}$$

Now multiplying Eq. (13) by Φ_1^* and integrating over the interval [0,1], we get

$$\int_0^1(|D\Phi_1|^2+a^2M_3|\Phi_1|^2)\,dz = \int_0^1(D\Phi_1^*)\theta dz$$

$$\leq\left|\int_0^1(D\Phi_1^*)\theta dz\right| \leq \int_0^1|(D\Phi_1^*)\theta|dz \leq \int_0^1|D\Phi_1^*|\,|\theta|dz \leq \int_0^1|D\Phi_1||\theta|dz$$

$$\leq \left(\int_0^1 |D\Phi_1|^2 dz\right)^{1/2} \left(\int_0^1 |\theta|^2 dz\right)^{1/2}, \tag{28}$$

(using the Schwartz's inequality)

which gives

$$\int_0^1 |D\Phi_1|^2 dz \leq \left(\int_0^1 |D\Phi_1|^2 dz\right)^{1/2} \left(\int_0^1 |\theta|^2 dz\right)^{1/2},$$

and hence

$$\left(\int_0^1 |D\Phi_1|^2 dz\right)^{1/2} \leq \left(\int_0^1 |\theta|^2 dz\right)^{1/2}. \tag{29}$$

On the similar lines Eq. (14) yieldsthe inequality

$$\left(\int_0^1 |D\Phi_2|^2 dz\right)^{1/2} \leq \left(\int_0^1 |\phi|^2 dz\right)^{1/2}. \tag{30}$$

Combining inequality (28) in inequality Eq. (29), we get

$$\int_0^1 (|D\phi_1|^2 + a^2 M_3 |\Phi_1|^2)\, dz \leq \int_0^1 |\theta|^2 dz. \tag{31}$$

Now multiplying Eq. (16) by its complex conjugate and integratingover the interval [0,1]for suitable of times by making use of boundary conditions (17).The real part of this resulting equation gives

$$\int_0^1 (|D^2\phi|^2 + 2a^2 |D\phi|^2 + a^4 |\phi|^2) dz + 2\sigma_r P_s \int_0^1 (|D\phi|^2 + a^2 |\phi|^2) dz + |\sigma|^2 {P_s}^2 \int_0^1 |\phi|^2 dz = a^2 R_s \int_0^1 |w|^2 dz. \tag{32}$$

Since $P_s \geq 0$, therefore from Eq. (32), we obtain

$$\int_0^1 |\phi|^2 dz \; < \frac{R_s a^2}{{P_s}^2 |\sigma|^2} \int_0^1 |w|^2 dz\,. \tag{33}$$

Using inequalities Eqs. (31) and (33) in Eq. (27), we obtain

$$\frac{1}{\varepsilon}\int_0^1 |Dw|^2 dz \; + \; a^2 \left[\frac{1}{\varepsilon} - \frac{\left[1 - M_1'\left(1 - \frac{1}{M_5}\right)\right] R_s}{P_s |\sigma|^2}\right] \int_0^1 |w|^2 dz \; + \; P_r \int_0^1 |\theta|^2 dz + \; M_4'(1 - M_5) P_s \int_0^1 (|D\Phi_2|^2 + a^2 M_3 |\Phi_2|^2) dz < 0, \tag{34}$$

which clearly implies that

$$|\sigma| < \sqrt{\frac{\varepsilon R_s \left[1 - M_1'\left(1 - \frac{1}{M_5}\right)\right]}{P_s}}.$$

This establishes the theorem.

The theorem proved above may be stated in an equivalent form, from the physical point of view, as: the complex growth rate of an arbitrary oscillatory motion of neutral or

growing amplitude in ferrothermosolutal convection in a densely packed porous medium, for the case of free boundaries, lies inside a semi-circle in the right half of the $\sigma_r\sigma_i$- plane whose centre is at the origin and radius equals to $\sqrt{\frac{\varepsilon R_s\left[1-M_1'\left(1-\frac{1}{M_5}\right)\right]}{P_s}}$.

Theorem2: If $R_a > 0,\ \ R_s > 0, M_1 > 0, M_1' > 0, 1 - M_5 > 0, P_r > 0,\ P_s > 0,\ \sigma_r \geq 0,$ $\delta > 0$ and $\sigma_i \neq 0$, then a necessary condition for the existence of a nontrivial solution $(w, \theta, \phi, \Phi_1, \Phi_2\ \sigma,)$ of the equations (10) and (13) - (16) together with the boundaryconditions (18) is that

$$|\sigma|^2\sigma_i^2 \ < \varepsilon^2\left\{\frac{R_a M_1(1-M_5)}{P_r} + \frac{R_s}{P_s}\left(1 + M_1'\left|1-\frac{1}{M_5}\right| - M_1'\left(1-\frac{1}{M_5}\right)\right)\right\}^2.$$

Proof: Multiplying equation (10) by w^* throughout and integrating the resulting equation over the interval [0,1], we get

$$\left(\frac{\sigma}{\varepsilon}+\frac{1}{k_1}\right)\int_0^1 w^*(D^2-a^2)\,w dz = a\,R_a{}^{1/2}(M_1 - M_4)\int_0^1 w^* D\Phi_1 dz - a\,R_a{}^{\frac{1}{2}}[1 + M_1 - M_4]\int_0^1 w^*\,\theta\,dz + a\,R_s{}^{\frac{1}{2}}(M_1' - M_4')\int_0^1 w^* D\Phi_2 dz + a\,R_s{}^{1/2}[1 - M_1' + M_4']\int_0^1 w^*\,\phi dz. \tag{35}$$

Eqs. (15) and (16) respectively yields

$$-a\,R_a{}^{1/2}[1 + M_1 - M_4]\int_0^1 w^*\theta\,dz \ = \ [1 + M_1(1 - M_5)]\int_0^1 \theta\,(D^2 - a^2 - P_r\sigma^*)\theta^* dz, \tag{36}$$

and

$$a\,R_s{}^{1/2}[1 - M_1' + M_4']\int_0^1 w^*\,\phi dz = -\left[1 - M_1'\left(1-\frac{1}{M_5}\right)\right]\int_0^1 \phi\,(D^2 - a^2 - P_s\sigma^*)\phi^* dz. \tag{37}$$

Combining Eqs. (35) – (37), we obtain

$$\left(\frac{\sigma}{\varepsilon}+\frac{1}{k_1}\right)\int_0^1 w^*(D^2-a^2)\,w dz \ = a\,R_a{}^{\frac{1}{2}}M_1(1 - M_5)\int_0^1 w^* D\Phi_1 dz + [1 + M_1(1 - M_5)]\int_0^1 \theta\,(D^2 - a^2 - P_r\sigma^*)\theta^* dz + a\,R_s{}^{\frac{1}{2}}M_1'\left(1-\frac{1}{M_5}\right)\int_0^1 w^* D\Phi_2 dz - \left[1 - M_1'\left(1-\frac{1}{M_5}\right)\right]\int_0^1 \phi\,(D^2 - a^2 - P_s\sigma^*)\phi^* dz\,. \tag{38}$$

Integrating the various terms of Eq. (38), by parts, for a suitable number of times and utilizing the boundary conditions (18) and equality (25) we get

$$\left(\frac{\sigma}{\varepsilon}+\frac{1}{k_1}\right)\int_0^1(|Dw|^2+a^2|w|^2)dz=-aR_a^{1/2}M_1(1-M_5)\int_0^1 w^*D\Phi_1dz+\ [1+M_1(1-M_5)]\int_0^1(|D\theta|^2+a^2|\theta|^2+P_r\sigma^*|\theta|^2)dz-\ aR_s^{1/2}M_1'\left(1-\frac{1}{M_5}\right)\int_0^1 w^*D\Phi_2dz-\left[1-M_1'\left(1-\frac{1}{M_5}\right)\right]\int_0^1(|D\phi|^2+a^2|\phi|^2+P_s\sigma^*|\phi|^2)\,dz. \quad (39)$$

Equating imaginary parts of both sides of Eq. (39) and dividing the resulting equation by $\sigma_i(\neq 0)$ throughout, we have

$$\frac{1}{\varepsilon}\int_0^1(|Dw|^2+a^2|w|^2)dz\ =-\ \frac{aR_a^{1/2}M_1(1-M_5)}{\sigma_i}\,imaginary\ part\ \text{of}\int_0^1 w^*D\Phi_1dz-[1+M_1(1-M_5)]P_r\int_0^1|\theta|^2\,dz-\ \frac{aR_s^{1/2}M_1'\left(1-\frac{1}{M_5}\right)}{\sigma_i}\,imaginary\ part\ \text{of}\int_0^1 w^*D\Phi_2dz+\left[1-M_1'\left(1-\frac{1}{M_5}\right)\right]P_s\int_0^1|\phi|^2\,dz. \quad (40)$$

Now multiplying Eq. (15) by its complex conjugate and integrating over the interval [0,1], by parts, for an appropriate number of times, using the boundary conditions (18) and then equating the real parts of both sides, we obtain

$$\int_0^1(|D^2\theta|^2+2a^2|D\theta|^2+a^4|\theta|^2)dz+2\sigma_r P_r\int_0^1(|D\theta|^2+a^2|\theta|^2)dz+|\sigma|^2P_r{}^2\int_0^1|\theta|^2dz=a^2R_a\int_0^1|w|^2dz, \quad (41)$$

since $\sigma_r\geq 0$, we have from Eq. (41) that

$$\int_0^1|\theta|^2dz\ \leq\ \frac{R_aa^2}{P_r^2|\sigma|^2}\int_0^1|w|^2dz\,. \quad (42)$$

Combining inequalities (29) and (42), we obtain

$$\left(\int_0^1|D\Phi_1|^2dz\right)^{1/2}\leq\ \frac{aR_a^{1/2}}{P_r|\sigma|}\left(\int_0^1|w|^2dz\right)^{1/2}. \quad (43)$$

Similarly combining inequalities (30) and (33) to obtain

$$\left(\int_0^1|D\Phi_2|^2dz\right)^{1/2}\leq\ \frac{aR_s^{1/2}}{P_s|\sigma|}\left(\int_0^1|w|^2dz\right)^{1/2}. \quad (44)$$

Now, $-\frac{aR_a^{1/2}M_1(1-M_5)}{\sigma_i}\,imaginary\ part\ \text{of}\int_0^1 w^*D\Phi_1dz$

$$\leq aR_a^{1/2}M_1(1-M_5)\left|\frac{1}{\sigma_i}\int_0^1 w^*D\Phi_1dz\right|$$

$$\leq\ \frac{aR_a^{1/2}\,M_1(1-M_5)}{|\sigma_i|}\int_0^1|w||D\Phi_1|\,dz$$

$\leq \frac{aR_a^{1/2} M_1(1-M_5)}{|\sigma_i|}\left(\int_0^1 |w|^2 dz\right)^{1/2}\left(\int_0^1 |D\Phi_1|^2 dz\right)^{1/2}$ (using Schwartz inequality)

$\leq \frac{a^2 R_a M_1(1-M_5)}{P_r|\sigma||\sigma_i|}\int_0^1 |w|^2 dz$. (using inequality (43)) (45)

Similarly, $-\frac{aR_s^{1/2} M_1'\left(1-\frac{1}{M_5}\right)}{\sigma_i}\, imaginary\ part$ of $\int_0^1 w^* D\Phi_2 dz$

$$\leq \frac{aR_s^{1/2} M_1'\left|1-\frac{1}{M_5}\right|}{|\sigma_i|}\int_0^1 |w||D\Phi_2|\, dz$$

$$\leq \frac{aR_s^{1/2} M_1'\left|1-\frac{1}{M_5}\right|}{|\sigma_i|}\left(\int_0^1 |w|^2 dz\right)^{1/2}\left(\int_0^1 |D\Phi_2|^2 dz\right)^{1/2}$$

$\leq \frac{a^2 R_s M_1'\left|1-\frac{1}{M_5}\right|}{P_s|\sigma||\sigma_i|}\int_0^1 |w|^2 dz$. (utilizing inequality (44)) (46)

Now, multiplying Eq. (16) by ϕ^* and integrating the resulting equation, by parts, for an appropriate number of times over the vertical range of z; and then from imaginary part of the final equation, we obtain

$$\int_0^1 |\phi|^2 dz = \frac{1}{\sigma_i}\, imaginary\ part\ of\ \frac{aR_s^{1/2}}{P_s}\int_0^1 \phi^* w dz$$

$$\leq \frac{aR_s^{1/2}}{|\sigma_i|P_s}\left|\int_0^1 \phi^* w dz\right|$$

$\leq \frac{aR_s^{1/2}}{|\sigma_i|P_s}\left(\int_0^1 |\phi|^2 dz\right)^{\frac{1}{2}}\left(\int_0^1 |w|^2 dz\right)^{\frac{1}{2}}$ (using Schwartz inequality)

$\leq \frac{a^2 R_S}{|\sigma||\sigma_i|{P_s}^2}\int_0^1 |w|^2 dz$. (utilizing inequality (33)) (47)

Thus using inequalities (45), (46) and (47) in Eq. (40), we finally, get

$$\frac{1}{\varepsilon}\int_0^1 |Dw|^2 dz + a^2\left(\frac{1}{\varepsilon} - \frac{R_a M_1(1-M_5)}{P_r|\sigma||\sigma_i|} - \frac{R_s M_1'\left|1-\frac{1}{M_5}\right|}{P_s|\sigma||\sigma_i|} - \frac{R_s\left[1-M_1'\left(1-\frac{1}{M_5}\right)\right]}{|\sigma||\sigma_i|P_s}\right)\int_0^1 |w|^2 dz +$$
$$[1+M_1(1-M_5)]P_r\int_0^1 |\theta|^2\, dz \leq 0,$$

which implies that

$$|\sigma|^2\sigma_i^2 < \varepsilon^2\left\{\frac{R_a M_1(1-M_5)}{P_r} + \frac{R_s}{P_s}\left(1+M_1'\left|1-\frac{1}{M_5}\right| - M_1'\left(1-\frac{1}{M_5}\right)\right)\right\}^2, \quad (48)$$

Above theorem may be stated, from the physical point of view, as: the complex growth rate of an arbitrary oscillatory disturbance of neutral or growing amplitude in ferrothermosolutal convection in a densely packed porous medium must lie inside the region represented by inequality (61). This result is valid when both the boundaries are rigid.

Note: It is worth to point out here that for most of the ferrofluids, which are formed by changing ferric oxides and carrier organic fluids (e. g. kerosene, alcohol and hydrocarbon etc.), the parametric value M_5 varies between 0.1 and 0.5 (Finlayson [4] and Gupta and Gupta [5]), so that the condition $1 - M_5 > 0$ and hence $1 - \frac{1}{M_5} < 0$ remains valid.

4. Conclusion

The present problem under consideration has been investigated by using the linear stability theory. The upper limits for the complex growth rates in ferrothermosolutal convection in a densely packed porous medium heated and salted from below has been obtained by using Darcy model. These results are important especially when at least one of the boundaries is rigid so that exact solutions in the closed form are not obtainable. The present investigations can present theoretical support to experimentalists.

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ON ARRESTING THE COMPLEX GROWTH RATES IN FERROMAGNETIC CONVECTION IN A FERROFLUID

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ABSTRACT

It is proved analytically that the complex growth rate $\omega = \omega_r + i\omega_i$ (ω_r and ω_i are respectively the real and imaginary parts of ω) of an arbitrary oscillatory motion of growing amplitude in ferrothermohaline convection with magnetic-field-dependent viscosity in a densely packed porous medium for the case of free boundaries lies inside a semicircle in the right half of the $\omega_r\omega_i$ plane whose center is at the origin and radius = $\sqrt{\varepsilon R_S}\,[1 - M'_1(1 - 1/M_5)]/P_s$, where R_S is the concentration Rayleigh number, ε is the porosity of the medium, P_s is the solutal Prandtl number, M'_1 is the ratio of magnetic flux due to concentration fluctuation to the gravitational force, and M_5 is the ratio of concentration effect on magnetic field to pyromagnetic coefficient. Bounds for the case of rigid boundaries are also derived separately.

KEY WORDS: ferrofluid, ferrothermohaline convection, magnetic-field-dependent viscosity, Darcy mode

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Trace of the positive integral powers of three and five dimensional rhotrices *

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Abstract The traces of powers of matrices frequently arise in several fields of mathematics. Rhotrices are a new paradigm of matrices which are represented as coupled matrices. The main aim of this paper is to find the trace of positive integral powers of three and five dimensional rhotrices. Further, the trace of positive integral powers of special type of circulant rhotrix is also discussed.

Key words Rhotrix, trace of a rhotrix, determinant, circulant rhotrix.

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1 Introduction

The trace of a positive integer power of a matrix needs to be evaluated in various problems in Network Analysis, Number Theory, Matrix Theory, Dynamical Systems and Differential Equations. To study a complex network, we need to compute the total number of triangles of a connected simple graph. The trace of integral powers of square matrices was discussed by Michiel [6] and Pahade and Jha [7]. Cisneros et al. [4] and Cisneros [5] discussed a formula for the trace of symmetric powers of a matrix. Also, Brezinski et al. [3] estimated the trace of powers of self adjoint operators. Zareula [14] discussed the congruences for the trace of powers of some matrices.
Rhotrix is a new paradigm in the study of matrix theory. Rhotrix is represented as coupled matrix. Ajibade [2] defined a 3–dimensional rhotrix, which is, in some way, between 2×2–dimensional and 3×3–dimensional matrices as

$$R_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle,$$

where a, b, c, d, e are real numbers and $h(R_3) = c$ is called the heart of rhotrix R_3.

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Let $Q_3 = \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle$, be another 3-dimensional rhotrix, then the addition of two rhotrices is defined as

$$R_3 + Q_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle + \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle = \left\langle \begin{array}{ccc} & a+f & \\ b+g & c+h & d+j \\ & e+k & \end{array} \right\rangle,$$

and for any real number α, the scalar multiplication of a rhotrix R_3 by α is defined as

$$\alpha\, R_3 = \alpha \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle = \left\langle \begin{array}{ccc} & \alpha\, a & \\ \alpha\, b & \alpha\, c & \alpha\, d \\ & \alpha\, e & \end{array} \right\rangle.$$

Two types of multiplications of rhotrices are discussed in the literature of rhotrices, namely, the heart oriented multiplication and the row-column multiplication. Ajibade [2] discussed the heart oriented multiplication of 3-dimensional rhotrices as given below:

Let $Q_3 = \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle$,be another 3-dimensional rhotrix, then the multiplication of two rhotrices is defined as

$$R_3\, o\; Q_3 = \left\langle \begin{array}{ccc} & ah+fc & \\ bh+gc & ch & dh+jc \\ & eh+kc & \end{array} \right\rangle.$$

Further, Absalom et al. [1] generalized the heart oriented multiplication of 3-dimensional rhotrices to n-dimensional rhotrices. The row column multiplication of 3-dimensional rhotrices is defined by Sani [8] as

$$R_3\, o\, Q_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle = \left\langle \begin{array}{ccc} & af+dg & \\ bf+eg & ch & aj+dk \\ & bj+ek & \end{array} \right\rangle.$$

Sani [9] also discussed the row-column multiplication of high dimension rhotrices as follows: Consider an n-dimensional rhotrix

$$P_n = \left\langle \begin{array}{ccccccc} & & & a_{11} & & & \\ & & a_{21} & c_{11} & a_{12} & & \\ & a_{31} & c_{21} & a_{22} & c_{12} & a_{13} & \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ a_{t1} & \cdots & \cdots & \cdots & \cdots & \cdots & a_{1t} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ & a_{tt-2} & c_{t-1t-2} & a_{t-1t-1} & c_{t-2t-1} & a_{t-2t} & \\ & & a_{tt-1} & c_{t-1t-1} & a_{t-1t} & & \\ & & & a_{tt} & & & \end{array} \right\rangle,$$

where $t = (n+1)/2$. Sani [10] represented rhotrix as a coupled matrix and denoted it as $P_n = \langle a_{ij},\ c_{lk} \rangle = \langle A, C \rangle$ with $i, j = 1, 2, ..., t$ and $l, k = 1, 2, ..., t-1$. The multiplication of two rhotrices P_n and Q_n defined by Sani [9] is as follows:

$$P_n\, o\, Q_n = \langle a_{i_1 j_1},\, c_{l_1 k_1} \rangle\; o\; \langle b_{i_2 j_2},\, d_{l_2 k_2} \rangle = \left\langle \sum_{i_2 j_1 = 1}^{t} (a_{i_1 j_1}\, b_{i_2 j_2}),\ \sum_{l_2 k_1 = 1}^{t-1} (c_{l_1 k_1}\, d_{l_2 k_2}) \right\rangle.$$

Sharma and Kanwar [11, 12] defined the trace of a rhotrix and discussed its properties. Sharma et al. [13] introduced circulant rhotrices in the literature of rhotrices.

Definition 1.1. [11] Let

$$R_n = \left\langle \begin{array}{ccccccccc} & & & & a_{11} & & & & \\ & & & a_{21} & c_{11} & a_{12} & & & \\ & & a_{31} & c_{21} & a_{22} & c_{12} & a_{13} & & \\ & .. & .. & .. & .. & .. & .. & .. & \\ a_{t1} & c_{t-11} & .. & .. & .. & .. & .. & c_{1t-1} & a_{1t} \\ & .. & .. & .. & .. & .. & .. & .. & \\ & & a_{t\,t-2} & c_{t-1t-2} & a_{t-1t-1} & c_{t-2t-1} & a_{t-2t} & & \\ & & & a_{t\,t-1} & c_{t-1t-1} & a_{t-1t} & & & \\ & & & & a_{tt} & & & & \end{array} \right\rangle$$

$$= \langle a_{i\,j},\ c_{l\,k} \rangle = \langle A,\ C \rangle\ ,$$

be a rhotrix, where $a_{i\,j},\ c_{l\,k} \in \mathbb{R}$, $1 \leq i, j \leq t$, $1 \leq l, k \leq t-1$ and $t = \frac{n+1}{2}$.
The trace of R_n is defined as

$$\begin{aligned} Tr\ R_n &= \sum_{i=1}^{t} a_{ii} + \sum_{i=1}^{t-1} c_{ii} \\ &= Tr\ A + Tr\ C \\ &= \sum_{r=1}^{t} x_{rs} \end{aligned}$$

That is, the trace of a rhotrix R_n, which is the sum of all its elements of the vertical diagonal, where $R_n = \langle x_{r\,s} \rangle$ is the general representation to the n–dimensional rhotrix. The elements $x_{r\,s}$ for $r = s\,(r \neq s)$ represent the vertical (non–vertical) diagonal entries of the rhotrix R_n.

2 Trace of positive integral powers of a three dimensional rhotrix

In this section, we put forward a result to evaluate the trace of any positive integral power of a three dimensional rhotrix.

Theorem 2.1. *Let $R_3 =< A, B >$ be a three dimensional rhotrix whose coupled matrices are $A = (a_{ij})_{2\times 2}$ and $B = (c)_{1\times 1}$. Then, the trace of R_3^n, where n is positive even integer, is given by:*

$$TrR_3^n = (TrA)^n - n.|A|.(TrA)^{n-2} + \frac{n\,(n-3)}{2!}.|A|^2.(TrA)^{n-4} - \frac{n\,(n-4)\,(n-5)}{3!}.|A|^3.(TrA)^{n-6} +$$
$$\ldots + (-1)^{\frac{n}{2}} \frac{n\left(n-\frac{n}{2}-1\right)\left(n-\frac{n}{2}-2\right)\ldots . up\ to\ \frac{n}{2}\ terms}{\left(\frac{n}{2}\right)!}.|A|^{\frac{n}{2}}\,(TrA)^{n-2\cdot\frac{n}{2}} + (TrB)^n.$$

Proof. Consider a three dimensional rhotrix

$$R_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle,$$

where a, b, c, d, e are real numbers and the coupled matrices are given as $A = \begin{bmatrix} a & d \\ b & e \end{bmatrix}$ and $B = [c]$.
Then, $|A| = ae - bd$ and $Tr\ A = a + e$.

$$A^2 = \begin{bmatrix} a^2 + bd & d(a+e) \\ b(a+e) & bd + e^2 \end{bmatrix}$$

and

$$\begin{aligned} Tr\ A^2 &= a^2 + 2bd + e^2 = a^2 + 2ae + e^2 - 2ae + 2bd \\ &= (a+e)^2 - 2(ae - bd) \end{aligned}$$

or,

$$TrA^2 = (TrA)^2 - 2.\,|A|\,. \tag{2.1}$$

Similarly,

$$A^3 = \begin{bmatrix} a^3 + abd + bd(a+e) & a^2d + d^2b + ed(a+e) \\ ab\,(a+e) + b^2d + e^2b & bd\,(a+e) + dbe + e^3 \end{bmatrix}$$

and

$$Tr\ A^3 = a^3 + e^3 + 3bd(a+e) = (a+e)^3 - 3(a+e)(ae - bd)$$

or,

$$TrA^3 = (TrA)^3 - 3.\,|A|\,.\,Tr\ A. \tag{2.2}$$

Replacing A by A^2 in (2.1), we get

$$Tr\ (A^2)^2 = \left(TrA^2\right)^2 - 2.\,|A^2|$$
$$= ((TrA)^2 - 2.\,|A|)^2 - 2(|A|)^2$$

or,

$$TrA^4 = (TrA)^4 - 4.\,|A|\,.(TrA)^2 + \frac{4(4-3)}{2!}.|A|^2.(TrA)^{4-2.\frac{4}{2}}$$

Also, replacing A by A^2 in (2.2), we get

$$Tr\ A^6 = Tr\ (A^2)^3 = \left(TrA^2\right)^3 - 3.\,|A^2|\,.\,TrA^2$$

$$= ((TrA)^2 - 2.\,|A|)^3 - 3.(|A|)^2((Tr\ A)^2 - 2.\,|A|)$$
$$= (TrA)^6 - 8.|A|^3 - 6.\,|A|\,.(TrA)^4 + 12|A|^2.\ (TrA)^2 - 3.(|A|)^2(Tr\ A)^2 + 6.(|A|)^3$$
$$TrA^6 = (TrA)^6 - 6.\,|A|\,.(TrA)^4 + \frac{6\,(6-3)}{2!}.|A|^2.\ (TrA)^2 - \frac{6\,(6-4)\,(6-5)}{3!}.|A|^3.\ (TrA)^{6-2.\frac{6}{2}}.$$

Thus, when n is an even integer, then

$$TrA^n = (TrA)^n - n.|A|.(TrA)^{n-2} + \frac{n\,(n-3)}{2!}.|A|^2.(TrA)^{n-4} - \frac{n\,(n-4)\,(n-5)}{3!}.|A|^3.(TrA)^{n-6} +$$
$$\ldots + (-1)^{\frac{n}{2}}\frac{n\left(n-\frac{n}{2}-1\right)\left(n-\frac{n}{2}-2\right)\ldots \text{up to } \frac{n}{2} \text{ terms}}{\left(\frac{n}{2}\right)!}.|A|^{\frac{n}{2}}(TrA)^{n-2.\frac{n}{2}}.$$

Also,

$$Tr\ B^n = c^n$$

By Definition 1.1 we know that

$$Tr\ R_3 = Tr\ A + Tr\ B.$$

Therefore,

$$TrR_3^n = Tr\ A^n + Tr\ B^n.$$

Hence,

$$TrR_3^n = \sum\nolimits_{k=0}^{n/2} \frac{(-1)^k}{k!} \cdot (n(n-k-1)(n-k-2)\ldots \text{up to } k \text{ terms}) \cdot |A|^k (TrA)^{(n-2k)} + c^n$$

where n is an even integer.

□

Example 2.2. Let

$$R_3 = \left\langle \begin{matrix} & 1 & \\ 2 & 1 & -1 \\ & 2 & \end{matrix} \right\rangle$$

be a three dimensional rhotrix such that its coupled matrices are $A = \begin{bmatrix} 1 & -1 \\ 2 & 2 \end{bmatrix}$ and $B = [1]$. Then, $Tr\ A = 3$ and $|A| = 4$ and $Tr\ B = 1$. Now,

$$Tr\ A^{10} = \sum_{k=0}^{5} \frac{(-1)^k}{k!}(n\,(n-k-1)\,(n-k-2)\ldots \text{up to } k \text{ terms}).|A|^k (TrA)^{n-2k}$$

$$= (TrA)^{10} - 10.|A|.(TrA)^8 + \frac{10.7}{2!}.|A|^2.(TrA)^6 - \frac{10.6.5}{3!}.|A|^3(TrA)^4 + \frac{10.5.4.3}{4!}.|A|^4(TrA)^2 - \frac{10.4.3.2.1}{5!}.|A|^5$$

$$= (3)^{10} - 10.4.(3)^8 + 35.(4)^2.(3)^6 - 50.(4)^3.(3)^4 + 25.(4)^4.(3)^2 - 2(4)^5 = 1201$$

and $Tr\ B^{10} = 1$. Therefore, ${R_3}^{10} = 1201 + 1 = 1202$.

Theorem 2.3. *Let $R_3 =< A, B >$ be a three dimensional rhotrix whose coupled matrices are $A = (a_{ij})_{2\times 2}$ and $B = (c)_{1\times 1}$ .Then, the trace of R_3^n where, n is a positive odd integer, is given by*

$$TrR_3^n = \sum_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n(n-k-1)(n-k-2)\dots \text{up to } k \text{ terms}) \cdot |A|^k \cdot (TrA)^{n-2k} + (TrB)^n$$

where $|A| = \det A$.

Proof. Consider a three dimensional rhotrix

$$R_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle$$

where a, b, c, d, e are real numbers and the coupled matrices are given by $A = \begin{bmatrix} a & d \\ b & e \end{bmatrix}$ and $B = [c]$.

Then, from the Theorem 2.1 TrA^3 is given by

$$TrA^3 = (TrA)^3 - 3.|A|.Tr\ A$$

$$= (TrA)^{3-2.0} + \frac{(-1)^1}{1!}.|A|^1.(Tr\ A)^{3-2.1}.$$

Similarly,

$$A^5 = A^3.A^2$$

$$= \begin{bmatrix} a^3 + abd + bd(a+e) & a^2d + d^2b + ed(a+e) \\ ab(a+e) + b^2d + e^2b & bd(a+e) + dbe + e^3 \end{bmatrix} \begin{bmatrix} a^2 + bd & d(a+e) \\ b(a+e) & bd + e^2 \end{bmatrix}$$

Now,

$$TrA^5 = a^5 + a^3bd + 2a^2bd(a+e) + a^3bd + ab^2d^2 + 4b^2d^2(a+e) + ebd(a+e)^2$$
$$+ abd(a+e)^2 + 2e^2bd(a+e) + eb^2d^2 + 2e^3bd$$
$$= (a+e)^5 - 5.(ae-bd).(a+e)^3 + 5(ae-bd)^2.(a+e)$$
$$= (TrA)^5 - 5.|A|.(TrA)^3 + \frac{5(5-3)}{2!}.|A|^2.(Tr\ A)$$
$$= (TrA)^{5-2.0} + \frac{(-1)^1}{1!}.5.|A|^1.(TrA)^{5-2.1} + \frac{(-1)^2}{2!}5(5-3).|A|^2.(Tr\ A)^{5-2.2}$$

Thus, when n is an odd integer, then

$$TrA^n = \sum_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n(n-k-1)(n-k-2)\dots \text{ up to } k \text{ terms}) \cdot |A|^k (TrA)^{n-2k}.$$

Also,

$$Tr\ B^n = c^n.$$

Sharma and Kanwar [11] showed that the trace of a rhotrix is given by,

$$Tr\ R_3 = Tr\ A + Tr\ B.$$

Therefore,

$$TrR_3^n = Tr\ A^n + Tr\ B^n.$$

Hence,

$$TrR_3^n = \sum_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n(n-k-1)(n-k-2)\dots \text{up to } k \text{ terms}) \cdot |A|^k (TrA)^{n-2k} + c^n$$

where n is an odd positive integer.

□

Example 2.4. Let

$$R_3 = \left\langle \begin{array}{ccc} & 1 & \\ 2 & 1 & -1 \\ & 2 & \end{array} \right\rangle$$

be a three dimensional rhotrix such that its coupled matrices are $A = \begin{bmatrix} 1 & -1 \\ 2 & 2 \end{bmatrix}$ and $B = [1]$. Then, $Tr\ A = 3$ and $|A| = 4$ and $Tr\ B = 1$. Now,

$$Tr\ A^9 = \sum_{k=0}^{4} \frac{(-1)^k}{k!} \cdot (n\,(n-k-1)\,(n-k-2)\ldots \text{up to } k \text{ terms}) \cdot |A|^k (TrA)^{n-2k}$$

$$= (TrA)^9 - 9.\,|A|\,.\,(TrA)^7 + \frac{9.7}{2!}.|A|^2.(TrA)^5 - \frac{9.5.4}{3!}.\,|A|^3(TrA)^3 + \frac{9.4.3}{4!}.|A|^4\ .TrA$$

$$= (3)^9 - 9.4.\ (3)^7 + \frac{63}{2}.\,(4)^2.\ (3)^5 - 30.(4)^3.\,(3)^3 + \frac{9}{2}.\ (4)^4.3 = 15039$$

and $Tr\ B^{10} = 1$. Therefore,

$$Tr\ {R_3}^{10} = 15039 + 1 = 15040.$$

3 Trace of positive integral powers of a five dimensional rhotrix

In this section, we put forward a result to evaluate the trace of any positive power of a five dimensional rhotrix.

Theorem 3.1. *Let $R_5 =< A, B >$ be a five dimensional rhotrix whose coupled matrices are $A = (a_{ij})_{3\times 3}$ and $B = (b_{ij})_{2\times 2}$. Then, the trace of R_5^n where n is a positive even integer is given by*

$$Tr\ R_5^n$$
$$= \sum\nolimits_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum\nolimits_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} [n\,(n-r_0-2r_1-1)\,(n-r_0-2r_1-2)\ldots(n-2r_0-3r_1+1)] \times \right.$$
$$\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} + \sum\nolimits_{k=0}^{\frac{n}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n-k-1)\,(n-k-2)\ldots(up\ to\ k\ terms)) \times$$
$$|B|^k (TrB)^{n-2k}$$

and the trace of R_5^n when n is positive odd integer, is given by

$$Tr\ R_5^n$$
$$= \sum\nolimits_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum\nolimits_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} [n\,(n-r_0-2r_1-1)\,(n-r_0-2r_1-2)\ldots(n-2r_0-3r_1+1)] \times \right.$$
$$\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} + \sum\nolimits_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n-k-1)\,(n-k-2)\ldots(up\ to\ k\ terms)) \times$$
$$|B|^k (TrB)^{n-2k}$$

where A_2 is the sum of all principal minors of order 2 in A, r_0 is the number of principal minor of order 1, r_1 is the number of principal minors of order 2, $\lfloor x \rfloor$ is the floor function, $|A| = \det A$ and $|B| = \det B$.

Proof. Let $R_5 = \left\langle \begin{array}{ccccc} & & a & & \\ & d & p & b & \\ g & r & e & q & c \\ & h & s & f & \\ & & i & & \end{array} \right\rangle$ be a five dimensional rhotrix whose coupled matrices are

$A = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$ and $B = \begin{bmatrix} p & q \\ r & s \end{bmatrix}$. As stated earlier, $TrR_5 = TrA + TrB$ and $TrR_5^n = TrA^n + TrB^n$. Since of B is a matrix order 2×2, therefore, the trace of B^n can be written directly from the

Theorem 2.1 and the Theorem 2.3. To get the trace of R_5^n, we need to evaluate the trace of A^n. Now, as

$$|A| = a\,(ei - hf) - b\,(di - gf) + +c\,(dh - eg)$$

and $Tr\ A = a + e + i$, therefore,

$$TrA^2 = (a + e + i)^2 - 2\,(ae - bd + ei - fh + ai - cg)$$
$$= (TrA)^2 - 2\sum_{i=1}^{3} |A_{ii}|,$$

where $|A_{ii}|$ are the principal minors of order 2 given as $|A_{11}| = \begin{vmatrix} a & b \\ d & e \end{vmatrix}$, $|A_{22}| = \begin{vmatrix} e & f \\ g & h \end{vmatrix}$, $|A_{33}| = \begin{vmatrix} a & c \\ g & i \end{vmatrix}$.

Therefore, if we put

$$A_2 = \sum_{i=1}^{3} |A_{ii}|$$

then

$$TrA^2 = (TrA)^2 - 2A_2.$$

Also,

$$\begin{aligned} TrA^4 &= a^4 + 2b^2d^2 + e^4 + 2c^2g^2 + 4a^2\,(bd + cg) + 4cdeh + 4e^2fh + 4cfgh \\ &\quad + 2f^2h^2 + cdhi + 4efhi + 4cgi^2 + 4fhi^2 + i^4 + 4a\,(bde + bfg + cdh + cgi) \\ &\quad + 4b\,\left(d\left(e^2 + cg + fh\right) + fg(e + i)\right) \\ &= (a + e + i)^4 - 4(a + e + i)^2\,(-bd + ae - cg - fh + ai + ei) \\ &\qquad + 2(-bd + ae - cg - fh + ai + ei)^2 \\ &\qquad + 4(a + e + i)(-ceg + bfg + cdh - afh - bdi + aei) \\ &= (TrA)^4 - 4\sum_{i=1}^{3} |A_{ii}|.TrA + 2(\sum_{i=1}^{3} |A_{ii}|)^{\ 2} + 4.TrA.\ |A| \\ &= (TrA)^4 - 4A_2.TrA + 2(A_2)^2 + 4.TrA.\ |A|\,. \end{aligned}$$

Similarly,

$$TrA^5 = (TrA)^5 - 5A_2.(TrA)^3 + 5\ TrA.(A_2)^2 + 5\ (TrA)^2.\ |A| - 5.A_2.\,|A|\,.$$

Therefore, TrA^n can be generalized as

$$\begin{aligned} &Tr\ A^n \\ &= \sum\nolimits_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum\nolimits_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} \left[n\,(n - r_0 - 2r_1 - 1)\,(n - r_0 - 2r_1 - 2)\ldots(n - 2r_0 - 3r_1 + 1)\right] \times \right. \\ &\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} \end{aligned}$$

For even positive integer n and using Theorem 2.1, we have

$$Tr\ B^n = \sum\nolimits_{k=0}^{\frac{n}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n - k - 1)\,(n - k - 2)\ldots(\text{up to } k \text{ terms})) \cdot |B|^k (TrB)^{n-2k}$$

Therefore, $TrR_5^n = Tr\ A^n + Tr\ B^n$. Now,

$$\begin{aligned} &Tr\ R_5^n \\ &= \sum\nolimits_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum\nolimits_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} \left[n\,(n - r_0 - 2r_1 - 1)\,(n - r_0 - 2r_1 - 2)\ldots(n - 2r_0 - 3r_1 + 1)\right] \times \right. \\ &\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} + \sum\nolimits_{k=0}^{\frac{n}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n - k - 1)\,(n - k - 2)\ldots(\text{up to } k \text{ terms})) \times \\ &|B|^k (TrB)^{n-2k} \end{aligned}$$

Also, $R_5^n = Tr\ A^n + Tr\ B^n$, for odd n, this gives

$$Tr\ R_5^n$$
$$= \sum_{r_1=0}^{\lfloor \frac{n}{3} \rfloor} \left[\sum_{r_0=0}^{\lfloor \frac{n-3r_1}{2} \rfloor} \frac{(-1)^{r_0}}{r_0!} \left[n\,(n-r_0-2r_1-1)\,(n-r_0-2r_1-2)\ldots(n-2r_0-3r_1+1) \right] \times \right.$$
$$\left. (TrA)^{n-2r_0-3r_1}.A_2^{r_0} \right] \frac{(|A|)^{r_1}}{r_1!} + \sum_{k=0}^{\frac{n-1}{2}} \frac{(-1)^k}{k!} \cdot (n\,(n-k-1)\,(n-k-2)\ldots(\text{up to } k \text{ terms})) \times$$
$$|B|^k (TrB)^{n-2k}$$

□

4 Trace of a special type of n-dimensional circulant rhotrix

Now we prove below a theorem for the trace of a special type of n-dimensional circulant rhotrix.

Theorem 4.1. *Let $R_n = \langle A_t, B_{t-1} \rangle$ be an $n-$dimensional special circulant rhotrix whose diagonal entries are zero and all other entries are one. A_t, B_{t-1} are the coupled matrices of R_n, where $t = \frac{n+1}{2}, A_t = (a_{ij})$, $1 \leq i,j \leq t$ and $B_{t-1} = (b_{ij})$, $1 \leq i,j \leq t-1$ such that $a_{ij} = \begin{cases} 0, & \text{if } i=j \\ 1, & \text{if } i \neq j \end{cases}$ and $b_{ij} = \begin{cases} 0, & \text{if } i=j \\ 1, & \text{if } i \neq j \end{cases}$. Then, the trace of positive powers of R_n, when r is a positive even integer, is given by*

$$Tr\ R_n^r = \sum_{m=1}^{\frac{r}{2}} N(t,m) t(t-1)^m (t-2)^{r-2m} + \sum_{m=1}^{\frac{r}{2}} N(t-1,m)\,(t-1)\,(t-2)^m (t-3)^{r-2m},$$

and the trace of positive powers of R_n, when r is a positive odd integer, is given by

$$Tr\ R_n^r = \sum_{m=1}^{\frac{r-1}{2}} N(t,m) t(t-1)^m (t-2)^{r-2m} + \sum_{m=1}^{\frac{r-1}{2}} N(t-1,m)\,(t-1)\,(t-2)^m (t-3)^{r-2m},$$

where, $N(k,1) = 1$, $N\left(k, \frac{k}{2}\right) = 1$, $N\left(k, \frac{k-1}{2}\right) = \frac{k-1}{2}$ and $N(k,\ r) = N(k-1,\ r) + N(k-2,\ r-1)$.

Proof. The rhotrix R_n is given by

$$R_n = \left\langle \begin{array}{ccccccc} & & & 0 & & & \\ & & 1 & 0 & 1 & & \\ & & & 1 & 0 & 1 & \ddots \\ 1 & \ldots & 1 & 0 & 1 & \ldots & 1 \\ & & \vdots & \vdots & \vdots & \vdots & \vdots \\ & & & 1 & 0 & 1 & \\ & & & & 0 & & \end{array} \right\rangle$$

whose coupled matrices for $t = \frac{n+1}{2}$ are A_t and B_{t-1} given as below:

$$A_t^2 = (a_{ij}) = \begin{cases} t-1, \text{ if } i=j \\ t-2, \text{ if } i \neq j \end{cases} \quad \text{and} \quad B_{t-1}^2 = (b_{ij}) = \begin{cases} t-2, \text{ if } i=j \\ t-3, \text{ if } i \neq j. \end{cases}$$

Therefore,

$$Tr\ A_t^2 = t(t-1) \ \text{ and } \ Tr\ B_{t-1}^2 = (t-1)\,(t-2)\,. \tag{4.1}$$

That is,

$$Tr\ A_t^2 = \sum_{m=1}^{\frac{r}{2}=1} N\,(2,1)\,t(t-1) \ \text{ and } \ B_{t-1}^2 = \sum_{m=1}^{\frac{r}{2}=1} N\,(2,1)\,(t-1)(t-2).$$

Hence,

$$Tr\ R_n^2 = Tr\ A_t^2 + Tr\ B_{t-1}^2 = \sum_{m=1}^{\frac{r}{2}=1} N(2,m)\, t(t-1) + \sum_{m=1}^{\frac{r}{2}=1} N(2,m)\,(t-1)(t-2).$$

Similarly,

$$A_t^3 = (a_{ij}) = \begin{cases} (t-1)(t-2), \text{ if } i=j \\ (t-1)+(t-2)^2, \text{ if } i\neq j \end{cases} \quad \text{and} \quad B_{t-1}^3 = (b_{ij}) = \begin{cases} (t-2)(t-3), \text{ if } i=j \\ (t-2)+(t-3)^2, \text{ if } i\neq j, \end{cases}$$

which gives,

$$Tr\ A_t^3 = t(t-1)(t-2) \ \text{ and } \ Tr\ B_{t-1}^3 = (t-1)\,(t-2)\,(t-3). \tag{4.2}$$

That is,

$$TrA_t^3 = \sum\nolimits_{m=1}^{\frac{r-1}{2}=1} N(3,m)\, t(t-1)(t-2) \quad \text{and} \quad TrB_{t-1}^3 = \sum\nolimits_{m=1}^{\frac{r-1}{2}=1} N(3,m)\,(t-1)(t-2)(t-3),$$

which gives,

$$Tr\ R_n^3 = Tr\ A_t^3 + Tr\ B_{t-1}^3 \ = \sum_{m=1}^{\frac{r-1}{2}=1} N(3,m)\, t(t-1)(t-2) + \sum_{m=1}^{\frac{r-1}{2}=1} N(3,m)\,(t-1)(t-2)(t-3).$$

Now,

$$A_t^4 = (a_{ij}) = \begin{cases} (t-1)\ \ [(t-1)+(t-2)^2], \ \text{ if } \ i=j \\ (t-1)\,(t-2)+(t-2)\,[(t-1)+(t-2)^2], \ \text{ if } \ i\neq j \end{cases}$$

and

$$B_{t-1}^4 = (b_{ij}) = \begin{cases} (t-2)\ \ [(t-2)+(t-3)^2], \ \text{ if } \ i=j \\ (t-2)\,(t-3)+(t-3)\,[(t-2)+(t-3)^2], \ \text{ if } \ i\neq j \end{cases}$$

which lends

$$Tr\ A_t^4 = t(t-1)^2 + t(t-1)(t-2)^2 \quad \text{and} \quad Tr\ B_{t-1}^4 = (t-1)(t-2)^2 + (t-1)(t-2)(t-3)^2. \tag{4.3}$$

That is,

$$TrA_t^4 = \sum_{m=1}^{\frac{r}{2}=2} N(4,m)\, t(t-1)^m (t-2)^{4-2m} \quad \text{and} \quad TrB_t^4 = \sum_{m=1}^{\frac{r}{2}=2} N(4,m)\,(t-1)\,(t-2)^m (t-3)^{4-2m}$$

which gives,

$$Tr\ R_n^4 = Tr\ A_t^4 + Tr\ B_{t-1}^4 \ = \sum_{m=1}^{\frac{r}{2}=2} N(4,m)\, t(t-1)^m (t-2)^{4-2m} + \sum_{m=1}^{\frac{r}{2}=2} N(4,m)\,(t-1)(t-2)^m (t-3)^{4-2m}.$$

Now,

$$A_t^5 = (a_{ij}) = \begin{cases} 2(t-1)^2\,(t-2) + (t-1)(t-2)^3, \ \text{ if } \ i=j \\ (t-1)^2 + 3\,(t-1)\,(t-2)^2 + (t-2)^4], \ \text{ if } \ i\neq j \end{cases}$$

and

$$B_{t-1}^5 = (b_{ij}) = \begin{cases} 2(t-2)^2\,(t-3) + (t-2)(t-3)^3, \ \text{ if } \ i=j \\ (t-2)^2 + 3\,(t-2)\,(t-3)^2 + (t-3)^4], \ \text{ if } \ i\neq j, \end{cases}$$

which gives,

$$Tr\ A_t^5 = 2t(t-1)^2(t-2) + t(t-1)(t-2)^3 \quad \text{and} \quad Tr\ B_{t-1}^5 = 2\,(t-1)\,(t-2)^2\,(t-3) + (t-1)(t-2)(t-3)^3. \tag{4.4}$$

That is,

$$TrA_t^5 = \sum_{m=1}^{\frac{r}{2}=2} N(5,m)\, t(t-1)^m (t-2)^{5-2m} \quad \text{and} \quad TrB_{t-1}^5 = \sum_{m=1}^{\frac{r}{2}=2} N(5,m)\,(t-1)(t-2)^m (t-3)^{5-2m}$$

from where follows that

$$Tr\ R_n^5 = Tr\ A_t^5 + Tr\ B_{t-1}^5 = \sum_{m=1}^{\frac{r}{2}=2} N\,(5,m)\,t(t-1)^m(t-2)^{5-2m} + \sum_{m=1}^{\frac{r}{2}=2} N\,(5,m)\,(t-1)(t-2)^m(t-3)^{5-2m}.$$

Thus, by induction, we conclude that

$$Tr\ R_n^r = \sum_{m=1}^{\frac{r}{2}} N(t,m)t(t-1)^m(t-2)^{r-2m} + \sum_{m=1}^{\frac{r}{2}} N(t-1,m)\,(t-1)\,(t-\ \ 2)^m(t-3)^{r-2m}$$

where, r is a positive even integer and

$$Tr\ R_n^r = \sum_{m=1}^{\frac{r-1}{2}} N(t,m)t(t-1)^m(t-2)^{r-2m} + \sum_{m=1}^{\frac{r-1}{2}} N(t-1,m)\,(t-1)\,(t-2)^m(t-3)^{r-2m}$$

where, r is a positive odd integer.

□

5 Conclusion

In this paper, we find the trace of positive integral powers of three and five dimensional rhotrices. Also, a result to find the traces of positive integral power of a special type of circulant rhotrix is derived.

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RESEARCH ARTICLE | OCTOBER 07 2022

Construction of symmetric balanced incomplete block design (*k* + 1, *k*, *k* - *1*) using circulant rhotrices

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Circulant matrices, due to their wide range of applicability in computer sciences as well as their intrinsic properties make them particularly interesting for researchers. Circulant Rhotrices have been investigated in the recent researches for similar applications. After its introduction in 1936 Balanced incomplete block design (BIBD) which is an area of combinatorial mathematics, has been developed progressively afterwards. The studies regarding BIBDs have gained researchers' attention due to their fixed cross-correlation property, which makes them unique in communication system. The applicability of BIBDs can be seen in various areas such as error control coding, cryptography, code-division multiple-access networks, key distribution in sensor networks and watermarking; to name a few. Symmetric designs, among a variety of BIBDs, are often used as codes. Present work primarily focuses on developing symmetric balanced incomplete block design (BIBD) by using circulant rhotrices.

Topics

Cryptography, Telecommunications engineering

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Construction of Maximum Distance Separable Rhotrices using Cauchy Rhotrices over Finite Fields

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ABSTRACT
Maximum distance separable (MDS) matrices are important in cryptography and particularly used in block ciphers due to their properties of diffusion. Rhotrices are represented by the coupled matrices. Therefore, maximum distance separable rhotrices are of much interest in the context of cryptography. In this paper, we define Cauchy rhotrix and then use it to construct MDS rhotrices over finite fields.

Keywords
Cauchy rhotrix, Finite field, Maximum distance separable rhotrix, Circulant rhotrix, Vandermonde rhotrix.

1. INTRODUCTION
Ajibade [1] defined a 3×3–dimensional rhotrix, which is, in some way, between 2×2–dimensional and 3×3–dimensional matrices as

$$R_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle,$$

where a,b,c,d,e are real numbers and $h(R_3) = c$ is called the heart of rhotrix R_3. He also defined the operations of addition and scalar multiplication as given below:

Let $Q_3 = \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle$, be another 3-dimensional rhotrix, then the addition of two rhotrices is defined as

$$R_3 + Q_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle + \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle$$

$$= \left\langle \begin{array}{ccc} & a+f & \\ b+g & c+h & d+j \\ & e+k & \end{array} \right\rangle,$$

and for any real number α, the scalar multiplication of a rhotrix R_3 is defined as

$$\alpha R_3 = \alpha \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle = \left\langle \begin{array}{ccc} & \alpha a & \\ \alpha b & \alpha c & \alpha d \\ & \alpha e & \end{array} \right\rangle.$$

Two types of multiplication of rhotrices are discussed in the literature of rhotrices, namely, heart oriented multiplication and row-column multiplication. Ajibade discussed the heart oriented multiplication of 3-dimensional rhotrices as given below:

$$R_3 \, o \, Q_3 = \left\langle \begin{array}{ccc} & ah + fc & \\ bh + gc & ch & dh + jc \\ & eh + kc & \end{array} \right\rangle.$$

Further, it is algorithmatized for computing machines by Mohammed et al. [2]. The extended heart oriented method for rhotrix multiplication is given by Mohammed [3] and also generalized the heart oriented multiplication of 3-dimensional rhotrices to n-dimensional rhotrices. The row column multiplication of 3-dimensional rhotrices is defined by Sani [4] as follows:

$$R_3 \, o Q_3 = \left\langle \begin{array}{ccc} & a & \\ b & c & d \\ & e & \end{array} \right\rangle \left\langle \begin{array}{ccc} & f & \\ g & h & j \\ & k & \end{array} \right\rangle$$

$$= \left\langle \begin{array}{ccc} & af + dg & \\ bf + eg & ch & aj + dk \\ & bj + ek & \end{array} \right\rangle.$$

Sani [5] also discussed the row-column multiplication of high dimension rhotrices as follows:

Consider a n -dimensional rhotrix

$$P_n = \left\langle \begin{array}{ccccccc} & & & a_{11} & & & \\ & & a_{21} & c_{11} & a_{12} & & \\ & a_{31} & c_{21} & a_{22} & c_{12} & a_{13} & \\ . & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ a_{t1} & \cdots & \cdots & \cdots & \cdots & \cdots & a_{1t} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ & a_{tt-2} & c_{t-1t-2} & a_{t-1t-1} & c_{t-2t-1} & a_{t-2t} & \\ & & a_{tt-1} & c_{t-1t-1} & a_{t-1t} & & \\ & & & a_{tt} & & & \end{array} \right\rangle,$$

where $t=(n+1)/2$ and denote it as $P_n=\langle a_{ij}, c_{lk}\rangle$ with $i,j=1,2,...,t$ and $l,k=1,2,...,t-1$. Then the multiplication of two rhotrices P_n and Q_n is defined as follows:

$$P_n \, o \, Q_n = \langle a_{i_1 j_1}, c_{l_1 k_1}\rangle o \langle b_{i_2 j_2}, d_{l_2 k_2}\rangle$$

$$= \left\langle \sum_{i_2 j_1=1}^{t} \left(a_{i_1 j_1} b_{i_2 j_2}\right), \sum_{l_2 k_1=1}^{t-1} \left(c_{l_1 k_1} d_{l_2 k_2}\right) \right\rangle.$$

Rhotrices over finite fields were discussed by Tudunkaya et al. [6]. Aminu [7, 8] investigated rhotrices over matrix theory and polynomials ring theory. Algebra and analysis of rhotrices is discussed in the literature, see [9, 10, 11]. Adjoint of a rhotrix, inner product spaces, bilinear forms and Caylay-Hamilton theorem are discussed by Sharma and Kanwar [12, 13, 14, 15, 16]. Different constructions of MDS rhotrices from companion matrices and Vandermonde matrices are given by Sharma et al. [17, 18, 19, 20, 21, 22, 23]. Sharma et al. [24] introduced circulant rhotrices in the literature of rhotrices and construct some MDS rhotrices using special type of circulant rhotrices, see [25].

Maximum distance separable (MDS) matrices have diffusion properties that are used in block ciphers and cryptographic hash functions, as discussed in [26, 27]. There are several methods to construct MDS matrices. Sajadieh et al. [28] and Lacan and Flimes [29] used Vandermonde matrices for the construction of MDS matrices. Gupta and Ray construct MDS rhotrices from companion matrices and circulant like matrices , see [30, 31]

Cauchy matrices have applications in coding theory such as in Goppa codes as discussed in [32]. Nakahara and Abraho [33] constructed an involutory MDS matrix of 16- order by using a Cauchy matrix which was used in MDS-AES design.

Definition 1.1. The matrix of the form $A=(a_{ij})_{mn}$ where

$$a_{ij}=\frac{1}{x_i-x_j},\ x_i-x_j\neq 0, 1\le i\le m, 1\le j\le n$$

is called a Cauchy matrix and x_i, x_j are the elements from F_{2^n}.

For example, a Cauchy matrix of n-order can be written as

$$A_n=\begin{bmatrix} \frac{1}{x_1-y_1} & \frac{1}{x_1-y_2} & \cdots & \frac{1}{x_1-y_n} \\ \frac{1}{x_2-y_1} & \frac{1}{x_2-y_2} & \cdots & \frac{1}{x_2-y_n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{1}{x_n-y_1} & \frac{1}{x_n-y_2} & \cdots & \frac{1}{x_n-y_n} \end{bmatrix}$$

In the present paper we denote the (i,j)th element of ith row and jth column by A[i][j].

Definition 1.2. A 5- dimensional Cauchy rhotrix C_5 is defined as

$$C_5=\left\langle \begin{matrix} & & \frac{1}{x_1-y_1} & & \\ & \frac{1}{x_2-y_1} & \frac{1}{s_1-t_1} & \frac{1}{x_1-y_2} & \\ \frac{1}{x_3-y_1} & \frac{1}{s_2-t_1} & \frac{1}{x_2-y_2} & \frac{1}{s_1-t_2} & \frac{1}{x_1-y_3} \\ & \frac{1}{x_3-y_2} & \frac{1}{s_2-t_2} & \frac{1}{x_2-y_3} & \\ & & \frac{1}{x_3-y_3} & & \end{matrix} \right\rangle,$$

where $x_i, y_j\ (i,j=1,2,3)$ and $s_l, t_m\ (l,m=1,2)$ are elements from a finite field. Two coupled matrices of C_5 are [35]

$$U=\begin{bmatrix} \frac{1}{x_1-y_1} & \frac{1}{x_1-y_2} & \frac{1}{x_1-y_3} \\ \frac{1}{x_2-y_1} & \frac{1}{x_2-y_2} & \frac{1}{x_2-y_3} \\ \frac{1}{x_3-y_1} & \frac{1}{x_3-y_2} & \frac{1}{x_3-y_3} \end{bmatrix} \text{ and}$$

$$V=\begin{bmatrix} \frac{1}{s_1-t_1} & \frac{1}{s_1-t_2} \\ \frac{1}{s_2-t_1} & \frac{1}{s_2-t_2} \end{bmatrix}.$$

Definition 1.3. Let F be a finite field, and p, q be two positive integers. Let $x\to M\times x$ be a mapping from F^p to F^q defined by the $q\times p$ matrix M. We say that it is an MDS matrix if the set of all pairs $(x, M\times x)$ is an MDS code, that is a linear code of dimension p, length $p+q$ and minimum distance $q+1$. In other form we can say that a square matrix is an MDS matrix if and only if every square sub-matrices of A are non-singular. This implies that all the entries of an MDS matrix must be nonzero.

Definition 1.4. An m$\times$ n rhotrix over a finite field K is an MDS rhotrix if it is the linear transformation $f(x)=Ax$ from K^n to K^m such that that no two different $m+n$-tuples of the form $(x, f(x))$ coincide. The necessary and sufficient condition of a rhotrix to be an MDS rhotrix is that all its sub-rhotrices are non-singular.

The construction of the MDS rhotrices is discussed by Sharma and Kumar [17]. The following Lemma 1.5 is also discussed in [17].

Lemma 1.5. Any rhotrix R_5 over GF(2^n) with all non zero entries is an MDS rhotrix iff its coupled matrices $M_1 = 3\times 3$ and $M_2 = 2\times 2$ are non-singular and all their entries are non zero.

Now, we construct maximum distance separable rhotrices by using Cauchy rhotrices.

2. MDS RHOTRICES FROM CAUCHY RHOTRICES OVER F_{2^3}

In this section, we constructed some maximum distance separable rhotrices from 5- dimensional Cauchy rhotrices using the elements of finite field F_{2^3}.

Theorem 2.1. Let R_5 be a Cauchy rhotrix whose coupled matrices $A = (a_{ij})_{3\times 3}$ and $B = (b_{lm})_{2\times 2}$ are defined as $a_{ij} = \frac{1}{x_i + y_j}$, $x_i + y_j \neq 0$ and $b_{lm} = \frac{1}{s_l + t_m}$, $s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j}$, $x_i = y_j^{\,j+1} + y_j + 1$, $i, j = 1,2,3$ and $s_l = \alpha^{2l} + \alpha^l ; t_m = \alpha^{2^m} + 1; l, m = 1,2$, where α is the root of irreducible polynomial $p(x) = x^3 + x + 1$ in the extension field of GF(2^3). Then A and B form MDS rhotrix R_5.

Proof: For given

$$A = (a_{ij})_{3\times 3};\ a_{ij} = \frac{1}{x_i + y_j},\ x_i + y_j \neq 0;$$

$$y_j = \alpha^{2^j},\ x_i = y_j^{\,j+1} + y_j + 1;\ i, j = 1,2,3$$

we have

$$y_1 = \alpha^2,\ y_2 = \alpha^2 + \alpha,\ y_3 = \alpha$$

and

$$x_1 = \alpha + 1,\ x_2 = 0,\ x_3 = \alpha^2 + 1.$$

Therefore,

$$A = \begin{bmatrix} \frac{1}{\alpha^2+\alpha+1} & \frac{1}{\alpha^2+1} & 1 \\ \frac{1}{\alpha^2} & \frac{1}{\alpha^2+\alpha} & \frac{1}{\alpha} \\ 1 & \frac{1}{\alpha+1} & \frac{1}{\alpha^2+\alpha+1} \end{bmatrix}. \quad (2.1)$$

Since, α is the root of $x^3 + x + 1 = 0$. Therefore, $\alpha^2 + \alpha + 1 \neq 0,\ \alpha^2 + \alpha \neq 0,\ \alpha^2 + 1 \neq 0,$ $\alpha^2 \neq 0,\ \alpha + 1 \neq 0\ , \alpha \neq 0.$

Also, det $A = \frac{\alpha^2+1}{\alpha^2+\alpha+1} \neq 0$. So, A is non-singular.

Also all the sub matrices of A are non-singular. From (2.1), we have

$$A[1][1] = A[3][3] = \frac{1}{\alpha^2+\alpha+1} \neq 0,$$

$$A[1][2] = \frac{1}{\alpha^2+1} \neq 0,$$

$$A[1][3] = A[3][1] = 1 \neq 0,$$

$$A[2][1] = \frac{1}{\alpha^2} \neq 0,$$

$$A[2][2] = \frac{1}{\alpha^2+\alpha} \neq 0,$$

$$A[2][3] = \frac{1}{\alpha} \neq 0,$$

$$A[3][2] = \frac{1}{\alpha+1} \neq 0.$$

This implies that A is MDS matrix.

Similarly, we can prove that

$$B = \begin{bmatrix} \frac{1}{\alpha+1} & 1 \\ \frac{1}{\alpha^2+\alpha+1} & \frac{1}{\alpha^2+1} \end{bmatrix} \quad (2.2)$$

is MDS matrix. From (2.2), we have

$$B[1][1] = \frac{1}{\alpha+1} \neq 0,$$

$$B[1][2] = 1 \neq 0,$$

$$B[2][1] = \frac{1}{\alpha^2+\alpha+1} \neq 0,$$

$$B[2][2] = \frac{1}{\alpha^2+1} \neq 0.$$

The rhotrix of the coupled matrices A and B is

$$R_5 = \left\langle \begin{array}{ccccc} & & A[1][1] & & \\ & A[2][1] & B[1][1] & A[1][2] & \\ A[3][1] & B[2][1] & A[2][2] & B[1][2] & A[1][3] \\ & A[3][2] & B[2][2] & A[2][3] & \\ & & A[3][3] & & \end{array} \right\rangle$$

(2.3)

that is,

$$R_5 = \left\langle \begin{array}{ccccc} & & \frac{1}{\alpha^2+\alpha+1} & & \\ & \frac{1}{\alpha^2} & \frac{1}{\alpha+1} & \frac{1}{\alpha^2+1} & \\ 1 & \frac{1}{\alpha^2+\alpha+1} & \frac{1}{\alpha^2+\alpha} & 1 & 1 \\ & \frac{1}{\alpha+1} & \frac{1}{\alpha^2+1} & \frac{1}{\alpha} & \\ & & \frac{1}{\alpha^2+\alpha+1} & & \end{array} \right\rangle.$$

Therefore, from Lemma 1.5, it is clear that R_5 is maximum distance separable rhotrix (MDSR).

On the similar arguments we can prove the following Theorems 2.2 to 2.4.

Theorem 2.2. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times3}$ and $B=(b_{lm})_{2\times2}$ are defined as

$a_{ij} = \frac{1}{x_i + y_j},\ x_i + y_j \neq 0$ and

$b_{lm} = \frac{1}{s_l + t_m},\ s_l + t_m \neq 0$. Let

$y_j = \alpha^{2^j} + \alpha^j + 1;\ x_i = y_j^{\,j+1} + y_j + 1,$

$i, j = 1,2,3$ and

$s_l = \alpha^{2^l};\ t_m = \alpha^m + \alpha + 1; l, m = 1,2,$ where α is the root of irreducible polynomial $p(x) = x^3 + x + 1$ in the extension field of GF (2^3). Then A and B form MDS rhotrix R_5.

Theorem 2.3. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times3}$ and $B=(b_{lm})_{2\times2}$ are defined as

$a_{ij} = \frac{1}{x_i + y_j},\ x_i + y_j \neq 0$ and

$b_{lm} = \frac{1}{s_l + t_m},\ s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j} + \alpha^j$; a

$x_i = y_j^{\,j+1} + 1,\ i, j = 1,2,3$ and

$s_l = \alpha^l + 1; t_m = \alpha^{2^m} + \alpha;\ l, m = 1,2,$ where α is the root of irreducible polynomial $p(x) = x^3 + x + 1$ in the extension field of GF (2^3). Then A and B form MDS rhotrix R_5.

Theorem 2.4. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times3}$ and $B=(b_{lm})_{2\times2}$ are defined as

$a_{ij} = \frac{1}{x_i + y_j},\ x_i + y_j \neq 0$ and

$b_{lm} = \frac{1}{s_l + t_m},\ s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j} + 1;$

$x_i = y_j + 1,\ i, j = 1,2,3$ and

$s_l = \alpha^{2l} + \alpha + 1; t_m = \alpha^{2^m} + \alpha;\ l, m = 1,2,$ where α is the root of irreducible polynomial $p(x) = x^3 + x + 1$ in the extension field of GF (2^3). Then A and B form MDS rhotrix R_5.

3. MDS RHOTRICES FROM CAUCHY RHOTRICES OVER F_{2^4}

Theorem 3.1. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times3}$ and $B=(b_{lm})_{2\times2}$ are defined as

$a_{ij} = \frac{1}{x_i + y_j},\ x_i + y_j \neq 0$ and

$b_{lm} = \frac{1}{s_l + t_m},\ s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j}$;

$x_i = y_j^{\,j+1} + y_j + 1,\ i, j = 1,2,3$ and

$s_l = \alpha^{2l} + \alpha^l; t_m = \alpha^{2^m} + 1; l, m = 1,2,$ where α is the root of irreducible polynomial $p(x) = x^4 + x + 1$ in the extension field of GF (2^4). Then A and B form MDS rhotrix R_5.

Proof: For given

$A=(a_{ij})_{3\times3};\ a_{ij} = \frac{1}{x_i + y_j},\ x_i + y_j \neq 0;\ y_j = \alpha^{2^j},$

$x_i = y_j^{\,j+1} + y_j + 1;\ i, j = 1,2,3,$

we have

$$y_1 = \alpha^2,\ y_2 = \alpha + 1,\ y_3 = \alpha^2 + 1$$

and

$$x_1 = \alpha^2 + \alpha,\ x_2 = \alpha^3 + \alpha^2 + 1,\ x_3 = 0.$$

Therefore,

$$A=\begin{bmatrix} \frac{1}{\alpha} & \frac{1}{\alpha^2+1} & \frac{1}{\alpha+1} \\ \frac{1}{\alpha^3+1} & \frac{1}{\alpha^3+\alpha^2+\alpha} & \frac{1}{\alpha^3} \\ \frac{1}{\alpha^2} & \frac{1}{\alpha+1} & \frac{1}{\alpha^2+1} \end{bmatrix}. \quad (3.1)$$

Since, α is the root of $x^4+x+1=0$. Therefore, $\alpha^3+\alpha^2+\alpha\neq 0,\ \alpha^2+1\neq 0,\ \alpha^3+1\neq 0,$ $\alpha^2\neq 0,\ \alpha^3\neq 0,\ \alpha+1\neq 0\ ,\alpha\neq 0.$

Also, $\det A=\frac{\alpha+1}{\alpha^3+\alpha+1}\neq 0$. So, A is non-singular.

Also all the sub matrices of A are non-singular. From (3.1), we have

$$A[1][1]=\frac{1}{\alpha}\neq 0,$$

$$A[1][2]=A[3][3]=\frac{1}{\alpha^2+1}\neq 0,$$

$$A[1][3]=A[3][2]=\frac{1}{\alpha+1}\neq 0,$$

$$A[2][1]=\frac{1}{\alpha^3+1}\neq 0,$$

$$A[2][2]=\frac{1}{\alpha^3+\alpha^2+\alpha}\neq 0$$

$$A[2][3]=\frac{1}{\alpha^3}\neq 0\ ,$$

$$A[3][1]=\frac{1}{\alpha^2}\neq 0.$$

Therefore, A is MDS matrix.

Similarly, we can prove that

$$B=\begin{bmatrix} \frac{1}{\alpha+1} & \frac{1}{\alpha^2} \\ \frac{1}{\alpha} & \frac{1}{\alpha^2+1} \end{bmatrix} \quad (3.2)$$

is MDS matrix. From (3.2),we have

$$B[1][1]=\frac{1}{\alpha+1}\neq 0,$$

$$B[1][2]=\frac{1}{\alpha^2}\neq 0,$$

$$B[2][1]=\frac{1}{\alpha}\neq 0,$$

$$B[2][2]=\frac{1}{\alpha^2+1}\neq 0.$$

The rhotrix of the coupled matrices A and B is

$$R_5=\left\langle \begin{matrix} & & A[1][1] & & \\ & A[2][1] & B[1][1] & A[1][2] & \\ A[3][1] & B[2][1] & A[2][2] & B[1][2] & A[1][3] \\ & A[3][2] & B[2][2] & A[2][3] & \\ & & A[3][3] & & \end{matrix} \right\rangle, \quad (3.3)$$

that is,

$$R_5=\left\langle \begin{matrix} & & \frac{1}{\alpha} & & \\ & \frac{1}{\alpha^3+1} & \frac{1}{\alpha+1} & \frac{1}{\alpha^2+1} & \\ \frac{1}{\alpha^2} & \frac{1}{\alpha} & \frac{1}{\alpha^3+\alpha^2+\alpha} & \frac{1}{\alpha^2} & \frac{1}{\alpha^3} \\ & \frac{1}{\alpha+1} & \frac{1}{\alpha^2+1} & \frac{1}{\alpha^3} & \\ & & \frac{1}{\alpha^2+1} & & \end{matrix} \right\rangle.$$

Therefore, from Lemma 1.5, it is clear that R_5 is maximum distance separable rhotrix (MDSR).

On the similar arguments we can prove the following theorems.

Theorem 3.2. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times 3}$ and $B=(b_{lm})_{2\times 2}$ are defined as

$a_{ij}=\frac{1}{x_i+y_j},\ x_i+y_j\neq 0$ and

$b_{lm}=\frac{1}{s_l+t_m},\ s_l+t_m\neq 0$. Let

$y_j=\alpha^{2^j}+\alpha^j+1;\ x_i=y_j^{\,j+1}+\ y_j+1,$

$i,j=1,2,3$ and

$s_l=\alpha^{2^l}\ ;\ t_m=\alpha^m+\alpha+1;l,m=1,2,$ where α is the root of irreducible polynomial $p(x)=x^4+x+1$ in the extension field of GF (2^4). Then A and B form MDS rhotrix R_5.

Theorem 3.3. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times 3}$ and $B=(b_{lm})_{2\times 2}$ are defined as

$a_{ij} = \frac{1}{x_i + y_j}$, $x_i + y_j \neq 0$ and

$b_{lm} = \frac{1}{s_l + t_m}$, $s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j} + \alpha^j$; a

$x_i = y_j^{j+1} + 1$, $i, j = 1,2,3$ and

$s_l = \alpha^l + 1; t_m = \alpha^{2^m} + \alpha$; $l, m = 1,2$, where α is the root of irreducible polynomial $p(x) = x^4 + x + 1$ in the extension field of GF (2^4). Then A and B form MDS rhotrix R_5.

Theorem 3.4. Let R_5 be a Cauchy rhotrix whose coupled matrices $A = (a_{ij})_{3\times3}$ and $B = (b_{lm})_{2\times2}$ are defined as

$a_{ij} = \frac{1}{x_i + y_j}$, $x_i + y_j \neq 0$ and

$b_{lm} = \frac{1}{s_l + t_m}$, $s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j} + 1$;

$x_i = y_j + 1$, $i, j = 1,2,3$ and

$s_l = \alpha^{2l} + \alpha + 1; t_m = \alpha^{2^m} + \alpha$; $l, m = 1,2$, where α is the root of irreducible polynomial $p(x) = x^4 + x + 1$ in the extension field of GF (2^4). Then A and B form MDS rhotrix R_5.

4. MDS RHOTRICES FROM CAUCHY RHOTRICES OVER F_{2^5}

In this section, we have construct some maximum distance separable rhotrices from 5- dimensional Cauchy rhotrices using the elements of finite field F_{2^5}.

Theorem 4.1. Let R_5 be a Cauchy rhotrix whose coupled matrices $A = (a_{ij})_{3\times3}$ and $B = (b_{lm})_{2\times2}$ are defined as

$a_{ij} = \frac{1}{x_i + y_j}$, $x_i + y_j \neq 0$ and

$b_{lm} = \frac{1}{s_l + t_m}$, $s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j}$,

$x_i = y_j^{j+1} + y_j + 1$, $i, j = 1,2,3$ and

$s_l = \alpha^{2l} + \alpha^l; t_m = \alpha^{2^m} + 1; l, m = 1,2$, where α is the root of irreducible polynomial $p(x) = x^5 + x^2 + 1$ in the extension field of GF (2^5). Then A and B form MDS rhotrix R_5.

Proof: For given

$A = (a_{ij})_{3\times3}$; $a_{ij} = \frac{1}{x_i + y_j}$, $x_i + y_j \neq 0$;

$y_j = \alpha^{2^j}$, $x_i = y_j^{j+1} + y_j + 1$; $i, j = 1,2,3$

we have

$$y_1 = \alpha^2, y_2 = \alpha^4, y_3 = \alpha^3 + \alpha^2 + 1$$

and

$x_1 = \alpha^4 + \alpha^2 + 1$, $x_2 = \alpha^4 + \alpha^3 + \alpha^2 + \alpha + 1$,
$x_3 = \alpha^3 + \alpha^2 + \alpha$.

Therefore,

$$A = \begin{bmatrix} \frac{1}{\alpha^4+1} & \frac{1}{\alpha^2+1} & \frac{1}{\alpha^4+\alpha^3} \\ \frac{1}{\alpha^4+\alpha^3+\alpha+1} & \frac{1}{\alpha^4+\alpha^2+\alpha+1} & \frac{1}{\alpha^4+\alpha} \\ \frac{1}{\alpha^4+\alpha} & \frac{1}{\alpha^4+\alpha^3+\alpha^2+\alpha} & \frac{1}{\alpha+1} \end{bmatrix}. \quad (4.1)$$

Since, α is the root of $x^5 + x^2 + 1 = 0$. Therefore, $\alpha^4 + \alpha^3 + \alpha^2 + \alpha \neq 0$, $\alpha^4 + \alpha^3 + \alpha + 1 \neq 0$, $\alpha^4 + \alpha^2 + \alpha + 1 \neq 0$, $\alpha^4 + \alpha^3 \neq 0$, $\alpha^4 + \alpha \neq 0$, $\alpha^4 + 1 \neq 0$, $\alpha^2 + 1 \neq 0$ and $\alpha + 1 \neq 0$.

Also, $\det A = \frac{\alpha^4}{\alpha^4 + \alpha^3 + a^2} \neq 0$. So, A is non-singular. Also all the sub matrices of A are non-singular. From (4.1), we have

$A[1][1] = \frac{1}{\alpha^4 + 1} \neq 0$,

$A[1][2] = \frac{1}{\alpha^2 + 1} \neq 0$,

$A[1][3] = A[3][1] = \frac{1}{\alpha^4 + \alpha^3} \neq 0$,

$A[2][1] = \frac{1}{\alpha^4 + \alpha^3 + \alpha + 1} \neq 0$,

$A[2][2] = \frac{1}{\alpha^3 + \alpha^2 + \alpha + 1} \neq 0$,

$$A[2][3] = \frac{1}{\alpha^4 + \alpha} \neq 0,$$

$$A[3][1] = \frac{1}{\alpha^3 + \alpha} \neq 0,$$

$$A[2][2] = \frac{1}{\alpha^3 + \alpha^2 + \alpha + 1} \neq 0,$$

$$A[3][3] = \frac{1}{\alpha + 1} \neq 0.$$

Therefore, A is MDS matrix.

Similarly, we can prove that

$$B = \begin{bmatrix} \frac{1}{\alpha + 1} & \frac{1}{\alpha^4 + \alpha^2 + \alpha + 1} \\ \frac{1}{\alpha^4 + 1} & \frac{1}{\alpha^2 + 1} \end{bmatrix} \quad (4.2)$$

is MDS matrix. From (4.2), we have

$$B[1][1] = \frac{1}{\alpha + 1} \neq 0,$$

$$B[1][2] = \frac{1}{\alpha^4 + \alpha^2 + \alpha + 1} \neq 0,$$

$$B[2][1] = \frac{1}{\alpha^4 + 1} \neq 0,$$

$$B[2][2] = \frac{1}{\alpha^2 + 1} \neq 0.$$

The rhotrix of the coupled matrices A and B is

$$R_5 = \left\langle \begin{array}{ccccc} & & A[1][1] & & \\ & A[2][1] & B[1][1] & A[1][2] & \\ A[3][1] & B[2][1] & A[2][2] & B[1][2] & A[1][3] \\ & A[3][2] & B[2][2] & A[2][3] & \\ & & A[3][3] & & \end{array} \right\rangle. \quad (4.3)$$

Using (4.1) and (4.2) in (4.3), we have

$$R_5 = \left\langle \begin{array}{ccccc} & & \frac{1}{\alpha^4+1} & & \\ & \frac{1}{\alpha^4+\alpha^3+\alpha+1} & \frac{1}{\alpha+1} & \frac{1}{\alpha^2+1} & \\ \frac{1}{\alpha^3+\alpha} & \frac{1}{\alpha^4+1} & \frac{1}{\alpha^3+\alpha^2+\alpha+1} & \frac{1}{\alpha^4+\alpha^2+\alpha+1} & \frac{1}{\alpha^4+\alpha^3} \\ & \frac{1}{\alpha^4+\alpha^3+\alpha^2+\alpha} & \frac{1}{\alpha^2+1} & \frac{1}{\alpha^4+\alpha} & \\ & & \frac{1}{\alpha+1} & & \end{array} \right\rangle.$$

Therefore, from Lemma 1.5, it is clear that R_5 is maximum distance separable rhotrix (MDSR).

In the similar ways we can prove the following theorems.

Theorem 4.2. Let R_5 be a Cauchy rhotrix whose coupled matrices $A = (a_{ij})_{3\times3}$ and $B = (b_{lm})_{2\times2}$ are defined as $a_{ij} = \frac{1}{x_i + y_j}$, $x_i + y_j \neq 0$ and $b_{lm} = \frac{1}{s_l + t_m}$, $s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j} + \alpha^j + 1$; $x_i = y_j^{\,j+1} + y_j + 1$, $i, j = 1,2,3$ and $s_l = \alpha^{2^l}$; $t_m = \alpha^m + \alpha + 1$; $l, m = 1,2$, where α is the root of irreducible polynomial $p(x) = x^5 + x^2 + 1$ in the extension field of GF(2^3). Then A and B form MDS rhotrix R_5.

Theorem 4.3. Let R_5 be a Cauchy rhotrix whose coupled matrices $A = (a_{ij})_{3\times3}$ and $B = (b_{lm})_{2\times2}$ are defined as $a_{ij} = \frac{1}{x_i + y_j}$, $x_i + y_j \neq 0$ and $b_{lm} = \frac{1}{s_l + t_m}$, $s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j} + \alpha^j$; a $x_i = y_j^{\,j+1} + 1$, $i, j = 1,2,3$ and $s_l = \alpha^l + 1$; $t_m = \alpha^{2^m} + \alpha$; $l, m = 1,2$, where α is the root of irreducible polynomial $p(x) = x^5 + x^2 + 1$ in the extension field of GF(2^3). Then A and B form MDS rhotrix R_5.

Theorem 4.4. Let R_5 be a Cauchy rhotrix whose coupled matrices $A = (a_{ij})_{3\times3}$ and $B = (b_{lm})_{2\times2}$ are defined as $a_{ij} = \frac{1}{x_i + y_j}$, $x_i + y_j \neq 0$ and $b_{lm} = \frac{1}{s_l + t_m}$, $s_l + t_m \neq 0$. Let $y_j = \alpha^{2^j} + 1$; $x_i = y_j + 1$, $i, j = 1,2,3$ and $s_l = \alpha^{2l} + \alpha + 1$; $t_m = \alpha^{2^m} + \alpha$; $l, m = 1,2$, where α is the root of irreducible polynomial $p(x) = x^5 + x^2 + 1$ in the extension field of GF(2^3). Then A and B form MDS rhotrix R_5.

5. MDS RHOTRICES FROM CAUCHY RHOTRICES OVER F_{2^6}

In this section, we have construct some maximum distance separable rhotrices from 5- dimensional Cauchy rhotrices using the elements of finite field F_{2^6}.

Theorem 5.1. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times3}$ and $B=(b_{lm})_{2\times2}$ are defined as $a_{ij}=\frac{1}{x_i+y_j}$, $x_i+y_j\neq0$ and $b_{lm}=\frac{1}{s_l+t_m}$, $s_l+t_m\neq0$. Let $y_j=\alpha^{2^j}$, $x_i=y_j^{\,j+1}+y_j+1$, $i,j=1,2,3$ and $s_l=\alpha^{2l}+\alpha^l; t_m=\alpha^{2^m}+1; l,m=1,2$, where α is the root of irreducible polynomial $p(x)=x^6+x+1$ in the extension field of GF(2^6). Then A and B form MDS rhotrix R_5.

Proof: For given $A=(a_{ij})_{3\times3}; a_{ij}=\frac{1}{x_i+y_j}, x_i+y_j\neq0;$, we have

$$y_j=\alpha^{2^j},\ x_i=y_j^{\,j+1}+y_j+1;\ i,j=1,2,3$$

$$y_1=\alpha^2,\ y_2=\alpha^4,\ y_3=\alpha^3+\alpha^2$$

and

$$x_1=\alpha^4+\alpha^2+1,\ x_2=\alpha^4+\alpha^2,\ x_3=\alpha^3.$$

Therefore,

$$A=\begin{bmatrix}\frac{1}{\alpha^4+1} & \frac{1}{\alpha^2+1} & \frac{1}{\alpha^4+\alpha^3+1}\\ \frac{1}{\alpha^4} & \frac{1}{\alpha^2} & \frac{1}{\alpha^4+\alpha^3}\\ \frac{1}{\alpha^3+\alpha^2} & \frac{1}{\alpha^4+\alpha^3} & \frac{1}{\alpha^2}\end{bmatrix}. \quad (5.1)$$

Since, α is the root of $x^6+x+1=0$. Therefore,

$\alpha^4+1\neq0, \alpha^2+1\neq0, \alpha^4+\alpha^2+\alpha+1\neq0,$
$\alpha^4+\alpha^3+1\neq0, \alpha^4\neq0, \alpha^2\neq0,$
$\alpha^4+\alpha^3\neq0,$ and $\alpha^3+\alpha^2\neq0.$

Also, det $A=\frac{\alpha^2+\alpha}{\alpha^5+\alpha^3+a^2}\neq0$. So, A is non-singular. Also all the sub matrices of A are non-singular.

From (5.1), we have

$$A[1][1]=\frac{1}{\alpha^4+1}\neq0,$$

$$A[1][2]=\frac{1}{\alpha^2+1}\neq0,$$

$$A[1][3]=\frac{1}{\alpha^4+\alpha^3+1}\neq0,$$

$$A[2][1]=\frac{1}{\alpha^4}\neq0,$$

$$A[2][2]=A[3][3]=\frac{1}{\alpha^2}\neq0,$$

$$A[2][3]=\frac{1}{\alpha^4+\alpha^3}\neq0,$$

$$A[3][1]=\frac{1}{\alpha^3+\alpha^2}\neq0,$$

$$A[2][2]=\frac{1}{\alpha^3+\alpha^2+\alpha+1}\neq0.$$

Therefore, A is MDS matrix.

Similarly, we can prove that

$$B=\begin{bmatrix}\frac{1}{\alpha+1} & \frac{1}{\alpha^4+\alpha^2+\alpha+1}\\ \frac{1}{\alpha^4+1} & \frac{1}{\alpha^2+1}\end{bmatrix} \quad (5.2)$$

is MDS matrix. From (5.2), we have

$$B[1][1]=\frac{1}{\alpha+1}\neq0,$$

$$B[1][2]=\frac{1}{\alpha^4+\alpha^2+\alpha+1}\neq0,$$

$$B[2][1]=\frac{1}{\alpha^4+1}\neq0,\ B[2][2]=\frac{1}{\alpha^2+1}\neq0.$$

The rhotrix of the coupled matrices A and B is

$$R_5=\left\langle\begin{array}{ccccc} & & A[1][1] & & \\ & A[2][1] & B[1][1] & A[1][2] & \\ A[3][1] & B[2][1] & A[2][2] & B[1][2] & A[1][3]\\ & A[3][2] & B[2][2] & A[2][3] & \\ & & A[3][3] & & \end{array}\right\rangle \quad (5.3)$$

.

Using (5.1) and (5.2) in (5.3), we have

$$R_5 = \left\langle \begin{matrix} & & \frac{1}{\alpha^4+1} & \\ & \frac{1}{\alpha^4} & \frac{1}{\alpha+1} & \frac{1}{\alpha^2+1} \\ \frac{1}{\alpha^3+\alpha^2} & \frac{1}{\alpha^4+1} & \frac{1}{\alpha^2} & \frac{1}{\alpha^4+\alpha^2+\alpha+1} \quad \frac{1}{\alpha^4+\alpha^3+1} \\ & \frac{1}{\alpha^4+\alpha^3} & \frac{1}{\alpha^2+1} & \frac{1}{\alpha^4+\alpha^3} \\ & & \frac{1}{\alpha^2} & \end{matrix} \right\rangle.$$

Therefore, from Lemma 1.5, it is clear that R_5 is maximum distance separable rhotrix (MDSR).

Theorem 5.2. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times3}$ and $B=(b_{lm})_{2\times2}$ are defined as $a_{ij}=\frac{1}{x_i+y_j}$, $x_i+y_j\neq0$ and $b_{lm}=\frac{1}{s_l+t_m}$, $s_l+t_m\neq0$. Let $y_j=\alpha^{2^j}+\alpha^j+1$; $x_i=y_j^{\,j+1}+y_j+1$, $i,j=1,2,3$ and $s_l=\alpha^{2^l}$; $t_m=\alpha^m+\alpha+1; l,m=1,2$, where α is the root of irreducible polynomial $p(x)=x^6+x+1$ in the extension field of GF(2^6). Then A and B form MDS rhotrix R_5.

Theorem 5.3. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times3}$ and $B=(b_{lm})_{2\times2}$ are defined as $a_{ij}=\frac{1}{x_i+y_j}$, $x_i+y_j\neq0$ and $b_{lm}=\frac{1}{s_l+t_m}$, $s_l+t_m\neq0$. Let $y_j=\alpha^{2^j}+\alpha^j$; a $x_i=y_j^{\,j+1}+1$, $i,j=1,2,3$ and $s_l=\alpha^l+1; t_m=\alpha^{2^m}+\alpha$; $l,m=1,2$, where α is the root of irreducible polynomial $p(x)=x^6+x+1$ in the extension field of GF(2^6). Then A and B form MDS rhotrix R_5.

Theorem 5.4. Let R_5 be a Cauchy rhotrix whose coupled matrices $A=(a_{ij})_{3\times3}$ and $B=(b_{lm})_{2\times2}$ are defined as $a_{ij}=\frac{1}{x_i+y_j}$, $x_i+y_j\neq0$ and $b_{lm}=\frac{1}{s_l+t_m}$, $s_l+t_m\neq0$. Let $y_j=\alpha^{2^j}+1$; $x_i=y_j+1$, $i,j=1,2,3$ and $s_l=\alpha^{2l}+\alpha+1; t_m=\alpha^{2^m}+\alpha$; $l,m=1,2$, where α is the root of irreducible polynomial $p(x)=x^6+x+1$ in the extension field of GF(2^6). Then A and B form MDS rhotrix R_5.

6. CONCLUSION

In the present paper, the Cauchy rhotrix is defined. The maximum distance seperable rhotrices (MDS) are of much interest in the field of cryptography. Therefore, MDS rhotrices over finite fields are also constructed in this paper.

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ABSTRACT:
This paper deals with the convection of micropolar fluids heated and soluted from below in the presence of suspended particles (fine dust) and uniform vertical rotation and uniform vertical magnetic field in a porous medium. Using the Boussinesq approximation, the linearized stability theory and normal mode analysis, the exact solutions are obtained for the case of two free boundaries. It is found that the presence of the suspended particles number density, the rotation parameter, stable solute, magnetic field intensity and medium permeability bring oscillatory modes which were non–existent in their absence. It is found that the presence of coupling between thermal and micropolar effects, rotation parameter, solute parameter and suspended particles may introduce overstability in the system. Graphs have been plotted by giving numerical values to the parameters accounting for rotation parameter , magnetic field solute parameter, the dynamic microrotation viscosity and coefficient of angular viscosity to depict the stability characteristics, for both the cases of stationary convection and overstability. It is found that Rayleigh number for the case of overstability and stationary convection increases with increase in rotation parameter, as well as with magnetic field intensity, solute parameter and decreases with increase in micropolar coefficients and medium permeability, for a fixed wave number, implying thereby the stabilizing effect of rotation parameter, magnetic field intensity ,solute parameter and destabilizing effect of micropolar coefficients and medium permeability on the thermosolutal convection of micropolar fluids.



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Research Article

On the Primary Decomposition of *k*-Ideals and Fuzzy *k*-Ideals in Semirings

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Abstract

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Observing that every *k*-irreducible ideal of a semiring *R* is a *k*-primary ideal, if *R* is an additively cancellative, yoked and commutative Noetherian semiring, we establish the primary decomposition and uniqueness of the primary decomposition of *k*-ideals of such semirings. Finally, the primary decomposition and uniqueness of primary decomposition proved for *k*-ideals is also generalised for fuzzy *k*-ideals of these semirings.

Keywords: Semirings | fuzzy *k*-ideals | primary ideals | primary decomposition

AMS Mathematics Subject Classification (2020): 16Y60

1. Introduction

Ideals play an important role in both ring theory and semiring theory. But in the absence of additive inverses in semirings, the structure of ideals in semirings differs from that of ring theory. The ideals in semirings possessing the very obvious property of

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and the role of these ideals in semirings becomes significant in the absence of additive inverses. The results which are true for ideals in rings have also been established for *k*-ideals in semirings by various authors (cf. [1–13]). In view of these facts various researchers attempted the primary decomposition for *k*-ideals in semirings analogous to the primary decomposition of ideals in rings: In a commutative Noetherian ring, every ideal can be decomposed as a finite intersection of primary ideals (Lasker–Noether Theorem [14]). For a deep study of primary ideals in rings and semirings one can refer to [8–12, 15–19].

The above result of ring theory is not true for arbitrary ideals in semirings as noticed in [20]. Atani and Atani [20, Theorem 4] had proved that in a commutative Noetherian semiring, every proper *k*-ideal can be represented as a finite intersection of *k*-primary ideals. But it was observed by Lescot [21] that there were some errors in the results used to prove the aforementioned result. For example, $I + Ra^n$ is not a *k*-ideal, even if *I* is a *k*-ideal. But in [20], it is taken for granted that the ideal $I + Ra^n$ is a *k*-ideal. Lescot [21] found these errors after observing in Example 6.2 that {0} ideal may not be a finite intersection of *k*-primary ideals in a commutative Noetherian semiring. With these observations, he developed the theory of weak primary decomposition for semirings of characteristic 1. But still the question of settling the primary decomposition for a proper *k*-ideal (other than $\{0\}$ and semiring *R*) remained unsolved. In this direction, Kar et al. [22, Theorem 4.4] proved that every proper *k*-ideal of a commutative Noetherian semiring *R* can be expressed as a finite intersection of *k*-irreducible ideals (Definition 2.1). They tried to prove the primary decomposition by observing that in a commutative Noetherian semiring, every *k*-irreducible ideal is a *k*-primary ideal [22, Theorem 4.6]. But the proof of this result has the same errors again and the problem still remains unsolved. This motivated us to establish the primary decomposition of *k*-ideals in commutative Noetherian semirings.

In this paper, we provide a correct proof of Theorem 4.6 of [22], which settles the primary decomposition for *k*-ideals in commutative Noetherian semirings. In order to establish the uniqueness of primary decomposition for semirings, first we prove some required basic results for uniqueness and finally establish the uniqueness of primary decomposition for *k*-ideals in commutative Noetherian semirings: If $I = \cap_{i=1}^{n} Q_i$, where each Q_i is a primary ideal and $\sqrt{Q_i} = P_i$, then the set $\{P_1, P_2, \ldots, P_n\}$ is independent of particular choice of decomposition of *I*.

Fuzzy *k*-ideals play an important role for the study of different

authors (cf. [1, 7, 10, 23–27]). From the primary decomposition of *k*-ideals in semirings, the fuzzy primary decomposition of fuzzy *k*-ideals follows as given in [22]. But the uniqueness theorem for fuzzy *k*-ideals [22, Theorem 5.5], is also incorrect. This motivated us to reinvestigate the uniqueness of fuzzy *k*-primary decomposition in semirings.

2. Primary Decomposition of *k*-Ideals in Semirings

Throughout this paper, *R* is a commutative semiring with identity. First, we recall some definitions and results which are necessary to prove the primary decomposition and uniqueness theorems for *k*-ideals in commutative Noetherian semirings.

Definition 2.1

A proper *k*-ideal *I* of a semiring *R* is called *k*-irreducible ideal if for any two *k*-ideals *J*, *K* of *R*, $I = J \cap K$ implies that either *I* = *J* or *I* = *K*.

Definition 2.2

Let *I* be a *k*-ideal of a semiring *R*. Then *I* is said to have a primary decomposition if *I* can be expressed as $I = \cap_{i=1}^{n} Q_i$, where each Q_i is a primary ideal of *R*. Also, a primary decomposition of the type $I = \cap_{i=1}^{n} Q_i$ with $\sqrt{Q_i} = P_i$, is called a reduced primary decomposition of *I*, if P_i's are distinct and *I* cannot be expressed as an intersection of a proper subset of ideals Q_i in the primary decomposition of *I*. A reduced primary decomposition can be obtained from any primary decomposition by deleting those Q_j that contains $\cap_{\substack{i=1 \\ i \neq j}}^{n} Q_i$ and grouping together all distinct $\sqrt{Q_i}$'s-primary ideal.

The main aim of this section is to prove the existence and uniqueness of primary decomposition for *k*-ideals in a commutative Noetherian semiring. First, we prove the existence part as stated below:

Theorem 2.3

Primary Decomposition of *k*-Ideals

Let *I* be a *k*-ideal of an additively cancellative, yoked and commutative Noetherian semiring *R*. Then *I* can be represented as a finite intersection of primary ideals of *R*, that is, *I* has a reduced primary decomposition.

The decomposition of *k*-ideals in terms of *k*-irreducible ideals has already been proved in [22] as follows:

[22], Theorem 2.1

Every proper *k*-ideal of a commutative Noetherian semiring *R* can be expressed as a finite intersection of *k*-irreducible ideals.

Therefore, primary decomposition for *k*-ideals in semirings follows immediately if we prove

Theorem 2.5

Let *R* be an additively cancellative, yoked and commutative Noetherian semiring. Then every *k*-irreducible ideal of *R* is a primary ideal of *R*.

Kar et al. [22, Theorem 4.6], made an attempt to prove the same without considering additively cancellative and yoked semiring, but the proof of the result has some errors as mentioned in the introduction. For the proof of the required result, we first analyse some common errors committed by many authors regarding *k*-ideals, and prove some facts about *k*-ideals. First, we note that any ideal $I =< a >$ is not a *k*-ideal in semirings as observed by Golan in [28, Example 6.17]. That is, if $I = \ < (1 + x) >$ is an ideal of $\mathbb{N}[x]$ (semiring of polynomials over non-negative integers $\mathbb{N}$ in the indeterminate *x*), then $(1 + x)^3 = (x^3 + 1) + 3x(1 + x) \in I, 3x(1 + x) \in I$, but $(x^3 + 1) \notin I$ implies that *I* is not a *k*-ideal of $\mathbb{N}[x]$. Any ideal generated by a single element becomes a *k*-ideal, if we impose some conditions on a semiring as shown below:

Lemma 2.6

Let *R* be an additively cancellative, yoked and zerosumfree semiring. Then for any $a \in R$, the ideal $I =< a >$ is a *k*- ideal of *R*.

Proof.

Let $a_1 + a_2, a_1 \in I$. Then there exist some $r_1, r_2 \in R$ such that $a_1 + a_2 = ar_1$ and $a_1 = ar_2$. As *R* is yoked, there exists some $r_3 \in R$ such that $r_1 + r_3 = r_2$ or $r_2 + r_3 = r_1$. If $r_1 + r_3 = r_2$, then $ar_1 = ar_2 + a_2 = ar_1 + ar_3 + a_2$ implies that $ar_3 + a_2 = 0$, as *R* is additively cancellative. Also, $a_2 = ar_3 = 0 \in I$, as *R* is zerosumfree.

Further, if $r_2 + r_3 = r_1$, then $ar_2 + a_2 = ar_1 = a(r_2 + r_3) = ar_2 + ar_3$ implies that $a_2 = ar_3 \in I$, since *R* is additively cancellative. Thus, $I =< a >$ is a *k*-ideal of *R*.

The semiring considered in above example is additively cancellative, zerosumfree, but it is not yoked, for let $f(x) = 5x^2 + 9x + 2 \quad \text{and} \quad g(x) = 11x^2 + 3x + 5$ be two polynomials in $\mathbb{N}[x]$, then there exists no $h(x) \in \mathbb{N}[x]$ such that either $f(x) + h(x) = g(x)$ or $g(x) + h(x) = f(x)$.

k-ideals may not be a *k*-ideal in a semiring. There are plenty of *k*-ideals in the semiring $\mathbb{N}$, but their sum is not a *k*-ideal. However, the sum of two *k*-ideals is a *k*-ideal in a lattice ordered semiring (cf. [28, Corollary 21.22]). While proving Theorem 2.5, the authors wrongly used that the ideals $(Q + < a^k >)$ and $(Q + < b >)$ are *k*-ideals. In view of the above observations, Theorem 2.5 follows verbatim as proved in [22, Theorem 4.6] for additively cancellative, yoked, zerosumfree and lattice ordered semirings, because in this case, both an ideal generated by a single element and sum of two *k*-ideals are *k*-ideals. Here, we give a proof of Theorem 2.5 without resorting to the restrictions: lattice ordered and zerosumfree semiring.

Proof of Theorem 2.5.

Let *Q* be a *k*-irreducible ideal of a Noetherian semiring *R*. Let $ab \in Q$ be such that $b \notin Q$. Now, we construct two ideals *I* and *J* of *R* as follows:
$I =< a^k > + Q \quad \text{and} \quad J =< b > + Q$. Then, clearly, $Q \subseteq I \cap J$.

Let $y \in I \cap J$. Then $y = a^n z + q$ for some $z \in R$ and $q \in Q$. Again $aJ \subseteq Q$ (since $ab \in Q$) and so $ay \in Q$ (since $y \in J$).

Therefore, $ay = a^{n+1}z + aq$. Thus, we get that $a^{n+1}z + aq \in Q$. Also, $aq \in Q$, since $q \in Q$ and *Q* is an ideal of *R*. It follows that $a^{n+1}z \in Q$, since *Q* is a *k*-ideal of *R*. Construct a set $A_n = \{x \in R \mid a^n x \in Q\}$. It is easy to check that A_n is an ideal of *R* and $A_1 \subseteq A_2 \cdots$. is an ascending chain of ideals. Since *R* is Noetherian, so $A_n = A_{n+1} = \cdots$. for some $n \in \mathbb{Z}^+$. Again $a^{n+1}z \in Q$ implies that $z \in A_{n+1} = A_n$. It demonstrates that $a^n z \in Q$ which implies that $y \in Q$ and hence $I \cap J = Q$.

Let $rad(R)$ denote the Jacobson Bourne radical of a semiring *R*, that is, the intersection of all maximal *k*-ideals of *R*, as *R* is assumed to be additively cancellative and yoked (cf. [29, Proposition 23]). Assume that *A* is an ideal of *R* and $rad(A)$ denotes the intersection of all maximal *k*-ideals of *R* containing *A*.

Let $\bar{A}$ denotes the *k*-closure of an ideal *A* of *R*, i.e.$\bar{A} = \{a \in A \mid a + b = c$, for some $b, c \in A\}$ and $\sqrt{I} = \{x \in R \mid a^n \in I$ for some positive integer $n\}$.

Obviously, $\bar{I}$ is a *k*-ideal of *R* and every Noetherian semiring is weakly Noetherian (a semiring *R* is weakly Noetherian if every ascending chain of *k*-ideals of *R* is ultimately stationary). Then by Lescot [21, Corollary 6.6], there are prime *k*-ideals $P_1, P_2, \ldots., P_n$ of *R* such that $\sqrt{I} = P_1 \cap P_2 \cdots . \cap P_n$. Thus, we have $\sqrt{I} \subseteq rad(R)$ and by Lescot [21, Lemma 2.2], $\bar{I} \cap \bar{J} \subseteq \sqrt{\bar{I}} \cap \sqrt{\bar{J}} = \sqrt{\overline{I \cap J}} \subseteq rad(\overline{I \cap J})$.

$\overline{J}$). So, we have $rad(\overline{I \cap J}) = rad(\overline{I}) \cap rad(\overline{J})$.

Now, $Q = I \cap J$ which implies that $\overline{Q} = \overline{I \cap J} \Rightarrow Q = \overline{I \cap J}$, since *Q* is a *k*-ideal of *R*. This shows that $rad(Q) = rad(\overline{I \cap J}) = rad(\overline{I}) \cap rad(\overline{J})$, that is, $rad(Q) = rad(\overline{I}) \cap rad(\overline{J})$.

Again, *Q* is a *k*-irreducible ideal, which implies that $rad(Q)$ is *k*-irreducible. Also $rad(Q) = Q \cap rad(R)$, but $rad(Q) \neq rad(R)$. Thus, $rad(Q) = Q$, since $rad(Q)$ is *k*-irreducible. Accordingly, $Q = rad(\overline{I}) \cap rad(\overline{J})$, where each of $rad(\overline{I})$ and $rad(\overline{J})$ are *k*-ideals of *R*. Now $b \in J$ implies that $b \in rad(\overline{J})$, but $b \notin Q$, that is, $Q \neq rad(\overline{J})$. So $Q = rad(\overline{I})$, since *Q* is *k*-irreducible. Further, $a^n \in I$ leads to $a^n \in rad(\overline{I}) = Q$. Hence, *Q* is a primary ideal.

Remark 2.7

Now Theorem 2.3, follows by combining Theorems 2.4 and 2.5. It is important to note here that all Q_i's in the primary decomposition of a *k*-ideal *I* have an additional property that these are also *k*-ideals. Now it only remains to prove the uniqueness of primary decomposition of a *k*-ideal *I*.

The following lemma will be used to prove the uniqueness of reduced primary decomposition of *k*-ideals in semirings.

Lemma 2.8

Let *R* be a semiring and *Q* a *P*-primary ideal of *R*. Then we have

(i) If $x \in R$, $(Q:x) = \{r \in R \mid rx \in Q\}$ is an ideal of *R*;

(ii) If $x \in Q$, then $(Q:x) = R$;

(iii) If $x \notin P$, then $(Q:x) = Q$;

(iv) If $x \notin Q$, then $(Q:x)$ is *P*-primary.

Proof.

(i) Let $r_1, r_2 \in (Q:x)$ and $a \in R$. Then $r_1x, r_2x \in Q$ implies that $(r_1 + r_2)x \in Q$ and $r_1ax \in Q$, as *Q* is an ideal of *R*. Hence $(Q:x)$ is an ideal of *R*.

(ii) If $x \in Q$, then $Rx \subseteq Q$, as *Q* is an ideal of *R* which implies that $R \subseteq (Q:x)$. Also, $(Q:x)$ is an ideal of *R* and so, $(Q:x) = R$.

(iii) Assume that $x \notin P$. If $a \in Q$, then $ax \in Q$ implies that $a \in (Q:x)$. For the converse part, suppose that $b \notin Q$ and $xb \in Q$. Then $x \in \sqrt{Q} = P$, as *Q* is *P*-primary ideal of *R* which contradicts that $x \notin P$. This infers that $xb \notin Q$ and so $b \notin (Q:x)$.

(iv) Suppose that $x \notin Q$. If $y \in (Q:x)$, then $xy \in Q$ implies that $y \in \sqrt{Q} = P$, as *Q* is *P*-primary ideal of *R*. Thus, $Q \subseteq (Q:x) \subseteq P$ implies

R. Clearly, the ideal $(Q:x)$ is a proper as $x \notin Q$ and so $1 \notin (Q:x)$. Assume that $ab \in (Q:x)$ and $b \notin \sqrt{(Q:x)}$ for $a, b \in R$. Then $abx \in Q$ and Q is a P-primary ideal of R which implies that either $ax \in Q$ or $b \in P = \sqrt{(Q:x)}$. Thus, $a \in (Q:x)$ as $b \notin \sqrt{(Q:x)}$.

We now prove the uniqueness of the reduced primary decomposition of a k-ideal of a semiring as follows:

Theorem 2.9

Uniqueness of Primary Decomposition

Let R be an additively cancellative, yoked and commutative Noetherian semiring and I be a k-ideal of R. If $I = \cap_{i=1}^{n} Q_i$ is a reduced primary decomposition of I with $\sqrt{Q_i} = P_i$ for $i = 1, 2 \cdots . n$, then

$\{P_1, P_2, \ldots . , P_n\} = \{\text{Prime ideals } P \mid \text{there exists } x \in R \text{ such that } P = \sqrt{(I:x)}\}$. The set $\{P_1, P_2 \cdots . P_n\}$ is independent of the particular reduced primary decomposition chosen for I.

Proof.

Let $x \in R$. Then by Lemma 2.8 (iv),
$\sqrt{(I:x)} = \sqrt{\left(\bigcap_{i=1}^{n} Q_i : x\right)} = \bigcap_{i=1}^{n} \sqrt{(Q_i:x)} = \bigcap_{i,\, x \notin Q_i} P_i$ and therefore,
$\sqrt{(I:x)} \subseteq P_i$, for all $i = 1, 2 \cdots . n$. Also, if $\sqrt{(I:x)}$ is prime, then Π
$P_{i,\, x \notin Q_i} \subseteq \cap_{i, x \notin Q_i} P_i = \sqrt{(I:x)}$ implies that $P_i \subseteq \sqrt{(I:x)}$ for some $i = 1, 2 \cdots n$.

Thus, we have
$\{P_1, P_2, \ldots . , P_n\} \subseteq \{\text{Prime ideals } P \mid \text{there exists } x \in R \text{ such that } P = \sqrt{(I:x)}\}$. On the other hand, for $i \in \{1, 2 \cdots . n\}$, we have $\cap_{j \neq i}^{n} Q_j \nsubseteq Q_i$, as the primary decomposition is reduced. So there exists some $x_i \in \cap_{j \neq i}^{n} Q_j$ and $x_i \notin Q_i$. If $y \in (Q_i : x_i)$, then $yx_i \in Q_i$ and $yx_i \in (\cap_{j \neq i}^{n} Q_j) \cap Q_i = I$ which implies that $y \in (I:x_i)$.

Thus, $(Q_i:x_i) \subseteq (I:x_i) \subseteq (Q_i:x_i)$, as $I \subseteq Q_i$.

So, $(Q_i:x_i) = (I:x_i)$ and by Lemma 2.8(iv), $\sqrt{(I:x_i)} = \sqrt{(Q_i:x_i)} = P_i$. Hence, $\{P_1, P_2, \ldots . , P_n\} = \{\text{Prime ideals } P \mid \exists x \in R \text{ such that } P = \sqrt{(I:x)}\}$.

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3. Fuzzy Primary Decomposition of Fuzzy k-Ideals in Semirings

In this section, we prove the existence and uniqueness of fuzzy primary decomposition of fuzzy k-ideals of semirings. We first recall some definitions from [22] which are required to prove the

Definition 3.1

Let μ be a fuzzy ideal of a semiring R. Then the radical of μ, denoted by $\sqrt{\mu}$ is defined by $\sqrt{\mu}(x) = \sup_{n\geq 1}\{\mu(x^n)$, for all $x \in R\}$.

Example 3.2

Consider the semiring $R = (\mathbb{N}, +, .)$ of non-negative integers with respect to usual addition and multiplication of integers. Define a fuzzy ideal μ of $\mathbb{N}$ as follows:

$\mu(x) = \begin{cases} 1 - \frac{1}{n}, & \text{if } x \in \langle 2^{n-1}\rangle \setminus \langle 2^n\rangle, n = 1, 2, \ldots \\ 1, & \text{if } x = 0 \end{cases}$. Observe that $im\ \mu = \{0, 1, \frac{1}{2}, \frac{2}{3}, \ldots., \frac{n}{n+1}, \ldots\}$ and clearly,

$\sqrt{\mu}(x) = \begin{cases} 1, & \text{if } x \in \langle 2\rangle \\ 0, & \text{if } x \in \mathbb{Z} \setminus \langle 2\rangle \end{cases}$.

Definition 3.3

Let μ be a non-constant fuzzy k-ideal of a semiring R. Then μ is said to be a fuzzy k-irreducible ideal of R if for any two fuzzy k-ideals θ and η of R, $\mu = \theta \cap \eta$ implies either $\mu = \theta$ or $\mu = \eta$.

Example 3.4

[22]

Let R be a semiring as in Example 3.2 and μ be a fuzzy ideal of R defined as follows:

$\mu(x) = \begin{cases} 1, & \text{if } x \in \langle 16\rangle \\ 0.4, & \text{otherwise} \end{cases}$. Then, by Kar et al. [22, Theorem 4.2], one can easily check that μ is a fuzzy k- irreducible ideal of R.

Definition 3.5

A fuzzy ideal μ of a semiring R is said to be fuzzy prime ideal of R if it is non-constant (i.e. $|im\mu| \geq 2$) and any two fuzzy ideals θ and η of R, $\theta \circ \eta \subseteq \mu$ implies that either $\theta \subseteq \mu$ or $\eta \subseteq \mu$.

Definition 3.6

A fuzzy ideal μ of a semiring R is said to be fuzzy primary ideal of R if it is non-constant (i.e. $|im\mu| \geq 2$) and any two fuzzy ideals θ and η of R, $\theta \circ \eta \subseteq \mu$ implies that either $\theta \subseteq \mu$ or $\eta \subseteq \sqrt{\mu}$. If $\sqrt{\mu} = \nu$, then μ is called fuzzy ν-primary ideal of R.

Definition 3.7

Let μ and θ be two fuzzy subsets of a semiring R. Then fuzzy colon ideal $(\mu: \theta)$ is defined by $(\mu: \theta)(x) = \sup_{\lambda \in IFS}\{\lambda(x) \mid \lambda \circ \theta \subseteq \mu\}$, where $IFS(R)$ denotes the set of all fuzzy subsets of R.

Definition 3.8

Definition 3.9

If μ is a fuzzy k-ideal of a semiring R, then μ is said to have a fuzzy primary decomposition if μ can be expressed as $\mu = \cap_{i=1}^{n} \mu_i$, where each μ_i is a fuzzy primary ideal of R. A fuzzy primary decomposition $\mu = \cap_{i=1}^{n} \mu_i$ is said to be reduced if $\sqrt{\mu_i}$'s are distinct and $\cap_{j \neq i}^{n} \mu_j \not\subseteq \mu_i$, for all $i = 1, 2 \cdots n$. By Kar et al. [22, Theorem 5.3], a reduced fuzzy primary decomposition can be obtained from a fuzzy primary decomposition $\mu = \cap_{i=1}^{n} \mu_i$, where each μ_i is a fuzzy primary ideal of R.

The primary decomposition proved for k-ideals in a commutative Noetherian semiring (Theorem 2.5) can be generalised to fuzzy k-ideals as in [22, Theorem 5.2]. Thus we have

Theorem 3.10

Fuzzy Primary Decomposition of Fuzzy k-Ideals

Let R be an additively cancellative, yoked and commutative Noetherian semiring and μ a fuzzy k-ideal of R such that $im\mu = \{1, \alpha\}$, where $\alpha \in [0, 1)$. Then μ can be represented as a finite intersection of fuzzy primary ideals of R, $i.e$, μ has a primary decomposition.

Similar to the primary decomposition of k-ideals in semirings, all μ_i's in the fuzzy primary decomposition of μ have an additional property that these are also fuzzy k-ideals.

There are some errors (as mentioned below) in the result used for the proof of uniqueness of fuzzy primary decomposition of fuzzy k-ideals in semirings. So the question of establishing the result still remains unsolved. First, we state the result used for uniqueness.

Theorem 3.11

[22], Theorem 5.4

Let μ be a fuzzy k- ideal of a semiring R and $\mu = \cap_{i=1}^{n} \mu_i$ be a reduced fuzzy primary decomposition of μ. Let λ be a fuzzy k-prime ideal of R. Then $\lambda = \sqrt{\mu_i}$ for some $i = 1, 2 \cdots . n$ if and only if there exists a fuzzy k-ideal θ of R such that $\theta \not\subseteq \mu$ and $\sqrt{(\mu : \theta)} = \lambda$, i.e. $(\mu : \theta)$ is a fuzzy λ-primary ideal of R.

In the proof of above result, $\mu = \cap_{i=1}^{n} \mu_i$ is a reduced fuzzy primary decomposition of fuzzy k-ideal μ, so $\sqrt{\mu_i}$'s are distinct for each $i = 1, 2, \ldots . n$. But the authors have used $\sqrt{\mu_i} = \lambda$, for each $i = 1, 2, \ldots . n$ in the step $\sqrt{\bigcap_{i=1}^{n} (\mu_i : \theta)} = \bigcap_{i=1}^{n} \sqrt{(\mu_i : \theta)} = \bigcap_{i=1}^{n} \sqrt{\mu_i} = \bigcap_{i=1}^{n} \lambda = \lambda$ contrary to the

In order to establish a correct proof of the uniqueness of fuzzy primary decomposition of a fuzzy *k*-ideal in a semiring, first we need the following result:

Lemma 3.12

Let μ be a fuzzy $\nu-$ primary ideal of a semiring R and θ a fuzzy ideal of R. Then the following hold:

(i) If $\theta \subseteq \mu$, then $(\mu: \theta) = \chi_R$, where χ_R is the chai function on R;

(ii) If $\theta \not\subseteq \mu$, then $(\mu: \theta)$ is a fuzzy $\nu-$ primary ideal of R, i.e. $\sqrt{(\mu: \theta)} = \nu$.

Proof.

(i) Let $x \in R$ and $\theta \subseteq \mu$. Then we have $(\mu: \theta)(x) = \sup_{\lambda \in IFS(R)} \{\lambda(x) \mid \lambda \circ \theta \subseteq \mu\}$. Also,

$$\begin{aligned}(\chi_R \circ \theta)(x) &= \sup\{\min(\chi_R(y), \theta(z)) \mid x = yz\} \\ &= \sup\{\theta(z) \mid x = yz\} \\ &\leq \theta(x) \\ &\leq \mu(x)\end{aligned}$$

as $\theta \subseteq \mu$. Thus, by the definition of colon ideal and $(\chi_R \circ \theta) \subseteq \mu$, we get $(\mu: \theta) = \chi_R$.

(ii) Let $\theta \not\subseteq \mu$ and $\eta_1 \circ \eta_2 \subseteq (\mu: \theta)$ for some fuzzy ideals η_1 and η_2 of R. Then by the definition of fuzzy colon ideal, $\eta_1 \circ \eta_2 \circ \theta \subseteq \mu$. Since μ is a fuzzy $\nu-$ primary ideal of R and $\theta \not\subseteq \mu$, we have $\eta_1 \circ \eta_2 \subseteq \sqrt{\mu}$ which further implies that either $\eta_1 \subseteq \sqrt{\mu}$ or $\eta_2 \subseteq \sqrt{\mu}$, as $\sqrt{\mu}$ is a fuzzy prime ideal of R.

If $\eta_1 \subseteq \sqrt{\mu}$, then by Kar et al. [22, Lemma 3.2 (iii) and Lemma 5.2 (i)], $\sqrt{\mu} \subseteq \sqrt{(\mu: \theta)}$ implies that $\eta_1 \subseteq \sqrt{(\mu: \theta)}$. Similarly, if $\eta_2 \subseteq \sqrt{\mu}$, then we get $\eta_2 \subseteq \sqrt{(\mu: \theta)}$. Thus, $(\mu: \theta)$ is a fuzzy primary ideal of R.

We now show that $\sqrt{(\mu: \theta)} = \nu$. For this, let $x \in R$. Then

$$\begin{aligned}\sqrt{(\mu: \theta)}(x) &= \sup_{n \geq 1}\{(\mu: \theta)(x^n)\} \\ &= \sup_{n \geq 1}\left\{\sup_{\lambda \in IFS(R)}\{\lambda(x^n) \mid \lambda \circ \theta \subseteq \mu\}\right\} \\ &= \sup_{n \geq 1}\left\{\sup_{\lambda \in IFS(R)}\{\lambda(x^n) \mid \lambda \subseteq \sqrt{\mu}\}\right\} \text{ as } \theta \not\subseteq \mu \text{ and } \sqrt{\mu} \text{ is a} \\ &\leq \sup_{n \geq 1}\{\sqrt{\mu}(x^n)\} \\ &= \sqrt{\sqrt{\mu}}(x) = \sqrt{\mu}(x)\end{aligned}$$

fuzzy prime ideal of R. Thus, $\sqrt{(\mu: \theta)} \subseteq \sqrt{\mu}$. Also by Kar et al. [22, Lemma 3.2 (iii) and Lemma 5.2 (i)], $\sqrt{\mu} \subseteq \sqrt{(\mu: \theta)}$ implies that $\sqrt{(\mu: \theta)} = \sqrt{\mu} = \nu$.

Now, we give the correct proof of Theorem 3.11, which is required for the establishment of uniqueness of fuzzy primary decomposition of a fuzzy *k*- ideal of a semiring as follows:

Let *R* be an additively cancellative, yoked, zerosumfree and commutative Noetherian semiring, and μ a fuzzy *k*- ideal of *R* such that $im\mu = \{1, \alpha\}$, where $\alpha \in [0, 1)$. Let $\mu = \cap_{i=1}^{n} \mu_i$ be a reduced fuzzy primary decomposition of μ and λ be a fuzzy prime ideal of *R*. Then $\lambda = \sqrt{\mu_i}$, for some $i = 1, 2, \ldots, n$ if and only if there exists a fuzzy *k*-ideal θ of *R* such that $\theta \not\subseteq \mu$ and $\sqrt{(\mu : \theta)} = \lambda$, i.e. $(\mu : \theta)$ is a fuzzy λ-primary ideal of *R*.

Proof.

Let $\lambda = \sqrt{\mu_i}$, for some $i = 1, 2, \ldots, n$. As $\mu = \cap_{i=1}^{n} \mu_i$ is a reduced fuzzy *k*-primary decomposition of μ, so $\cap_{\substack{j=1 \\ j \neq i}}^{n} \mu_j \not\subseteq \mu_i$, for any $i \neq j$. Therefore, there exists some $x_i \in R$ such that $\cap_{\substack{j=1 \\ j \neq i}}^{n} \mu_j(x_i) > \mu_i(x_i)$. Assume that $\cap_{\substack{j=1 \\ j \neq i}}^{n} \mu_j(x_i) = a$, where $a \in [0, 1)$. We now establish a fuzzy subset θ of *R* as follows:

$\theta(x) = \begin{cases} a, & \text{if } x \in \langle x_i \rangle \\ 0, & \text{otherwise} \end{cases}$. By Lemma 3.8, the ideal $\langle x_i \rangle$ is a *k*-ideal as *R* is additively cancellative, yoked and zerosumfree, which clearly implies that θ is a fuzzy *k*-ideal of *R*. Also,

$\theta(x_i) = a = \underset{\substack{j=1 \\ j \neq i}}{\cap}^{n} \mu_j(x_i) > \mu_i(x_i) > \underset{i=1}{\cap}^{n} \mu_i(x_i) = \mu(x_i)$ implies that $\theta \not\subseteq \mu$ and $\theta \not\subseteq \mu_i$, for $i \neq j$. Further,

$\theta(x_i) = a = \underset{\substack{j=1 \\ j \neq i}}{\cap}^{n} \mu_j(x_i) = inf\{\mu_1(x_i), \mu_2(x_i), \ldots, \mu_{i-1}(x_i), \mu_{i+1}(x_i), \ldots . \mu_n(x_i)\} \leq \mu_j(x_i)$ for all $j \neq i$ and $j = 1, 2, \ldots n$. Now, we claim that $\theta \subseteq \mu_j$, for all $j \neq i$ and $j = 1, 2, \ldots, n$. Let $x = x_i y_i \in < x_i >$, for some $y_i \in R$. Then

$\theta(x) = \theta(x_i) \leq \mu_j(x_i) \leq \mu_j(x_i y_i) = \mu_j(x)$ implies that $\theta \subseteq \mu_j$ for all $j \neq i$ and $j = 1, 2, \ldots, n$. Thus, by Lemma 3.12 (i), we have

$(\mu_j : \theta) = \chi_R$, for all $j \neq i$, $j = 1, 2, \ldots, n$ and $\sqrt{(\mu_i : \theta)} = \sqrt{\mu_i} = \lambda$. Finally, by Kar et al. [22, Theorem 3.2 (v) and Lemma 5.2 (iii)], we get

$\sqrt{(\mu : \theta)} = \sqrt{\left(\underset{i=1}{\cap}^{n} \mu_i : \theta \right)} = \sqrt{\underset{i=1}{\cap}^{n} (\mu_i : \theta)} = \underset{i=1}{\cap}^{n} \sqrt{(\mu_i : \theta)} = \sqrt{(\mu_i : \theta)} = \lambda$.

Also by Lemma 3.12 (ii), $(\mu : \theta)$ is a fuzzy λ-primary ideal of *R*.

Conversely, assume that there exists a fuzzy *k*-ideal θ of *R* such that $\theta \not\subseteq \mu$ and $\sqrt{(\mu : \theta)} = \lambda$. As $\theta \not\subseteq \mu = \underset{i=1}{\cap}^{n} \mu_i$, we get $\theta \not\subseteq \mu_j$ for some $j \in \{1, 2 \cdots . n\}$ and by Lemma 3.12 (ii), we have $\sqrt{(\mu_j : \theta)} = \sqrt{\mu_j}$.

Also,

$\sqrt{(\mu : \theta)} = \underset{i=1}{\cap}^{n} \sqrt{(\mu_i : \theta)} = \lambda$ implies that $\underset{\substack{i=1 \\ i \neq j}}{\cap}^{n} \sqrt{(\mu_i : \theta)} \cap \sqrt{\mu_j} = \lambda$. Further,

$\bigcap_{\substack{i=1 \\ i\neq j}}\sqrt{\quad\quad}\sqrt{\quad}\Big/\quad\bigcap_{\substack{i=1 \\ i\neq j}}\sqrt{\quad\quad}\Big/\quad\sqrt{\quad}$

$\lambda = \bigcap_{i=1}^{n}\sqrt{(\mu_i:\theta)} \subseteq \bigcap_{\substack{i=1 \\ i\neq j}}^{n}\sqrt{(\mu_i:\theta)}$ implies that $\sqrt{\mu_j} \subseteq \lambda$, as λ is prime.

Also,

$\lambda = \sqrt{(\mu:\theta)} = \sqrt{\bigcap_{i=1}^{n}(\mu_i:\theta)} = \bigcap_{i=1}^{n}\sqrt{(\mu_i:\theta)} \subseteq \sqrt{(\mu_j:\theta)} = \sqrt{\mu_j}$. Thus, we get $\lambda = \sqrt{\mu_j}$ for some, $j \in \{1, 2\cdots . n\}$.

Finally, we are in a position to give the correct proof of uniqueness theorem of reduced fuzzy *k*-primary decomposition of a fuzzy *k*-ideal in semirings as follows:

Theorem 3.14

Uniqueness of Fuzzy Primary Decomposition

Let *R* be an additively cancellative, yoked, zerosumfree and commutative Noetherian semiring, and μ a fuzzy *k*-ideal of *R* such that $im\mu = \{1, \alpha\}$, where $\alpha \in [0, 1)$. Let $\mu = \cap_{i=1}^{n}\mu_i$ with $\sqrt{\mu_i} = \nu_i$ for $i = 1, 2, \ldots . n$ and $\mu = \cap_{i=1}^{m}\xi_i$ with $\sqrt{\xi_i} = \eta_i$ for $i = 1, 2, \ldots . m$ be two reduced fuzzy *k*- primary decompositions of μ. Then, $n = m$ and $\{\nu_1, \nu_2\cdots . \nu_n\} = \{\eta_1, \eta_2, \ldots . , \eta_m\}$.

Proof.

Let $\nu_i \in \{\nu_1, \nu_2\cdots . \nu_n\}$. Then by Theorem 3.13, there exists a fuzzy *k*-ideal θ of *R* such that $\theta \not\subseteq \mu$ and $\sqrt{(\mu:\theta)} = \sqrt{u_i} = \nu_i$ for some, $i \in \{1, 2, ..., n\}$. Also, since $\mu = \cap_{i=1}^{m}\xi_i$ with $\sqrt{\xi_i} = \eta_i$ for $i = 1, 2, \ldots . m$ is another reduced fuzzy *k*-primary decomposition of μ, therefore there exists some $j \in \{1, 2\cdots . m\}$ such that $\nu_i = \sqrt{(\mu:\theta)} = \sqrt{\xi_j} = \eta_j$. This implies that $\{\nu_1, \nu_2\cdots . \nu_n\} \subseteq \{\eta_1, \eta_2, \ldots . , \eta_m\}$ and so $n \leq m$. By reversing the role of ν_i and ξ_j, we get $\{\eta_1, \eta_2, \ldots . , \eta_m\} \subseteq \{\nu_1, \nu_2\cdots . \nu_n\}$ and $m \leq n$. Thus, $\{\nu_1, \nu_2\cdots . \nu_n\} = \{\eta_1, \eta_2, \ldots . , \eta_m\}$ and $n = m$.

4. Conclusions

All the results that hold good for ideals in rings may not be true for the ideals in semirings and not even for the *k*-ideals in semirings. But this fact was ignored by various mathematicians while generalising the Lasker-Noether's Theorem for semirings. This made Lescot [21] to establish weak primary decomposition for *k*-ideals in semirings in 2015. But the question of settling the primary decomposition for *k*- ideals still remained unsolved. In

Let *I* be a *k*-ideal of an additively cancellative, yoked and commutative Noetherian semiring *R*. Then *I* can be uniquely represented as a finite intersection of primary ideals of *R*, i.e.*I* has a unique reduced primary decomposition. The above said result is also generalised for fuzzy *k*-ideals of same class of semirings.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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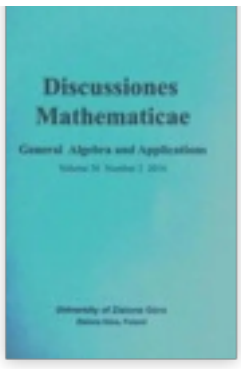

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STUDY OF ADDITIVELY REGULAR Γ-SEMIRINGS AND DERIVATIONS

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Abstract

In this paper, the notions of commutator and derivation in additively regular Γ-semirings with (A_2, Γ)-condition are introduced. We also characterize Jordan product for additively regular Γ-semiring and establish some results which investigate the relationship between commutators, derivations and inner derivations. In 1957, E.C. Posner has shown that if there exists a non-zero centralizing derivation in a prime ring R, then R is commutative. This result is extended in the frame work of derivations of prime additively regular Γ-semirings.

Keywords: semirings, Γ-semirings, additively regular Γ-semirings, derivations and commutators.

2010 Mathematics Subject Classification: 16Y60, 16Y99.

1. Introduction

The concept of derivation is quite old and plays vital role in algebraic geometry and algebra. The algebraists in this direction have studied the concept of derivation in semirings, Γ-rings and Γ-semirings. It is pertinent to note here that the results which are true for rings motivated the researchers to generalize the analogous results for derivations in Γ-rings and Γ-semirings. The concept of derivation in a prime Γ−ring was first introduced by Yang [12] in 1991. Over the years, the researchers studied the concept of derivation in Γ-rings and other algebraic structures [2, 3, 6]. The algebraic structure additively regular Γ-semiring

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is a generalization of semirings [9, 10, 11], additively regular semirings [5], and Γ-rings.

There are some algebraic structures in which binary operation "multiplication" fails. For instance, let R be the set of all $m \times n$ matrices over a boolean semiring under usual addition and multiplication of matrices. One can easily examine that R is not closed under multiplication. This problem has attracted the attention of various mathematicians for a long period. Therefore, another algebraic structure Γ was introduced; for example, consider A is an additive semigroup consisting of all homomorphisms from a semiring R_1 to semiring R_2 and Γ is an additive semigroup consisting of all homomorphisms from R_2 to R_1. Here the product g_1hg_2 belongs to A for any arbitrary elements g_1, g_2 of A and h of Γ. So, A is closed under multiplication. The importance of aforementioned algebraic structure Γ motivated us to explore the structure of Γ-semirings.

Rao [7, 8] introduced the notion of Γ-semirings and additively inverse Γ-semirings. According to Rao, if R_Γ and Γ are additive commutative semigroups with identity elements 0_{R_Γ} and 0_Γ respectively, then R_Γ is said to be a Γ-semiring if there exists a map $R_\Gamma \times \Gamma \times R_\Gamma \longrightarrow R_\Gamma$, defined as $(x, \gamma, y) \longmapsto x\gamma y$ such that $x\alpha(y + z) = x\alpha y + x\alpha z$; $(x + y)\alpha z = x\alpha z + y\alpha z$; $x(\alpha + \beta)y = x\alpha y + x\beta y$; $(x\alpha y)\beta z = x\alpha(y\beta z)$; $x\gamma 0_{R_\Gamma} = 0_{R_\Gamma}\gamma x = 0_{R_\Gamma}$ and $x\gamma 0_\Gamma = 0_\Gamma\gamma x = 0_\Gamma$ $\forall\ x, y, z \in R_\Gamma$, $\alpha, \beta, \gamma \in \Gamma$. Further, a Γ-semiring R_Γ is said to be additively regular if for each element $x \in R_\Gamma$ there exists an element $x' \in R_\Gamma$ such that $x = x + x' + x$. If in addition the element x' is unique and $x' = x' + x + x'$, then R_Γ is called an additively inverse Γ-semiring. Such an element x' is called pseudo inverse of x. Consider $M = \{0, 1, 2, \ldots, 50\}$ and $R_\Gamma = \mathbb{Z} \times M = \{(a, r) : a \in \mathbb{Z},\ r \in M\}$. We define binary operations of addition $\oplus$ and multiplication $\odot$ by $(a, r) \oplus (b, s) = (a + b, \max(r, s))$ and $(a, r) \odot (b, s) = (ab, \min(r, s))$ for all $(a, r), (b, s) \in R_\Gamma$. Take $\Gamma = \{(0, m) : m \in M\}$ with same binary operations defined as above. One can easily check that R_Γ and Γ are additive commutative semigroups. Moreover, define map $R_\Gamma \times \Gamma \times R_\Gamma \longrightarrow R_\Gamma$ by $(a, r) \odot (0, m) \odot (b, s) = (0, \min(r, m, s))$. Then R_Γ is a Γ-semiring. Further, if we define the pseudo inverse of an element (a, r) of R_Γ by $(a, r)' = (-a, r)$. Then R_Γ is an additively inverse Γ-semiring. Throughout this article, additively inverse Γ-semiring along with 1 has been intensively explored and represented as "additively regular Γ-semiring" which will persuade the readers in its accuracy and truthfulness.

In present paper, we introduce and characterize the concept of derivations for additively regular Γ-semirings with (A_2, Γ)-condition. Here (A_2, Γ)-condition means that the sum of an element x of R_Γ and its pseudo inverse $x' \in R_\Gamma$ lies in the centre of R_Γ. For example, let $B = \{0, 1\}$ and $\Gamma = \{a, b\}$, where $0, 1$ and a, b are additively idempotent elements of R_Γ and Γ, respectively. Further, addition in B is defined by $0 + 1 = 1 = 1 + 0$ and in Γ by $a + b = b = b + a$. Moreover, a map $B \times \Gamma \times B \longrightarrow B$ is defined as $0a0 = 0a1 = 1a0 = 0b0 = 0b1 = 1b0 = 0$ and

$1a1 = 1b1 = 1$. Then B is an additively regular Γ-semiring with (A_2, Γ)-condition. Throughout this paper, R_Γ will denote an additively regular
(A_2, Γ)-condition. In continuation, the study of commutators f
ular Γ-semirings is also initiated which is the generalization of
of rings. In section 3, some fundamental identities for commutators of additively

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regular Γ-semirings with (A_2, Γ)-condition.

2. Additively regular Γ-semiring with (A_2, Γ)-condition

In this section, we prove some basic results and examples of additively regular Γ-semirings with (A_2, Γ)-condition. First we define commutativity and primeness of additively regular Γ-semiring R_Γ.

Definition 2.1. An additively regular Γ-semiring R_Γ is said to be commutative if $x\gamma y = y\gamma x \ \forall\ x, y \in R_\Gamma, \gamma \in \Gamma$.

Definition 2.2. An additively regular Γ-semiring R_Γ is said to be prime if $x\Gamma R_\Gamma \Gamma y = 0$ implies that either $x = 0$ or $y = 0$.

Now, we give an example of an additively regular Γ-semiring which is both commutative as well as prime.

Example 2.3. Let $R_\Gamma = \{0, 1, u\}$ and $\Gamma = \{\alpha, \beta\}$. We define operations with the help of following tables:

+	0	1	u
0	0	1	u
1	1	1	u
u	u	u	u

+	α	β
α	α	β
β	β	β

α	0	1	u
0	0	0	0
1	0	1	u
u	0	u	u

β	0	1	u
0	0	0	0
1	0	1	u
u	0	u	u

Then R_Γ is an additively regular Γ-semiring with (A_2, Γ)-condition and $a' = a$ for all $a \in R_\Gamma$. From the tables, it is clear that additively regular Γ-semiring R_Γ is prime and commutative.

Note that every additively regular semiring S is an additively regular Γ-semiring with $\Gamma = S$.

Next two examples show that every additively regular Γ-semiring may not satisfy (A_2, Γ)-condition.

Example 2.4. Let R_Γ be the set of all 2×2 matrices over boolean semiring B, i.e., $M_{2\times 2}(B)$ and $\Gamma = \left\{ \begin{pmatrix} a & 0 \\ 0 & a \end{pmatrix} : a \in B \right\}$. Define a map $R_\Gamma \times \Gamma \times R_\Gamma \to R_\Gamma$ by $(x, \gamma, y) \longmapsto x\gamma y$ for all $x, y \in R_\Gamma, \gamma \in \Gamma$. We define pseudo inverse of an element of R_Γ as $\begin{pmatrix} a & b \\ c & d \end{pmatrix}' = \begin{pmatrix} a' & b' \\ c' & d' \end{pmatrix}$. Then R_Γ is an additively regular Γ-semiring which do not satisfy (A_2, Γ)-condition under the usual multiplication of matrices.

Example 2.5. Let R be a non commutative ring and S be an additively regular semiring. Then the set $K = \{(a, \alpha) : a \in R, \alpha \in S\}$ is a non commutative additively regular semiring with operations pointwise addition and pointwise multiplication. We define pseudo inverse of an element of K as $(a, \alpha)' = (-a, \alpha')$. Take $\Gamma = \{(0, \beta) : 0 \in R, \beta \in S\}$ with operations pointwise addition and pointwise multiplication. Then Γ is an additive commutative semigroup. Further, define a map $K \times \Gamma \times K \to K$ by $(x, \gamma, y) = x\gamma y$ for all $x, y \in K, \gamma \in \Gamma$. Then K is an additively regular Γ-semiring.

Note that K satisfies (A_2, Γ)-condition only if S is commutative.

Throughout this paper, we consider an assumption $(*)$ $x\alpha y\beta z = x\beta y\alpha z$ for all $x, y, z \in R_\Gamma$ and $\alpha, \beta \in \Gamma$.

Lemma 2.6 [(Theorem 12, [8])]. *Let R_Γ be an additively regular Γ-semiring and $a, b \in R_\Gamma$, $\gamma \in \Gamma$. Then we have the following:*

(i) $a'' = a$,
(ii) $(a + b)' = a' + b'$,
(iii) $(a\gamma b)' = a'\gamma b = a\gamma b'$,
(iv) $a'\gamma b' = (a'\gamma b)' = (a\gamma b)'' = a\gamma b$.

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additively regular Γ*-semiring.*

Proof. Let R_Γ be an additively regular Γ-semiring and $Z(R_\Gamma)$ be its centre. The map $Z(R_\Gamma) \times \Gamma \times Z(R_\Gamma) \longrightarrow Z(R_\Gamma)$ defined by $(a, \alpha, b) \longmapsto a\alpha b \ \forall\ a, b \in Z(R_\Gamma)$, $\alpha \in \Gamma$ is well defined map. Clearly, $Z(R_\Gamma)$ is an additive commutative semigroup and satisfies all the properties of Γ-semiring and hence $Z(R_\Gamma)$ is a Γ-semiring. Further, let $a \in Z(R_\Gamma)$. Then $a\gamma x = x\gamma a \ \forall\ x \in R_\Gamma, \gamma \in \Gamma$ implies that $(a\gamma x)' = (x\gamma a)'$, i.e., $a'\gamma x = x\gamma a' \ \forall\ x \in R_\Gamma, \gamma \in \Gamma$ and hence $a' \in Z(R_\Gamma)$. This completes the proof. ■

Remark 2.9. Let R_Γ be an additively regular Γ-semiring and X be a non-empty set. If $Map(X, R_\Gamma)$ is the set of all mappings from X into R_Γ, then define '+' in $Map(X, R_\Gamma)$ as $(f + g)(x) = f(x) + g(x) \ \forall\ f, g \in Map(X, R_\Gamma)$ and $Map(X, R_\Gamma) \times \Gamma \times Map(X, R_\Gamma) \longrightarrow Map(X, R_\Gamma)$ as $(f, \gamma, g) \longmapsto f\gamma g$ where $f\gamma g : X \longrightarrow R_\Gamma$ is defined by $(f\gamma g)(x) = f\ (x)\gamma g(x) \ \forall f, g \in Map(X, R_\Gamma)$, $\gamma \in \Gamma, x \in X$. Then $Map(X, R_\Gamma)$ is a Γ-semiring. Define $f' : X \longrightarrow R_\Gamma$ by $f'(x) = (f(x))'$ for each $f \in Map(X, R_\Gamma)$. Then it can be easily checked that f' is pseudo inverse of f and $f' \in Map(X, R_\Gamma)$ for each $f \in Map(X, R_\Gamma)$. Thus, $Map(X, R_\Gamma)$ is an additively regular Γ-semiring.

The proofs of the next two propositions are quite easy so we omit the proofs.

Proposition 2.10. *If R_Γ is an additively regular* Γ*-semiring, then $R_\Gamma[x]$ the set of all polynomials over R_Γ is an additively regular* Γ*-semiring.*

Proposition 2.11. *Let R_{Γ_1} be an additively regular Γ_1-semiring and R_{Γ_2} be an additively regular Γ_2-semiring. Then $R_\Gamma = R_{\Gamma_1} \times R_{\Gamma_2} = \{(r, s) : r \in R_{\Gamma_1}, s \in R_{\Gamma_2}\}$ is an additively regular $\Gamma = \Gamma_1 \times \Gamma_2$-semiring.*

3. Commutators of additively regular Γ-semirings

In this section, we introduce the concept of α-commutator for additively regular Γ-semirings and generalize some results of commutators of rings.

Definition 3.1. Let R_Γ be an additively regular Γ-semiring and α be a fixed element of Γ. We define α-commutator as a mapping $[,]_\alpha : R_\Gamma \times \Gamma \times R_\Gamma \to R_\Gamma$ by $[x, y]_\alpha = x\alpha y + (y\alpha x)' = x\alpha y + y'\alpha x = x\alpha y + y\alpha x'$ for all $x, y \in R_\Gamma$. Then $[x, y]_\alpha$ is called α- commutator of x, y.

For convenience, we denote $x + x'$ by $x_\circ$ for each $x \in R_\Gamma$. Then clearly $x_\circ + x_\circ = x_\circ = x'_\circ$; $x + x_\circ = x$ and $x' + x_\circ = x'$.

Lemma 3.2. *If R_Γ is an additively regular* Γ*-semiring, then $(x\gamma y)_\circ = x_\circ\gamma y = x\gamma y_\circ = x_\circ\gamma y_\circ = y_\circ\gamma x_\circ = (y\gamma x)_\circ \ \forall\ x, y \in R_\Gamma, \gamma \in \Gamma$.*

Proof. By using Lemma 2.6, we have $(x\gamma y)_\circ = x\gamma y + x'\gamma y = x_\circ\gamma y$. Similarly, $(x\gamma y)_\circ = x\gamma y_\circ$. Now, $x_\circ\gamma y_\circ = (x + x')\gamma\,(y + y') = x\gamma y + x\gamma y' + x'\gamma y + x'\gamma y' = x\gamma y + x\gamma y' + x'\gamma y + x\gamma y = x\gamma y + x'\gamma y = x_\circ\gamma y$. Similarly, $y\gamma x_\circ = y_\circ\gamma x = y_\circ\gamma x_\circ = (y\gamma x)_\circ$. By (A_2, Γ)-condition, we have $x_\circ = x + x' \in Z(R_\Gamma)$. Thus $x_\circ\gamma y = y\gamma x_\circ$. Hence $(x\gamma y)_\circ = x_\circ\gamma y = x\gamma y_\circ = x_\circ\gamma y_\circ = y_\circ\gamma x_\circ = (y\gamma x)_\circ$. ■

In the next Theorem, we generalize some basic commutator identities of rings for additively regular Γ-semirings.

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Theorem 3.3. *Let R_Γ be an additively regular Γ-semiring. Then for all $x, y, z, x_1, x_2, y_1, y_2 \in R_\Gamma$ and $\alpha, \beta \in \Gamma$, the following identities hold:*

(i) $[x + y, z]_\alpha = [x, z]_\alpha + [y, z]_\alpha$.
(ii) $[x, y + z]_\alpha = [x, y]_\alpha + [x, z]_\alpha$.
(iii) $[x, 0_{R_\Gamma}]_\alpha = [0_{R_\Gamma}, x]_\alpha = 0_{R_\Gamma}$.
(iv) $[x_1 + x_2, y_1 + y_2]_\alpha = [x_1, y_1]_\alpha + [x_1, y_2]_\alpha + [x_2, y_1]_\alpha + [x_2, y_2]_\alpha$.
(v) $([x, y]_\alpha)' = [y, x]_\alpha = [x, y']_\alpha = [x', y]_\alpha$. (*Anti-commutativity*)
(vi) $[[x, y]_\alpha, z]_\beta = [x, y]_\alpha \beta z + z\beta[y, x]_\alpha$.
(vii) $[nx, y]_\alpha = n[x, y]_\alpha$, *for any positive integer* n.

Proof. One can easily prove the identities (i) to (iv) by using Definition 3.1.

(v) By Lemma 2.6 and Definition 3.1, we have $([x, y]_\alpha)' = (x\alpha y + y'\alpha x)' = x'\alpha y + y\alpha x = [y, x]_\alpha$. Again, $([x, y]_\alpha)' = (x\alpha y + y'\alpha x)' = x\alpha y' + y'\alpha x' = [x, y']_\alpha$. Now, $[x', y]_\alpha = x'\alpha y + y\alpha x'' = x'\alpha y + y\alpha x = [y, x]_\alpha$.

(vi) Using Definition 3.1 and (v), we have $[[x, y]_\alpha, z]_\beta = [x, y]_\alpha \beta z + z\beta([x, y]_\alpha)' = [x, y]_\alpha \beta z + z\beta[y, x]_\alpha$.

(vii) By Lemma 2.6 and Definition 3.1, we have $[nx, y]_\alpha = nx\alpha y + y'\alpha nx = n(x\alpha y + y'\alpha x) = n[x, y]_\alpha$. ∎

Theorem 3.4. *Let R_Γ be an additively regular Γ-semiring. Then for all $x, y, z, u \in R_\Gamma$ and $\alpha, \beta, \gamma \in \Gamma$, the following identities are valid:*

(i) $[x, y\beta z]_\alpha = [x, y]_\alpha \beta z + y\beta[x, z]_\alpha$.
(ii) $[x\beta y, z]_\alpha = x\beta[y, z]_\alpha + [x, z]_\alpha \beta y$.
(iii) $[x\beta y, z\gamma u]_\alpha = x\beta[y, z]_\alpha \gamma u + [x, z]_\alpha \beta y\gamma u + z\gamma x\beta[y, u]_\alpha + z\gamma[x, u]_\alpha \beta y$.

Proof. (i) By assumption (*) and Definition 3.1, we have $[x, y\beta z]_\alpha = x\alpha y\beta z + y\beta z\alpha x' = x\alpha y\beta z + y\beta z\alpha(x' + x) + y\beta z\alpha x' = x\alpha y\beta z + y\beta(x' + x)\alpha z + y\beta z\alpha x' = x\alpha y\beta z + y\beta x'\alpha z + y\beta x\alpha z + y\beta z\alpha x' = x\alpha y\beta z + y\alpha x'\beta z + y\beta x\alpha z + y\beta z\alpha x' = [x, y]_\alpha \beta z + y\beta[x, z]_\alpha$.

Similarly we can prove (ii).

(iii) By using Definition 3.1, Lemma 2.6, Lemma 3.2 and assumption $(*)$ we have $[x\beta y, z\gamma u]_\alpha = x\beta y\alpha z\gamma u + z'\gamma u\alpha x\beta y = x\beta y\alpha z\gamma u + (z' + z + z')\gamma u\alpha x\beta y + z_\circ\gamma u\alpha x\beta y = x\beta y\alpha z\gamma u + z'\gamma u\alpha x\beta y + z_\circ\gamma u\alpha x\beta y + (z\gamma u)_\circ\alpha x\beta y = x\beta y\alpha z\gamma u + z'\gamma u\alpha x\beta y + (z\gamma u)_\circ\alpha x\beta y + x\beta(z\gamma u)_\circ\alpha y = x\beta y\alpha z\gamma u + z'\gamma u\alpha x\beta y + z\gamma u_\circ\alpha x\beta y + x\beta z\gamma u_\circ\alpha y = x\beta y\alpha z\gamma u + z'\gamma u\alpha x\beta y + z\gamma x\alpha u_\circ\beta y + x\beta z\alpha(y\gamma u)_\circ = x\beta y\alpha z\gamma u + z'\gamma u\alpha x\beta y + z\gamma x\alpha u\beta y + z\gamma x\alpha(u' + u_\circ)\beta y + x\beta z\alpha y_\circ\gamma u = x\beta[y, z]_\alpha \gamma u + z\gamma u\alpha x'\beta y + z\gamma x\alpha u\beta y + z\gamma x\beta u'\alpha y + z\gamma x\beta y\alpha u + z\gamma x\beta y\alpha u' + x\beta z\alpha y\gamma u = x\beta[y, z]_\alpha \gamma u + z\gamma[x, u]_\alpha \beta y + z\gamma x\beta[y, u]_\alpha + z\alpha x'\beta y\gamma u + x\alpha z\beta y\gamma u = x\beta[y, z]_\alpha \gamma u + [x, z]_\alpha \beta y\gamma u + z\gamma x\beta[y, u]_\alpha + z\gamma[x, u]_\alpha \beta y$. ∎

Note that by assumption $(*)$, we have $[x, y]_\alpha \beta z = [x, y]_\beta \alpha z$ and $x\alpha[y, z]_\beta = x\beta[y, z]_\alpha$ for all $x, y, z \in R_\Gamma, \alpha, \beta \in \Gamma$.

Now, we generalize the Jacobian identity of rings for additively regular Γ-semirings which might be useful to develop Lie type theory for additively regular Γ-semirings.

Theorem 3.5. *If R_Γ is an additively regular Γ-semiring, then $[x, [y, z]_\alpha]_\beta + [y, [z, x]_\alpha]_\beta = [[x, y]_\alpha, z]_\beta$ holds for all $x, y, z \in R_\Gamma, \alpha, \beta \in \Gamma$.*

Proof. Using Lemma 2.6, Lemma 3.2, Definition 3.1 and Th
have $[x, [y, z]_\alpha]_\beta = ([[y, z]_\alpha, x]_\beta)' = [z, y]_\alpha \beta x + x\beta[y, z]_\alpha$ for all x
Γ. Similarly $[y, [z, x]_\alpha]_\beta = [x, z]_\alpha \beta y + y\beta[z, x]_\alpha$. Therefore, $[x, [y,$
$= [z, y]_\alpha \beta x + x\beta[y, z]_\alpha + [x, z]_\alpha \beta y + y\beta[z, x]_\alpha = z\alpha y\beta x + y'\alpha z\beta x +$

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Theorem 3.6. *If R_Γ is an additively regular Γ-semiring, then for all $x, y, z \in R_\Gamma$ and $\alpha, \beta, \gamma \in \Gamma$, the following identities hold:*

(i) $[x\alpha y, z]_\beta + [y\alpha z, x]_\beta + [z\alpha x, y]_\beta = [x, [y, z]_\alpha]_\beta + [y, [z, x]_\alpha]_\beta + [z, [x, y]_\alpha]_\beta$.

(ii) $[x\alpha y\beta z, u]_\gamma = x\alpha y\beta[z, u]_\gamma + x\alpha[y, u]_\gamma\beta z + [x, u]_\gamma\alpha y\beta z$.

(iii) $[x, y\beta z\gamma u]_\alpha = [x, y]_\alpha\beta z\gamma u + y\beta[x, z]_\alpha\gamma u + y\beta z\gamma[x, u]_\alpha$.

Proof. (i) By using Definition 3.1, Theorem 3.3(v) and Theorem 3.4(ii), $[x, [y, z]_\alpha]_\beta + [y, [z, x]_\alpha]_\beta + [z, [x, y]_\alpha]_\beta = x\beta[y, z]_\alpha + ([y, z]_\alpha)'\beta x + y\beta[z, x]_\alpha + ([z, x]_\alpha)'\beta y + z\beta[x, y]_\alpha + ([x, y]_\alpha)'\beta z = x\alpha[y, z]_\beta + [z, y]_\beta\alpha x + y\alpha[z, x]_\beta + [x, z]_\beta\alpha y + z\alpha[x, y]_\beta + [y, x]_\beta\alpha z = [x\alpha y, z]_\beta + [y\alpha z, x]_\beta + [z\alpha x, y]_\beta$.

(ii) By Definition 3.1 and Lemma 3.2 we have $x\alpha y\beta[z, u]_\gamma + x\alpha[y, u]_\gamma\beta z + [x, u]_\gamma\alpha y\beta z = x\alpha y\beta z\gamma u + x\alpha y\beta u'\gamma z + x\alpha y\gamma u\beta z + x\alpha u'\gamma y\beta z + x\gamma u\alpha y\beta z + u'\gamma x\alpha y\beta z = x\alpha y\beta z\gamma u + x\alpha y\beta u_\circ\gamma z + x\alpha u_\circ\gamma y\beta z + u'\gamma x\alpha y\beta z = x\alpha y\beta z\gamma u + x\alpha y\beta z\gamma u_\circ + u_\circ\alpha x\gamma y\beta z + u'\gamma x\alpha y\beta z = x\alpha y\beta z\gamma u + u'\gamma x\alpha y\beta z = [x\alpha y\beta z, u]_\gamma$.

Similarly we can prove (iii). ■

Theorem 3.7. *If R_Γ is an additively regular Γ-semiring, then for all $x, y, x_1, x_2, \ldots, x_n, y_1, y_2, \ldots, y_n \in R_\Gamma$ and $\alpha, \beta_1, \beta_2, \ldots, \beta_{n-1} \in \Gamma$, the following identities are valid:*

(i) $[x, y_1\beta_1 y_2\beta_2 \cdots \beta_{n-1}y_n]_\alpha = [x, y_1]_\alpha\beta_1 y_2\beta_2 \cdots \beta_{n-1}y_n + y_1\beta_1[x, y_2]_\alpha\beta_2 \cdots \beta_{n-1}y_n + \cdots + y_1\beta_1 y_2\beta_2 \cdots \beta_{n-1}[x, y_n]_\alpha$

(ii) $[x_1\beta_1 x_2\beta_2 \cdots \beta_{n-1}x_n, y]_\alpha = x_1\beta_1 x_2\beta_2 \cdots \beta_{n-1}[x_n, y]_\alpha + x_1\beta_1 x_2\beta_2 \cdots \beta_{n-2}[x_{n-1}, y]_\alpha\beta_{n-1}x_n + \cdots + [x_1, y]_\alpha\beta_1 x_2\beta_2 \cdots \beta_{n-1}x_n$.

Proof. (i) We will prove the result by using induction on n, the result is already true for $n = 2, 3$ from Theorem 3.4(i) and Theorem 3.6(iii). Now assume that the result is true for $n = k - 1$, i.e., $[x, y_1\beta_1 y_2\beta_2 \cdots \beta_{k-2}y_{k-1}]_\alpha = [x, y_1]_\alpha\beta_1 y_2\beta_2 \cdots \beta_{k-2}y_{k-1} + y_1\beta_1[x, y_2]_\alpha\beta_2 \cdots \beta_{k-2}y_{k-1} + \cdots + y_1\beta_1 y_2\beta_2 \cdots \beta_{k-2}[x, y_{k-1}]_\alpha$. For $n = k$, by using Theorem 3.4(i) and induction hypothesis, we have $[x, y_1\beta_1 y_2\beta_2 \cdots \beta_{k-1}y_k]_\alpha = [x, (y_1\beta_1 y_2\beta_2 \cdots \beta_{k-2}y_{k-1})\beta_{k-1}y_k]_\alpha = [x, y_1\beta_1 y_2\beta_2 \cdots \beta_{k-2}y_{k-1}]_\alpha\beta_{k-1}y_k + y_1\beta_1 y_2\beta_2 \cdots \beta_{k-2}y_{k-1}\beta_{k-1}[x, y_k]_\alpha = [x, y_1]_\alpha\beta_1 y_2\beta_2 \cdots \beta_{k-1}y_k + y_1\beta_1[x, y_2]_\alpha\beta_2 \cdots \beta_{k-1}y_k + \cdots + y_1\beta_1 y_2\beta_2 \cdots \beta_{k-1}[x, y_k]_\alpha$.

Similarly we can prove (ii). ■

The following identities are generalizations of commutator identities of ring theory (c.f. [1, 4]).

Proposition 3.8. *Let R_Γ be an additively regular Γ-semiring. Then for all $x, y, z \in R_\Gamma, \alpha, \beta, \gamma \in \Gamma$, the following identities hold:*

(i) $[x\alpha y, z]_\beta + [y\alpha z, x]_\beta = [y, z\alpha x]_\beta$

(ii) $[x\alpha y\beta z, u]_\gamma + [y\alpha z\beta u, x]_\gamma + [z\alpha u\beta x, y]_\gamma = [z, u\alpha x\beta y]_\gamma$.

Proof. (i) By using Lemma 2.6, Definition 3.1 and Lemma 3.2, (i) becomes $[x\alpha y, z]_\beta + [y\alpha z, x]_\beta = x\alpha y\beta z + z'\beta x\alpha y + y\alpha z\beta x + x\beta y\alpha z' = z'\beta x\alpha y + y\alpha z\beta x + x\beta y\alpha z_\circ = z'\beta x\alpha y + y\alpha z\beta x + z_\circ\beta x\alpha y = y\alpha z\beta x + z'\beta x\alpha y = y\beta z\alpha x + z'\alpha x\beta y = [y, z\alpha x]_\beta$.

(ii) By Lemma 2.6, Definition 3.1 and Lemma 3.2, (ii) reduces to $[x\alpha y\beta z, u]_\gamma + [y\alpha z\beta u, x]_\gamma + [z\alpha u\beta x, y]_\gamma = x\alpha y\beta z\gamma u + u'\gamma x\alpha y\beta z + y\alpha z\beta u\gamma x + x\gamma y\alpha z\beta u' + z\alpha u\beta x\gamma y + y'\gamma z\alpha u\beta x = x\alpha y\beta z\gamma u_\circ + u'\gamma x\alpha y\beta z + z\alpha u\beta x\gamma y + y_\circ\alpha z\beta u\gamma x = u_\circ\gamma x\alpha y\beta z + u'\gamma x\alpha y\beta z + z\beta u\gamma x\alpha y_\circ + z\beta u\gamma x\alpha y = u'\gamma x\alpha y\beta z + z\beta u\gamma x\alpha y = u'\alpha x\beta y\gamma z + z\gamma u\alpha x\beta y = [z, u\alpha x\beta y]_\gamma$. ■

Definition 3.9. Let α be a fixed element of Γ. Then we define α-Jordan product as $(x \circ y)_\alpha = x\alpha y + y\alpha x$ for all $x, y \in R_\Gamma$.

Proposition 3.10. *Let R_Γ be an additively regular Γ-semiring. Then for all $x, y, z \in R_\Gamma, \alpha, \beta \in \Gamma$, the following α-Jordan identities hold:*

(i) $(x \circ y)_\alpha = (y \circ x)_\alpha$

(ii) $((x + y) \circ z)_\alpha = (x \circ z)_\alpha + (y \circ z)_\alpha$

(iii) $[(x \circ y)_\alpha, z]_\beta + [(y \circ z)_\alpha, x]_\beta = [y, (z \circ x)_\alpha]_\beta$.

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$x\beta(y\alpha z + z\alpha y) = y\alpha z\beta x + y\alpha x\beta z + x\alpha y\beta z + z\beta y\alpha x +$
$z\beta x\alpha y' + x\alpha z\beta y' = y\alpha z\beta x + y\alpha x\beta z + x\alpha y_o\beta z + z\beta y_o\alpha x + z\alpha x\beta y' + x\alpha z\beta y' =$

$y\beta z\alpha x + y_o\beta z\alpha x + y\beta x\alpha z + y_o\beta x\alpha z + (z \circ x)_\alpha\beta y' = y\beta(z\alpha x + x\alpha z) + (z \circ x)_\alpha\beta y' =$
$[y, (z \circ x)_\alpha]_\beta$. ■

Proposition 3.11. *Let R_Γ be an additively regular Γ-semiring. Then for all $x, y, z \in R_\Gamma$ and $\alpha, \beta \in \Gamma$, the α-Jordan identity $(x \circ [y, z]_\beta)_\alpha + ([x, z]_\beta \circ y)_\alpha = [(x \circ y)_\alpha, z]_\beta$ holds.*

Proof. By Lemma 2.6, Definition 3.1 and Definition 3.9, the left hand side reduces to $(x \circ [y, z]_\beta)_\alpha + ([x, z]_\beta \circ y)_\alpha = (x \circ (y\beta z + z'\beta y))_\alpha + ((x\beta z + z'\beta x) \circ y)_\alpha = x\alpha y\beta z + x\alpha z'\beta y + y\beta z\alpha x + z'\beta y\alpha x + x\beta z\alpha y + z'\beta x\alpha y + y\alpha x\beta z + y\alpha z'\beta = (x\alpha y + y\alpha x)\beta z + x\alpha(z + z')\beta y + y\beta(z + z')\alpha x + z'\beta y\alpha x + z'\beta x\alpha y = (\ x \circ y)_\alpha\beta z + z_o\beta x\alpha y + z_o\beta y\alpha x + z'\beta x\alpha y + z'\beta y\alpha x = (\ x \circ y)_\alpha\beta z + z'\beta(x\alpha y + y\alpha x) = [(x \circ y)_\alpha, z]_\beta$. ■

4. Derivations of additively regular Γ-semiring

In this section, we introduce the concept of derivation and inner derivation in additively regular Γ-semiring. Also, we establish the relationships between commutators and derivations of additively regular Γ-semirings.

Definition 4.1. A map $d : R_\Gamma \to R_\Gamma$ is called a derivation of additively regular Γ-semiring R_Γ if d is additive and d satisfies $d(x\gamma y) = d(x)\gamma y + x\gamma d(y)$ for all $x, y \in R_\Gamma, \gamma \in \Gamma$.

Example 4.2. Let R be an additively regular Γ-semiring. Take $R_\Gamma = \left\{ \begin{pmatrix} a & b \\ 0 & c \end{pmatrix} : a, b, c \in R \right\}$ and $\Gamma = \left\{ \begin{pmatrix} a & 0 \\ 0 & a \end{pmatrix} : a \in R \right\}$. Define a map $R_\Gamma \times \Gamma \times R_\Gamma \to R_\Gamma$ by $(x, \gamma, y) \longmapsto x\gamma y \ \forall\ x, y \in R_\Gamma, \gamma \in \Gamma$. Then R_Γ is an additively regular Γ-semiring under the usual multiplication of matrices. Define $d : R_\Gamma \to R_\Gamma$ by $d\begin{pmatrix} a & b \\ 0 & c \end{pmatrix} = \begin{pmatrix} 0 & b \\ 0 & 0 \end{pmatrix}$, then d is a derivation on R_Γ.

Example 4.3. Let R_Γ be an additively regular Γ-semiring. Then by Proposition 2.10, $R_\Gamma[x]$ is also an additively regular Γ-semiring. We define $d : R_\Gamma[x] \to R_\Gamma[x]$ by $d(a_0 + a_1x + a_2x^2 + a_3x^3 + \cdots) = a_1 + 2a_2x + 3a_3x^2 + \cdots$ for all $a_0 + a_1x + a_2x^2 + a_3x^3 + \cdots \in R_\Gamma[x]$. Then d is a derivation on $R_\Gamma[x]$.

Definition 4.4. Let R_Γ be an additively regular Γ-semiring and a be a fixed element of R_Γ and α be a fixed element of Γ. Define $d : R_\Gamma \to R_\Gamma$ by $d(x) = [a, x]_\alpha$, for all $x \in R_\Gamma$. The function d so defined can be easily checked to be additive and $d(x\gamma y) = [a, x\gamma y]_\alpha = x\gamma[a, y]_\alpha + [a, x]_\alpha\gamma y = x\gamma d(y) + d(x)\gamma y$ for all $x, y \in R_\Gamma, \gamma \in \Gamma$. Thus, d is a derivation which is called inner derivation of R_Γ determined by a and α.

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Proposition 4.6. *If R_Γ is an additively regular Γ-semiring and d is a derivation on R_Γ, then*

(i) $d(x') = (d(x))' \ \forall\ x \in R_\Gamma$.

(ii) $d' : R_\Gamma \to R_\Gamma$ *is also a derivation on* R_Γ.

Proposition 4.7. *If R_Γ is an additively regular Γ-semiring and d is a derivation on R_Γ, then $d(x\gamma y) = d(x'\gamma y'),\ \forall\ x, y \in R_\Gamma, \gamma \in \Gamma$.*

Proof. Let $x, y \in R_\Gamma, \gamma \in \Gamma$. Then by using Lemma 2.6 and Proposition 4.6(i), we have $d(x'\gamma y') = d(x')\gamma y' + x'\gamma d(y') = (d(x))'\gamma y' + x'\gamma(d(y))' = d(x)\gamma y + x\gamma d(y) = d(x\gamma y)$. ■

Theorem 4.8. *If R_Γ is an additively regular Γ-semiring, $a \in R_\Gamma, \alpha \in \Gamma$ and d is an inner derivation determined by a and α, i.e., $d(x) = [a, x]_\alpha$, for all $x \in R_\Gamma$, then $[x\beta y, z]^d_\gamma + [y\beta z, x]^d_\gamma = [y, z\beta x]^d_\gamma$ for all $x, y, z \in R_\Gamma, \beta, \gamma \in \Gamma$.*

Proof. By Lemma 2.6, Definition 3.1 and Remark 4.5, the left hand side reduces to $[x\beta y, z]^d_\gamma + [y\beta z, x]^d_\gamma = [a, [x\beta y, z]_\gamma]_\alpha + [a, [y\beta z, x]_\gamma]_\alpha = a\alpha(x\beta y\gamma z + z'\gamma x\beta y) + (x\beta y\gamma z + z'\gamma x\beta y)\alpha a' + a\alpha(y\beta z\gamma x + x'\gamma y\beta z) + (y\beta z\gamma x + x'\gamma y\beta z)\alpha a' = a\alpha(x+x')\beta y\gamma z + a\alpha z'\gamma x\beta y + (x+x')\beta y\gamma z\alpha a' + z'\gamma x\beta y\alpha a' + a\alpha y\beta z\gamma x + y\beta z\gamma x\alpha a' = a\alpha z'\gamma x\beta y + z'\gamma x\beta y\alpha a' + a\alpha y\gamma z\beta(x + x_\circ) + y\gamma z\beta(x + x_\circ)\alpha a' = a\alpha z'\beta x\gamma y + z'\beta x\gamma y\alpha a' + a\alpha y\gamma z\beta x + y\gamma z\beta x\alpha a' = [y, z\beta x]^d_\gamma$. ■

Proposition 4.9. *Let R_Γ be an additively regular Γ-semiring, $a \in R_\Gamma, \alpha \in \Gamma$ and d be an inner derivation determined by a and α, i.e., $d(x) = [a, x]_\alpha$ for all $x \in R_\Gamma$. Then for all $x, y, z, u \in R_\Gamma, \beta, \gamma, \delta \in \Gamma$, the following identities are valid:*

(i) $[x\beta y\gamma z, u]^d_\delta = (x\beta y\gamma[z, u]_\delta)^d + (x\beta[y, u]_\delta\gamma z)^d + ([x, u]_\delta\beta y\gamma z)^d$.

(ii) $[x\beta y\gamma z, u]^d_\delta + [y\beta z\gamma u, x]^d_\delta + [z\beta u\gamma x, y]^d_\delta = [z, u\beta x\gamma y]^d_\delta$.

Proof. (i) Taking right hand side of (i) and by using Lemma 2.6, Definition 3.1 and Remark 4.5, we get $(x\beta y\gamma[z, u]_\delta)^d + (x\beta[y, u]_\delta\gamma z)^d + ([x, u]_\delta\beta y\gamma z)^d = [a, x\beta y\gamma[z, u]_\delta]_\alpha + [a, x\beta[y, u]_\delta\gamma z]_\alpha + [a, [x, u]_\delta\beta y\gamma z]_\alpha = a\alpha x\beta y\gamma z\delta u + a\alpha x\beta y\gamma u\delta z' + x\beta y\gamma z\delta u\alpha a' + x\beta y\gamma u\delta z'\alpha a' + a\alpha x\beta y\delta u\gamma z + a\alpha x\beta u'\delta y\gamma z + x\beta y\delta u\gamma z\alpha a' + x\beta u'\delta y\gamma z\alpha a' + a\alpha x\delta u\beta y\gamma z + a\alpha u'\delta x\beta y\gamma z + x\delta u\beta y\gamma z\alpha a' + u'\delta x\beta y\gamma z\alpha a' = a\alpha x\beta y\gamma z\delta u + a\alpha u'\delta x\beta y\gamma z + x\beta y\gamma z\delta u\alpha a' + u'\delta x\beta y\gamma z\alpha a' + a\alpha x\beta y\gamma u\delta z_\circ + x\beta y\gamma u\delta z_\circ\alpha a' + a\alpha x\beta u_\circ\delta y\gamma z + x\beta u_\circ\delta y\gamma z\alpha a' = a\alpha x\beta y\gamma z\delta u + a\alpha u'\delta x\beta y\gamma z + x\beta y\gamma z\delta u\alpha a' + u'\delta x\beta y\gamma z\alpha a' + a\alpha x\beta y\gamma z_\circ\delta u + x\beta y\gamma z_\circ\delta u\alpha a' + a\alpha u_\circ\beta x\delta y\gamma z + u_\circ\beta x\delta y\gamma z\alpha a' = a\alpha x\beta y\gamma z\delta u + x\beta y\gamma z\delta u\alpha a' + a\alpha u'\delta x\beta y\gamma z + u'\delta x\beta y\gamma z\alpha a' = [a, [x\beta y\gamma z, u]_\delta]_\alpha = [x\beta y\gamma z, u]^d_\delta$.

(ii) Taking left hand side of (ii) and by using Lemma 2.6, Definition 3.1 and Remark 4.5, we have $[x\beta y\gamma z, u]^d_\delta + [y\beta z\gamma u, x]^d_\delta + [z\beta u\gamma x, y]^d_\delta = [a, [x\beta y\gamma z, u]_\delta]_\alpha + [a, [y\beta z\gamma u, x]_\delta]_\alpha + [a, [z\beta u\gamma x, y]_\delta]_\alpha = a\alpha x\beta y\gamma z\delta u + a\alpha u\delta x'\beta y\gamma z + x\beta y\gamma z\delta u\alpha a' + u\delta x'\beta y\gamma z\alpha a' + a\alpha y\beta z\gamma u\delta x + a\alpha x'\delta y\beta z\gamma u + y\beta z\gamma u\delta x\alpha a' + x'\delta y\beta z\gamma u\alpha a' + a\alpha z\beta u\gamma x\delta y + a\alpha y'\delta z\beta u\gamma x + z\beta u\gamma x\delta y\alpha a' + y'\delta z\beta u\gamma x\alpha a' = a\alpha x_\circ\beta y\gamma z\delta u + a\alpha y_\circ\beta z\gamma u\delta x + a\alpha u\delta x'\beta y\gamma z + a\alpha z\beta u\gamma x\delta y + x_\circ\beta y\gamma z\delta u\alpha a' + y_\circ\beta z\gamma u\delta x\alpha a' + u\delta x'\beta y\gamma z\alpha a' + z\beta u\gamma x\delta y\alpha a' = a\alpha u\delta x_\circ\beta y\gamma z + a\alpha u\delta x'\beta y\gamma z + a\alpha z\gamma u\delta x\beta y_\circ + a\alpha z\gamma u\delta x\beta y + u\delta x_\circ\beta y\gamma z\alpha a' + u\delta x'\beta y\gamma z\alpha a' + z\gamma u\delta x\beta y_\circ\alpha a' + z\gamma u\delta x\beta y\alpha a' = a\alpha u\delta x'\beta y\gamma z + a\alpha z\gamma u\delta x\beta y + u\delta x'\beta y\gamma z\alpha a' + z\gamma u\delta x\beta y\alpha a' = a\alpha(u\beta x'\gamma y\delta z + z\delta u\beta x\gamma y) + (u\beta x'\gamma y\delta z + z\delta u\beta x\gamma y)\alpha a' = [z, u\beta x\gamma y]^d_\delta$. ■

The next Theorem is the generalization of Jordan identity.

Theorem 4.10. *If R_Γ is an additively regular Γ-semiring, $a \in R_\Gamma, \alpha \in \Gamma$ and d is an inner derivation determined by a and α, then for all $x, y, z \in R_\Gamma, \beta, \gamma \in \Gamma$, the following identities hold:*

(i) $[(x \circ y)_\beta, z]^d_\gamma + [(y \circ z)_\beta, x]^d_\gamma = [y, (z \circ x)_\beta]^d_\gamma$.

(ii) $((x \circ [y, z]_\gamma)_\beta)^d + (([x, z]_\gamma \circ y)_\beta)^d = [(x \circ y)_\beta, z]^d_\gamma$.

Proof. (i) Using Lemma 2.6, Definition 3.1, Definition 3.9 and Remark 4.5, the left hand side of (i) becomes $[(x \circ y)_\beta, z]^d_\gamma + [(y \circ z)_\beta, x]^d_\gamma = [a, [(x \circ y)_\beta, z]_\gamma]_\alpha + [a, [(y \circ$

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$x_o\beta y\gamma z\alpha a' + z_o\gamma y\beta x\alpha a' = a\alpha y\beta x\gamma z + a\alpha y\beta z\gamma x + a\alpha z'\gamma x\beta y + a\alpha x'\gamma z\beta y + y\beta z\gamma x\alpha a'$
$+y\beta x\gamma z\alpha a' + z'\gamma x\beta y\alpha a' + x'\gamma z\beta y\alpha a' + a\alpha y\gamma z\beta x_o + a\alpha y\beta x\gamma z_o + y\gamma z\beta x_o\alpha a' +$
$y\beta x\gamma z_o\alpha a' = a\alpha y\beta z\gamma x + a\alpha y\beta x\gamma z + a\alpha z'\gamma x\beta y + a\alpha x'\gamma z\beta y + y\beta z\gamma x\alpha a' + y\beta x\gamma z\alpha a'$
$+z'\gamma x\beta y\alpha a' + x'\gamma z\beta y\alpha a' = a\alpha y\gamma z\beta x + a\alpha y\gamma x\beta z + a\alpha z\beta x\gamma y' + a\alpha x\beta z\gamma y' +$
$y\gamma z\beta x\alpha a' + y\gamma x\beta z\alpha a' + z\beta x\gamma y'\alpha a' + x\beta z\gamma y'\alpha a' = [y, (z \circ x)_\beta]^d_\gamma$.

(ii) Using Lemma 2.6, Definition 3.1, Lemma 3.2, Definition 3.9 and Remark 4.5, we have $((x \circ [y, z]_\gamma)_\beta)^d + (([x, z]_\gamma \circ y)_\beta)^d = a\alpha x\beta y\gamma z + a\alpha x\beta z\gamma y' +$
$a\alpha y\gamma z\beta x + a\alpha z\gamma y'\beta x + x\beta y\gamma z\alpha a' + x\beta z\gamma y'\alpha a' + y\gamma z\beta x\alpha a' + z\gamma y'\beta x\alpha a' + a\alpha x\gamma z\beta y +$
$a\alpha z\gamma x'\beta y + a\alpha y\beta x\gamma z + a\alpha y\beta z\gamma x' + x\gamma z\beta y\alpha a' + z\gamma x'\beta y\alpha a' + y\beta x\gamma z\alpha a' + y\beta z\gamma x'\alpha a' =$
$a\alpha x\beta y\gamma z + a\alpha z\gamma x'\beta y + a\alpha z\gamma y'\beta x + x\beta y\gamma z\alpha a' + a\alpha y\beta x\gamma z + z\gamma x'\beta y\alpha a' + y\beta x\gamma z\alpha a' +$
$z\gamma y'\beta x\alpha a' + a\alpha y\gamma z\beta x_o + x\beta z\gamma y_o\alpha a' + y\gamma z\beta x_o\alpha a' + a\alpha x\beta z\gamma y_o = a\alpha x\beta y\gamma z +$
$a\alpha z\gamma x'\beta y + a\alpha z\gamma y'\beta x + x\beta y\gamma z\alpha a' + a\alpha y\beta x\gamma z + z\gamma x'\beta y\alpha a' + y\beta x\gamma z\alpha a' + z\gamma y'\beta x\alpha a' +$
$a\alpha x_o\beta y\gamma z + y_o\gamma x\beta z\alpha a' + x_o\beta y\gamma z\alpha a' + a\alpha y_o\gamma x\beta z = a\alpha x\beta y\gamma z + a\alpha y\beta x\gamma z +$
$y\beta x\gamma z\alpha a' + x\beta y\gamma z\alpha a' + a\alpha z'\gamma x\beta y + a\alpha z'\gamma y\beta x + z'\gamma x\beta y\alpha a' + z'\gamma y\beta x\alpha a' = [(x \circ$
$y)_\beta, z]^d_\gamma$. ■

Next, we define a symmetric map.

Definition 4.11. Let R_Γ be an additively regular Γ-semiring. Then a mapping $B : R_\Gamma \times \Gamma \times R_\Gamma \to R_\Gamma$ is said to be symmetric, if $B(x, \gamma, y) = B(y, \gamma, x)$ for all $x, y \in R_\Gamma, \gamma \in \Gamma$.

Definition 4.12. A mapping $f : R_\Gamma \to R_\Gamma$ defined by $f(x) = B(x, \gamma, x)$ is called trace of B. Further, for an additively regular Γ-semiring R_Γ and derivation $d : R_\Gamma \to R_\Gamma$, we define a map $B_d : R_\Gamma \times \Gamma \times R_\Gamma \to R_\Gamma$ corresponding to derivation d as $B_d(x, \gamma, y) = [d(x), y]_\gamma + [d(y), x]_\gamma$ for all $x, y \in R_\Gamma, \gamma \in \Gamma$.

The following proposition shows that the mapping B_d is symmetric.

Proposition 4.13. *Let R_Γ be an additively regular Γ-semiring. Then following statements hold:*

(i) *If $d : R_\Gamma \to R_\Gamma$ is a derivation, then B_d is symmetric.*

(ii) *If f is trace of B_d, then $f(x+y) = f(x)+f(y)+2B_d(x, \gamma, y)$ for all $x, y \in R_\Gamma$.*

Proof. (i) By Definition 4.11 and Definition 4.12, we have $B_d(x, \gamma, y) = [d(x), y]_\gamma + [d(y), x]_\gamma = [d(y), x]_\gamma + [d(x), y]_\gamma = B_d(y, \gamma, x)$ for all $x, y \in R_\Gamma, \gamma \in \Gamma$. This shows that B_d is symmetric.

(ii) As $d : R_\Gamma \to R_\Gamma$ is a derivation, hence by Definition 4.12, we have $f(x+y) = B_d(x+y, \gamma, x+y) = [d(x+y), x+y]_\gamma + [d(x+y), x+y]_\gamma = [d(x), x]_\gamma +$
$[d(x), x]_\gamma + [d(y), y]_\gamma + [d(y), y]_\gamma + 2([d(x), y]_\gamma + [d(y), x]_\gamma) = B_d(x, \gamma, x) + B_d(y, \gamma, y)$
$+ 2B_d(x, \gamma, y) = f(x) + f(y) + 2B_d(x, \gamma, y)$. ■

Proposition 4.14. *Let R_Γ be an additively regular Γ-semiring and d be a derivation of R_Γ into itself. Then for all $x, y, z \in R_\Gamma, \beta, \gamma \in \Gamma$, we have $B_d(x, \gamma, z)\beta y + x\beta B_d(y, \gamma, z) = [z, d(x)]_\gamma \beta y' + x'\beta[z, d(y)]_\gamma + [d(z), x\beta y]_\gamma$.*

Proof. By Lemma 2.6, Definition 4.12, Theorem 3.4(i) and Theorem 3.3(v), we have $B_d(x, \gamma, z)\beta y + x\beta B_d(y, \gamma, z) = [d(x), z]_\gamma \beta y + [d(z), x]_\gamma \beta y + x\beta[d(y), z]_\gamma +$
$x\beta[d(z), y]_\gamma = [d(x), z']_\gamma \beta y' + x'\beta[d(y), z]'_\gamma + [d(z), x]_\gamma \beta y + x\beta[d(z), y]_\gamma = [z, d(x)]_\gamma$
$\beta y' + x'\beta[z, d(y)]_\gamma + [d(z), x\beta y]_\gamma$. ■

Theorem 4.15. *Let R_Γ be an additively regular Γ-semiring and d be a derivation of R_Γ into itself. Then $B_d(x\beta y, \gamma, z) = B_d(x, \gamma, z)\beta y + x\beta B_d(y, \gamma, z) +$
$d(x)\beta[y, z]_\gamma + [x, z]_\gamma \beta d(y)$ $\forall$ $x, y, z \in R_\Gamma, \beta, \gamma \in \Gamma$.*

Proof. By Definition 4.12, Lemma 2.6, Theorem 3.4(i) and Theorem 3.3, we have $B_d(x\beta y, \gamma, z) = [d(x\beta y), z]_\gamma + [d(z), x\beta y]_\gamma = [d(x)\beta y, z]_\gamma + [x\beta d(y), z]_\gamma +$
$[d(z), x\beta y]_\gamma = [z, d(x)\beta y']_\gamma + [z, x'\beta d(y)]_\gamma + [d(z), x\beta y]_\gamma = [z, d(x)]_\gamma \beta y' + x'\beta[z,$
$d(y)]_\gamma + d(x)\beta[y, z]_\gamma + [x, z]_\gamma \beta d(y) + [d(z), x]_\gamma \beta y + x\beta[d(z), y]_\gamma = B_d(x, \gamma, z)\beta y +$
$x\beta B_d(y, \gamma, z) + d(x)\beta[y, z]_\gamma + [x, z]_\gamma \beta d(y)$. ■

Proposition 4.16. *Let R_Γ be an additively regular Γ-semiring ι*
2 and d be a derivation of R_Γ into itself. Then d^2 is again a d

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Proof. Let d be a derivation on R_Γ. Then clearly d^2 is additive and $d^2(x\gamma y) = d(d(x)\gamma y + x\gamma d(y)) = d(d(x))\gamma y + 2d(x)\gamma d(y) + x\gamma d(d(y)) = d^2(x)\gamma y + x\gamma d^2(y)$. ■

Lemma 4.17. *Let R_Γ be an additively regular Γ-semiring such that $[x,y]_\gamma = 0$ $\forall\ x, y \in R_\Gamma, \gamma \in \Gamma$. Then R_Γ is commutative.*

The proof of this lemma is quite easy so we omit the proof.

Definition 4.18. An additive mapping f of an additively regular Γ-semiring R_Γ is said to be centralizing if $[[f(x),x]_\alpha, y]_\beta = 0$ for all $x, y \in R_\Gamma, \alpha, \beta \in \Gamma$. Moreover, f is said to be commuting if $[f(x),x]_\alpha = 0$ for all $x \in R_\Gamma, \alpha \in \Gamma$.

Remark 4.19. Let f be a centralizing map on a prime additively regular Γ-semiring R_Γ. Then $[[f(x),x]_\alpha, y]_\beta = 0$ for all $x, y \in R_\Gamma, \alpha, \beta \in \Gamma$, that is, $[f(x),x]_\alpha \beta y + (y' + y)\beta[f(x),x]_\alpha = y\beta[f(x),x]_\alpha$ for all $x, y \in R_\Gamma, \alpha, \beta \in \Gamma$. So, (A_2, Γ)-condition implies that $[f(x),x]_\alpha$ belongs to the centre of R_Γ for all $x \in R_\Gamma, \alpha \in \Gamma$. Moreover, the definition of f forces $[[f(x),x]_\alpha, x]_\beta = 0$ for all $x \in R_\Gamma, \alpha, \beta \in \Gamma$, that is, for all $x \in R_\Gamma, \alpha, \beta \in \Gamma$ we have

$0 = [f(x),x]_\alpha \beta x + x'\beta[f(x),x]_\alpha = [f(x),x]_\alpha \beta(x + x')$, since $[f(x),x]_\alpha$ belongs to the centre of R_Γ.

Hence, $[f(x),x]_\alpha \Gamma(R_\Gamma + R'_\Gamma) = (0)$ leading to $[f(x),x]_\alpha \Gamma R_\Gamma = (0)$ for all $x \in R_\Gamma, \alpha \in \Gamma$ as R'_Γ is contained in R_Γ. Therefore, $[f(x),x]_\alpha \Gamma R_\Gamma \Gamma 1 = (0)$ for all $x \in R_\Gamma, \alpha \in \Gamma$. By using primeness of R_Γ we can conclude that $[f(x),x]_\alpha = 0$ for all $x \in R_\Gamma, \alpha \in \Gamma$. Therefore, every centralizing mapping of a prime additively regular Γ-semiring R_Γ is also commuting.

Theorem 4.20. *Let d be a non-zero derivation of prime additively regular Γ-semiring R_Γ such that $d([x,y]_\gamma) = 0$ for all $x, y \in R_\Gamma, \gamma \in \Gamma$. Then R_Γ is commutative.*

Proof. Let d be a derivation of R_Γ such that $d([x,y]_\gamma) = 0$ for all $x, y \in R_\Gamma$, $\gamma \in \Gamma$. Then by using Definitions 3.1 and 4.1, we are left with

$$\text{(i)} \qquad [d(x),y]_\gamma + [x,d(y)]_\gamma = 0 \text{ for all } x, y \in R_\Gamma,\ \gamma \in \Gamma.$$

By replacing y by $y\beta x$ in (i) and then using Definition 3.1, Theorem 3.4, Definition 4.1 and equation (i), we get $0 = [d(x), y\beta x]_\gamma + [x, d(y\beta x)]_\gamma = d(y)\beta[x,x]_\gamma + [x,y]_\gamma \beta d(x)$. So,

$$\text{(ii)} \qquad d(y)\beta[x,x]_\gamma + [x,y]_\gamma \beta d(x) = 0 \text{ for all } x, y \in R_\Gamma, \beta,\ \gamma \in \Gamma.$$

Replacing y by $r\alpha y$ in (ii) and then by using Theorem 3.4, Lemma 2.6, Lemma 3.2, equations (i) and (ii), we have $0 = d(r\alpha y)\beta[x,x]_\gamma + [x, r\alpha y]_\gamma \beta d(x) = [x,r]_\gamma \alpha y \beta d(x) + r\alpha[x,y]_\gamma \beta d(x) + d(r)\alpha y \beta[x,x]_\gamma + r\alpha d(y)\beta[x,x]_\gamma = (x\gamma r + r'\gamma x)\alpha y \beta d(x) + r_\circ \gamma x \alpha y \beta d(x) + d(r)\alpha y \beta x \gamma x_\circ = [x,r]_\gamma \alpha y \beta d(x) + d(r)\gamma(x + x')\alpha y \beta x + r\gamma x \alpha y \beta d(x) + r'\gamma x \alpha y \beta d(x) + r_\circ \gamma x \alpha y \beta d(x) = [x,r]_\gamma \alpha y \beta d(x) + d(r)\gamma(x + x_\circ)\alpha y \beta x +$

$d(r)\gamma x' \alpha y \beta x + r_\circ \gamma x \alpha y \beta d(x) + (d(x))'\gamma r \alpha y \beta x + d(x)\gamma r \alpha y \beta x =$
$(d(r)\gamma x + x'\gamma d(r))\alpha y \beta x + (x\gamma d(r) + d(r)\gamma x')\alpha y \beta x + (r\gamma d(x) +$
$(r'\gamma d(x) + d(x)\gamma r)\alpha y \beta x = [x,r]_\gamma \alpha y \beta d(x) + ([d(r),x]_\gamma + [r,d(x)]_\gamma)$
$+ [d(x),r]_\gamma)\alpha y \beta x = [x,r]_\gamma \alpha y \beta d(x)$ for all $x, y, r \in R_\Gamma, \alpha, \beta, \gamma \in \Gamma$. Then by

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semiring R_Γ such that $[d(x), x]_\gamma = 0$ for all $x \in R_\Gamma, \gamma \in \Gamma$. Then R_Γ is commutative.

Proof. As $0 = [d(x+y), x+y]_\gamma = [d(x), y]_\gamma + [d(y), x]_\gamma$. Hence we have

(i) $$[d(x), y]_\gamma + [d(y), x]_\gamma = 0 \text{ for all } x, y \in R_\Gamma,\ \gamma \in \Gamma.$$

By replacing y by $y\beta x$ in (i) and then using Theorem 3.4 and equation (i), we get $0 = [d(x), y\beta x]_\gamma + [d(y\beta x), x]_\gamma = d(y)\,\beta[x, x]_\gamma + [y, x]_\gamma \beta d(x)$. So,

(ii) $$d(y)\,\beta[x, x]_\gamma + [y, x]_\gamma \beta d(x) = 0 \text{ for all } x, y \in R_\Gamma, \beta, \gamma \in \Gamma.$$

Replacing y by $r\alpha y$ in (ii) and then by using Theorem 3.4, Lemma 2.6, Lemma 3.2, equations (i) and (ii), we get $0 = [r\alpha y, x]_\gamma \beta d(x) + d(r\alpha y)\,\beta[x, x]_\gamma = [r, x]_\gamma \alpha y \beta d(x) + d(r)\alpha y \beta x \gamma x_\circ = [r, x]_\gamma \alpha y \beta d(x) + x_\circ \gamma r \alpha y \beta d(x) + d(r)\gamma(x + x')\alpha y \beta x = [r, x]_\gamma \alpha y \beta d(x) + (d(r)\gamma x + d(r)\gamma x_\circ)\alpha y \beta x + d(r)\gamma x' \alpha y \beta x + x\gamma r \alpha y \beta d(x) + x_\circ \gamma r \alpha y \beta d(x) + x' \gamma r \alpha y \beta d(x) = [r, x]_\gamma \alpha y \beta d(x) + [d(r), x]_\gamma \alpha y \beta x + x\gamma d(r) \alpha y \beta x + d(r)\gamma x' \alpha y \beta x + x_\circ \gamma r \alpha y \beta d(x) + r_\circ \gamma x \alpha y \beta d(x) = [r, x]_\gamma \alpha y \beta d(x) + [d(r), x]_\gamma \alpha y \beta x + [x, d(r)]_\gamma \alpha y \beta x + r_\circ \gamma d(x) \alpha y \beta x + d(x)\gamma r_\circ \alpha y \beta x = [r, x]_\gamma \alpha y \beta d(x) + ([d(r), x]_\gamma + [d(x), r]_\gamma)\alpha y \beta x + ([r, d(x)]_\gamma + [x, d(r)]_\gamma)\alpha y \beta x = [r, x]_\gamma \alpha y \beta d(x)$ for all $x, y.r \in R_\Gamma, \alpha, \beta, \gamma \in \Gamma$. Then by primeness of R_Γ, either $[r, x]_\gamma = 0$ for all $x, r \in R_\Gamma, \gamma \in \Gamma$ or $d(x) = 0$ for all $x \in R_\Gamma$. But as d is non-zero so we have $[r, x]_\gamma = 0$ for all $x, r \in R_\Gamma, \gamma \in \Gamma$. Thus R_Γ is commutative. ■

The next result is a generalization of Posner's second theorem for additively regular Γ-semiring R_Γ.

Theorem 4.22. *Let R_Γ be a prime additively regular Γ-semiring. If there is a non-zero centralizing derivation of R_Γ, then R_Γ is commutative.*

Proof. Let R_Γ be a prime additively regular Γ-semiring and d be a non-zero centralizing derivation of R_Γ. Then by using Remark 4.19, we have $[d(x), x]_\gamma = 0$ for all $x \in R_\Gamma, \gamma \in \Gamma$. Thus from Theorem 4.21, R_Γ is commutative. ■

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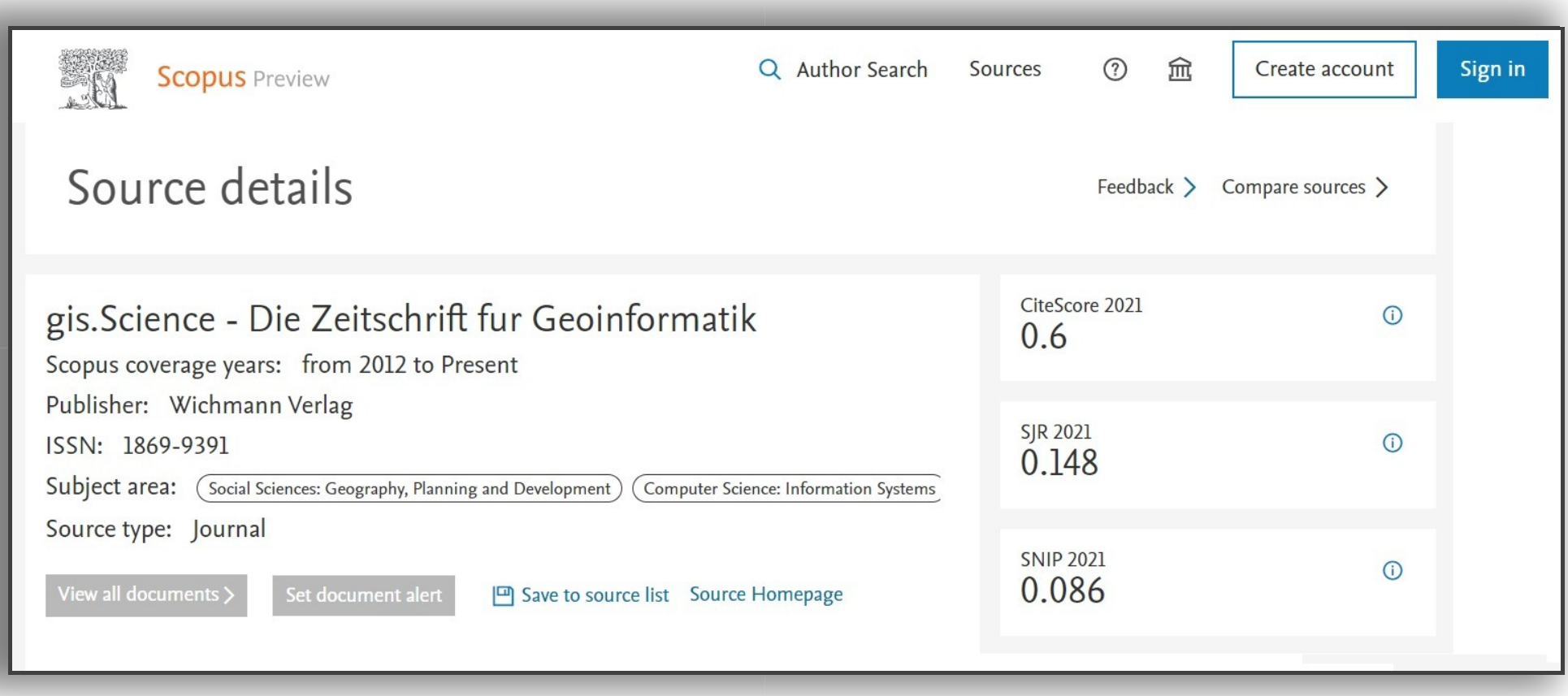

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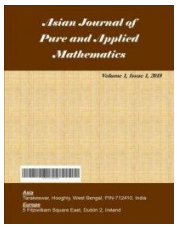

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Instability of a Plasma in Porous Medium

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Abstract

The double-diffusive instability of a plasma is considered in the presence of finite Larmor radius effect and porous medium. Following linear stability theory and normal mode analysis method, the dispersion relation is obtained. It is found that the finite Larmor radius, stable solute gradient and magnetic field introduce oscillatory modes in the systems which were non-existent in their absence. For stationary convection case, the finite Larmor radius and stable solute gradient have stabilizing effects on the system. On the other hand, the medium permeability has a destabilizing (or stabilizing) effect and the magnetic field has a stabilizing (or destabilizing) effect under certain condition in the presence of finite Larmor radius effect whereas in the absence of finite Larmor radius effect, the medium permeability and the magnetic field have destabilizing and stabilizing effects, respectively. The sufficient conditions for non-existence of overstability are also obtained.

Keywords: Double-diffusive instability; plasma; finite Larmor radius effect; porous medium.

1 Introduction

The study of onset of convection in a porous medium has attracted considerable interest because of its natural occurrence and of its intrinsic importance in many industrial problems, particularly in petroleum-exploration, chemical and nuclear industries. The derivation of the basic equations of a layer of fluid heated from below in porous medium, using Boussinesq approximation, has been given by Joseph [1]. The study of a layer of fluid heated from below in porous media is motivated both theoretically and by its practical applications in engineering disciplines. Among the applications in engineering disciplines one can find the food process industry, chemical process industry, solidification and centrifugal casting of metals. The development of geothermal power resources has increased general interest in the properties of convection in porous medium. Lapwood [2] has studied the stability of convective flow in a porous medium using Rayleigh's procedure. The Rayleigh instability of a thermal boundary layer in flow through a porous medium has been considered by Wooding [3].

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A detailed account of the theoretical and experimental results of the onset of thermal instability (Bénard convection) in a fluid layer under varying assumptions of hydrodynamics and hydromagnetics has been given in the celebrated monograph by Chandrasekhar [4]. Veronis [5] has investigated the problem of thermohaline convection in a layer of fluid heated from below and subjected to a stable salinity gradient. The buoyancy forces can arise not only from density differences due to variations in temperature but also from those due to variations in solute concentration. Thermosolutal convection problems arise in oceanography, limnology and engineering. The investigation of thermosolutal convection is motivated by its interesting complexities as a double diffusion phenomena as well as its direct relevance to geophysics and astrophysics. Stomell et al. [6] did the pioneering work regarding the investigation of thermosolutal convection. This work was elaborated in different physical situations by Stern [7] and Nield [8]. Examples of particular interest are provided by ponds built to trap solar heat (Tabor and Matz [9]) and some Antarctic lakes (Shirtcliffe [10]). The physics is quite similar in the stellar case in that Helium acts like salt in raising the density and in diffusing more slowly than heat. The conditions under which convective motion in thermosolutal convection are important (e.g. in lower parts of the Earth's atmosphere, astrophysics and several geophysical situation) are usually far removed from the consideration of a single component fluid and rigid boundaries and therefore it is desirable to consider a fluid acted on by a solute gradient and free boundaries. A double-diffusive instability that occurs when a solution of a slowly diffusing protein is layered over a denser solution of more rapidly diffusing sucrose has been explained by Brakke [11]. Nason et al. [12] found that this instability, which is deleterious to certain biochemical separations, can be suppressed by rotation in the ultra centrifuge.

The properties of ionized space and laboratory magnetic fluids (plasmas) have been intensively investigated theoretically and experimentally in the past sixty years. One of the key aspects studied in this context is the stability of plasma structures. Usually, instabilities can be divided into two categories: macro- and micro-instabilities. Macro-instabilities occur with low frequencies compared to the plasma and cyclotron frequency and they are studied within the framework of magnetohydrodynamics (MHD). Physicists have understood the behavior of macro-instabilities and they showed how to avoid the most destructive of them, but small-scale gradient driven micro-instabilities are still a serious obstacle for having a stable plasma for a large range of parameters. Micro-instabilities are described by models which include, e.g. finite Larmor radius (FLR) and collisionless dissipative effects in plasmas. Time and length scales of micro-instabilities are comparable to the turbulent length scales and the length scales of transport coefficients. In general, the FLR effect is neglected. However, when the Larmor radius becomes comparable to the hydromagnetic length of the problem (e.g. wavelength) or the gyration frequency of ions in the magnetic field is of the same order as the wave frequency, finiteness of the Larmor radius must be taken into account. Strictly speaking, the space and time scale for the breakdown of hydromagnetics are on the respective scales of ion gyration about the field, and the ion Larmor frequency. In the present paper, we explore the effect of FLR on the double diffusive instability of a plasma. Finite Larmor radius effect on plasma instabilities has been the subject of many investigations. In many astrophysical plasma situations such as in solar corona, interstellar and interplanetary plasmas the assumption of zero Larmor radius is not valid. Roberts and Taylor [13] and Rosenbluth et al. [14] have shown the stabilizing influence of finite ion Larmor radius (FLR) effects on plasma instabilities. Hernegger [15] investigated the stabilizing effect of FLR on thermal instability and showed that thermal criterion is changed by FLR for wave propagation perpendicular to the magnetic field. Sharma [16] investigated the stabilizing effect of FLR on thermal instability of rotating plasma. Ariel [17] discussed the stabilizing effect of FLR on thermal instability of conducting plasma layer of finite thickness surrounded by a non-conducting matter. Vaghela and Chhajlani [18] studied the stabilizing effect of FLR on magneto-thermal stability of resistive plasma through a porous medium with thermal conduction. Bhatia and Chhonkar [19] investigated the stabilizing effect of FLR on the instability of a rotating layer of self-gravitating plasma incorporating the effects of viscosity and Hall current. Vyas and Chhajlani [20] pointed out the stabilizing effect of FLR on the thermal instability of magnetized rotating plasma incorporating the effects of viscosity, finite electrical conductivity, porosity and thermal conductivity. Marcu and Ballai [21] showed the stabilizing effect of FLR on thermosolutal stability of two-component rotating plasma. Kaothekar and Chhajlani [22] investigated the problem of Jeans instability of self-gravitating rotating radiative plasma with finite Larmor radius corrections. Thus FLR effect is an important factor in the discussion of thermosolutal instability and other hydromagnetic instabilities. Kaothekar [23] has

studied the effect of Hall current and finite Larmor radius corrections on thermal instability of radiative plasma for star formation in interstellar medium. The impact of porosity on the Jeans instability in a viscous quantum magneto plasma has been investigated by Sutar [24]. In another study, Kaothekar [25] has discussed the thermal instability of partially ionized viscous plasma with Hall effect and FLR corrections flowing through a porous medium. Keeping these in mind, an attempt is made to study the thermosolutal instability of a plasma in porous medium in the presence of finite Larmor radius effects in the present paper.

2 Formulation of the Problem and Perturbation Equations

Consider an infinite, horizontal, incompressible, viscous and finitely (electrically) conducting plasma layer of depth d, heated and soluted from below so that the temperatures, densities and solute concentrations at the bottom surface $z = 0$ are T_0, ρ_0 and C_0 and at the upper surface $z = d$ are T_d, ρ_d and C_d, respectively, and that a uniform temperature gradient $\beta(= \left|{}^{dT}/_{dz}\right|)$ and uniform solute gradient $\beta'(= \left|{}^{dC}/_{dz}\right|)$ are maintained. The gravity field $\vec{g}(0, 0, -g)$ and uniform vertical magnetic field $\vec{H}(0, 0, H)$ pervade the system. This plasma layer is assumed to be flowing through an isotropic and homogeneous porous medium of porosity ε and medium permeability k_1.

Let $p, \rho, T, C, \alpha, \alpha', \chi, \chi', g, \mu_e, \mu, \nu\left(=\frac{\mu}{\rho_0}\right), \vec{v}\,(u, v, w), \eta$ and $\overleftrightarrow{P}$ denote, respectively, the pressure, density, temperature, solute concentration, thermal coefficient of expansion, an analogous solute coefficient of expansion, thermal diffusity, solute diffusity, gravitational acceleration, magnetic permeability, viscosity, kinematic viscosity, velocity, resistivity and stress tensor taking into account the finite Larmor radius effect. Then the equations expressing the conservation of momentum, mass, heat, solute mass concentration and equation of state are

$$\frac{1}{\varepsilon}\left[\frac{\partial \vec{V}}{\partial t} + \frac{1}{\varepsilon}(\vec{V}.\nabla)\vec{V}\right] = -\frac{1}{\rho_0}\nabla p + \vec{g}\left(1 + \frac{\delta\rho}{\rho_0}\right) + \frac{\mu_e}{4\pi\rho_0}(\nabla \times \vec{H}) \times \vec{H} - \frac{\nu}{k_1}\vec{V} - \frac{1}{\rho_0}\overleftrightarrow{P}, \tag{1}$$

$$\nabla.\vec{V} = 0, \tag{2}$$

$$E\frac{\partial T}{\partial t} + (\vec{V}.\nabla)T = \kappa\nabla^2 T, \tag{3}$$

$$E^{\frac{\partial C}{\partial t}} + (\vec{V}.\nabla) = \kappa^{\nabla^2} C, \tag{4}$$

$$\rho = \rho_0[1 - \alpha(T - T_0) + \alpha'(C - C_0)]. \tag{5}$$

Here use has been made of the Boussinesq approximation in writing equation (1). Now the Maxwell's equations yield

$$\varepsilon\frac{d\vec{H}}{dt} = (\vec{H}.\nabla)\vec{V} + \epsilon\eta\nabla^2\vec{H}, \tag{6}$$

$$\nabla.\vec{H} = 0, \tag{7}$$

Where $d/dt = \partial/\partial t + (1/\varepsilon)\vec{V}.\nabla$ stands for the convective derivative, $E = \varepsilon + (1 - \varepsilon)\,\rho_s C_s/\rho_0 C$ and E' is an analogous solute coefficient. ρ_s, C_s and ρ_0, C stand for density and specific heat of solid (porous matrix) and fluid, respectively.

For the magnetic field along the z −axis, the stress tensor $\vec{\vec{P}}$, taking into account the finite ion gyration radius (Vandakurov [26]), has the components

$$P_{xx} = -\rho_0 \nu_0 \left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right),$$
$$P_{xy} = P_{yz} = \rho_0 \nu_0 \left(\frac{\partial u}{\partial x} - \frac{\partial v}{\partial y}\right),$$
$$P_{xz} = P_{zx} = -2\rho_0 \nu_0 \left(\frac{\partial v}{\partial z} + \frac{\partial w}{\partial y}\right), \tag{8}$$

$$P_{yy} = \rho_0 \nu_0 \left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial z}\right),$$
$$P_{yz} = P_{xy} = 2\rho_0 \nu_0 \left(\frac{\partial w}{\partial x} + \frac{\partial u}{\partial z}\right), \qquad P_{zz} = 0,$$

where $\rho_0 \nu_0 = NT/4\omega_H$, ω_H being the ion-gyration frequency, while N and T are number density and temperature of the ions, respectively.

The steady state solution is

$$\vec{V} = 0, \qquad T = T_0 - \beta z, \qquad C = C_0 - \beta' z, \qquad \rho = \rho_0(1 + \alpha\beta z - \alpha'\beta' z). \tag{9}$$

Now we consider a small perturbation on the steady state and let $\delta p, \delta\rho, \theta, \gamma, \vec{h}(h_x, h_y, h_z)$ and $\vec{V}(u, v, w)$ denote, respectively, the perturbations in pressure p, density ρ, temperature T, solute concentration C, magnetic field $\vec{H}$, and velocity. The change in density $\delta\rho$, caused by the perturbations θ and γ in temperature and concentration, is given by

$$\delta\rho = -\rho_0(\alpha\theta - \alpha'\gamma). \tag{10}$$

Then the linearized hydromagnetic perturbation equations become

$$\frac{1}{\varepsilon}\frac{\partial \vec{V}}{\partial t} = -\frac{1}{\rho_0}\nabla\delta p + \vec{g}\left(\frac{\delta\rho}{\rho_0}\right) + \frac{\mu_e}{4\pi\rho_0}(\nabla \times \vec{h}) \times \vec{H} - \frac{\nu}{k_1}\vec{V} - \frac{1}{\rho_0}\nabla\vec{\vec{P}}, \tag{11}$$

$$\nabla.\vec{V} = 0, \tag{12}$$

$$E\frac{\partial\theta}{\partial t} = \beta w + \kappa\nabla^2\theta, \tag{13}$$

$$E'\frac{\partial\gamma}{\partial t} = \beta' w + \kappa'\nabla^2\gamma, \tag{14}$$

$$\varepsilon\frac{\partial\vec{h}}{\partial t} = (\vec{H}.\nabla)\vec{V} + \epsilon\eta\nabla^2\vec{h}, \tag{15}$$

$$\nabla.\vec{h} = 0. \tag{16}$$

3 Dispersion Relation

For obtaining the dispersion relation, we now analyzing the disturbances into normal modes, assuming that the perturbation quantities are of the form

$$[w, \theta, \gamma, h_z, \zeta, \xi] = [W(z), \Theta(z), \Gamma(z), K(z), Z(z), X(z)] exp\left[ik_x x + ik_y y + nt\right], \quad (17)$$

where k_x and k_y are the wave numbers in the $x-$ and $y-$ directions, respectively, $k = \sqrt{k_x^2 + k_y^2}$ is the resultant wave number, and n is, in general, a complex constant. $\zeta = \partial v/\partial x - \partial u/\partial y$ and $\xi = \partial h_y/\partial x - \partial h_x/\partial y$ stand for the $z-$components of vorticity and current density, respectively.

Expressing the coordinates x, y, z in the new unit of length d and letting $a = kd, \sigma = nd^2/\nu, p_1 = \nu/\kappa, p_2 = \nu/\eta, q = \nu/\kappa', P_l = k_1/d^2,\ and\ D = d/dz$, equations (11) - (16), with the help of (10) and expression (17), in non-dimensional form, become

$$\left(\frac{\sigma}{\varepsilon} + \frac{1}{P_l}\right)(D^2 - a^2)W + \left(\frac{gd^2}{\nu}\right)a^2(\alpha\Theta - \alpha\Gamma) - \frac{\mu_e H d}{4\pi\rho_0\nu}(D^2 - a^2)DK + \left(\frac{\nu_0 d}{\nu}\right)(2D^2 + a^2)DZ = 0, \quad (18)$$

$$\left(\frac{\sigma}{\varepsilon} + \frac{1}{P_l}\right)Z = \left(\frac{\mu_e H d}{4\pi\rho_0\nu}\right)DX + \left(\frac{\nu_0}{\nu d}\right)(2D^2 + a^2)DW, \quad (19)$$

$$[D^2 - a^2 - Ep_1\sigma]\Theta = -\left(\frac{\beta d^2}{\kappa}\right)W, \quad (20)$$

$$[D^2 - a^2 - E'q\sigma]\Gamma = -\left(\frac{\beta' d^2}{\kappa'}\right)W, \quad (21)$$

$$[D^2 - a^2 - p_2\sigma]K = -\left(\frac{Hd}{\varepsilon\eta}\right)DW, \quad (22)$$

$$[D^2 - a^2 - p_2\sigma]X = -\left(\frac{Hd}{\varepsilon\eta}\right)DZ. \quad (23)$$

Consider the case where both boundaries are free as well as perfect conductors of both heat and solute, while the adjoining medium is electrically non-conducting. The boundary conditions for this case, using (17), are

$$W = D^2W = DZ = X = \Theta = \Gamma = 0\ and\ \vec{h}\ are\ continuous\ at\ z = 0\ and\ 1. \quad (24)$$

In the absence of any surface current, the tangential components of the magnetic field are continuous. Hence the boundary conditions, in addition to (24), are

$$DK = 0 \text{ on the boundaries.} \quad (25)$$

Using the above boundary conditions, it can be shown that all the even order derivatives of W must vanish for $z = 0\ and\ 1$ and hence the proper solution of W characterizing the lowest mode is

$$W = W_0 sin\ \pi z, \quad (26)$$

where W_0 is a constant.

Eliminating $Z, K, X, \Theta \; and \; \Gamma$ between equations (18)-(23) and substituting the proper solution (26) in the resultant equation, we obtain the dispersion relation

$$R_1 x = (1+x)\left(\frac{i\sigma_1}{\varepsilon}+\frac{1}{P}\right)(1+x+iEp_1\sigma_1) + S_1 x\frac{(1+x+iEp_1\sigma_1)}{(1+x+iE'q\sigma_1)} + Q_1\frac{(1+x)(1+x+iEp_1\sigma_1)}{\varepsilon(1+x+ip_2\sigma_1)} + \frac{U(2-x)^2(1+x+ip_2\sigma_1)(1+x+iEp_1\sigma_1)}{\left[(1+x+ip_2\sigma_1)\left(\frac{i\sigma_1}{\varepsilon}+\frac{1}{P}\right)+\frac{Q_1}{\varepsilon}\right]}, \tag{27}$$

Where

$$Q_1 = \frac{\mu_e H^2 d^2}{4\pi\rho_0 \nu\eta\pi^2}, \quad R_1 = \frac{g\alpha\beta d^4}{\nu\kappa\pi^4}, \quad S_1 = \frac{g\alpha'\beta' d^4}{\nu\kappa'\pi^4}, \quad U = \frac{\nu_0^2}{\nu^2}, \; P = \pi^2 P_l, i\sigma_1 = \frac{\sigma}{\pi^2}, x = \frac{a^2}{\pi^2}.$$

4 Important Theorems and Discussion

Theorem 1: The system is stable or unstable.

Proof: Multiplying equation (18) by W^*, the complex conjugate of W, and using equations (19) - (23) together with the boundary conditions (24) and (25), we obtain

$$\left(\frac{\sigma}{\varepsilon}+\frac{1}{P_l}\right)I_1 + \frac{g\alpha'\kappa' a^2}{\nu\beta'}(I_4 + E'q\sigma^* I_5) + \frac{\mu_e\nu\varepsilon}{4\pi\rho_0\nu}(I_6 + p_2\sigma^* I_7) + d^2\left(\frac{\sigma^*}{\varepsilon}+\frac{1}{P_l}\right)I_8 + \frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}(I_9 + p_2\sigma I_{10}) - \frac{g\alpha\kappa a^2}{\nu\beta}(I_2 + Ep_1\sigma^* I_3) = 0, \tag{28}$$

Where

$$I_1 = \int_0^1 (|DW|^2 + a^2|W|^2)\,dz, \; I_2 = \int_0^1 (|D\Theta|^2 + a^2|\Theta|^2)dz, \; I_3 = \int_0^1 (|\Theta|^2)dz,$$
$$I_4 = \int_0^1 (|D\Gamma|^2 + a^2|\Gamma|^2)dz, I_5 = \int_0^1 (|\Gamma|^2)dz, \; I_6 = \int_0^1 (|D^2K|^2 + 2a^2|DK|^2 + a^4|K|^2)dz,$$
$$I_7 = \int_0^1 (|DK|^2 + a^2|K|^2)dz, \; I_8 = \int_0^1 (|Z|^2)dz, \; I_9 = \int_0^1 (|DX|^2 + a^2|X|^2)dz,$$
$$I_{10} = \int_0^1 (|X|^2)dz. \tag{29}$$

and σ^* is the complex conjugate of σ. The integrals $I_1, \ldots\ldots\ldots\ldots I_{10}$ are all positive definite. Putting $\sigma = \sigma_r + i\sigma_i$ and equating the real and imaginary parts of equation (28), we obtain

$$\left[\frac{I_1}{\varepsilon} + \frac{g\alpha'\kappa' a^2}{\nu\beta'}E'qI_5 + \frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}p_2 I_7 + \frac{d^2}{\varepsilon}I_8 + \frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}p_2 I_{10} - \frac{g\alpha\kappa a^2}{\nu\beta}Ep_1 I_3\right]\sigma_r =$$
$$-\left[\frac{1}{P_l}I_1 + \frac{g\alpha'\kappa' a^2}{\nu\beta'}I_4 + \frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}I_6 + d^2\left(\frac{1}{P_l}\right)I_8 + \frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}I_9 - \frac{g\alpha\kappa a^2}{\nu\beta}I_2\right], \tag{30}$$

and

$$\left[\frac{I_1}{\varepsilon} - \frac{g\alpha'\kappa' a^2}{\nu\beta'}E'qI_5 - \frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}p_2 I_7 - \frac{d^2}{\varepsilon}I_8 + \frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}p_2 I_{10} + \frac{g\alpha\kappa a^2}{\nu\beta}Ep_1 I_3\right]\sigma_i = 0. \tag{31}$$

It is evident from equation (30) that σ_r is positive or negative. The system is, therefore, stable or unstable.

Theorem 2: The modes may be oscillatory or non-oscillatory in contrast to case of no magnetic field, and in the absence of finite Larmor radius and stable solute gradient where modes are non-oscillatory.

Proof: Equation (31) yields that σ_i may be zero or non-zero, which means that the modes may be non-oscillatory or oscillatory. In the absence of finite Larmor radius, stable solute gradient and magnetic field, equation (31) reduces to

$$\sigma_i \left[\frac{I_1}{\varepsilon} + \frac{g\alpha\kappa a^2}{\nu\beta} E p_1 I_3\right] = 0$$

and the terms in brackets are positive definite. Thus$\sigma_i = 0$, which means that oscillatory modes are not allowed and the principle of exchange of stabilities is valid. The oscillatory modes are introduced due to the presence of magnetic field, finite Larmor radius and stable solute gradient which were non-existent in their absence.

Theorem 3: The system is stable for $\frac{g\alpha\kappa}{\nu\beta} \leq \frac{27\pi^4}{4}$ and under the condition $\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4}$, the system becomes unstable.

Proof: From equation (31), it is clear that σ_i is zero when the quantity multiplying it is not zero and arbitrary when this quantity is zero.

If $\sigma_i \neq 0$, then equation (31) gives

$$\frac{I_1}{\varepsilon} + \frac{\mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} p_2 I_{10} = \frac{g\alpha'\kappa' a^2}{\nu\beta'} E' q I_5 + \frac{\mu_e \eta \varepsilon}{4\pi\rho_0} p_2 I_7 + \frac{d^2}{\varepsilon} I_8 - \frac{g\alpha\kappa a^2}{\nu\beta} E p_1 I_3$$

Substituting this in equation (30), we get

$$\frac{2\sigma_r I_1}{\varepsilon} + \frac{1}{P_l} I_1 + \frac{g\alpha'\kappa' a^2}{\nu\beta'} I_4 + \frac{\mu_e \eta \varepsilon}{4\pi\rho_0 \nu} I_6 + d^2 \left(\frac{1}{P_l}\right) I_8 + \frac{\mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} I_9 + \frac{2\sigma_r \mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} p_2 I_{10} = \frac{g\alpha\kappa a^2}{\nu\beta} I_2 \,. \tag{32}$$

Equation (32) on using Rayleigh-Ritz inequality gives

$$\frac{(\pi^2 + a^2)^3}{a^2} \int_0^1 |W|^2 \, dz + \frac{(\pi^2 + a^2)}{a^2} \left\{ \frac{2\sigma_r \mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} p_2 I_{10} + \frac{\mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} I_9 + d^2 \left(\frac{1}{P_l}\right) I_8 + \frac{\mu_e \eta \varepsilon}{4\pi\rho_0 \nu} I_6 + \frac{g\alpha'\kappa' a^2}{\nu\beta'} I_4 + \frac{1}{P_l'} I_1 + \frac{2\sigma_r}{\varepsilon} I_1 \right\} \leq \frac{g\alpha\kappa}{\beta\nu} \int_0^1 |W|^2 \, dz \;. \tag{33}$$

Therefore, it follows from equation (33) that

$$\left[\frac{27\pi^4}{4} - \frac{g\alpha\kappa}{\nu\beta}\right] \int_0^1 |W|^2 \, dz + \frac{(\pi^2 + a^2)}{a^2} \left\{ \frac{2\sigma_r \mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} p_2 I_{10} + \frac{\mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} I_9 + d^2 \left(\frac{1}{P_l}\right) I_8 + \frac{\mu_e \eta \varepsilon}{4\pi\rho_0 \nu} I_6 + \frac{g\alpha'\kappa' a^2}{\nu\beta'} I_4 + \frac{1}{P_l'} I_1 + \frac{2\sigma_r}{\varepsilon} I_1 \right\} \leq 0 \tag{34}$$

since minimum value of $\frac{(\pi^2+a^2)^3}{a^2}$ with respect to a^2 is $\frac{27\pi^4}{4}$.

Now, let $\sigma_r \geq 0$, we necessary have from (34) that

$$\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4} \quad . \tag{35}$$

Hence, if

$$\frac{g\alpha\kappa}{\nu\beta} \leq \frac{27\pi^4}{4} \quad , \tag{36}$$

then $\sigma_r < 0$. Therefore, the system is stable. Thus, under condition (36), the system is stable and under condition (35) the system becomes unstable.

Theorem 4: For stationary convection case:

(I) Finite Larmor radius and stable solute gradient have stabilizing effects on the system.
(II) In the absence of finite Larmor radius effect, the medium permeability and the magnetic field have destabilizing and stabilizing effects respectively.
(III) In the presence of finite Larmor radius effect if

$$\left[\frac{1+x}{P} + \frac{Q_1}{\varepsilon}\right]^2 > (or\ <)\ U(2-x)^2(1+x)$$

the medium permeability has a destabilizing (or stabilizing) and the magnetic field has a stabilizing (or destabilizing) effect on the system.

Proof: When the instability sets in as stationary convection, the marginal state will be characterized by $\sigma = 0$. Putting$\sigma = 0$, the dispersion relation (27) reduces to

$$R_1 = \left(\frac{1+x}{x}\right)\left[\frac{1+x}{P} + \frac{Q_1}{\varepsilon}\right] + \frac{U(2-x)^2(1+x)^2}{x\left[\frac{1+x}{P} + \frac{Q_1}{\varepsilon}\right]} + S_1 \,, \tag{37}$$

which expresses the modified Rayleigh number R_1 as a function of the dimensionless wave number x and the parameters $S_1\,, Q_1, U\ and\ P$. To investigate the effects of stable solute gradient, finite Larmor radius, medium permeability and magnetic field, we examine the behaviour of $dR_1/dS_1\,, dR_1/dU\ , dR_1/dP\ and\ dR_1/dQ_1$ analytically.

(I) Equation (37) yields

$$\frac{dR_1}{dS_1} = +1\,, \tag{38}$$

which is positive. Thus, the stable solute gradient has a stabilizing effect on the system for the case of stationary convection.

Equation (37) also yields

$$\frac{dR_1}{dU} = \frac{(2-x)^2(1+x)^2}{x\left[\frac{1+x}{P} + \frac{Q_1}{\varepsilon}\right]}\,, \tag{39}$$

which is always positive. The finite Larmor radius, therefore, has a stabilizing effect on the system for the case of stationary convection.

(II) It is evident from equation (37) that

$$\frac{dR_1}{dP} = -\frac{(1+x)}{xP^2}\left[\frac{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2 - U(2-x)^2(1+x)}{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2}\right], \tag{40}$$

and

$$\frac{dR_1}{dQ_1} = \left(\frac{1+x}{\varepsilon x}\right)\left[\frac{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2 - U(2-x)^2(1+x)}{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2}\right], \tag{41}$$

In the absence of finite Larmor radius effect, equation (40) reduces to

$$\frac{dR_1}{dP} = -\frac{(1+x)}{xP^2}, \tag{42}$$

which is negative. Hence, the medium permeability has a destabilizing effect on the system in the absence of finite Larmor radius effect.

Now, in the absence of finite Larmor radius effect, equation (41) gives

$$\frac{dR_1}{dQ_1} = \left(\frac{1+x}{x}\right), \tag{43}$$

which is positive. The magnetic field, therefore, has a stabilizing effect on the system for the case of stationary convection in the absence of finite Larmor radius effect.

(III) In the presence of finite Larmor radius effect, it is clear from equations (40) and (41) that the medium permeability has a destabilizing (or stabilizing) and the magnetic field has a stabilizing (or destabilizing) effect on the system for the case of stationary convection if

$$\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]^2 > (or\ <)\ U(2-x)^2(1+x)\,. \tag{44}$$

Theorem 5: The sufficient conditions for the non-existence of overstability are

$$\kappa < \eta E, E'\kappa < E\kappa' and\ k < (\pi/d)\sqrt{Evd\varepsilon/(\pi^2 k_1\kappa) - 1}$$

Proof: Here we discuss the possibility of whether instability may occur as overstability. Since we wish to determine the critical Rayleigh number for the onset of instability via a state of pure oscillations, it suffices to find conditions for which (27) will admit of solutions with σ_1 real.

Equating the real and imaginary parts of equation (27) and eliminating R_1 between them, we obtain

$$A_5C_1^5 + A_4C_1^4 + A_3C_1^3 + A_2C_1^2 + A_1C_1 + A_0 = 0\,, \tag{45}$$

where $C_1 = \sigma_1^2$, $b = 1 + x\ and$

$$A_5 = bP^4E'^2q^2\left[b + \frac{Ep_1}{P}\right], \tag{46}$$

$$A_0 = P^4\left[\frac{1}{P^2}\right]b^8 + P^4\left[\frac{2Q_1}{P} + \frac{Ep_1}{P^2}\right]b^7$$
$$+ P^4\left[\frac{Q_1}{P^2}(Ep_1 - p_2) + Q_1^2 + \frac{2Ep_1Q_1}{P^2} + U(3-b)^2\left(\frac{Ep_1}{P} - b\right) + \frac{\varepsilon S_1}{P^2}(Ep_1 - E'q)\right]b^6 +$$
$$+P^4\left[\frac{2Q_1^2}{P}(Ep_1 - p_2) + Q_1U(3-b)^2(Ep_1 + p_2) + \frac{Q_1^2}{P}Ep_1\right]b^5$$
$$+P^4\left[Q_1^3(Ep_1 - p_2) + \frac{2\varepsilon S_1(b-1)Q_1}{P}(Ep_1 - E'q)\right]b^4 + P^4[\varepsilon S_1(b-1)Q_1^2(Ep_1 - E'q)]b^3. \quad (47)$$

The coefficients $A_1 - A_4$ being quite lengthy and not needed in the discussion of overstability, have not been written here. Since σ_1 is real for overstability, the five values of C_1 are positive. The product of the roots of (38) is $-A_0/A_5$ and if this is to be positive, then $A_0 < 0$ (since from (46), $A_5 > 0$).

It is clear from (47) that A_0 is always positive if

$$Ep_1 > p_2\,, \qquad Ep_1 > E'q, \qquad \frac{Ep_1}{P} > b\,, \quad (48)$$

which implies that

$$\kappa < \eta E\,, \qquad E'\kappa < E\kappa', \quad k < \frac{\pi}{d}\sqrt{\frac{Ev d\varepsilon}{\pi^2 k_1 \kappa} - 1}\,. \quad (49)$$

Thus $\kappa < \eta E, E'\kappa < E\kappa' and\ k < (\pi/d)\sqrt{Ev d\varepsilon/(\pi^2 k_1\kappa) - 1}$ are the sufficient conditions for the non-existence of overstability, the violation of which does not necessarily imply the occurrence of overstability.

5 Conclusions

The double-diffusive instability of a plasma in porous medium in the presence of finite Larmor radius effect is considered in the present paper. The investigation is motivated by its interesting complexities as a double diffusion phenomena as well as its direct relevance to astrophysics and geophysics. The main conclusions from the analysis of this paper are as follows:

- It is found that the finite Larmor radius, stable solute gradient and magnetic field introduce oscillatory modes in the system which was non-existent in their absence.
- It is observed that the system is stable for $\frac{g\alpha\kappa}{\nu\beta} \leq \frac{27\pi^4}{4}$ and under the condition $\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4}$, the system becomes unstable.
- For the case of stationary convection, the stable solute gradient and finite Larmor radius are found to have stabilizing effects on the system.
- It is also observed for the case of stationary convection that in the presence of finite Larmor radius effect, the magnetic field has a stabilizing (or destabilizing) effect and the medium permeability has a destabilizing (or stabilizing) effect under certain conditions whereas in the absence of finite Larmor radius effect, the magnetic field and the medium permeability have stabilizing and destabilizing effects, respectively.
- The case of overstability is also considered. The conditions

  $\kappa < \eta E, E'\kappa < E\kappa' and\ k < (\pi/d)\sqrt{Ev d\varepsilon/(\pi^2 k_1\kappa) - 1}$

  are the sufficient conditions for the non-existence of overstability, the violation of which does not necessarily imply the occurrence of overstability.

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Competing Interests

Authors have declared that no competing interests exist.

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Isolation and Idenficatiion of Vibrio Spp from Different Dye Industry Effluent in Salem Distric Tamilnadu

Authors : Dr. V. Kalaiselvi ; P. Umamagesh ; D. Ammu ; R. Latha

DOI : doi.org/10.47752/sjsr.310.129.132 (https://doi.org/10.47752/sjsr.310.129.132)

Abstract:

Studies were carried out on the Different type of vibrio spp, isolated from dye industry effluent. Among the 90 strains of vibrio spp isolated from effluents of textile industries, three showed optimize at different factors such as pH, Temperatue, salinity, carbone source, nitrogen source etc.

Pages: 129-132

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Effective Interfacial Tension Effect on Kelvin-Helmholtz Instability

Authors : Pardeep Kumar ; Hari Mohan

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Abstract:

The instability of the plane interface between two uniform, superposed and streaming Walters' B' viscoelastic fluids through porous medium in the presence of effective interfacial tension is considered. The case of two uniform streaming fluids separated by a horizontal boundary is studied. It is observed, for the special case where the effective interfacial tension is ignored, that the system is stable or unstable for the potentially stable configuration which is in contrast to the case of Rivlin-Ericksen viscoelastic fluid or Newtonian fluid where the system is always stable for the potentially stable configuration. Moreover, if the perturbations in the direction of streaming are ignored, then the perturbations transverse to the direction of streaming are found to be unaffected by the presence of streaming, whereas for perturbations in all other directions there exists instability for a certain wave number range. 'Effective interfacial tension' is able to suppress this Kelvin-Helmholtz instability for small wavelength perturbations, the medium porosity reduces the stability range given in terms of a difference in streaming velocities.

Pages: 122-128

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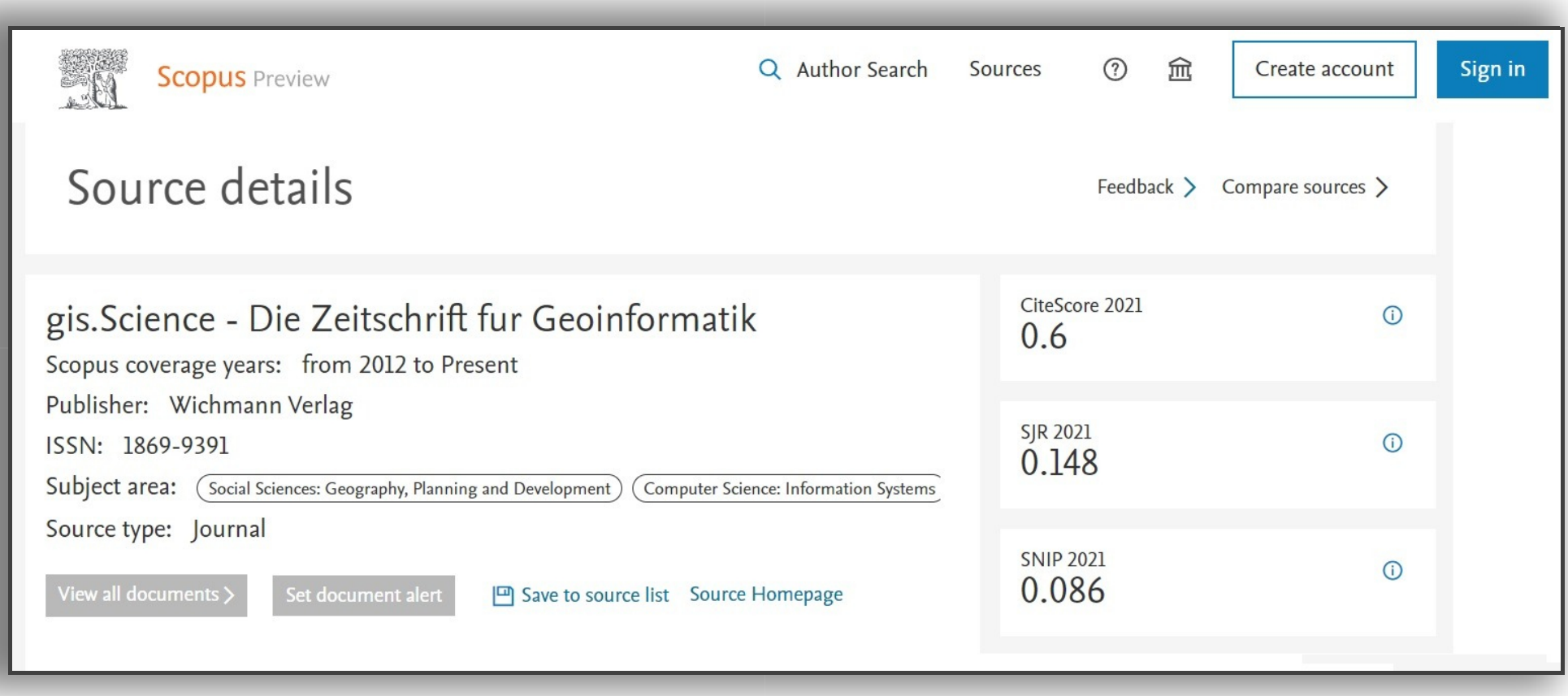

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Stability Analysis in Couple-Stress Rotatory Fluid

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Abstract: The aim of the present research was to study the effect of uniform rotation on the layer of a couple-stress fluid heated from below in porous medium. Following the linearized stability theory, Boussinesq approximation and normal mode analysis, the dispersion relation is obtained. The stationary convection, stability of the system and oscillatory modes are discussed. For the case of stationary convection, it is found that rotation has a stabilizing effect, whereas the couple-stress parameter and medium permeability have both stabilizing and destabilizing effects on the system. It is found that the presence of rotation introduces oscillatory modes in the system which were non-existent in its absence. A sufficient condition for the non-existent of overstability is also obtained.

Key-Words: couple-stress fluid, heated from below, linearized stability theory, normal mode analysis method, porous medium, uniform rotation

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1 Introduction

The thermal instability of a fluid layer heated from below plays an important role in geophysics, oceanography, atmospheric physics etc., and has been investigated by many authors, e.g. Be′nard [1], Rayleigh [2], Jeffreys [3]. A detailed account of the theoretical and experimental results of the onset of thermal instability (Be′nard convection) in a fluid layer under varying assumptions of hydrodynamics and hydromagnetics has been given in a treatise by Chandrasekhar [4] in his celebrated monograph. The use of the Boussinesq approximation has been made throughout, which states that the variations of density in the equations of motion can safely be ignored everywhere except in its association with the external force. The approximation is well justified in the case of incompressible fluids. Abdul-Bari and Al-Rubai [5] have studied the influence of Rayleigh-number in turbulent and laminar region in parallel-plate vertical channels. The influence of radiation on the unsteady free convection flow of a viscous incompressible fluid past a moving vertical plate with Newtonian heating has been investigated theoretically by Narahari and Ishak [6]. Vest and Arpaci [7] have studied the stability of a horizontal layer of Maxwell's viscoelastic fluid heated from below. The nature of instability and some factors may have different effects, on viscoelastic fluids as compared to the Newtonian fluids. For example, Bhatia and Steiner [8] have considered the effect of a uniform rotation on the thermal instability of a Maxwell fluid and have found that rotation has a destabilizing influence, in contrast to the stabilizing effect on a Newtonian fluid. Bhatia and Steiner [9] have also considered the thermal instability of a Maxwell fluid in hydromagnetics and have found that the magnetic field has stabilizing effect on viscoelastic fluid, just as in case of Newtonian fluid. Sharma [10] has studied the thermal instability of a layer of Oldroydian [11] fluid acted on by a uniform rotation and found that rotation has destabilizing and stabilizing effects under certain conditions, in contrast to a Maxwell fluid where the effect is destabilizing.

There are many fluids that cannot be characterized by Maxwell's or Oldroyd's constitutive relations. One type of such fluids are couple-stress fluids. The theory of couple-stress fluid has been formulated by Stokes [12]. One of the applications of couple-stress fluid is its use to the study of the mechanisms of lubrications of synovial joints, which has

become the object of scientific research. A human joint is a dynamically loaded bearing which has articular cartilage as the bearing and synovial fluid as the lubricant. When a fluid film is generated, squeeze-film action is capable of providing considerable protection to the cartilage surface. The shoulder, ankle, knee and hip joints are the loaded–bearing synovial joints of the human body and these joints have a low friction coefficient and negligible wear.

Normal synovial fluid is a viscous, non-Newtonian fluid and is generally clear or yellowish. According to the theory of Stokes [12], couple-stresses appear in noticeable magnitudes in fluids with very large molecules. Many of the flow problems in fluids with couple-stresses, discussed by Stokes, indicate some possible experiments, which could be used for determining the material constants, and the results are found to differ from those of Newtonian fluid. Couple-stresses are found to appear in noticeable magnitudes in polymer solutions for force and couple-stresses. This theory is developed in an effort to examine the simplest generalization of the classical theory, which would allow polar effects. The constitutive equations proposed by Stokes [12] are:

$$T_{(ij)} = (-p + \lambda D_{kk})\delta_{ij} + 2\mu D_{ij} \ ,$$

$$T_{[ij]} = -2\eta \overrightarrow{W}_{ij.kk} - \frac{\rho}{2}\vec{\varepsilon}_{ijs} G_s \ ,$$

and

$$M_{ij} = 4\eta \vec{\omega}_{j,i} + 4\eta' \vec{\omega}_{i,j} \ ,$$

where

$$D_{ij} = \frac{1}{2}\left(V_{i,j} + V_{j,i}\right), \overrightarrow{W}_{ij} = -\frac{1}{2}\left(V_{i,j} - V_{j,i}\right)$$

and $\vec{\omega}_i = \frac{1}{2}\vec{\varepsilon}_{ijk} V_{k,j}$.

Here T_{ij}, $T_{(ij)}$, $T_{[ij]}$, M_{ij}, D_{ij} , $\overrightarrow{W}_{i,j}$, $\vec{\omega}_i$, G_s, $\vec{\varepsilon}_{ijk}$, V, ρ and λ , μ , η , η' , are stress tensor, symmetric part of T_{ij}, anti-symmetric part of T_{ij}, the couple-stress tensor, deformation tensor, the vorticity tensor, the vorticity vector, body couple, the alternating unit tensor, velocity field, the density and material constants respectively. The dimensions of λ and μ are those of viscosity whereas the dimensions of η and η' are those of momentum.

Since the long chain hyaluronic acid molecules are found as additives in synovial fluids, Walicki and Walicka [13] modeled the synovial fluid as a couple-stress fluid. The synovial fluid is the natural lubricant of joints of the vertebrates. The detailed description of the joint lubrication has very important practical implications. Practically all diseases of joints are caused by or connected with a malfunction of the lubrication. The efficiency of the physiological joint lubrication is caused by several mechanisms. The synovial fluid is, due to its content of the hyaluronic acid, a fluid of high viscosity, near to a gel. Goel et al. [14] have studied the hydromagnetic stability of an unbounded couple-stress binary fluid mixture under rotation with vertical temperature and concentration gradients. Sharma et al. [15] have considered a couple-stress fluid with suspended particles heated from below. They have found that for stationary convection, couple-stress has a stabilizing effect whereas suspended particles have a destabilizing effect. Kumar et al. [16] have considered the thermal instability of a layer of a couple–stress fluid acted on by a uniform rotation, and have found that for stationary convection, the rotation has a stabilizing effect whereas couple-stress has both stabilizing and destabilizing effects. Thermosolutal convection in a couple-stress fluid in presence of magnetic field and rotation, separately, has been investigated by Kumar and Singh [17, 18]. Kumar and Kumar [19] have considered the problem of thermosolutal convection in compressible couple-stress fluid in presence of suspended particles. In another study, Kumar and Kumar [20] have considered the transport of vorticity in couple-stress fluid in the presence of suspended magnetic particles.

In recent years, the investigations of flow of fluids through porous media have become an important topic due to the recovery of crude oil from the pores of reservoir rocks. The study of the onset of convection in a porous medium has attracted considerable interest because of its natural occurrence and of its intrinsic importance in many industrial problems, particularly in petroleum exploration, chemical, and nuclear industries. The derivation of the basic equations of a layer of fluid heated from below in porous medium, using the Boussinesq approximation, has been given by Joseph [21]. The study of a layer of fluid heated from below

in porous media is motivated both theoretically and by its practical applications in engineering disciplines. Among the applications in engineering disciplines one can find the food process industry, chemical process industry, solidification and centrifugal casting of metals. The development of geothermal power resources has increased general interest in the properties of convection in porous medium. When a fluid permeates an isotropic and homogeneous porous medium, the gross effect is represented by Darcy's law. A great number of applications in geophysics may be found in the books by Phillips [22], Ingham and Pop [23], and Nield and Bejan [24]. Kumar and Kumar [25] have mathematically investigated the triply diffusive convection in couple-stress fluid in the presence of uniform vertical magnetic field through porous medium.

Keeping in mind the importance in geophysics, soil sciences, ground water hydrology, astrophysics, and various applications mentioned above, the present paper is devoted to the linear stability analysis of a layer of couple-stress fluid heated from below in the presence of uniform rotation through porous medium.

2 Formulation of the Problem and Dispersion Relation

The present problem is studied using methods of linearized stability theory and normal mode analysis. First of all linearized perturbation equations relevant to the problem are obtained and then dispersion relation obtained by using normal analysis method.

Consider an infinite horizontal incompressible layer of a couple-stress fluid of thickness d, heated from below so that the temperatures and densities at the bottom surface $z = 0$ are T_0, ρ_0 and at the upper surface $z = d$ are T_d, ρ_d, respectively, and that a uniform adverse temperature gradient $\beta(= |dT/dz|)$ is maintained. This layer is acted on by a uniform rotation $\vec{\Omega} = (0,0,\Omega)$ and the gravity field $\vec{g} = (0,0,-g)$ pervades the system. This fluid layer is flowing through an isotropic and homogeneous porous medium of porosity ε and the medium permeability k_1.

Let $\Gamma_{ij}, \tau_{ij}, e_{ij}, \delta_{ij}, \mu, \mu', v_i, and\ x_i$ denote the stress tensor, shear stress tensor, rate-of-strain tensor, Kronecker delta, viscosity, couple-stress viscosity, velocity vector and position vector, respectively. The constitutive relations for the couple-stress fluids are

$$\left.\begin{aligned} \Gamma_{ij} &= -p\delta_{ij} + \tau_{ij}\ , \\ \tau_{ij} &= 2(\mu - \mu'\nabla^2)e_{ij}\ , \\ e_{ij} &= \frac{1}{2}\left(\frac{\partial v_i}{\partial x_j} + \frac{\partial v_j}{\partial x_i}\right). \end{aligned}\right\} \tag{1}$$

Let $p,\ \rho,\ T\ and\ \vec{q}(u,v,w)$ denote the fluid pressure, density, temperature and filter velocity respectively. Then the momentum balance, mass balance and energy balance equations of the couple-stress fluid through porous medium (Stokes [12], Joseph [21]) in the presence of rotation are

$$\frac{1}{\varepsilon}\left[\frac{\partial \vec{q}}{\partial t} + \frac{1}{\varepsilon}(\vec{q}.\nabla)\vec{q}\right] = -\nabla\left(\frac{p}{\rho_0} - \frac{1}{2}\left|\vec{\Omega}\times\vec{r}\right|^2\right)$$

$$+\vec{g}\left(1 + \frac{\delta\rho}{\rho_0}\right) - \frac{1}{k_1}\left(\nu - \frac{\mu'}{\rho_0}\nabla^2\right)\vec{q} + \frac{2}{\varepsilon}\left(\vec{q}\times\vec{\Omega}\right) \tag{2}$$

$$\nabla.\vec{q} = 0, \tag{3}$$

$$E\frac{\partial T}{\partial t} + (\vec{q}.\nabla)T = \kappa\nabla^2 T. \tag{4}$$

The equation of state is

$$\rho = \rho_0[1 - \alpha(T - T_0)], \tag{5}$$

where the suffix zero refers to values at the reference level $z = 0$. In writing equation (2), use has been made of the Boussinesq approximation which states that the density variations are ignored in all terms in the equation of motion except the external force term. The kinematic viscosity ν, thermal diffusivity κ, couple-stress viscosity μ' and coefficient of thermal expansion α are all assumed to be constants. Here $E = \varepsilon + (1-\varepsilon)\rho_S c_S/(\rho_0 c_V)$, is constant where ρ_S, c_S and ρ_0, c_V stand for density and heat capacity of solid (porous matrix) material and fluid, respectively and $\vec{r} = (x,y,z)$.

The basic motionless solution is

$$\vec{q} = (0,0,0), T = T_0 - \beta z,$$
$$\rho = \rho_0(1 + \alpha\beta z). \quad (6)$$

Assume small perturbations around the basic solution and let $\vec{q}(u,v,w), \theta, \delta\rho \; and \; \delta p$ denote, respectively, the perturbations in fluid velocity $(0,0,0)$, temperature T, density ρ and pressure p. The change in density $\delta\rho$, caused mainly by the perturbation θ in temperature, is given by

$$\delta\rho = -\alpha\rho_0\theta. \quad (7)$$

Then the linearized perturbation equations are

$$\frac{1}{\varepsilon}\frac{\partial\vec{q}}{\partial t} = -\frac{1}{\rho_0}\nabla\delta p - \vec{g}\alpha\theta - \frac{1}{k_1}\left(\nu - \frac{\mu'}{\rho_0}\nabla^2\right)\vec{q} + \frac{2}{\varepsilon}(\vec{q}\times\vec{\Omega}), \quad (8)$$

$$\nabla.\vec{q} = 0, \quad (9)$$

$$E\frac{\partial\theta}{\partial t} = \beta w + \kappa\nabla^2\theta. \quad (10)$$

Writing the scalar components of equation (8) and eliminating $u, v, \delta p$ between them by using (9), we obtain

$$\frac{1}{\varepsilon}\frac{\partial}{\partial t}\nabla^2 w + \frac{1}{k_1}\left(\nu - \frac{\mu'}{\rho_0}\nabla^2\right)\nabla^2 w - g\alpha\left(\frac{\partial^2\theta}{\partial x^2} + \frac{\partial^2\theta}{\partial y^2}\right) + \frac{2\Omega}{\varepsilon}\frac{\partial\zeta}{\partial z} = 0, \quad (11)$$

$$\frac{1}{\varepsilon}\frac{\partial\zeta}{\partial t} + \frac{1}{k_1}\left(\nu - \frac{\mu'}{\rho_0}\nabla^2\right)\zeta = \frac{2\Omega}{\varepsilon}\frac{\partial w}{\partial z}, \quad (12)$$

where

$$\zeta\left(=\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$$

is the $z-$ component of vorticity.

We now analyze the disturbances into normal modes, assuming that the perturbation quantities are of the form

$$[w,\ \theta,\ \zeta] = [W(z), \Theta(z), Z(z)]exp(ik_x x + ik_y y + nt), \quad (13)$$

where k_x, k_y are wave numbers along the $x-$ direction and $y-$ direction, respectively, $k\left[=\left(k_x^2 + k_y^2\right)^{1/2}\right]$ is the resultant wave number and n is the growth rate which is, in general, a complex constant.

Using expression (13), equations (10) - (12) in non-dimensional form become

$$(D^2 - a^2)\left[\frac{\sigma}{\varepsilon} + \frac{1}{P_l} - \frac{F}{P_l}(D^2 - a^2)\right]W + \frac{g\alpha d^2}{\nu}a^2\Theta + \frac{2\Omega d^3}{\nu\varepsilon}DZ = 0, \quad (14)$$

$$\left[\frac{\sigma}{\varepsilon} + \frac{1}{P_l} - \frac{F}{P_l}(D^2 - a^2)\right]Z - \frac{2\Omega d}{\nu\varepsilon}DW = 0, \quad (15)$$

$$(D^2 - a^2 - Ep_1\sigma)\Theta = -\left(\frac{\beta d^2}{\kappa}\right)W, \quad (16)$$

where we have put $a = kd, \sigma = nd^2/\nu, x^* = x/d, y^* = y/d, z^* = z/d \; and \; D = d/dz$.

$p_1 = \nu/\kappa$ is the Prandtl number, $P_l = k_1/d^2$ is the dimensionless medium permeability and $F = \mu'/(\rho_0 d^2\nu)$ is the dimensionless couple-stress parameter. We shall suppress the stars $(*)$ for convenience hereafter.

Eliminating Z and Θ between equations (14) - (16), we obtain

$$(D^2 - a^2)(D^2 - a^2 - Ep_1)\left[\frac{\sigma}{\varepsilon} + \frac{1}{P_l} - \frac{F}{P_l}(D^2 - a^2)\right]^2 W + T_A(D^2 - a^2 - Ep_1\sigma)D^2 W = Ra^2\left[\frac{\sigma}{\varepsilon} + \frac{1}{P_l} - \frac{F}{P_l}(D^2 - a^2)\right]W, \quad (17)$$

where $R = g\alpha\beta d^4/(\nu\kappa)$ is the Rayleigh number and $T_A = \frac{4\Omega^2 d^4}{\nu^2\varepsilon^2}$ is the modified Taylor number.

We now assume that the fluid layer is confined between two free boundaries. The case of two free boundaries is of artificial nature, but due to mathematically simplicity it enables us to find analytical solutions and to make some qualitative conclusions. The appropriate

boundary conditions, with respect to which equations (14) – (16) must be solved, are

$$W = D^2W = 0, \Theta = 0, DZ = 0$$

$$for\ z = 0\ and\ z = 1. \qquad (18)$$

Using the boundary conditions (18), it can be shown that all the even order derivatives of W must vanish on the boundaries, and hence the proper solution of (17) characterizing the lowest mode is

$$W = W_0 \sin \pi z, \qquad (19)$$

where W_0 is a constant.

Substituting the proper solution (19) in equation (17), we obtain the dispersion relation

$$R_1 = \frac{(1 + x + iEp_1\sigma_1)\left[(1+x)\left\{\frac{i\sigma_1}{\varepsilon} + \frac{1}{P} + \frac{\pi^2 F}{P}(1+x)\right\}^2 + T_1\right]}{x\left(\frac{i\sigma_1}{\varepsilon} + \frac{1}{P} + \frac{\pi^2 F}{P}(1+x)\right)}, \qquad (20)$$

where

$$R_1 = R/\pi^4, T_1 = T_A/\pi^4, x = a^2/\pi^2,$$

$$i\sigma_1 = \sigma/\pi^2\ and\ P = \pi^2 P_l.$$

3 Important Theorems and Discussion

Here we discuss the case of stationary convection in Theorem 1, theoretically as well as analytically. In Theorems 2 – 4, the case of stability of the system and oscillatory modes discussed. In Theorem 5, the case of overstability discussed in which a sufficient condition for the non-existence of overstability is derived.

Theorem 1: For stationary convection case:

(I) In the absence of rotation, the couple-stress parameter postpones the onset of convection i.e. has a stabilizing effect and in the presence of rotation, the couple-stress parameter has both stabilizing and destabilizing effects on the system.

(II) In the absence of rotation, the medium permeability hastens the onset of convection i.e. has a destabilizing effect and in the presence of rotation, the medium permeability has both stabilizing and destabilizing effects on the system.

(III) Rotation postpones the onset of convection i.e. rotation has a stabilizing effect in couple-stress fluid heated from below in porous medium.

Proof: When the instability sets in as stationary convection, the marginal state will be characterized by $\sigma = 0$. Putting $\sigma = 0$, the dispersion relation (20) reduces to

$$R_1 = \frac{(1+x)[(1+x)\{1+\pi^2F(1+x)\}^2 + P^2T_1]}{xP\left(1+\pi^2F(1+x)\right)}. \qquad (21)$$

which expresses the Rayleigh number R_1 as a function of the dimensionless wave number x and the parameters F, P and T_1. To investigate the effects of couple-stress parameter, medium permeability and rotation, we examine the natur es of

$$\frac{dR_1}{dF}, \frac{dR_1}{dP}\ and\ \frac{dR_1}{dT_1}$$

analytically.

(I) Equation (21) yields

$$\frac{dR_1}{dF} = \frac{\pi^2(1+x)^2}{xP}\left[(1+x) - \frac{P^2T_1}{\{1+\pi^2F(1+x)\}^2}\right]. \qquad (22)$$

It is clear from equation (22) that in the absence of rotation, $\frac{dR_1}{dF}$ is always positive. So the couple-stress parameter postpones the onset of convection i.e. has a stabilizing effect on the system in the absence of rotation.

In the presence of rotation, if

$$T_1 < \frac{(1+x)\{1+\pi^2 F(1+x)\}^2}{P^2}, \qquad (23)$$

the couple-stress parameter postpones the onset of convection, whereas it is clear from equation (22) that if

$$T_1 > \frac{(1+x)\{1+\pi^2 F(1+x)\}^2}{P^2}. \qquad (24)$$

the couple-stress parameter hastens the onset of convection. Therefore, in the presence of rotation, under condition (23), the couple-stress parameter has stabilizing effect and under condition (24), the couple-stress parameter has a destabilizing effect.

(II) It is evident from equation (21) that

$$\frac{dR_1}{dP} = \frac{(1+x)}{x\{1+\pi^2 F(1+x)\}}\left[T_1 - \frac{(1+x)}{P^2}\{1 + \pi^2 F(1+x)\}^2\right]. \qquad (25)$$

It is clear from equation (25) that, for stationary convection, the medium permeability hastens the onset of convection in the absence of rotation i.e. has a destabilizing effect and also hastens the onset of convection in the presence of rotation if (23) holds good, whereas the medium permeability postpones the onset of convection if (24) holds good. The medium permeability thus has both stabilizing and destabilizing effects on the system in the presence of rotation.

(III) It is clear from equation (21) that

$$\frac{dR_1}{dT_1} = \frac{(1+x)P}{x\{1+\pi^2 F(1+x)\}}, \qquad (26)$$

which is always positive. So the rotation postpones the onset of convection i.e. has a stabilizing effect in couple-stress fluid heated from below in porous medium.

Analytical Explanation: The dispersion relation (21) analyzed numerically. In Figure 1a, R_1 is plotted against x for F = 2, 3, 4, and T_1 = 0. It is clear that the couple-stress postpones the onset of convection in the absence of rotation as the Rayleigh number increases with the increase in couple-stress parameter. In Figure 1b, R_1 is plotted against x for F = 1, 2, 3, 4, P = 100, and T_1 = 1. Here we also find that the couple-stress hastens the onset of convection in the presence of rotation for small wave numbers whereas the couple-stress postpones the onset of convection in the presence of rotation for higher wave numbers. In Figure 2a, R_1 is plotted against x for P = 10, 15, 20, F = 2, and T_1 = 0. It is clear that the medium permeability hastens the onset of convection in the absence of rotation as the Rayleigh number decreases with the increase in medium permeability parameter. In Figure 2b, R_1 is plotted against x for P = 10, 15, 20, 25, F = 2, and T_1 = 100. Here we also find that the medium permeability hastens the onset of convection in the presence of rotation for small wave numbers whereas the medium permeability postpones the onset of convection in the presence of rotation for higher wave numbers. In Figure 3, R_1 is plotted against x for T_1 = 100, 200, 300, P = 2, and F = 2. It is clear that the rotation postpones the onset of convection as the Rayleigh number increases with the increase in rotation parameter.

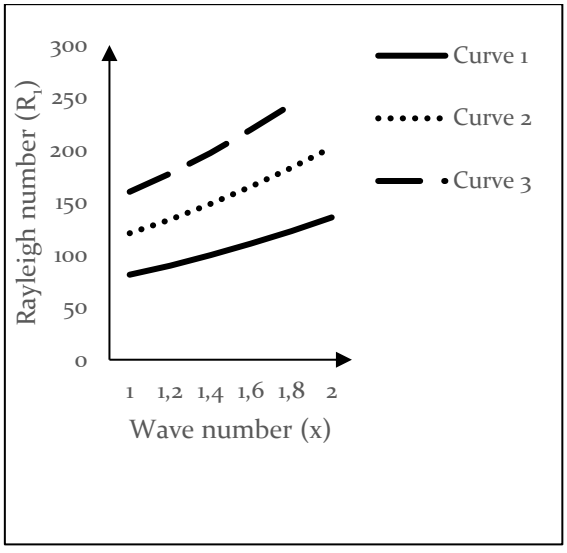

Fig 1a: The variation of Rayleigh number (R_1) with wave number (x) for P = 2, T_1 = 0, F = 2 for Curve 1, F = 3 for Curve 2 and F = 4 for Curve 3

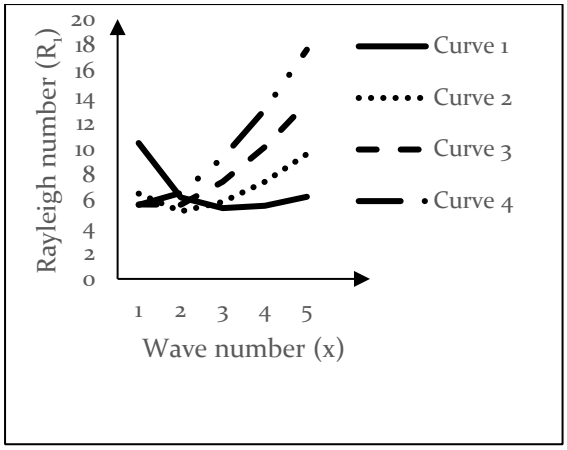

Fig 1b: The variation of Rayleigh number (R_1) with wave number (x) for P = 100, T_1 = 1, F = 1 for Curve 1, F = 2 for Curve 2, F = 3 for Curve 3 and F = 4 for Curve 4

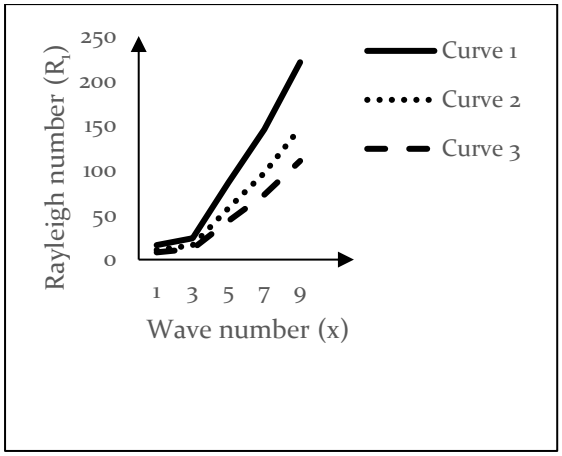

Fig 2a: The variation of Rayleigh number (R_1) with wave number (x) for F = 2, T_1 = 0, P = 10 for Curve 1, P = 15 for Curve 2 and P = 20 for Curve 3

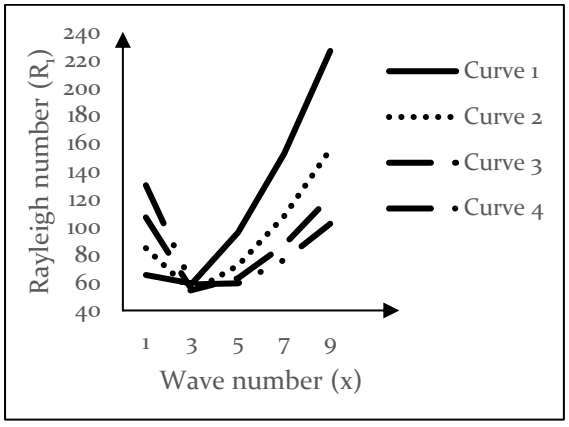

Fig 2b: The variation of Rayleigh number (R_1) with wave number (x) for F = 2, T_1 = 100, P = 10 for Curve 1, P = 15 for Curve 2, P = 20 for Curve 3 and P = 25 for Curve 4

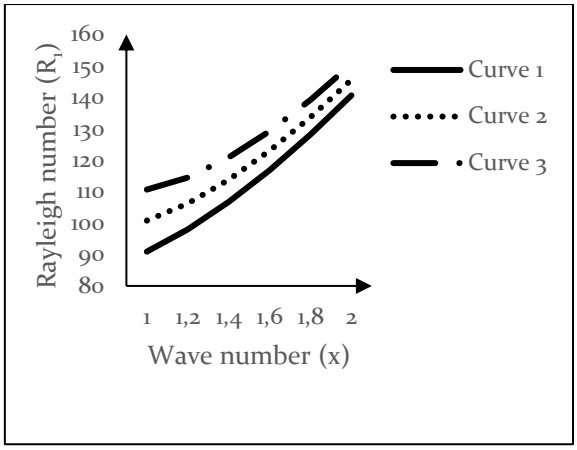

Fig 3: The variation of Rayleigh number (R_1) with wave number (x) for F = 2, P = 2, T_1 = 100 for Curve 1, T_1 = 200 for Curve 2 and T_1 = 300 for Curve 3

Theorem 2: The system is stable or unstable in the presence of couple-stress parameter, rotation and porous medium.

Proof: Multiplying equation (14) by W^*, the complex conjugate of W, integrating over the range of z, and making use of equations (15) and (16) together with the boundary conditions (18), we obtain

$$FI_1 + \left(1 + P_l \frac{\sigma}{\varepsilon}\right) I_2 - \frac{g\alpha\kappa a^2 P_l}{\nu\beta} [I_3 + Ep_1\sigma^* I_4] + d^2 \left[\left(1 + P_l \frac{\sigma^*}{\varepsilon}\right) I_6 + FI_5\right] = 0, \quad (27)$$

where

$$I_1 = \int_0^1 (|D^2W|^2 + 2a^2|DW|^2 + a^4|W|^2)dz,\ I_2 = \int_0^1 (|DW|^2 + a^2|W|^2)dz,$$

$$I_3 = \int_0^1 (|D\Theta|^2 + a^2|\Theta|^2)dz,\ I_4 = \int_0^1 |\Theta|^2 dz,\ I_5 = \int_0^1 (|DZ|^2 + a^2|Z|^2)dz,$$

$$I_6 = \int_0^1 (|Z|^2)dz, \quad (28)$$

which are all positive definite. Substituting $\sigma = \sigma_r + i\sigma_i$ and then equating real and imaginary parts of equation (27), we obtain

$$\sigma_r\left[\frac{I_2}{\varepsilon} - \frac{g\alpha\kappa a^2}{\nu\beta}Ep_1I_4 + \frac{d^2}{\varepsilon}I_6\right] = -\left[\frac{F}{P_l}I_1 + \frac{1}{P_l}I_2 - \frac{g\alpha\kappa a^2}{\nu\beta}I_3 + \frac{d^2}{P_l}I_6 + \frac{Fd^2}{P_l}I_5\right], \quad (29)$$

and

$$\sigma_i\left[\frac{I_2}{\varepsilon} + \frac{g\alpha\kappa a^2}{\nu\beta}Ep_1I_4 - \frac{d^2}{\varepsilon}I_6\right] = 0. \quad (30)$$

Equation (29) yields that σ_r may be positive or negative i.e. there may be stability or instability in the presence of couple-stress parameter, rotation and porous medium. The system is, therefore, either stable or unstable.

Theorem 3: The modes may be oscillatory or non-oscillatory in contrast to non-rotatory case.

Proof: Equation (30) yields that $\sigma_i = 0\ or\ \sigma_i \neq 0$, which means that the modes may be non-oscillatory or oscillatory.

In the absence of rotation, equation (30) reduces to

$$\sigma_i\left[\frac{I_2}{\varepsilon} + \frac{g\alpha\kappa a^2}{\nu\beta}Ep_1I_4\right] = 0, \quad (31)$$

and the terms in brackets are positive definite. Thus $\sigma_i = 0$, which means that oscillatory modes are not allowed and the principle of exchange of stabilities is satisfied for the couple-stress fluid heated from below in porous medium in the absence of rotation. It is clear from equation (30) that the presence of rotation brings oscillatory modes (as σ_i may not be zero) which were non-existent in its absence for a couple-stress fluid layer heated from below in porous medium.

Theorem 4: The system is stable for $\frac{g\alpha\kappa}{\nu\beta} \leq \frac{27\pi^4}{4}$ and under the condition $\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4}$, the system becomes unstable.

Proof: From equation (30), it is clear that σ_i is zero when the quantity multiplying it is not zero and arbitrary when this quantity is zero.

If $\sigma_i \neq 0$, then equation (30) gives

$$\frac{I_2}{\varepsilon} = -\frac{g\alpha\kappa a^2}{\nu\beta}Ep_1I_4 + \frac{d^2}{\varepsilon}I_6$$

Substituting this in equation (29), we get

$$\frac{2\sigma_rI_2}{\varepsilon} + \frac{F}{P_l}I_1 + \frac{1}{P_l}I_2 + \frac{d^2}{P_l}I_6 + \frac{Fd^2}{P_l}I_5 = \frac{g\alpha\kappa a^2}{\nu\beta}I_3, \quad (32)$$

Equation (32) on using Rayleigh-Ritz inequality gives

$$\frac{(\pi^2+a^2)^3}{a^2}\int_0^1 |W|^2dz + \frac{(\pi^2+a^2)}{a^2}\left\{\frac{d^2}{P_l}I_6 + \frac{Fd^2}{P_l}I_5 + \frac{1}{P_l}I_2 + \frac{2\sigma_r}{\varepsilon}I_2 + \frac{F}{P_l}I_1\right\} \leq \frac{g\alpha\kappa}{\nu\beta}\int_0^1 |W|^2dz\ . \quad (33)$$

Therefore, it follows from equation (33) that

$$\left[\frac{27\pi^4}{4} - \frac{g\alpha\kappa}{\nu\beta}\right]\int_0^1 |W|^2dz + \frac{(\pi^2+a^2)}{a^2}\left\{\frac{d^2}{P_l}I_6 + \frac{Fd^2}{P_l}I_5 + \frac{1}{P_l}I_2 + \frac{2\sigma_r}{\varepsilon}I_2 + \frac{F}{P_l}I_1\right\} \leq 0, \quad (34)$$

since minimum value of $\frac{(\pi^2+a^2)^3}{a^2}$ with respect to a^2 is $\frac{27\pi^4}{4}$.

Now, let $\sigma_r \geq 0$, we necessary have from (34) that

$$\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4}\ . \quad (35)$$

Hence, if

$$\frac{g\alpha\kappa}{\nu\beta} \leq \frac{27\pi^4}{4}\ , \quad (36)$$

then $\sigma_r < 0$. Therefore, the system is stable. Thus, under condition (36), the system is stable and under condition (35) the system becomes unstable.

Theorem 5: The sufficient condition for the non-existence of overstability is

$$\kappa < \left(\frac{\nu\varepsilon}{k_1}\right)^3 \left(\frac{d^2}{4\Omega^2\pi^2}\right)\left[\varepsilon + (1-\varepsilon)\frac{\rho_s c_s}{\rho_0 c_v}\right].$$

Proof: Here we discuss the possibility of whether instability may occur as overstability. Since for overstability, we wish to determine the critical Rayleigh number for the onset of instability via a state of pure oscillations, it suffices to find conditions for which equation (20) will admit of solutions with σ_1 real. Equating real and imaginary parts of equation (20), and eliminating R_1 from the resulting equations, we obtain

$$\sigma_1^2\left[\frac{b}{\varepsilon^2} + \frac{Ep_1}{\varepsilon}\left(\frac{1}{P} + \frac{\pi^2 Fb}{P}\right)\right] b + \left[b^2\left(\frac{1}{P} + \frac{\pi^2 Fb}{P}\right)^2 + Ep_1\varepsilon T_1\left(\frac{1}{P} + \frac{\pi^2 Fb}{P}\right)\right] + b\left[Ep_1\varepsilon\left(\frac{1}{P} + \frac{\pi^2 Fb}{P}\right)^3 - T_1\right] = 0, \quad (37)$$

where we have put $b = 1 + x$.

Since σ_1 is real for overstability, the value of σ_1^2 is positive. Equation (37) shows that this is impossible if

$$T_1 < \frac{Ep_1\varepsilon}{P^3}, \quad (38)$$

which means that

$$\kappa < \left(\frac{\nu\varepsilon}{k_1}\right)^3 \left(\frac{d^2}{4\Omega^2\pi^2}\right)\left[\varepsilon + (1-\varepsilon)\frac{\rho_s c_s}{\rho_0 c_v}\right]. \quad (39)$$

The condition (39) is, therefore, a sufficient condition for the non-existence of overstability, the violation of which does not necessarily imply the occurrence of overstability.

4 Conclusions

With the growing importance of non-Newtonian fluids in modern technology and industries, investigation of such fluids is desirable. Stokes [12] formulated the theory of couple-stress fluid. One of the applications of couple-stress fluid is its use in the study of mechanisms of lubrications of synovial joints, which has become the object of scientific research. A human joint is a dynamically loaded bearing that has articular cartilage as the bearing and synovial fluid as the lubricant. The shoulder, ankle, knee, and hip joints are the loaded-bearing synovial joints of the human body. Since long chain hyaluronic acid molecules are found as additives in synovial fluids, Walicki and Walicka modeled the synovial fluid as a couple-stress fluid. Therefore, an attempt has been made to investigate the effect of uniform rotation on a layer of couple-stress fluid heated from below in porous medium. . The main conclusions from the analysis of this paper are as follows:

- For the case of stationary convection, the couple-stress parameter and medium permeability has both stabilizing and destabilizing effects on the system whereas the rotation has a stabilizing effect on the system.
- It is found that rotation introduces oscillatory modes in the system which was non-existent in its absence.
- It is observed that the system is stable for $\frac{g\alpha\kappa}{\nu\beta} \leq \frac{27\pi^4}{4}$ and under the condition $\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4}$, the system becomes unstable.
- The case of overstability is also considered. The condition
$$\kappa < \left(\frac{\nu\varepsilon}{k_1}\right)^3 \left(\frac{d^2}{4\Omega^2\pi^2}\right)\left[\varepsilon + (1-\varepsilon)\frac{\rho_s c_s}{\rho_0 c_v}\right]$$
is the sufficient condition for the non-existence of overstability, the violation of which does not necessarily imply the occurrence of overstability.

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Convection of a Rotatory Plasma in Porous Medium

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Abstract: The thermal convection of a plasma in porous medium is investigated to include simultaneously the effect of rotation and the finiteness of the ion Larmor radius (FLR) in the presence of a vertical magnetic field. Following linear stability theory and normal mode analysis method, the dispersion relation is obtained. It is found that the presence of a uniform rotation, finite Larmor radius and magnetic field introduces oscillatory modes in the system which were, otherwise, non-existent in their absence. When the instability sets in as stationary convection, finite Larmor radius, rotation, medium permeability and magnetic field are found to have stabilizing (or destabilizing) effects under certain conditions. In the absence of rotation, finite Larmor radius has stabilizing effect on the thermal instability of the system whereas the medium permeability and the magnetic field may have stabilizing or destabilizing effect under certain conditions. The conditions

$$\kappa < \left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta \;\; and \; \kappa < \frac{\varepsilon^2\left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\nu}{P^2\left[\varepsilon P\left\{\sqrt{U}(x-2) + \sqrt{T_{A_1}}\right\}^2 - 2Q_1\right]}$$

are the sufficient conditions for non-existence of overstability, the violation of which does not necessary involve an occurrence of overstability.

Key-Words: Thermal convection; plasma; finite Larmor radius effect; rotation; porous medium

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1 Introduction

The theoretical and experimental results on thermal convection in a fluid layer, under varying assumptions of hydrodynamics and hydromagnetics, have been discussed in a treatise by Chandrasekhar [1]. The effects of the finiteness of the ion Larmor radius which exhibits itself in the form of 'magnetic viscosity' in the fluid equations have been studied by many authors (Jukes [2]; Vandakurov [3]). Sharma and Prakash [4] have studied the effect of finite Larmor radius on the thermal instability of a plasma. Melchior and Popowich [5] have considered the finite Larmor radius effect on the Kelvin-Helmholtz instability in a fully ionized plasma while that on Rayleigh-Taylor instability has been studied by Singh and Hans [6]. The effect of finite Larmor radius on the thermal instability of a plasma in the presence of a vertical magnetic field has been studied by Sharma [7]. Bhatia and Chhonkar [8] investigated the simultaneous effects of rotation and finite Larmor radius on the Rayleigh-Taylor instability of two viscous fluids.

The study of the breakdown of the stability of a layer of fluid subject to a vertical temperature gradient in porous medium and the possibility of convective flow is of considerable interest in recent years. The study of onset of convection in a porous medium has attracted considerable interest because of its natural occurrence and of its intrinsic importance in many industrial problems, particularly in petroleum-exploration, chemical and nuclear industries. The derivation of the basic equations of a layer of fluid heated from below in porous medium,

using Boussinesq approximation, has been given by Joseph [9]. The study of a layer of fluid heated from below in porous media is motivated both theoretically and by its practical applications in engineering disciplines. Among the applications in engineering disciplines one can find the food process industry, chemical process industry, solidification and centrifugal casting of metals. The development of geothermal power resources has increased general interest in the properties of convection in porous medium. Lapwood [10] has studied the stability of convective flow in a porous medium using Rayleigh's procedure. The Rayleigh instability of a thermal boundary layer in flow through a porous medium has been considered by Wooding [11].

The properties of ionized space and laboratory magnetic fluids (plasmas) have been intensively investigated theoretically and experimentally in the past sixty years. One of the key aspects studied in this context is the stability of plasma structures. Usually, instabilities can be divided into two categories: macro- and micro-instabilities. Macro-instabilities occur with low frequencies compared to the plasma and cyclotron frequency and they are studied within the framework of magnetohydrodynamics (MHD). Physicists have understood the behaviour of macro-instabilities and they showed how to avoid the most destructive of them, but small-scale gradient driven micro-instabilities are still a serious obstacle for having a stable plasma for a large range of parameters. Micro-instabilities are described by models which include, e.g. finite Larmor radius (FLR) and collisionless dissipative effects in plasmas. Time and length scales of micro-instabilities are comparable to the turbulent length scales and the length scales of transport coefficients. In general, the FLR effect is neglected. However, when the Larmor radius becomes comparable to the hydromagnetic length of the problem (e.g. wavelength) or the gyration frequency of ions in the magnetic field is of the same order as the wave frequency, finiteness of the Larmor radius must be taken into account. Strictly speaking, the space and time scale for the breakdown of hydromagnetics are on the respective scales of ion gyration about the field, and the ion Larmor frequency. In the present paper, we explore the effect of FLR on the thermal instability of a plasma in porous medium. Finite Larmor radius effect on plasma instabilities has been the subject of many investigations. In many astrophysical plasma situations such as in solar corona, interstellar and interplanetary plasmas the assumption of zero Larmor radius is not valid. Roberts and Taylor [12] and Rosenbluth et al. [13] have shown the stabilizing influence of finite ion Larmor radius (FLR) effects on plasma instabilities. Hernegger [14] investigated the stabilizing effect of FLR on thermal instability and showed that thermal criterion is changed by FLR for wave propagation perpendicular to the magnetic field. Sharma [15] investigated the stabilizing effect of FLR on thermal instability of rotating plasma. Ariel [16] discussed the stabilizing effect of FLR on thermal instability of conducting plasma layer of finite thickness surrounded by a non-conducting matter. Vaghela and Chhajlani [17] studied the stabilizing effect of FLR on magneto-thermal stability of resistive plasma through a porous medium with thermal conduction. Bhatia and Chhonkar [18] investigated the stabilizing effect of FLR on the instability of a rotating layer of self-gravitating plasma incorporating the effects of viscosity and Hall current. Vyas and Chhajlani [19] pointed out the stabilizing effect of FLR on the thermal instability of magnetized rotating plasma incorporating the effects of viscosity, finite electrical conductivity, porosity and thermal conductivity. Kaothekar and Chhajlani [20] investigated the problem of Jeans instability of self-gravitating rotating radiative plasma with finite Larmor radius corrections. Thus FLR effect is an important factor in the discussion of thermal convection and other hydromagnetic instabilities. Keeping these in mind, an attempt is made to study the effects of finite Larmor radius and rotation on the thermal convection of incompressible plasma in porous medium in the present paper.

2 Formulation of the Problem and Perturbation Equations

Consider an infinite, horizontal, incompressible, viscous and electrically conducting plasma layer of depth d bounded by the planes $z = 0$ and $z = d$ in an isotropic and homogeneous medium of porosity ε and medium permeability k_1. This layer is heated from below such that a steady temperature gradient $\beta(= \left|{}^{dT}/_{dz}\right|)$ is maintained. Temperatures and densities at the bottom surface $z = 0$ are T_0 and ρ_0 and at the upper surface $z = d$ are T_1 and ρ_1 respectively. The system is acted on by a uniform vertical magnetic field $\vec{H}(0, 0, H)$, a uniform rotation $\vec{\Omega}(0,\ 0,\ \Omega)$ and gravity field $\vec{g}(0, 0, -g)$. Let $\rho, T, \alpha, \kappa, g, \mu_e, \mu, \nu\left(= \frac{\mu}{\rho_0}\right), \eta$ and $\vec{\vec{P}}$ denote, respectively, the density, temperature, coefficient of thermal expansion, thermal diffusivity, gravitational acceleration, magnetic permeability, viscosity, kinematic viscosity, electrical resistivity and stress tensor taking into account the finite Larmor radius effect. When the plasma flows through a porous medium, the gross effect is represented by Darcy's law. As a result, the resistance term $-\left(\frac{\mu}{k_1}\right)\vec{q}$ replaces the usual viscous term, here $\vec{q}$ stands for the filter velocity of the plasma. Then the equations expressing the conservation of momentum, mass and heat are

$$\frac{1}{\varepsilon}\left[\frac{\partial \vec{q}}{\partial t} + \frac{1}{\varepsilon}(\vec{q}.\ \nabla)\vec{q}\right] = -\frac{1}{\rho_0}\nabla\left(\vec{\vec{P}} - \frac{1}{2\varepsilon^2}\left|\vec{\Omega} \times \vec{q}\right|^2\right) + \vec{g}\left(1 + \frac{\delta\rho}{\rho_0}\right) + \frac{\mu_e}{4\pi\rho_0}(\nabla \times \vec{\mathrm{H}}) \times \vec{H} - \frac{\nu}{k_1}\vec{q} + \frac{2}{\varepsilon}(\vec{q} \times \vec{\Omega}), \quad (1)$$

$$\nabla.\vec{q} = 0, \quad (2)$$

$$\frac{\partial T}{\partial t} + (\vec{q}.\nabla)T = \kappa\nabla^2 T, \quad (3)$$

where $= \varepsilon + (1 - \varepsilon)\frac{\rho_s C_s}{\rho_0 C}$; ρ_0, C are the density and heat capacity of the plasma and ρ_s, C_s are the density and the heat capacity of the solid (porous) material respectively.

The equation of the state is

$\rho = \rho_0[1 - \alpha(T - T_0)]$, where the suffix zero refers to the values at the reference level $z = 0$.

The Maxwell's equations yield

$$\varepsilon\frac{d\vec{H}}{dt} = (\vec{H}.\nabla)\vec{q} + \epsilon\eta\nabla^2\vec{H}, \quad (4)$$

$$\nabla.\vec{H} = 0, \quad (5)$$

where $d/dt = \partial/\partial t + (1/\varepsilon)(\vec{q}.\nabla)$ stands for the convective derivative.

For the magnetic field along the $z-$axis, the stress tensor $\vec{\vec{P}}$, taking into account the finite ion gyration radius (Vandakurov [3]), has the components

$$P_{xx} = p - \rho_0\nu_0\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right),$$

$$P_{xy} = P_{yx} = \rho_0\nu_0\left(\frac{\partial u}{\partial x} - \frac{\partial v}{\partial y}\right),$$

$$P_{xz} = P_{zx} = -2\rho_0\nu_0\left(\frac{\partial v}{\partial z} + \frac{\partial w}{\partial y}\right), \quad (6)$$

$$P_{yy} = p + \rho_0\nu_0\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right),$$

$$P_{yz} = P_{zy} = 2\rho_0\nu_0\left(\frac{\partial w}{\partial x} + \frac{\partial u}{\partial z}\right),$$

$$P_{zz} = p,$$

where p is the scalar part of the pressure and $\rho_0\nu_0 = Nk^*T/4\omega_H$, ω_H being the ion-gyration frequency, k^* is Boltzman constant, while N and T are number density and temperature of the ions, respectively.

The steady state solution is

$$\vec{q} = (0,\ 0,\ 0), T = T_0 - \beta z, \quad \rho = \rho_0(1 + \alpha\beta z), \quad (7)$$

where $\beta = \frac{T_0 - T_1}{d}$ is the magnitude of uniform temperature gradient which is maintained and is positive as temperature decreases upwards.

Now we consider a small perturbation on the steady state and let $\delta\rho, \delta\vec{\vec{P}}, \theta, \vec{q}(u,\ v, w)$ and $\vec{h}(h_x,\ h_y,\ h_z)$ denote, respectively, the perturbations in density, stress tensor,

temperature, hydromagnetic fluid velocity (initially zero) and the magnetic field. The change in density $\delta\rho$, caused by the perturbation θ in temperature, is given by

$$\delta\rho = -\alpha\rho_0\theta\,. \tag{8}$$

Then the linearized hydromagnetic perturbation equations relevant to the problem are

$$\frac{1}{\varepsilon}\frac{\partial\vec{q}}{\partial t} = -\frac{1}{\rho_0}\nabla\delta\vec{P} + \vec{g}\left(\frac{\delta\rho}{\rho_0}\right) + \frac{\mu_e}{4\pi\rho_0}(\nabla\times\vec{h}) \times\vec{H} - \frac{\nu}{k_1}\vec{q} + \frac{2}{\varepsilon}(\vec{q}\times\vec{\Omega})\,, \tag{9}$$

$$\nabla.\vec{q} = 0\,, \tag{10}$$

$$E\frac{\partial\theta}{\partial t} = \beta w + \kappa\nabla^2\theta\,, \tag{11}$$

$$\varepsilon\frac{\partial\vec{h}}{\partial t} = (\vec{H}.\nabla)\vec{q} + \epsilon\eta\nabla^2\vec{h}\,, \tag{12}$$

$$\nabla.\vec{h} = 0. \tag{13}$$

Within the framework of the Boussinesq approximation, equations (9) – (13) become

$$\left(\frac{\partial}{\partial t} + \frac{\nu\varepsilon}{k_1}\right)\nabla^2 = \varepsilon g\alpha\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)\theta + \frac{\mu_e H\varepsilon}{4\pi\rho_0}\frac{\partial}{\partial z}(\nabla^2 h_z) + \varepsilon\nu_0\left(\nabla^2 - 3\frac{\partial^2}{\partial z^2}\right)\frac{\partial\zeta}{\partial z} - 2\Omega\frac{\partial\zeta}{\partial z}, \tag{14}$$

$$\left(\frac{\partial}{\partial t} + \frac{\nu\varepsilon}{k_1}\right)\zeta = \frac{\mu_e\varepsilon H}{4\pi\rho_0}\frac{\partial\xi}{\partial z} - \varepsilon\nu_0\left(\nabla^2 - 3\frac{\partial^2}{\partial z^2}\right)\frac{\partial w}{\partial z} + 2\Omega\frac{\partial w}{\partial z}, \tag{15}$$

$$\varepsilon\frac{\partial\xi}{\partial t} = H\frac{\partial\zeta}{\partial z} + \varepsilon\eta\nabla^2\xi \tag{16}$$

$$\left[E\frac{\partial}{\partial t} - \kappa\nabla^2\right]\theta = \beta w, \tag{17}$$

$$\varepsilon\left[\frac{\partial}{\partial t} - \eta\nabla^2\right]h_z = H\frac{\partial w}{\partial z}, \tag{18}$$

where $\nabla^2 = {\partial^2}/{\partial x^2} + {\partial^2}/{\partial y^2} + {\partial^2}/{\partial z^2}$

and $\zeta = {\partial v}/{\partial x} - {\partial u}/{\partial y}$; $\xi = {\partial h_y}/{\partial x} - {\partial h_x}/{\partial y}$

stand for the z-components of vorticity and current density, respectively.

3 Dispersion Relation

Analyzing the disturbances into normal modes, we assume that the perturbation quantities are of the form

$$[w, h_z, \zeta, \xi, \theta] = [W(z), K(z), Z(z), X(z), \Theta(z)]exp\left[ik_x x + ik_y y + nt\right], \tag{19}$$

where k_x and k_y are the wave numbers along the $x-$ and $y-$ directions, respectively, $k = \sqrt{k_x^2 + k_y^2}$ is the resultant wave number, and n is, in general, a complex constant.

Using expression (19), equations (14)-(18) in non-dimensional form transform to

$$\left(\frac{\sigma}{\varepsilon} + \frac{1}{P_l}\right)(D^2 - a^2)W + \left(\frac{gd^2}{\nu}\right)a^2\alpha\Theta - \frac{\mu_e Hd}{4\pi\rho_0\nu}(D^2 - a^2)DK + \left(\frac{\nu_0 d}{\nu}\right)(2D^2 + a^2)DZ + \frac{2\Omega d^3}{\nu\varepsilon}DZ = 0, \tag{20}$$

$$\left(\frac{\sigma}{\varepsilon} + \frac{1}{P_l}\right)Z = \left(\frac{\mu_e Hd}{4\pi\rho_0\nu}\right)DX + \left(\frac{\nu_0}{\nu d}\right)(2D^2 + a^2)DW + \frac{2\Omega d}{\nu\varepsilon}DW, \tag{21}$$

$$[D^2 - a^2 - Ep_1\sigma]\Theta = -\left(\frac{\beta d^2}{\kappa}\right)W, \tag{22}$$

$$[D^2 - a^2 - p_2\sigma]K = -\left(\frac{Hd}{\varepsilon\eta}\right)DW, \tag{23}$$

$$[D^2 - a^2 - p_2\sigma]X = -\left(\frac{Hd}{\varepsilon\eta}\right)DZ, \qquad (24)$$

where we have introduced new coordinates $(x^*, y^*, z^*) = \left({}^{x}/_{d}, {}^{y}/_{d}, {}^{z}/_{d}\right)$ in the new unit of length d and $D = {}^{d}/_{dz^*}$. For convenience, the asterisks are dropped hereafter. Also we have put $a = kd$ and $\sigma = {}^{nd^2}/_{\nu}$, $p_1 = {}^{\nu}/_{\kappa}$ is the Prandtl number, $p_2 = {}^{\nu}/_{\eta}$ is the magnetic Prandtl number and $P_l = {}^{k_1}/_{d^2}$ is the dimensionless medium permeability.

Here we consider the case where both boundaries are free as well as perfect conductors of heat, while the adjoining medium is electrically non-conducting. The case of two free boundaries is slightly artificial, except in stellar atmospheres (Spiegel [21]) and in certain geophysical situations where it is most appropriate. However, the case of two free boundaries allows us to obtain analytical solution without affecting the essential features of the problem. The appropriate boundary conditions, with respect to which equations (20) – (24) must be solved, are

$$W = D^2W = 0,\ DZ = 0, \Theta = 0, X = 0 \ \ at\ z = 0\ and\ 1, \qquad (25)$$

on a perfectly conducting boundary.

The tangential components of the magnetic field are continuous in the absence of any surface current. Another boundary condition is

$$DK = 0 \text{ on the boundaries,} \qquad (26)$$

in addition to other boundary conditions given by the equation (25).

Using the above boundary conditions, it can be shown that all the even order derivatives of W must vanish for $z = 0\ and\ 1$ and hence the proper solution of W characterizing the lowest mode is

$$W = W_0 sin\,\pi z, \qquad (27)$$

where W_0 is a constant.

Eliminating $Z, K, X\ and\ \Theta$ between equations (20) - (24) and substituting the proper solution (27) in the resultant equation, we obtain the dispersion relation

$$\begin{aligned} R_1 x &= (1+x)\left(\frac{i\sigma_1}{\varepsilon} + \frac{1}{P}\right)(1 + x + iEp_1\sigma_1) \\ &+ Q_1 \frac{(1+x)(1+x+iEp_1\sigma_1)}{\varepsilon(1+x+ip_2\sigma_1)} \\ &+ \frac{(1+x+ip_2\sigma_1)(1+x+iEp_1\sigma_1)}{\left[(1+x+ip_2\sigma_1)\left(\frac{i\sigma_1}{\varepsilon}+\frac{1}{P}\right)+\frac{Q_1}{\varepsilon}\right]} \\ &+ \frac{\left[\sqrt{U}(x-2)+\sqrt{T_{A_1}}\right]^2}{\left[(1+x+ip_2\sigma_1)\left(\frac{i\sigma_1}{\varepsilon}+\frac{1}{P}\right)+\frac{Q_1}{\varepsilon}\right]}, \end{aligned} \qquad (28)$$

where

$$Q = \frac{\mu_e H^2 d^2}{4\pi\rho_0\nu\eta}, R = \frac{g\alpha\beta d^4}{\nu\kappa}, \ U = \frac{\nu_0^2}{\nu^2},$$

stand for the Chandrasekhar number, the thermal Rayleigh number, a non-dimensional number accounting for the finite Larmor radius, respectively, and we have also put

$$x = \frac{a^2}{\pi^2},\ P = \pi^2 P_l,\ i\sigma_1 = \frac{\sigma}{\pi^2},\ Q_1 = \frac{Q}{\pi^2},\ R_1 = \frac{R}{\pi^4}\ \ T_A = \frac{4\Omega^2 d^4}{\nu^2}(Taylor\ number),\ \ T_{A_1} = \frac{T_A}{\varepsilon^2\pi^4}\ and\ i = \sqrt{-1}\,.$$

4 Important Theorems and Discussion

Theorem 1: The system is stable or unstable.

Proof: Multiplying equation (20) by W^*, the complex conjugate of W, and using equations (21) - (24) together with the boundary conditions (25) and (26), we obtain

$$\begin{aligned} \left(\frac{\sigma}{\varepsilon}+\frac{1}{P_l}\right)I_1 - \frac{g\alpha\kappa a^2}{\nu\beta}(I_2 + Ep_1\sigma^* I_3) \\ + \frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}(I_4 + p_2\sigma^* I_5) \\ + d^2\left(\frac{\sigma^*}{\varepsilon}+\frac{1}{P_l}\right)I_6 \\ + \frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}(I_7 + p_2\sigma I_8) \\ = 0\,, \end{aligned} \qquad (29)$$

where

$$I_1 = \int_0^1 (|DW|^2 + a^2|W|^2)\, dz,$$

$$I_2 = \int_0^1 (|D\Theta|^2 + a^2|\Theta|^2) dz,$$

$$I_3 = \int_0^1 (|\Theta|^2) dz,$$

$$I_4 = \int_0^1 (|D^2K|^2 + 2a^2|DK|^2 + a^4|K|^2) dz,$$

$$I_5 = \int_0^1 (|DK|^2 + a^2|K|^2) dz,$$

$$I_6 = \int_0^1 (|Z|^2) dz,$$

$$I_7 = \int_0^1 (|DX|^2 + a^2|X|^2) dz,$$

$$I_8 = \int_0^1 (|X|^2) dz, \qquad (30)$$

and σ^* is the complex conjugate of σ. The integrals $I_1, \ldots\ldots\ldots\ldots I_8$ are all positive definite. Putting $\sigma = \sigma_r + i\sigma_i$ and equating the real and imaginary parts of equation (29), we obtain

$$\left[\frac{I_1}{\varepsilon} + \frac{\mu_e \eta \varepsilon p_2}{4\pi\rho_0 \nu}(I_5 + d^2 I_8) - \frac{g\alpha\kappa a^2}{\nu\beta} E p_1 I_3 + \frac{d^2}{\varepsilon} I_6\right]\sigma_r =$$

$$-\left[\frac{1}{P_l} I_1 + \frac{\mu_e \eta \varepsilon}{4\pi\rho_0 \nu}(I_4 + d^2 I_7) - \frac{g\alpha\kappa a^2}{\nu\beta} I_2 + \frac{d^2}{P_l} I_6\right], \qquad (31)$$

and

$$\left[\frac{I_1}{\varepsilon} + \frac{g\alpha\kappa a^2}{\nu\beta} E p_1 I_3 - \frac{\mu_e \eta \varepsilon p_2}{4\pi\rho_0 \nu}(I_5 - d^2 I_8) - \frac{d^2}{\varepsilon} I_6\right]\sigma_i = 0\,. \qquad (32)$$

It is evident from equation (31) that σ_r may be positive or negative i.e. there may be instability or stability in the presence of rotation, finite Larmor radius and magnetic field in porous medium which is also true in their absence.

Theorem 2: The modes may be oscillatory or non-oscillatory in contrast to case of no magnetic field, and in the absence of rotation, finite Larmor radius and magnetic field where modes are non-oscillatory.

Proof: Equation (32) yields that σ_i may be zero or non-zero, which means that the modes may be non-oscillatory or oscillatory. In the absence of rotation, finite Larmor radius and magnetic field, equation (32) reduces to

$$\sigma_i \left[\frac{I_1}{\varepsilon} + \frac{g\alpha\kappa a^2}{\nu\beta} E p_1 I_3\right] = 0 \qquad (33)$$

and the terms in brackets are positive definite. Thus $\sigma_i = 0$, which means that oscillatory modes are not allowed and the principle of exchange of stabilities is satisfied for a porous medium in the absence of rotation, finite Larmor radius and magnetic field. The oscillatory modes are introduced due to the presence of rotation, magnetic field and finite Larmor radius which were non-existent in their absence.

Theorem 3: The system is stable for $\frac{g\alpha\kappa}{\nu\beta} \leq \frac{27\pi^4}{4}$ and under the condition $\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4}$, the system becomes unstable.

Proof: From equation (32), it is clear that σ_i is zero when the quantity multiplying it is not zero and arbitrary when this quantity is zero.

If $\sigma_i \neq 0$, then equation (31) gives

$$\frac{I_1}{\varepsilon} + \frac{\mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} p_2 I_8 = \frac{\mu_e \eta \varepsilon}{4\pi\rho_0 \nu} p_2 I_5 + \frac{d^2}{\varepsilon} I_6 - \frac{g\alpha\kappa a^2}{\nu\beta} E p_1 I_3$$

Substituting this in equation (30), we get

$$\frac{2\sigma_r I_1}{\varepsilon} + \frac{1}{P_l} I_1 + \frac{\mu_e \eta \varepsilon}{4\pi\rho_0 \nu} I_4 + d^2\left(\frac{1}{P_l}\right) I_6 + \frac{\mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} I_7 + \frac{2\sigma_r \mu_e \eta d^2 \varepsilon}{4\pi\rho_0 \nu} p_2 I_8 = \frac{g\alpha\kappa a^2}{\nu\beta} I_2\,. \qquad (34)$$

Equation (34) on using Rayleigh-Ritz inequality gives

$$\frac{(\pi^2+a^2)^3}{a^2}\int_0^1 |W|^2\,dz + \frac{(\pi^2+a^2)}{a^2}\left\{\frac{2\sigma_r\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}p_2 I_8 + \frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}I_7 + d^2\left(\frac{1}{P_l}\right)I_6 + \frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}I_4 + \frac{1}{P_;}I_1 + \frac{2\sigma_r}{\varepsilon}I_1\right\} \leq \frac{g\alpha\kappa}{\beta\nu}\int_0^1 |W|^2\,dz \quad . \tag{35}$$

Therefore, it follows from equation (35) that

$$\left[\frac{27\pi^4}{4} - \frac{g\alpha\kappa}{\nu\beta}\right]\int_0^1 |W|^2\,dz + \frac{(\pi^2+a^2)}{a^2}\left\{\frac{2\sigma_r\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}p_2 I_8 + \frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}I_7 + d^2\left(\frac{1}{P_l}\right)I_6 + \frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}I_4 + \frac{1}{P_;}I_1 + \frac{2\sigma_r}{\varepsilon}I_1\right\} \leq 0 \tag{36}$$

since minimum value of $\frac{(\pi^2+a^2)^3}{a^2}$ with respect to a^2 is $\frac{27\pi^4}{4}$.

Now, let $\sigma_r \geq 0$, we necessary have from (36) that

$$\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4} \quad . \tag{37}$$

Hence, if

$$\frac{g\alpha\kappa}{\nu\beta} \leq \frac{27\pi^4}{4} \quad , \tag{38}$$

then $\sigma_r < 0$. Therefore, the system is stable. Thus, under condition (38), the system is stable and under condition (37) the system becomes unstable.

Theorem 4: For stationary convection case:

(I) If $x > 2$, both finite Larmor radius and rotation have a stabilizing effect on the system. On the other hand if $x < 2$, finite Larmor radius has stabilizing (or destabilizing) effect and rotation has destabilizing (or stabilizing) effect if

$$(x-2) > (or\ <)\ \left(\frac{T_{A_1}}{U}\right)^{1/2}.$$

(II) In the presence of finite Larmor radius effect and rotation if

$$\left[\frac{1+x}{P} + \frac{Q_1}{\varepsilon}\right]^2 > (or\ <)\ \left\{\sqrt{U}(x-2) + \sqrt{T_{A_1}}\right\}^2 (1+x)$$

the medium permeability has a destabilizing (or stabilizing) and the magnetic field has a stabilizing (or destabilizing) effect on the system.

(III) In the absence of rotation, finite Larmor radius always has a stabilizing effect on the system whereas the medium permeability and the magnetic field may have stabilizing effect for some wave numbers and destabilizing effect for other wave numbers given by

$$U(x-2)^2(1+x) \geqq \left(\frac{1+x}{P} + \frac{Q_1}{\varepsilon}\right)^2.$$

Proof: When the instability sets in as stationary convection, the marginal state will be characterized by $\sigma = 0$. Putting $\sigma = 0$, the dispersion relation (28) reduces to

$$R_1 = \left(\frac{1+x}{x}\right)\left[\frac{1+x}{P} + \frac{Q_1}{\varepsilon}\right] + \frac{\left[U^{1/2}(x-2) + {T_{A_1}}^{1/2}\right]^2 (1+x)^2}{x\left[\frac{1+x}{P} + \frac{Q_1}{\varepsilon}\right]}, \tag{39}$$

which expresses the modified Rayleigh number R_1 as a function of the dimensionless wave number x and the parameters $Q_1, U\ P\ and\ T_{A_1}$. To study the effects of finite Larmor radius, rotation, medium permeability and magnetic field on R_1, we examine the nature of $dR_1/dU\ , dR_1/dT_{A_1},\ dR_1/dP\ and\ dR_1/dQ_1$ analytically.

(I) It follows from equation (39),

$$\frac{dR_1}{dU} = \frac{(x-2)(1+x)^2\left[(x-2)+\left(\frac{T_{A_1}}{U}\right)^{1/2}\right]}{x\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]}, \quad (40)$$

and

$$\frac{dR_1}{dT_{A_1}} = \frac{(1+x)^2\left(\frac{U}{T_{A_1}}\right)^{1/2}\left[(x-2)+\left(\frac{T_{A_1}}{U}\right)^{1/2}\right]}{x\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]}. \quad (41)$$

If $x > 2$, both finite Larmor radius and rotation have a stabilizing effect on the system.

If < 2 , finite Larmor radius has stabilizing (or destabilizing) effect and rotation has destabilizing (or stabilizing) effect if

$$(x-2) > (or <)\left(\frac{T_{A_1}}{U}\right)^{1/2}. \quad (42)$$

(II) Also equation (39) yields

$$\frac{dR_1}{dP} = -\frac{(1+x)}{xP^2}\left[\frac{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2-\left\{\sqrt{U}(x-2)+\sqrt{T_{A_1}}\right\}^2}{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2}\right], \quad (43)$$

and

$$\frac{dR_1}{dQ_1} = \left(\frac{1+x}{\varepsilon x}\right)\left[\frac{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2-\left\{\sqrt{U}(x-2)+\sqrt{T_{A_1}}\right\}^2(1+x)}{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2}\right], \quad (44)$$

In the equations (43) and (44) if

$$\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]^2 > \left\{\sqrt{U}(x-2)+\sqrt{T_{A_1}}\right\}^2(1+x), \quad (45)$$

then

$$\frac{dR_1}{dP} < 0 \; and \; \frac{dR_1}{dQ_1} > 0,$$

which exhibits the destabilizing effect of medium permeability and stabilizing effect of magnetic field respectively.

Again if

$$\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]^2 < \left\{\sqrt{U}(x-2)+\sqrt{T_{A_1}}\right\}^2(1+x), \quad (46)$$

then

$$\frac{dR_1}{dP} > 0 \; and \; \frac{dR_1}{dQ_1} < 0,$$

which shows the stabilizing effect of medium permeability and destabilizing effect of the magnetic field on the thermal instability of a plasma in porous media in the light of condition (46).

(III) In the absence of rotation,

$$\frac{dR_1}{dU} = \frac{(x-2)^2(1+x)^2}{x\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]} > 0, \quad (47)$$

$$\frac{dR_1}{dP} = -\frac{(1+x)^2}{xP^2}\frac{\left[\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2-U(x-2)^2(1+x)\right]}{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2}, \quad (48)$$

and

$$\frac{dR_1}{dQ_1} = \left(\frac{1+x}{\varepsilon x}\right)\frac{\left[\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2-U(x-2)^2(1+x)\right]}{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2}. \quad (49)$$

Now

$$\frac{dR_1}{dP} \gtrless 0 \; and \; \frac{dR_1}{dQ_1} \lessgtr 0$$

according as

$$U(x-2)^2(1+x) \gtrless \left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2. \quad (50)$$

Thus in the absence of rotation, finite Larmor radius always has a stabilizing effect on the thermal instability of plasma whereas the

medium permeability and magnetic field may have stabilizing effect for some wave numbers and destabilizing effect for other wave numbers given by relation (50).

Theorem 5: The sufficient conditions for the non-existence of overstability are

$$\kappa < \left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta \ \ and$$

$$\kappa < \frac{\varepsilon^2\left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\nu}{P^2\left[\varepsilon P\left\{\sqrt{U}(x-2)+\sqrt{T_{A_1}}\right\}^2 - 2Q_1\right]}.$$

Proof: Here we discuss the possibility of whether instability may occur as overstability. Since for overstability, our interest is to determine the critical Rayleigh number for the onset of instability via a state of pure oscillations, it will suffice to find conditions for which equation (28) will admit solutions with σ_1 real.

Assuming σ_1 to be real and equating the real and imaginary parts of equation (28) and eliminating R_1 between them, we obtain

$$A_3 C_1^3 + A_2 C_1^2 + A_1 C_1 + A_0 = 0\,, \qquad (51)$$

where $C_1 = \sigma_1^2\,,\ b = 1 + x\ and$

$$A_3 = \frac{b p_2^4}{\varepsilon^2}\left(\frac{Ep_1}{P} + \frac{b}{\varepsilon}\right), \qquad (52)$$

$$A_0 = \frac{b^6}{\varepsilon P^2} + \left[\left(\frac{Ep_1}{P^3} + \frac{2Q_1}{\varepsilon^2 P}\right) - \left\{\frac{\sqrt{U}(b-3)-\sqrt{T_{A_1}}}{\varepsilon}\right\}^2\right] b^5 + \left[\frac{Q_1^2}{\varepsilon^3} + \frac{Q_1}{\varepsilon P^2}(3Ep_1 - p_2) + \left\{\sqrt{U}(b-3)+\sqrt{T_{A_1}}\right\}^2 \frac{Ep_1}{P}\right] b^4 + \left[\frac{Q_1^2}{\varepsilon^2 P}(3Ep_1 - 2p_2) + \left\{\sqrt{U}(b-3) + \sqrt{T_{A_1}}\right\}^2\left(\frac{p_2 Q_1}{\varepsilon} + \frac{Ep_1 Q_1}{\varepsilon}\right)\right] b^3 + \frac{Q_1^3}{\varepsilon^3}(Ep_1 - p_2) b^2. \qquad (53)$$

The values of coefficients $A_1\ and\ A_2$ are not written here because their expressions are very lengthy and also not needed in the discussion of overstability. Since σ_1 is real for overstability, the three values of $C_1(=\sigma_1^2)$ are positive. The product of the roots of (51) is $-A_0/A_3$ and if this is to be positive, then A_0 must be negative since from (52) A_3 is positive.

It is clear from (53) that A_0 is always positive if

$$Ep_1 > p_2\,, \quad and \quad \left(\frac{Ep_1}{P^3} + \frac{2Q_1}{\varepsilon^2 P}\right) > \frac{1}{\varepsilon}\left\{\sqrt{U}(b-3) + \sqrt{T_{A_1}}\right\}^2 \qquad (54)$$

which implies that

$$\kappa < \left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta \ \ and\ \kappa < \frac{\varepsilon^2\left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\nu}{P^2\left[\varepsilon P\left\{\sqrt{U}(x-2)+\sqrt{T_{A_1}}\right\}^2 - 2Q_1\right]}. \qquad (55)$$

The inequalities (55) are, therefore, the sufficient conditions for the non-existence of overstability, the violation of which does not necessarily imply the occurrence of overstability.

5 Conclusions

The thermal convection of a plasma in porous medium in the presence of finite Larmor radius effect, rotation and vertical magnetic field is considered in the present paper. The main conclusions from the analysis of this paper are as follows:

- It is found that rotation, finite Larmor radius and uniform magnetic field introduce oscillatory modes in the system which were non-existent in their absence.
- It is observed that the system is stable for $\frac{g\alpha\kappa}{\nu\beta} \le \frac{27\pi^4}{4}$ and under the condition $\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4}$, the system becomes unstable.
- For the case of stationary convection, if $x > 2$, both finite Larmor radius and rotation have a stabilizing effect on the system. On the other hand if $x < 2$, finite Larmor radius has stabilizing (or destabilizing) effect and rotation has destabilizing (or stabilizing) effect if

$$(x-2) > (or\ <)$$

$$\left(\frac{T_{A_1}}{U}\right)^{1/2}.$$

In the presence of finite Larmor radius effect and rotation if

$$\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]^2 > (or\ <)$$
$$\left\{\sqrt{U}(x-2)+\sqrt{T_{A_1}}\right\}^2 (1+x)$$

the medium permeability has a destabilizing (or stabilizing) and the magnetic field has a stabilizing (or destabilizing) effect on the system.

- In the absence of rotation, finite Larmor radius always has a stabilizing effect on the system whereas the medium permeability and the magnetic field may have stabilizing effect for some wave numbers and destabilizing effect for other wave numbers given by

$$U(x-2)^2(1+x) \gtrless \left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2.$$

- The case of overstability is also considered. The conditions

$$\kappa < \left[\varepsilon+(1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta \ \ and\ \kappa < \frac{\varepsilon^2\left[\varepsilon+(1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\nu}{P^2\left[\varepsilon P\left\{\sqrt{U}(x-2)+\sqrt{T_{A_1}}\right\}^2-2Q_1\right]}.$$

are the sufficient conditions for the non-existence of overstability, the violation of which does not necessarily imply the occurrence of overstability.

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Thermosolutal-convective Instability in Stern's Type Configuration

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Abstract:- The thermal-convective instability of a stellar atmosphere in the presence of stable solute gradient in Stern's type configuration is studied in the presence of radiative transfer effect. A criterion for monotonic instability is obtained in terms of the source functions S. The criterion for monotonic instability is found to be unchanged in the presence of radiative transfer and rotation effects. The problem of thermosolutal-convective instability of a hydromagnetic composite medium is also studied to include the frictional effects with neutrals. The criterion derived for monotonic instability in terms of heat-loss function is found to be the same in the presence or absence of the collisional effects.

Key-Words:-Frictional effects, Thermosolutal-convective instability, Radiative transfer effect, Rotation,

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1. Introduction

Defouw [1] has generalized the Schwarzschild criterion for convection to include departures from adiabatic motion and has shown that a thermally unstable atmosphere is also convectively unstable, irrespective of the atmospheric temperature gradient. The instability in which motions are driven by buoyancy forces of a thermally unstable atmosphere has been termed as "thermal convective instability". Defouw [1] has shown that an inviscid stellar atmosphere is unstable is unstable if

$$D = \frac{1}{C_P}\left(L_T - \rho\alpha L_\rho\right) + \kappa k^2 < 0, \qquad (1)$$

where L is the energy lost minus the energy gained per gram per second (the heat loss function) and ρ, α, κ, k, L_T, L_ρ denote respectively the density, the coefficient of thermal expansion, the coefficient of thermometric conductivity, the wave number of the perturbation, the partial derivative of L with respect to temperature T and the partial derivative of L with respect to density ρ, both evaluated in the equilibrium state. In general, the instability due to inequality (1) may be either oscillatory or monotonic. Defouw [1] has also shown that inequality (1) is a sufficient condition for monotonic instability in the presence of magnetic field and rotation on thermal convective instability.

Defouw [1] has also studied the effect of radiative transfer on the thermal-convective instability and has found that the source functions S which lead to thermal-convective instability are those for which $S_T - (\rho/T)S_\rho < 0$, the subscripts on S denote the partial derivatives of S with respect to T and ρ both evaluated in the equilibrium state.

A detailed account of thermal convection, under varying assumptions of hydrodynamics and hydromagnetics, has been given by Chandrasekhar [2]. Veronis [3] has considered the problem of thermohaline convection in a layer of fluid heated from below and subjected to a stable salinity gradient. The thermohaline convection in a horizontal layer of viscous fluid heated from below and salted from above has been studied by Nield [4]. In thermohaline-convective instability problem, buoyancy forces can arise not from density differences due to variations in temperature but also from those due to variations in solute concentrations. The conditions under which convective motions are important in stellar atmospheres are usually far

removed the consideration of a single component fluid and rigid boundaries and therefore it is desirable to consider one gas component acted on by solute concentration gradient and free boundaries. The thermosolutal-convective instability of a stellar atmosphere in the presence of suspended particles has been studied by Sharma and Singh [5]. The criteria for monotonic instability are derived and are found to hold good also in the presence of uniform rotation and uniform magnetic field on the thermosolutal-convective instability.

A partially ionized plasma represents a state which often exists in the Universe. There are several situations where the interaction between the ionized and neutral gas components becomes important in cosmic physics. As a reasonably simple approximation, the plasma may be idealized as a composite mixture of a hydromagnetic (ionized) component and a neutral component, the two interacting through mutual collisional (frictional) effects. Hans [6] made this simplified approximation and found that these collisions have a stabilizing effect on the Rayleigh-Taylor instability.Marcu and Ballai [7] have studied the thermosolutal linear stability of a composite two-component plasma in the presence of Coriolis forces, finite Larmor radius, taking into account the collisions between neutral and ionized particles. The thermosolutal instability appears due to a material convection (thermosolutal convection) in a two component fluid with different molecular diffusivities which contribute in an opposing sense to the locally vertical density gradient. Natural convection with Soret and radiation effects in a binary fluid saturating a horizontal porous layer under the influence of magnetic field has been investigated by Israel-Cookey and Amos [8]. Sheri et. al [9] has studied the transient radiative reactive thermosolutal magnetohydrodynamic convection in inclined MHD hall generator flow with dissipation and cross diffusion.

In the present paper we consider the thermosolutal-convective instability in Stern's type configuration of a stellar atmosphere (the thermal-convective instability in the presence of stable solute gradient) to include the radiative transfer effect. The effects of radiative transfer and rotation are also studied on the thermosolutal-convective instability. The effects of radiative transfer arise when self absorption is not negligible. As a partially ionized plasma represents a state which often exists in the Universe, the problem of thermosolutal-convective instability of a hydromagnetic composite medium is, therefore, studied to include the frictional effects with neutrals. Theseaspects form the subject matter of the present study.

2. Description of the Instability and Perturbation Equations

Consider an infinite horizontal fluid layer of thickness d heated from above and subjected to a stable solute concentration gradient so that the temperatures and solute concentrations at the bottom surface $z = 0$are T_0 and C_0 and at the upper surface $z = d$ are T_1 and C_1 respectively, z -axis being taken as vertical. This layer is acted on by a gravity force $\vec{g}(0,\ 0,\ -g)$. Then, following the Boussinesq approximation, which states that the inertial effects produced by density variation are negligible in comparison to its gravitational effects i.e. ρ can be taken as constant everywhere in the equations of motion except in the term with external force, consequently the equations governing the motion of the fluid assume the following form:

$$\frac{\partial \vec{v}}{\partial t} + (\vec{v}\ .\ \nabla)\vec{v} = -\frac{1}{\rho_0}\nabla p + \nu\,\nabla^2\vec{v} + \vec{g}\left(1 + \frac{\delta\rho}{\rho_0}\right), \tag{2}$$

$$\nabla.\vec{v} = 0\,, \tag{3}$$

$$\frac{\partial C}{\partial t} + (\vec{v}\ .\ \nabla)C = \kappa'\nabla^2 C\,, \tag{4}$$

$$\rho = \rho_0[1 - \alpha(T - T_0) + \alpha'(C - C_0)]. \tag{5}$$

The suffix zero refers to values at the reference level $z = 0$. Equations (2) – (4) express respectively the conservation of momentum,

mass and solute mass concentration. Equation (5) represents the equation of state. Here $\rho, p, T, C, \vec{v}(u, v, w), g, \alpha \; and \; \alpha'$ stand for density, pressure, temperature, solute concentration, velocity, gravitational acceleration, thermal coefficient of expansion and an analogous solvent coefficient, respectively. The kinematic viscosity, the thermal diffusivity κ and the solute diffusivity κ' are each assumed to be constant.

The steady state solution is

$$\vec{v} = 0, T = T_0 + \beta z, C = C_0 - \beta' z, \rho = \rho_0[1 - \alpha\beta z - \alpha'\beta' z'], \quad (6)$$

where

$$\beta = \frac{T_1 - T_0}{d}, and \; \beta' = \frac{C_0 - C_1}{d}$$

are the magnitudes of uniform temperature and concentration gradients.

We now consider a small perturbation on the steady state solution and let $\vec{v}, \delta\rho, \delta p, \theta$ and γ denote the perturbations in velocity, density, pressure, temperature and solute concentration respectively so that the change in density $\delta\rho$, caused by the perturbations $\theta \; and \; \gamma$ in temperature and concentration, is given by

$$\delta\rho = -\rho_0(\alpha\theta - \alpha'\gamma). \quad (7)$$

Equations (2) – (4) on linearization give

$$\frac{\partial \vec{v}}{\partial t} = -\frac{1}{\rho_0}\nabla\delta p + \nu\nabla^2\vec{v} - \vec{g}(\alpha\theta - \alpha'\gamma), \quad (8)$$

$$\nabla . \vec{v} = 0, \quad (9)$$

$$\frac{\partial \gamma}{\partial t} - \kappa'\nabla^2\gamma = \beta' w. \quad (10)$$

Now, the first law of thermodynamics may be written in the form

$$C_v\frac{dT}{dt} = -L + \frac{K}{\rho}\nabla^2 T + \frac{P}{\rho^2}\frac{d\rho}{dt}, \quad (11)$$

where $L, K, C_v, T, t \; and \; \rho$ denote respectively, the heat-loss function, the thermal conductivity, the specific heat at constant volume, the temperature, the time and the pressure.

Following Defouw [1], the linearized perturbation form of equation (11) is

$$\frac{\partial\theta}{\partial t} + \frac{1}{C_p}(L_T - \rho\alpha L_\rho)\theta - \kappa\nabla^2\theta = -\left(\beta + \frac{g}{C_P}\right)w. \quad (12)$$

The effects of radiative transfer arise when self-absorption is not negligible. In considering the heat-loss function $L(\rho, T)$ to be dependent only on the local values of density and temperature, it is assumed that the gas is optically thin. We shall study radiative transfer with the Eddington approximation which is accurate in both the optically thick and optically thin limits as pointed by Unno and Spiegel [10].

The heat equation for a grey gas, using this approximation, may be written as

$$\rho C_v\frac{dT}{dt} - \frac{p}{\rho}\frac{d\rho}{dt} = \nabla.\left[\frac{1}{3m\rho}\nabla\left\{\frac{1}{m\rho}\left(\rho C_v\frac{dT}{dt} - \frac{p}{\rho}\frac{d\rho}{dt}\right) + 4\pi S\right\}\right], \quad (13)$$

where m is the mass absorption coefficient and S is the source function.

Since the layer depth is small and the temperature gradient maintained is also small so that their product is very small in comparison with the temperature of the lower boundary, the temperature at an intermediate point may be approximately taken as the temperature of the lower boundary. The source function S and the mass absorption coefficient m may, therefore, be treated as independent of height in the equilibrium state. Then the linearized perturbation form of equation (12) may be obtained as

$$3m^2\rho^2\frac{\partial\theta}{\partial t} - \frac{4\pi m}{C_P}(S_T - \rho\alpha S_P)\nabla^2\theta - \frac{\partial}{\partial t}\nabla^2\theta = -\left(\beta + \frac{g}{C_P}\right)(3m^2\rho^2 w - \nabla^2 w), \quad (14)$$

where S_T and S_ρ denote respectively the partial derivatives of S with respect to T and ρ.

We consider the case in which the boundaries are free as well as perfect conductors of both heat and solute. The density changes arise principally from thermal effects. The case of two free boundaries is most appropriate for stellar atmospheres as pointed by Spiegel [11]. The boundary conditions appropriate for the problem are

$$w = {\partial^2 w}/{\partial z^2} = \theta = \gamma = 0.$$

3. The Dispersion Relation

We shall now analyze an arbitrary perturbation into complete set of normal modes by seeking solutions whose dependence on space and time coordinates is of the form

$$exp\left(ik_x x + ik_y y + nt\right) \sin k_z z\,, \qquad (15)$$

where n is the growth rate and $k_z = {s\pi}/{d}$, s being any integer and d is the thickness of the layer and $k = \left(k_x^2 + k_y^2 + k_z^2\right)^{1/2}$ is the wave number of the perturbation.

Equations (8) – (10) and (14) give

$$\frac{\partial}{\partial t}(\nabla^2 w) = g\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)(\alpha\theta - \alpha'\gamma) + \nu\nabla^4 w\,, \qquad (16)$$

$$\left(\frac{\partial}{\partial t} - \kappa'\nabla^2\right)\gamma = \beta' w\,, \qquad (17)$$

$$\left(\frac{\partial}{\partial t} + E\right)\theta = -\left(\beta + \frac{g}{C_P}\right)w\,, \qquad (18)$$

where

$$E = \frac{4\pi m\left(S_T - \rho\alpha S_\rho\right)}{C_P\left(1 + \frac{3m^2\rho^2}{k^2}\right)}\ . \qquad (19)$$

The system of equations (16) - (18) together with boundary conditions

$$w = {\partial^2 w}/{\partial z^2} = \theta = \gamma = 0.$$

constitutes a characteristics value problem for n, for given values of the parameters and a given state of system is stable, neutral or unstable according as n_r , the real part of n, is negative , zero or positive. Further, if $n_r = 0 \Rightarrow n_i = 0$ for all wave number k, then the principle of exchange of stabilities (PES) is valid otherwise we have overstability atleast when instability sets in as certain modes. The above system of equations can be solved by using linear stability analysis method.

Eliminating θ, γ from equations $(16) - (18)$ and using (16), we obtain the dispersion relation

$$n^3 + [E + k^2(\nu + \kappa')]n^2 + \left[k^2 E(\nu + \kappa') + \Gamma\left(\beta + \frac{g}{C_P}\right) + \nu\kappa' k^4 + \Gamma'\beta'\right]n + \left[\Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2 + (\nu\kappa' k^4 + \Gamma'\beta')E\right] = 0\,, \qquad (20)$$

where

$$\Gamma = g\alpha\frac{k_x^2 + k_y^2}{k^2}\ and\ \Gamma' = \frac{g\alpha'\left(k_x^2 + k_y^2\right)}{k^2}. \qquad (21)$$

4. Discussion and Further Extensions

Theorem 1: Acriterion that a stellar atmosphere in the presence of stable solute concentration gradient and radiative transfer effect is unstable if

$$S_T - \frac{\rho}{T}S_\rho < 0\ and\ |(\nu\kappa' k^4 + \Gamma'\beta')E| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2\ .$$

Proof: Taking the dispersion relation (20), when

$$S_T - \frac{\rho}{T}S_\rho < 0\ and\ |(\nu\kappa' k^4 + \Gamma'\beta')E| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2\ , \qquad (22)$$

The constant term in relation (20) is negative. Equation (20), therefore, involves one change of sign and hence contains one positive real root. The occurrence of positive root implies monotonic instability.

We thus obtain a criterion that a stellar atmosphere in the presence of stable solute concentration gradient and radiative transfer effect is unstable if

$$S_T - \frac{\rho}{T}S_\rho < 0 \; and \; |(\nu\kappa' k^4 + \Gamma'\beta')E| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2 \; , \quad (23)$$

Hence the result.

Further Extension-1: The rotation induces a component of vorticity in the direction of rotation. The effects of radiative transfer arise when self-absorption is not negligible. It may be of some interest to examine the influence of radiative transfer and rotation on thermosolutal-convective instability of a stellar atmosphere.

Theorem 2: The criterion for monotonic instability (22) also holds good in the presence of radiative transfer and rotation effects on thermosolutal-convective instability in Stern's type configuration in a stellar atmosphere.

Proof: Here we consider an infinite horizontal fluid layer heated from above and solute concentrated from below and acted on by a uniform rotation $\vec{\Omega}(0,0,\Omega)$ and gravity force $\vec{g}(0,0,-g)$. The linearized perturbed equations of motion become

$$\frac{\partial \vec{v}}{\partial t} = -\frac{1}{\rho_0}\nabla\delta p + \nu\nabla^2\vec{v} - \vec{g}(\alpha\theta - \alpha'\gamma) + 2\left(\vec{v}\times\vec{\Omega}\right), \quad (24)$$

Equations (9), (10) and (14) remain unaltered.

Equations (9), (10), (14) and (24) give

$$\frac{\partial}{\partial t}(\nabla^2 w) = g\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)(\alpha\theta - \alpha'\gamma) + \nu\nabla^4 w - 2\Omega\frac{\partial\zeta}{\partial z} \; , \quad (25)$$

$$\frac{\partial\zeta}{\partial t} - \nu\nabla^2\zeta = 2\Omega\frac{\partial w}{\partial z} \; , \quad (26)$$

where

$$\zeta = \frac{\partial v}{\partial z} - \frac{\partial u}{\partial y}$$

denotes the z-component of vorticity, Equations (17) and (18) remain the same. Eliminating θ , ζ and γ from equations (17), (18), (25) and (26) and using expression (15), we obtain the dispersion relation

$$\begin{aligned} &n^4 + [E + k^2(2\nu + \kappa')]n^3 \\ &+ \left[\nu\kappa' k^4 + \Gamma'\beta' + Ek^2(\nu + \kappa') + \Gamma\left(\beta + \frac{g}{C_P}\right)\right. \\ &\left. + \nu k^2(E + k^2\overline{\nu + \kappa'}) + \frac{4\Omega^2 k_z^2}{k^2}\right]n^2 \\ &+ \left[(\nu\kappa' k^4 + \Gamma'\beta')E + \Gamma\left(\beta + \frac{g}{C_P}\right)k^2(\nu + \kappa')\right. \\ &+ \nu k^2\{\nu\kappa' k^4 + \Gamma'\beta' + k^2 E(\nu + \kappa')\} \\ &\left. + \frac{4\Omega^2 k_z^2}{k^2}(E + \kappa' k^2)\right]n \\ &+ \left[\nu k^2\left\{(\nu\kappa' k^4 + \Gamma'\beta')E + \kappa' k^2\Gamma\left(\beta + \frac{g}{C_P}\right)\right\}\right. \\ &\left. + 4\Omega^2 k_z^2\kappa' E\right] = 0. \end{aligned} \quad (27)$$

When (22) is satisfied, the constant term in equation (27) is negative. The product of the roots must be negative. Therefore at least one root of equation (27) is positive and one root is negative. The occurrence of positive root implies monotonic instability. The criterion for monotonic instability thus holds good in the presence of radiative transfer and rotation effects on thermosolutal-convective instability in a stellar atmosphere.

Further Extension-2: Further we study the effect of collisions on thermosolutal-convective instability of a composite medium. Quite frequently it happens that the plasma is not fully ionized and may instead be permeated with neutral atoms. The plasma may be idealized, therefore, following Hans [6], as a composite mixture of a hydromagnetic (ionized) component and a neutral component, the two interacting through mutual collisional (frictional) effects. A partially ionized plasma represents a

state which often exists in the universe. Hence it is of interest to investigate the influence of these frictional effects with neutrals on thermosolutal-convective instability of a composite medium.

Here we consider an infinite horizontal composite layer consisting of a finitely conducting hydromagnetic fluid of density ρ and a neutral gas of density ρ_d, acted on by a uniform vertical magnetic field $\vec{H}(0,0,H)$ and gravity force $\vec{g}(0,0,-g)$. This layer is heated from above and solute concentrated from below such that a steady temperature gradient $\beta\left(=dT/_{dz}\right)$ and a concentration gradient $\beta'\left(=-dC/_{dz}\right)$ are maintained. Regarding the model under consideration we observe that the number density of neutral particles is extremely smaller than the number density of ionized particles (Tanenbaum [12]). The pressure and buoyancy effects acting on neutral particles, therefore, have negligible influence (the volume fraction of the neutral particles being extremely small) whereas they are significant in the case of ionized component. In a partially ionized gas the magnetic field interacts with the charged component and is not directly affected by the neutral component (Parker [13]).

Now we prove the following Theorem :

Theorem 3: A criterion that the thermosolutal-convective instability of a composite stellar atmosphere in the presence of stable solute concentration gradient and collisional effects is unstable if

$$D < 0 \ and \ |(\nu\kappa' k^4 + \Gamma'\beta')D| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2.$$

Proof: Let $\vec{h}(h_x, h_y, h_z)$, η, $\overrightarrow{v_d}$ and ν_C denote respectively the perturbation in magnetic field $\vec{H}$, the resistivity, the velocity of the neutral gas and the collision frequency between the two components of the composite medium. Then the linearized perturbation equations appropriate to the problem are

$$\frac{\partial \vec{v}}{\partial t} = -\frac{1}{\rho_0}\nabla\delta p + \nu\nabla^2\vec{v} + \frac{1}{4\pi\rho_0}\left(\nabla\times\vec{h}\right)\times\vec{H} + \vec{g}\frac{\delta\rho}{\rho_0} + \frac{\rho_d\nu_C}{\rho_0}(\overrightarrow{v_d} - \vec{v}), \quad (28)$$

$$\frac{\partial \overrightarrow{v_d}}{\partial t} = -\nu_C(\overrightarrow{v_d} - \vec{v}), \quad (29)$$

$$\frac{\partial \vec{h}}{\partial t} = \nabla\times\left(\vec{v}\times\vec{H}\right) + \eta\nabla^2\vec{h}, \quad (30)$$

$$\nabla.\vec{h} = 0, \quad (31)$$

together with equations (7), (9), (10) and (12). Equations (7), (9), (10), (12) and (28)-(31) give

$$\frac{\partial}{\partial t}\left(1 + \frac{\alpha_0\nu_C}{\frac{\partial}{\partial t} + \nu_C}\right)(\nabla^2 w) = g\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)(\alpha\theta - \alpha'\gamma) + \nu\nabla^4 w + \frac{H}{4\pi\rho_0}\nabla^2\frac{\partial h_z}{\partial z}, \quad (32)$$

$$\left(\frac{\partial}{\partial t} - \eta\nabla^2\right)h_z = H\frac{\partial w}{\partial z}, \quad (33)$$

$$\left(\frac{\partial}{\partial t} + D\right)\theta = -\left(\beta + \frac{g}{C_P}\right)w, \quad (34)$$

$$\left(\frac{\partial}{\partial t} - \kappa'\nabla^2\right)\gamma = \beta' w, \quad (35)$$

where $\alpha_0 = \rho_d/\rho_0$

Eliminating θ, γ and h_z from equations (32)-(35) and using expression (15), we obtain the dispersion relation

$$n^5 + A_4 n^4 + A_3 n^3 + A_2 n^2 + A_1 n + A_0 = 0, \quad (36)$$

where

$$A_4 = D + \nu_C(\alpha_0 + 1) + k^2(\nu + \eta + \kappa')$$

$$A_3 = \kappa'\eta k^4 + k^2 D(\eta + \kappa') + (\nu_C + \nu k^2 + \alpha_0 \nu_C)\{D + k^2(\eta + \kappa')\} + \nu k^2 \nu_C + \Gamma\left(\beta + \frac{g}{C_P}\right) + \Gamma'\beta' + k_z^2 V_A^2,$$

$$A_2 = \kappa'\eta k^4 D + (\nu_C + \nu k^2 + \alpha_0 \nu_C)\{\kappa'\eta k^4 + k^2 D(\eta + \kappa')\} + \nu k^2 \nu_C\{D + k^2(\eta + \kappa')\} + \Gamma\left(\beta + \frac{g}{C_P}\right)(\nu_C + \eta k^2 + \kappa' k^2) + \Gamma'\beta'(\nu_C + \eta k^2 + D) + k_z^2 V_A^2(\nu_C + \kappa' k^2 + D),$$

$$A_1 = \kappa'\eta k^4 D(\nu_C + \nu k^2 + \alpha_0 \nu_C) + \nu k^2 \nu_C\{\kappa'\eta k^4 + k^2 D(\eta + \kappa')\} + \Gamma\left(\beta + \frac{g}{C_P}\right)\{\eta k^2 \nu_C + \kappa' k^2(\nu_C + \eta k^2)\} + \Gamma'\beta'\{\eta k^2 \nu_C + D(\nu_C + \eta k^2)\} + k_z^2 V_A^2\{\kappa' k^2 \nu_C + D(\nu_C + \kappa' k^2)\},$$

$$A_0 = \eta k^2 \nu_C\left\{(\nu\kappa' k^4 + \Gamma'\beta')D + \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2\right\} + k_z^2 V_A^2 D\kappa' k^2 \nu_C, \quad (37)$$

where

$$V_A^2 = \frac{H^2}{4\pi\rho_0}.$$

When

$$D < 0 \ \ and \ |(\nu\kappa' k^4 + \Gamma'\beta')D| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2, \quad (38)$$

the constant term in equation (36) is negative. Equation (36), therefore, involves one change of sign and hence contains one positive real root. The occurrence of positive root implies monotonic instability.

We thus obtain a criterion that the thermosolutal-convective instability of a composite stellar atmosphere in the presence of stable solute concentration gradient and collisional effects is unstable if

$$D < 0 \ \ and \ |(\nu\kappa' k^4 + \Gamma'\beta')D| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2.$$

The criterion for monotonic instability is the same in the presence or absence (Sharma and Sharma [14]) of the collisional effect on thermosolutal-convective instability of a composite stellar atmosphere.

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On Thermal Convection of a Plasma in Porous Medium

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Abstract: The effect of finite Larmor radius of the ions on thermal convection of a plasma is investigated. The case with vertical magnetic field is discussed. Following linear stability theory and normal mode analysis method, the dispersion relation is obtained. It is found that the presence of finite Larmor radius and magnetic field introduces oscillatory modes in the system which were, otherwise, non-existent in their absence. When the instability sets in as stationary convection, finite Larmor radius is found to have a stabilizing effect. Medium permeability has a destabilizing (or stabilizing) effect and the magnetic field has a stabilizing (or destabilizing) effect under certain conditions in the presence of finite Larmor radius effect whereas in the absence of finite Larmor radius effect, the medium permeability and the magnetic field have destabilizing and stabilizing effects, respectively. The sufficient conditions for the non-existence of overstability are also obtained.

Key-words: Finite Larmor radius effect, plasma, porous medium, thermal convection, vertical magnetic field

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1 Introduction

The theoretical and experimental results on thermal convection in a fluid layer, under varying assumptions of hydrodynamics and hydromagnetics, have been discussed in a treatise by Chandrasekhar [1]. The effects of the finiteness of the ion Larmor radius which exhibits itself in the form of 'magnetic viscosity' in the fluid equations have been studied by many authors (Jukes [2]; Vandakurov [3]]) Sharma and Prakash [4] have studied the effect of finite Larmor radius on the thermal instability of a plasma. Melchior and Popowich [5] have considered the finite Larmor radius effect on the Kelvin-Helmholtz instability in a fully ionized plasma while that on Rayleigh-Taylor instability has been studied by Singh and Hans [6]. The effect of finite Larmor radius on the thermal instability of a plasma in the presence of a vertical magnetic field has been studied by Sharma [7].

The study of the breakdown of the stability of a layer of fluid subject to a vertical temperature gradient in porous medium and the possibility of convective flow is of considerable interest in recent years. The study of onset of convection in a porous medium has attracted considerable interest because of its natural occurrence and of its intrinsic importance in many industrial problems, particularly in petroleum-exploration, chemical and nuclear industries. The derivation of the basic equations of a layer of fluid heated from below in porous medium, using Boussinesq approximation, has been given by Joseph [8]. The study of a layer of fluid heated from below in porous media is motivated both theoretically and by its practical applications in engineering disciplines. Among the applications in engineering disciplines one can find the food process industry, chemical process industry, solidification and centrifugal casting of metals. The development of geothermal power resources has increased general interest in the properties of convection in porous medium. Lapwood [9] has studied the stability of convective flow in a porous medium

using Rayleigh's procedure. The Rayleigh instability of a thermal boundary layer in flow through a porous medium has been considered by Wooding [10].

The properties of ionized space and laboratory magnetic fluids (plasmas) have been intensively investigated theoretically and experimentally in the past sixty years. One of the key aspects studied in this context is the stability of plasma structures. Usually, instabilities can be divided into two categories: macro- and micro-instabilities. Macro-instabilities occur with low frequencies compared to the plasma and cyclotron frequency and they are studied within the framework of magnetohydrodynamics (MHD). Physicists have understood the behavior of macro-instabilities and they showed how to avoid the most destructive of them, but small-scale gradient driven micro-instabilities are still a serious obstacle for having a stable plasma for a large range of parameters. Micro-instabilities are described by models which include, e.g. finite Larmor radius (FLR) and collisionless dissipative effects in plasmas. Time and length scales of micro-instabilities are comparable to the turbulent length scales and the length scales of transport coefficients. In general, the FLR effect is neglected. However, when the Larmor radius becomes comparable to the hydromagnetic length of the problem (e.g. wavelength) or the gyration frequency of ions in the magnetic field is of the same order as the wave frequency, finiteness of the Larmor radius must be taken into account. Strictly speaking, the space and time scale for the breakdown of hydromagnetics are on the respective scales of ion gyration about the field, and the ion Larmor frequency. In the present paper, we explore the effect of FLR on the thermal instability of a plasma in porous medium. Finite Larmor radius effect on plasma instabilities has been the subject of many investigations. In many astrophysical plasma situations such as in solar corona, interstellar and interplanetary plasmas the assumption of zero Larmor radius is not valid. Roberts and Taylor [11] and Rosenbluth et al. [12] have shown the stabilizing influence of finite ion Larmor radius (FLR) effects on plasma instabilities. Hernegger [13] investigated the stabilizing effect of FLR on thermal instability and showed that thermal criterion is changed by FLR for wave propagation perpendicular to the magnetic field. Sharma [14] investigated the stabilizing effect of FLR on thermal instability of rotating plasma. Ariel [15] discussed the stabilizing effect of FLR on thermal instability of conducting plasma layer of finite thickness surrounded by a non-conducting matter. Vaghela and Chhajlani [16] studied the stabilizing effect of FLR on magneto-thermal stability of resistive plasma through a porous medium with thermal conduction. Bhatia and Chhonkar [17] investigated the stabilizing effect of FLR on the instability of a rotating layer of self-gravitating plasma incorporating the effects of viscosity and Hall current. Vyas and Chhajlani [18] pointed out the stabilizing effect of FLR on the thermal instability of magnetized rotating plasma incorporating the effects of viscosity, finite electrical conductivity, porosity and thermal conductivity. Kaothekar and Chhajlani [19] investigated the problem of Jeans instability of self-gravitating rotating radiative plasma with finite Larmor radius corrections. Thus FLR effect is an important factor in the discussion of thermal convection and other hydromagnetic instabilities. Keeping these in mind, an attempt is made to study the thermal convection of incompressible plasma in porous medium in the presence of finite Larmor radius effect in the present paper.

2 Formulation of the Problem and Perturbation Equations

Consider an infinite, horizontal, incompressible, viscous and electrically conducting plasma layer of depth d bounded by the planes $z = 0$ and $z = d$ in an isotropic and homogeneous medium of porosity ε and medium permeability k_1. This layer is heated from below such that a steady temperature gradient $\beta(= \left|{}^{dT}/_{dz}\right|)$ is maintained. Temperatures and densities at the bottom surface $z = 0$ are T_0 and ρ_0 and at the upper surface $z = d$ are T_1 and ρ_1 respectively. The system is acted on by a uniform vertical magnetic field $\vec{H}(0, 0, H)$ and gravity field $\vec{g}(0, 0, -g)$. Let $\rho, T, \alpha, \chi, g, \mu_e, \mu, \nu \left(= \frac{\mu}{\rho_0}\right), (u, v, w), \eta$ and $\vec{P}$ denote, respectively, the density, temperature, thermal coefficient of expansion, thermal diffusivity, gravitational

acceleration, magnetic permeability, viscosity, kinematic viscosity, electrical resistivity and stress tensor taking into account the finite Larmor radius effect. When the plasma flows through a porous medium, the gross effect is represented by Darcy's law. As a result, the resistance term $-\left(\frac{\mu}{k_1}\right)\vec{q}$ replaces the usual viscous term, here $\vec{q}$ stands for the filter velocity of the plasma. Then the equations expressing the conservation of momentum, mass and heat are

$$\frac{1}{\varepsilon}\left[\frac{\partial \vec{q}}{\partial t}+\frac{1}{\varepsilon}(\vec{q}.\nabla)\vec{q}\right]=-\frac{1}{\rho_0}\vec{P}+\vec{g}\left(1+\frac{\delta\rho}{\rho_0}\right)+\frac{\mu_e}{4\pi\rho_0}(\nabla\times\vec{\mathrm{H}})\times\vec{H}-\frac{\nu}{k_1}\vec{q}\,, \quad (1)$$

$$\nabla.\vec{q}=0\,, \quad (2)$$

$$E\frac{\partial T}{\partial t}+(\vec{q}.\nabla)T=\kappa\nabla^2 T, \quad (3)$$

where $E=\varepsilon+(1-\varepsilon)\frac{\rho_s C_s}{\rho_0 C}$s ; ρ_0, C are the density and heat capacity of the plasma and ρ_s, C_s are the density and the heat capacity of the solid matrix respectively.

The equation of the state is

$$\rho=\rho_0[1-\alpha(T-T_0)],$$

where the suffix zero refers to the values at the reference level $z=0$.

The Maxwell's equations yield

$$\varepsilon\frac{d\vec{H}}{dt}=(\vec{H}.\nabla)\vec{q}+\epsilon\eta\nabla^2\vec{H}\,, \quad (4)$$

$$\nabla.\vec{H}=0\,, \quad (5)$$

where $d/dt=\partial/\partial t+(1/\varepsilon)(\vec{q}.\nabla)$ stands for the convective derivative.

For the magnetic field along the $z-$axis, the stress tensor $\vec{\vec{P}}$, taking into account the finite ion gyration radius (Vandakurov, [3]), has the components

$$P_{xx}=p-\rho_0\nu_0\left(\frac{\partial u}{\partial y}+\frac{\partial v}{\partial x}\right),$$

$$P_{xy}=P_{yx}=\rho_0\nu_0\left(\frac{\partial u}{\partial x}-\frac{\partial v}{\partial y}\right),$$

$$P_{xz}=P_{zx}=-2\rho_0\nu_0\left(\frac{\partial v}{\partial z}+\frac{\partial w}{\partial y}\right), \quad (6)$$

$$P_{yy}=p+\rho_0\nu_0\left(\frac{\partial u}{\partial y}+\frac{\partial v}{\partial x}\right),$$

$$P_{yz}=P_{zy}=2\rho_0\nu_0\left(\frac{\partial w}{\partial x}+\frac{\partial u}{\partial z}\right), \quad P_{zz}=p\,,$$

where p is the scalar part of the pressure and $\rho_0\nu_0=Nk^*T/4\omega_H$, ω_H being the ion-gyration frequency, k^* is Boltzman constant, while N and T are number density and temperature of the ions, respectively.

The steady state solution is

$$\vec{q}=(0,\,0,\,0), T=T_0-\beta z, \quad \rho=\rho_0(1+\alpha\beta z), \quad (7)$$

where $\beta=\frac{T_0-T_1}{d}$ is the magnitude of uniform temperature gradient which is maintained and is positive as temperature decreases upwards.

Now we consider a small perturbation on the steady state and let $\delta\rho,\delta\vec{\vec{P}},\theta,\vec{q}(u,\,v,w)$ and $\vec{h}(h_x,\,h_y,\,h_z)$ denote, respectively, the perturbations in density, stress tensor, temperature, hydromagnetic fluid velocity (initially zero) and the magnetic field. The change in density $\delta\rho$, caused by the perturbations θ in temperature, is given by

$$\delta\rho=-\alpha\rho_0\theta\,. \quad (8)$$

Then the linearized hydromagnetic perturbation equations relevant to the problem are

$$\frac{1}{\varepsilon}\frac{\partial\vec{q}}{\partial t}=-\frac{1}{\rho_0}\nabla\delta\vec{\vec{P}}+\vec{g}\left(\frac{\delta\rho}{\rho_0}\right)+\frac{\mu_e}{4\pi\rho_0}(\nabla\times\vec{h})\times\vec{H}-\frac{\nu}{k_1}\vec{q}\,, \quad (9)$$

$$\nabla.\vec{q}=0\,, \quad (10)$$

$$E\frac{\partial\theta}{\partial t}=\beta w+\kappa\nabla^2\theta\,, \quad (11)$$

$$\varepsilon\frac{\partial\vec{h}}{\partial t}=(\vec{H}.\nabla)\vec{q}+\epsilon\eta\nabla^2\vec{h}\,, \quad (12)$$

$$\nabla.\vec{h}=0. \quad (13)$$

Within the framework of the Boussinesq approximation, equations (9) – (13) become

$$\left(\frac{\partial}{\partial t}+\frac{\nu\varepsilon}{k_1}\right)\nabla^2 = \varepsilon g\alpha\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\theta + \frac{\mu_e H\varepsilon}{4\pi\rho_0}\frac{\partial}{\partial z}(\nabla^2 h_z) + \varepsilon\nu_0\left(\nabla^2 - 3\frac{\partial^2}{\partial z^2}\right)\frac{\partial\zeta}{\partial z}, \quad (14)$$

$$\left(\frac{\partial}{\partial t}+\frac{\nu\varepsilon}{k_1}\right)\zeta = \frac{\mu_e\varepsilon H}{4\pi\rho_0}\frac{\partial\xi}{\partial z} - \varepsilon\nu_0\left(\nabla^2 - 3\frac{\partial^2}{\partial z^2}\right)\frac{\partial w}{\partial z}, \quad (15)$$

$$\varepsilon\frac{\partial\xi}{\partial t} = H\frac{\partial\zeta}{\partial z} + \varepsilon\eta\nabla^2\xi, \quad (16)$$

$$\left[E\frac{\partial}{\partial t} - \kappa\nabla^2\right]\theta = \beta w, \quad (17)$$

$$\varepsilon\left[\frac{\partial}{\partial t} - \eta\nabla^2\right]h_z = H\frac{\partial w}{\partial z}, \quad (18)$$

where $\nabla^2 = {\partial^2}/{\partial x^2} + {\partial^2}/{\partial y^2} + {\partial^2}/{\partial z^2}$

and $\zeta = {\partial v}/{\partial x} - {\partial u}/{\partial y};\ \xi = {\partial h_y}/{\partial x} - {\partial h_x}/{\partial y}$

stand for the z-components of vorticity and current density, respectively.

3 Dispersion Relation

We decompose the disturbances into normal modes and assume that the perturbed quantities are of the form

$$[w, h_z, \zeta, \xi, \theta] = [W(z), K(z), Z(z), X(z), \Theta(z)]exp\left[ik_x x + ik_y y + nt\right], \quad (19)$$

where k_x and k_y are the wave numbers along the $x-$ and $y-$ directions, respectively, $k = \sqrt{k_x^2 + k_y^2}$ is the resultant wave number, and n is, in general, a complex constant.

Using expression (19), equations (14) - (18) in non-dimensional form transform to

$$\left(\frac{\sigma}{\varepsilon}+\frac{1}{P_l}\right)(D^2-a^2)W + \left(\frac{gd^2}{\nu}\right)a^2\alpha\Theta - \frac{\mu_e H d}{4\pi\rho_0\nu}(D^2-a^2)DK + \left(\frac{\nu_0 d}{\nu}\right)(2D^2+a^2)DZ = 0, \quad (20)$$

$$\left(\frac{\sigma}{\varepsilon}+\frac{1}{P_l}\right)Z = \left(\frac{\mu_e H d}{4\pi\rho_0\nu}\right)DX + \left(\frac{\nu_0}{\nu d}\right)(2D^2+a^2)DW, \quad (21)$$

$$[D^2 - a^2 - Ep_1\sigma]\Theta = -\left(\frac{\beta d^2}{\kappa}\right)W, \quad (22)$$

$$[D^2 - a^2 - p_2\sigma]K = -\left(\frac{Hd}{\varepsilon\eta}\right)DW, \quad (23)$$

$$[D^2 - a^2 - p_2\sigma]X = -\left(\frac{Hd}{\varepsilon\eta}\right)DZ, \quad (24)$$

where we have introduced new coordinates $(x^*, y^*, z^*) = \left({x}/{d}, {y}/{d}, {z}/{d}\right)$ in the new unit of length d and $D = {d}/{dz^*}$. For convenience, the asterisks are dropped hereafter. Also we have put $a = kd$ and $\sigma = {nd^2}/{\nu}$, $p_1 = {\nu}/{\kappa}$ is the Prandtl number, $p_2 = {\nu}/{\eta}$ is the magnetic Prandtl number and $P_l = {k_1}/{d^2}$ is the dimensionless medium permeability.

Here we consider the case where both boundaries are free as well as perfect conductors of heat, while the adjoining medium is electrically non-conducting. The case of two free boundaries is slightly artificial, except in stellar atmospheres (Spiegel [20]) and in certain geophysical situations where it is most appropriate. However, the case of two free boundaries allows us to obtain analytical solution without affecting the essential features of the problem. The appropriate boundary conditions, with respect to which equations (20) – (24) must be solved, are

$$W = D^2W = 0,\ DZ = 0, \Theta = 0, X = 0 = 0\ \ at\ z = 0\ and\ 1, \quad (25)$$

on a perfectly conducting boundary.

In the absence of any surface current, the tangential components of the magnetic field are continuous. Hence the boundary conditions, in addition to (25), are

$DK = 0$ on the boundaries. (26)

Using the above boundary conditions, it can be shown that all the even order derivatives of W must vanish for $z = 0\ and\ 1$ and hence the proper solution of W characterizing the lowest mode is

$$W = W_0 sin\, \pi z, \tag{27}$$

where W_0 is a constant.

Eliminating $Z, K, X\ and\ \Theta$ between equations (20) - (24) and substituting the proper solution (27) in the resultant equation, we obtain the dispersion relation

$$\begin{aligned} &R_1 x \\ &= (1+x)\left(\frac{i\sigma_1}{\varepsilon}+\frac{1}{P}\right)(1+x+iEp_1\sigma_1) \\ &+ Q_1\frac{(1+x)(1+x+iEp_1\sigma_1)}{\varepsilon(1+x+ip_2\sigma_1)} \\ &+\frac{U(x-2)^2(1+x+ip_2\sigma_1)(1+x+iEp_1\sigma_1)}{\left[(1+x+ip_2\sigma_1)\left(\frac{i\sigma_1}{\varepsilon}+\frac{1}{P}\right)+\frac{Q_1}{\varepsilon}\right]}, \end{aligned} \tag{28}$$

where

$$Q = \frac{\mu_e H^2 d^2}{4\pi\rho_0\nu\eta}, R = \frac{g\alpha\beta d^4}{\nu\kappa}\ ,\ U = \frac{\nu_0^2}{\nu^2},$$

stand for the Chandrasekhar number, the thermal Rayleigh number, a non-dimensional number accounting for the finite Larmor radius, respectively, and we have also put

$$x = \frac{a^2}{\pi^2},\ P = \pi^2 P_l,\ i\sigma_1 = \frac{\sigma}{\pi^2},\ Q_1 = \frac{Q}{\pi^2},\ R_1 = \frac{R}{\pi^4}\ \ and\ i\ \ = \sqrt{-1}\,.$$

4 Important Theorems and Discussion

Theorem 1: The system is stable or unstable.

Proof: Multiplying equation (20) by W^*, the complex conjugate of W, and using equations (21) - (24) together with the boundary conditions (25) and (26), we obtain

$$\begin{aligned} &\left(\frac{\sigma}{\varepsilon}+\frac{1}{P_l}\right)I_1 - \frac{g\alpha\kappa a^2}{\nu\beta}(I_2 + Ep_1\sigma^* I_3) \\ &+\frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}(I_4 + p_2\sigma^* I_5) + d^2\left(\frac{\sigma^*}{\varepsilon}+\frac{1}{P_l}\right)I_6 \\ &+\frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}(I_7 + p_2\sigma I_8) \\ &= 0\,, \end{aligned} \tag{29}$$

where

$$I_1 = \int_0^1 (|DW|^2 + a^2|W|^2)\, dz,$$

$$I_2 = \int_0^1 (|D\Theta|^2 + a^2|\Theta|^2) dz,$$

$$I_3 = \int_0^1 (|\Theta|^2) dz,$$

$$I_4 = \int_0^1 (|D^2K|^2 + 2a^2|DK|^2 + a^4|K|^2) dz,$$

$$I_5 = \int_0^1 (|DK|^2 + a^2|K|^2) dz,$$

$$I_6 = \int_0^1 (|Z|^2) dz,$$

$$I_7 = \int_0^1 (|DX|^2 + a^2|X|^2) dz,$$

$$I_8 = \int_0^1 (|X|^2) dz. \tag{30}$$

and σ^* is the complex conjugate of σ. The integrals $I_1, \ldots\ldots\ldots\ldots I_8$ are all positive definite. Putting $\sigma = \sigma_r + i\sigma_i$ and equating the real and imaginary parts of equation (29), we obtain

$$\begin{aligned} &\left[\frac{I_1}{\varepsilon}+\frac{\mu_e\eta\varepsilon p_2}{4\pi\rho_0\nu}(I_5 + d^2 I_8) - \frac{g\alpha\kappa a^2}{\nu\beta}Ep_1 I_3 + \frac{d^2}{\varepsilon}I_6\right]\sigma_r = \\ &-\left[\frac{1}{P_l}I_1 + \frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}(I_4 + d^2 I_7) - \frac{g\alpha\kappa a^2}{\nu\beta}I_2 + \frac{d^2}{P_l}I_6\right], \end{aligned} \tag{31}$$

and

$$\left[\frac{I_1}{\varepsilon}+\frac{g\alpha\kappa a^2}{\nu\beta}Ep_1I_3-\frac{\mu_e\eta\varepsilon p_2}{4\pi\rho_0\nu}(I_5-d^2I_8)-\frac{d^2}{\varepsilon}I_6\right]\sigma_i=0\,. \quad (32)$$

It is evident from equation (31) that σ_r may be positive or negative. The system is, therefore, stable or unstable.

Theorem 2: The modes may be oscillatory or non-oscillatory in contrast to case of no magnetic field, and in the absence of finite Larmor radius and stable solute gradient where modes are non-oscillatory.

Proof: Equation (32) yields that σ_i may be zero or non-zero, which means that the modes may be non-oscillatory or oscillatory. In the absence of finite Larmor radius and magnetic field, equation (32) reduces to

$$\sigma_i\left[\frac{I_1}{\varepsilon}+\frac{g\alpha\kappa a^2}{\nu\beta}Ep_1I_3\right]=0, \quad (33)$$

and the terms in brackets are positive definite. Thus $\sigma_i=0$, which means that oscillatory modes are not allowed and the principle of exchange of stabilities is valid. The oscillatory modes are introduced due to the presence of magnetic field and finite Larmor radius which were non-existent in their absence.

Theorem 3: The system is stable for $\frac{g\alpha\kappa}{\nu\beta}\leq\frac{27\pi^4}{4}$ and under the condition $\frac{g\alpha\kappa}{\nu\beta}>\frac{27\pi^4}{4}$, the system becomes unstable.

Proof: From equation (32), it is clear that σ_i is zero when the quantity multiplying it is not zero and arbitrary when this quantity is zero.

If $\sigma_i\neq 0$, then equation (31) gives

$$\frac{I_1}{\varepsilon}+\frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}p_2I_8=\frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}p_2I_5+\frac{d^2}{\varepsilon}I_6-\frac{g\alpha\kappa a^2}{\nu\beta}Ep_1I_3$$

Substituting this in equation (30), we get

$$\frac{2\sigma_rI_1}{\varepsilon}+\frac{1}{P_l}I_1+\frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}I_4+d^2\left(\frac{1}{P_l}\right)I_6+\frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}I_7+\frac{2\sigma_r\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}p_2I_8=\frac{g\alpha\kappa a^2}{\nu\beta}I_2\,. \quad (34)$$

Equation (34) on using Rayleigh-Ritz inequality gives

$$\frac{(\pi^2+a^2)^3}{a^2}\int_0^1|W|^2\,dz+\frac{(\pi^2+a^2)}{a^2}\left\{\frac{2\sigma_r\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}p_2I_8+\frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}I_7+d^2\left(\frac{1}{P_l}\right)I_6+\frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}I_4+\frac{1}{P_;}I_1+\frac{2\sigma_r}{\varepsilon}I_1\right\}\leq\frac{g\alpha\kappa}{\beta\nu}\int_0^1|W|^2\,dz\ . \quad (35)$$

Therefore, it follows from equation (35) that

$$\left[\frac{27\pi^4}{4}-\frac{g\alpha\kappa}{\nu\beta}\right]\int_0^1|W|^2\,dz+\frac{(\pi^2+a^2)}{a^2}\left\{\frac{2\sigma_r\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}p_2I_8+\frac{\mu_e\eta d^2\varepsilon}{4\pi\rho_0\nu}I_7+d^2\left(\frac{1}{P_l}\right)I_6+\frac{\mu_e\eta\varepsilon}{4\pi\rho_0\nu}I_4+\frac{1}{P_;}I_1+\frac{2\sigma_r}{\varepsilon}I_1\right\}\leq 0 \quad (36)$$

since minimum value of $\frac{(\pi^2+a^2)^3}{a^2}$ with respect to a^2 is $\frac{27\pi^4}{4}$.

Now, let $\sigma_r\geq 0$, we necessary have from (36) that

$$\frac{g\alpha\kappa}{\nu\beta}>\frac{27\pi^4}{4}\quad . \quad (37)$$

Hence, if

$$\frac{g\alpha\kappa}{\nu\beta}\leq\frac{27\pi^4}{4}\quad , \quad (38)$$

then $\sigma_r<0$. Therefore, the system is stable. Thus, under condition (38), the system is stable and under condition (37) the system becomes unstable.

Theorem 4: For stationary convection case:

(I) Finite Larmor radius has stabilizing effects on the system.

(II) In the absence of finite Larmor radius effect, the medium permeability and the magnetic field have destabilizing and stabilizing effects respectively.

(III) In the presence of finite Larmor radius effect if

$$\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]^2 > (or\ <) \\ U(x-2)^2(1+x)$$

the medium permeability has a destabilizing (or stabilizing) and the magnetic field has a stabilizing (or destabilizing) effect on the system.

Proof: When the instability sets in as stationary convection, the marginal state will be characterized by $\sigma = 0$. Putting $\sigma = 0$, the dispersion relation (28) reduces to

$$R_1 = \left(\frac{1+x}{x}\right)\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right] + \frac{U(x-2)^2(1+x)^2}{x\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]}, \quad (39)$$

which expresses the modified Rayleigh number R_1 as a function of the dimensionless wave number x and the parameters $Q_1, U\ and\ P$. To study the effects of finite Larmor radius, medium permeability and magnetic field on R_1, we examine the nature of $dR_1/dU\ , dR_1/dP\ and\ dR_1/dQ_1$ analytically.

(I) It follows from equation (39),

$$\frac{dR_1}{dU} = \frac{(x-2)^2(1+x)^2}{x\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]} > 0, \quad (40)$$

which implies that finite Larmor radius has stabilizing effect on the system.

(II) Also equation (39) yields

$$\frac{dR_1}{dP} = -\frac{(1+x)}{xP^2}$$

$$\left[\frac{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2 - U(x-2)^2}{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2}\right], \quad (41)$$

and

$$\frac{dR_1}{dQ_1} = \left(\frac{1+x}{\varepsilon x}\right)$$

$$\left[\frac{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2 - U(x-2)^2(1+x)}{\left(\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right)^2}\right], \quad (42)$$

If

$$\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]^2 < U(x-2)^2(1+x), \quad (43)$$

then

$$\frac{dR_1}{dP} > 0\ and\ \frac{dR_1}{dQ_1} < 0,$$

exhibiting the stabilizing effect of medium permeability and destabilizing effect of magnetic field respectively.

If

$$\left[\frac{1+x}{P}+\frac{Q_1}{\varepsilon}\right]^2 > U(x-2)^2(1+x), \quad (44)$$

then

$$\frac{dR_1}{dP} < 0\ and\ \frac{dR_1}{dQ_1} > 0,$$

meaning thereby the destabilizing effect of medium permeability and stabilizing effect of the magnetic field on the thermal instability of a plasma in porous media.

In the absence of finite Larmor radius effect, equation (41) reduces to

$$\frac{dR_1}{dP} = -\frac{(1+x)^2}{xP^2} < 0, \quad (45)$$

and

$$\frac{dR_1}{dQ_1} = \left(\frac{1+x}{\varepsilon x}\right) > 0. \quad (46)$$

The medium permeability and magnetic field thus have destabilizing and stabilizing effects respectively.

Theorem 5: The sufficient conditions for the non-existence of overstability are

$$\kappa < \left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta \ \ and\ \kappa < \frac{\left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta}{P^3\left[\left(\frac{\nu_0}{\nu}\right)^2 \varepsilon(b-3)^2 - \frac{\mu_e H^2 d^2}{2\varepsilon^2 \rho_0 \nu \eta \pi^3 P}\right]}.$$

Proof: Here we discuss the possibility of whether instability may occur as overstability. Since for overstability, our interest is to determine the critical Rayleigh number for the onset of instability via a state of pure oscillations, it will suffice to find conditions for which equation (28) will admit of solutions with σ_1 real.

Assuming that σ_1 is real and equating the real and imaginary parts of equation (28) and eliminating R_1 between them, we obtain

$$A_3 C_1^3 + A_2 C_1^2 + A_1 C_1 + A_0 = 0\,, \qquad (47)$$

where $C_1 = \sigma_1^2\,,\ b = 1 + x\ and$

$$A_3 = \frac{b p_2^4}{\varepsilon^2}\left(\frac{E p_1}{P} + \frac{b}{\varepsilon}\right), \qquad (48)$$

$$\begin{aligned} A_0 = \frac{b^6}{\varepsilon P^2} + \Bigg[&\left(\frac{E p_1}{P^3} + \frac{2Q_1}{\varepsilon^2 P}\right) - \frac{U(b-3)^2}{\varepsilon}\Bigg] b^5 \\ &+ \left[\frac{Q_1^2}{\varepsilon^3} + \frac{Q_1}{\varepsilon P^2}(3E p_1 - p_2) + U(b-3)^2 \frac{E p_1}{P}\right] b^4 \\ &+ \left[\frac{Q_1^2}{\varepsilon^2 P}(3E p_1 - 2p_2) + U(b-3)^2\left(\frac{p_2 Q_1}{\varepsilon} + \frac{E p_1 Q_1}{\varepsilon}\right)\right] b^3 \\ &+ \frac{Q_1^3}{\varepsilon^3}(E p_1 - p_2) b^2. \end{aligned} \qquad (49)$$

The coefficients $A_1 - A_2$ being quite lengthy and not needed in the discussion of overstability, have not been written here. Since σ_1 is real for overstability, the three values of $C_1 (= \sigma_1^2)$ are positive. The product of the roots of (47) is $-A_0/A_3$ and if this is to be positive, then A_0 must be negative since A_3 is positive.

It is clear from (49) that A_0 is always positive if

$$E p_1 > p_2\,, \quad and \quad \left(\frac{E p_1}{P^3} + \frac{2Q_1}{\varepsilon^2 P}\right) > \frac{U(b-3)^2}{\varepsilon}, \qquad (50)$$

which implies that

$$\kappa < \left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta \ \ and\ \kappa < \frac{\left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta}{P^3\left[\left(\frac{\nu_0}{\nu}\right)^2 \varepsilon(b-3)^2 - \frac{\mu_e H^2 d^2}{2\varepsilon^2 \rho_0 \nu \eta \pi^3 P}\right]} \qquad (51)$$

The inequalities (51) are, therefore, the sufficient conditions for the non-existence of overstability, the violation of which does not necessarily imply the occurrence of overstability.

5 Conclusions

The thermal convection of a plasma in porous medium in the presence of finite Larmor radius effect is considered in the present paper. The main conclusions from the analysis of this paper are as follows:

- It is found that the finite Larmor radius and magnetic field introduce oscillatory modes in the system which were non-existent in their absence.
- It is observed that the system is stable for $\frac{g\alpha\kappa}{\nu\beta} \le \frac{27\pi^4}{4}$ and under the condition $\frac{g\alpha\kappa}{\nu\beta} > \frac{27\pi^4}{4}$, the system becomes unstable.
- For the case of stationary convection, finite Larmor radius has stabilizing effect on the system.
- It is also observed for the case of stationary convection that in the presence of finite Larmor radius effect, the magnetic field has a stabilizing (or destabilizing) effect and the medium permeability has a destabilizing (or stabilizing) effect under certain conditions whereas in the absence of finite Larmor radius effect, the magnetic field and the medium

permeability have stabilizing and destabilizing effects, respectively.

- The case of overstability is also considered. The conditions

$$\kappa < \left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta \ \ and\ \kappa < \frac{\left[\varepsilon + (1-\varepsilon)\frac{\rho_S C_S}{\rho_0 C}\right]\eta}{P^3\left[\left(\frac{\nu_0}{\nu}\right)^2 \varepsilon(b-3)^2 - \frac{\mu_e H^2 d^2}{2\varepsilon^2 \rho_0 \nu \eta \pi^3 P}\right]}$$

are the sufficient conditions for the non-existence of overstability, the violation of which does not necessarily imply the occurrence of overstability.

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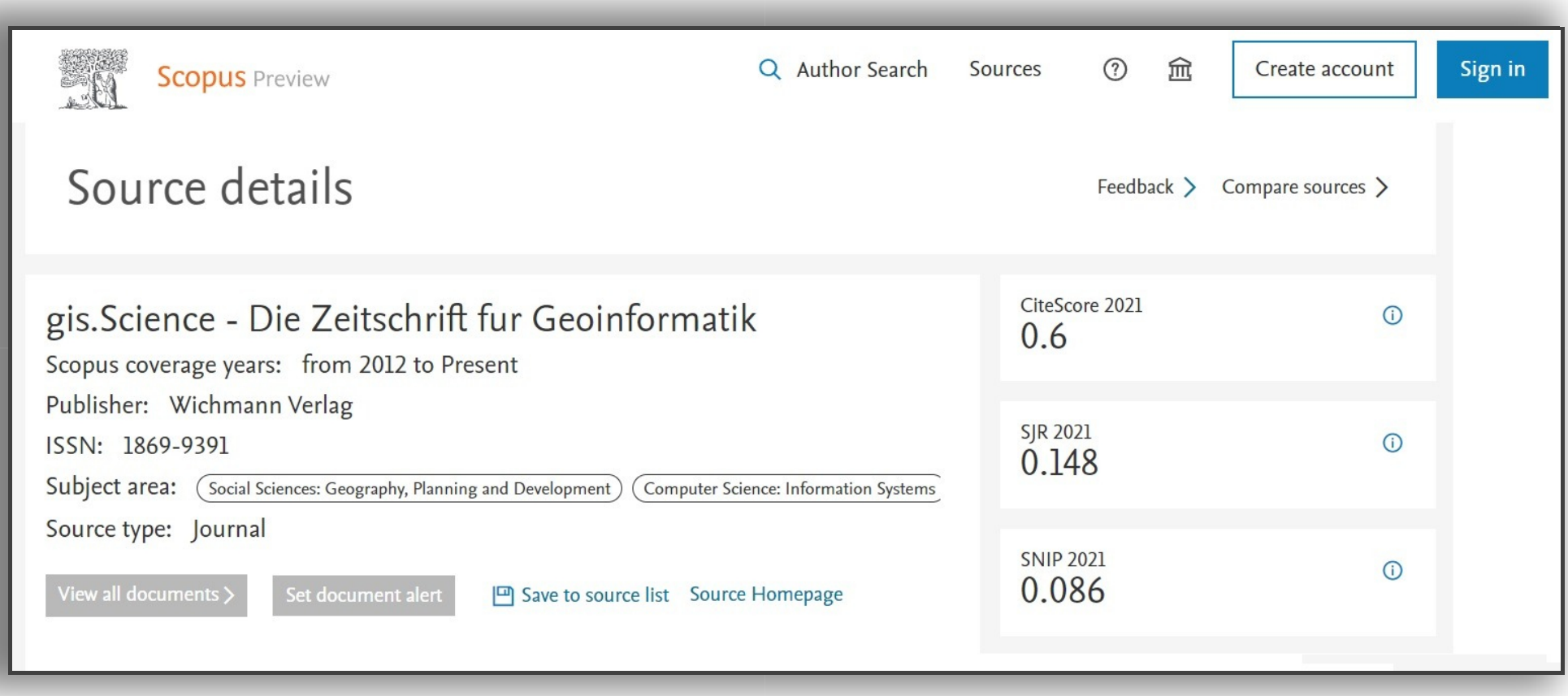

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Volume 3 Issue 10 (2020)

Isolation and Idenficatiion of Vibrio Spp from Different Dye Industry Effluent in Salem Distric Tamilnadu

Authors : Dr. V. Kalaiselvi ; P. Umamagesh ; D. Ammu ; R. Latha

DOI : doi.org/10.47752/sjsr.310.129.132 (https://doi.org/10.47752/sjsr.310.129.132)

Abstract:

Studies were carried out on the Different type of vibrio spp, isolated from dye industry effluent. Among the 90 strains of vibrio spp isolated from effluents of textile industries, three showed optimize at different factors such as pH, Temperatue, salinity, carbone source, nitrogen source etc.

Pages: 129-132

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Effective Interfacial Tension Effect on Kelvin-Helmholtz Instability

Authors : Pardeep Kumar ; Hari Mohan

DOI : doi.org/10.47752/sjsr.310.122.128 (https://doi.org/10.47752/sjsr.310.122.128)

Abstract:

The instability of the plane interface between two uniform, superposed and streaming Walters' B' viscoelastic fluids through porous medium in the presence of effective interfacial tension is considered. The case of two uniform streaming fluids separated by a horizontal boundary is studied. It is observed, for the special case where the effective interfacial tension is ignored, that the system is stable or unstable for the potentially stable configuration which is in contrast to the case of Rivlin-Ericksen viscoelastic fluid or Newtonian fluid where the system is always stable for the potentially stable configuration. Moreover, if the perturbations in the direction of streaming are ignored, then the perturbations transverse to the direction of streaming are found to be unaffected by the presence of streaming, whereas for perturbations in all other directions there exists instability for a certain wave number range. 'Effective interfacial tension' is able to suppress this Kelvin-Helmholtz instability for small wavelength perturbations, the medium porosity reduces the stability range given in terms of a difference in streaming velocities.

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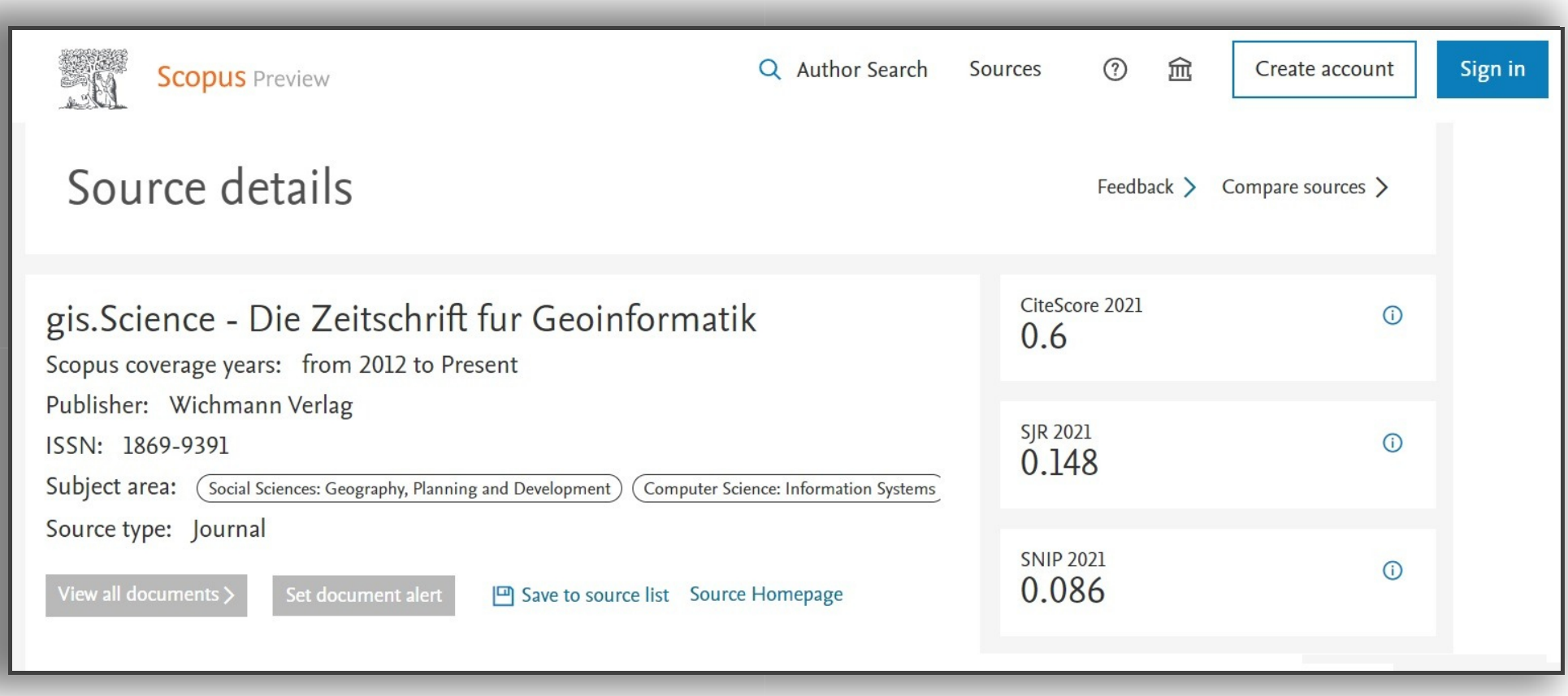

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Thermosolutal-convective Instability in Stern's Type Configuration

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Abstract:- The thermal-convective instability of a stellar atmosphere in the presence of stable solute gradient in Stern's type configuration is studied in the presence of radiative transfer effect. A criterion for monotonic instability is obtained in terms of the source functions S. The criterion for monotonic instability is found to be unchanged in the presence of radiative transfer and rotation effects. The problem of thermosolutal-convective instability of a hydromagnetic composite medium is also studied to include the frictional effects with neutrals. The criterion derived for monotonic instability in terms of heat-loss function is found to be the same in the presence or absence of the collisional effects.

Key-Words:-Frictional effects, Thermosolutal-convective instability, Radiative transfer effect, Rotation,

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1. Introduction

Defouw [1] has generalized the Schwarzschild criterion for convection to include departures from adiabatic motion and has shown that a thermally unstable atmosphere is also convectively unstable, irrespective of the atmospheric temperature gradient. The instability in which motions are driven by buoyancy forces of a thermally unstable atmosphere has been termed as "thermal convective instability". Defouw [1] has shown that an inviscid stellar atmosphere is unstable is unstable if

$$D = \frac{1}{C_P}\left(L_T - \rho\alpha L_\rho\right) + \kappa k^2 < 0, \qquad (1)$$

where L is the energy lost minus the energy gained per gram per second (the heat loss function) and ρ, α, κ, k, L_T, L_ρ denote respectively the density, the coefficient of thermal expansion, the coefficient of thermometric conductivity, the wave number of the perturbation, the partial derivative of L with respect to temperature T and the partial derivative of L with respect to density ρ, both evaluated in the equilibrium state. In general, the instability due to inequality (1) may be either oscillatory or monotonic. Defouw [1] has also shown that inequality (1) is a sufficient condition for monotonic instability in the presence of magnetic field and rotation on thermal convective instability.

Defouw [1] has also studied the effect of radiative transfer on the thermal-convective instability and has found that the source functions S which lead to thermal-convective instability are those for which $S_T - (\rho/T)S_\rho < 0$, the subscripts on S denote the partial derivatives of S with respect to T and ρ both evaluated in the equilibrium state.

A detailed account of thermal convection, under varying assumptions of hydrodynamics and hydromagnetics, has been given by Chandrasekhar [2]. Veronis [3] has considered the problem of thermohaline convection in a layer of fluid heated from below and subjected to a stable salinity gradient. The thermohaline convection in a horizontal layer of viscous fluid heated from below and salted from above has been studied by Nield [4]. In thermohaline-convective instability problem, buoyancy forces can arise not from density differences due to variations in temperature but also from those due to variations in solute concentrations. The conditions under which convective motions are important in stellar atmospheres are usually far

removed the consideration of a single component fluid and rigid boundaries and therefore it is desirable to consider one gas component acted on by solute concentration gradient and free boundaries. The thermosolutal-convective instability of a stellar atmosphere in the presence of suspended particles has been studied by Sharma and Singh [5]. The criteria for monotonic instability are derived and are found to hold good also in the presence of uniform rotation and uniform magnetic field on the thermosolutal-convective instability.

A partially ionized plasma represents a state which often exists in the Universe. There are several situations where the interaction between the ionized and neutral gas components becomes important in cosmic physics. As a reasonably simple approximation, the plasma may be idealized as a composite mixture of a hydromagnetic (ionized) component and a neutral component, the two interacting through mutual collisional (frictional) effects. Hans [6] made this simplified approximation and found that these collisions have a stabilizing effect on the Rayleigh-Taylor instability.Marcu and Ballai [7] have studied the thermosolutal linear stability of a composite two-component plasma in the presence of Coriolis forces, finite Larmor radius, taking into account the collisions between neutral and ionized particles. The thermosolutal instability appears due to a material convection (thermosolutal convection) in a two component fluid with different molecular diffusivities which contribute in an opposing sense to the locally vertical density gradient. Natural convection with Soret and radiation effects in a binary fluid saturating a horizontal porous layer under the influence of magnetic field has been investigated by Israel-Cookey and Amos [8]. Sheri et. al [9] has studied the transient radiative reactive thermosolutal magnetohydrodynamic convection in inclined MHD hall generator flow with dissipation and cross diffusion.

In the present paper we consider the thermosolutal-convective instability in Stern's type configuration of a stellar atmosphere (the thermal-convective instability in the presence of stable solute gradient) to include the radiative transfer effect. The effects of radiative transfer and rotation are also studied on the thermosolutal-convective instability. The effects of radiative transfer arise when self absorption is not negligible. As a partially ionized plasma represents a state which often exists in the Universe, the problem of thermosolutal-convective instability of a hydromagnetic composite medium is, therefore, studied to include the frictional effects with neutrals. Theseaspects form the subject matter of the present study.

2. Description of the Instability and Perturbation Equations

Consider an infinite horizontal fluid layer of thickness d heated from above and subjected to a stable solute concentration gradient so that the temperatures and solute concentrations at the bottom surface $z = 0$are T_0 and C_0 and at the upper surface $z = d$ are T_1 and C_1 respectively, z -axis being taken as vertical. This layer is acted on by a gravity force $\vec{g}(0,\ 0,\ -g)$. Then, following the Boussinesq approximation, which states that the inertial effects produced by density variation are negligible in comparison to its gravitational effects i.e. ρ can be taken as constant everywhere in the equations of motion except in the term with external force, consequently the equations governing the motion of the fluid assume the following form:

$$\frac{\partial \vec{v}}{\partial t} + (\vec{v}\ .\ \nabla)\vec{v} = -\frac{1}{\rho_0}\nabla p + \nu\,\nabla^2\vec{v} + \vec{g}\left(1 + \frac{\delta\rho}{\rho_0}\right), \tag{2}$$

$$\nabla.\vec{v} = 0\,, \tag{3}$$

$$\frac{\partial C}{\partial t} + (\vec{v}\ .\ \nabla)C = \kappa'\nabla^2 C\,, \tag{4}$$

$$\rho = \rho_0[1 - \alpha(T - T_0) + \alpha'(C - C_0)]. \tag{5}$$

The suffix zero refers to values at the reference level $z = 0$. Equations (2) – (4) express respectively the conservation of momentum,

mass and solute mass concentration. Equation (5) represents the equation of state. Here $\rho, p, T, C, \vec{v}(u, v, w), g, \alpha \; and \; \alpha'$ stand for density, pressure, temperature, solute concentration, velocity, gravitational acceleration, thermal coefficient of expansion and an analogous solvent coefficient, respectively. The kinematic viscosity, the thermal diffusivity κ and the solute diffusivity κ' are each assumed to be constant.

The steady state solution is

$$\vec{v} = 0, T = T_0 + \beta z, C = C_0 - \beta' z, \rho = \rho_0[1 - \alpha\beta z - \alpha'\beta' z'], \quad (6)$$

where

$$\beta = \frac{T_1 - T_0}{d}, and \; \beta' = \frac{C_0 - C_1}{d}$$

are the magnitudes of uniform temperature and concentration gradients.

We now consider a small perturbation on the steady state solution and let $\vec{v}, \delta\rho, \delta p, \theta$ and γ denote the perturbations in velocity, density, pressure, temperature and solute concentration respectively so that the change in density $\delta\rho$, caused by the perturbations $\theta \; and \; \gamma$ in temperature and concentration, is given by

$$\delta\rho = -\rho_0(\alpha\theta - \alpha'\gamma). \quad (7)$$

Equations (2) – (4) on linearization give

$$\frac{\partial \vec{v}}{\partial t} = -\frac{1}{\rho_0}\nabla\delta p + \nu\nabla^2\vec{v} - \vec{g}(\alpha\theta - \alpha'\gamma), \quad (8)$$

$$\nabla . \vec{v} = 0, \quad (9)$$

$$\frac{\partial \gamma}{\partial t} - \kappa'\nabla^2\gamma = \beta' w. \quad (10)$$

Now, the first law of thermodynamics may be written in the form

$$C_v\frac{dT}{dt} = -L + \frac{K}{\rho}\nabla^2 T + \frac{P}{\rho^2}\frac{d\rho}{dt}, \quad (11)$$

where $L, K, C_v, T, t \; and \; \rho$ denote respectively, the heat-loss function, the thermal conductivity, the specific heat at constant volume, the temperature, the time and the pressure.

Following Defouw [1], the linearized perturbation form of equation (11) is

$$\frac{\partial\theta}{\partial t} + \frac{1}{C_p}(L_T - \rho\alpha L_\rho)\theta - \kappa\nabla^2\theta = -\left(\beta + \frac{g}{C_P}\right)w. \quad (12)$$

The effects of radiative transfer arise when self-absorption is not negligible. In considering the heat-loss function $L(\rho, T)$ to be dependent only on the local values of density and temperature, it is assumed that the gas is optically thin. We shall study radiative transfer with the Eddington approximation which is accurate in both the optically thick and optically thin limits as pointed by Unno and Spiegel [10].

The heat equation for a grey gas, using this approximation, may be written as

$$\rho C_v\frac{dT}{dt} - \frac{p}{\rho}\frac{d\rho}{dt} = \nabla.\left[\frac{1}{3m\rho}\nabla\left\{\frac{1}{m\rho}\left(\rho C_v\frac{dT}{dt} - \frac{p}{\rho}\frac{d\rho}{dt}\right) + 4\pi S\right\}\right], \quad (13)$$

where m is the mass absorption coefficient and S is the source function.

Since the layer depth is small and the temperature gradient maintained is also small so that their product is very small in comparison with the temperature of the lower boundary, the temperature at an intermediate point may be approximately taken as the temperature of the lower boundary. The source function S and the mass absorption coefficient m may, therefore, be treated as independent of height in the equilibrium state. Then the linearized perturbation form of equation (12) may be obtained as

$$3m^2\rho^2\frac{\partial\theta}{\partial t} - \frac{4\pi m}{C_P}(S_T - \rho\alpha S_P)\nabla^2\theta - \frac{\partial}{\partial t}\nabla^2\theta = -\left(\beta + \frac{g}{C_P}\right)(3m^2\rho^2 w - \nabla^2 w), \quad (14)$$

where S_T and S_ρ denote respectively the partial derivatives of S with respect to T and ρ.

We consider the case in which the boundaries are free as well as perfect conductors of both heat and solute. The density changes arise principally from thermal effects. The case of two free boundaries is most appropriate for stellar atmospheres as pointed by Spiegel [11]. The boundary conditions appropriate for the problem are

$$w = {\partial^2 w}/{\partial z^2} = \theta = \gamma = 0.$$

3. The Dispersion Relation

We shall now analyze an arbitrary perturbation into complete set of normal modes by seeking solutions whose dependence on space and time coordinates is of the form

$$exp\left(ik_x x + ik_y y + nt\right) \sin k_z z\,, \qquad (15)$$

where n is the growth rate and $k_z = {s\pi}/{d}$, s being any integer and d is the thickness of the layer and $k = \left(k_x^2 + k_y^2 + k_z^2\right)^{1/2}$ is the wave number of the perturbation.

Equations (8) – (10) and (14) give

$$\frac{\partial}{\partial t}(\nabla^2 w) = g\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)(\alpha\theta - \alpha'\gamma) + \nu\nabla^4 w\,, \qquad (16)$$

$$\left(\frac{\partial}{\partial t} - \kappa'\nabla^2\right)\gamma = \beta' w\,, \qquad (17)$$

$$\left(\frac{\partial}{\partial t} + E\right)\theta = -\left(\beta + \frac{g}{C_P}\right)w\,, \qquad (18)$$

where

$$E = \frac{4\pi m\left(S_T - \rho\alpha S_\rho\right)}{C_P\left(1 + \frac{3m^2\rho^2}{k^2}\right)}\ . \qquad (19)$$

The system of equations (16) - (18) together with boundary conditions

$$w = {\partial^2 w}/{\partial z^2} = \theta = \gamma = 0.$$

constitutes a characteristics value problem for n, for given values of the parameters and a given state of system is stable, neutral or unstable according as n_r , the real part of n, is negative , zero or positive. Further, if $n_r = 0 \Rightarrow n_i = 0$ for all wave number k, then the principle of exchange of stabilities (PES) is valid otherwise we have overstability atleast when instability sets in as certain modes. The above system of equations can be solved by using linear stability analysis method.

Eliminating θ, γ from equations $(16) - (18)$ and using (16), we obtain the dispersion relation

$$n^3 + [E + k^2(\nu + \kappa')]n^2 + \left[k^2 E(\nu + \kappa') + \Gamma\left(\beta + \frac{g}{C_P}\right) + \nu\kappa' k^4 + \Gamma'\beta'\right]n + \left[\Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2 + (\nu\kappa' k^4 + \Gamma'\beta')E\right] = 0\,, \qquad (20)$$

where

$$\Gamma = g\alpha\frac{k_x^2 + k_y^2}{k^2}\ and\ \Gamma' = \frac{g\alpha'\left(k_x^2 + k_y^2\right)}{k^2}. \qquad (21)$$

4. Discussion and Further Extensions

Theorem 1: Acriterion that a stellar atmosphere in the presence of stable solute concentration gradient and radiative transfer effect is unstable if

$$S_T - \frac{\rho}{T}S_\rho < 0\ and\ |(\nu\kappa' k^4 + \Gamma'\beta')E| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2\ .$$

Proof: Taking the dispersion relation (20), when

$$S_T - \frac{\rho}{T}S_\rho < 0\ and\ |(\nu\kappa' k^4 + \Gamma'\beta')E| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2\ , \qquad (22)$$

The constant term in relation (20) is negative. Equation (20), therefore, involves one change of sign and hence contains one positive real root. The occurrence of positive root implies monotonic instability.

We thus obtain a criterion that a stellar atmosphere in the presence of stable solute concentration gradient and radiative transfer effect is unstable if

$$S_T - \frac{\rho}{T}S_\rho < 0 \; and \; |(\nu\kappa' k^4 + \Gamma'\beta')E| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2 \; , \quad (23)$$

Hence the result.

Further Extension-1: The rotation induces a component of vorticity in the direction of rotation. The effects of radiative transfer arise when self-absorption is not negligible. It may be of some interest to examine the influence of radiative transfer and rotation on thermosolutal-convective instability of a stellar atmosphere.

Theorem 2: The criterion for monotonic instability (22) also holds good in the presence of radiative transfer and rotation effects on thermosolutal-convective instability in Stern's type configuration in a stellar atmosphere.

Proof: Here we consider an infinite horizontal fluid layer heated from above and solute concentrated from below and acted on by a uniform rotation $\vec{\Omega}(0,0,\Omega)$ and gravity force $\vec{g}(0,0,-g)$. The linearized perturbed equations of motion become

$$\frac{\partial \vec{v}}{\partial t} = -\frac{1}{\rho_0}\nabla\delta p + \nu\nabla^2\vec{v} - \vec{g}(\alpha\theta - \alpha'\gamma) + 2\left(\vec{v}\times\vec{\Omega}\right), \quad (24)$$

Equations (9), (10) and (14) remain unaltered.

Equations (9), (10), (14) and (24) give

$$\frac{\partial}{\partial t}(\nabla^2 w) = g\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)(\alpha\theta - \alpha'\gamma) + \nu\nabla^4 w - 2\Omega\frac{\partial\zeta}{\partial z} \; , \quad (25)$$

$$\frac{\partial\zeta}{\partial t} - \nu\nabla^2\zeta = 2\Omega\frac{\partial w}{\partial z} \; , \quad (26)$$

where

$$\zeta = \frac{\partial v}{\partial z} - \frac{\partial u}{\partial y}$$

denotes the z-component of vorticity, Equations (17) and (18) remain the same. Eliminating θ , ζ and γ from equations (17), (18), (25) and (26) and using expression (15), we obtain the dispersion relation

$$\begin{aligned} &n^4 + [E + k^2(2\nu + \kappa')]n^3 \\ &+ \left[\nu\kappa' k^4 + \Gamma'\beta' + Ek^2(\nu + \kappa') + \Gamma\left(\beta + \frac{g}{C_P}\right)\right. \\ &\left. + \nu k^2(E + k^2\overline{\nu + \kappa'}) + \frac{4\Omega^2 k_z^2}{k^2}\right]n^2 \\ &+ \left[(\nu\kappa' k^4 + \Gamma'\beta')E + \Gamma\left(\beta + \frac{g}{C_P}\right)k^2(\nu + \kappa')\right. \\ &+ \nu k^2\{\nu\kappa' k^4 + \Gamma'\beta' + k^2 E(\nu + \kappa')\} \\ &\left. + \frac{4\Omega^2 k_z^2}{k^2}(E + \kappa' k^2)\right]n \\ &+ \left[\nu k^2\left\{(\nu\kappa' k^4 + \Gamma'\beta')E + \kappa' k^2\Gamma\left(\beta + \frac{g}{C_P}\right)\right\}\right. \\ &\left. + 4\Omega^2 k_z^2\kappa' E\right] = 0. \end{aligned} \quad (27)$$

When (22) is satisfied, the constant term in equation (27) is negative. The product of the roots must be negative. Therefore at least one root of equation (27) is positive and one root is negative. The occurrence of positive root implies monotonic instability. The criterion for monotonic instability thus holds good in the presence of radiative transfer and rotation effects on thermosolutal-convective instability in a stellar atmosphere.

Further Extension-2: Further we study the effect of collisions on thermosolutal-convective instability of a composite medium. Quite frequently it happens that the plasma is not fully ionized and may instead be permeated with neutral atoms. The plasma may be idealized, therefore, following Hans [6], as a composite mixture of a hydromagnetic (ionized) component and a neutral component, the two interacting through mutual collisional (frictional) effects. A partially ionized plasma represents a

state which often exists in the universe. Hence it is of interest to investigate the influence of these frictional effects with neutrals on thermosolutal-convective instability of a composite medium.

Here we consider an infinite horizontal composite layer consisting of a finitely conducting hydromagnetic fluid of density ρ and a neutral gas of density ρ_d, acted on by a uniform vertical magnetic field $\vec{H}(0,0,H)$ and gravity force $\vec{g}(0,0,-g)$. This layer is heated from above and solute concentrated from below such that a steady temperature gradient $\beta\left(=dT/_{dz}\right)$ and a concentration gradient $\beta'\left(=-dC/_{dz}\right)$ are maintained. Regarding the model under consideration we observe that the number density of neutral particles is extremely smaller than the number density of ionized particles (Tanenbaum [12]). The pressure and buoyancy effects acting on neutral particles, therefore, have negligible influence (the volume fraction of the neutral particles being extremely small) whereas they are significant in the case of ionized component. In a partially ionized gas the magnetic field interacts with the charged component and is not directly affected by the neutral component (Parker [13]).

Now we prove the following Theorem :

Theorem 3: A criterion that the thermosolutal-convective instability of a composite stellar atmosphere in the presence of stable solute concentration gradient and collisional effects is unstable if

$$D < 0 \ and \ |(\nu\kappa' k^4 + \Gamma'\beta')D| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2.$$

Proof: Let $\vec{h}(h_x, h_y, h_z)$, η, $\overrightarrow{v_d}$ and ν_C denote respectively the perturbation in magnetic field $\vec{H}$, the resistivity, the velocity of the neutral gas and the collision frequency between the two components of the composite medium. Then the linearized perturbation equations appropriate to the problem are

$$\frac{\partial \vec{v}}{\partial t} = -\frac{1}{\rho_0}\nabla\delta p + \nu\nabla^2\vec{v} + \frac{1}{4\pi\rho_0}\left(\nabla\times\vec{h}\right)\times\vec{H} + \vec{g}\frac{\delta\rho}{\rho_0} + \frac{\rho_d\nu_C}{\rho_0}(\overrightarrow{v_d} - \vec{v}), \quad (28)$$

$$\frac{\partial \overrightarrow{v_d}}{\partial t} = -\nu_C(\overrightarrow{v_d} - \vec{v}), \quad (29)$$

$$\frac{\partial \vec{h}}{\partial t} = \nabla\times\left(\vec{v}\times\vec{H}\right) + \eta\nabla^2\vec{h}, \quad (30)$$

$$\nabla.\vec{h} = 0, \quad (31)$$

together with equations (7), (9), (10) and (12). Equations (7), (9), (10), (12) and (28)-(31) give

$$\frac{\partial}{\partial t}\left(1 + \frac{\alpha_0\nu_C}{\frac{\partial}{\partial t} + \nu_C}\right)(\nabla^2 w) = g\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)(\alpha\theta - \alpha'\gamma) + \nu\nabla^4 w + \frac{H}{4\pi\rho_0}\nabla^2\frac{\partial h_z}{\partial z}, \quad (32)$$

$$\left(\frac{\partial}{\partial t} - \eta\nabla^2\right)h_z = H\frac{\partial w}{\partial z}, \quad (33)$$

$$\left(\frac{\partial}{\partial t} + D\right)\theta = -\left(\beta + \frac{g}{C_P}\right)w, \quad (34)$$

$$\left(\frac{\partial}{\partial t} - \kappa'\nabla^2\right)\gamma = \beta' w, \quad (35)$$

where $\alpha_0 = \rho_d/\rho_0$

Eliminating θ, γ and h_z from equations (32)-(35) and using expression (15), we obtain the dispersion relation

$$n^5 + A_4 n^4 + A_3 n^3 + A_2 n^2 + A_1 n + A_0 = 0, \quad (36)$$

where

$$A_4 = D + \nu_C(\alpha_0 + 1) + k^2(\nu + \eta + \kappa')$$

$$A_3 = \kappa'\eta k^4 + k^2 D(\eta + \kappa') + (\nu_C + \nu k^2 + \alpha_0 \nu_C)\{D + k^2(\eta + \kappa')\} + \nu k^2 \nu_C + \Gamma\left(\beta + \frac{g}{C_P}\right) + \Gamma'\beta' + k_z^2 V_A^2,$$

$$A_2 = \kappa'\eta k^4 D + (\nu_C + \nu k^2 + \alpha_0 \nu_C)\{\kappa'\eta k^4 + k^2 D(\eta + \kappa')\} + \nu k^2 \nu_C\{D + k^2(\eta + \kappa')\} + \Gamma\left(\beta + \frac{g}{C_P}\right)(\nu_C + \eta k^2 + \kappa' k^2) + \Gamma'\beta'(\nu_C + \eta k^2 + D) + k_z^2 V_A^2(\nu_C + \kappa' k^2 + D),$$

$$A_1 = \kappa'\eta k^4 D(\nu_C + \nu k^2 + \alpha_0 \nu_C) + \nu k^2 \nu_C\{\kappa'\eta k^4 + k^2 D(\eta + \kappa')\} + \Gamma\left(\beta + \frac{g}{C_P}\right)\{\eta k^2 \nu_C + \kappa' k^2(\nu_C + \eta k^2)\} + \Gamma'\beta'\{\eta k^2 \nu_C + D(\nu_C + \eta k^2)\} + k_z^2 V_A^2\{\kappa' k^2 \nu_C + D(\nu_C + \kappa' k^2)\},$$

$$A_0 = \eta k^2 \nu_C\left\{(\nu\kappa' k^4 + \Gamma'\beta')D + \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2\right\} + k_z^2 V_A^2 D\kappa' k^2 \nu_C, \quad (37)$$

where

$$V_A^2 = \frac{H^2}{4\pi\rho_0}.$$

When

$$D < 0 \ \ and \ |(\nu\kappa' k^4 + \Gamma'\beta')D| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2, \quad (38)$$

the constant term in equation (36) is negative. Equation (36), therefore, involves one change of sign and hence contains one positive real root. The occurrence of positive root implies monotonic instability.

We thus obtain a criterion that the thermosolutal-convective instability of a composite stellar atmosphere in the presence of stable solute concentration gradient and collisional effects is unstable if

$$D < 0 \ \ and \ |(\nu\kappa' k^4 + \Gamma'\beta')D| > \Gamma\left(\beta + \frac{g}{C_P}\right)\kappa' k^2.$$

The criterion for monotonic instability is the same in the presence or absence (Sharma and Sharma [14]) of the collisional effect on thermosolutal-convective instability of a composite stellar atmosphere.

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FREEDOM OF WORSHIP TO WOMEN: WHITHER COMMITMENT

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Abstract: Indian Constitution has provided the Right to Equality, Right against Discrimination, Right to Worship and many other fundamental and constitutional rights to the women at par with men. On papers, women enjoy equal status with men. But the reality is somewhat different. Sadly, they are not enjoying their rights fully. Reasons are many and one among those is the biological feature of their body i.e. menstruation. This feature of their body has been made a reason for discrimination by religious beliefs and myths. Because of this they are deprived of their rights and this happened in Sabarimala, where women of fertile age group were not allowed to enter the temple and perform prayers there. When this issue was first raised in Kerala High Court it upheld the restriction. But in 2018 Supreme Court of India lifted up the ban and allowed the women of every age group to enter the temple. It was not only a fight to women's rights in the Court but also a conflict between religion and Constitution arose in which Constitution won. But it has failed somewhere to change the mental set up of people as there were protests by the people including women against the judgment. Education and awareness are the weapons which can change the society and importance to women in religious works such as their appointments as priests should be promoted.

KEY WORDS: Fundamental Rights, Worship, Menstruation, sabrimala tample

Introduction

"If by strength is meant moral power, then woman is immeasurably man's superior."[1] She is great Goddess - a boon giver, she is Nature (prakriti) which makes this world worth living, and she is Shakti who kills demons. India is a country where woman is worshiped in the temples as Goddess and this is not enough to understand what a woman is. A woman is an essential and integral part of society without whom life is not possible. From household to education, sports, politics, science and technology they have done their best and contributed in the development of nation. No doubt many rights are given to them by Constitution of India and other laws of the country, and government has initiated many schemes for the up liftment and security of woman. On one hand there are many rights and opportunities given to women and on the other hand they are deprived of their rights sometimes on the name of society, sometimes in the name of religious practices and many other reasons. Why so? When man and woman both are equal then why woman's rights are sacrificed? Constitution of India, the supreme law of the land has given many rights to people of India and other individuals as well such as equality. Equality means everyone is equal in the eyes of law [2] and there should be no discrimination on the grounds of religion, race, caste, sex and place of birth[3] But sadly there are many religious practices or strong beliefs because of which they are deprived of their rights or we can say that they can't use them. The menstruating nature of a female body is one of the reasons of discrimination as during these days they are not allowed to worship, to enter temples, touch the holy books, do prayers and such type of activities which is an infringement of their right to equality, right to worship and right against discrimination, hence this practice is totally anti constitutional. Sadly this practice is prevailing in our society on large scale whether at homes or at temples. The women are taught from childhood not to practice any kind of activity related to worship during these

days. In Public places, there are wide spread customs prohibiting the women to enter the religious establishments. This issue of discrimination came into light in Subrimala Temple, where as per the custom it takes forty days of purification (vratam) to enter this temple, women of certain age group, which is the fertile age of a woman, were not allowed to enter the holy shrine. The reason was during forty days a woman of fertile age is supposed to bleed and hence she does not remain pure. This practice was utter discrimination of their right to pray because of the menstruation they undergo every month. This practice is not restricted to a particular region or religion but is widely spread across the countries. In musjids, women of all age are not allowed to participate in *namaaz.* Amongst Hindus, Women are not allowed to enter the religious places during their menstruation period. They are even compelled to live in separate accommodations and even compelled to live in the cattle sheds where separate place is not available. Women menstruation cycle which is a physiological process and totally natural has become an instrument of discrimination, which has not only affected the rights of the women but has also, affected their psychological, social and mental health. Judiciary has given many verdicts and states that woman and man both are equal and the Constitution of India has also given Right to Equality to all persons.[4] But sadly the practice differs from the Constitutional provisions.

Menstruation Taboo:

Menstruation taboo is a kind of social taboo, which is linked with menstruation. Menstruation is the normal bleeding that occurs to women as monthly cycles. It is totally a biological and natural process. But in some societies it is considered as unclean and impure. There are many myths related to menstruation cycle and these myths are the mothers of religious beliefs which are discriminatory to women. These religious and social practices have such an impact on the mental setup of the society to such an extent that it is considered to be a forbidden subject to be discussed in public. As a result there is lack of awareness in the society regarding psychological, mental and physical health of women during Menstruation. On the contrary, women are prohibited from entering the religious places, kitchen. In the conservative Indian Society, women are considered as untouchable and impure during this period. They are not allowed to enter the public religious places among Hindus, Muslims and Parsis. Outside public places of worship, there are deep rooted notions of women's impurity during menstruation. They are restricted from touching the religious books and objects, doing prayers, cooking and entering the kitchen. There is no need of any signboard to keep bleeding women out of these places. Girls are socialized into period norms from a very young age. Not only this, the menstruating nature of their bodies is the reason to deny their role as priests, pandits, qazis, imaams. Menstrual period is considered as a sin of the women for which atonement is required. Among Hindus, a specific fast (Chandan shashti vrat),which women takes once in a year as atonement for touching kitchen or entering worship places by mistake during menstrual cycle. In many parts of India, women are not allowed to sleep in the bed, enter the main house, touch the other family members of the family or eat spicy food[5] . They are forced to live in the cowsheds or huts made specifically for the purpose. The impact of such practices on the psychology of girls on the initial years of mensuretion is unimaginable. We can observe the heights of hypocrisy in our society on this issue. Where on one side a Goddess Kamakhya is worshiped by us and the Earth's menstruation is celebrated during the Ambabuchi Mela, an annual fertility festival held in June in Assam, on the other side menstruating woman is restricted from religious activities.

Constitutional and Legal Rights of Women

"*I measure the progress of a community by the degree of progress which women have achieved*."These great lines are given by Dr. B.R Ambedkar and by these lines we can understand that by the progress of women the whole community progresses. The rights given to women can be classified into two categories such as Constitutional rights and Legal rights. Constitutional rights are the rights which are enshrined in the Constitution of India and legal rights are those rights which are provided in various Acts of Parliament and State Legislature. Equality before law is well defined under the Article 14 of the Constitution which ensures that every citizen shall be protected by the laws of the country and State will not discriminate any of the Indian citizens on the basis of their gender, caste, creed, religion or even the place of birth. Recently in a judgment, Supreme Court of India held that the absolute exclusion of women from command assignments is against Article 14 of the Constitution and unjustified. Hence, the policy the women will be given only staff appointment was held to be unenforceable by the court." According to Constitution of India, the State shall not discriminate any citizen of India on the ground of religion, race, caste, sex and place of birth[6.] Article 15 secures the citizens of India from every sort of discrimination by State, on the grounds of religion, race, caste, sex

and place of birth. According to this Article not only State but private person also cannot discriminate anyone on the ground of religion, race, caste, sex and place of birth. Hence, this is a right provided to women against discrimination by Constitution of India. There shall not be any discrimination to women on the ground of being a woman. This right also guarantees the equal treatment of the women even in the religious activities. According to Article 15 (3) State is empowered to make any special provision for the development of women and children. The great example of this provision is reservation of seats for women in the local bodies and provision of free education to children. In ***Government of A.P v. P.B Vijaya kumar*** [7]The Supreme Court explaining the object of Article 15(3) observed that : "The insertion of clause (3) of Article 15 in relation to women is a recognition of the fact that for centuries, women of this country have been socially and economically handicapped. As a result, they are unable to participate in the socially and economic activities of the nation on a footing of equality. It is in order to eliminate this socio-economic backwardness of women and to empower them in a manner that would bring about effective equality between men and women that clause (3) is placed in Article 15. Its object is to strengthen and improve the status of women. "The other Important right provided to all the human beings is Right to life, which also includes right to live with dignity[8]. Women also have right to live with dignity .If a women is prohibited from entering a religious place; it is not only the violation of their right of dignity but also affects their Pschycology. Article 25 of the Indian Constitution guarantees the freedom of religion to all the citizens without any discrimination on the basis of cast, sex, religion etc. This Article provides the right to women to practice profess, propagate their religion without any discrimination. To enter in the religious premises can be considered as the part of this right. Apart from these rights, there are some fundamental duties, which are imposed the protection of dignity of women. However, the practices throughout India shows that this right is denied to women of different religions in the name of customs, religious practices etc .

Sabarimala Issue

Sabrimala temple is the temple of Lord Ayappa situated in the Sabri hills of Kerala in Sabrimala temple, there was a ban on the entry of women of menstruating age group (10 to 50 years) in the holy shrine. A verdict was given by Supreme Court in 2018 which lifted up the ban and allowed the women of every age group to enter the holy shrine. Huge protest was done against and for the verdict by the people. Sabrimala temple is one of the largest pilgrimages of the world and according to an estimate about 3.5 crore Hindu pilgrims visited the temple in 2017. Lord Ayyappan is the son of Shiva and Mohini [9] and is of celibate nature. His celibacy is the one reason on the ban of entry of women of 10 to 50 years of age group. The reason why this temple became so famous is that there was ban on the entry of women of menstruating nature. They were banned even from making the trek to the shrine .The justification which was given for this prohibition was that, the devotees who come to Sabrimala temple has to do the vratam of 40 days before entering the temple and worshiping there. It is believed that a woman of menstruating age group is unable to do vratam of 40 days period because of monthly bleeding. Because of this monthly bleeding they do not qualify to embark the pilgrimage. According to the rules of Kerala Hindu Places of Public Worship (Authorization of Entry) Rules 1965 the ban on the menstruating women was enforced.[10] In 1991 the High Court of Kerala upheld the ban on the women of menstruating age to enter the holy shrine[11]. Regarding the entry of women rules were framed under section 9 of the Temple Entry Act. Rule 6 (c) framed there under relates to entry of women. The restriction is only for entry of women at such time during which they are not by customs and usages allowed to enter temples. The Board issues notification every year informing the public about the prohibition regarding entry of women of age group of 10 to 50 years in the Sabrimala temple.

The whole issue of Sabarimala temple started when a petition was filed in the Supreme Court challenging the verdict of Kerala High Court which upheld the ban on the entry of women of menstruation age group in the Sabarimala temple [12]. The ban which was upheld by the Kerala High Court on the entry of women was against the right to equality and right to worship. The practice of the restriction on the women of menstruating age group to enter the temple was derogatory to the dignity of women. The Supreme Court observed that restrictions on women to enter the worshiping places are not only in sabarimala but in other places also. The Supreme Court held that the ban on the entry of women is against the Right of Equality and Right of Worship. This is the violation of the rights of women granted by the Constitution of India. It was further observed by the Court that everyone has right to freely profess, practice and propagate their religious beliefs as per the Constitution of India [13]. The practice prevailed there is an utter discrimination and the violation of the right to equality. On September 28,

2018 the Supreme Court of India gave its judgment on the Sabrimala issue. The Court held that the practice of non entry of women of menstruating age group in the temple is unconstitutional and discriminatory in nature. It is violation of the rights of women. The Court struck down the rule 3 (b) of the Kerala Hindu Places Of Public Worship Act by stating that it is totally unconstitutional as it allows the restriction on the entry of women in the temple if the restriction is based on the usages and customs prevailed there. The dissent opinions were given by the judges of the bench which included Chief justice Deepak Mishra, Justice Nariman, Justice Chandra chud and Justice Indu Malhotra.

After the judgment many female devotees of this age group tried to enter the temple but they were stopped in their way sometimes by the men and sometimes by women. They faced the great resistance and violence from the men and women. The protests and hartals by the people show that people were not happy with the verdict of Supreme Court. Where it was a step towards the concept of equality there on the other side some people were showing anger against the verdict. The change in the society was not accepted by some people and they did not want these types of practices to stop.

Sabrimala Review Petition:

The Supreme Court received almost 56 petitions for review of the judgement allowing the women to enter the temple. On November 14, 2019 a five judge bench referred the Sabarimala review petitions to a seven judge bench which was headed by Chief Justice of India Ranjan Gogoi. Justices Chandrachud and Nariman held that when a judgment is delivered, it is final and binds all. The Supreme Court did not changed its judgment regarding the entry of women in the temple and also added other issues related to women with this issue. In another case ***Dr. Noorjahan Safia Niaz v. Y.N Bhardwaj*** [14], there was a petition filed under Article 226 of Constitution by petitioners who were some social activists against the restriction on women's entry in Haji Ali Dargah before the High Court of Bombay. The case was filed because of gender discrimination and denial of entry of women in the sanctum sanctorum at Haji Ali Dargah. The Trust argued that women were denied to enter the dargaah because the entry involved various kinds of risks. The risks were such as : the visibility of their breasts when they offered the prayers, entry of women in their periods, and sexual harassment. The Court held that these points are totally illogical with respect to the ban on the entry and the restriction of women on entering the Dargaah is the contravention of articles 14, 15 and 25 guaranteed by the Constitution of India. This judgment became the precedent and ended the deadlock of superstition and religious barriers in India. The Court further held the State accountable for providing adequate protection to women at places of public worship.

Another incident of restriction of women to enter the temple refers to ***Shani Signapur*** temple. In Maharashtra, the popular temple of Shani Shignapur was also famous for the ban on the entry of women. For many years, social reformers and activists were criticizing the this ban there. But this came into the picture in January 2016 when a woman entered the temple by mistake and after that the temple was closed for purity. The idol situated in the temple was purified and in order to purification the idol was bathed with milk. This act downgraded the women and after that Trupati Desai, a social activist, with her organization 'Bhumta Brigade' lead 1000 women activists and entered the temple forcefully. This was a move against the gender bias rules prevailing there. In Maharashtra, the Maharashtra Temple Entry Act, 1956 has banned women from entering the temple. The Bombay High Court opened the ways of women's entry into the Shani temple and said that no rule could prevent women from entering the temple. It was further held by the Court that the law should be same for everybody irrespective of any consideration.

Conflict between Religion and Constitution:

When the historical judgment of Sabarimala issue was delivered by the Supreme Court of India some people were highly dissatisfied by the judgment while some were celebrating the victory of women. Many people protested against the judgment in order to protect their precious religious practices while other were appreciating the judgment. The protest was not limited only with men, but women were also protesting against the judgment. When the petition was filed in the court against the practice prevailed in the Sabarimala temple, then the conflict between religion and Constitution arose. The supreme law of the land provides women with right to equality, right to worship and religion is not allowed to snatch these rights from them. Rules based on biological characteristics will not muster Constitution. The reason for not

providing the women their right to worship in the temple was the celibacy of the deity and to impose man's celibacy on woman is to deny women rights and the Constitution doesn't recognize such rights. These practices are not only unconstitutional but also against the basic human rights of women.

Conclusion

The women are an integral part of the society without whom life is not possible. In India, the irony is that, although the different Goddesses are worshipped but women of a specific age are not allowed to enter in the temples. Freedom of religion is provided to all the citizens of the country, which include women also, but they cannot enter the various religious places. We live in a patriarchal system of society where only woman has to sacrifice her rights. Gender inequality is the root of various discriminatory practices which is prevailed against the women. The rights of women are being infringed because of various religious beliefs. Gender discrimination is prohibited by the Constitution of India under Article 15 and in case of any infringement of this right; relief can be claimed through the court. But t is not easy to litigate against every instance of such discrimination because these norms are being followed in almost every home without any complaint. A biological process has become a reason for the violation of constitutional rights of women. Menstruation is a physiological process which is considered as impure by the society. However, there is nothing like impurity in this process. The deep rooted notions of women impurity has taken the shape of denial of their roles as pandits, qazis, imams and other positions related to worship or temple. This fact was proved by Hon'ble Supreme Court in its verdict of Sabarimala temple issue. Not only in this verdict but there are some other decisions given by Court in which the emphasis was on the right to equality and worship. The Court stated the practice of restriction on the entry of women totally discriminatory and gender bias. In the verdict of *Dr Noorjahan Safia's* case, the court held that the exclusion of women from entering the sanctum sanctorum is illegal and illogical and in the verdict given by the Bombay High Court in Shani Shignapur temple's issue ,the court also stated the. In the name of religious beliefs the women are deprived of their rights..

UDHR and ICCPR are the two covenants which provides the freedom of religion. India is signatory to both. UDHR provides that the every individual is free to profess and practice his religion. However, ICCPR says that freedom of religion is not absolute but restricted. It is restricted for the public safety, morality etc. But no where it is written that it should restrict the entry of women in worship places.

In order to eradicate such [i]malpractices certain initiatives are required to be taken. Due to illiteracy and lack of exposure women are not aware about their constitutional and legal rights. Education is the only solution of this problem. Legal literacy camps should be organized by the government in which law graduates and persons having the knowledge of law should be appointed to inform women about their rights. Secondly, Menstruation taboo is the biggest problem women are facing these days. They feel ashamed while talking about it. A biological process has become a matter of shame. Women should be informed about this process and also that there is nothing like impurity in it. The education and awareness are the only weapons to change the mentality of people. Girls should be empowered with the menstrual knowledge and hygiene so that the concept of impurity should be removed. Thirdly, Moves like "Happy to Bleed" should be started by activists and supported by government

Outside some worship places there are boards on which it is written that menstrual women is not allowed inside the sanctum sanctorum. Such type of boards should be removed and where there it is found written, strict action should be taken. Lastly, the Government should appoint women as pandits, qazis, imams etc. In religious worship places in order to stop gender discrimination should be stopped in religious places whether to perform worship inside the temple or any other religious place should be the discretion of the person. No one should be allowed to stop someone from entering the worship place. It must be the choice of the person and one should respect it.

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14 CALL (COMPUTER ASSISTED LANGUAGE LEARNING): A VIRTUAL LEARNING PLATFORM FOR LANGUAGE DRILLS

Dr. Gitanjali Thapar

Abstract

Learning is a never ending process and the present day digital era has eased out the process of learning through online resources. Under blended learning concepts an innovative step towards learning grammar is CALL (Computer Assisted Language Learning) which is a well developed and diversifying field which encompasses a conceptualised approach towards language learning .The multidisciplinary nature of CALL includes psychological theory of B.F. Skinner. The methods are useful for applied linguistics and second language acquisition. The present paper attempts to evaluate the paradigm shift from classroom teaching methods to the virtual methods of Computer Assisted Language Learning. CALL is a multidisciplinary field which involves various contents and methods of language drills. The language drills of B.F.Skinner's operant conditioning model of linguistic behaviour would also be discussed.

Keywords: *CALL, Blended Learning*

Learning is a never ending process and the present day digital era has eased out the process of learning through online resources. Under blended learning concepts an innovative step towards learning grammar is CALL

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Encroachers and victims

Framing of community dynamics by small-town journalists in Dharamshala, India

By Harikrishnan Bhaskaran, Sandeep Sharma, Pradeep Nair, Harsh Mishra

Abstract

Dharamshala is home to the Tibetan Government-in-Exile. Its small-town journalism landscape is unique due to specific forms of community journalism practice adopted by Indian and Tibetan journalists. The Tibetan press there faces a paradox: simultaneously "local and community specific" for Tibetans-in-exile, "refugee voices" for the international community, and "foreign journalism" for Indians. This framing study identified interpretive packages in news coverage of conflict and integration between Dharamshala communities, by examining stories from community news outlets. Indian Hindi journalists enact a "community booster" role by actively framing issues of conflict in favor of the community, while Tibetan journalists' approach was comparatively more balanced.

Keywords

community journalism, community dynamics, refugee–host relationship, conflict, Tibetans-in-exile, framing, India

Bhaskaran and Mishra are assistant professors and Nair is professor of new media. All are in the School of Journalism, Mass Communication and New Media, Central University of Himachal Pradesh. Sharma is a doctoral student at the School of Journalism, Mass Communication and New Media, Central University of Himachal Pradesh. Nair is the corresponding author: nairdevcom@gmail.com.

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Gender Equal Society
Myth and Reality

Editors:
Sushma Rewal Chugh
Seema Thakur
Anju Devi

Centre for Women's Studies & Development
Himachal Pradesh University

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The opinions expressed in this book are personal views of the individual author and in no way reflect the opinion of the Editor. The individual author is solely responsible for the contents in his/her write-up and the Editor takes no responsibility in this regard.

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HISTORICAL PERSPECTIVE OF WOMEN EMPOWERMENT IN INDIA

Sunil Kumar

Women constitute half of the human race. But their position in society is ambiguous. They have been subjected to all forms of discrimination and in every institutional structure extending from family to state. The subordination of women could be measured by the levels of their disproportionate representation in various areas of life such as education, employment, politics, health etc. Empowerment has become a fashionable concept nowadays. Earlier the term was used by political scientists. They used it in a very restricted sense and considered it as political power or usually the power politically assigned to an institution by the Constitution or by administrative rules. Later on, the concept became a tradition of the social sciences. With the coming of globalization, empowerment is now being increasingly applied to the economically poor nations and the weaker and subaltern masses of people. Actually the idea of empowerment is drawn from the concept of human rights. Human Rights in this sense are broader.

Keywords: Women, Empowerment, Historical Perspective

Women constitute half of the human race. But their position in society is ambiguous. They have been subjected to all forms of discrimination and in every institutional structure extending from family to state. The subordination of women could be measured by the levels of their disproportionate representation in various areas of life such as education, employment, politics, health etc.

There is no chance for the welfare of the world unless the condition of women is improved. Swami Vivekananda had said, "it is not possible for a bird to fly on only one wing". The greatest champions of women's rights have been great men like Raja Ram Mohan Ray, Maharishi Karve, Ishwar Chandra Vidyasagar, Gandhiji and ironically those who have systematically exploited and degraded them have also been of a largely male dominated society. Women have always been treated as a weaker section of human species. They have had an inferior status in society. We hear about so many organizations and programmes, which are being planned to improve the status of women.

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A generalised approach to calculate various transport observables for a linear array of series and parallel quantum dots

Sushila Devi, P K Ahluwalia & Shyam Chand

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Abstract

A systematic generalised approach to find transport observables for a linear array of different quantum dot (QD) systems has been discussed, using non-equilibrium Green function (NEGF) formalism, in the presence of on-dot Coulomb interaction and inter-dot tunnelling. The equation of motion (EOM) method has been used to derive expressions for Green functions (GFs) within the simplest mean-field approximation to tackle the Coulomb correlation term. Starting from the mathematical structures of GFs for single, double and triple quantum dot systems, the expressions for GFs and transport observables have been generalised for the quantum dot systems containing N number of quantum dots in series as well as parallel linear array of dots. Further, the formulae so obtained have been used for numerical calculations of transmission probability and the I–V characteristics of linear arrays of quantum dots in series as well as parallel configuration containing up to three dots. The results show that, with the increase in number of dots in the scattering region, transmission probability and electron current decrease in series case, while both quantities increase in parallel configuration of dots. The inter-dot tunnelling leads to the splitting of transmission peaks in double QD system in series case whereas, it induces Fano effect in triple QD system in parallel configuration.

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Appendices

Appendix A

1.1 A.1 Equations of motion for Green's functions of dots

(a) *For the single quantum dot*

$$\omega\langle\langle c_\sigma, c_\sigma^\dagger\rangle\rangle^r = 1 + \varepsilon\langle\langle c_\sigma, c_\sigma^\dagger\rangle\rangle^r + U\langle\langle n_{-\sigma}c_\sigma, c_\sigma^\dagger\rangle\rangle^r + V_k^{\mathrm{L}}\langle\langle a_{k\sigma}, c_\sigma^\dagger\rangle\rangle^r + V_p^{\mathrm{R}}\langle\langle b_{p\sigma}, c_\sigma^\dagger\rangle\rangle^r \quad \text{(A.1)}$$

Further,

$$\langle\langle a_{k\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r = V_k^{\mathrm{L}*} g_k^r \langle\langle c_\sigma, c_\sigma^\dagger\rangle\rangle^r$$

and

$$\langle\langle b_{p\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r = V_p^{\mathrm{R}*} g_k^r \langle\langle c_\sigma, c_\sigma^\dagger\rangle\rangle^r.$$

(b) *For the double quantum dot in series*

$$(\omega - \epsilon_1)\langle\langle c_{1\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r = 1 + V_d\langle\langle c_{2\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r + U_1\langle\langle c_{1\sigma}n_{1-\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r + V_k^{\mathrm{L}}\langle\langle a_{k\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r \quad \text{(A.2)}$$

$$(\omega - \epsilon_2)\langle\langle c_{2\sigma}, c_{2\sigma}^\dagger\rangle\rangle^r = 1 + V_d^*\langle\langle c_{1\sigma}, c_{2\sigma}^\dagger\rangle\rangle^r + U_2\langle\langle c_{2\sigma}n_{2-\sigma}, c_{2\sigma}^\dagger\rangle\rangle^r + V_p^{\mathrm{R}}\langle\langle b_{p\sigma}, c_{2\sigma}^\dagger\rangle\rangle^r \quad \text{(A.3)}$$

$$(\omega - \epsilon_2)\langle\langle c_{2\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r = V_d^*\langle\langle c_{1\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r + U_2\langle\langle c_{2\sigma}n_{2-\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r + V_p^{\mathrm{R}}\langle\langle b_{p\sigma}, c_{2\sigma}^\dagger\rangle\rangle^r \quad \text{(A.4)}$$

$$(\omega - \epsilon_1)\langle\langle c_{1\sigma}, c_{2\sigma}^\dagger\rangle\rangle^r = V_d\langle\langle c_{2\sigma}, c_{2\sigma}^\dagger\rangle\rangle^r + U_1\langle\langle c_{1\sigma}n_{1-\sigma}, c_{2\sigma}^\dagger\rangle\rangle^r + V_k^{\mathrm{L}}\langle\langle a_{k\sigma}, c_{1\sigma}^\dagger\rangle\rangle^r.$$

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Here

$$\langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} = V_{k1}^{\mathrm{L}*} g_{k}^{r} \langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}$$

and

$$\langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} = V_{p2}^{\mathrm{R}*} g_{k}^{r} \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}.$$

(c) *For the double quantum dot in parallel*

$$\begin{aligned}(\omega - \epsilon_1)\,\langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} &= 1 + V_d \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ U_1 \langle\langle c_{1\sigma} n_{1-\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + V_{k1}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{p1}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.6)

$$\begin{aligned}(\omega - \epsilon_1 - n_1 U_1)\,\langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} &= 1 + V_d \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{k1}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + V_{p1}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.7)

$$\begin{aligned}&\left(\omega - \epsilon_1 - n_1 U_1 - i\frac{\Gamma_{11}}{2}\right) \langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &\quad = 1 + V_d \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + i\frac{\Gamma_{12}}{2} \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.8)

$$\begin{aligned}&\left(\omega - \epsilon_2 - n_2 U_2 - i\frac{\Gamma_{22}}{2}\right) \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &\quad = V_d \langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + i\frac{\Gamma_{21}}{2} \langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.9)

$$\begin{aligned}&\left(\omega - \epsilon_2 - n_2 U_2 - i\frac{\Gamma_{22}}{2}\right) \langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &\quad = 1 + V_d \langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} + i\frac{\Gamma_{21}}{2} \langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.10)

$$\begin{aligned}&(\omega - \epsilon_1 - n_1 U_1)\,\langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &\quad = 1 + V_d \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + V_{k1}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &\qquad + V_{p1}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.11)

$$\begin{aligned}&\left(\omega - \epsilon_1 - n_1 U_1 - i\frac{\Gamma_{11}}{2}\right) \langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &\qquad = 1 + V_d \langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} + i\frac{\Gamma_{12}}{2} \langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}.\end{aligned}$$

(A.12)

The Green's functions $\langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}$ and $\langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}$ arise due to the

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tunnelling of electrons between dots and leads. The EOM for these gives the following Dyson equations:

$$\begin{aligned}\langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} =& V_{k1}^{\mathrm{L}*} g_{k}^{\mathrm{r}} \langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{k2}^{\mathrm{L}*} g_{k}^{r} \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ \langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} =& V_{p1}^{\mathrm{R}*} g_{k}^{r} \langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{p2}^{\mathrm{R}*} g_{k}^{r} \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}.\end{aligned}$$

(d) *For the triple quantum dots in series*

$$\begin{aligned}(\omega-\epsilon_1)\langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} &= 1+V_d\langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+U_1\langle\langle c_{1\sigma}n_{1-\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}+V_k^{\mathrm{L}}\langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.13)

$$\begin{aligned}(\omega-\epsilon_2)\langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} &= 1+V_d^{*}\langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &+V_d\langle\langle c_{3\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}+U_2\langle\langle c_{2\sigma}n_{2-\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.14)

$$\begin{aligned}(\omega-\epsilon_3)\langle\langle c_{3\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} &= 1+V_d^{*}\langle\langle c_{2\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} \\ &+U_3\langle\langle c_{3\sigma}n_{3-\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r}+V_p^{\mathrm{R}}\langle\langle b_{p\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.15)

$$\begin{aligned}(\omega-\epsilon_1)\langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} &= V_d\langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &+U_1\langle\langle c_{1\sigma}n_{1-\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}+V_k^{\mathrm{L}}\langle\langle a_{k\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.16)

$$\begin{aligned}(\omega-\epsilon_1)\langle\langle c_{1\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} &= V_d\langle\langle c_{2\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} \\ &+U_1\langle\langle c_{1\sigma}n_{1-\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r}+V_k^{\mathrm{L}}\langle\langle a_{k\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.17)

$$\begin{aligned}(\omega-\epsilon_2)\langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} &= V_d^{*}\langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+V_d\langle\langle c_{3\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}+U_2\langle\langle c_{2\sigma}n_{2-\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.18)

$$\begin{aligned}(\omega-\epsilon_2)\langle\langle c_{2\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} &= V_{\mathrm{d}}^{*}\langle\langle c_{1\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} \\ &+V_d\langle\langle c_{3\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r}+U_2\langle\langle c_{2\sigma}n_{2-\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.19)

$$\begin{aligned}(\omega-\epsilon_3)\langle\langle c_{3\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} &= V_d^{*}\langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+U_3\langle\langle c_{3\sigma}n_{3-\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}+V_p^{\mathrm{R}}\langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.20)

$$\begin{aligned}(\omega-\epsilon_3)\langle\langle c_{3\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} &= V_d^{*}\langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &+U_3\langle\langle c_{3\sigma}n_{3-\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}+V_p^{\mathrm{R}}\langle\langle b_{p\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}.\end{aligned}$$

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The Dyson equations for lead-dot GFs in series combination are

$$\langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} = V_{k1}^{\mathrm{L}*} g_{k}^{r} \langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}$$

and

$$\langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} = V_{p3}^{\mathrm{R}*} g_{k}^{\mathrm{r}} \langle\langle c_{3\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}.$$

(e) *For the triple quantum dots in parallel*

$$\begin{aligned}(\omega - \epsilon_1)\,\langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} &= 1 + V_d \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ U_1 \langle\langle c_{1\sigma} n_{1-\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + V_{k1}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{p1}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.22)

$$\begin{aligned}(\omega - \epsilon_2)\,\langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} &= 1 + V_d^{*} \langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_d \langle\langle c_{3\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} + V_{k2}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ U_2 \langle\langle c_{2\sigma} n_{2-\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + V_{p2}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.23)

$$\begin{aligned}(\omega - \epsilon_3)\,\langle\langle c_{3\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} &= 1 + V_d^{*} \langle\langle c_{2\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ U_3 \langle\langle c_{3\sigma} n_{3-\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} + V_{k3}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{p3}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.24)

$$\begin{aligned}(\omega - \epsilon_1)\,\langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} &= V_{\mathrm{d}} \langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ U_1 \langle\langle c_{1\sigma} n_{1-\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} + V_{k1}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{p1}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.25)

$$\begin{aligned}(\omega - \epsilon_2)\,\langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} &= V_d^{*} \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_d \langle\langle c_{3\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + U_2 \langle\langle c_{2\sigma} n_{2-\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{p2}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + V_{k2}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.26)

$$\begin{aligned}(\omega - \epsilon_3)\,\langle\langle c_{3\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} &= V_d^{*} \langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ U_3 \langle\langle c_{3\sigma} n_{3-\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} + V_{k3}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{p3}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.27)

$$\begin{aligned}(\omega - \epsilon_1)\,\langle\langle c_{1\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} &= V_d \langle\langle c_{2\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ U_1 \langle\langle c_{1\sigma} n_{1-\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} + V_{k1}^{\mathrm{L}} \langle\langle a_{k\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r} \\ &+ V_{p1}^{\mathrm{R}} \langle\langle b_{p\sigma}, c_{3\sigma}^{\dagger}\rangle\rangle^{r}\end{aligned}$$

(A.28)

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$$(\omega-\epsilon_2)\langle\langle c_{2\sigma},c^\dagger_{3\sigma}\rangle\rangle^r = V_d^*\langle\langle c_{1\sigma},c^\dagger_{3\sigma}\rangle\rangle^r + V_d\langle\langle c_{3\sigma},c^\dagger_{3\sigma}\rangle\rangle^r + U_2\langle\langle c_{2\sigma}n_{2-\sigma},c^\dagger_{3\sigma}\rangle\rangle^r + V^{\mathrm{R}}_{p2}\langle\langle b_{p\sigma},c^\dagger_{3\sigma}\rangle\rangle^r + V^{\mathrm{L}}_{k2}\langle\langle a_{k\sigma},c^\dagger_{3\sigma}\rangle\rangle^r \quad \text{(A.29)}$$

$$(\omega-\epsilon_3)\langle\langle c_{3\sigma},c^\dagger_{2\sigma}\rangle\rangle^r = V_d^*\langle\langle c_{2\sigma},c^\dagger_{2\sigma}\rangle\rangle^r + U_3\langle\langle c_{3\sigma}n_{3-\sigma},c^\dagger_{2\sigma}\rangle\rangle^r + V^{\mathrm{L}}_{k3}\langle\langle a_{k\sigma},c^\dagger_{2\sigma}\rangle\rangle^r + V^{\mathrm{R}}_{p3}\langle\langle b_{p\sigma},c^\dagger_{2\sigma}\rangle\rangle^r \quad \text{(A.30)}$$

$$\left(\omega-\epsilon_1-n_1U_1-i\frac{\Gamma_{11}}{2}\right)\langle\langle c_{1\sigma},c^\dagger_{1\sigma}\rangle\rangle^r = 1+V_d\langle\langle c_{2\sigma},c^\dagger_{1\sigma}\rangle\rangle^r + i\frac{\Gamma_{12}}{2}\langle\langle c_{2\sigma},c^\dagger_{1\sigma}\rangle\rangle^r + i\frac{\Gamma_{13}}{2}\langle\langle c_{3\sigma},c^\dagger_{1\sigma}\rangle\rangle^r \quad \text{(A.31)}$$

$$\left(\omega-\epsilon_2-n_2U_2-i\frac{\Gamma_{22}}{2}\right)\langle\langle c_{2\sigma},c^\dagger_{1\sigma}\rangle\rangle^r = V_d\langle\langle c_{1\sigma},c^\dagger_{1\sigma}\rangle\rangle^r + i\frac{\Gamma_{21}}{2}\langle\langle c_{1\sigma},c^\dagger_{1\sigma}\rangle\rangle^r \quad \text{(A.32)}$$

$$\left(\omega-\epsilon_3-n_3U_3-i\frac{\Gamma_{33}}{2}\right)\langle\langle c_{3\sigma},c^\dagger_{3\sigma}\rangle\rangle^r = 1+V_d\langle\langle c_{2\sigma},c^\dagger_{3\sigma}\rangle\rangle^r + i\frac{\Gamma_{32}}{2}\langle\langle c_{2\sigma},c^\dagger_{3\sigma}\rangle\rangle^r. \quad \text{(A.33)}$$

The EOM for lead-dot coupling GFs are given by following Dyson equations:

$$\begin{aligned}\langle\langle a_{k\sigma},c^\dagger_{1\sigma}\rangle\rangle^r =& V^{\mathrm{L}*}_{k1}g^r_k\langle\langle c_{1\sigma},c^\dagger_{1\sigma}\rangle\rangle^r + V^{\mathrm{L}*}_{k2}g^r_k\langle\langle c_{2\sigma},c^\dagger_{1\sigma}\rangle\rangle^r + V^{\mathrm{L}*}_{k3}g^r_k\langle\langle c_{3\sigma},c^\dagger_{1\sigma}\rangle\rangle^r\\ \langle\langle b_{p\sigma},c^\dagger_{1\sigma}\rangle\rangle^r =& V^{\mathrm{R}*}_{p1}g^r_k\langle\langle c_{1\sigma},c^\dagger_{1\sigma}\rangle\rangle^r + V^{\mathrm{R}*}_{p2}g^r_k\langle\langle c_{2\sigma},c^\dagger_{1\sigma}\rangle\rangle^r + V^{\mathrm{R}*}_{p3}g^r_k\langle\langle c_{3\sigma},c^\dagger_{1\sigma}\rangle\rangle^r.\end{aligned}$$

The GFs of QDs in various configurations can be obtained by using the simplest mean-field approximation, such that GFs of the type $\langle\langle c_{i\sigma}n_{i-\sigma},c^\dagger_{j\sigma}\rangle\rangle^r \approx n_{i-\sigma}\langle\langle c_{i\sigma},c^\dagger_{j\sigma}\rangle\rangle^r$ and hierarchy of GFs in the above EOMs get closed to the final forms of the respective GFs.

Appendix B

1.1 B.1 Current

To discuss the method for deriving relation for the total current, we take

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the case of parallel double quantum dot system. The expression for the current due to the left lead is

$$I_{\mathrm{L}} = \frac{e}{h}\sum_{ki\sigma}\int\left(V_{ki}^{\mathrm{L}}\langle\langle a_{k\sigma}, c_{i\sigma}^{\dagger}\rangle\rangle_{\omega}^{<} - V_{ki}^{\mathrm{L}*}\langle\langle c_{k\sigma}, a_{i\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\right)\mathrm{d}\omega \quad (i=1,2).$$

(B.1)

Similarly, the current due to the right lead can be written as

$$I_{\mathrm{R}} = \frac{e}{h}\sum_{pi\sigma}\int\left(V_{pi}^{\mathrm{R}}\langle\langle b_{p\sigma}, c_{i\sigma}^{\dagger}\rangle\rangle_{\omega}^{<} - V_{pi}^{\mathrm{R}*}\langle\langle c_{k\sigma}, b_{i\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\right)\mathrm{d}\omega \quad (i=1,2).$$

(B.2)

The Dyson equations for the GFs appearing in these expressions are

$$\begin{aligned}
&\langle\langle a_{k\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\\
&\quad = V_{k1}^{\mathrm{L}*}g_k^r\langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle_{\omega}^{<} + V_{k1}^{\mathrm{L}*}g_k^{<}\langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle_{\omega}^{a}\\
&\qquad + V_{k2}^{\mathrm{L}*}g_k^r\langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle_{\omega}^{<} + V_{k2}^{\mathrm{L}*}g_k^{<}\langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle_{\omega}^{a}\\
&\langle\langle a_{k\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\\
&\quad = V_{k2}^{\mathrm{L}*}g_k^r\langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle_{\omega}^{<} + V_{k2}^{\mathrm{L}*}g_k^{<}\langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle_{\omega}^{a}\\
&\qquad + V_{k1}^{\mathrm{L}*}g_k^r\langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle_{\omega}^{<} + V_{k1}^{\mathrm{L}*}g_k^{<}\langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle_{\omega}^{a}\\
&\langle\langle c_{1\sigma}, a_{k\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\\
&\quad = V_{k1}^{\mathrm{L}}g_k^{<}\langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle_{\omega}^{r} + V_{k1}^{\mathrm{L}}g_k^{a}\langle\langle c_{1\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\\
&\qquad + V_{k2}^{\mathrm{L}}g_k^{<}\langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle_{\omega}^{r} + V_{k2}^{\mathrm{L}}g_k^{a}\langle\langle c_{2\sigma}, c_{1\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\\
&\langle\langle c_{2\sigma}, a_{k\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\\
&\quad = V_{k2}^{\mathrm{L}}g_k^{<}\langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle_{\omega}^{r} + V_{k2}^{\mathrm{L}}g_k^{a}\langle\langle c_{2\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\\
&\qquad + V_{k1}^{\mathrm{L}}g_k^{<}\langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle_{\omega}^{r} + V_{k1}^{\mathrm{L}}g_k^{a}\langle\langle c_{1\sigma}, c_{2\sigma}^{\dagger}\rangle\rangle_{\omega}^{<}\\
&I_{\mathrm{L}} = \frac{e}{h}\sum_{\sigma}\int i\mathrm{Tr}\left[\Gamma^{\mathrm{L}}G^{<} + f_{\mathrm{L}}\Gamma^{\mathrm{L}}(G^r - G^a)\right]\mathrm{d}\omega
\end{aligned}$$

(B.3)

$$I_{\mathrm{R}} = \frac{e}{h}\sum_{\sigma}\int i\mathrm{Tr}\left[\Gamma^{\mathrm{R}}G^{<} + f_{\mathrm{R}}\Gamma^{\mathrm{R}}(G^r - G^a)\right]\mathrm{d}\omega.$$

(B.4)

Further,

$$I = I_{\mathrm{L}} = -I_{\mathrm{R}} = \frac{I_{\mathrm{L}} - \mathrm{I}_{\mathrm{R}}}{2}.$$

The total current in the couple quantum dots is

$$\begin{aligned}
I = &\frac{ie}{2h}\sum_{\sigma}\int\mathrm{Tr}\left[\left(\Gamma^{\mathrm{L}} - \Gamma^{\mathrm{R}}\right)G^{<}\right.\\
&\left.+(\Gamma^{\mathrm{L}}f_{\mathrm{L}} - \Gamma^{\mathrm{R}}f_{\mathrm{R}})(G^r - G^a)\right]\mathrm{d}\omega.
\end{aligned}$$

(B.5)

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$$\Gamma^{\mathrm{L}} = \lambda \Gamma^{\mathrm{R}} \quad \text{and} \quad x = \frac{1}{1+\lambda}.$$

The current can be written as $I = xI_{\mathrm{L}} - (1-x)I_{\mathrm{R}}$. Hence,

$$I = \frac{ie}{h} \sum_{\sigma} \int (f_{\mathrm{L}} - f_{\mathrm{R}}) \times \mathrm{Tr}\left[\left(\frac{\Gamma^{\mathrm{L}}\Gamma^{\mathrm{R}}}{\Gamma^{\mathrm{L}} - \Gamma^{\mathrm{R}}}\right)(G^r - G^a)\right] \mathrm{d}\omega. \tag{B.6}$$

Also, by making use of the identity $G^r - G^a = -i\left(\Gamma^{\mathrm{L}} - \Gamma^{\mathrm{R}}\right) G^r G^a$, the expression for the total current leads to the following well-known Landauer–Buttiker current formula:

$$I = \frac{e}{h} \sum_{\sigma} \int (f_{\mathrm{L}} - f_{\mathrm{R}}) \, \mathrm{Tr}\left(G^a \Gamma^{\mathrm{R}} G^r \Gamma^{\mathrm{L}}\right) \mathrm{d}\omega = \frac{e}{h} \sum_{\sigma} \int (f_{\mathrm{L}} - f_{\mathrm{R}}) \, T(\omega) \, \mathrm{d}\omega. \tag{B.7}$$

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RESEARCH ARTICLE | NOVEMBER 05 2020

First principle study of electronic and optical properties of functionalized Stanene quantum dot

Sushila Devi ; Munish Sharma; Brij Mohan; P. K. Ahluwalia; Shyam Chand

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A Stanene quantum dot in triangular shape has been investigated within the Density Functional Theory. The effect of edge passivationwith hydrogen, fluorine and chlorine atoms on electronic and optical properties has been explored. We observed that HOMO-LUMO energy gap in functionalized structures varies from 0.33 eV to 0.27eV and magnetic moment variation from 2.52 μ_B to 1.98μ_B. In dielectric function, red shift is observed for halogens(-F, -Cl) passivation comparative to hydrogenation and plasmons lie in infrared region of frequency spectrum.

Topics

HOMO and LUMO, Density functional theory, First-principle calculations, Plasmons, Magnetic dipole moment, Optical properties, Quantum dots, Topological insulator, Hydrogenation process

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Abstract

The present study investigates the behaviour of helical soil-nailed wall in a dry cohesionless medium under static and seismic conditions. Initially, results from laboratory pullout tests are used to develop a pullout capacity equation, which is subsequently used for stability analysis of helical soil-nailed wall. A detailed parametric study is conducted to evaluate the effect of angle of internal friction of soil, nail inclination, vertical spacing of nails, number of nails, helix size, number of helices, and the face angle on the stability of the soil-nailed wall. Results from the present method are compared and validated with similar existing methods available in the literature. The results suggest that for the given input parameters, the factor of safety (FoS) values from the present method are lower than the pseudo-static and pseudo-dynamic values. Further, the study clearly highlights the significance of input excitation frequency on the FoS of helical soil-nailed walls. In addition, the effects of strain-dependent dynamic properties (shear modulus and damping ratio) on the stability of helical soil-nailed walls are studied using the newly proposed equivalent linear analysis approach. The results computed from the proposed linear and equivalent linear analysis are also compared and discussed in detail.

Résumé

La présente étude examine le comportement des parois hélicoïdales clouées au sol dans un milieu sec et sans cohésion dans des conditions statiques et sismiques. Initialement, les résultats des tests d'arrachement en laboratoire sont utilisés pour développer l'équation de la capacité d'arrachement, qui est ensuite utilisée pour l'analyse de stabilité des parois hélicoïdales clouées au sol. Une étude paramétrique détaillée est menée pour évaluer l'effet de l'angle de frottement interne du sol, l'inclinaison des clous, l'espacement vertical des clous, le nombre de clous, la taille de l'hélice, le nombre d'hélices et l'angle du visage sur la stabilité du mur cloué au sol. Les résultats de la présente méthode sont comparés et validés avec les méthodes similaires existantes dans la littérature. Les résultats suggèrent que, pour les paramètres d'entrée donnés, les valeurs du facteur de sécurité (« FoS ») de la méthode actuelle sont inférieures aux valeurs pseudo-statiques et pseudo-dynamiques. En outre, l'étude souligne clairement l'importance de la fréquence d'excitation d'entrée sur le FoS des murs hélicoïdaux cloués au sol. En outre, l'effet des propriétés dynamiques dépendantes de la contrainte (module de cisaillement et rapport d'amortissement) sur la stabilité des murs cloués hélicoïdaux de sol est étudié à l'aide de la nouvelle méthode d'analyse linéaire équivalente proposée. Les résultats calculés à partir de l'analyse linéaire et de l'analyse linéaire équivalente proposée sont également comparés et discutés en détail. [Traduit par la Rédaction]

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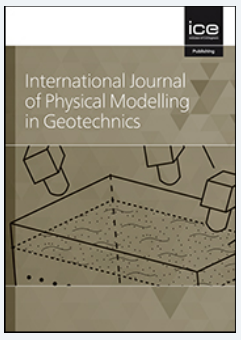

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A study on interface shear behaviour of soil nails from pullout and direct shear tests

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Abstract

Pullout and direct shear (DS) tests are most commonly used to measure the interface shear strength parameters required for soil–nail design. This paper investigates the effect of the surface roughness, and relative density (RD) and installation process on interface shear behaviour between the groutless soil nail and dry sand medium through laboratory pullout and DS interface tests. The test procedure and the interface shear results obtained from pullout tests are discussed and compared with that obtained from DS tests besides the existing literature. The study shows that in the pre-peak stage, the shear stress–displacement behaviour obtained from interface shear tests is similar to pullout tests and soil–soil DS tests. However, in the post-peak stage, the behaviour is similar to soil–soil DS tests but different from pullout tests. The interface shear stress behaviour of soil nail is significantly influenced by the installation process, RD of soil sample and surface roughness of the soil nail.

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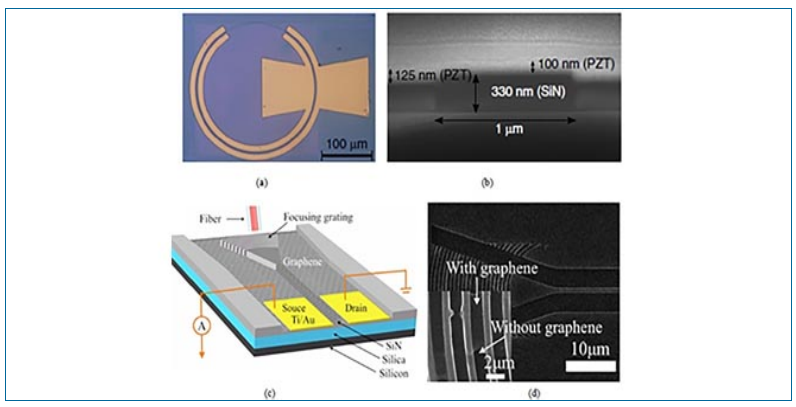

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Silicon photonic devices used in the photonics industry over the past three decades have helped in realizing large-scale photonic integrated circuits. Silicon nitride (Si_3N_4) is another CMOS-compatible platform that provides several advantages such as low loss, high optical power tolerance, and broad spectral operation band from visible to infrared wavelengths. Recently, the combination of Si_3N_4 waveguide technology with silicon photonics and III-V materials has opened up new areas in on-chip applications. Researchers in the field are primarily focusing on its applications such as on-chip gas sensing, nonlinear optical signal processing, and label-free biosensors based on photonic integrated circuits. In this review paper, we discuss Si_3N_4 material-based platforms for a variety of applications with devices ranging from passive to active and hybrid photonic devices.

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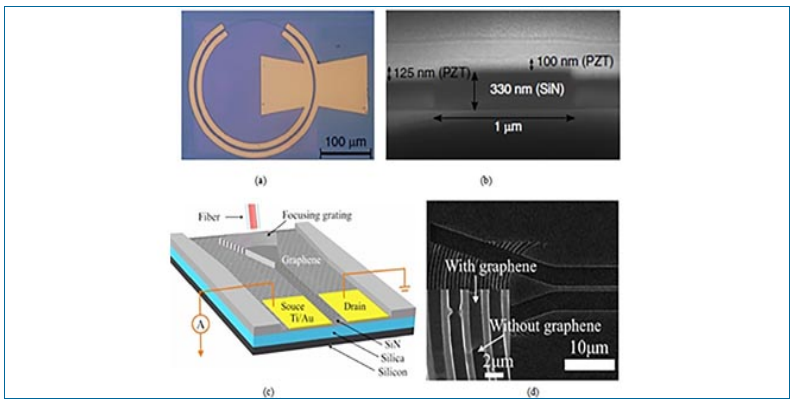

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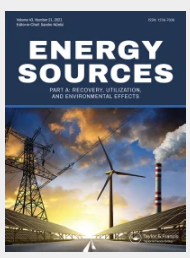

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Optimal Sizing of Stand Alone Hybrid Renewable Energy System with Load Shifting

Sanjay Kumar, Tarlochan Kaur, Subho Upadhyay, Vivek Sharma & Deven Vatsal

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ABSTRACT

In the present study, a model is proposed for the sizing optimization of a hybrid renewable energy system (HRES) based on local resource assessment and demand side management (DSM). It involves resource estimation for both micro hydro and solar photovoltaic systems. The sizing optimization of the HRES with or without load shifting based DSM is carried out using PSO (particle swarm optimization) and BBO (biogeography-based optimization) techniques. The purpose of DSM is to reduce the peak hourly power consumption. The cycle charging dispatch strategy has been used for sizing optimization of HRES. A comparative analysis has been made for PSO and BBO algorithms, by keeping energy index ratio at 1. Based on demand side management, the cost of energy, net present cost, renewable fraction, and emissions of carbon dioxide from diesel generators are also calculated. The results show that HRES with diesel generator (DG) of (10 kW), solar photovoltaic system (SPV) of (0.3 kW), and batteries of (300 Ah) each are most cost effective in the present scenario. This HRES combination consists of 4 units of DGs, 184 units SPV, and 44 units battery possesses 95.31% of renewable fraction during load

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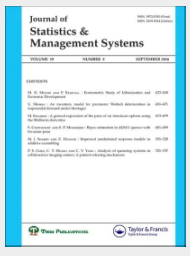

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Modified SEIR model for prediction of COVID-19 outbreak trend in India with effectiveness of preventive care

Sanjay Kumar, Vineet Kumar, Uday Awasthi, Manu Vatsal & Sanjay Kumar Singh

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Abstract

The outbreak of COVID 19 among community is a threat to society. The world is still looking for its vaccine in the market due to rapid growth in positive cases. The shutdown of essential service in global market due to COVID-19 has produced a threat to economic security and society growth. In present study, SEIR (Susceptible, Exposed, Infectious and Recovered) model using ode45 solver has been developed for prediction of number of COVID-19 cases that could possibly be there in India in next 227 days. The impact of COVID-19 cases with and without and preventive care has been predicted with proposed model. The effect of reproductive number (R) in respect to preventive care has also been analysed.

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Highly sensitive and reusable Cu^{+2}/polyaniline/reduced graphene oxide nanocomposite ink-based non-enzymatic glucose sensor

Vijay Kumar Anand, Archana Bukke, Kapil Bhatt, Sandeep Kumar, Sandeep Sharma, Rakesh Goyal & G. S. Virdi

Applied Physics A **126**, Article number: 500 (2020)

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Abstract

The present work focuses on the preparation and characterizations of a highly sensitive, reusable, linear, anti-interferent, and low-cost Cu^{+2}/polyaniline (PANI)/reduced graphene oxide (rGO) nanocomposite ink-based non-enzymatic glucose (NEG) sensor. The synergistic properties of Cu^{+2}/PANI and rGO result in a large number of electrochemically active and stable sites which catalytically favored the glucose oxidation. The crystal structure and morphology of PANI, Cu^{+2}/PANI composite, and Cu^{+2}/PANI/rGO nanocomposite ink encouraged the usefulness of Cu^{+2}/PANI/rGO nanocomposite ink as an electrocatalyst in NEG detection. A NEG sensor was prepared by drop coating Cu^{+2}/PANI/rGO nanocomposite ink on a low-cost patterned FR4 electrode. The cyclic voltammetry and chronoamperometry tests were performed to estimate the electrochemical behavior of prepared Cu^{+2}/PANI/rGO/FR4 NEG sensor. The electrooxidation of glucose was achieved at an applied potential of 0.66 V. An anti-interferent Cu^{+2}/PANI/rGO/FR4 NEG sensor demonstrated a linear response in two different glucose concentration regimes 2.8–22.2 μM and 0–4 mM with current sensitivity of 4168.37 μA mM^{-1} cm^{-2} and 525.4 μA mM^{-1} cm^{-2}, respectively. The prepared sensor displayed a limit of detection (LOD) of 4.93 μM with a response time of < 5 s. The excellent performance parameters of the Cu^{+2}/PANI/rGO/FR4 NEG sensor recommend its relevance in human serum samples. These values of operating voltage, current sensitivity, linear range, LOD and anti-interference ability promise its usefulness in practical applications.

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High-performance ultra-low leakage current graphene-based screen-printed field-effect transistor on paper substrate

Kapil Bhatt, Sandeep Kumar & C C Tripathi

Pramana **94**, Article number: 31 (2020)

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Abstract

Exploiting the advantages of additive patterning process over complex fabrication processes, herein we report the fabrication of field-effect transistor (FET) using the screen-printing method. The graphene conductive composite dielectric ink as the channel and the dielectric layer respectively was screen printed on cellulose paper substrate. The fabricated device shows the hole and electron mobility of 135 \(\hbox {cm}^{2}/\)V s and 98 \(\hbox {cm}^{2}/\)V s respectively with an ultra-low leakage current of \(\sim \)25 nA. The proposed technique can be used for large-scale roll-to-roll commercial manufacturing of disposable FET-based sensors such as temperature and IR sensors, health monitoring devices etc.

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Graphene field effect transistor **gate leakage current**

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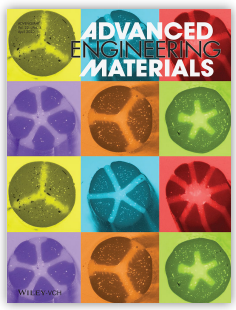

Volume 22, Issue 4
April 2020
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Full Paper

Impact of Triple Roll Milling Processing Parameters on Fluidic/Rheological and Electrical Properties of Aqueous Graphene Ink

Sandeep Kumar, Pramod Kumar, Kapil Bhatt, Shilpi Shrivastva, Amit Kumar, Ravinder Singh, Rajesh Punia, Chandra Charu Tripathi

First published: 17 December 2019 | https://doi.org/10.1002/adem.201901187 | Citations: 5

Abstract

Graphene ink is a potential candidate for the printing of electronic devices. Rheological studies of graphene inks are necessary to estimate and tune the behavior of ink during and after printing. Ink constituents and their fundamental properties play an important role in modifying the rheological behavior of ink. During the processing of ink, modification of these properties takes place. So, it is quite important to investigate the role of processing equipment on the ink constituents and correspondingly on the rheological behavior of ink and printed functional devices. Herein, graphene ink formulation through a triple roll mill (TRM) is presented. The particle size of graphene ink reduces substantially with both the speed of rollers and number of passes. Approximately 52% reduction in particle size is observed after five passes at the highest roller speed, and it further reduces up to 72% with an increase in the number of passes. Correspondingly, solvent loss, density, and viscosity of the inks are observed in respect of roller speed and number of passes. The impact of TRM parameters on ink constituents, rheology, and electrical properties of screen-printed resistors is discussed and explained in terms of simple analytical models.

Conflict of Interest

The authors declare no conflict of interest.

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Two-Tier Converter: A New Structure of High Gain DC-DC Converter with Reduced Voltage Stress

Publisher: IEEE

Cite This PDF

Nikita Gupta ; Mahajan Sagar Bhaskar ; Dhafer Almakhles ; P. Sanjeevikumar ; Frede Blaabjerg ; Zbigniew Leonowicz **All Authors**

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III. Effect of Effective Series Resistance of Inductor L_{1} and L_{2} on Voltage Gain

IV. Comparison of Ttcwith Othersimilar Topologies

V. Numerical Simulation Results

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Abstract:

With the advent of distributed generation (DG), the need for efficient power electronic converter is increasing as the incorporation of renewables with battery unit and loads rely heavily on them. This paper suggests an original structure of high-gain DC to DC converter named as “Two-Tier converter” with the reduction in voltage stress. The configuration is resultant of stacking two-stage of the classical boost converter. The voltage gain offered is high for even lower values of duty cycle as the relation of gain is quadratic. Also, the converter current at the input is continuous, and the load configuration offered is grounded. Analysis and operational modes of the proposed converters and effect of the effective series resistance of inductors on voltage gain are presented in detail. A comparative analysis of suggested and new high-gain converters is presented in detail. The suggested configuration is confirmed using detailed simulation studies.

Published in: 2020 IEEE International Conference on Environment and Electrical Engineering and 2020 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe)

Date of Conference: 09-12 June 2020

INSPEC Accession Number: 19872813

Date Added to IEEE *Xplore*: 06 August 2020

DOI: 10.1109/EEEIC/ICPSEurope49358.2020.9160526

ISBN Information:

Publisher: IEEE

Conference Location: Madrid, Spain

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I. Introduction

Distributed generation (DG) penetration at both low and medium (LV and MV) is increasing worldwide [1]. DG application has key potentials at reducing carbon emissions as it promotes renewables like solar modules, small turbines for wind energy, fuel cells, etc. [2]. Also, DG setup has generation close to the end-users that leads to reliability and power quality improvement of electric supply [3]. DG design and operation require new interfacing technologies primarily because of

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intermittent nature and low level of the terminal voltage of renewable energy sources [4]. Need for efficient DC-DC converters having high voltage gain is one of them. The conventional boost, buck-boost converter configurations can provide a high voltage level at the output; however, efficiency is severely affected as duty ratio approaches unity mainly due to increased conduction losses of switches [5]. Thus, to increase the voltage gain ratio with improved performance and efficiency, several configurations suggested in the available theory [6]–[7]. The converter topologies with transformers achieve high voltage level, but they face low-efficiency issues due to the leakage inductance, which induces high voltage and thus, significant switching losses problems. Also, apart from industrial applications, transformer use in converters adds to the cost and size and reduces efficiency. Further, converters with coupled inductors were introduced that able to achieve a high voltage gain, but they suffer from the same leakage inductance issue and a large-size spike in current. Moreover, the additional clamping circuit, with filters circuitry associated with these converters, and which makes circuit complex and costly [7].

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New concepts for distributed power generation and power quality for large scale integration of renewable energy sources
2005 European Conference on Power Electronics and Applications
Published: 2005

Sustainable MVDC Railway System Integrated with Renewable Energy Sources and EV Charging Station
2022 IEEE Vehicle Power and Propulsion Conference (VPPC)
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Novel Non-Isolated Quad-Switched Inductor Double-Switch Converter for DC Microgrid Application

Publisher: IEEE

Cite This PDF

Nikita Gupta ; Mahajan Sagar Bhaskar ; Dhafer Almakhles ; P. Sanjeevikumar ; Umashankar Subramaniam ; Zbigniew Leonowicz ; Massimo … **All Authors**

9 Paper Citations

181 Full Text Views

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III. Comparative Observation

IV. Numerical Simulation Test Results

V. Conclusion

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Abstract:

In DC microgrid, the combination of energy source, especially renewable with the unit for storage and utility load rely heavily upon the electronics power converters. This paper proposes a novel DC to DC converter called Quad-Switched-Inductor Double-Switch (QSI-DS) converter for microgrid voltage step-up applications. The non-isolated topology utilizes Quad-Switched-Inductors network to develop to proposed converter configuration to achieve high voltage gain. Two switches used to control the flow of energy from input to the output of the converter. Reduced voltage stress across the switches and high gain are the merits of the proposed converter in this work. Principle of operation for continuous, and discontinues modes of the suggested converter, also elaborated. Analysis for gain calculation, comparison with recently suggested converters is presented. The theoretical analysis and performance of the suggested topology of converter validated through Simulink model.

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INSPEC Accession Number: 20030687

Date Added to IEEE *Xplore*: 06 August 2020

DOI: 10.1109/EEEIC/ICPSEurope49358.2020.9160839

ISBN Information:

Publisher: IEEE

Conference Location: Madrid, Spain

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I. Introduction

Recently, the growing concerns over greenhouse gas emissions and reduction in fossil fuel reserves have led to increased interest and attention towards renewable energy sources. Renewable energy sources offer considerable promises of an efficient, reliable and environment-friendly electric system [1]. Solar photovoltaic (PV) is one that gaining popularity because of the abundance of solar

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irradiation, its inexhaustible potential, its increasingly competitive cost and environmental benefits [2]. But the penetration of renewables as distributed generation sources at the distribution level causes issues like excessive voltage rise, increase in the fault level, power quality issues, etc. Recently, DC microgrid has progressed as a reliable mode of the power distribution network as it agreements a natural interface to DC energy sources, storage units for energy, and utility loads when compared to AC grid [3]. Fig. 1 depicts a schematic layout of 400 V microgrid (DC) consisting of solar PV as renewable energy sources, battery as an energy storage device and loads systems connected to a universal DC bus through DC-DC and DC-AC converters. Various configurations have been proposed in the literature for DC distribution systems [4]–[5]. The main issues lie at a low level and intermittent nature of the terminal voltage of PV modules. PV panels are connected in series to boost the output voltage, which consequences in a dip in efficiency increased cost and size of the system.

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An improved high-power DC/DC Converter for distributed power generation
2009 10th International Conference on Electrical Power Quality and Utilisation
Published: 2009

A Novel Adaptive Control Strategy for Transient Performance Improvement of DC/DC Converter in Distributed Power Generation Systems
2022 IEEE/IAS Industrial and Commercial Power System Asia (I&CPS Asia)
Published: 2022

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3Nx DC-DC Converter: Interleaved Topology To Enhance Voltage Transfer Gain

Publisher: IEEE

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II. Proposed Configuration

III. Comparison

IV. Simulation Results

V. Conclusion

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Abstract:

To mitigate the voltage transfer gain issue of the classical power converters, an isolated boost converter can be a solution. However, it increases the power circuit dimension and expense due to the involvement of many coupled inductors and transformer. In this treatise, a 3Nx DC-DC converter is proposed for high voltage gain application. High voltage transfer gain is obtained by suggested converters and circuitry is derived from two multistage converters (one inverting and second non-inverting) by connecting them. In more specific, 3Nx power converter fusing the characteristics of 2Nx power converter and Nx DC-DC converter, where voltage multiplier and switched inductor cells are used to improve voltage gain. By doing this, the 3Nx power converter generates the voltage transfer gain 3N times higher than the simple boost power converter, where N is several stages in the suggested power converter. The magnitudes of DC voltage can be increased with more number of stages to make renewable energy resources appropriate at the user level. The operation, voltage gain derivation, comparison with recent converter, simulation study are given. The obtained results are closely matched with mathematical analysis and approve the operation of the 3Nx power converter.

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DOI: 10.1109/PEDES49360.2020.9379588

Publisher: IEEE

Conference Location: Jaipur, India

Funding Agency:

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I. Introduction

Recent years have seen the exponential development of renewable energies, including wind, solar,

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mare, biomass etc. The abundance of energy produced means that among other highly agreed and most allowed sources [1]–[4], solar energy is the main source of energy output. The output voltages are relatively modest for clean sources, including photovoltaic (PV) arrays. However, a high voltage DC bus is required for the grid. Although these renewables have comparatively low voltage performance characteristics, they require substantial incremental voltage gains and high-quality DC-DC converters. The DC-DC boost converter provided the photovoltaic panel step-up voltage with the requisite value for the inverter to inject energy into the grid [5]–[6] to solve this serious issue. As seen in Fig. 1(a) the typical boost converter could achieve an infinite voltage conversion ratio according to theoretical. The simple converter is, however, an inefficient solution for high duty cycles, provided that the ESR series equal resistance, an issue with diode recovery, etc., limits the boost ratio and makes the transformer unstable [7]. The existence of passive components such as condensers and inductor, which do not discharge in such situations will be unstable. Cascade converters may be a workaround for high voltage gains, but the voltage and current of the converter switches are not homogeneous. It also increases the number and complexity of the semi-conducting switches by reducing the device performance [7]–[8]. Isolated converters help solve problems, but isolated converter topologies make the control circuit voluminous and expensive [7]–[10]. Several recent topologies were determined to reach high transfer gain without the transformer values or service cycles being overexploited.

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Discussions on control loop design in average current mode control [PWM DC/DC power convertors]

Conference Record of the 2000 IEEE Industry Applications Conference. Thirty-Fifth IAS Annual Meeting and World Conference on Industrial Applications of Electrical Energy (Cat. No.00CH37129)

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A high gain DC-DC converter using voltage multiplier

2014 International Conference on Advances in Electrical Engineering (ICAEE)

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Single-Phase Series Compensator Circuit for Mitigating Voltage Sag or Swell in the Power System Networks - Methodology and Modelling

Publisher: IEEE

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Harshal D. Vaidya ; Mahajan Sagar Bhaskar ; Nikita Gupta ; P. Sanjeevikumar ; Dhafer Almakhles ; S. Umashankar ; Zbigniew Leonowicz **All Authors**

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Abstract:
Nowadays, power quality becomes an essential concern in the field of power system networks due to the use of sensitive devices. The problem associated with power quality is voltage sag, damage to power equipment, product quality degradations, voltage swell, etc. But one of the severe disturbances in the power system is the problem of voltage sag. To mitigating these disturbances, the use of custom power devices or FACTS devices with the help of power electronic devices is presented. Hence an economical and proficient power device called as the Series Compensator Circuit (SCC) is employed in power distribution networks. This device helps in injecting the voltage in synchronism with the standard system voltage to compensate the voltage influences in the situation of voltage disturbance. This article deals with modelling, methodology and simulation of a Series Compensator Circuit (SCC). A simulation is modelled using MATLAB/Simulink. The simulation results are presented, which validates the functionality and the concept effectively.

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ISBN Information:

Publisher: IEEE

Conference Location: Madrid, Spain

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Modern-day household and industrial appliances are too much sensitive to power quality irregularities. Factors like voltage magnitude, frequency and wave-shape primarily define the power quality. The IEEE standards categorize the irregularities of power quality into seven types based on

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waveshape as transients, interruptions, under-voltage or voltage sag, over-voltage or voltage swell, waveform distortion, voltage fluctuations, and frequency variations. The widely prevailing irregular state is voltage sag which majorly affects the sensitive loads. From IEEE 519–1992 and IEEE 1159–1995 standards it can be stated that, in the period of voltage sag, RMS voltage might fall from 10 to 90 per cent of rated voltage and able to withstand for the extent of 0.5 to 30 cycles [1]. Likewise, in the period of voltage swell, RMS voltage might increase from 10 to 80% of rated voltage and able to withstand, for an extent of 0.5 to 30 cycles [2]. The series connection of SCC in the power line ahead of the sensitive load guards the load against voltage instabilities [3].

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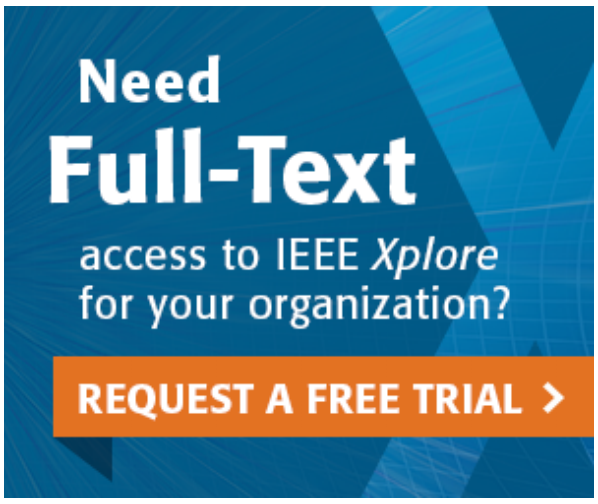

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Flexible AC Transmission Systems (FACTS) and Resilient AC Distribution Systems (RACDS) in Smart Grid
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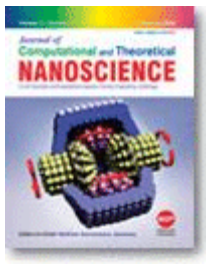

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Publisher: American Scientific Publishers
DOI: https://doi.org/10.1166/jctn.2020.8934

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Breast cancer is one of the common malignant diseases in female all over the world. Microscopic investigation of tissues in breast is essential for analysis of breast cancer. For detection of breast cancer, pathologist uses various magnificent stages for obtaining accurate diagnosis of biopsy images which is time consuming. Development in digital imaging techniques has helped in assessment of pathology images using machine learning and computerized methods which could computerize a few of the pathology stages in the diagnosis of breast cancer. This kind of automation can be helpful in achieving quick and exact results reducing the observers' inconsistency, thus increasing the accuracy. In this work, a new method is proposed to categorize breast cancer histopathology images. The objective is to evaluate the robustness and accuracy of a classification system based on machine learning, to automatically identify invasive tumor on digitized images without extracting the features. Here, a new method is presented that employs machine learning classifiers for classification of invasive tumor on whole slide images. The accuracy of different classifiers varies from 80% to 85%, leaving scope for improvement. The aim is to gather different researchers in both machine learning and medical field to proceed toward this Computer Aided Diagnosis (CAD) system for classification of invasive ductal carcinoma (IDC).

Keywords: Breast Cancer; Computer Aided Diagnosis; Invasive Ductal Carcinoma; Machine Learning; SVM
Document Type: Research Article
Affiliations: Chitkara University Institute of Engineering and Technology, Chitkara University, 140401, Punjab, India
Publication date: June 1, 2020

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Research Article

Optimization of Growth Conditions for Oxalate Decarboxylase Production from Pseudomonas sp. OXDC12 and *in vitro* Inhibition of Calcium Oxalate Crystallization by Oxalate Decarboxylase

Author(s): Shruti Gupta and Shamsher S. Kanwar*

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Abstract

Combination of classical and statistical approaches to enhance the fermentation conditions and increase the yield of Lipopeptide(s) by Pseudomonas sp. OXDC12: its partial purification and determining antifungal property

Vivek Chauhan [1], Vivek Dhiman [1], Shamsher Singh Kanwar [1]

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Abstract

Around 200 different lipopeptides (LPs) have been identified to date, most of which are produced via *Bacillus* and *Pseudomonas* species. The clinical nature of the lipopeptide (LP) has led to a big surge in its research. They show antimicrobial and antitumor activities due to which mass-scale production and purification of LPs are beneficial. Response surface methodology (RSM) approach has emerged as an alternative in the field of computational biology for optimizing the reaction parameters using statistical models. In the present study, *Pseudomonas* sp. strain OXDC12 was used for production and partial purification of LPs using Thin Layer Chromatography (TLC). The main goal of the study was to increase the overall yield of LPs by optimizing the different variables in the fermentation broth. This was achieved using a combination of one factor at a time (OFAT) and response surface methodology (RSM) approaches. OFAT technique was used to optimize the necessary parameters and was followed by the creation of statistical models (RSM) to optimize the remaining variables. Maximum mycelial growth inhibition (%) against the fungus Mucor sp. was 61.3% for LP. Overall, the combination of both OFAT and RSM helped in increasing the LPs yield by 3 folds from 367mg/L to 1169mg/L.

Keywords: Fermentation; TLC; antifungal activity; optimization; purification; statistical evaluation.

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Bulletin of the National Research Centre

RESEARCH Open Access

Purification and characterization of actinidin from *Actinidia deliciosa* and its utilization in inactivation of α-amylase

Vivek Kumar Dhiman[1], Vivek Chauhan[1], Shamsher Singh Kanwar[1], Devendra Singh[2*] and Himanshu Pandey[3]

Abstract

Background: Actinidin is an anionic thiol-proteinase predominant and unique to Chinese gooseberry or kiwifruit, whose strong digestibility enables proteins or enzymes vulnerable to digestion. The arrangement of active cysteine–thiol residues (Cys22-Cys65, Cys56-Cys98, and Cys156-Cys206) stabilizes the catalytic unit, thus allowing an effective Inhibition of α-amylase protein on exposure to the highest concentrations of actinidin under optimum conditions. When starch-rich foods are consumed with kiwifruit, starch digestion may be slowed by the inactivation of α-amylase (digestive enzyme), specifically reducing the blood sugar levels by hindering starch digestion that is helpful in diabetes mellitus. Thus, the study aimed at actinidin purification, optimization for maximal activity, and its demonstration as a potential to degrade α-amylase.

Results: Protease showed a molecular mass of 27 kDa on SDS-PAGE analysis. One factor at a time method was applied for process optimization, increasing the actinidin yield up to 176.03 U/mg. The enzyme was stable at a wide pH range; however, it was most active and stable at pH 7.5. The enzyme possessed half-life at 35 °C of 5.5 h, at 40 °C of 4.5 h, at 45 °C of 2.5 h, and at 50 °C of 1 h. Lineweaver–Burk plot showed Michaelis–Menten constant (*Km*: 3.14 mg/ml) and maximal velocity (*Vmax*: 1.428 mmol/ml/min) using casein. The actinidin activity was enhanced with Ca^{2+} while it was inhibited by Cd^{2+} and Hg^{2+} ions. The α-amylase protein was successfully inactivated upon incubation with actinidin for 30 min; around ~ 85% of the α-amylase activity diminished. IC_{50} for inhibition of α-amylase was 2.54 mg/ml for crude actinidin and 1.86 mg/ml for purified actinidin.

Conclusions: Purified Actinidin showed a 1.28-fold increase in proteolytic activity. The proteinase showed an active pH range of 3.5–8.5 under varied buffer conditions and thermostability up to 50 °C. The results revealed a significant potential utility of actinidin to retard amylase as it effectively degraded the amylolytic enzyme under in vitro conditions and could be beneficial for lowering glycemic response to ingested starch. However, further in vitro as well as in vivo studies need to be conducted under gastrointestinal conditions to establish the hypothesis.

Keywords: Kiwifruit, *Actinidia deliciosa*, actinidin, SDS-PAGE, MALDI–TOF MS, Characterization, α-amylase

Background

Proteases have a key role in basic research because of their specificity to cleave peptide bonds used to elucidate protein sequence and structure. Commercially important proteases are obtained from a wide variety of living organisms (Baker et al. 1980). Kiwifruit belongs to the genus *Actinidia* and is a good source of actinidin protease. Actinidin is a plant-derived protease unique to *Actinidia sp.* It belongs to the cysteine or thiol protease

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Purification, characterization and cytotoxic properties of a bacterial RNase

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Highlights

- The purified RNase exhibited a very low (0.3 mM) and high V_{max} (9.2 μmol/mg/min)
- The enzyme was stable over wide range of pH and temperature

Optimization of culture conditions for extracellular cholesterol oxidase production from *Castellaniella* sp. for cholesterol conversion to 4-cholesten-3-one

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Abstract

Cholesterol oxidase (CHOx) production by a new isolate characterized as Castellaniella sp. was studied in different fermentation conditions. The effects of various medium components and physicochemical conditions included production profile, inoculum size, inoculum age, carbon source, nitrogen source (organic and inorganic), surfactants, pH and temperature on extracellular CHOx production.

The maximum CHOx production was observed after 62 h of production time with 8.0%, v/v inoculum size with optimized fermentation medium containing cholesterol (0.1%, w/v), yeast extract (0.5%, w/v) and Triton X-100 (0.2%, v/v). The optimum pH and temperature for maximum CHOx production were found to be 8.0 and 35°C respectively. The classical "one-factor-at-a-time" approach increased CHOx activity of Castellaniella sp. from 0.067 U/ml to 0.396 U/ml, indicating 5.9-fold enhancement. Cholesterol biotransformation of 73± 3.0% to 4-cholesten-3-one was achieved by using enzyme solution/ n-decane biphasic system after 3 h of reaction by using 0.2% (w/v) cholesterol. The bioconversion was confirmed by TLC, HPLC and FTIR analysis of synthesized 4-cholesten-3-one.

Keywords: Cholesterol oxidase, 4-cholesten-3-one, bioconversion, *Castellaniella* sp.

Introduction

Enzymes are natural macromolecular catalysts and today the use of enzymes is unlimited. Highly efficient biocatalysts enzymes are explored for industrial-scale catalysis due to instead of 4-cholesten-3-one (CEO).[9] CHOx is strictly of bacterial origin and is not produced in plant or animal systems.[16] The most common and versatile CHOx producers are bacteria of gram-positive origin including *Arthrobacter*[5], *Bacillus* spp.[21], *Bordetella*[23], *Brevibacterium*[14], *Corynebacterium*[32], *Rhodococcus*[18] and *Streptomyces*.[11] The actinomycetes group is most common producer of CHOx. Few gram-negative bacteria including *Burkholderia*[7], *Chromobacterium*[9] and *Pseudomonas* sp.[15] are also reported for producing CHOx.

Screening and isolating new CHOx producing microorganisms are considered very important due to a range of applications that the enzyme holds and keeping it in focus, the enzyme has been isolated and purified from various microbial sources.[9] One of the well-established applications of CHOx is its use in the enzymatic assay carried out to detect and quantify the amount of cholesterol in food, serum and various other clinical samples.[27] The CHOx has also been stated to show promising results as an effective insecticidal and larvicidal agent.[30] CHOx can also play an important role as a biocatalyst for the production of a large range of valuable steroid intermediates such as 4-androstene-3, 17-dione (AD) and 1, 4-androstadiene-3,17-dione (ADD), which serve as starting materials in the synthesis of many anabolic drugs and steroid hormones.[15]

Cholest-4-en-3-one formed by catalysis of cholesterol by CHOx is an important synthetic intermediate in many steroid transformations and is found to be effective against obesity, liver disease and keratinization.[36] A previous study evaluated the functional effect of 4-cholesten-3-one in human cells and it was found that 4-cholesten-3-one generated after cholesterol oxidation restrained cell migration.[28]

Phytochemical characterization of Caraway *(Carum carvi)* seed extract and its use as a potent medicinal agent

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Abstract
Carum carvi (Caraway) is a member of Apiaceae family which originated in Asia. Due to its economic importance, it is widely cultivated. Caraway is the only annual species, commonly present in arable land, moist meadows and on low lands to mountains. Caraway has different applications in pharmaceutical and food industries. Phytochemical screening of different medicinal plants is helpful in identifying new sources of industrially and therapeutically important compounds.

In this study, Caraway obtained from forest surrounding the village Goherman, Lahaul and Spiti, Himachal Pradesh (India) was used. Seed extract of caraway extracted in methanol (MSE) and distilled water (WSE) was used for phytochemical analysis to determine the constituents of caraway seeds. Further, caraway seeds extract was checked for antibacterial activity [Staphylococcus aureus (ATCC 6538), Salmonella typhimurium (NCTC 74), Escherichia coli (ATCC 25922) and Staphylococcus epidermidis (ATCC 12228)], antioxidant activity and acid neutralizing activity. After analysing the results, it can be said that caraway seeds possess many medicinal properties and it can be used in enhancing human health.

Keywords: Phytochemical characterization, TLC analysis, antimicrobial, antacid, antioxidant.

Introduction
Carum carvi (Caraway) a member of Apiaceae family which originated in Asia.[26] Caraway is the only annual species out of 25 species in Carum genus. It is commonly present in arable land, moist meadows and on low lands to mountains. Caraway has high economic value due to its applications in pharmaceutical and food industries. Caraway is extensively used in many food products on account of its pleasant flavour and preservative properties and also has a high medicinal value as its fruits can be used to cure pneumonia and indigestion and can be used as carminative, appetizer and galactagogue.[26,36] which in turn increase the appetite and results in digestive stimulation.[8]

About 5000 years ago, first evidence of caraway was found in Middle Eastern Asia.[27] Today, it is known to be cultivated in many countries like Russia, Holland, Poland, the Netherlands, Hungary, Denmark, Romania, Bulgaria, Morocco, Syria, the USA, Turkey and India. In India, the species is available in wild in the high-altitude regions of Jammu and Kashmir (Zanskar, Ladakh and Lungna), Himachal Pradesh (Lahaul and Spiti, Pangi-Bharmour and Kinnaur) and is cultivated in hills (as summer crop) and in plains (Northern India) as annual winter crop.[9]

Caraway seeds are rich source of dietary fibre and about 100 g of seeds can fulfil daily recommended intake (38%) of fibre. A pungent, anise-like aroma and flavour of caraway fruit is an attribute of essential oils mostly anethole, limonene and carvone. Due to abundance of essential oils caraway is frequently added to sauerkraut. Caraway fruits are used as remedy against pneumonia, indigestion and as appetizer and carminative in different traditional systems. The roots of this plant also serve as a food source and are cooked as vegetable like parsnips or carrots. In addition, leaves of caraway are consumed as herbs similar to parsley[44]. On account of this diverse spectrum of caraway applications, an attempt was made to study caraway seeds and test them for their medical benefits.

Material and Methods
Collection of sample: Collection of a sample (Caraway) was done from forest surrounding the village Goherman (32°.37.47. N; 76°.52.37. E), Lahaul and Spiti, Himachal Pradesh (India).

Moisture content estimation: The moisture content of Caraway seeds was determined according to the Standard method of AOAC (1999). The sample was weighed and placed in a hot-air oven maintained at 37± 1ºC for 4 days. The material was then cooled to room temperature using a desiccator and the weight loss in percentage was reported as moisture content of the seeds.

Preparation of Caraway Seeds extract(s): Dried plant seeds were washed under running tap water, air dried and

Process optimization for extracellular production of RNase by alginate-entrapped cells of *Bacillus* sp. RB-3

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Abstract
RNase, an endoribonuclease is a key enzyme that plays an indispensable role in gene expression and regulation in all organisms. Its active action either leads to the inevitable rapid destruction of transcripts or reveals their roles in RNase processing. In the present study, alginate-entrapped cells of a *Bacillus* strain were used for the production of an extracellular RNase by optimization of the fermentation process in a batch culture system. The alginate-entrapped bacterial cells after process optimization resulted in a 2.2-fold increase in RNase in the fermentation broth. The addition of glucose (1%; w/v), peptone (1.5%; w/v) and sodium nitrate (1.0%; w/v) in the production broth (pH 9.0) at 35°C for 24 h under continuous shaking (160 rpm) provided a yield 6.59± 0.028 U/ml of RNase by *Bacillus* sp. RB-3. During repetitive use of alginate-entrapped bacterial cells, the maximum RNase was recorded at 2ndcycle (6.71±0.035 U/ml) of fermentation under optimized process. Although, a further, reuse of alginate-entrapped bacterial cells exhibited a gradual decline in the RNase yield, yet ~47% of RNase could be achieved in the fermentation broth thereafter.
Keywords: RNase; alginate; immobilization; fermentation; batch system; process optimization.

1. Introduction

Bacterial RNase E, an endoribonuclease plays a key role in gene expression and regulation in organisms. Its active action either leads to the inevitable rapid destruction of transcripts or reveals their participation in RNase processing [1]. This enzyme also helps to control the quality of the synthesized rRNAs. RNase E activity can be controlled and modulated using signals provided *via* regulatory RNAs that guide the enzyme towards specific silencing transcripts [2]. Interestingly, an ancient human civilization could be traced with the use of enzyme-mediated processes. There is now significant research and development in the field of industrial enzymes that contributes to the development of both a variety of products and processes [3]. Also, enzymes are used to increase the efficiency of a variety of existing bioprocesses to improve yield of the product. Evidently, almost 4,000 enzymes are known, and 200 of them are commercially used [4]. Extracellular RNase circulates in the human blood plasma. Occasionally, it displays variations in concentration/patterns, during infection, trauma and in cancer [5]. There is a very large variety of RNA molecules in blood plasma. The circulating fragments of RNA molecules contain mitochondrial RNA, ribosomal RNA (rRNA), transfer RNA (t-RNA) and messenger RNA (m-RNA) fragments, and small non-coding RNA (snoRNA) fragments [6]. A new form of antiviral ribonuclease, secreted into the medium against TB mosaic virus, was observed in *Bacillus cereus* ZH14 strain [7]. Many ribonucleases could inhibit the replication of viruses in cells *in vitro* and laboratory animals, but their antiviral molecular mechanisms remained unclear. The cytotoxic activity of RNase against tumor cells made it valuable for therapeutic use, one such extracellular bacterial ribonucleases studied is RNase produced by *Bacillus pumilus* [8]. Besides, RNases can also lead to activation of tumor-derived macrophages either being triggered into the M1 phenotyl with well-established antitumor immune response control functions, or M2-macrophages, which can reduce tumor development, metastasis, and angiogenesis [9]. Several pieces of evidence were reported for RNases as conventional immune response components that form a perspective agent for the production of new antiviral therapy [10]. Microbial RNases have a strong cytotoxic nature and they degrade the cellular RNA within cell systems into oligonucleotides and mononucleotides. The cytotoxic effects of RNases involve the destruction of RNA molecules which triggers protein synthesis leading to blockage in malignant cells and inducing apoptosis [11]. Many RNases could prevent the replication and reproduction of viruses in infected cell cultures and laboratory animals, but their antiviral molecular mechanisms remain unknown [12].

Interestingly, it has been observed that entire cells and cell-components might be immobilized to function as multi-enzyme structures. The enzymes which are either available in tiny amounts or are costly are often chosen for immobilization on an appropriate matrix [13]. Cell immobilization has also been a favored method for enzymes that rely on the special arrangement of the membrane. The methods used for cell immobilization are almost the same as those used with acceptable adaptations for the immobilization of enzymes. Surface fitting and trapping are done using the gelling materials and membranes [14]. The physical isolation of cell or cellular organelles using the immobile system allows for a simple medium exchange for metabolic or nutritional regeneration purposes in these cell systems [15]. Cell immobilization is distinct from cell entrapment, since it imprisons, immobilizes as well as absorbs them into supportive materials [14]. Entrapment of enzymes/

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RESEARCH Open Access

Purification and identification of a surfactin biosurfactant and engine oil degradation by *Bacillus velezensis* KLP2016

Khem Raj Meena[1,5*], Rajni Dhiman[2,5], Kailash Singh[3], Sachin Kumar[4], Abhishek Sharma[5], Shamsher S. Kanwar[5], Rittick Mondal[6], Sandip Das[7], Octavio L. Franco[8,9*] and Amit Kumar Mandal[6,10*]

Abstract

Engine oil used in automobiles is a threat to soil and water due to the recalcitrant properties of its hydrocarbons. It pollutes surrounding environment which affects both flora and fauna. Microbes can degrade hydrocarbons containing engine oil and utilize it as a substrate for their growth. Our results demonstrated that cell-free broth of *Bacillus velezensis* KLP2016 (Gram + ve, endospore forming; Accession number KY214239) recorded an emulsification index (E_{24}%) from 52.3% to 65.7% against different organic solvents, such as benzene, pentane, cyclohexane, xylene, *n*-hexane, toluene and engine oil. The surface tension of the cell-free broth of *B. velezensis* grown in Luria–Bertani broth at 35 °C decreased from 55 to 40 mN m^{-1}at critical micelle concentration 17.2 µg/mL. The active biosurfactant molecule of cell-free broth of *Bacillus velezensis* KLP2016 was purified by Diethylaminoethyl-cellulose and size exclusion chromatography, followed by HPLC (RT = 1.130), UV–vis spectrophotometry (210 nm) and thin layer chromatography (R_f = 0.90). The molecular weight of purified biosurfactant was found to be ~ 1.0 kDa, based on Electron Spray Ionization-MS. A concentration of 1980 × 10^{-2} parts per million of CO_2 was trapped in a KOH solution after 15 days of incubation in Luria–Bertani broth containing 1% engine oil. Our results suggest that bacterium *Bacillus velezensis* KLP2016 may promise a new dimension to solving the engine oil pollution problem in near future.

Keywords: *Bacillus velezensis*, Biosurfactant, CO_2 estimation, Engine oil, Surfactin

Introduction

Environmental pollution is currently one of the most serious global issues. Engine oil used in automobiles is hazardous and toxic to the soil. Used engine oil that is spilled or wrongly discarded may enter storm water runoff and eventually enter into water bodies affecting adversely the environmental health of receiving water bodies [1]. Oil spills into the sea is an emerging issue, harming marine flora and fauna [2]. To protect the flora and fauna of the water bodies, treatment of engine oil (main polluting agent) is usually required.

Various treatment procedure involving both chemical and physical methods, like dissolving, precipitation or absorption, using a range and combination of processes to remove non-hydrocarbons, impurities and other constituents that may severely affect the performance properties of finished products or reduce the efficiency of the conversion processes. Methods comprise separation or removal of aromatics and naphthenes, including impurities and undesirable contaminants. Before processing Sweetening compounds and acids are used to desulphurize crude oil. Other treatment methods include chemical

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Application of Lipase Purified from *Aspergillus fumigatus* in the Syntheses of Ethyl Acetate and Ethyl Lactate

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Abstract: Microbial lipases are used for the synthesis of various short chain esters such as octyl acetate, methyl salicylate, ethyl acetate and ethyl lactate. In this study, a purified lipase of *Aspergillus fumigatus* was utilized for the synthesis of two esters i.e. ethyl acetate and ethyl lactate. The purified lipase from *Aspergillus fumigatus* performed esterification of ethanol and acetic acid (at a molar ratio of 1:1) when incubated at 40℃ under shaking (130 min^{-1}) for 12 h resulting in the formation of ethyl acetate (89%). In case of ethyl lactate maximum esterification (87.32%) was achieved when ethanol and lactic acid (500:100 mM) was used in heptane resulting in the synthesis of ethyl lactate at 40℃ under shaking (120 rpm) after 12 h of reaction time. These esters of short chain carboxylic acid and alcohols belong to the highly important natural aroma compounds and are used as green solvents in food and pharmaceutical industry.

Key words: ethyl acetate, ethyl lactate, *Aspergillus fumigatus*, esterification, lipase

1 Introduction

Lipases (triacylglycerol ester hydrolases E.C. 3.1.1.3) are ubiquitous enzymes that catalyse the breakdown of fats and oils with subsequent release of free fatty acid, diacylglycerol, monoacylglycerol and glycerol[1-4]. They are found in animals, plants, fungi and bacteria and are of considerable physiological significance and industrial potential[5]. However, the most suitable sources for lipase production are the microorganisms which can produce high quality lipases in lower cost and shorter time[6]. Fungi are more preferred sources of lipases because of their stability at different temperature and pH[7]. Purification of enzymes allows successful determination of their primary amino acid sequence and three-dimensional structure. Purified lipase preparations are needed in industries employing the enzymes for the biocatalytic production of food additives (flavour modifying enzymes), industrial reagents (glyceride hydrolyzing enzyme), stain removing agents (detergent additives), digestive drugs, diagnostic enzymes in medical applications, nutraceuticals, surfactants and additives in cosmetics[8-10].

Esters of short chain carboxylic acid and alcohols belong to the highly important natural aroma compounds. The production of natural aroma compounds by fermentation and enzymatic reactions in aqueous[11], organic solvent[12, 13] or novel environmentally friendly solvent media[14] has become a widely-studied field of research in the last few years. Ethyl acetate is used in the nail polish remover and in decaffeinating tea, coffee and cigarettes. It is also used in the perfumes because it evaporates quickly leaving the scent on the skin. It is found as a solvent in the cosmetic products. It is widely used as an extraction agent, intermediate in the pharmaceuticals. Ethyl acetate is an effective poison for use in entomology as its vapours are a respiratory tract irritant which can kill the insects quickly. It is also used as a carrier solvent for herbicides.

Ethyl lactate finds industrial applications in specialty coatings, inks, cleaners because of its high performance and versatility. Due to its low toxicity, ethyl lactate is a popular choice across many different scenarios. Ethyl lactate is a flavouring agent present in cabbage, peas, vinegar, bread, roasted chicken, butter, blackberry, pineapple, raspberry and various wines and spirits[15]. Ethyl lactate also known as lactic acid ethyl ester, is a monobasic ester formed from lactic acid and ethanol, commonly used as a solvent[16-18]. As a "green" solubilizing agent, ethyl lactate has many advantages compared with other organic-based solubilizing agents.

With the great recent interest for natural products, the flavour industry is more and more interested in the use of

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Influence of Culture Conditions on the Production of Extracellular Esterase from *Bacillus licheniformis* and Its Characterization

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Abstract: Esterases catalyze the hydrolysis of ester bonds in fatty acid esters with short-chain acyl groups. In the present study, thirty-seven bacterial isolates were isolated from soil contaminated with waste cooking oil, dairy waste etc. from Shimla and Solan district of H.P. Out of 37 isolates, the isolate RL-1, which gave maximum activity, was identified as *Bacillus licheniformis* MH061919. The optimization of various production parameters resulted in maximum activity at inoculum age of 24 h and inoculum size of 1.5% (v/v). Esterase gave considerable activity in production medium containing sodium chloride (0.5 % w/v), galactose (1%, w/v), coconut oil (2.0%, v/v) and beef extract (0.3%, w/v) at a temperature of 45℃ and pH 8.5. The enzyme production was enhanced by 3-fold after optimization of production parameters. Further, on optimizing reaction conditions, enzyme gave maximum activity at a temperature of 45℃ and pH 8.5. The para-nitrophenyl acetate (*p*-NPA) was found to be optimum substrate and metal ions and detergents have inhibitory effect on esterase activity.

Key words: esterase, coconut oil, *p*-NPA, *Bacillus licheniformis*, metal ions

1 Introduction

Microorganisms inhabit all possible locations from those offering ideal conditions for growth and reproduction to those representing extreme environments. Microbial lipolytic enzymes are more useful than those of other origins because of their high yields and ease of genetic manipulation[1]. Compared with chemical catalysis, enzyme-catalyzed reactions are generally more selective and run under environment friendly conditions with lower energy cost[2]. Microbial esterases are resistant to organic solvents, which makes them important catalysts in organic syntheses and especially for enantioselective or steroselective hydrolysis of esters[3]. Lipolytic enzymes including lipases and esterases are one of the most important groups of biocatalysts applied in many industries such as food, detergent, chemicals, cosmetic, biodiesel and pharmaceuticals[4].

Esterases (E.C. 3.1.1.1) belong to hydrolases class of enzymes which catalyze the cleavage and synthesis of ester bonds[5]. Esterases have broad substrate specificity, high chemo-, regio-, enantio-selectivity and non-aqueous catalytic properties[6]. Lipases and esterases can be distinguished on the basis of their substrate specificity, as esterasescatalyze the hydrolysis of carboxylic ester bonds of short chain fatty acids (<10 carbon atoms), with tributyrin as the standard substrate. However, true lipases have marked preference for long chain fatty acids (>10 carbon atoms) as substrates[6-10]. Esterases can catalyze esterification, interesterification and transesterification reactions in non-aqueous media without using cofactors[11-13]. They can also catalyse the ester synthesis and trans-esterification in water free or water-restricted medium[14, 15].

Esterases have a wide range of industrial applications. Microbial esterases perform some useful reactionslike the synthesis of short-chain esters, alcohol, lactones, and phenolic compounds, which contribute to the typical flavour of food[15, 16]. Esterases hydrolyse ester bonds and act on a wide variety of natural and xenobiotic compounds which makes them quite useful enzymes in bioremediation[17]. Marine esterases play an important role in marine organic carbon degradation and cycling[18].

There is a great urge to explore novel esterases from diverse microbial sources for potential industrial applications. However, the growing demand for esterases can be satisfied by developing the suitable production strategies. The present paper focused on isolation of esterase producing microorganism and optimization of enzyme production

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RESEARCH ARTICLE

Purification and Properties of an Esterase from *Bacillus licheniformis* and it's Application in Synthesis of Octyl Acetate

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Abstract:

Background:

Esterase plays a major role in the degradation of natural materials, industrial pollutants and also provides an immense contribution to the eco-friendly approaches in various industrial applications.

Objective:

In the present study, extracellular esterase from bacterial isolate *Bacillus licheniformis* was purified, characterized and used in the synthesis of octyl acetate.

Methods:

Purification of esterase from *Bacillus licheniformis* was achieved using Sephadex G-75 column chromatography. Gas chromatography was used to analyze the octyl acetate synthesis.

Results:

The enzyme was salted out using ammonium sulphate precipitation and 60-70% saturation gave maximum specific activity of the enzyme during precipitation. A purification fold of 6.46 and yield of 9.69% was achieved when esterase from *Bacillus licheniformis* was purified using Sephadex G-75 column chromatography. Native as well as SDS-PAGE analysis gave a single band of 42 kDa. This showed that the enzyme was purified to homogeneity and it was a monomer with molecular weight of 42 kDa. Biochemical characterization of the enzyme revealed that it had optimum temperature of 45°C in 0.1 M Tris-HCl buffer of pH 8.0. On optimizing different parameters, such as molar ratio of reactants, incubation time, temperature, and amount of protein, the % yield of octyl acetate was found to be 77.3%.

Conclusion:

In this work, simple method was used to purify esterase and the enzyme was further used in producing esters/products of commercial value within a reasonably short period of 12 h with a maximum yield of 77.3%.

Keywords: Esterase, *Bacillus licheniformis*, Octyl acetate, *p*-NPA, Sephadex G-75, Tris-HCl.

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1. INTRODUCTION

Enzymes are biocatalysts that play an important role in metabolic and biochemical reactions [1, 2]. The demand for enzymes in the global market is projected to rise at a fast pace in recent years [3]. Micro-organisms are the primary source of enzymes because they are cultured in large quantities in a short span of time and genetic manipulations can be done on bacterial cells to enhance enzyme production [4]. In addition, the microbial enzymes have been paid more attention due to their active and stable nature as compared to enzymes from plants and animals [5]. Lipolytic enzymes, such as esterases, lipases and phospholipases, constitute a class of enzymes that catalyze the hydrolysis of a wide variety of substrates such as acylglycerols, fatty acid esters, or peptides [6 - 8].

Esterases (EC 3.1.1.1) represent a diverse group of hydrolases catalyzing the cleavage and formation of ester bonds. Esterases can catalyze esterification, interesterification, and transesterification, reactions in non-aqueous media without

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Abstract

Esterases act on a wide variety of natural and xenobiotic compounds which makes them quite useful enzymes in bioremediation. In the present study, fifty-seven bacterial isolates were isolated from soil rich in oil or diesel (automobile workshop), contaminated with plastic wastes, sweet shop waste, garden soil, dairy soil and other soil samples in and around Hamirpur, Shimla and Solan districts of Himachal Pradesh, India. Out of these, the isolate EST-4, which gave maximum esterase activity, was identified as *Serratia* sp. (NCBI Accession No.: MH538970). Esterase gave considerable activity in PM5 medium containing g/l peptone (10.0, w/v), NaCl (5.0, w/v), beef extract (10.0, w/v), yeast extract (2.0, w/v) and cotton seed oil (1.0%, v/v). Further optimization of various production parameters resulted in maximum production at inoculum age of 18 h, inoculum size 1.0% (v/v), temperature 40 °C and pH 8.5. The presence of 1.0% (w/v) maltose, 4.0% (v/v) cotton seed oil and 2.0% (w/v) peptone in the medium enhanced esterase production when compared with other carbohydrate, lipid and nitrogen sources respectively. The enzyme production was enhanced by 2.12-fold after optimization of production parameters.

Keywords: Esterase; Cotton seed oil; *p*-NPA; *Serratia* sp.; Peptone; Maltose.

1. Introduction

Enzymes are the biocatalysts that play important role in metabolic and biochemical reactions.[1,2] They are ubiquitous in nature and are found in plants, animals and microorganisms.[3,4] The demand of enzymes in the global market is projected to rise at fast pace in recent years.[5] Lipolytic enzymes are highly diversified in their industrial applications. Esterases (E.C. 3.1.1.1, Carboxyl ester hydrolases) belong to hydrolase class of enzymes which catalyze the cleavage and synthesis of ester bonds.[6] They bring about the hydrolysis and synthesis of acyl glycerides and other fatty acids esters.[7,8] Esterases are enzymes that catalyze the hydrolysis of various types of both endogenous and exogenous esters.[9]

Microbial esterases are resistant to organic solvents, which makes them important catalysts in organic syntheses and especially for enantioselective and/or stereoselective hydrolysis of esters.[10] Microbial esterases are of considerable interest because their cost of production is low and they are also convenient to manipulate.[11] Esterase producing bacteria have been found in diverse habitats such as soil contaminated with oil, dairy waste, industrial wastes, oil seed and decaying food, compost heaps, coal tips and hot spring.[12,13] Esterases can catalyze esterification, interesterification and transesterification reactions in non aqueous media without using cofactors.[14,15] Particularly they catalyze the hydrolysis of esters composed of short-chain fatty acids.[16]

Carboxyl esterases can also be distinguished from lipases by their substrate spectra, using *p*-nitrophenyl palmitate (cleaved by lipases) vs. *p*-nitrophenyl butyrate (cleaved by esterases and sometimes by lipases).[4,17] The industrial applications of esterases provide an immense contribution to the eco-friendly approaches towards nature and also in food, textile industries, as additives in detergents, agrochemical (herbicides, insecticides) industries and bioremediation.[18,19] Esterases also play a major role in the degradation of natural materials and industrial pollutants, viz., cereal wastes, plastics and other toxic chemicals. They are useful in the synthesis of optically pure compounds, antioxidants, flavoring agents and perfumes.[20,21] A highly active cross-linked enzyme aggregates from a novel thermostable esterase estUT1 of the bacteria *Ureibacillus thermosphaericus* have been used for the removal of malathion from waste water.[22] Polyurethane esterase from *Comamonas acidovorans* degrades low molecular weight polylactic acid made up of poly diethylene adipate by cleaving the ester bond between polymers.[17] Due to numerous biotechnological applications, researchers have made attempts to isolate esterase producing micro-organisms.[23]

The present work is focused on screening of esterase-producing microorganisms and isolation of *Serratia* sp. The optimization of various production conditions such as carbohydrates, lipid and nitrogen sources was studied, with focus on the role of carbohydrates on the esterase activity. This is one of the few reports on the production of extracellular esterase from *Serratia* sp.

2. Materials and Methods

2.1 Chemicals

The chemicals used were tributyrin, *p*-nitrophenyl acetate (*p*-NPA), *p*-nitrophenol (*p*-NP), isopropanol, Tris buffer, maltose, galactose, glucose, lactose, beef extract and peptone. All the chemicals used were of analytical grade and high purity either procured from Sigma Aldrich (U.S.A) or HIMEDIA (Mumbai, India).

2.2 Methods

2.2.1 Sample collection

Samples were collected from various locations such as soil rich in oil or diesel (automobile workshop), contaminated with plastic wastes, sweet shop waste, garden soil, dairy soil and other soil samples in and

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REVIEW ARTICLE

Polyhydroxyalkanoate and its efficient production: an eco-friendly approach towards development

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Abstract
Polyhydroxyalkanoate (PHA) is the most promising solution to major ecological problem of plastic accumulation. The biodegradable and biocompatible properties of PHA make it highly demanding in the biomedical and agricultural field. The limited market share of PHA industries despite having tremendous demand as concerned with environment has led to knock the doors of scientific research for finding ways for the economic production of PHA. Therefore, new methods of its production have been applied such as using a wide variety of feedstock like organic wastes and modifying PHA synthesizing enzyme at molecular level. Modifying metabolic pathways for PHA production using new emerging techniques like CRISPR/Cas9 technology has simplified the process spending less amount of time. Using green solvents under pressurized conditions, ionic liquids, supercritical solvents, hypotonic cell disintegration for release of PHA granules, switchable anionic surfactants and even digestion of non-PHA biomass by animals are some novel strategies for PHA recovery which play an important role in sustainable production of PHA. Hence, this review provides a view of recent applications, significance of PHA and new methods used for its production which are missing in the available literature.

Keywords Applications · Biodegradable plastic · Biosynthesis of PHA · Economic production · Molecular approach

Introduction

The consistent accumulation of conventional synthetic plastic in environment has compelled us to think that there is an urgent need to replace it with biodegradable plastics. Polyhydroxyalkanoate (PHA) is the most promising solution to this major ecological problem. The properties of PHA make it close to plastics hence PHA bioplastic makes a good alternate which is biodegradable and biocompatible. Chemically, PHAs are in vivo polymerized polyoxoesters of hydroxyalkanoates (Sowinski et al. 2010) which are produced by microorganisms when there is carbon rich and nutrient (nitrogen, phosphorous, magnesium or sulfur) limiting condition for their energy and carbon storage (Koller 2018a, b). PHAs are produced in the form of water insoluble granules within the cytoplasm of the cell. PHA help microorganisms to survive under environmental stress conditions, and it is the key mechanism for their survival (Saharan et al. 2014). During starvation, the presence of PHA protects the cellular components such as RNA and proteins (Vinet and Zhedanov 2010) and it also plays an important role in sporulation. It has potential protective mechanisms for bacterial cells when they are exposed to freezing and thawing (Obruca et al. 2016), osmotic shocks, oxidative pressure, desiccation, H_2O_2 supply, heavy metals and UV exposures (Obruca et al. 2020).

PHA was first discovered by Lemoigne in 1925 from *Bacillus megaterium* (Chee et al. 2010) in poly(3-hydroxybutyrate) (PHB) form. Other forms of PHA were discovered afterwards. In 1974, Wallen and Rohwedder (1974) extracted 3-hydroxyvalerate along with 3-Hydroxybutyrates and some higher molecular weight components from activated sewage sludge. Short chain length hydroxyacids of 11 different types were reported by Findlay and White (1983) from marine sediment extracts, also 3-Hydroxyheptanoate (3HHp) was detected in *B. megaterium* in same year. Since then the number of PHA being discovered is increasing, and nearly 150

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Phytochemical analysis, antioxidant and antimicrobial activity assessment of *Allium sativum* (garlic) extract

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Abstract

Garlic (Allium sativum) is recognized for its potential to treat and prevent various diseases including cardiovascular problems, common cold, bacterial and fungal infections. Garlic is bestowed with an array of organosulphur compounds rich in phytochemicals which act as antioxidant agents. Present study was undertaken for qualitative as well as quantitative analysis of phytochemical constituents of Allium sativum.

The 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity of methanol and chloroform extracts of garlic was found to be better than other extracts used in the study. These extracts showed good antibacterial activity against selected pathogenic bacterial cultures including Pseudomonas, Bacillus, Shigella and Salmonella. Sliver nanoparticles were also synthesized with the aid of garlic extract and were characterized by X-Ray diffraction. Synthesized silver nanoparticles showed good antibacterial activity against all Salmonella followed by Bacillus, Shigella and Pseudomonas.

Keywords: *Allium sativum*, Phytochemicals, Antioxidant, Antimicrobial, Silver nanoparticles.

Introduction

Allium is a genus of perennial bulbulous plants that produces chemical compounds which are a characteristic of onion or garlic flavour and aroma.[1] *Allium sativum* commonly known as garlic, is a member of Alliaceae family.[2] When crushed, *Allium sativum* yields allicin and phytonicide which serve as antimicrobial compounds.[3] It also contains other compounds including allinin, ajoene, diallylsulfide, B-vitamins, proteins and many phytochemicals.[4] Phytochemicals are the bioactive compounds found in plants that work with nutrients and dietary fibres to protect human against diseases.[5]

Many phytochemicals have antioxidant activity and reduce the risk of many diseases. The biological synthesis of silver nanoparticles emerges as an eco-friendly and exciting approach in the field of nanotechnology.[6] Silver nanoparticles (AgNPs) have been known to have inhibitory and bactericidal effects.[7,8] Use of biological organisms, plant extracts or plant biomass for the synthesis of silver nanoparticles serves as an alternative to the chemical and physical methods which are expensive and hazardous to the environment.[15] The present study demonstrated *in-vitro* evaluation of antimicrobial properties of different solvent extracts of garlic and the synthesized silver nanoparticles.

Material and Methods

Plant material and preparation of extract: *Allium sativum* (garlic) cloves were collected from local market of Shimla, Himachal Pradesh. Bulbs of *Allium sativum* were first washed with tap water followed by distilled water and ground to fine paste using mortar and pestle. 50 g each was soaked in 100 ml of different solvents i.e. distilled water, methanol, chloroform and dimethyl sulfoxide for 24 hours.[9] The extracts were then transferred to four different plates and kept at 40-60℃ to evaporate the solvents. Powdered form was obtained after 24-72 hours.[10]

Phytochemical analysis: The qualitative phytochemical analysis was carried out to detect the presence of different phytoconstituents including carbohydrates, tannins, flavonoids, amino acids, saponins and cardiac glycosides according to the standard method described by Arora and Kaur[11] and Gayathri and Kiruba[8]. General reactions revealed the presence or absence of these compounds.

Quantitative analysis of different solvent extracts of *Allium sativum*: To determine the amount of a substance per unit volume or unit weight, quantitative assay was performed. Crude samples prepared in different solvents were used for the determination of amino acid concentration.

Thin Layer Chromatography: The thin layer chromatography (TLC) was used to determine the retention factor (R_f) value of separated compounds. Aliquots of the extract and standard were applied on the TLC plate. The plate was placed in a glass beaker containing n-butanol:acetic acid:distilled water in ratio of 2:2:6 as a mobile phase.[12]

Anti-oxidant assay: DPPH free radical scavenging activity assay was performed by slightly modified method of Veluman.[13]

Assessment of Antibacterial Activity: Antibacterial activity of different solvent extracts was tested against *Pseudomonas*, *Shigella*, *Salmonella* and *Bacillus* by using well diffusion method according to Clinical and Laboratory Standards Institute (CLSI) protocol.

Minimum Inhibitory Concentration (MIC) against selected pathogenic cultures: MIC was performed by using the method of Teh et al.[14]

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Polyhydroxyalkanoate (PHA): Properties and Modifications

Vibhuti Sharma ✉, Rutika Sehgal ✉, Reena Gupta ✉

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Highlights

- Replacement of conventional synthetic plastics with PHA.
- PHA possesses properties like biodegradability, renewability, biocompatibility, etc.
- Modifications of PHA using physical, chemical and biological methods for their efficient production.

Springer Link

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Isolation, characterization and identification of pesticide degrading bacteria from contaminated soil for bioremediation

Akshita Mehta, Kamal Kumar Bhardwaj, Mayorin Shaiza & Reena Gupta

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Abstract

In this study, malathion and chlorpyrifos degrading bacteria were isolated from agricultural soil samples taken from the Himachal region in India. A total of 52 organisms were isolated which were further screened for their efficiency for chlorpyrifos and malathion degradation. Screening was done by checking the growth on Nutrient Agar, Mineral Salt Medium and MacConkey agar plates containing chlorpyrifos and malathion; 37 isolates showed growth in these. Biomass assay and minimum inhibitory concentration (MIC) determination were carried out for the selection of most efficient bacterial isolates. Out of the seven isolates which showed good biomass assay and MIC, only three isolates (PDM-2, PDM-15 and PDM-20) were selected for further studies. These were characterized by various biochemical tests, Gram staining, indole test, methyl red test, Voges-Proskauer test, citrate utilization test and carbohydrate fermentation test. Out of three isolates, PDM-15 showed good resistance against the antibiotics such as erythromycin, chloramphenicol, ampicillin and penicillin and identified as *Kocuria assamensis*. Degradation of 71.3% of chlorpyrifos and 85% of malathion was observed by the gas chromatography. Therefore, the *Kocuria assamensis* can be used in the bioremediation of pesticide-contaminated soil.

3 Biotech (2021) 11:308
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ORIGINAL ARTICLE

Purification of high molecular weight thermotolerant esterase from *Serratia* sp. and its characterization

Kamal Kumar Bhardwaj[1] · Shweta Kishen[1] · Akshita Mehta[1] · Abhishek Sharma[1] · Reena Gupta[1]

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Abstract
In the present study, an extracellular esterase from *Serratia* sp. was purified 24.46 fold using an initial ammonium sulphate precipitation step (optimized concentration of 30–40%), followed by Diethylaminoethyl cellulose (DEAE-cellulose) chromatography and size exclusion Sephadex G-200 column chromatography steps. The molecular weight of the esterase using native polyacrylamide gel electrophoresis (PAGE) was determined to be 236 kDa and by using sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) was found to be 60 kDa suggesting that the enzyme was a tetramer of 4 subunits. The purified esterase was able to catalyze the hydrolysis of *p*-nitrophenyl esters, especially *p*-nitrophenyl acetate. Maximum esterase activity was achieved in 0.15 M Tris–HCl buffer of pH 8.5 at 50 °C after 10 min. The enzyme was stable for at least 8 h at 4 and 35 °C but the half-life was determined to be 4.5 h at 50 °C and 3 h at 60 °C. The esterase activity was inhibited by detergents (1 mM) (Triton X-100, Tween 60, Tween 80, ethylenediamine tetraacetic acid and SDS) except Tween 20. The esterase activity was inhibited by organic solvents (1 mM) such as ethanol, methanol, acetone, acetonitrile and was stable in the presence of glycerol, isopropanol but the organic solvent dimethyl sulfoxide (DMSO) significantly ($p < 0.05$) enhanced esterase activity. The matrix-assisted laser desorption ionization-time of flight mass spectrometry showed that the enzyme exhibited similarity with the pimeloyl-[acyl carrier protein] methyl ester esterase of *Serratia marcescens*.

Keywords Diethylaminoethyl cellulose · Tris–HCl buffer · *p*-NPA · SDS-PAGE · Esterase · Matrix-assisted laser desorption ionization-time of flight mass spectrometry

Introduction

Esterases play a dominant role in lipid metabolism in plants, animals, and microbes (Castro et al. 2018). A large number of microbes are known to produce esterases and include *Micropolyspora faeni, Bacillus pumilis, E. coli, B. subtilis, Pseudomonas fluorescens, Halobacillus* sp. strain LY5, *Bacillus subtilis* NRRL, *Vibrio fischeri, Streptomyces lividans* 66, *Bacillus licheniformis.* Esterases are of considerable interest as they have large numbers of industrial applications, can be produced relatively quickly due to the fast microbial growth rates and can be cheaply produced due to the ease of culturing microbes on cheap medium (Kulkarni et al. 2013; Liu et al. 2020).

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Under natural conditions, esterases catalyze the hydrolysis of ester bonds at the interface between an insoluble substrate phase and the aqueous phase in which the enzyme is dissolved. Under certain experimental conditions, such as in the absence of water, they are capable of reversing the reaction. These enzymes have good chemo-, regio-, and/or enatio-selectivity (Gupta et al. 2012). Esterase plays a major role in the degradation of natural materials and industrial pollutants, viz., cereal wastes, plastics, and other xenobiotic compounds (Bhardwaj et al. 2020; Wei et al. 2020). The enzyme has the potential for the synthesis of flavor esters (Bhardwaj et al. 2017; Zwane et al. 2017; Maester et al. 2020), optically pure compounds, antioxidants and perfumes (Panda and Gowrishankar 2005).

Esterases have diverse applications in biotechnology as additives in laundry detergents and as stereo-specific biocatalysts in pharmaceutical production (Panda and Gowrishankar 2005). Esterases differ in their substrate specificity and can be used in various medical applications (Kumari et al. 2021). However, most industrial processes often

Insights into bioactive compounds and *in vitro* antioxidant, antibacterial and cytotoxic potential of *Solanum lycopersicum*

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Abstract
Solanum lycopersicum (tomato) is a widely cultivated vegetable crop worldwide and its consumption is increasing day by day. The only edible part of tomato plant is its fruit. Therefore, the residual tomato plant parts are considered as waste after fruit collection. Present study aimed to detect the phytochemical, antioxidant, antibacterial and cytotoxic activities of *Solanum lycopersicum*. Phytochemical analysis of *Solanum lycopersicum* peel and pulp revealed the presence of tannins, flavonoids, amino acids and reducing sugars. DPPH (2,2-diphenyl-1-picrylhydrazyl) radical assay showed that methanol and DMSO extracts of *Solanum lycopersicum* peel and pulp were strong antioxidants. Methanol extract of *Solanum lycopersicum* peel was active against *S. flexnari, B. cereus* and *P. aeruginosa* with MIC values of 0.03 mg/100µl, 0.03 mg/100µl and 0.01 mg/100µl, respectively. *B. cereus* was also inhibited by distilled water extract of *Solanum lycopersicum* peel having MIC value of 0.03 mg/100µl. Chloroform extract of *Solanum lycopersicum* pulp was most active against *S. typhi* with MIC value of 0.03 mg/100µl. The effect of cytotoxicity of *Solanum lycopersicum* peel and pulp on RD cell line was evaluated through micro-culture tetrazolium assay (MTT) and the results showed a reduction in cell viability of RD cell line. Methanol extract of *Solanum lycopersicum* peel reduced the cell viability of RD cell line at 10 mg/µl, 20 mg/µl concentrations to 49.1%, 19.8%, respectively and the pulp extract reduced the cell growth to 44.8%, 15.7% at 10 mg/µl and 20 mg/µl concentrations, respectively.

Keywords: *Solanum lycopersicum,* bioactive, antioxidant, cytotoxic, antimicrobial

1.Introduction

Solanum lycopersicum (tomato) is a versatile fruit that is consumed fresh as well as in the form of processed products. Substantial quantities of tomatoes are processed into juices and purees, which generate wastes. The remaining plant materials are typically used as an unbalanced food for feeding livestock (mainly cattle), without any apparent economic benefit for the tomato producers. Consumption of tomatoes, tomato products and isolated bioactive tomato ingredients is reported to be associated with lowered risk of hypertension, heart disease, diabetes, cardiovascular disease and cancer [1]. *Solanum lycopersicum* belongs to the plant family solanaceae and genus *solanum* and it is spread throughout the world. It is used as juice, soup, puree, ketchup or paste and is known to be beneficial for the heart. It contains the carotene lycopene, one of the most powerful natural antioxidants. Lycopene has also been shown to improve the skin's ability to protect against harmful UV rays [2]. In addition to its flavor properties, *Solanum lycopersicum* is reported to possess numerous beneficial nutritional and bioactive components that may also benefit human health. These include the nutrients vitamin A, vitamin C, iron, and potassium. *Solanum lycopersicum* is also an excellent source of free radical-scavenging, bone healthy vitamin K, vitamin B6 and folate.

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In addition, *Solanum lycopersicum* is a good source of heart-healthy magnesium, niacin, vitamin E, vitamin B1 and phosphorus [3,4]. Consumption of tomatoes, tomato products and isolated bioactive tomato ingredients is reported to be associated with lowered risk of hypertension, heart disease, diabetes, cardiovascular disease and cancer. Cancer is a major health problem, with significant associated death and disability and it is second leading cause of death in developed countries [2]. Globally, cancer is a major public health burden, accounting for one in eight deaths overall more than AIDS, tuberculosis and malaria combined. The world health organization (WHO) reports that 1.1 million people die of lung cancer each year. Epidemiological studies have suggested that lycopene decreases the risk of several types of human malignancies, such as breast and lung cancer [4]. These considerations suggest that edible tomato contains antibacterial, antioxidant, anticancer and phytochemical properties which may have multiple benefits [3].

2. Materials and Methods

2.1 Plant material and preparation of extract

The plant material used in present study was collected from local market of Shimla, Himachal Pradesh. Tomatoes were first washed with tap water followed by distilled water and then peeled. Peeled tomatoes and pulp were ground to fine paste using mixer grinder. 50 g each was soaked in 100 ml of different solvents *i.e.* methanol, chloroform, dimethyl sulfoxide (DMSO) and distilled water for 24-48 hrs. The extracts were then filtered using Whatmann No. 1 filter paper. The resulting extracts were collected in falcon tubes for further use.

Review Paper:

Insights into pathophysiology, immune response and treatment of novel CoVID-19

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Abstract

The beginning of year 2020 has brought with it mass destruction of mankind in form of novel coronavirus, named as CoVID-19. Declared as pandemic by World Health Organization (WHO), CoVID-19 has its origin in bats and pangolin from which it was probably transferred to human. Subsequent human to human transmission has been seen by respiratory droplets, fomites and oral-fecal route. The disease has caused widespread deaths in America, China, France and Italy followed by many European and Asian countries. CoVID-19 targets the human lungs and multiplies in alveoli using host machinery. Interstitial edema and alveolar edema at later stages cause alveoli collapse and difficulty in breathing. Severe cases may pave to systemic inflammatory response that has fatal response in body.

Unfortunately, researchers are still struggling for potential vaccine or promising drug to combat the disease. WHO has issued guidelines suggesting regular hand washing, social distancing, wearing masks and quarantination as the best ways to prevent infection. This review gives an overview of the novel CoVID-19, conditions and immune response of human body related with it.

Keywords: CoVID-19, coronavirus, pathophysiological, immune response, treatment.

Introduction

The early December 2019 marked the beginning of the widespread outbreak of coronavirus (CoVID-19) or the Severe Acute Respiratory Syndrome Virus-2 (SARS-CoV-2) in Wuhan city of Hubei province of China[69].The Huanan seafood wholesale market was suspected to be associated with this outbreak of coronavirus and hence this market was ceased by Wuhan public health authorities. The researchers of China isolated the SARS-CoV-2 from infected patients and characterized it by using next generation sequencing and real time reverse transcription polymerase chain reaction[83].

It has spread expeditiously infecting a wide range of people globally. On 31st January 2020, World Health Organization declared it as Public Health Emergency of International Concern (PHEIC) following widespread infections. On 11th of March 2020, it was declared as a pandemic[80].

Novel SARS-CoV-2 belongs to the family coronaviridae, subfamily coronavirinae and genus betacoronavirus[17]. Table 1 shows a list of coronaviruses that infect humans.

Until the spread of Severe Acute Respiratory Syndrome in 2002, coronaviruses were known to cause mild respiratory and gastrointestinal infections only[11, 50]. But over last two decades, mankind has faced severe high fatality rates caused by (SARS)-CoV, Middle East Respiratory Syndrome (MERS)-CoV and SARS-CoV-2 betacoronaviruses showing their potential to dwell in interspecies host and causing widespread infections[5,79]. Coronaviruses are spherical in shape and derive their name from their crown like appearances due to the presence of structural spike proteins (S). Diameter of a typical SARS-CoV-2 varies between 60 nm to 140 nm[41].

The genetic material consisting of 30 kb single stranded positive sense RNA (3'-poly-A tail and 5'-cap) is enveloped inside structural proteins namely envelop proteins, membrane (M) and spike proteins[6]. The virus uses the spike proteins to bind to the type II pneumocyte cells in the upper respiratory tract by specific receptors called as angiotensin converting enzyme-2 (ACE-2)[81].

Table 1
List of coronaviruses that infect humans

Genus	Varieties causing disease in humans
Alphacoronaviruses	• Human coronavirus 229E (HCov-229E)
Betacoronaviruses	• Human coronavirus NL63 (HCoV-NL63, New Haven coronavirus) • Human coronavirus OC43 (HCov-OC43) • Middle East Respiratory Syndrome-related coronavirus (MERS-CoV or HCoV-OC43) • Severe Acute Respiratory Syndrome coronavirus (SARS-CoV-1, which causes SARS) • Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2, which causes CoVID-19)

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Original article

Optimization of culture conditions by response surface methodology for production of extracellular esterase from *Serratia* sp. EST-4

Kamal Kumar Bhardwaj, Rakesh Kumar, Suhani Bhagta, Reena Gupta *

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Response surface methodology
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ABSTRACT

Objective: The aim of present study was to determine the effect of interaction among different production variables on esterase production from *Serratia* sp. EST-4.
Method: The optimum and combined effect of independent parameters were determined using Plackett-Burman and Central Composite Design (CCD) (Design Expert 11).
Results: The effect of six parameters-cotton seed oil, peptone and maltose concentrations, pH, temperature and inoculum volume for production of esterase was determined by Plackett-Burman design. Four factors *i.e.* inoculum size, pH, peptone concentration and cotton seed oil concentration had significant effect on yield of esterase as suggested by the Pareto chart. Under optimized conditions, (inoculum size (1.0%, v/v), pH (8.0), peptone concentration (1.5%, w/v) and cotton seed oil concentration (4.0%, v/v)), the maximum esterase production was 9.77 U/ml. Analysis of variance (ANOVA) of the Central Composite Design (CCD)-based experiment exhibited the model F-value of 44.24 and P-value of <0.0001 which implies that model was significant and adequate to represent the system.
Conclusion: Inoculum size 1.0%, v/v, pH 8.0, concentration of peptone 1.5%, w/v and concentration of cotton seed oil 4.0%, v/v had positive effect on esterase production and provided 1.52-fold increase in esterase production than that obtained by optimizing one factor at one time.
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1. Introduction

Microorganisms are main source of enzymes, because they can be manipulated genetically to increase the production of enzyme and are cultured on large scale in short time (Anbu et al., 2017; Sarkar et al., 2020). Phospholipases, lipases and esterases are lipolytic enzymes and belong to hydrolase class of enzymes that hydrolyze various substrates such as triacylglycerides, esters or peptides (Miranda et al., 2015,; Bhardwaj et al., 2017; Wang et al., 2018). Esterases are important group of hydrolases which catalyze different reactions such as esterification, interesterification and *trans*-esterification in water free or water-restricted mediumwithout using metal ions (Godinhoet al.,2011; Duarte et al., 2016). Esterases are widely used in the remediation of pyrethroid, ester-containing carbamate and organophosphate pesticides and are environment-friendly choice for the removal of recalcitrant compounds (Bhatt et al., 2020a; Bhatt et al., 2021). In general, all esterases contain the consensus sequence Glycine-X1-Serine-X2-Glycine as the catalytic moiety. (López-López et al., 2014; Ding et al., 2018; Bhardwaj et al., 2020).

The production of new esterases from different microbial sources is great compulsion for various biotechnological applications which requires cost effective production and stability of biocatalyst under extreme conditions (Maesteret al., 2020; Adiguzel, 2020). However, suitable production strategies must be developed to meet the growing demand of esterases. The optimization of enzyme production by varying one factor at a time does not consider the combined effect of all parameters, is laborious and cannot gave assurance of the optimum level of each parameter conditions (Lotfy et al., 2007; Hye et al., 2008; Kammoun et al., 2008; Gadhe et al., 2011; Tijani et al., 2011). On the other hand, Response Surface Methodology (RSM) can provide reliable optimization results as it helps in studying the effect of several variables at a time at different degrees to evaluate the combined effect of more than one parameters (Benzina et al., 2012; Yasmeen et al., 2013).

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European Polymer Journal

Volume 161, 5 December 2021, 110824

Blends and composites of polyhydroxyalkanoates (PHAs) and their applications

Vasant Kumar, Rutika Sehgal, Reena Gupta

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Highlights

- Blending with starch, lignin and cellulose derivatives which provide extended stability, elasticity and decreased oxygen permeability.
- Blending with biodegradable synthetic polymers such as PLA, PCL, PBAT and PVA increases its biodegradability, ease of processing, mechanical performance.
- Applications in Tissue engineering, 3D imprinting, bioremediation, drug delivery system along with packaging in food industries.

Requires Authentication Published by De Gruyter November 30, 2021

A Purified Alkaline and Detergent-Tolerant Lipase from *Aspergillus fumigatus* with Potential Application in Removal of Mustard Oil Stains from Cotton Fabric

Eine gereinigte, alkali- und waschmitteltolerante Lipase aus *Aspergillus fumigatus* mit Anwendungspotenzial bei der Entfernung von Senfölflecken aus Baumwollgeweben

Akshita Mehta, Aashna Gupta, Kamal Kumar Bhardwaj and Reena Gupta ✉

From the journal Tenside Surfactants Detergents

https://doi.org/10.1515/tsd-2021-2378

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Review Articles

Immobilization and applications of esterases

Divya Sharma, Kamal Kumar Bhardwaj & Reena Gupta

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Download citation https://doi.org/10.1080/10242422.2021.2013825 Check for updates

Abstract

Esterase belongs to hydrolase class of enzyme which catalyses the breakdown and creation of the ester bond. Due to its properties like regio-selectivity, stereo-specificity and stability in organic solvents, esterase is widely used in industrial processes. Esterases have applications in food industry, paper industry, notably in degradation of plastics and pesticides and for the synthesis of optically pure compounds. One of the toughest tasks is upholding the structural stability of enzyme for the duration of any biochemical reaction. Immobilization provides solution for this problem. Immobilization is the restraining of enzyme to a support. With the recent advances in technology, the use of new approach like nanoparticles, magnetic nanoparticles and cross-linked enzyme aggregates (CLEAs) is preferred by researchers. Nanoparticles provide better stability, multi-functionality and higher surface area for immobilization. Current review comprises of various methods used in immobilization of esterase and applications of esterase.

Keywords: Cross-linked enzyme aggregates (CLEAs) | esterase | food industry | hydrolases | immobilization | nanoparticles | pesticides degradation | regio-selectivity

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Research Article

CLONING AND SEQUENCING OF POTATO *trnI* AND *trnA* PLASTID DNA FRAGMENTS FOR DEVELOPING HOMOLOGOUS PLASTID TRANSFORMATION VECTOR

Neelam Kaushik*[1], Arvind Kumar Bhatt [2], Swarup Kumar Chakrabarti[1]

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ABSTRACT

For developing plastid transformation vector, based on homologous targeting regions of potato (*Solanum tuberosum* L.), the *trnI* and *trnA* intergenic regions of the plastome from the commercial potato cultivar Kufri Bahar was PCR amplified, cloned and sequenced. Isolation and cloning of potato *trnI* and *trnA* cpDNA fragments into pDrive cloning vector yielded plasmid pD*trnI* and pD*trnA* with cpDNA fragments of approximately 800 bp and 1000bp, respectively. Sequence alignment using Clustal W revealed 98% sequence homology with the corresponding fragment of *Nicotiana tabacum* L. (GenBank Accession no. Z00044). The most remarkable difference was 9 bp insertion from 647-655 in potato plastome that was missing in tobacco. Similarly, sequence alignment of potato *trnA* region showed 100% identity to the respective fragment of *Nicotiana tabacum* L., except an insertion of 102 nucleotides from 700-801. The observed differences in the sequence homology between potato and tobacco plastome might be responsible for lower transformation efficiency in potato using tobacco-based vector. The presence of unique restriction enzyme sites within the intergenic region of both fragments will make possible the construction of potato specific plastid transformation vector. The cloned *trnI*/*trnA* region of the potato plastome will contribute towards designing plastid transformation vector with better transformation efficiency.

Keywords: Chloroplast DNA, Plastid transformation, Plastome, Potato, Tobacco.

1. INTRODUCTION

The plastid genome is an attractive target for genetic engineering in higher plants which offers several unique advantages over nuclear transformation including maternal inheritance of transgene, no position effect as the genes of interest are introduced into the plastome via homologous recombination and high level of foreign protein expression [1-3]. Plastid transformation in higher plant was first successfully reported in tobacco using mutant plastid 16S ribosomal RNA gene for selection of transformants [4]. Plastid transformation has been reported in many other higher plants such as *Arabidopsis thaliana* L. [5], potato [6-9], rapeseed [10], rice [11,12], tomato [13-14], soybean [15], carrot [16], cotton [17], wheat [18], eggplant [19,20] and many more. Recently plastid transformation has been reported in bitter melon [21], medicinal plant (*Artemisia annua* L.) [22] and licorice weed (*Scoparia dulcisi* L.) [23]. However, plastid transformation is routinely reported in tobacco and the efficiency of transformation is much lower in other plants than in tobacco [24]. Due to this success and specially because *Arabidopsis*, potato and tomato were transformed with homeologous vectors (not species-specific vectors), the plastid genomes of important crop species have received increasing attention with the possibility to develop chloroplast transformation systems to introduce agronomically important traits for plant improvement into the chloroplast genome [25] .

The chloroplast genome generally has a highly conserved organization among different plant species, having two identical copies of a 20 to 30 kb inverted repeat region (IRA and IRB) separating a large single copy (LSC) region and a small single copy (SSC) region [26]. Stability of plastid transformation depends on the integration of foreign gene into the plastid genome by homologous recombination of flanking sequences used in plastid transformation vectors. Hence the introduced gene must be flanked by sequences homologous to the plastid genome.

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ORIGINAL ARTICLE

Enhanced C-5 sugar production from pine needle waste biomass using *Bacillus* sp. XPB-11 mutant and its biotransformation to bioethanol

Parul Suri[1] · Divya Dwivedi[1] · Ranju Kumari Rathour[1] · Nidhi Rana[1] · Vaishali Sharma[1] · Ravi Kant Bhatia[1] · Arvind Kumar Bhatt[1]

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Abstract
Xylan, second most abundant natural polysaccharide after cellulose, has tremendous applications in various industrial processes. There are several xylan degrading catalysts available, but, still, there is continuous quest among the scientific community to search for new hyperactive xylanases. In the present study, the catalytic potential of xylanase from *Bacillus* sp. XPB-11 was improved using various mutagens. 5-Bromo-Uracil proved to be the best mutagen resulting in stable and hyperactive mutant BU-7 that showed maximum xylanase activity, i.e., 154.16 ± 2.23 U/mg protein. Further, optimizing the various parameters resulted in 20% enhancement and overall twofold increase in the xylanase activity of mutant, i.e.188.24 ± 1.80 U/mg protein. This hyperactive mutant released 26.8 ± 2.17 mg/ml of C-5 sugar from microwave + 0.5 N NaOH pretreated pine needle waste biomass that on fermentation using *Kluyveromyces marxianus* MTCC 1498 produced 5.34 g/l of bioethanol with 3.89% yield and 93.5% purity. The hyperactive xylanase from *Bacillus* sp. XPB-11 mutant BU-7, developed in the present study to release C-5 sugar from pine needle waste biomass and its subsequent biotransformation into bioethanol, is of commercial significance to utilize one of the problematic waste biomass from Himalayan Region for its conversion into second-generation biofuel i.e. bioethanol.

Keywords Xylanase · Mutagenesis · Pine needle hydrolysate · *Kluyveromyces marxianus* · Fermentation · Bioethanol

1 Introduction

Lignocellulose is one of the most abundant biomass available in nature. It mainly consists of cellulose (33–51%), hemicellulose (19–34%), and lignin (20–30%) [1]. Hemicellulose particularly contains xylan which has tremendous industrial applications and can be converted to various useful products including biofuel, nutraceuticals, and other value-added products once converted to xylose by xylanolytic [2]. Several cellulase-free xylanases are well characterized and reported which differ in chemical structures and functions based upon the organisms from which these are derived [3–5]. To meet the demands of various industries, R & D efforts have been focused on the studies related to enzyme stability under different processing conditions, such as pH, temperature, inhibitory ions, and the yield of the enzyme, in addition to its ability to hydrolyze the substrate and improving the enzyme activity [6, 7]. Although number of xylanolytic enzymes from various wild type strains have been studied with typcial characteristics but still many of them lack the desired features to meet the demand of industries. Moreover, industrial applications need prolonged stability, high efficiency and productivity on a sustainable basis at a low cost. This requires isolation, screening of hyper enzyme-producing strains, their improvement along with development of efficient industrial processes for various biotechnological applications [8]. Genetic manipulations through mutagenesis, genetic engineering, and recombinant DNA technology play an important role in the large-scale production of xylanases with desired features, but enzyme yield has been a problem most of the time [9, 10]. These hyperactive xylanases could also play an important role in releasing C-5 sugar from lignocellulosic biomass which can

Parul Suri and Divya Dwivedi contributed equally to this work.

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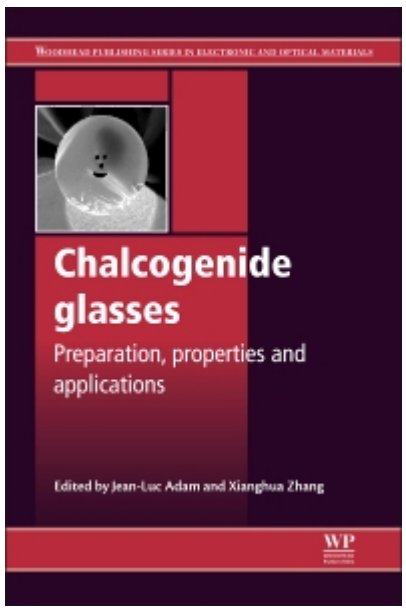

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The unique properties and functionalities of chalcogenide glasses make them promising materials for photonic applications. Chalcogenide glasses are transparent from the visible to the near infrared region and can be moulded into lenses or drawn into fibres. They have useful commercial applications as components for lenses for infrared cameras, and chalcogenide glass fibres and optical components are used in waveguides for use with lasers, for optical switching, chemical and temperature sensing and phase change memories. Chalcogenide glasses comprehensively reviews the latest technological advances in this field and the industrial applications of the technology.Part one outlines the preparation methods and properties of chalcogenide glasses, including the thermal properties, structure, and optical properties, before going on to discuss mean coordination and topological constraints in chalcogenide network glasses, and the photo-induced phenomena in chalcogenide glasses. This section also covers the ionic conductivity and physical aging of chalcogenide glasses, deposition techniques for chalcogenide thin films, and transparent chalcogenide glass-ceramics. Part two explores the applications of chalcogenide glasses. Topics discussed include rare-earth-doped chalcogenide glass for lasers and amplifiers, the applications of chalcogenide glasses for infrared sensing, microstructured optical fibres for infrared applications, and chalcogenide glass waveguide devices for all-optical signal processing. This section also discusses the control of light on the nanoscale with chalcogenide thin films, chalcogenide glass resists for lithography, and chalcogenide for phase change optical and electrical memories. The book concludes with an overview of chalcogenide glasses as electrolytes for batteries.Chalcogenide glasses comprehensively reviews the latest technological advances and applications of chalcogenide glasses, and is an essential text for academics, materials scientists and electrical engineers working in the photonics and optoelectronics industry.

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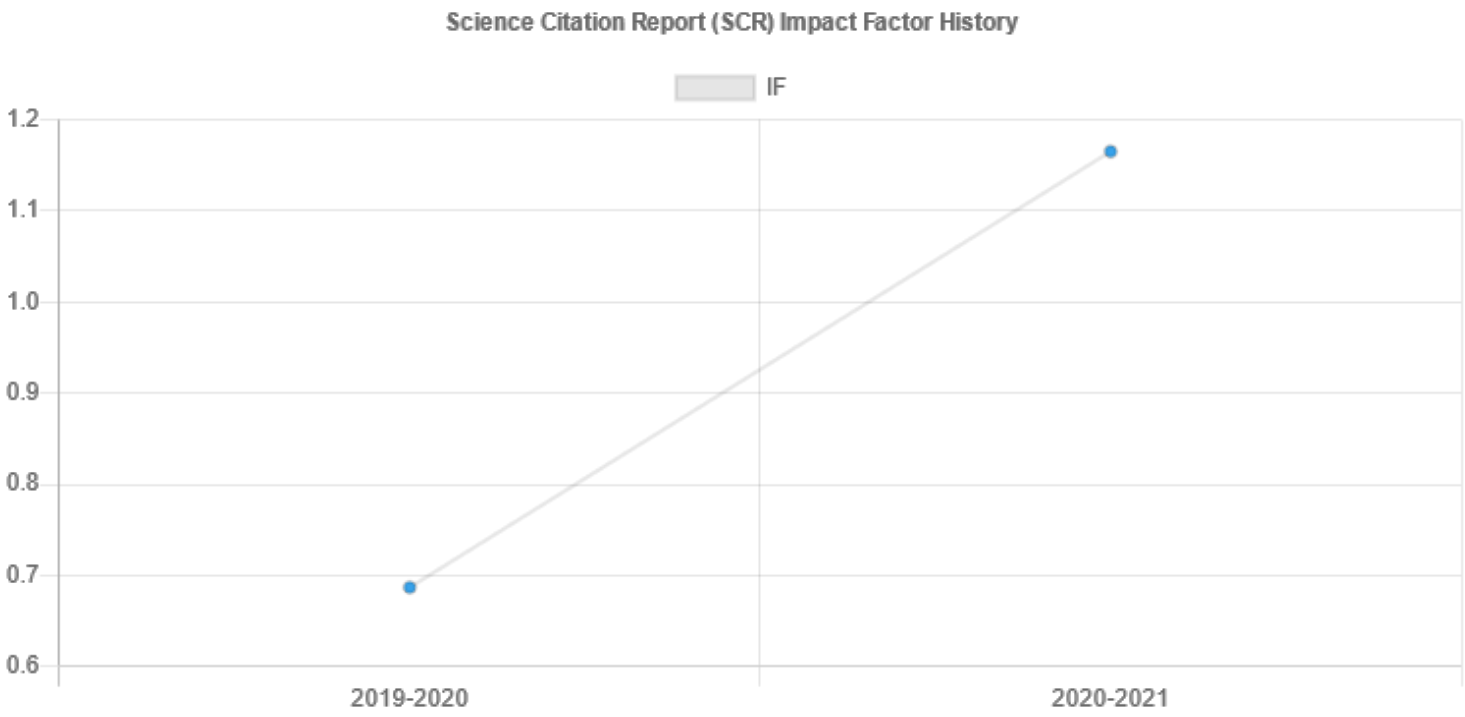

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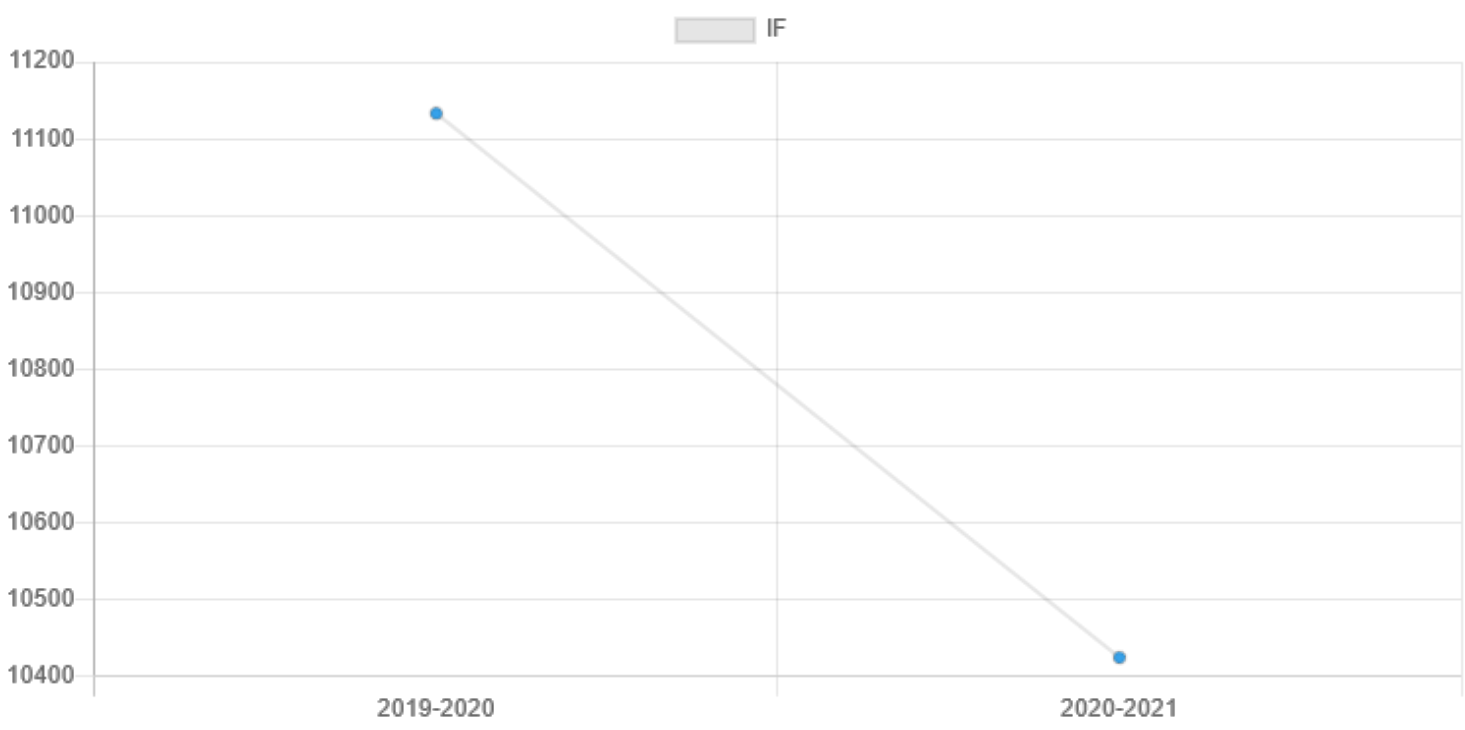

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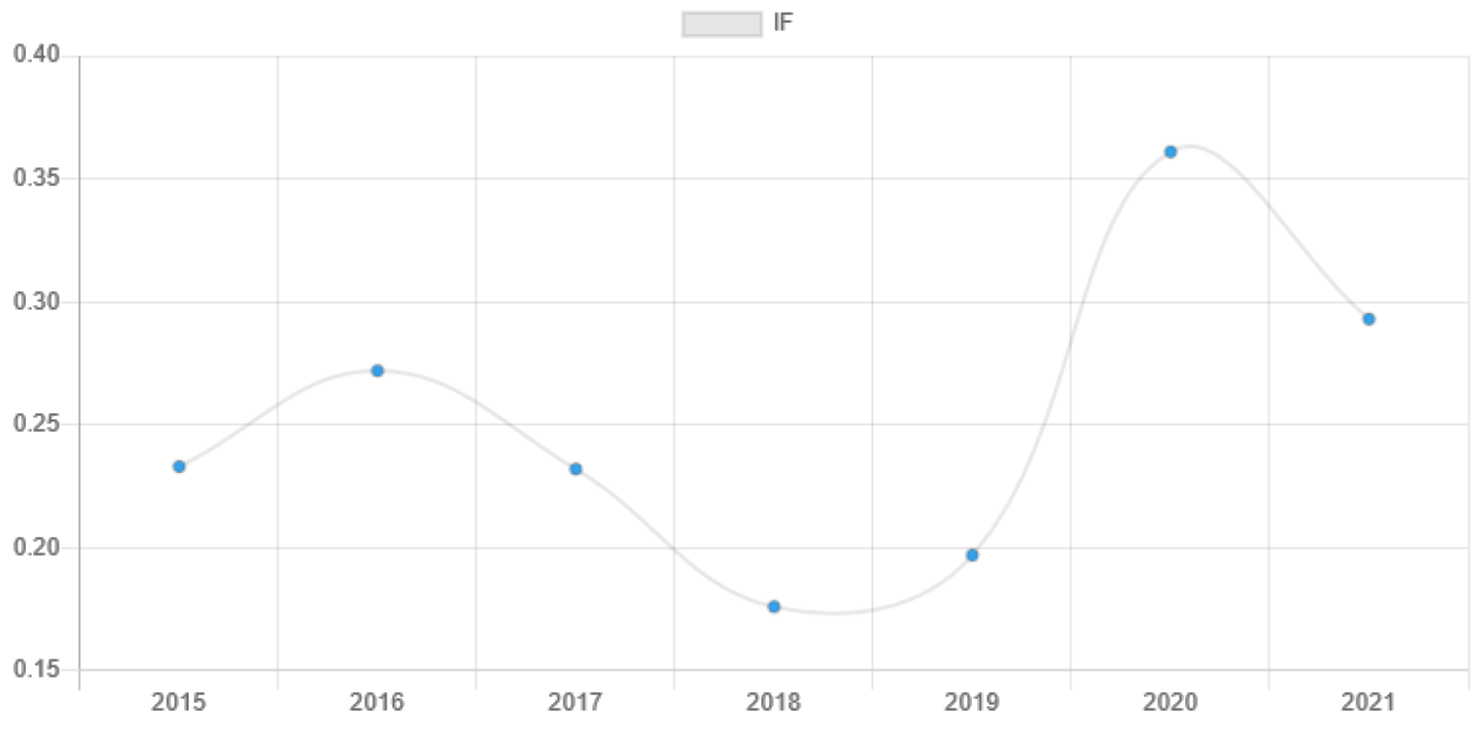

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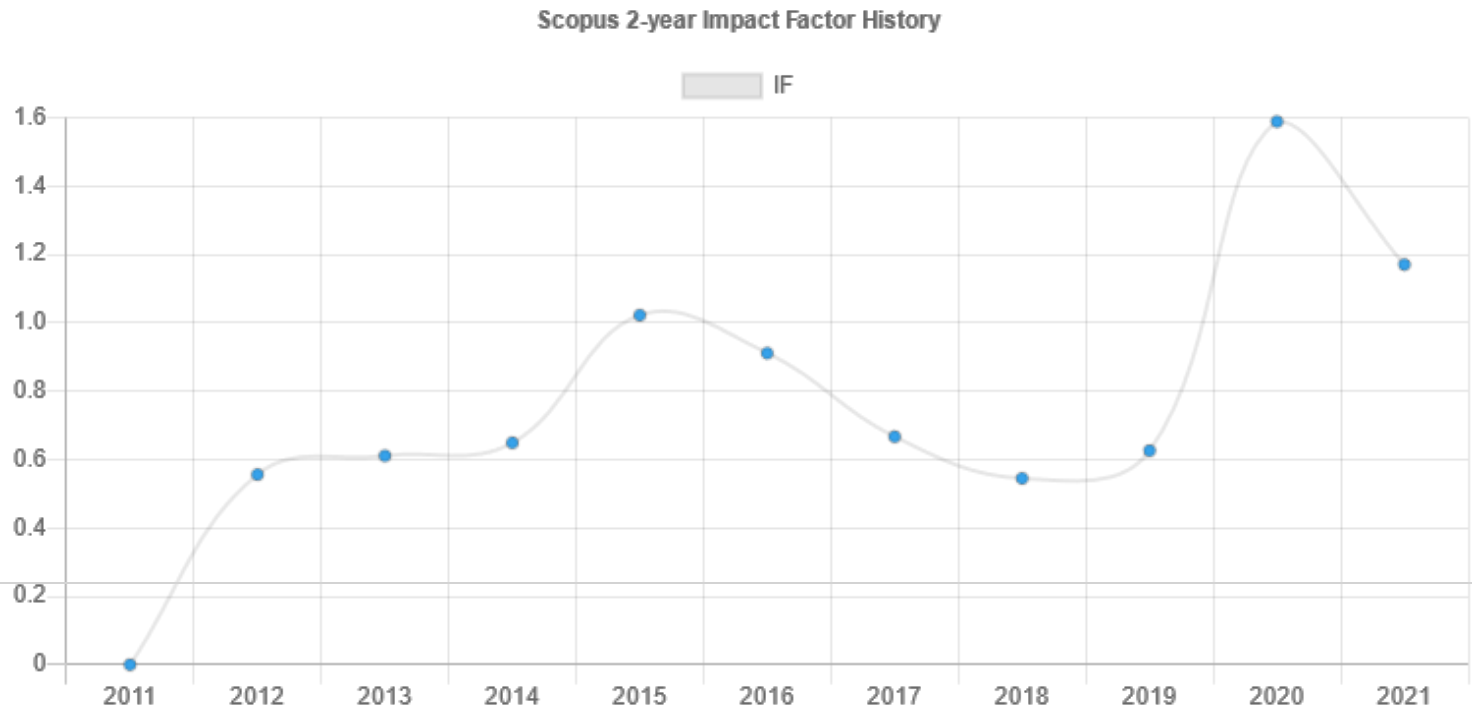

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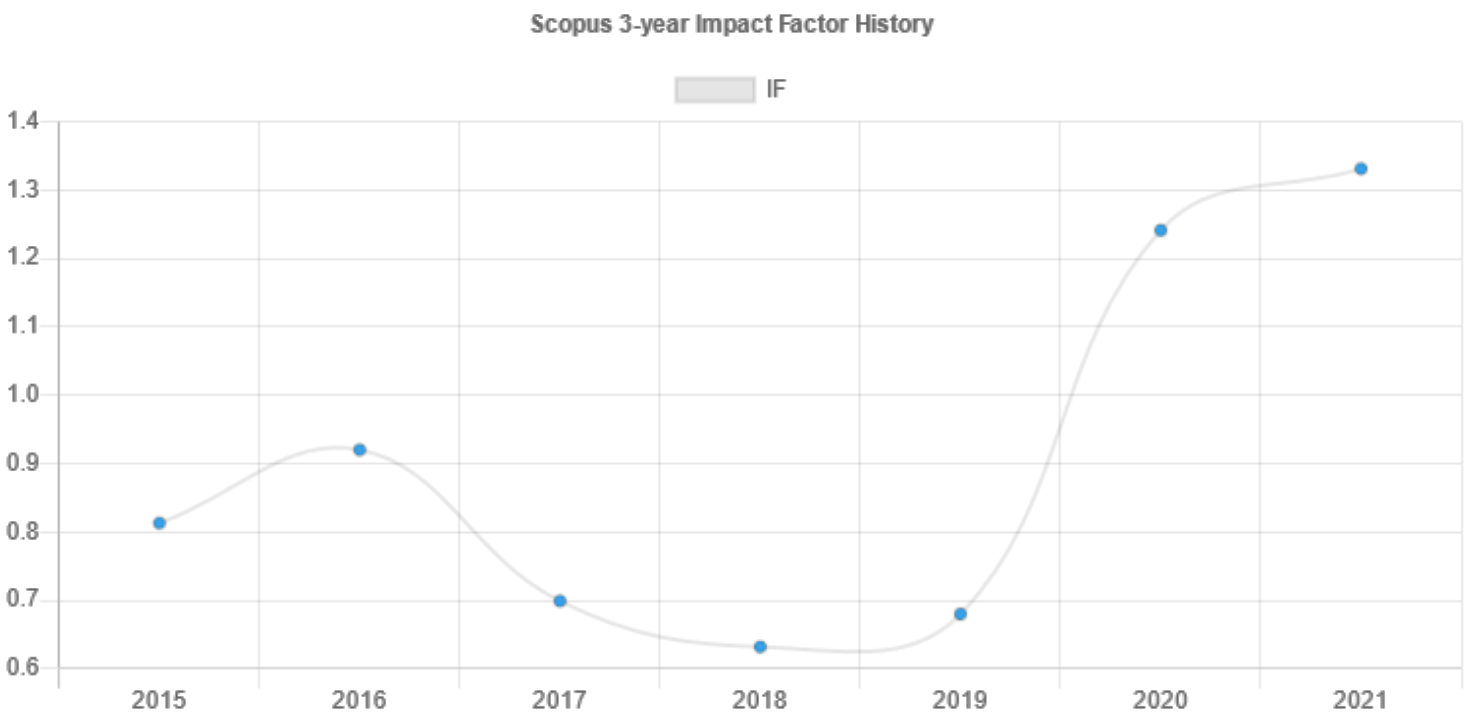

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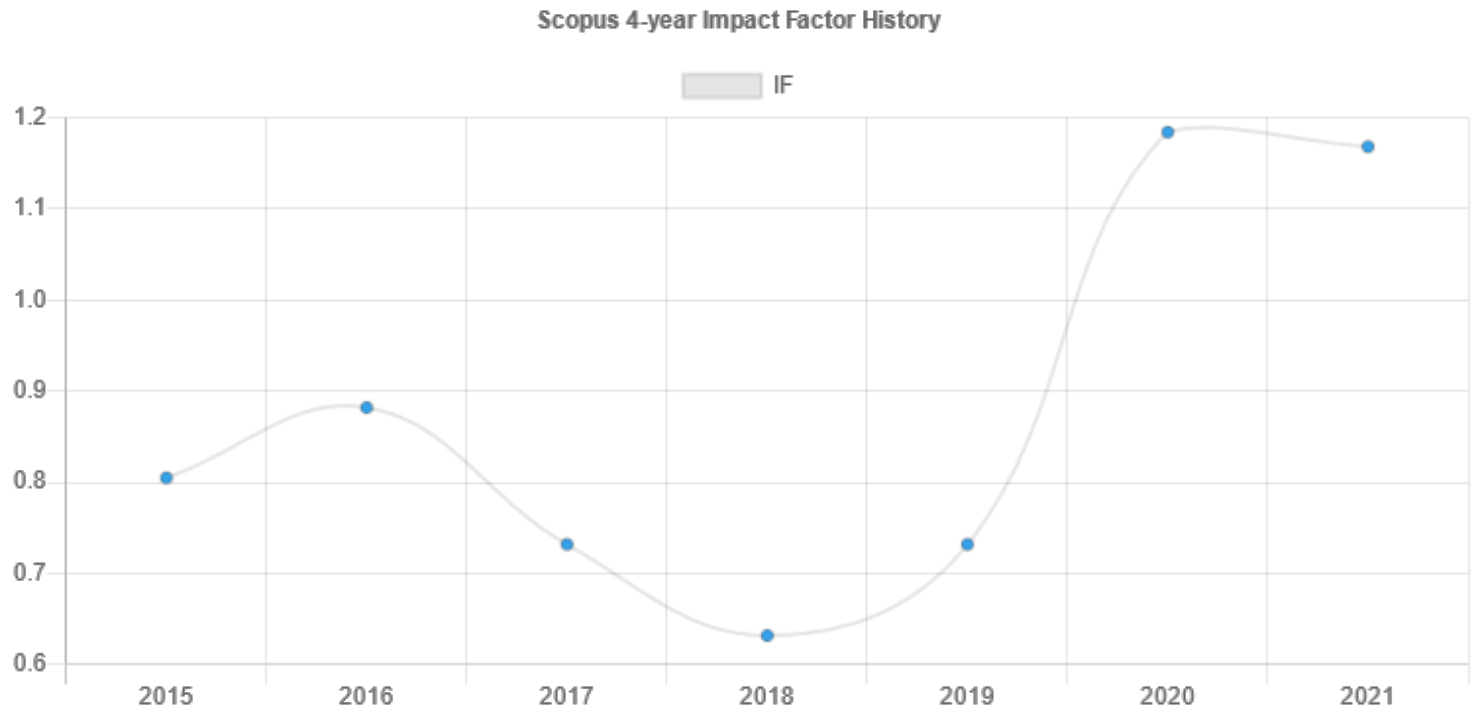

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	2008 Impact Factor	NA	NA	NA
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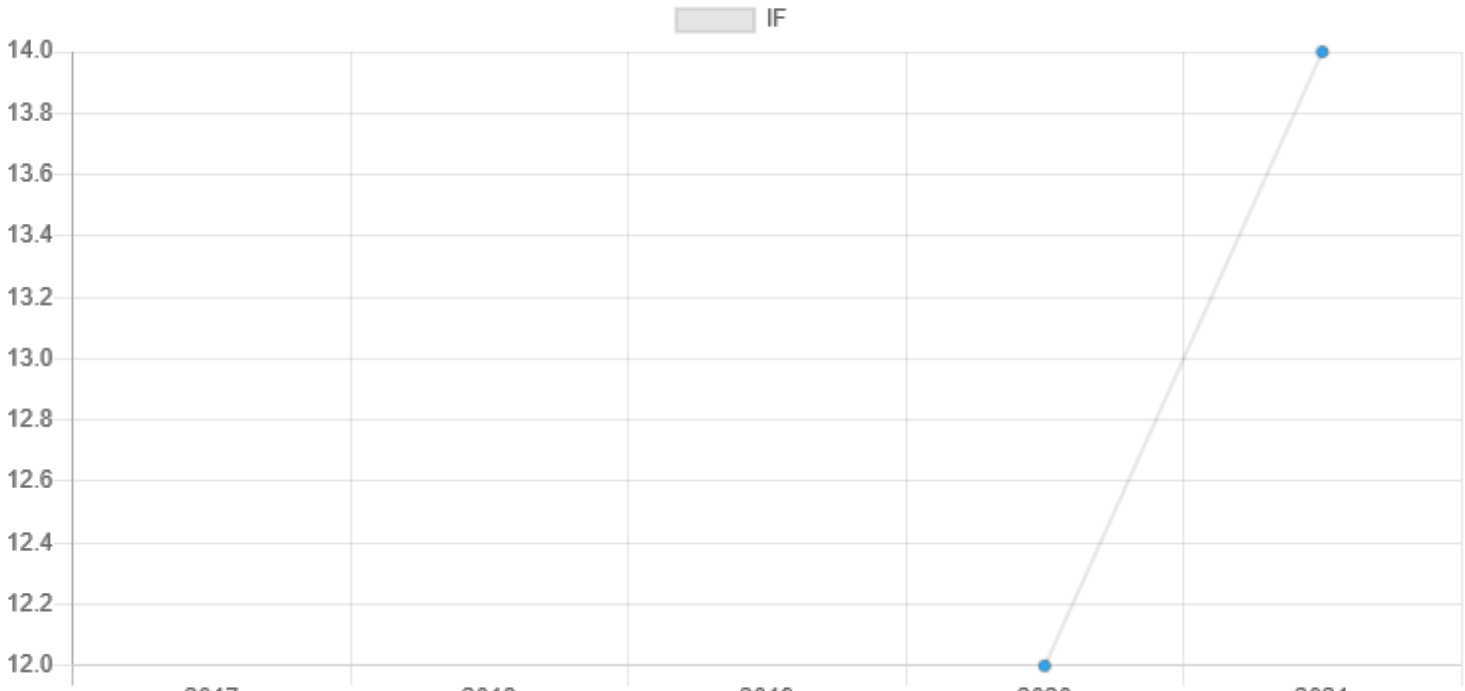

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Performance enhancement of Na^+ ion conducting porous gel polymer electrolyte using $NaAlO_2$ active filler

Arvind Kumar Chauhan [a d], Deepak Kumar [b], Kuldeep Mishra [c], Amarjeet Singh [d]

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Abstract

In this paper, we report the enhanced electrochemical characteristic performance of porous gel polymer electrolyte, due to dispersion of sodium aluminate ($NaAlO_2$) active fillers in it. The salt solution consisting of, sodium perchlorate ($NaClO_4$) dissolved in binary mixture of ethylene carbonate and propylene carbonate (EC:PC) was entrapped in poly(vinylidinefluoride-co-hexafluoropropylene) (PVdF-HFP) polymer matrix to obtain the micro-porous sodium ion conducting gel polymer electrolyte films by using the phase inversion technique. Small loading of the active $NaAlO_2$ fillers in gel polymer electrolyte results in significantly improved ionic conductivity (σ_{max}=0.68 mS cm^{-1} at room temperature), Na^+ ion transference number (t_{Na+}~ 0.45) and electrochemical stability window (ESW ~ 4.1 V). Dielectric studies have been performed to explore the ion dynamics in the electrolyte system. The Na-S prototype battery delivers maximum discharge capacities of ~ 210, 139 and 51 mA h g^{-1} at drain currents of 0.10, 0.25 and 0.50 mA cm^{-2}, respectively. The optimized electrolyte composition with high liquid retention, conductivity and transport properties can be utilized for upcoming sodium batteries operating at room temperature.

Introduction

Gel polymer electrolytes (GPEs) have been extensively studied in last decade as a potential electrode separator for batteries and supercapacitors [1,2]. These electrolytes are flexible, free-standing and carry good ionic conductivity (> 0.1 mS cm^{-1}) with sufficient electrochemical stability window like liquid electrolytes. These are liquid-rich systems carrying higher content of liquid electrolyte (LE), a molar solution of specific salt in less/non-volatile and high dielectric constant solvent such as ethyl carbonate (EC), propylene carbonate (PC) and diethyl carbonate (DEC) and various room temperature ionic liquids, immobilized in a solid polymer skeleton. The high ionic conductivity of these electrolyte systems makes them catchy option for supercapacitor application. However, for the applications like rechargeable batteries, where the transport of cations is important, these electrolytes appears not that much attractive. Poly(vinylidinefluoride-co-hexafluoropropylene) (PVdF-HFP) is one of the most studied polymers for GPEs preparation [1,2]. One molecule of this polymer has eight fluorine atoms attached with it. Since, the fluorine is highly electronegative in nature, therefore the transport of Na^+ ion in the vicinity of fluorine atoms is hindered.

In order to deal with this issue, the dispersion of nano/micro-size ceramic fillers in the GPEs is an effective approach. These fillers (neutral and acidic) show Lewis acid-base reactions with the salt and form hydrogen bonding with the anion of the salt and, consequently, set more free cations in the electrolyte [3]. Additionally, these fillers settle in the microstructures of the polymer skeleton and break its crystalline orientation, which plays an important role in improving the ionic mobility and hence ionic conductivity of the GPEs. The thermal and mechanical stability of the GPEs may also be enhanced upon dispersion of ceramic filler. Various GPEs with fillers, like Al_2O_3, SiO_2, ZrO_2, TiO_2, have been reported in last few years for battery applications with superior cationic transference numbers [1,4].

There is another category of fillers, called active fillers, which have specific cation in their structure inherently, such as $LiTi_2(PO_4)_3$ [5], $LiAlO_2$ [6] and NASSICON structured $Li_{1.3}Al_{0.3}Ti_{1.7}(PO_4)_3$ [7] for lithium ion conducting electrolytes, $NaAlO_2$ [8], NASICON structured $Na_3Zr_2Si_2PO_{12}$ [9] for sodium ion conducting electrolytes, MgO [10] and $MgAl_2O_4$ [11] for magnesium ion conducting

electrolytes. These active fillers are inherently ion conducting for favorable cation and form ionic dipoles with high dipole movement in the polymer electrolyte system and hence promote cationic kinetics in the electrolyte system. These fillers have been observed not only to enhance the ionic conductivity but also the cation transport number along with other electrochemical properties. Kim et al. [9] used the $Na_3Zr_2Si_2PO_{12}$ filler, which is inherently a sodium ion conducting material and may suppress the anion mobility in the electrolyte system. They reported NASICON structured $Na_3Zr_2Si_2PO_{12}$ dispersed in PVdF–HFP + 1 M $NaCF_3SO_3$ in TEGDME (LE) electrolyte system. The above electrolyte delivered high ionic conductivity of 0.12 mS cm^{-1} at 0 °C, with exceptionally high cation (Na^+) transference number (t_{Na+}) ~ 0.92 and electrochemical stability window of 5 V. Recently, Pareek et al. [12] reported significant enhancement in Li^+ ion transference number from ~ 0.20 to maximum 0.73 with ionic conductivity jump from 2.35×10^{-6} to 5.76×10^{-5} S cm^{-1} on dispersion of Li-active NASICON-structured $LiSnZr(PO_4)_3$ ceramic filler in PVDF + LiTFSI polymer electrolyte system. Hashmi and his co-workers demonstrated the effective role of active fillers,Na aluminate ($NaAlO_2$) and Mg aluminate ($MgAl_2O_4$), in comparison to the passive Al_2O_3fillers, in the sodium and magnesium ion conducting GPEs, respectively [8,11]. They obtained significant jump in the cationic transference numbers when active fillers were used. Not only cation transport number but active fillers introduce more amorphicity in the polymer chains and also improve thermal stability of the electrolyte system [10]. In general, GPEs are prepared by conventional solution casting technique. In recent years, another approach is being in trend called phase inversion technique for GPE preparation [[13], [14], [15], [16], [17], [18], [19]]. In this technique, a porous polymer film is first prepared, via techniques like electrospinning, use of non-solvents etc, and then activated in specific LE to obtain porous gel polymer electrolyte (PGPE). These electrolytes are easy to prepare, cost effective and mechanically more stable than conventional solution casted gel polymer electrolytes. Yadav et al. [20] have reported a simple and quick method of obtaining porous polymer films just by exposing the polymer solution in steam at elevated temperature. The same group prepared PGPE system comprising ZrO_2 dispersed PVdF-HFP. They obtained maximum ionic conductivity of 0.60 mS cm^{-1} with slightly reduced electrochemical stability window of 3 V [21]. Verma et al. [22] reported the effect of passive TiO_2 nanoparticles on the physical and electrochemical properties of PGPE obtained by the same method. They obtained good ionic conductivity of 1.30 mS cm^{-1} with cationic (Na^+) transference number ~ 0.31 with electrochemical stability window of 3.50 V.

In the present paper, an attempt to enhance electrochemical properties of PVdF-HFP/$NaClO_4$ + EC-PC PGPE is demonstrated using $NaAlO_2$ active fillers. The $NaAlO_2$/PVdF-HFP composite porous films were obtained by phase inversion technique. Ionic conductivity, electrochemical stability window, Na^+ ion transference number (t_{Na+}) and dielectric studies for porous gel polymer electrolytes dispersed with and without $NaAlO_2$ active fillers are presented and explained. A proto-type room temperature (RT) Na-S battery has been assembled and tested for OCV and discharge capacity using the optimized composition of PGPE.

Section snippets

Materials

PVdF-HFP (average M_w 400,000), Sodium aluminate ($NaAlO_2$) powder, Sodium perchlorate ($NaClO_4$) (≥ 98 %), ethylene carbonate (EC) (98 %), propylene carbonate (PC) (99.7 %) and elemental Sulfur (S) were purchased from sigma Aldrich, USA. The solvent dimethyl formamide (DMF) (AR grade) was purchased from SD Fine Chem, India. Activated carbon (AC) was purchased from YEC-8, Fuzhou Carbon Co., China.…

Preparation of PGPEs

The PGPEs were prepared by the phase inversion technique as reported by Yadav et al. [16]. Initially,…

Results and discussions

The variation of porosity and the LE uptake, calculated using Eqs. 1 and 2, of the porous $NaAlO_2$/PVdF-HFP/EC-PC/$NaClO_4$ films with various $NaAlO_2$ contents are drawn in Fig. 2. The porosity of the films is directly connected to their LE uptake which can be clearly seen from the figure. The porosity and LE uptake of the PVdF-HFP film are obtained 69 % and 311 %, respectively this is well in corroboration with earlier reports. On dispersion of $NaAlO_2$ fillers, both these factors, porosity and LE…

Conclusions

PGPE films are prepared using phase inversion techniques and the effect of Na-active $NaAlO_2$ fillers on performance enhancement of porous gel polymer electrolyte has been investigated using electrochemical and dielectric studies. The filler particles enhance the retention of sodium salt solution within gel polymer electrolyte matrix and thus the ionic conductivity of the PGPE significantly increases from 0.22 mS cm^{-1} to maximum 0.68 mS cm^{-1} for optimized composition with 0.50 wt.% $NaAlO_2$. The Na^+…

Declaration of Competing Interest

The authors report no declarations of interest.…

Acknowledgments

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Effect of NASICON-type LiSnZr (PO4) 3 ceramic filler on the ionic conductivity and electrochemical behavior of PVDF based composite electrolyte
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B. Liu *et al.*
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L. Zhao *et al.*
Gel polymer electrolyte based on polymethyl methacrylate matrix composited with methacrylisobutyl-polyhedral oligomeric silsesquioxane by phase inversion method
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N. Yadav *et al.*
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...EIS is commonly used to study the (dis)charging process of batteries under their various conditions (i.e. state-of-charge, temperature) [24]. EIS was applied for analysis of the electrical response to yield useful information about the electrochemical and physicochemical properties of the Li-S system [25] and dielectrics [26–28]. A typical EIS spectrum for Li-S batteries is commonly composed of three parts, two semicircles (high- and middle-frequency) and an inclined line (low-frequency) [29–31]....

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A Facile Route to Synthesis of Ferromagnetic and Antiferromagnetic Phases of Iron Oxide Nanoparticles by Controlled Heat Treatment of Ferritin

Sunil Kumar, Anjali Thakur, Saral K. Gupta, Parasmani Rajput & Amarjeet Singh

Journal of Superconductivity and Novel Magnetism **33**, 3841–3852 (2020)

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Abstract

Magnetic nanoparticles of ferromagnetic and antiferromagnetic phases were synthesized from controlled heat treatment of dry ferritin powder in a bottom-up approach. Heat treatment paves the way for synthesis of Fe_2O_3 solid phase from iron molecular complexes stored in the cavity of ferritin; the strong increase (~ 150 times) in saturation magnetization is a sign of the presence of ferromagnetic exchange coupling which exists only in solid phase. In this experimental study, vibrating sample magnetometer (VSM) was used to study magnetic induction. X-ray diffraction (XRD) and scanning electron microscopy (SEM) were employed for analysis of structure and morphology of the samples. Differential scanning calorimetry (DSC) was used to search for indicators of structural phase transformation through scanning of temperature. The nanoparticle size with highly narrow distribution (mean size ~ 6 nm) was observed by SEM for sample annealed at 430 °C. As indicated by XRD measurements, the majority phase of Fe_2O_3 nanoparticles was amorphous up to 500 °C, whereas DSC demarcates the crystalline phase transition temperature at 545 °C. The annealing temperature range from 400 to 500 °C was found to be suitable for growing ferromagnetic nanoparticles endowed with high saturation magnetization and low coercivity. At higher range of annealing temperature (500–700 °C), XRD confirms the presence of α-Fe_2O_3 (haematite) phase which is an antiferromagnetic crystalline system with weak magnetization. A systematic decline of magnetization on increasing the annealing temperature beyond 500 °C was attributed to finite size effects and increased purity of antiferromagnetic phase.

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Research Article

A study of thickness dependent microstructure of poly (3-hexylthiophene) thin films using grazing incidence x-ray diffraction

Manoj Kumar, Srihari Velaga & **Amarjeet Singh**

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ABSTRACT

Thin films of poly (3-hexylthiophene), abbreviated as P3HT, are widely used systems of semiconducting polymer for applications in organic electronic devices. We studied the microstructure of spin-coated thin films of P3HT using grazing incidence x-ray diffraction (GID) by combining high-resolution vertical scan with 2D intensity maps obtained using area detector. Microstructure of the films was quantitatively analyzed in terms of relative crystalline density, texture and coherence length. The structure of the films was relaxed by annealing at 110°C. The relaxed microstructure shows strong thickness dependence. Thick film (61 nm) was highly crystalline and textured. For thin film (32 nm), relative crystalline density was very weak but the coherence length of crystallites was larger and the orientation of crystallites was even more strongly textured. For thick film, the strong increase of crystalline density takes place through fresh nucleation and reorientation of crystallites already present in the films. For thin films, the substrate interaction induced very strong alignment of lamellar crystallites through degeneration of off-oriented crystallites and increased lamellar crystalline

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KEYWORDS: Poly (3-hexylthiophene) semi-crystalline polymers thin films microstructure grazing incidence x-ray diffraction

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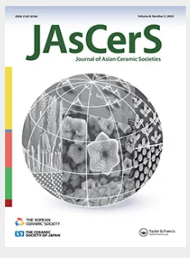

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On the structural and thermophysical study of Pb-doped Se-Te-In nanochalcogenide alloys

Anjali, **Balbir Singh Patial** & Nagesh Thakur

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ABSTRACT
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ABSTRACT

Pb additive nanochalcogenide materials are becoming well-known materials in modern optoelectronics. In this paper, multicomponent Se-Te-In-Pb nanochalcogenide alloys are prepared using melt-quenching technique. The physical and submicron structural features of investigated system are reported and discussed. Characteristic peaks in x-ray spectra signify nanorange of each sample under investigation validated by FESEM and HRTEM. Influence of Pb content on examined composition has been deliberated with respect to their physical characterization namely average coordination number (<*r*>), mean bond energy (<*E*>), cross-linking density (*X*), lone-pair electrons (*L*), fraction of floppy modes (*f*), constraints (N_c), electronegativity (χ), cohesive energy (*CE*), glass transition temperature (T_g), and heat of atomization (H_s). It is realized that addition of Pb content, enhanced N_c, *X*, and <*r*>. Whereas, <*E*>, *L*, *f*, χ, *CE*, T_g, and H_s decrease with Pb addition. Cohesive energy is analyzed through chemical-bond approach. T_g is estimated by Tichy-Ticha and Lankhorst approaches and are found in consistent with experimental results. The band gap of investigated system has

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deduced results are analyzed through cohesive energy, electronegativity, and average single-bond energy. Also the compositional dependence of experimentally derived optical band gap has been analyzed and discussed.

KEYWORDS: Nanochalcogenide FESEM theoretical band gap mean bond energy cohesive energy glass transition temperature

1. Introduction

In scientific research, the nanostructure configurations are gradually becoming promising materials owing to basic research point of view as well as for their inimitable features as distinctive optical properties, exclusive electronic properties, an enormous surface-to-volume ratio, etc., as contrasted to bulk systems [1,2]. Moreover, the nanostructure synthesis has been analyzed for several materials in consequence of advancement in the characterization and visualization techniques. Recently, the interest has been developed in lead chalcogenide nanocrystalline semiconductors because of their unique size tuneable properties arising from the effect of quantum confinement in addition to have potential applications as detectors of infrared radiation, photosensors, solar energy conversion devices, thermoelectric devices, photodetectors, photoresistors, lasers, nonlinear optical devices, and more recently, as solar control coatings and infrared emitters [3–6].

The metal-containing nanocrystalline materials are well-known promising materials owing to their some unusual properties, including anomalous order of band gaps, high carrier mobility, exclusive chemical durability, high dielectric constant, extended infrared (IR) transparency, high reflection index, low phonon energy, high photo sensitivity, high thermal stability, and special nonlinear optical properties [2,7–9]. These fascinating and incomparable properties of lead nanostructured semiconductors have inculcated great interest in the fundamental studies of these materials. Additionally, multicomponent nanochalcogenide crystals proposed excessive assistance of having tuneable electronic, optical, structural, and defect properties which facilitate photovoltaic properties [10]. Nanochalcogenides materials are not well studied and there is a lot of scope for the study of these materials in a nanorange.

Se-based chalcogenide materials are tremendously utilized in the

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[11,12]. These materials are useful in optical memory switching rectifiers and photocells due to observation of reversible transformation [13]. But these Se-based alloys found to be thermally unstable and have limited reversibility for technological applications [2]. However, the insertion of trace elements is one of the most efficient techniques for developing new alloys with improved properties. Huang et al. stated [14] that the atomic packing becomes denser, if atomic radius of element to be added is extensively dissimilar from alloy elements or has analogous chemical characteristics to that of the one element of alloy component. This causes an enhancement in tensile strength, thermal stability, glass-forming ability (GFA), and other mechanical properties [14–16]. The progression of inclusion of Pb in Se-based system effected their band structure along with bonding network. This in turn produces thermally more stable glassy alloys by reducing aging effect and enhancing glass forming ability. Pb doping prominently makes an impact on physical, structural, electronic, optical, and thermal properties of host material [2,17]. Our preceding research on ternary Se-Te-In composition signifies that In = 6 at. wt.% has greater thermal stability among investigated alloys [18,19]. Furthermore, in our earlier measurements on AC conductivity and dielectric study in Se-Te-Pb system illustrate considerable influence of Pb addition on conduction mechanism [17]. The fundamental interest in multicomponent quaternary chalcogenide alloys has been revived due to the observation of quick reversible laser-induced crystalline to amorphous and amorphous to crystalline phase transitions. Quaternary chalcogenide alloys act as considerable source of tuneable emission in IR wavelength region [2,20,21]. In device fabrication, the lattice perfection and the optical gap of the material plays an important role which can be modified by the insertion of the doping element like Pb. The insertion of trace element like Pb may enhance the valance alteration pair (VAP)-type defects, limiting molecular mobility, and connecting neighboring chains, which causes *p* to *n* transition in certain chalcogenide systems [2,17]. All these eminent characteristics indicate that Pb is exclusive amongst the trace element in case of semiconducting chalcogenide materials.

The advancement in the characterization and visualization techniques opens up a new window in materials science for controlling synthesis of materials at nanolevel. The growth of nanostructured materials by simple and economic methods becomes important in the field of fabrication of nanoscale devices. The rapid growth in nanotechnology and nanoscience will bring us in a new world. Exploring new techniques that comprise

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fabrication of nanostructured materials with desirable features, controllable dimensions together with morphologies is recently a great challenge to both synthetic chemists as well as materials scientists. To produce monodisperse nanocrystals of Pb chalcogenides with high quality, tuneable size and shape; it is significant to understand their nanocrystal formation process. In the past few years, the various novel techniques have been established for the synthesis of nanocrystalline semiconducting metal chalcogenides including microwave-assisted heating, sol-gel method, solvothermal technique, thermal evaporation, sonochemical method, photochemical synthesis, sonoelectrochemical method, microemulsion route, electrochemical template synthesis, high-energy ball milling, sputtering, pulse laser deposition, etc. [22–33]. In the present study, nanomaterials synthesis is achieve by using melt quenching technique as this is a simplest, most cost effective as well as proven technique for producing high-quality nanomaterials along with optimum stoichiometry and morphology [5,34–38]. Other researchers also reported that the progression of inclusion of Pb additives have considerable influence on the growth of nanocrystalline semiconducting chalcogenide materials [1,2,3,4,5,6,22,23,24,25,26,27,28,29,30,31,32,33,39,40,41,42,43]. In some cases, Pb additive act as a modifier in the host system by increasing the number of defects. Consequently, crystalline size reduced with Pb addition as observed by others [40–42]. Due to all these eminent characteristics of Pb; in the present work also, Pb is used as a doping element for synthesis of nanochalcogenide alloys.

The physical properties of nanochalcogenide alloys have received much attention because of their attractive unpredictable features and extensive range of structural network alterations [43], which is essential for understanding the materials properties in addition to materials engineering. The variation in composition brings changes in short-range order which helpful in tailoring the properties of glassy materials to a desired requirement [44]. Further, the evaluation of physical parameters is useful to explore the best characteristics of the system and can predict the stability of a glass system to greater extent, making it easier for the selection and solution of the problem before performing experiment.

In the present research paper, influence of Pb content on investigated system have been studied with respect to their physical parameters via average coordination number (<*r*>), mean bond energy (<*E*>), cross-linking density (*X*), lone-pair electrons (*L*),

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cohesive energy (CE), glass transition temperature (T_g), heat of atomization (H_s), etc. X-ray diffraction (XRD) technique is used for analyzed nanocrystalline nature of primed samples. Elemental composition of investigated samples is analyzed through energy-dispersive x-ray (EDX) analysis. Surface morphology and nanonature of examined composition is validated by field emission scanning electron microscope (FESEM) and high-resolution transmission electron microscope (HRTEM). The optical measurements are used to find the band-gap values. A correlation is established among the mean coordination number and other deduced physical parameters.

2. Experimental details

Nanochalcogenide $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10 at. wt.%) alloys are synthesized by melt quenching process. Pure (99.999%) element as per at. wt.% has been pondered with 10^{-4} g accuracy and sealed in (diameter ~ 12 mm, length ~ 5 cm) quartz ampoule under a vacuum ~ 2×10^{-5} mbar. Heating of sealed ampoules has been done at 3–4°C min^{-1} heating rate up to 900°C for 10 h and ampoules were frequently rocked to make the melt homogenous at maximum temperature. The quenching of molten sample has been performed very quickly in ice-cooled water. Deduced sample is grinded into a fine powder. Structural analysis is done at room temperature by taking XRD pattern of the examined samples through PANalytical X'Pert x-ray diffractometer in $10° < 2\theta < 90°$ range at 1°/min scanning rate using Cu $K\alpha$ (λ = 1.54056 Å). The investigation of premier characteristic peaks in the XRD spectrum signifies the nanonature of examined alloys. XRD spectra of nanocrystalline chalcogenide $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 8, and 10 at. wt.%) alloys have been plotted in Figure 1 and for x = 4 and 6 at. wt.% of Pb is shown in our other research papers [2,41]. Diffraction peaks and observed d spacing of investigated alloys match closely with those of the standard JCPDS card no.: 76-1182. All the observed nanocrystalline peaks in XRD spectra (Figure 1) can be perfectly indexed to the rhombohedral structure of Se-Te-In and indexed as (0 2 4), (2 1 5), (2 0 8), (2 2 0), (2 1 $\bar{8}$), (0 2 10), (0 0 12), (0 4 8), (0 3 12), (1 3 $\overline{11}$), (2 4 $\bar{2}$), (1 4 $\bar{9}$), (5 0 8), (0 1 17), (6 0 0), (4 2 $\overline{10}$), (4 3 7), (6 1 5), and (7 0 1) crystal planes. XRD study clearly reveals that no characteristics peaks related to impurities or other precursor compounds in pure and doped Se-Te-In alloys has been observed. XRD patterns of synthesized nanochalcogenides clearly reveal a preferred orientation along (0 2 10) direction [corresponding to $2\theta \approx 29°$], as this diffraction peak shows significantly high intensity and narrow width as compared

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nature (as indicates by diffraction patterns) and broadening in peak signifies nanocrystalline nature. Presence of high strain and large numbers of defects might be the other reason which contributes to peak broadening [45,46]. The envelope of various reflections peaks at lower angles further provides the confirmation of narrow size distribution of investigated system (Figure 1). It is observed that prominent (0 2 10) phase remains unaltered, however, becomes more sharp and intense with increasing Pb content. This observation illustrates that crystallinity of Se-Te-In nanocrystals enhance with Pb doping. As Pb concentration increases, intensity of (0 2 4), (2 1 5), (2 0 8), and (600) plane peaks decreases whereas intensity of (0 2 10), (0 0 12), (0 4 8), and (5 0 8) plane peaks increases; coupled with appearance of minor peaks at $2\theta \approx 49.10°$, 52.78°, 68.34°, and 76.02° (corresponds to rhombohedral structure of Se-Te-In). In addition, it is observed that preferred orientation along (0 2 10) direction changes to (5 0 8) direction with Pb doping. The minimization in surface energy and internal stress might be dominating the occurrence of preferential orientation [47–52]. These observations reveal that growth direction of examined nanocrystalline composition changes with Pb amount. It also signifies the polycrystalline nature of doped nanocrystalline composition. The Scherrer's formula [17] has been used for deducing average crystallite size (D_{XRD}) of investigated alloys:

(1)

$$D_{\mathrm{XRD}} = K\lambda / \beta \cos\theta$$

(1)

Figure 1. XRD patterns at various concentrations of Pb in nanocrystalline chalcogenide $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 8, and 10 at. wt.%) alloys.

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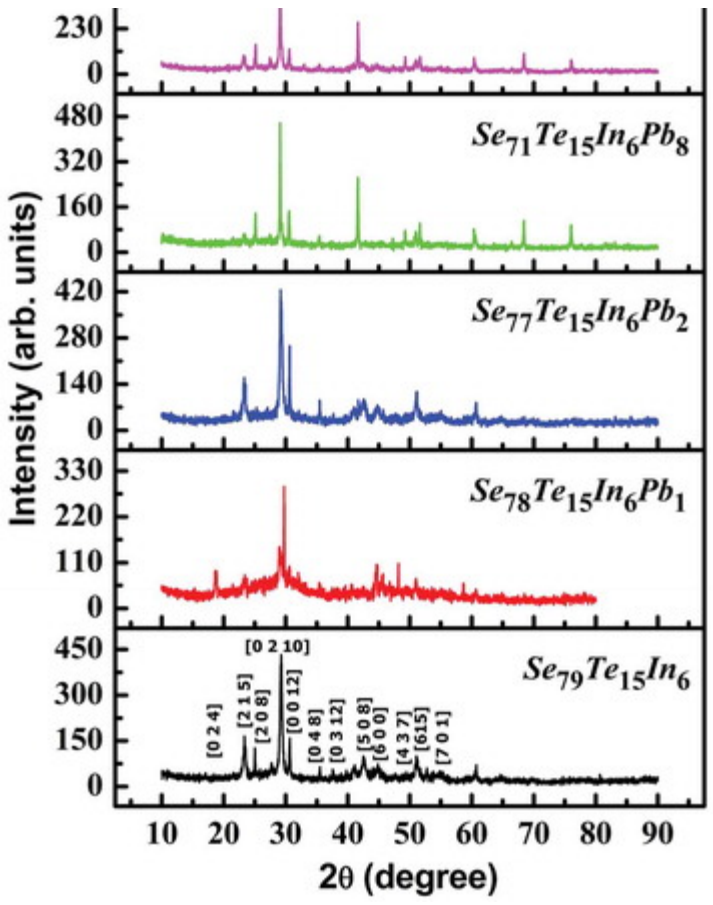

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where K denotes the Scherrer constant (K = 0.9), D indicates the crystalline size, θ is the peak position, β is full width at half maximum (FWHM) of the premier intense peak in XRD spectrum used to realize the crystallite size for each investigated alloy and λ signifies x-rays wavelength. The crystallite size of all investigated chalcogenide nanoparticles found to be in nanorange between 12.4 and 49.38 nm (Table 1, Figure 2). The amount of defects and imperfections in crystal lattice can be provided by dislocation density (δ) of system and is calculated by using the relation [50]:

(2)

$$\delta = 1 / D_{\mathrm{XRD}}^{2}$$

(2)

Table 1. Values of average crystallite size from XRD (D_{XRD}), average particle size from FESEM (D_{FESEM}), average particle size from TEM (D_{TEM}), dislocation density (δ), and strain (ε) for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10) nanocrystalline system.

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Figure 2. Variation of average crystallite size (D) and optical band gap (E_g^{opt}) for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10) nanochalcogenide system.

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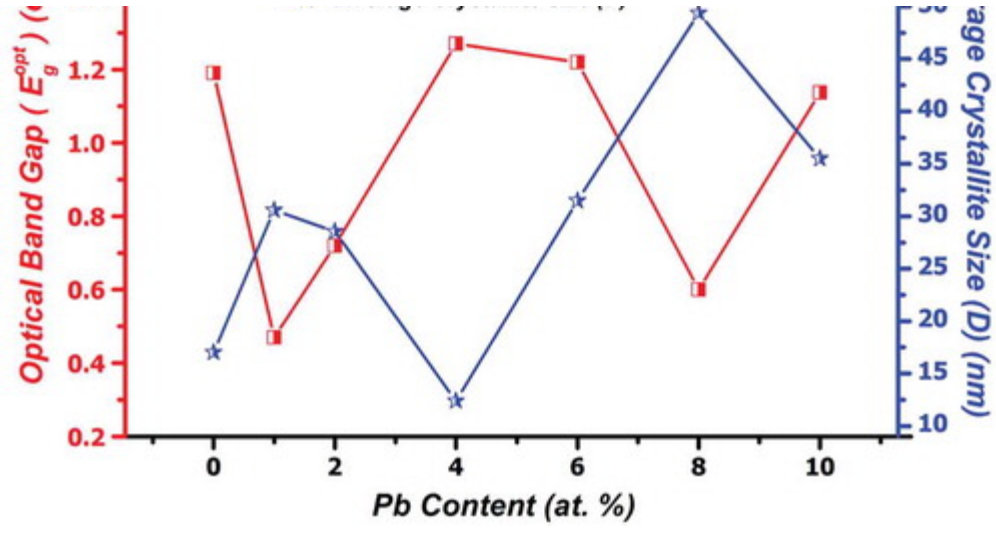

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Moreover, microstrain (ε) developed owing to displacement of atoms with respect to their reference lattice position. ε is determined by following relation [52]:

$$\varepsilon = \beta \cos\theta / 4 \quad (3)$$

The deduced values of δ and ε are given in Table 1. Variation in crystallite size is observed with enhancing Pb content, further, confirmed by dislocation density, microstrain along with crystalline nature of examined composition. Presence of high strain, large numbers of defects, ionic radii mismatch among doping element and host ion, drag force exerted by dopant ions on grain growth, and boundary motion might contributes to this variation in crystallite size [46]. The highly intense structural peak is observed at $2\theta \approx 29°$ in the XRD pattern for all investigated samples. Moreover, the shift is in the direction of lower value of 2θ that indicates contraction of crystal structure along with extension of lattice parameters due to replacement of Se by Pb [1,17]. This shift can be attributed to an increase in grain size, lattice spacing, dislocation densities, and microstrain, which is due to imperfections within the crystalline lattice. Sharp discrete peaks having lower intensity than the most intense peak are also observed due to inclusion of Pb in Se-Te-In system. Consequently, Pb may create most stable state by compensate disorder in the investigating system.

Surface morphology as well as nanocrystalline nature of examined system is further analyzed by FESEM (HITACHI-SU8010) operating at accelerating voltage of 15 kV; which indicates good consistency with XRD outcome. Figure 3((a)–(e)) shows the few scanned images of multicomponent nanochalcogenide $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 8, and 10 at. wt.%) alloys and FESEM images of 4 and 6 at. wt.% of Pb are given elsewhere in our earlier papers [2,41]. Inset histogram of Figure 3((a)–(e)) indicates the

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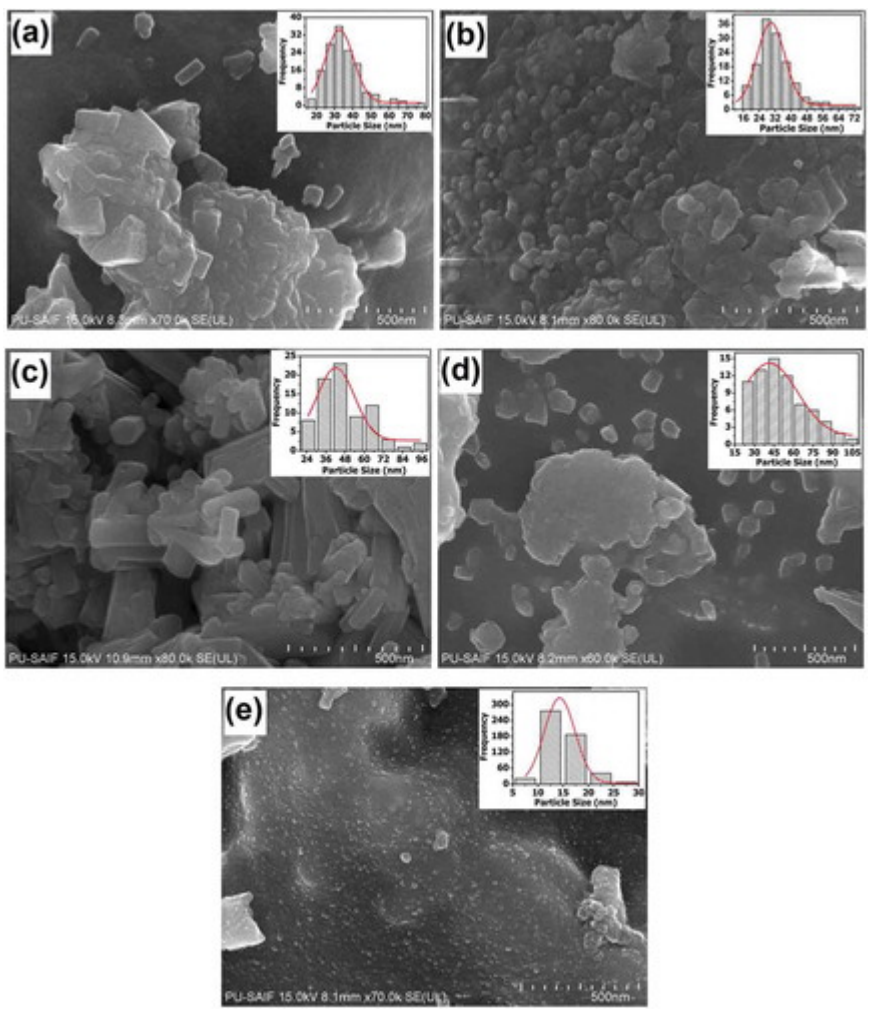
corresponding FESEM images and their respective values of average particle size (D_{FESEM}) are listed in Table 1. Average particle size deduced from FESEM measurements is not consistent with crystallite size estimated through XRD analysis and may be due to unsymmetrical and nonuniform nanoparticles distribution. That is nanoparticle distribution has either long right or left tail. Consequently, mean value is not same at point of maxima in distribution [53,54]. These scanned images reveal almost rod and spherical shapes of nanoparticles in scanned area of examined composition. These nanoparticles are not perfectly spherical and exhibit significant faceting; which contributes to broad size distributions of nanocrystals [55,56] contribute to inconsistency in FESEM and XRD measurements. Further, with increasing Pb content, average crystallite size deduced from XRD varies as compare to particle size analyzed through FESEM. This reveals that polycrystalline nature of nanocrystals approaching toward nearly single crystalline nature [48,57].

Figure 3. FESEM micrographs of $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 8, and 10 at. wt.%) nanochalcogenide alloys (a) ×70 k (for x = 0), (b) × 80 k (for x = 1), (c) × 80 k (for x = 2), (d) × 60 k (for x = 8), and (e) × 70 k (for x = 10). (Inset for all figures shows nanocrystalline particle size distribution).



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The surface morphology and size of primed nanochalcogenide composition is further characterized by HRTEM analysis. The TEM measurements are performed through FP-5022/22-Tecnai G2 20S-Twin ultrahigh-resolution TEM with scanning-mode TEM (STEM)

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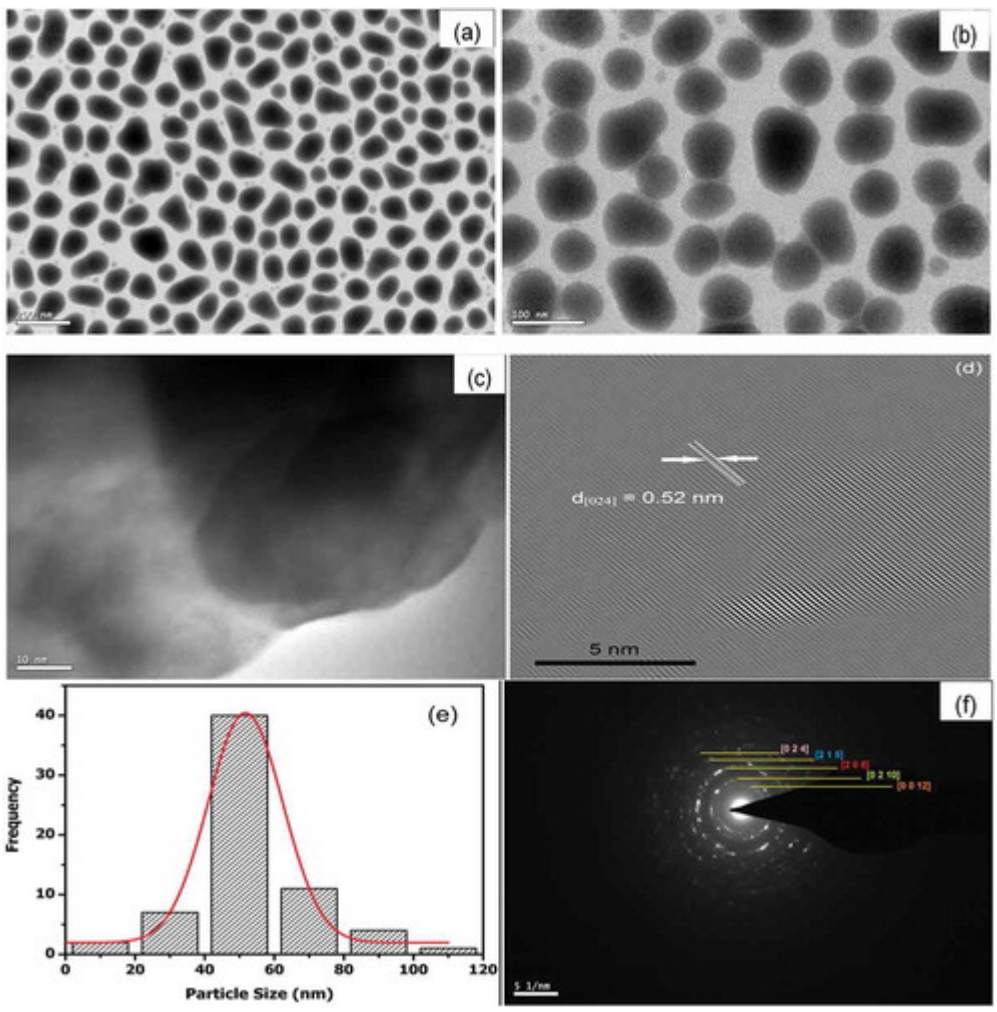
primed by dispersing small amount of powder in ethanol solution followed by sonication (ultrasonic vibration) for 30 min. After that a drop of dispersion is placed onto a copper grid; which is coated by layer of amorphous carbon (holey). Figure 4 shows TEM images, HRTEM images, and selected area electron diffraction (SAED) pattern of as-synthesized nanochalcogenide $Se_{71}Te_{15}In_6Pb_8$ alloy. Images with different magnification are shown in Figure 4((a)–(c)). These micrographs illustrate the nearly spherical shape of nanoparticles as validated by FESEM. The nanocrystals shapes are not perfectly spherical and exhibit significant faceting; which contributes to broad size distributions of nanocrystals. The average particle size of primed nanoparticles has been estimated by statistical analysis of nanoparticles and is found equal to ≈ 51.50 nm, as indicated in the histogram (Figure 4 (e)).

Figure 4. (a)–(c) TEM micrographs at different magnifications; (d) HRTEM image; (e) nanocrystalline size histogram; and (f) SAED pattern of nanocrystalline $Se_{71}Te_{15}In_6Pb_8$ chalcogenide system.



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In addition HRTEM analysis is further used to confirm the crystallinity and structure of nanoparticles. High-resolution TEM micrograph (Figure 4 (d)) assures the high-quality crystallinity of these nanocrystals with lattice spacing of ≈ 0.52 nm, which corresponds to [024] plane of rhombohedral structure of Se-Te-In (see JCPDS card no.: 76-1182) and is in accordance with the results of XRD analysis. The corresponding SAED pattern (Figure 4 (f)) of

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polycrystalline nature of nanoparticles. These rings are indexed with (0 0 12), (0 2 10), (2 0 8), (2 1 5), and (0 2 4) planes of rhombohedral structure of Se-Te-In (see JCPDS card no.: 76-1182), respectively. These crystalline planes are in consistent with that of measured XRD principal peaks and confirm that primed Se-Te-In nanoparticles are composed of pure phase. Although diffraction rings are discontinuous as well as consist of sharp and bright spots (as shown in Figure 4 (f)) reveals that nanocrystals are well crystallized and approaching toward nearly single crystalline nature. Also, it is observed that average particle sizes (D_{TEM}) lies in nanorange between 12.01 and 51.59 nm for all investigated alloys (Table 1). HRTEM measurements are in agreement with XRD and FESEM analysis, which reflects nearly single crystalline nature of investigated composition as well as validate the nanonature. Scherrer's formula calculates the coherence length of x-ray and any crystal imperfections will leads to smaller deduced size as compare to true size [58]. In our composition, the deduced TEM particle size are close to estimated XRD crystallite size, at least in (0 2 10) direction.

Elemental composition of primed samples is verified using EDX data. Compositional analysis has been carried out on different sections of the examined composition to investigate the chemical composition, formation, and purity of the synthesized Pb-doped Se-Te-In samples. Figure 5 shows the EDX spectrum of nanochalcogenide $Se_{79}Te_{15}In_6$ alloy. The composition of the bulk $Se_{79}Te_{15}In_6$ sample is found to be uniform within the measurement accuracy of about ± 2% (Table 2). Similar results are also observed in the other investigated samples within the experimental error (not shown here). Moreover, neither carbon (C) nor nitrogen (N) signal has been observed in the EDX spectrum. Both XRD and EDX characterization illustrate that pure Se-Te-In nanocrystals are successfully primed through mentioned melt-quench technique.

Table 2. EDX elemental analysis of nanocrystalline $Se_{79}Te_{15}In_6$ chalcogenide system.

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Figure 5. EDX spectrum of $Se_{79}Te_{15}In_6$ nanocrystalline chalcogenide alloy.

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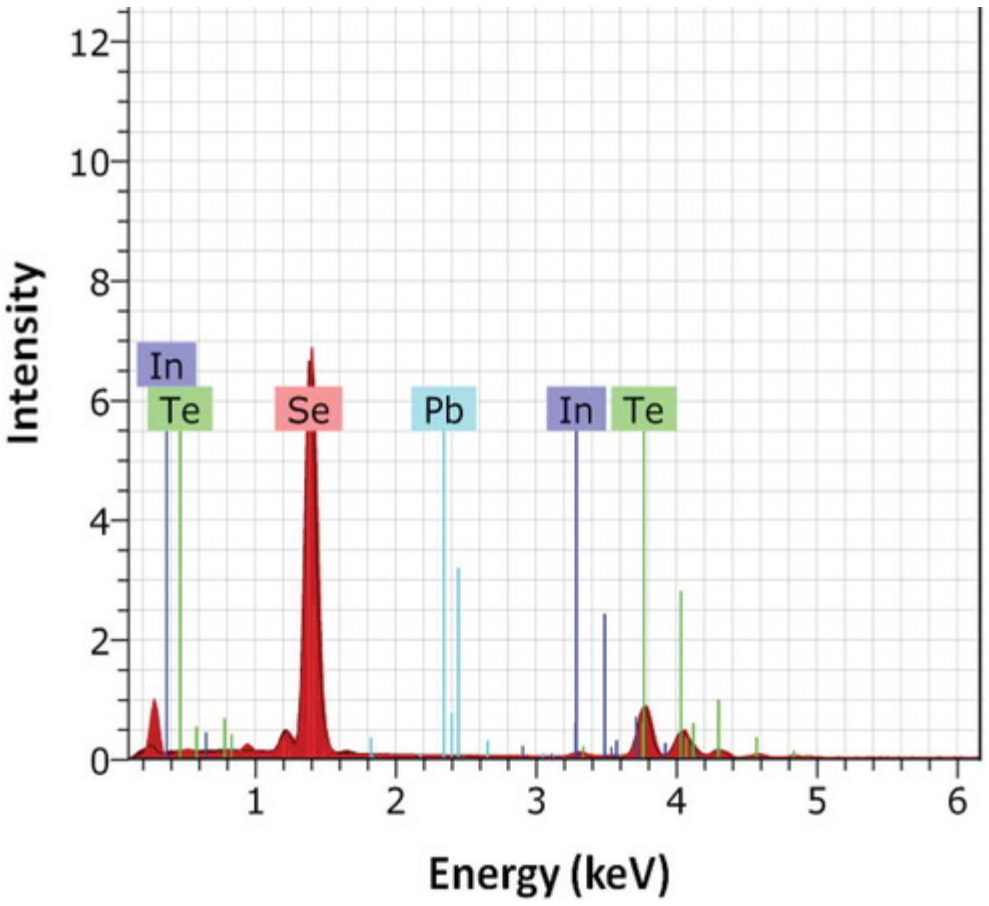

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The thermal behavior of material has been analyzed through differential scanning calorimetry (DSC) technique in nonisothermal conditions. The precision of heat flow is ± 0.01 mW and precision of temperature is ± 0.1°C as deduced by microprocessor of thermal analyzer. A standard aluminum pan has been used to encapsulate a sample of around 3–5 mg at a flow of 40 mL/min which is in powder form, under dry nitrogen atmosphere. Samples are heated at heating rates: 5, 10, 15, and 20°C min^{-1}. Characteristic temperatures: the glass transition temperature, peak temperature of crystallization (T_p), and melting temperature (T_m) are deduced by microprocessor of thermal analyzer. A typical DSC thermogram of studied Se-Te-In-Pb nanochalcogenide system at heating rate 10°C min^{-1} is shown in Figure 6.

Figure 6. DSC thermograms of the nanocrystalline $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10) multicomponent chalcogenide system at 10°C min^{-1} heating rate.

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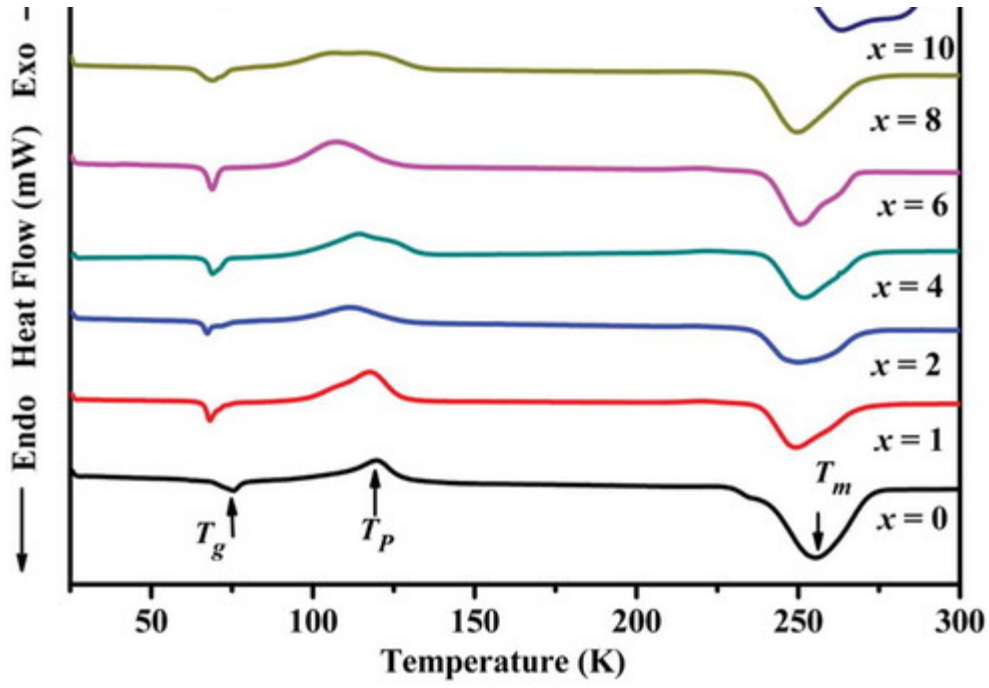

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Thin films of Se-Te-In-Pb investigated nanocrystalline samples has been deposited on thoroughly clean microscope glass substrates by well-known vacuum flash evaporation technique using molybdenum boat (HINDHIVAC 12A 4D Model). Since thin films are not self-supporting, therefore, a suitable substrate is used for deposition. During the evaporation process, a vacuum ~10^{-5} mbar has been retained in the deposition chamber. The primed films are kept inside the deposition chamber for 24 h to achieve a metastable equilibrium. The optical transmittances of the thin films are carried out at nearly normal incidence of light in the wavelength range 400–3000 nm by using UV-Vis-NIR spectrophotometer (Perkin Elmer Lambda-750) at room temperature.

3. Results and discussion

3.1. Average coordination number and constraints

The concept of average coordination number (<*r*>) was introduced by Phillips [44] for use with binary alloys and this idea is extended to depict properties of covalent chains forming glasses. In multicomponent covalent-bonded glassy alloys, degree of cross linking is often connected with <*r*>. Hence, it is an essential factor for demonstrating physical and structural parameters in glassy alloys. For Se-Te-In-Pb investigated nanochalcogenide system, average coordination number is evaluated by relation [59]:

(4)

$$<r> = \frac{\alpha N_{\mathrm{Se}} + \beta N_{\mathrm{Te}} + \gamma N_{\mathrm{In}} + \delta N_{\mathrm{Pb}}}{\alpha + \beta + \gamma + \delta}$$

(4)

where *α, β, γ*, and *δ* denote at. wt.% of Se, Te, In, and Pb,

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Table 3 (Figure 7). It is observed that <*r*> increases from 2.06 to 2.26 with Pb addition indicates the cross linking of chains among the atoms increases. Accumulation of fourfold-coordinated Pb leads to three-dimensional network; consequently, increases average coordination number. The increase in <*r*> promotes network strength and rigidity. As value of <*r*> is less than 2.4, therefore network of glassy alloy can be considered as floppy. Hence, the system under examination is a tremendous glass former.

Table 3. Values of average coordination number (<r>), bond-bending constraints (N_β), bond-stretching constraints(N_α), total number of constraints (N_c), cross-linking density (X), lone-pair electron (L), floppy modes (f), and deviation from stoichiometry (R) for nanocrystalline $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10) chalcogenide system.

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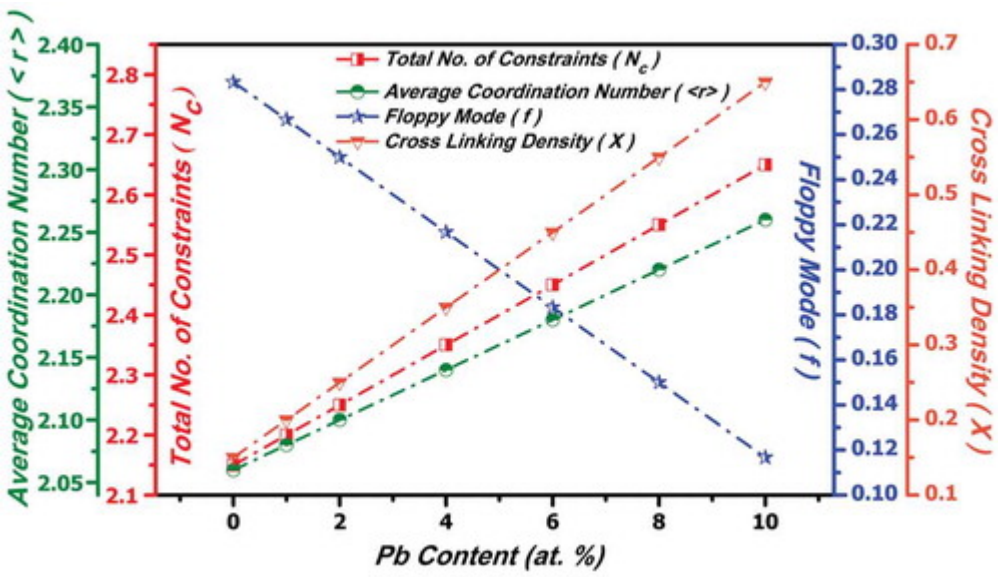
Figure 7. Variation of total number of constraints (N_c), average coordination number (<*r*>), floppy mode (*f*), and cross-linking density (*X*) with Pb content for nanocrystalline $Se_{79-x}Te_{15}In_6Pb_x$ (*x* = 0, 1, 2, 4, 6, 8, and 10) multicomponent system.



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Phillips, Thorpe, and Tanaka [60] demonstrated theories of constraint, according to which there exist two topological thresholds: first one is mechanical thresholds which occur at 2.4; second, the chemical thresholds which correspond to 2.67. They also demonstrated that the chalcogenide system with <*r*> less than 2.4 are loosely connected or under constrained (“floppy” or “spongy” or “polymeric glasses”) and glasses with <*r*> > 2.4 are

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solids) [60]. Therefore, it has been predicted that $r = 2.4$ recognized as rigidity percolation threshold; at which number of interatomic force constraints per atom equal to the number of degree of freedom per atom (N_d) available in the network [60]. Whereas $<r> = 2.67$ recognized as chemical threshold which relates two-dimensional to three-dimensional network structural transitions [61]. The mechanical constraints mainly contained two types of constraints: (i) bond-stretching constraints per atom (N_α) and (ii) bond-bending constraints per atom (N_β), which are given by $<r>/2$ and $2<r>-3$, respectively [61]. In covalent-bonded glasses, N_β and N_α appear due to angular forces and radial force, respectively. Therefore, total number of mechanical constraints per atom (N_c) equal to the average of bond-stretching with bond-bending constraints is $N_c = N_\alpha + N_\beta$.

Thorpe [62] proposed that uncoordinated networks possess a finite fraction of zero frequency normal vibrational modes (floppy modes), which is calculated by using the relationship:

(5)

$$f = 2 - \frac{5}{6} <r>$$

(5)

The cross-linking density (X) is deduced by relation [59]:

(6)

$$X = N_c - 2$$

(6)

The deduced values of N_c, f, and X are listed in Table 3. Variation of total number of constraints and cross-linking density against at. wt.% of Pb plotted in Figure 7 and observed that the values of N_c and X increase with the increase in Pb content. According to Phillips and Thorpe [61], the optimum condition intended for glass formation occurs when N_c is equivalent to degree of freedom N_d, i.e. when $N_c = N_d = 3$. In the investigated composition, N_c – › 3 with Pb content; which indicates that number of constraints N_c operating on network stabilized by degree of freedom accessible from the atoms in the network. Also, it is found that value of f – › 0 (Figure 7). This defines a floppy to rigid phase transition, consequently, system becomes more and more rigid, which shows that investigated system have a stronger tendency for making glass [59].

3.2. Glass forming ability and lone-pair electrons

Lone pair of electrons (L) defined as nonbonding pair of electrons exists in valence band. The stable vitreous state has been achieved if adequate amount of L occur in chalcogenide system. Valence shell electron pair repulsion theory can be used to

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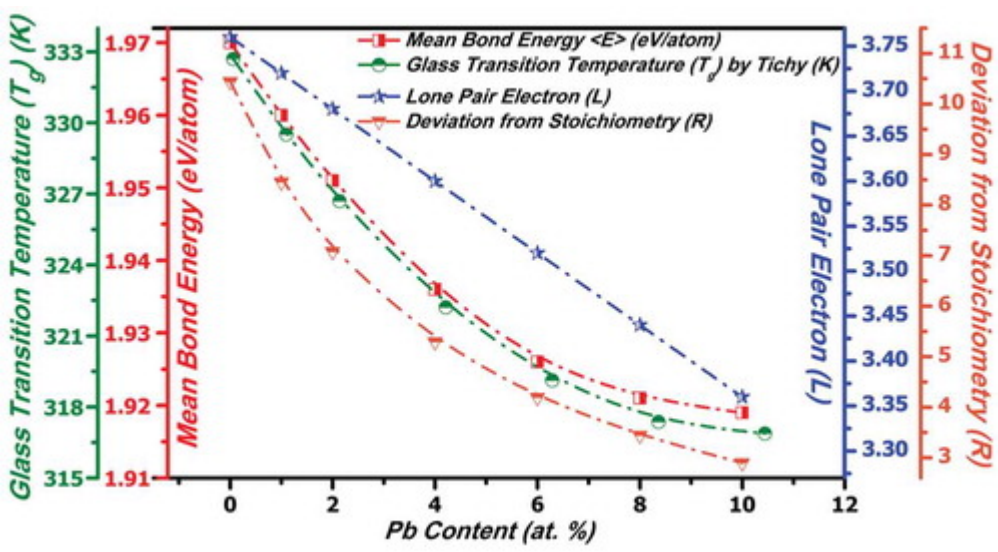
pair electron occurrence favors the formation of glass by removing strain force in the system. Phillips [44,62] has proposed a relation for calculating *L* in a semiconducting chalcogenide system as given below:

$$L = V - \langle r \rangle \quad (7)$$

(7)

where *V* denotes valance electrons. Zhenhua [63] suggested a simple criterion to check glass forming proficiency of chalcogenide glasses according to which for binary system, *L* should be greater than 2.6 and for a ternary system, *L* should be greater than 1. The calculated values of *L* are tabulated in Table 3 and its variation with Pb additive shown in Figure 8. It depicts that *L* decreases with Pb content. Decrease in *L* can be understood in term of interaction among lone-pair electron of bridging Se atom and Pb ion. Due to this interaction in the system *L* decreases. It is observed that values of *L* are greater than three for investigated system, hence, composition under consideration have good glass-forming tendency.

Figure 8. Plot illustrating the variation of various physical parameters with Pb content for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10) nanocrystalline compositions.



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3.3. Deviation from stoichiometry, mean bond energy, and prediction of glass transition temperature

Deviation from stoichiometry is expressed by a parameter *R*, which is described as a ratio of covalent-bonding assumptions of chalcogen atoms to that of nonchalcogen atoms [44]. Threshold occurs at *R* = 1 and at this point only heteropolar bonds occur. The composition is regarded as chalcogenide rich, if *R* is greater than 1. Although the composition is consider as chalcogen poor, if *R* is less than 1.

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using the following relationship [64]:

$$R = \alpha \times N_{\mathrm{Se}} + \beta \times N_{\mathrm{Te}}\gamma \times N_{\mathrm{In}} + \delta \times N_{\mathrm{Pb}} \quad (8)$$

The deduced values of R are plotted in Figure 8 (Table 3) and it is observed that $R > 1$ for investigated composition. So it reasonable to state that system under investigation is chalcogen rich.

Glass transition temperature (T_g) denoted a point, at which a transition happen and below T_g, supercooled liquid forms a glass. Thus, it is logical to assume that magnitude of cohesive forces inside the material is related to T_g and to allow the atomic movement, these forces should be overcome. In chalcogenide glasses, huge attention is given to prediction of T_g and is related to mean bond energy (<E>), this represent the material rigidity as well as cohesive forces. Tichy and Ticha have been related T_g with connectedness of the material, i.e. with <r> and mean bond energy among atoms of the material, i.e. quality of connections [63–65]. They were considered the covalent-bond approach for chalcogenide systems and gave a correlation among T_g and <E> as given below:

$$T_g = 311[38; <E> - 38; 0.9] \quad (9)$$

There is one another empirical relation proposed by Lankhorst [66], which gives a correlation among enthalpy of atomization H_s (kJ/g-atom) and T_g (K) given as:

$$T_g = 3.44\, H_s - 480 \quad (10)$$

T_g and properties of glassy system are closely related to overall <E>, depends on parameters like degree of cross linking, average coordination number, and bond energy along with nature of the bonds. For investigated composition, <E> has been evaluated by using the correlation given by Tichy [67]:

$$<E> = E_{cl} + E_{rm} \quad (11)$$

where E_{cl} denotes the overall participation to the bond energy occur due to strong heteropolar bonds and E_{rm} indicates the contribution occur due to weaker bonds that left behind strong bonds have been maximized.

$$E_{cl} = P_r\, D_{hb} \quad (12)$$

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here D_{hb} is average heteropolar-bond energy and P_r denotes degree of cross linking. Estimated values of <*E*> are summarized in Table 4 and it is found that <*E*> decreases with Pb addition. Values of T_g deduced from Tichy-Ticha and Lankhorst approaches are tabulated (Table 4) and shown in Figure 8 and depicting the fall in T_g with the increase in Pb content. In the investigated system, Pb replaces Se-Se homopolar bonds (44 kcal/mol) with Pb-Se heteropolar bonds (31.47 kcal/mol) [17] leads to decrease in bond energy of system; hence, T_g. Experimental values of T_g for investigated composition are also listed in Table 4 and are in agreement with theoretically predicted T_g using Tichy-Ticha and Lankhorst approaches.

Table 4. Values of average single-bond energy (H_s/<*r*>), heat of atomization (H_s), mean bond energy (<*E*>), glass transition temperature T_g (K), and band gap (E_g^{th}) for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10) nanocrystalline chalcogenide compositions.

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3.4. Average heat of atomization, average single-bond energy, and theoretical band gap

The average heat of atomization ($\overline{H}_s$) is a parameter that reflects relative bond strength of a material as it directly provides a measure of cohesive energy. It represents a heat change in a chemical substance by total separation of all atoms (either a chemical element or a chemical compound) [44]. Thus, assets of chalcogenide system must be correlated with $\overline{H}_s$. Pauling stated that [68] for binary semiconductor consist of A along with B atoms, at standard pressure as well as temperature, the $\overline{H}_s$ is the sum of heat of formation (ΔH) with average heats of atomization H_s^{A} and H_s^{B}, respectively, that related to the average nonpolar-bond energy of the two atoms:

(13)

$$H_s\,(\mathrm{A}\text{ - }\mathrm{B}) = \Delta\mathrm{H} + \frac{1}{2}\,[38; \mathrm{H_s^A} + \mathrm{H_s^B}]$$

(13)

Here ΔH term is related to the square of difference among electronegativity χ_{A} and χ_{B} of two atoms.

(14)

$$\Delta H \quad \alpha \quad (\chi_{\mathrm{A}} - \chi_{\mathrm{B}})^2$$

(14)

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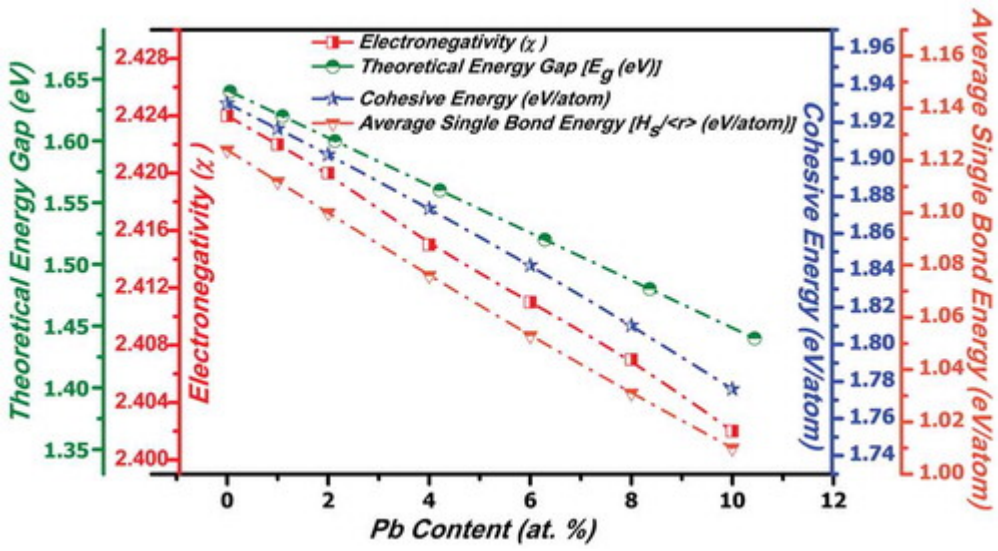
$Se_\alpha Te_\beta In_\gamma Pb_\delta$ as a direct assess of cohesive energy which is expressed as:

$$\overline{H}_s = \alpha H_S^{Se} + \beta H_S^{Te} + \gamma H_S^{In} + \delta H_S^{Pb} \alpha + \beta + \gamma + \delta \quad (15)$$

(15)

here H_S(Se) = 227 kJ/mol, H_S(Te) = 197 kJ/mol, H_S(In) = 243 kJ/mol, and H_S(Pb) = 195 kJ/mol are average heat of atomization values for Se, Te, In, and Pb, respectively [44,68]. Deduced values of $\overline{H}_s$ and $\overline{H}_s$/<*r*> are tabulated (Table 4). Figure 9 represents the variation of $\overline{H}_s$/<*r*> with Pb. $\overline{H}_s$/<*r*> indicates the bond strength. It is clearly examined from Figure 9 and Table 4 that $\overline{H}_s$ and /<*r*> decreases with increasing Pb concentration. Reduction in $\overline{H}_s$ and $\overline{H}_s$/<*r*> may be attributed to substitution of stronger Se-Se bonds (bond energies 44 kcal/mol) with weaker Pb-Se bonds (bond energies 31.47 kcal/mol) [17,44], may cause lowering of overall energy of system, consequently, specifies a decrease in cohesive energy [69].

Figure 9. Variation of various physical parameters with Pb additive for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) nanocrystalline chalcogenide system.



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The energy gap (E_g^{th}) for nanochalcogenide Se-Te-In-Pb multicomponent composition is computed theoretically using Shimakawa relation [70] given as:

$$E_g^{\mathrm{th}}\mathrm{Se-Te-In-Pb} = \alpha E_g\mathrm{Se} + \beta E_g\mathrm{Te} + \gamma E_g\mathrm{In} + \delta E_g\mathrm{Pb} \quad (16)$$

(16)

where E_g(Se) = 1.95 eV, E_g(Te) = 0.65 eV, E_g(In) = 0 eV, and E_g(Pb) = 0 eV represent the energy gap for the elements in braces. Figure 9 indicating the variation of $\overline{H}_s$/<*r*> with Pb content. It is observed that energy gap decreases by Pb addition in investigated Se-Te-In-Pb system and may be explained by correlating the energy gap to

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E_g^{th} of the system can be explained in term of decrease in electronegativity (χ) with increasing Pb at. wt.% (Tables 4 and 5). In chalcogenide system, the top of valence band is form by Se atom lone pair and the bottom of conduction band is form by antibonding band [17,71]. When electropositive In atom (χ = 1.78) is replaced by electronegative Pb atom (χ = 2.33), the lone-pair energy gets augmented along with valence band shift toward energy gap [17,71], which may cause lowering in energy band gap. This might be apparent from Table 5 with decreasing electronegativity values.

Table 5. Values of cohesive energy (*CE*), distribution of their respective bonds, optical band gap (E_g^{opt}), and electronegativity (χ) for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10) nanocrystalline chalcogenide system.

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3.5. Cohesive energy and electronegativity

Cohesive energy (*CE*) is described as the quantity of energy (normalized per atom, per electron, etc.) which attains by a material to be in a solid phase. Therefore, in solid, cohesive energy is illustrated as energy required for breaking all bonds present within its constituent atoms. Chemical-bond approach (CBA) [72] is used for evaluating cohesive energy (the stabilization energy of infinitely large clusters of material per atom). According to CBA model, heteropolar bonds occur more easily (firstly) as compare to homopolar bonds and the bonds are appeared in succession of lowering bond energy unless existing valence of atoms are satisfied. Additionally, bond energies have additive nature. Cohesive energy is determined by adding bond energies of all bonds expect in examined system as given below:

(17)

$$CE = \frac{\sum_i C_i D_i}{100}$$

(17)

here C_i denotes the number of expected chemical bonds and D_i indicates energy of corresponding bonds. Sanderson's principle [73] has been used for calculating the electronegativity (χ) for the investigated composition. According to Sanderson's theory, the electronegativity (χ) of the system can be expressed as the geometric mean of electronegativity of its constituent elements [73]. According to Pauling scale, 2.55, 2.1, 1.78, and 2.33 are the

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The variation of cohesive energy (*CE*) and electronegativity (χ) with increasing Pb concentration is shown in Figure 9 (Table 5). It has been recognized that *CE* and χ reduces with the increase in Pb content. The lowering in energy gap can be understood in terms of decrease in *CE*. Therefore, decrease in *CE* causes lowering in conduction band edge energy, thus lead to decrease in band gap among bonding along with antibonding orbital's. Consequently, the optical energy gap decreases [44].

3.6. Optical band gap

UV-Vis-NIR spectroscopy has been becoming an effective tool to analyze the size and optical properties of materials. The optical (transmittance and absorption) spectra recorded in optical studies (corresponds to electronic transitions) are very helpful to understand the electronic band structure and energy gap of semiconducting films. Therefore, optical characterizations give an insight into the behavior of investigated system by simple interaction with electromagnetic radiation. Moreover, optical band gap in an important parameter and plays a key role in photovoltaic cells construction.

Swanepoel has been extended the transmission method suggested by Manificier [74,75]. According to Swanepoel method, total spectrum is divided in three different spectral regions, beginning at the long wavelength end and moving to shorter wavelengths. In the transparent region of the film, absorption coefficient $\alpha \approx 0$, the transmission is determined by refractive index of investigated thin film *n* and corresponding glass substrate *s* through multiple reflections. In the weak absorption region, α is small so the transmission starts to decrease. In the region of medium absorption, α is large and hence determines the overall transmission. Optical transmission showed a strong dependence on the absorption coefficient. The absorption coefficient (α) is determined by using the relationship [23]:

(18)

$$\alpha = \frac{1}{d} \ln \frac{1}{x}$$

(18)

where *d* is the thickness and *x* is absorbance of thin film. The fundamental absorption, which is related with electron excitation from valance to conduction band, can be utilized to analyze the nature and value of optical band gap (E_g^{opt}). The value of E_g^{opt} has been calculated from absorption coefficient data as a function of photon energy by using the relation [24]:

(19)

$$\alpha h\nu = Bh\nu - E_g^{opt^m}$$

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where B is the band tailing parameter and depends on the transition probability and m is the power that can assume values of 1/2, 3/2, ... or 2, 3, ... depending on the transition process. In the above equation, m = 2 for an indirect allowed transition, m = 3 for an indirect forbidden transition, m = 1/2 for a direct allowed transition, and m = 1/3 for a direct forbidden transition. The linearity of $(\alpha h\nu)^{1/2}$ against $h\nu$ plots (Figure 10) indicates the existence of allowed indirect transitions. Hence the value of m = 1/2 is found to be a best fit of the experimental outcomes of investigated nanochalcogenide samples corresponding to an indirect allowed transition. E_g^{opt} has been estimated by extrapolating linear part of $(\alpha h\nu)^{1/2}$ versus $h\nu$ plots (Figure 10) and intercept from abscissa (at α = 0, $E_g^{opt} = h\nu$) and calculated values are listed in Table 5 for all investigated alloys and compositional dependence is shown in Figure 2. Variation in E_g^{opt} with composition can be illustrated in terms of structural changes, density of localized states, crystallite size, and chemical disordering owing to Pb addition. It is observed that E_g^{opt} decreases for Pb ~ 1 at. wt.%, which may be attributed to increment in charged defect states and large crystalline size of sample as compare to base composition. According to Mott and Davis [23], in case of semiconducting materials, the degree of defects and disorder present in the system decide the width of localized states near the mobility edge. Such kinds of defects are produced owing to unsaturated bonds which form localized states in band gap. Inclusion of Pb content to Se-Te-In chalcogenide system may enhance the number of charged defect states due to small electronegativity of Pb as compared to Se [76]. At the same time, average crystalline size of nanocrystals of investigated composition shows a marginal increase from 17.02 to 30.59 nm (Table 1) and contributes to decrease in E_g^{opt}. A decrease in E_g^{opt} can be correlated with shifting of Fermi level due to impurity doping in investigated system [77]. Moreover upon further increment in Pb content up to 4 at. wt.%, E_g^{opt} increases with respect to Pb = 1 at. wt.%. These deduced observations may be attributed to small crystallite size of samples as well as a result of strong quantum confinement [60]. Accordance with quantum confinement, band gap becomes wider due to smaller crystallite size values, which corresponds to shifting of absorption edge to shorter wavelength region due to individual confinement of electron and holes [60]. This increase in E_g^{opt} can be explained in term of chemical bonding among Se and Pb ions. Actually with Pb addition, chalcogenide matrix becomes heavily cross linked along with deeper penetration of localized states in the energy gap, consequently steric hindrance enhanced and causes increases in

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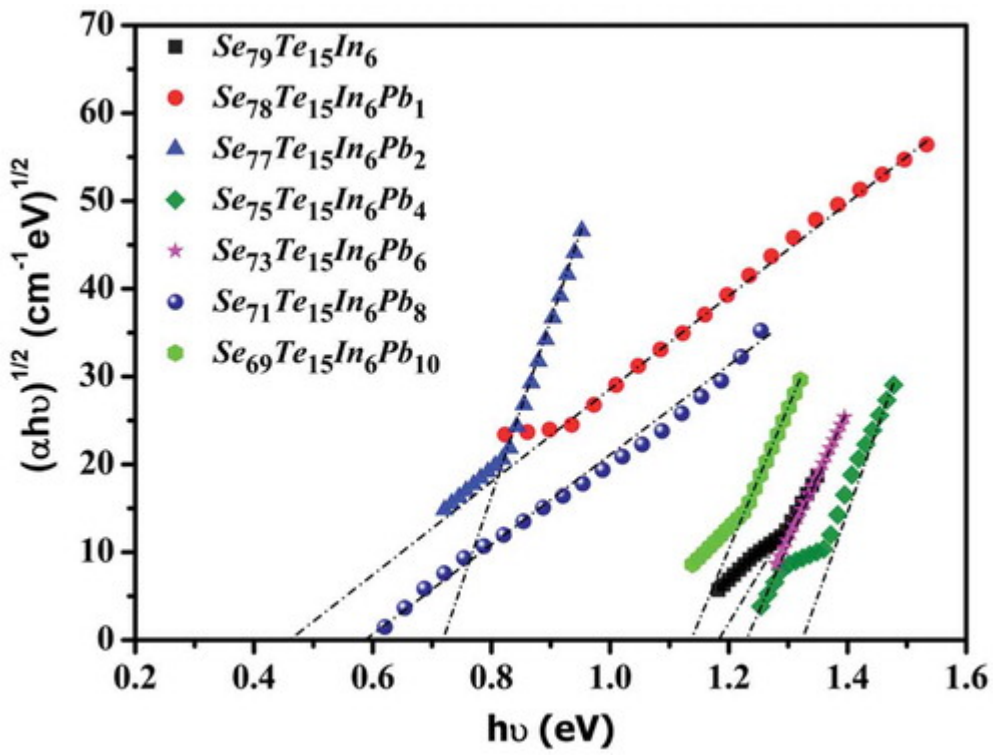
bonds with Pb-Se bonds, which have higher bond energy [6,17].

After that more inclusion of Pb favor the formation of Pb-Pb bonds by reducing Pb-Se bonds concentrations. As Pb-Pb bond have lower bond energy than Pb-Se bonds [17,23], which causes decrement in E_g^{opt} value up to 8 at. wt.% of Pb additive. Consequently, this could be explained owing to increase in crystalline size and presence of large number of defects with Pb incorporation [6,17]. Additionally at higher Pb content (10 at. wt.%), the optical band gap again increases. This again attributes to combine effect of smaller crystalline size of sample, strong confinement and decrease in density of defected states [78]. In addition, such an anomalous behavior is observed by other researchers [6, 17, 41, 46 and 78]. All these observation shows clearly an agreement with the deduced results on variation in band gap, density of defected states [41] as well as average crystalline size from XRD results with Pb content listed in Tables 1, 4, and 5, respectively.

Figure 10. Dependence of $(\alpha h\upsilon)^{1/2}$ on photon energy ($h\upsilon$) for nanocrystalline $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10) chalcogenide thin films.



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The obtained results on E_g^{opt} are in good agreement with the deduced value of activation energy (ΔE_σ) for nanochalcogenide $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8, and 10 at. wt.%) systems in our previous results [41]. As obtained values of ΔE_σ for investigated system is almost half the deduced value of E_g^{opt}, which indicates band-to-band conduction as suggested by Davis and Mott [23] in case of many amorphous semiconductors. On comparing the experimentally deduced values of optical band gap (E_g^{opt}) with theoretically estimated values of energy gap (E_g^{th}), it is concluded that they are slightly consistent with each other in case of

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be understood in term of structural changes, density of localized states, crystallite size as well as chemical disordering owing to Pb addition. Effect of system bond strength and electronegativity is considered for E_g^{opt}. Whereas, the variation in density of localized states, crystallite size, structural changes, and chemical disordering may also contribute to E_g^{opt} with Pb addition in investigated Se-Te-In-Pb nanocrystalline system. As degree of defects and disorder present in the system decides the width of localized states near the mobility edge. Additionally in quantum confinement, band gap become wider due to smaller crystallite size values, which corresponds to shifting of absorption edge to shorter wavelength region due to individual confinement of electron and holes.

4. Conclusions

In this research paper, overall physical properties and submicron structural features have been analyzed for Pb-doped Se-Te-In nanochalcogenide alloys synthesized via melt-quench technique. Nanonature of synthesized samples is analyzed through XRD technique and the average crystalline size estimated from Scherrer's formula for investigated chalcogenide composition found to lie in nanorange between 12.4 and 49.38 nm. Moreover, the surface morphology as well as nanonature of examined compositions are validated by FESEM and HRTEM. The elemental composition of primed samples is analyzed through EDX analysis. EDX analysis reveals that atomic ratio of Se, Te, In, and Pb is consistent with their stoichiomatric ratio within experimental error. Consequently, structural analysis illustrates that pure Se-Te-In nanocrystals are successfully primed through mentioned technique. In theoretical predictions, influence of Pb content on examined composition has been studied with respect to their physical characterization via average coordination number (<*r*>), mean bond energy (<*E*>), cross-linking density (*X*), lone-pair electrons (*L*), fraction of floppy modes (*f*), constraints (N_c), electronegativity (χ), cohesive energy (*CE*), glass transition temperature (T_g), and heat of atomization (H_s). The mean bond energy has been derived from chemical-bond ordering model whereas CBA is utilized for calculating the cohesive energy. T_g is estimated by Tichy-Ticha and Lankhorst approaches. Addition of Pb in Se-Te-In system leads to enhanced N_c, *X*, and <*r*>. However <*E*>, *L*, *f*, χ, *CE*, T_g, and H_s are found to decrease with Pb content. This can be explained in term of replacement of stronger Se-Se bonds with weaker Pb-Se bonds with the increase in Pb content. Also, the size effect of the Pb also contributes to weaken the

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theoretically estimated using Hafy-Hand and Lankford approaches are in consistent with experimental values. The band gap of investigated system has been calculated theoretically by Shimakawa's relation and deduced results are analyzed through cohesive energy, electronegativity along with average single-bond energy. A correlation is established among mean coordination number as well as several deduced physical parameters. The optical absorption phenomena in the examined system seem to be due to allowed indirect transitions with optical band gap energy (E_g^{opt}) found in the range between 0.47 and 1.27 eV.

Disclosure statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Fabrication of thermostable and reusable nanobiocatalyst for dye decolourization by immobilization of lignin peroxidase on graphene oxide functionalized $MnFe_2O_4$ superparamagnetic nanoparticles

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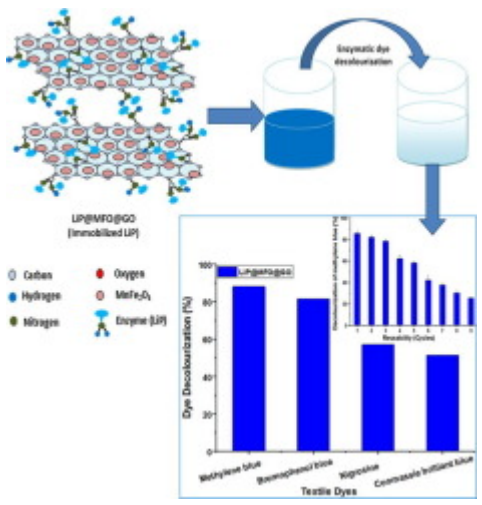
Abstract

In view of the potential applications of immobilized enzymes, partially purified Lignin Peroxidase (LiP) from *Pseudomonas fluorescens* LiP-RL5 was immobilized on Graphene Oxide functionalized $MnFe_2O_4$ nanoparticles (10nm, synthesized by sol-gel auto-combustion) to fabricate a new hyperactive and thermostable nanobiocatalyst and thereafter characterized by using standard techniques. Immobilized LiP was quite stable at 50°C with the half-life of 14h and showed higher tolerance towards various metal ions and solvents than free LiP. Immobilized LiP retained 50% of enzyme activity even after nine consecutive runs. When tested against various textile dyes, the immobilized LiP was found quite effective with higher dye decolourization efficiency (up to 88%) within 1h of incubation at 30°C. The results of this research effort confirmed that the immobilization of LiP and fabrication of nanobiocatalyst increase the efficacy, stability, and reusability of the enzyme which could be efficiently utilized under harsh industrial conditions.

Graphical abstract



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Introduction

Dyes are coloured aromatic organic compounds that contain the chromophore conjugated with the appropriate auxochrome. Chromophores are delocalized electron system with conjugated double bonds (–NO_2, –N═N–, –C═O, –C═N–, –C═C– and quinoid rings), which enable the dye molecules to absorb or reflect the electromagnetic radiations in the visible range (400–700nm), whereas auxochromes are the functional groups with one or more non-bonded pairs of electron (–OH, –SO_3H –COOH and –NH_3) which enhance the color of the dye by altering the overall energy of the electron system when combined with

the appropriate chromophore (Molinari et al., 2004). Based on the chemical structure of the chromophore group, dyes are named as indigoid, anthraquinone, triphenylmethane, azodyes, etc. The extensive use of these coloured synthetic dyes in several industrial processes such as textile, paint, paper, solar cells, sensors, etc. have polluted the water bodies as thus affects human health and aquatic life to a greater extent (Abu Talha et al., 2018). Further, the high toxicity and possible carcinogenicity of these also affect the biological cycles and ecosystem which becomes a major threat to the environment (Iark et al., 2019). Therefore, an effective and efficient strategy for the detoxification and degradation of dyes should be imperative. Many physical (coagulation-flocculation, adsorption, etc.), chemical (photocatalysis, electrochemical destruction, Fenton reagent, etc.) and biological (enzymatic degradation, bio-sorption, etc.) approaches have been proposed for the degradation of textile dyes (Darwesh et al., 2019, Lin and Peng, 1994, Sadri Moghaddam et al., 2010). The use of physico-chemical methods are restricted in the scale of operation due to their high operational cost, limited versatility, intensive energy requirement, high sludge generation, and secondary pollution problem. On the converse, biological treatment which involves the use of micro-organisms and their enzymes is most effective, cost-competitive, less energy intensive, and ecofriendly approach for the treatment of various industrial effluents containing dyes as it converts organic compounds to harmless inorganic compounds like water, ammonia, carbon dioxide, and non-toxic end products in a natural way (Abu Talha et al., 2018).

Various enzymes offer the affordable, effective, and eco-friendly options for the remediation of these toxic industrial dyes. The lignolytic extracellular enzymes (laccase (Lac), manganese peroxidase (MnP), lignin peroxidase (LiP)) secreted by various micro-organisms including white rot fungi, bacteria, and yeasts have been widely studied for this possible use in industrial dye decolourization (Cheng et al., 2007, Iark et al., 2019, Sofia et al., 2016). These enzymes show strong oxidative potential towards the degradation of highly toxic aromatic and phenolic pollutants including dyes (Wong, 2009). However, lignin peroxidase (LiP), belonging to the family of oxidoreductases, is quite different from others in terms of its H_2O_2 dependent catalytic activity towards the substrates without any other mediator (Cai and Tien, 1992). This heme-containing ligninolytic LiP requires H_2O_2 as the electron acceptor in the oxidation of aromatic rings of chromophoric dye by generating the free radicals, which are responsible for the catalytic degradation of phenolic and non-phenolic compounds (Cai and Tien, 1992, Wong, 2009). LiP has been used in many industrial activities such as food, pharmaceutical, pulp, paper, wastewater treatment, biosensors, and cosmetics (Asgher et al., 2014, Wong, 2009). Moreover, for industrial applications of the LiP enzyme, it should be able to withstand and perform under harsh environmental conditions. The use of free enzyme is limited due to low operational stability at elevated temperature, pressure, pH, presence of different organic or inorganic solvents besides other factors (Amirbandeh et al., 2017). In addition, recovery of water soluble free enzyme from the reaction blend is a challenging task which further limits its reusability (Soozanipour et al., 2015). Therefore, the enzyme is required to be fixed to a solid insoluble matrix. Immobilization of enzymes helps to reduce production cost through reusability, improved pH, high catalytic efficiency, thermal stability, and tolerance under harsh operating conditions (Ahmad and Khare, 2018, Defaei et al., 2018). Immobilized enzymes also ensure the purity and quality of final product. The immobilization methods such as physical adsorption, encapsulation, and covalent bonding have been reported for LiP immobilization (Hu et al., 2013, Qiu et al., 2009, Shaheen et al., 2017). The covalent bonding method is preferred over physical adsorption and encapsulation methods as multipoint covalent bonding between the enzyme molecules and the support enhance the stability of enzymes by forming the intermolecular bonds between enzyme molecules and support, and thus prevent the enzyme loss from the support (Bilal and Iqbal, 2019).

Besides other factors, the support matrix plays a major role in improving the efficacy and the utility of enzymes. Immobilization of enzyme molecules on the magnetic core nanoparticles like ferrites provide a mechanism for recovery of expensive catalyst from the reaction blend by applying an external magnetic field. Magnetic ferrite nanoparticles possess excellent atomic and magnetic properties, high surface to volume ratio, biocompatibility, low toxicity, good chemical stability, and ease of synthesis which help in easy biomedical and catalytic reuses (Badoei-dalfard et al., 2019, Hazra and Ghosh, 2014, Kiran, 2020, Xu and Sun, 2013). However, uncoated magnetic nanoparticles get aggregated due to the high surface to volume ratio and dipolar interactions between nanoparticles, which further limits its use for immobilization. Therefore, an appropriate functionalization is required to reduce the surface free energy in order to protect the nanoparticles from aggregation.

Graphene oxide (GO), one of the important functionalization agent, has a large surface area accompanied by numerous reactive contact sites in the form of oxygen functionalities (Wang et al., 2011). Properties such as high water solubility, good biocompatibility, porous nature, and presence of oxygen functionalities make it a most suitable nominee for surface modification of magnetic ferrite nanoparticles (Badoei-dalfard et al., 2019). Graphene oxide functionalization on magnetic nanoparticles not only inhibits aggregation and increases stability, but the presence of these hydrophilic functional groups on GO surface also create more hydrophilic surface for binding of biomolecules. Immobilization of different peroxidases (HRP, MnP, and others) on several insoluble solid matrices using different immobilization techniques has been well reported (Bilal et al., 2019, Hibi et al., 2012). However, reports are comparatively few available on extraction, purification, optimization, immobilization, and applications of LiP extracted from *Pseudomonas fluorescens (P. fluorescens)* LiP-RL5. In this present study, a new kind of matrix i.e. GO functionalized iron-based manganese ferrite ($MnFe_2O_4$) nanoparticles was used for immobilization of partially purified LiP via covalent bonding using glutaraldehyde as a crosslinker to achieve the maximum immobilization yield and improved thermostability. Different

surface energies of the matrix also play an important role in surface interactions between LiP and matrix support. Hence, for further investigation of its practical utility in various industrial applications, immobilized LiP was tested for decolourization/biodegradation of synthetic dyes besides its re-usability in order to reduce the cost and to improve the efficacy.

Section snippets

Strains and chemicals

Previously isolated bacterial isolate *P. fluorescens* LiP-RL5 (Rathour et al., 2020) was used for the production of lignin peroxidase. Chemicals used for various experiments were procured from S.D. Fine-Chem. Ltd., Hyderabad, India, Sigma-Aldrich Chemical Co. St Louis, USA, HIMEDIA Laboratory Ltd., Mumbai, India, and Merck Life Science Pvt. Ltd., Germany. All the reagents used were of high quality, purity, and analytical grade. All the experiments were conducted in triplicates and repeated again …

Effect of metal ions on immobilized LiP

The effect of different inhibitors (Mn^{2+}, Mg^{2+}, K^{+}, NH_4^{+}, Ca^{2+}, Fe^{3+}, Na^{+}, Hg^{2+}, Cd^{2+} and Ag^{2+}) on the catalytic mechanism of free and immobilized biocatalyst was examined by taking 1:2 ratio (v/v) of biocatalyst to selected metal ions (1 mM) and pre-incubated at 30 °C at 150 rpm for 10 min under continuous agitation. After incubation, the activity of immobilized LiP was measured at 595 nm.…

Effect of organic solvents on immobilized LiP

Ideally, enzymes need to proceed the reactions in the presence of different organic or inorganic solvents…

Production of LiP from *P. fluorescens* LiP-RL5

Bacterial isolate *P. fluorescens* LiP-RL5 was used to produce lignin peroxidase (LiP) as described earlier in Section 2.2. The enzyme assay when performed with crude enzyme, resulted in 15.2 U/mL enzyme activity. Yang et al. (2018) also used *Pseudomonas* Q18 for production of lignin peroxidase which was later used for biodegradation of lignin.…

Partial purification of LiP

Lignin peroxidase was partially purified using ammonium sulfate salting-out method followed by dialysis as described earlier in Section 2.3. The enzyme…

Conclusion

Immobilization of Lignin Peroxidase (LiP) from *P. fluorescens* LiP-RL5 on MFO@GO magnetic nanoparticles was successfully confirmed by FTIR, RAMAN, and AFM spectroscopy. Immobilized LiP exhibited higher thermal stability, reusability till nine cycles, higher tolerance towards tested metal ions and solvents in comparison to free enzyme. Immobilized LiP also exhibited great potential for textile dye biodegradation with high decolourization efficiency and better recovery, and reusability up to nine…

CRediT authorship contribution statement

Kiran: Methodology, Investigation, Formal Analysis, Writing - original draft. **Ranju Kumari Rathour:** Methodology, Investigation, Formal Analysis, Writing - original draft. **Ravi Kant Bhatia:** Writing – Review & Editing. **Dilbag Singh Rana:** Writing – Review & Editing. **Arvind Kumar Bhatt:** Conceptualization, Supervision, Validation, Writing – Review & Editing. **Nagesh Thakur:** Conceptualization, Supervision, Validation, Writing – Review & Editing.…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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2023, Process Biochemistry

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2023, Journal of Hazardous Materials

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> ...The decline in Vmax could be probably ascribed to the large contact of laccase with the surface of Fe3O4@NaBC@GA and the interaction of functional groups results in the ABTS molecule having limited access to the laccase activity sites (Rouhani et al., 2018). Km was often used to indicate the affinity between enzymes and substrate (Isanapong et al., 2021; Kiran et al., 2020). The significant increase in the value of Km reveals that the affinity of laccase to ABTS was weakened which could be considered as that lower structural flexibility after laccase immobilization reduced mass transfer resistance (Isanapong et al., 2021)....

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> ...Before measuring the device under test, the VNA was calibrated using the Short-Open-Load-Through (SOLT) standard calibration kit (Keysight 85054B, 50 Ω type N connectors) to remove the errors caused by the reflection loss, phase difference introduced by the leads, transmission loss, directivity, source match, load match, crosstalk, etc. The X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, Raman spectroscopy, high-resolution transmission electron microscope (HRTEM), and magnetic hysteresis results for the prepared samples have been reported in our previous studies [22,23]. The crystallite size for MFO, MFO@GO, and MFO@rGO has been reported to be 10.20 nm, 10.30 nm, and 11.65 nm, respectively....

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On the crystallization kinetics of multicomponent nano-chalcogenide $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) alloys

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Abstract

Nanotechnology continuously rises due to its potential applications. To control nano-materials design and microstructure, it is very essential to understand nucleation and crystalline growth in these materials. In this research contribution, crystallization kinetics and thermal behaviour of nano-crystalline $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10 at. wt%) chalcogenide alloys is analyzed through differential scanning calorimetry (DSC) process under non-isothermal conditions at four different heating rates; 5, 10, 15 and 20 °C min^{-1}. The examined Se-Te-In-Pb nano-chalcogenide system is prepared through melt-quenching process. Characteristic temperatures namely glass transition temperature (T_g), onset crystallization temperature (To), peak temperature of crystallization (T_p) and melting temperature (T_m) show dependence on heating rate and composition. The various kinetic parameters such as activation energy of glass transition (E_g), activation energy of crystallization (E_c), reduced glass transition temperature (T_{rg}), Hruby number (K_{gl}), thermal stability parameters (S and H') and fragility index (F_i) are analyzed for investigated Se-Te-In-Pb nano-crystalline system. Different empirical approaches are applied to determine the apparent glass transition activation energy (E_g) and crystallization activation energy (E_c).

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1. Introduction

The advancement in characterization and visualization techniques opens up a new window in materials science for control synthesis of materials at nano-level. The nanostructure configurations are progressively attracting huge attention not only for basic research point of view but for their unique properties; electronic, optical, large surface-to-volume ratio etc as compared to bulk systems [1, 2]. Nanostructure synthesis has been analyzed for several materials and interest has been developed in nano-crystalline Pb-chalcogenide semiconductors because of size tuneable properties occurring due to quantum confinement [3, 4]. They have potential applications as solar conversion devices, photo-sensors, and detectors of infrared radiation, photo resistors, photo detectors, nonlinear optical devices, thermo-electric devices, lasers, infrared emitters and solar control coatings [5–7].

A lot of research is focused on fundamental issues of these metal-containing nano-crystalline materials due to their unusual properties, including chemical durability, anomalous order of band-gaps, large dielectric constant, high carrier mobility, low phonon energy, extended IR transparency, large photo sensitivity, special nonlinear optical properties and high thermal stability [2, 8–14]. The multi-component chalcogenide nano-crystals proposed excessive assistance of having tuneable electronic, optical, defect and structural properties which facilitate photovoltaic characteristics [12]. All these fascinating, attractive and unique properties of Pb additive nano-structured semiconductors have prompted scientists to explore fundamental properties of these systems and there is a lot of scope for studying these materials in nano-range.

Chalcogenide, mostly Se-based alloys have been tremendously used in synthesis of various nano-tubes, nano-wire and nano-particles [15, 16]. Although, for technological appliances, these Se based system have limited reversibility and found to be thermally unstable [2]. Among these glasses, binary Se-Te system has gained superiority over pure amorphous Se due to their different parameters like higher crystallization temperature, higher conductivity, greater hardness, smaller ageing effect and higher sensitivity [17]. But, for practical applications these Se-Te alloys must be thermally stable with temperature and time during use. Thermal instability leads to crystallization is one of limitation of these chalcogenides systems [18]. However, addition of dopant is most efficient technique for fabricating new alloys having improved properties [19, 20]. The insertion of indium in Se-Te glassy system produces thermally stable system, thus, increases the crystallization temperature and glass transition temperature by getting cross linked structure and creating configurational and compositional disorder [21, 22]. Fundamental interest in multi-component quaternary chalcogenide alloys has been revived due to observation of quick reversible laser-induced amorphous to crystalline and crystalline to amorphous phase transitions [2]. In device fabrication, optical gap and lattice perfection plays an important role to enhance the proficiency; which depends on insertion of dopant like Pb. In certain chalcogenide systems, addition of element like Pb will cause *p* to *n* transition by limiting molecular mobility, connecting neighbouring chains and enhancing valance alteration pair (VAP) type defects [2, 17]. Pb addition to Se-based system; enhances glass forming ability, reduces aging effect and produces thermally stable system by affecting their bonding network. Pb doping prominently impacts its structural, physical, optical, electronic and thermal properties [23, 24]. All these eminent features of Pb make it attractive among the doping element in case of chalcogenide semiconductors. Our previous work on ternary Se-Te-In composition illustrates that $Se_{79}Te_{15}In_6$ has higher thermal stability among investigated alloys [18, 21]. Furthermore, our earlier analysis on dielectric and *AC* conductivity measurement in Se-Te-Pb system signifies considerable influence of Pb doping on conduction mechanism [2, 17]. Recently, intermediate phases are observed in chalcogenide glasses; which correspond to a glassy composition having an ideal stress free network and whose glass-forming tendency is optimized [25, 26].

In nano-scale devices fabrication, the synthesis of nano-structured materials by economic and simple methods becomes an importance issue. To synthesize mono-disperse, high quality, tuneable size and shape nano-crystals; it is very essential to understand the nucleation and crystalline growth in these materials [13, 14]. The crystallization kinetics of nano-chalcogenide systems plays an important role in analyzing the thermal stability, transport mechanisms, glass forming ability and thus eventually to determine the suitable range of operating temperature for a specific technological application before crystallization takes place [27].

In present research paper, the effect of Pb additive has been analyzed in term of amorphous-crystallization transformation, thermal stability, glass transition, glass forming ability of nano-chalcogenide $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10 at. wt%) alloys using DSC technique under non-isothermal conditions at four heating rates viz 5, 10, 15 and 20 °C min^{-1}.

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2. Experimental details

Nano-chalcogenide $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10 at. wt%) alloys were synthesized with melt quenching process. Pure (99.999%) elements as per at.wt% are pondered with accuracy 10^{-4} g and sealed in (length ~5 cm, diameter ~12 mm) quartz ampoule under a vacuum ~2×10^{-5} mbar. Heating of sealed ampoules is done for 10 h at 3–4 °Cmin^{-1} heating rate up to 900 °C. Ampoules were frequently rocked for making melt homogenous at maximum temperature. The molten ampoule is quenched in ice cooled water. Deduced samples were grind into a fine powder

Structural characterization is performed at room temperature by taking X-ray diffraction of investigated composition. The analysis of intense characteristics peaks in X-ray pattern illustrates nano-nature of studied composition further confirmed by field emission scanning electron microscope [2, 13].

The thermal behaviour of examined composition is analyzed through temperature modulated differential scanning calorimeter (TA instrument, DSC 2910). The precision of heat flow is ±0.01 mW and precision of temperature is ±0.1 °C as deduced by microprocessor of thermal analyzer. A standard aluminium pan has been used to encapsulate a sample of around 3−5 mg at a flow of 40 ml min^{-1} under dry nitrogen atmosphere. Samples are reheated at heating rates of 5, 10, 15 and 20 °C min^{-1}. Characteristic temperatures; glass transition temperature (T_g), peak temperature of crystallization (Tp) and melting temperature (T_m) are deduced with microprocessor of thermal analyzer. In case of activation energies and other kinetic parameters, least-squares fitting technique is used to determine best fit of results.

3. Results and discussion

A typical DSC thermogram of $Se_{78}Te_{15}In_6Pb_1$ nano-chalcogenide alloy at four heating rates is given in figure 1. DSC thermogram of examined Se-Te-In-Pb nano-chalcogenide system at heating rate of 15 °C min^{-1} is given in figure 2. DSC thermogram can be resolved into three main regions. The first region characterized by first endothermic peak is glass transition region, that's arising due to rapid enhancement in specific heat of sample. The peak value of first endotherm is denoted as T_g. The second region corresponds to exothermic peak specified by crystallization process. The onset of crystallization is indicated by T_o i.e. the temperature where crystallization just starts and T_p represents peak temperature of crystallization. The third region is designated as melting temperature associated with second endothermic peak. Herein T_m corresponds to peak value of melting endotherm. It is observed that with enhancing heating rate, T_g and Tp of examined composition shift towards higher temperatures. The increase in T_g with heating rate may be attributed to relaxation dynamics in the glass transition period. T_g is the temperature at which relaxation time is equivalent to relaxation time of observation and T_g varies inversely with relaxation time [21]. Consequently when heating rate raises, T_g increase owing to reduction in relaxation time of observation. Samples primed by cooling from molten state (very high rate of cooling); associated with new degree of freedom or configuration energy states. In calorimetric analysis, samples are reheated with different heating rates, which is not similar to cooling rates during preparation. So larger is the difference, more is the structural dissimilarity among reheated solid and glass. The glassy material has 'longer' tendency to remain in glassy state if reheating rate is faster; which corresponds to a higher T_g [28]. Tp is found to shift towards higher temperature with heating rate. This can be explained as due to high heating rate system doesn't have enough time for crystallization and nucleation; which cause shifting towards higher temperature [29]. The values of T_g, T_o, Tp and T_m at all heating rates are determined for each examined alloy. The outcomes show that 1 at.wt% Pb alloy has a higher T_p. An alloy with higher Tp value has maximum operation temperature, consequently increases the archival life time [30]. Therefore, 1 at.wt% Pb system have higher value of crystallization temperature, which attributes to a single phase homogeneous morphology as confirm from DSC [30]. It is found that 10 at.wt%Pb alloy has a lower T_m value. As lower value of melting temperature reduces the RESET current and this material is advantageous in phase change random access memory (PCRAM) devices [30].

Figure 1. DSC thermograms of chalcogenide $Se_{78}Te_{15}In_6Pb_1$ glass at different heating rates.

Figure 2. DSC thermograms of the nano-chalcogenide $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) multi-component alloys at 15 °C min^{-1} heating rate.

3.1. Glass transition activation energy

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T_g reveals information about rigidity and strength of glassy network [31]. The glass transition region has been analyzed in terms of glass transition activation energy (E_g) and variation of T_g with heating rate. Lasocka suggested empirical relation [31] which relates T_g with heating rate as given below:

where A and B are constants depending on glassy system and α signifies heating rate. A denotes glass transition temperature at 1 $Kmin^{-1}$ heating rate and within glass transition region, the time response of configurational changes with heating rate is determine by B. T_g variation with $\ln(\alpha)$ is shown in figure 3 for investigated $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) nano-chalcogenide alloys. According to equation (1), plot among $\ln(\alpha)$ versus T_g should be straight line and holds true for investigated chalcogenide system. The constant A and B are deduced from intercept and slope of T_g versus $\ln(\alpha)$ plot respectively and tabulated in table 1. As cooling rate of melt is connected with constant B; so lesser is the value of B, lower is cooling rate of melt. Consequently, physical significance of B lies in configurational modification in glass transformation region [32]. As for studied nano-chalcogenide materials the values of B (given in table 1) are different; which illustrates that investigated systems undergoes different structural changes.

Figure 3. Plots of T_g versus $\ln(\alpha)$ for glassy $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) nano-crystalline compositions.

Table 1. Kinetic parameters (A and B) and activation energy of the glass transition (E_g) for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10 at. wt%) multi-component chalcogenide alloys.

			E_g (kJ mol^{-1})	
Composition	A (K)	B(min)	Kissinger equation	Moynihan approximation
$Se_{79}Te_{15}In_6$	335.67 ± 4.32	4.92 ± 1.75	154.71 ± 6.89	160.46 ± 6.89
$Se_{78}Te_{15}In_6Pb_1$	330.51 ± 1.33	4.59 ± 0.54	198.74 ± 2.92	204.40 ± 2.92
$Se_{77}Te_{15}In_6Pb_2$	329.08 ± 2.46	5.34 ± 0.99	164.17 ± 3.78	169.85 ± 3.77
$Se_{75}Te_{15}In_6Pb_4$	329.59 ± 0.38	5.43 ± 0.15	173.23 ± 0.52	178.91 ± 0.52
$Se_{73}Te_{15}In_6Pb_6$	309.45 ± 6.97	12.72 ± 2.83	61.53 ± 1.85	67.12 ± 1.85
$Se_{71}Te_{15}In_6Pb_8$	329.88 ± 0.81	5.32 ± 0.33	176.15 ± 1.26	181.84 ± 1.25
$Se_{69}Te_{15}In_6Pb_{10}$	332.57 ± 2.48	6.37 ± 1.01	144.42 ± 2.81	150.20 ± 2.81

In second approach, the apparent E_g for investigated composition has been determined using Kissinger's equation [33, 34]. As in crystallization process the activation energy is most offend determined by Kissinger equation. However it is indicated [35] that same equation can be utilized for evaluation of E_g, which is written as [32]:

where R is universal gas constant. Apparent value of E_g is calculated from slope of $\ln(\alpha/)$ with $1/T_g$ plot (figure 4). The deduced values of E_g for examined system are given in table 1. In addition, when alteration in $1/$ against $\ln(\alpha)$ is so slower as compare to alteration of $1/T_g$ versus $\ln(\alpha)$; E_g can be more simplified and estimated by Moynihan *et al* [36] formulation. Moynihan and co-workers [37, 38] use the theory of structural relaxation for evaluating E_g through heating rate dependence of T_g, which is deduced by relation:

Slope of $\ln(\alpha)$ with $1/T_g$ plot gives E_g and the calculated values of E_g are listed in table 1. For the investigated nano-systems the $\ln(\alpha)$ variation against $1000/T_g$ is shown in figure 5.

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Figure 4. Plot of ln(α/) as a function of 1000/T_g for glassy $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) alloys.

Figure 5. Plot of ln(α) versus 1000/T_g for various nano-crystalline $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) chalcogenide glasses.

E_g depends on T_g, α and rearrangement of atoms around T_g along with molecular motion. In glassy region, E_g signifies amount of energy that required by group of atoms to jump from one metastable state to another [32]. This means E_g is responsible for rearrangement and molecular motion of atoms in region of T_g [39]. So, atom having minimum E_g value has larger probability to occupy lower internal energy metastable state, which is a most stable state. Moreover outcome shows that $Se_{73}Te_{15}In_6Pb_6$ alloy have minimum value of E_g. Consequently this composition is the most stable among the investigated alloys. It is observed that values of E_g estimated by Moynihan's relation as well as Kissinger's equation are in good agreement with each other. This indicates that in the glass transition region either of two relations can be used to calculate E_g.

3.2. Crystallization activation energy

In amorphous materials, nucleation and growth process are responsible to control amorphous-crystallization (a-c) transformation mechanism, which are illustrated through activation energy and dimensionality of growth process. In glassy alloys, DSC is best technique for quantitative analysis of crystallization kinetics. As pointed out in literature [18], the three activation energies has been involved in crystallization process: (a) nucleation activation energy, (b) growth activation energy and (c) whole crystallization process activation energy. Additionally, when activation energy for growth is deduced through thermal analysis, then it can be taken equal to activation energy for whole crystallization as mentioned in different works [15, 33, 40, 41]. The activation energy for a-c transformation (E_c) is evaluated by analyzing DSC thermograms of investigated system. E_c has been evaluated from Kissinger's equation, which gives T_p variation with heating rate (α) as below [34, 36]:

where E_c signifies activation energy of crystallization. ln(α/) plots against 1/T_p are shown in figure 6. Slope of the graph among ln(α/) with 1/T_p gives value of apparent E_c and values are listed in table 2. If (I/) variation with ln(α) is very small as compared to (1/T_p) variation; Mahadevan *et al* [40] have approximate equation (4) in the following form:

Figure 6. Plots of ln(α/) against 1000/T_p for glassy $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) chalcogenide system.

Table 2. The crystallization activation energy (E_c) for glassy $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10 at. wt%) nano-crystalline composition deduced using different methods.

	Kissinger's method	Mahadevan et al	Augis and Bennett method			Augis and Bennett Approximation
Composition	E_c (kJ mol^{-1})	E_c (kJ mol^{-1})	E_c (kJ mol^{-1})	ln(K_o)	K_o (min^{-1})	E_c (kJ mol^{-1})
$Se_{79}Te_{15}In_6$	194.16 ± 8.51	200.16 ± 8.51	179.20 ± 9.84	54.09 ± 25.19	3.10×10^{23}	203.60 ± 9.27
$Se_{78}Te_{15}In_6Pb_1$	117.27 ± 0.93	123.78 ± 0.93	111.13 ± 0.94	33.37 ± 2.41	3.10×10^{14}	119.84 ± 2.57
$Se_{77}Te_{15}In_6Pb_2$	97.34 ± 0.21	103.72 ± 0.21	81.81 ± 0.95	25.07 ± 2.47	7.73×10^{10}	120.52 ± 0.92
$Se_{75}Te_{15}In_6Pb_4$	110.45 ± 0.74	116.88 ± 0.74	96.13 ± 1.08	28.96 ± 2.79	3.76×10^{12}	113.66 ± 0.74
$Se_{73}Te_{15}In_6Pb_6$	296.47 ± 7.94	302.81 ± 7.94	410.73 ± 11.25	129.45 ± 29.50	1.66×10^{56}	299.64 ± 7.94
$Se_{71}Te_{15}In_6Pb_8$	116.93 ± 0.38	123.25 ± 0.37	83.90 ± 0.88	26.01 ± 2.30	1.98×10^{11}	120.00 ± 0.38

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	Kissinger's method	Mahadevan et al	Augis and Bennett method			Augis and Bennett Approximation
Composition	E_c (kJ mol^{-1})	E_c (kJ mol^{-1})	E_c (kJ mol^{-1})	ln(K_o)	K_o (min^{-1})	E_c (kJ mol^{-1})
$Se_{69}Te_{15}In_6Pb_{10}$	116.45 ± 2.55	122.87 ± 6.52	101.73 ± 2.86	30.76 ± 7.40	1.07×10^{16}	119.66 ± 2.52

The ln(α) against $1/T_p$ plot should yield straight line as indicated in figure 7. E_c can be computed from the slope of plot and deduced values are tabulated in table 2.

Figure 7. Plots of ln(α) as a function of $1000/T_p$ for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) chalcogenide alloys.

The E_c and frequency factor (K_o) can determine through Augis and Bennett method [42]:

where K_o denotes frequency factor. Frequency factor indicates probability of molecular collision which is effective for formation of activated complex as well as description of phase transformation. Slope of this function determine through fitting of data, calculated E_c given in table 2. K_o is estimated from intercept of plot ln($\alpha/(T_p—T_o)$) versus $1/T_p$ (figure 8) and given in table 2. From the outcomes, it is analyzed that K_o is maximum for 6 at.wt% of Pb, which implies that $Se_{73}Te_{15}In_6Pb_6$ glass has maximum resistance to crystallization. Additionally, if $T_p \gg T_o$, then above equation reduces to the following relation [43]:

Plot of ln(α/T_p) with $1/T_p$ should be straight line, as revealed in figure 9. Slope of these plots provides approximated value of crystallization activation energy; listed in table 2.

Figure 8. Plots of ln($\alpha/(T_p—T_o)$ versus $1000/T_p$ for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) nano-crystalline multi-component glasses.

Figure 9. Variation of ln(α/T_p) with $1000/T_p$ for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) multi-component glassy alloys.

Thermal analysis is used to deduce E_c, which is assumed to be sum of crystal growth activation energy (E_G) and nucleation activation energy (E_N) [28]. In non-isothermal process, crystallization exotherm describes growth of crystalline phase from amorphous matrix owing to huge discrepancies in latent heats of nucleation and growth along with rapid increase in temperature. Also at temperature below crystallization exotherm nucleation calorimetrically is unobservable [28]. Therefore, in examined system deduced E_c values can be represent by E_G. E_c values obtained from above mentioned route are summarized in table 2 for the investigated samples. However, there is a slight variation in value of E_c deduced from different routes. This variation may be arising due to various assumptions taken during their formulations. On comparing E_c deduced values through different empirical routes; it is concluded that either of these formulations can be utilized to realize E_c value along with distinct precisions.

3.3. The ease of glass formation

In nano-chalcogenide materials analysis thermal stability and glass forming ability are fundamental issues, as these informations are essential to determine utility of investigating system as recording materials. Erasing and phase change optical recording processes are basically depends on laser induced thermal amorphization as well as crystallization of chalcogenide systems [32]. However thermal stability of glass is significant from technical point of view. The 'two-third' rule is excellent relationship proposed by Kauzmann [44]; which use reduced glass transition

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temperature (T_{rg}) to determine glass forming ability (i.e. $T_{rg} \geq 2/3$). T_{rg} provide information regarding ease of glass formation as [44]:

At all heating rates, '2/3' rule fits good for studied nano-chalcogenide materials (table 3). The deduced T_{rg} values are in 2/3order, demonstrating that glass forming ability (*GFA*) of each investigated nano-material is high.

Table 3. Values of parameters T_{rg} and $(T_p - T_g)$ for various nano-crystalline $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10 at. wt%) chalcogenid glasses at 5, 10, 15 and 20 °C min^{-1} heating rates.

	T_{rg}				$(T_p - T_g)$(K)			
Composition	5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}	5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}
$Se_{79}Te_{15}In_6$	0.6543	0.6609	0.6595	0.6595	43.7918	43.3513	44.1775	43.2169
$Se_{78}Te_{15}In_6Pb_1$	0.6468	0.6526	0.6552	0.6539	46.9289	49.2895	52.0326	55.0019
$Se_{77}Te_{15}In_6Pb_2$	0.6453	0.6510	0.6536	0.6574	38.1033	43.9772	44.6337	47.6016
$Se_{75}Te_{15}In_6Pb_4$	0.6465	0.6513	0.6555	0.6577	41.4443	45.5750	46.5010	49.0139
$Se_{73}Te_{15}In_6Pb_6$	0.6281	0.6527	0.6543	0.6591	50.7717	38.4370	38.6866	38.2523
$Se_{71}Te_{15}In_6Pb_8$	0.6488	0.6539	0.6568	0.6602	34.7882	37.8187	39.6681	40.8682
$Se_{69}Te_{15}In_6Pb_{10}$	0.6430	0.6452	0.6524	0.6555	36.4482	37.3982	39.7145	40.7024

The distortion in local atomic configuration in amorphous chalcogenides causes changes in various kinds of photo-induced structural or photo-chemical and memory switching properties. Hence in these materials such structural transformation come from boundaries where glasses are stable; and have tendency to crystallize when heated or cooled slowly [27]. So in memory and switching materials, it is important to mention thermal stability and GFA. When physical conditions rapidly varies due to heating effect, thermal stability is an important parameter [27]. For example, In optical recording situation; amorphous state at low temperature as well as having small crystallization time. This reveals that a phenomenon of phase transformation occurring rapidly in these glassy alloys [27, 45]. Additionally, the difference among T_p and T_g indicates thermal stability as well as *GFA* of glass against crystallization. As higher values of (T_p—T_g) correspond to higher thermal stability and *GFA*; signify a delay in nucleation procedure and kinetic resistance to crystallization. However smaller value of (T_m—T_p) reveals retardation in growth procedure [32, 39]. The deduced (T_p—T_g) values for all nano-crystalline system at various heating rates are tabulated in table 3. In Se-Te-In-Pb nano-chalcogenide system it is fascinating to observed that the (T_p—T_g) values are maximum for Pb = 1 at. wt%. This means that glass with 1 at. wt% of Pb is thermally more stable, lesser tendency to crystallization and maximum GFA in studied system. Also Hruby [46] has given a parameter K_{gl} to determine the *GFA* which is given as:

By this relation, Hruby correlate nucleation with growth aspect of phase transformation. For investigated compositions K_{gl} values at various heating rates are calculated (listed in table 4). It is stated that for $K_{gl} \leq 0.1$, a good glass forming ability has not been obtained [47]. It is clearly observed from table 4 that $K_{gl} > 0.1$, for investigated chalcogenide system; indicates good glass forming ability.

Table 4. Calculated values of Hurby number (K_{gl}), thermal stability parameters (S and H') for various glassy alloys at different heating rates.

	GFA (K_{gl})				H'				Stability factor (S)			
Composition	5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}	5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}	5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}
$Se_{79}Te_{15}In_6$	0.3199	0.3200	0.3254	0.3159	0.0399	0.0263	0.0229	0.0287	1.2028	0.8980	0.8289	0.9540
$Se_{78}Te_{15}In_6Pb_1$	0.3413	0.3724	0.4042	0.4333	0.0775	0.0800	0.0851	0.0900	1.6086	1.7600	1.9402	2.1658
$Se_{77}Te_{15}In_6Pb_2$	0.2580	0.3175	0.3235	0.3605	0.0697	0.0748	0.0791	0.0790	1.0137	1.3850	1.3747	1.6086
$Se_{75}Te_{15}In_6Pb_4$	0.2885	0.3315	0.3458	0.3742	0.0583	0.0571	0.0596	0.0604	1.2660	1.4873	1.5484	1.6985

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	GFA (K_{gl})				H'				Stability factor (S)			
Composition	5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}	5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}	5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}
$Se_{73}Te_{15}In_6Pb_6$	0.3535	0.2680	0.2698	0.2724	0.0784	0.0402	0.0535	0.0557	1.9631	0.9932	1.0833	1.0590
$Se_{71}Te_{15}In_6Pb_8$	0.2342	0.2643	0.2831	0.2976	0.0629	0.0560	0.0607	0.0556	0.8484	1.0458	1.1402	1.2023
$Se_{69}Te_{15}In_6Pb_{10}$	0.2365	0.2446	0.2702	0.2823	0.0335	0.0352	0.0322	0.0273	0.8359	0.8882	0.9150	0.8498

Saad and Poulain [48] have described two parameters for determining thermal stability of system, which is expressed by the following relations [32]:

Thermal stability parameter illustrates resistance to devitrification after glass formation. In equation (11) rate of devitrification transformation is related to term (T_p—T_o). The H' and S parameters are deduced (table 4). It is detected from table 4 that 1 at. wt% of Pb have highest values of H' and S; which demonstrates that nano-crystalline $Se_{78}Te_{15}In_6Pb_1$ alloy is thermally more stable than other alloys of this series. Moreover for Pb additive Se-Te-In nano-system dependence of thermal stability parameters (T_{rg}, K_{gl}, H' and S) on heating rates are shown in figure 10, which depends on characteristic temperatures (T_g, T_o, T_p and T_m). Figure 10 shows a linear dependence of T_{rg}, K_{gl}, H' and S on ln(α), which reveals enhancement in thermal stability with heating rates.

Figure 10. Dependence of thermal stability parameters (T_{rg}, K_{gl}, H' and S)) on lnα for $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) glassy alloys.

The empirical parameters which are evaluated above have been mostly use for quantitative characterization of glass formation. As there is no standard criteria for parameterize glass formation. For measuring *GFA* of glassy system, fragility index (F_i) is a significant parameter. F_i signify rate through which relaxation time reduces with temperature raising around T_g. F_i is calculated through the following relationship [49, 50]:

It is stated by Viglis that [51] glass-forming liquids that's reveal approximate dependence on Arrhenius temperature are characterized as strong glass-forming liquids. These liquids have low value of F_i ($F_i \approx 16$), where as high value of F_i ($F_i \approx 200$) signifies limit of fragile glass forming liquid [21]. Consequently in categorization of glass-formation upon viscosities [28], it concludes that strong glass-forming liquids reveal an Arrhenius temperature dependence on viscosity. Whereas fragile glass-forming liquids show non-Arrhenius behavior. For examined compositions at various heating rates, F_i is calculated by using value of E_g deduced from Kissinger's formula and Moynihan approximation and are listed in table 5. As all F_i values are within above-mention limit, so investigated nano $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10) chalcogenide system are primed from strong glass-forming liquid. However, F_i decreases with heating rate and this can be explained through increase in T_g with heating rate.

Table 5. Fragility index (F) for glassy $Se_{79-x}Te_{15}In_6Pb_x$ (x = 0, 1, 2, 4, 6, 8 and 10 at. wt%) nano-crystalline composition at 5, 10, 15 and 20 °C min^{-1} heating rates.

		Fragility index (F)			
Composition		5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}
$Se_{79}Te_{15}In_6$	Kissinger equation	33.82	23.19	19.72	17.82
	Moynihan approximation	35.07	24.05	20.45	18.48
$Se_{78}Te_{15}In_6Pb_1$	Kissinger equation	43.98	30.43	25.69	23.21
	Moynihan approximation	45.23	31.30	26.43	23.87

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		Fragility index (F)			
Composition		5 K min^{-1}	10 K min^{-1}	15 K min^{-1}	20 K min^{-1}
$Se_{77}Te_{15}In_6Pb_2$	Kissinger equation	36.30	25.20	21.16	19.12
	Moynihan approximation	37.56	26.07	21.90	19.78
$Se_{75}Te_{15}In_6Pb_4$	Kissinger equation	38.26	26.47	22.35	20.11
	Moynihan approximation	39.51	27.33	23.08	20.76
$Se_{73}Te_{15}In_6Pb_6$	Kissinger equation	14.01	9.40	7.93	7.15
	Moynihan approximation	15.28	10.26	8.65	7.80
$Se_{71}Te_{15}In_6Pb_8$	Kissinger equation	38.88	26.92	22.79	20.43
	Moynihan approximation	40.13	27.79	23.47	21.09
$Se_{69}Te_{15}In_6Pb_{10}$	Kissinger equation	31.44	21.80	18.30	16.48
	Moynihan approximation	32.70	22.68	19.04	17.14

4. Conclusions

In present research paper, the crystallization kinetics analysis has been performed for Pb additive Se-Te-In nano-chalcogenide system through DSC under non-isothermal conditions at four heating rates 5, 10, 15 and 20 °Cmin^{-1}. The examined nano-chalcogenide system is prepared via melt-quench process. The kinetic parameters, namely activation energy for glass transition (E_g), activation energy for crystallization (E_c), reduced glass transition temperature (T_{rg}), Hruby's parameter (K_{gl}), thermal stability parameters (S and H') and fragility index (F_i) are deduced from heating rate dependence of T_p and T_g. It is analyzed that value of E_g calculated from Moynihan's as well as Kissinger's approaches are consistent. The outcome shows that nano-crystalline $Se_{78}Te_{15}In_6Pb_1$ alloy has a higher T_p value among the examined system; which indicates that this composition has maximum operation temperature, archival life time and attributes to a single phase homogeneous morphology. Also it is observed that 10 at. wt% Pb alloy has a lower T_m value; which reduces the RESET current and may be useful in memory device. Additionally, the values of E_c deduced by different approach are in good agreement with each other. The K_o is maximum for 6 at. wt% of Pb, which indicates that $Se_{73}Te_{15}In_6Pb_6$ nano-crystalline system have maximum resistance to crystallization. Moreover 2/3 rule holds good for nano-crystalline Se-Te-In-Pb chalcogenide system; signifies good glass forming ability of investigated systems. Also (T_p—T_g) is maximum for Pb = 1 at. wt% ; illustrating maximum thermal stability in analyzed compositions. K_{gl}, S and H' are also maximum for 1 at. wt% of Pb. Consequently, the deduced result shows that nano-crystalline $Se_{78}Te_{15}In_6Pb_1$ system has better glass-forming ability than other composition under examination. Moreover the value of F_i indicates that investigated system is obtained from strong glass forming liquids.

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Abstract

In this paper, silver-doped zinc oxide nanoparticles were synthesized by using a solution combustion technique, in which zinc nitrate is used as an oxidizer and tartaric acid as a fuel. The phase composition, morphology and structural properties of the as-synthesized zinc oxide and silver-doped zinc oxide were established by using powdered X-ray diffraction, field emission scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy, and X-ray photoelectron spectroscopy studies. Due to well-defined morphologies and crystallinity, the pure zinc oxide and silver-doped zinc oxide nanostructures can be used as efficient chemical sensors for the detection of p-nitrophenol (PNP). ZnO was found to show a low value of the limit of detection (LOD), i.e., 2.175 μM/L, for p-nitrophenol sensing; moreover, a sharp decrease in the limit of detection was observed with an increase in the concentration of silver ions, and the LOD value decreased to 0.669 μM/L for 10 mol % silver-doped zinc oxide. It is therefore concluded that Ag-doped ZnO shows a lower limit of detection as compared to pure ZnO for p-nitrophenol sensing.

Keywords: Ag-doped ZnO (/search?q=Ag-doped+ZnO); **solution combustion (/search?q=solution+combustion)**; **luminescence (/search?q=luminescence)**; **p-nitrophenol sensing (/search?q=p-nitrophenol+sensing)**

1. Introduction

Rapid industrialization and various anthropogenic activities have led to the discharge of various types of toxic chemicals, which contaminate the environment and adversely affect the ecosystem. Among various toxic chemicals, the nitrophenols and organic dyes are the most emerging environmental pollutants. In particular, p-nitrophenol (PNP) is commercially very useful and finds application in various fields such as use as an intermediate in the synthesis of paracetamol and an important base material for the synthesis of commonly used pesticides such as acetophenetidine; it also plays an important role in the leather industry, etc. [**1**,**2**,**3**]. The release of PNP into the environment takes place through a number of ways, such as release as a side product of many pharmaceutical industries, the disintegration of other pesticides and the transformation of phenol into nitrophenol molecules. PNP is very stable in the environment under normal conditions and is a highly toxic chemical that leads to bioaccumulation as well as cytotoxic/carcinogenic effects on living organisms [**4**,**5**]; due to all these reasons, the United States Environmental Protection Agency (USEPA) has considered PNP as a priority contaminant [**6**]. PNP is considered as the root cause of different problems such as irritation and inflammation in the eyes and nose, respiratory tract disorders, cardiac disorders, hematological problems, digestive problems, musculoskeletal issues, renal disease, and dermal/ocular problems in living organisms. It easily reacts with blood and leads to the formation of methemoglobin, which is mainly responsible for cyanosis, confusion and unconsciousness [**5**,**7**]. Different environmental organizations such as the Brazilian Environmental Council, USEPA and European Commission have declared 100, 60 and 0.1 ppb of PNP as maximum permitted limits [**5**,**7**], respectively. Therefore, the detection of PNP at trace levels is required.

Hence, it is the need of the hour to design a highly reliable and robust chemical sensor for the rapid detection of PNP. Several methods are reported in the literature for the effective and selective determination of PNP such as gas chromatography, high-

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performance liquid chromatography (HPLC), spectrophotometry, fluorescence, electrophoresis/capillary electrophoresis etc. [**8**,**9**,**10**,**11**,**12**]. However, expensive columns and a lot of reagents are required in HPLC and electrophoresis, aqueous samples cannot be used directly in gas chromatography, and interference is a major problem in spectrophotometric and fluorometric methods. In other words, all these techniques are either very expensive or time consuming or suffer from some other problems. Therefore, there is a need to develop a simple, cost-effective and quick technique that can effectively monitor the presence of PNP in a sample. Recently, several attempts have been made to synthesize a PNP sensor using various metal oxide nanomaterials such as copper oxide nanoparticles [**13**], a reduced graphene oxide/Au nanoparticle composite [**14**], a gold–ZnO–SiO_2 nanostructure [**15**], a CeO_2/ZnO nano-composite [**16**], Ag doped Nd_2O_3 nanoparticles [**17**] and CeO_2–ZnO nanoellipsoids [**18**].

Among the various transition metal oxides, zinc oxide is a very versatile, multifunctional semiconductor with a direct band gap of 3.37 eV. Zinc oxide is preferred over other metal oxide nanomaterials because it has a high exciton binding energy (60 meV), high catalytic efficiency, high-electron communication property, and cost-effective environmental sustainability [**19**,**20**,**21**,**22**,**23**,**24**]. Moreover, it has been observed that we can alter the properties of ZnO nanostructures for desired applications by manipulating the shape, grain size and morphology. However, the doping of ZnO nanostructures with transition metals, such as Mn, Ga, Fe, In, Co, Mg, Al, Sb, Sn, Ag, etc., has been found to deliver better control over the band gap [**24**,**25**,**26**]. Among the various transition metals, Ag ions have become the interest of many research groups [**27**,**28**], because of their suitable band gap, as they reduces the electron hole recombination and hence result in improvement in the photocatalytic properties, as well as proving to be an effective sensor material for toxic chemicals [**29**].

In this paper, we report the solution combustion synthesis of silver-doped zinc oxide nanostructures, $Ag_xZn_{1-x}O$ (x = 0, 0.01, 0.05 and 0.10). The solution combustion synthesis route was utilized in the present paper for the production of nanostructure materials in a single step, a time- and energy-saving process [**30**,**31**,**32**]. As-synthesized $Ag_xZn_{1-x}O$ nanostructures were utilized for the formation of a highly sensitive luminescence sensor for the detection of PNP in an aqueous medium. The limit of detection (LOD) for PNP was calculated for ZnO as well as Ag-doped ZnO samples, by using the Stern–Volmer equation.

2. Experimental

2.1. Materials

Zinc nitrate hexahydrate ($Zn(NO_3)_2{\cdot}6H_2O$), tartaric acid ($C_4H_6O_6$), silver nitrate ($AgNO_3$) and p-nitrophenol ($C_6H_5NO_3$) (PNP) were all of analytical grade and obtained from Merck, Germany and these chemicals were directly used as received without further purification. Deionized (DI) water obtained from a Millipore Elix system was used for all the experiments.

2.2. Synthesis of ZnO Nanoparticles

Pure ZnO nanostructures were synthesized from zinc nitrate hexahydrate (oxidizer) and tartaric acid (fuel) using a typical reaction procedure of solution combustion by optimizing the stoichiometric ratio (ϕ = 1). In the synthesis process, 4.0 g of $Zn(NO_3)_2{\cdot}6H_2O$ and 2.0 g of $C_4H_6O_6$ were dissolved in 50 mL of deionized water, separately. Then, the tartaric acid solution was added drop-wise to the $Zn(NO_3)_2{\cdot}6H_2O$ solution with continuous stirring at room temperature. The resultant solution was thoroughly stirred at room temperature for 30 min, and the resulting solution was heated till the evaporation of the excess water content to obtain the gel-like materials. The resulting gel-like material was transferred into a muffle furnace in a silicate crucible at 500 °C for 1 h. In the muffle furnace, tartaric acid (fuel) and zinc nitrate hexahydrate (oxidizer) were combusted for the formation of the crystalline ZnO nanostructures, at high temperature. The synthesized nanostructures were further washed with distilled water followed by ethanol, and finally, the precipitates were dried in an oven at 60 °C.

2.3. Synthesis of Ag-Doped ZnO Nanostructures

The same procedure was adopted for the synthesis of Ag-doped ZnO by taking an appropriate amount of $AgNO_3$. For the synthesis of 1%, 5% and 10% Ag-doped ZnO, 0.022, 0.114 and 0.228 g of $AgNO_3$ dissolved in 50 mL of water was added, respectively; after that, the same procedure was adopted as in **Section 2.2**.

2.4. Characterization

The synthesis of the nanostructures was confirmed by characterizing them for their morphological, structural and optical properties. The morphological investigation was carried out by using field emission scanning electron microscopy (SEM) with a FEI Quanta 200 FEG (Pittsburgh, PA, USA) with the energy dispersive X-ray spectrometer Bruker XFlash 4030 (EDS), while the structural characterization was performed using X-ray diffractometer (D8 Discover, Bruker AXS, Karlsruhe, Germany). The optical properties of the as-synthesized nanostructures were examined at room temperature by using UV–visible spectroscopy (AvaSpec-2048). The XPS study of the ZnO powder and Ag-doped ZnO powder was carried out by employing X-ray energy dispersion spectrometer (Bruker XFlash 4030, Karlsruhe, Germany). The sensing properties of the pure ZnO and Ag-doped ZnO nanostructures were recorded using room-temperature photoluminescence spectra (Perkin Elmer-LS55 fluorescence spectrophotometer, Waltham, MA, USA).

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2.5. Luminescent Sensor Evaluation of ZnO and Ag-ZnO Nanoparticles

The Perkin Elmer LS55 fluorescence spectrophotometer was used at room temperature to determine the sensing properties of the pure ZnO and Ag-ZnO nanostructure. In this investigation, the pure ZnO and Ag-ZnO nanostructures were utilized to fabricate the luminescent sensor interface for the sensing of PNP. The obtained ZnO and Ag-ZnO nanostructures were dispersed in DI water (1.5 mg

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in 50 mL of H_2O), and a 5 mM stock solution of PNP was also prepared for the entire experiment. All the solutions were prepared 30 min before performing the experiments. The sensing experiments were performed at different concentrations of PNP in the range of 0.833–9.980 µM.

3. Results and Discussion

3.1. FESEM of $Ag_xZn_{1-x}O$ Nanostructure

The surface morphology and variation in the particle size were studied by using high-resolution FESEM. Typical low and high magnification FESEM images of the pure ZnO, 1% Ag-ZnO, 5% Ag-ZnO and 10% Ag-ZnO nanostructures are shown in **Figure 1**a–h. A careful observation of **Figure 1** reveals that the as-synthesized nanostructures were uniformly grown at very high density. It was also observed that the structure of ZnO did not show any deviation with the doping of silver ions and remained uniform even at a high concentration of silver ions (10% Ag ions).

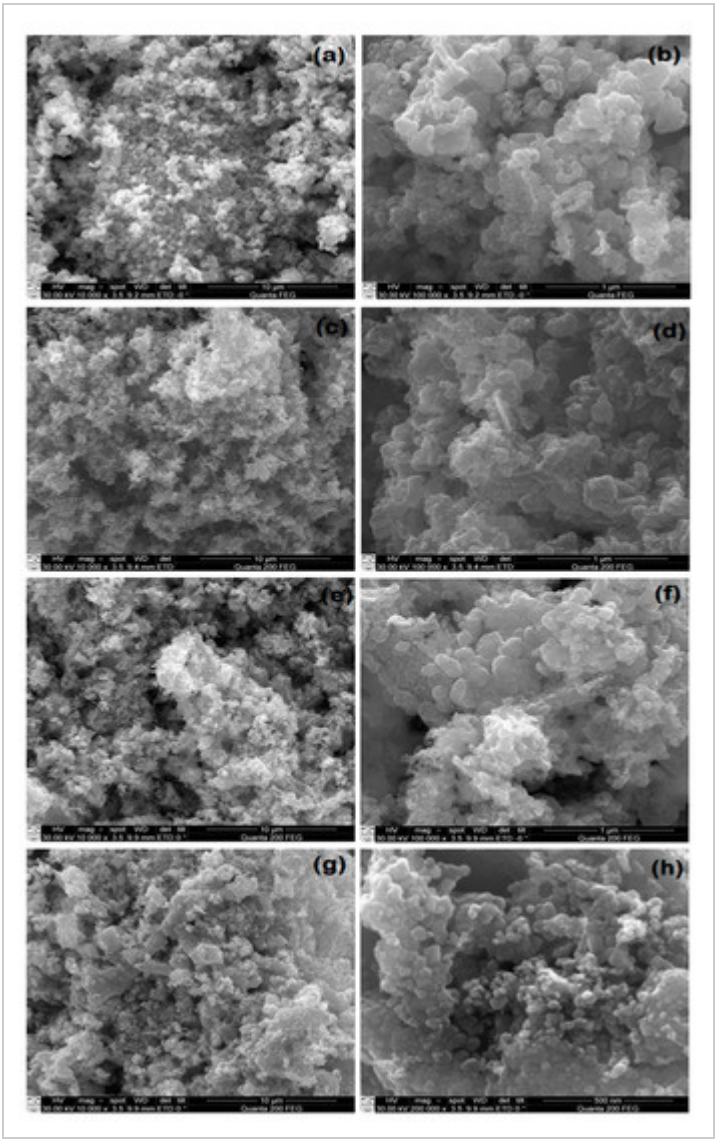

Figure 1. Low and high-magnification FESEM micrographs of pure ZnO (**a**,**b**) and 1% (**c**,**d**), 5% (**e**,**f**) and 10% (**g**,**h**) Ag-doped ZnO nanostructures.

3.2. PXRD

Figure 2a represents the XRD spectra of the pure ZnO and Ag-ZnO nanostructures, which were recorded in the range of 20–80°. The XRD spectra show that pure ZnO has characteristic diffraction peaks attributed to the crystalline nature of ZnO. A clear peak of silver ions was also observed for the Ag-ZnO composite, confirming the doping of Ag into ZnO. The intensity of the peak also revealed that there is a slight intensity increase with an increasing concentration of silver ions.

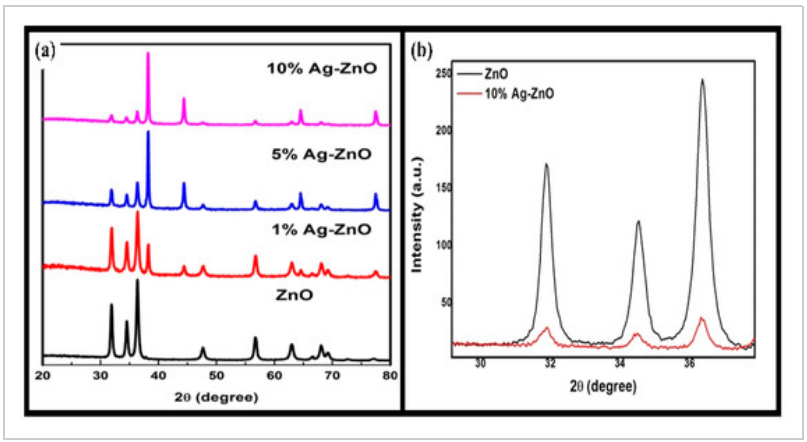

Figure 2. (**a**) XRD pattern of $Ag_xZn_{1-x}O$ nanostructure and (**b**) comparison of (100), (002) and (101) peaks from the XRD pattern of pure ZnO and 10% Ag-ZnO nanostructures.

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The data were found to be in reasonable agreement with the Joint Committee on Powder Diffraction Standards (JCPDS) card for ZnO (JCPDS 036-1451) [**33**]. In **Figure 2**a, the strongest dhkl values resemble the 2θ values of 31.74°, 34.42°, 36.26°, 47.66°, 56.70°,

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63.07°, 66.42°, 67.92°, 69.10°, 72.45° and 77.31° for (100), (002), (101), (102), (110), (103), (200), (112), (201), (004) and (202), respectively, which confirms the presence of the wurtzite hexagonal phase of ZnO. However, in the silver-doped zinc oxide sample, in addition to the ZnO reflections, the characteristic peaks (111), (200) and (220) corresponding to Ag ions appeared at 2θ of 38.29°, 44.28° and 62.93°, respectively. From **Figure 2**a, it can be observed that as the concentration of Ag increases, the intensity of the Ag ion peaks becomes more predominant. The XRD spectra clearly indicate that only ZnO and Ag ions are present; no other peak is found corresponding to any other impurity atom such as Zn and Ag_2O. This simply reveals that the as-synthesized nanostructures are crystalline and pure up to the detection limit of XRD.

Furthermore, a close comparison of the peaks (100), (002) and (101) is shown in **Figure 2**b, which clearly reveals that up to the studied concentration of silver ions (10% Ag), no deformation in the structure is observed. The crystallite size was calculated using the XRD peak with the Debye–Scherrer formula, which is given as:

$$D = \frac{k\lambda}{\beta Cos\,\theta} \quad (1)$$

where *k* is the structural constant, *λ* is the wavelength of the X-ray, *D* is the size of the nanoparticle and *β* is the full width at half maximum. Using Equation (1), the crystallite particle sizes were determined to be 39, 32, 26 and 21 nm, respectively, for the pure ZnO and 1%, 5% and 10% Ag-doped ZnO nanostructures.

3.3. EDS

The composition and purity of the as-synthesized ZnO and Ag-ZnO nanostructures were investigated by using EDS. The EDS data are provided as **supplementary data (Figures S1–S4)**, which confirmed that the nanoparticles were made of zinc, oxygen and silver atoms only.

3.4. UV–Visible

The optical properties of the $Ag_xZn_{1-x}O$ (x = 0, 0.01, 0.05 and 0.10) nanostructures were studied by using UV–visible (UV–Vis) spectroscopy. The results indicate that the maximum absorption peaks are at 375, 379, 382 and 385 nm (**Figure 3**) for the pure ZnO, 1% Ag-ZnO, 5% Ag-ZnO and 10% Ag-ZnO nanostructures, respectively, corresponding to wurtzite hexagonal phase bulk ZnO [**29**]. The red shift due to the presence of Ag ions observed in the absorption maxima is attributed to the decrease in the band gap energy with an increase in the concentration of Ag ions. No other absorption peak was detected corresponding to impurities, which confirms that the synthesized Ag/ZnO nanostructures possess good optical properties.

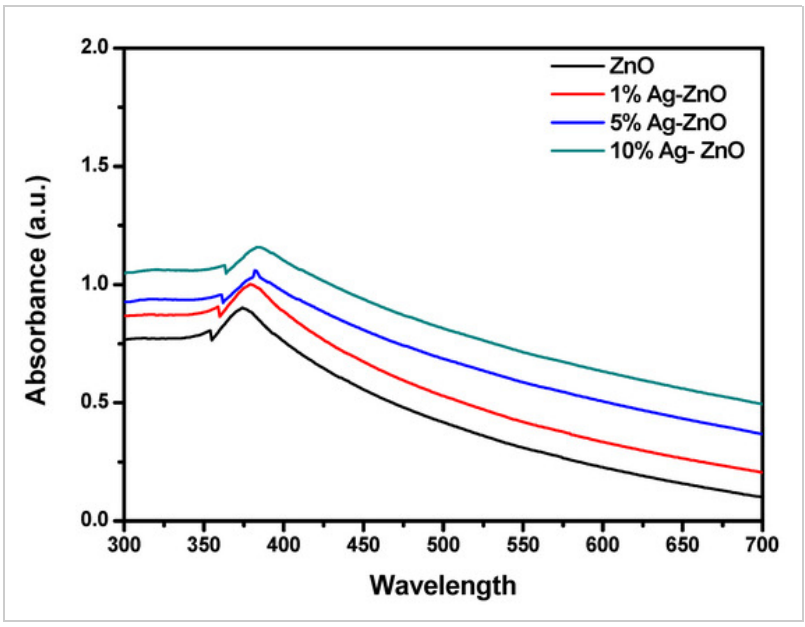

Figure 3. UV–Vis spectrum of pure ZnO, 1% Ag-ZnO, 5% Ag-ZnO and 10% Ag-ZnO nanostructures.

3.5. XPS

The XPS survey spectra for the ZnO and Ag-doped ZnO samples are presented in **Figure 4**. From the spectra, one can see that the main elements on the surface of the samples are zinc, oxygen, carbon and silver. It can be noted that the silver Ag 3d peak appears only for the Ag-doped ZnO samples. A low-intensity carbon C 1s peak at 285 eV is present, most likely due to atmospheric contaminants adsorbed on the surface of the sample. High-resolution spectra were acquired in the O 1s, Zn 2p and Ag 3d regions for obtaining the atomic concentrations (**Table 1**) and possible chemical bond identification. The data in **Table 1** were determined by calculating the appropriate peak area after Shirley background subtraction. The zinc high-resolution XPS spectra in the Zn 2p region (**Figure 5**) for the ZnO and Ag-doped ZnO samples show two peaks due to spin-orbit splitting: Zn $2p_{3/2}$ and Zn $2p_{1/2}$. The position of the Zn $2p_{3/2}$ peak at approximately 1021.7 eV is assigned to the ZnO bond since it is in good agreement with the known peak values and shape for ZnO (1021.7 eV) [**34**,**35**].

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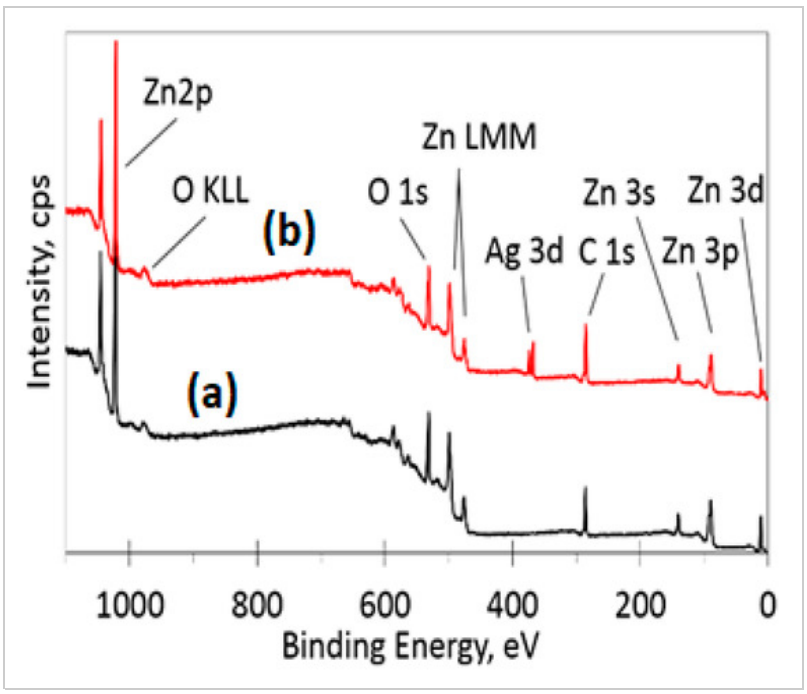

Figure 4. XPS survey spectra of (**a**) ZnO and (**b**) 10% Ag-ZnO powder samples.

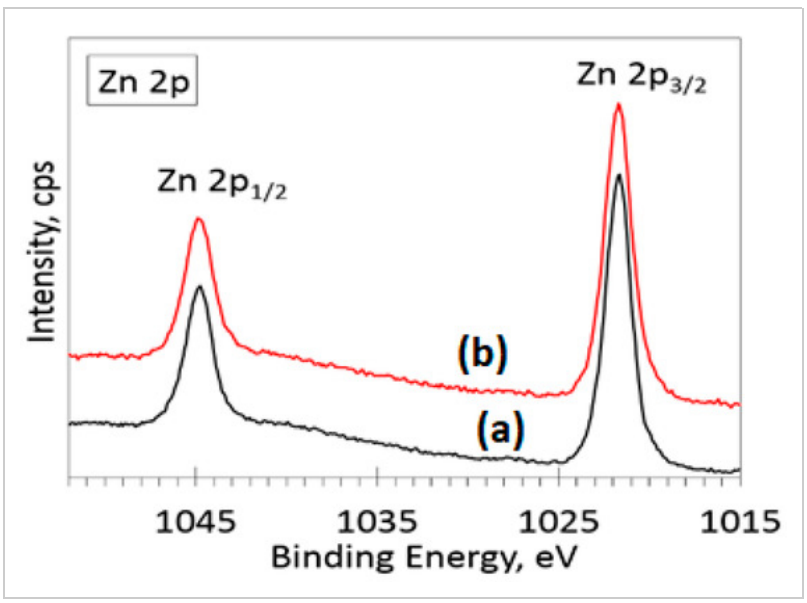

Figure 5. High-resolution XPS spectra in Zn 2p region for (**a**) ZnO and (**b**) 10% Ag-ZnO powder samples.

Table 1. Atomic concentrations calculated from the XPS measurements.

The deconvolution of the O 1s spectra (**Figure 6**b) showed a negligible shift (less than 0.1 eV) of the main peak (ZnO) position (530.4 eV) due to the incorporation of 10% Ag. The main difference between the two spectra is in the left side of the spectra. Namely, the peaks at 531.8 eV (oxygen-deficient regions within the matrix of ZnO, green curve) and 532.5 eV (C-O bonds and chemisorbed atmospheric oxygen species, blue curve) are more intense for the 10% Ag sample. This variation of intensity could arise due to different amounts of adsorbed atmospheric contaminants on the sample surface. The highest binding energy peak at 532.5 eV is usually assigned to C-O bonds and chemisorbed atmospheric oxygen species [**34**,**35**,**36**]. Both peaks (531.8 and 532.5 eV) are more intense for the 10% Ag-doped sample (**Figure 6**b). This increase in intensity could arise due to different amounts of adsorbed atmospheric contaminants on the sample surface. The lower intensity peak positioned at 531.8 eV corresponds to the known values of binding energy for O^{2-} ions in oxygen-deficient regions within the matrix of ZnO [**37**] or O-C=O/C=O species bonds from adsorbed atmospheric contaminants [**38**]. In the Ag 3d spectra (**Figure 7**), two peaks were detected, fitted using a sum of Lorentzian–Gaussian (80:20) functions, with an asymmetric peak shape at positions 386.2 and 374.2 eV on the binding energy scale. The deconvoluted Ag 3d spectra for the 1% Ag-ZnO powder sample is shown in the **supplementary data (Figure S5)**. These peak positions are in good agreement with the well-known spin-orbit split energy values [**39**] of Ag $3d_{5/2}$ and Ag $3d_{3/2}$ doublet peaks for Ag^0. The position and shape of these peaks indicate the presence of metallic silver in Ag-doped ZnO powder samples.

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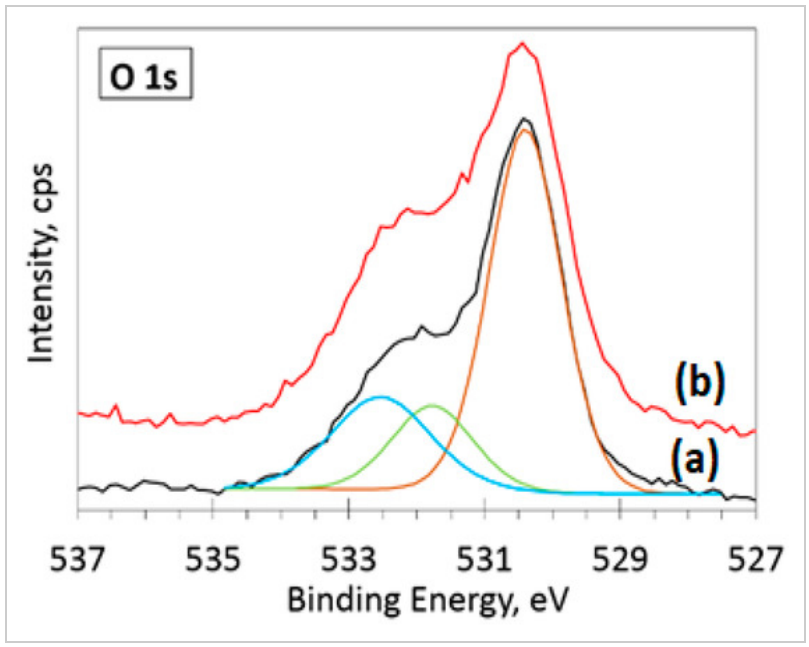

Figure 6. Deconvoluted high-resolution XPS spectra in O 1s region for (**a**) ZnO and (**b**) 10% Ag-ZnO powder samples.

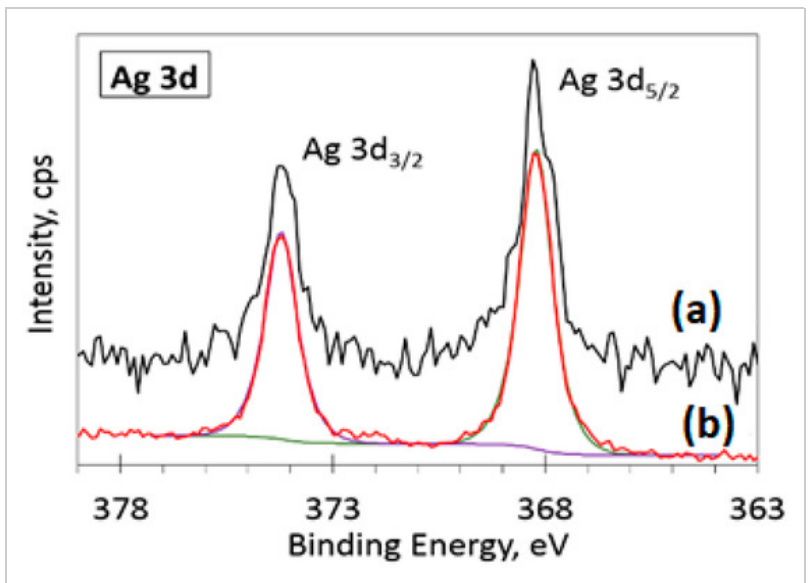

Figure 7. High-resolution XPS spectra for (**a**) 1% Ag-ZnO powder sample and (**b**) deconvoluted spectra for 10% sample.

3.6. Ag-ZnO Nanoparticles as Fluorescent Sensor for p-Nitrophenol

The stability of the synthesized Ag-doped ZnO nanostructures was studied by using a fluorescence spectrophotometer, and there was no change in the intensity and position of the peak, even after a time of 15 days. The reproducibility values of the fluorescence measurements were estimated to be ±0.1%. The as-synthesized $Ag_xZn_{1-x}O$ (x = 0, 0.01, 0.05 and 0.10) samples were studied for the fluorescence sensing of p-nitrophenol (PNP). Before conducting the sensing experiments, photoluminescence (PL) spectra of pure ZnO and Ag-doped ZnO nanostructures were recorded at various excitation wavelengths in the range 330–410 nm with a regular gap of 10 nm in order to find out the excitation maxima for the nanostructures. In the PNP concentration-dependent studies, the concentration of PNP was changed gradually, while the concentrations of the nanostructures were kept constant (1.5 mg in 50 mL). The response of the PL quenching for ZnO and Ag-doped ZnO is illustrated in **Figure 8**.

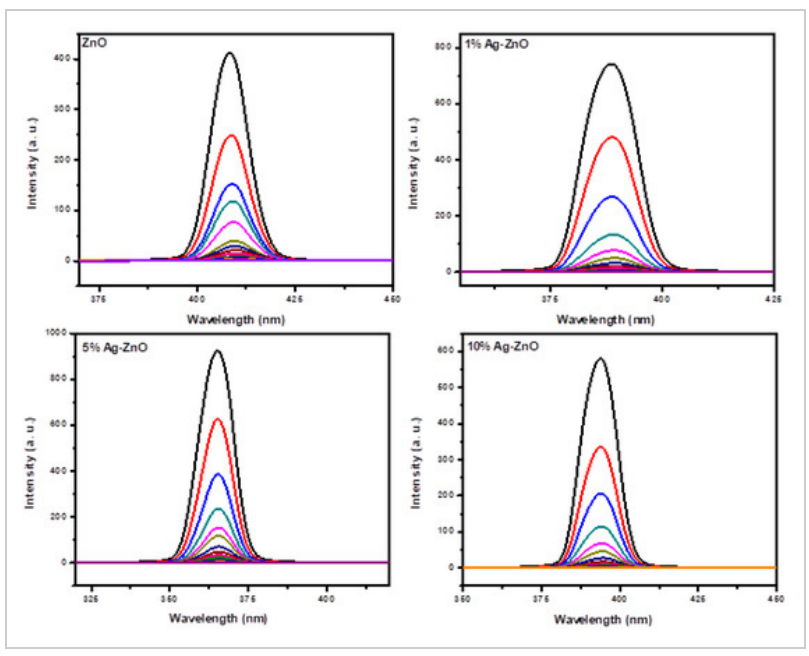

Figure 8. It was observed that the photoluminescence (PL) intensity of the pure ZnO and Ag-doped ZnO nanostructures decreases with an increase in the concentration of p-nitrophenol (PNP), which clearly indicates the binding of PNP to the surface of nanostructures.

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The Stern and Volmer equation [**40**] initially deal with the kinetics analysis of fluorescence quenching, which has promising

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applications for investigating bimolecular interactions in the electronic excited state. The analysis of the fluorescence quenching processes was performed by using the Stern–Volmer equation [**40**]:

$$\frac{I_o}{I} = K_{sv}[Q] + 1 \quad (2)$$

where I_o is the intensity before and after the addition of PNP, while I correspond to the intensity after the addition of PNP. K_{sv} and [Q] are the Stern–Volmer quenching constant and the concentration of the quencher, respectively. **Figure 9** shows the variation of $(I_o/I)-1$ vs. the concentration of the PNP quencher. In pure ZnO as well as Ag-doped ZnO, it was observed that the Stern–Volmer plots show exponential behavior (linear as well as non-linear) over the entire concentration range of PNP studied. Linear behavior was observed upon increasing the concentration up to a certain level, implying the dominance of the static quenching over the dynamic quenching process; however, a further increase in concentration resulted in an exponential increase, which suggests that there exist both types of quenching, i.e., a combination of static and dynamic quenching by the same quencher [**40**].

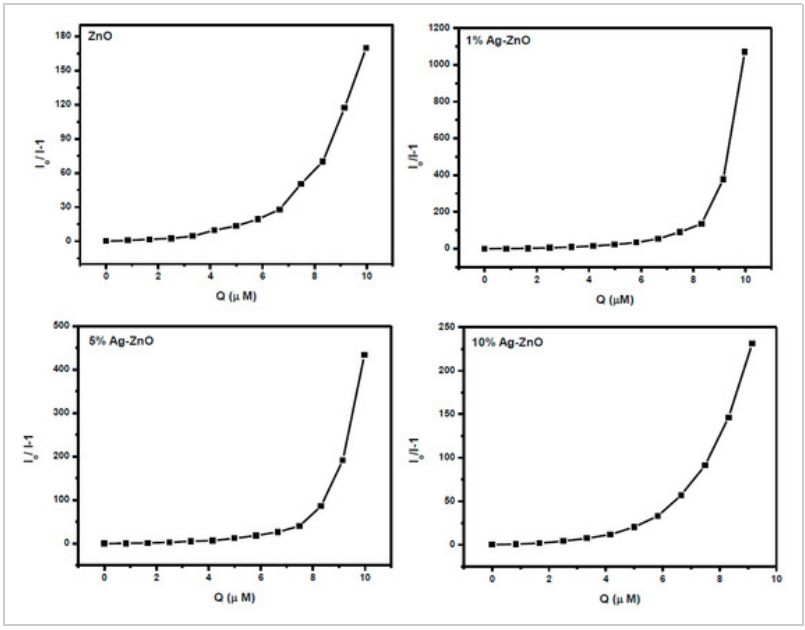

Figure 9. Stern–Volmer plots of $Ag_xZn_{1-x}O$ nanostructure with increasing concentration of p-nitrophenol.

To resolve this ambiguity, on account of the non-linear response of the intensity ratio to the concentration of the analyte, a modified Stern–Volmer equation has been suggested [**37**,**41**]:

$$\frac{I_o}{I} = K_{sv}[Q]e^{V[Q]} + 1 \quad (3)$$

Equation (3) can further be simplified as follows:

$$\frac{I_o - I}{Ie^{V[Q]}} = K_{sv}[Q] \quad (4)$$

where V is the static quenching constant and is obtained from Equation (4) by plotting $\frac{I_o-I}{Ie^{V[Q]}}$ vs. [Q] and by varying V till a linear response is obtained as shown in Figure.

Figure 10a–d show a linear fit of the plot $\frac{I_o-I}{Ie^{V[Q]}}$ versus PNP concentration, with regression coefficients of 0.952, 0.963, 0.975 and 0.994 for the pure ZnO and 1%, 5% and 10% Ag-doped ZnO nanostructures, respectively. The value of V fits to 0.31 with a K_{SV} of 7.33 × 10^5 M^{-1} in the case of pure ZnO, while V fits to 0.30, 0.25 and 0.42 with K_{SV} of 1.31 × 10^6, 8.093 × 10^5 and 5.24 × 10^5 M^{-1} for the 1%, 5% and 10% Ag-doped ZnO nanostructures, respectively. The limits of detection (LODs), calculated following the 3σ IUPAC criteria, were found to be 2.17, 1.60, 1.18 and 0.66 μM for the pure ZnO and 1%, 5% and 10% Ag-doped ZnO nanostructures, respectively, which clearly indicates that the presence of Ag improved the LOD for a luminescent sensor for PNP. The sensing mechanism has been shown in **Scheme 1**. The PL quenching of Ag-doped ZnO can be attributed to the analytes binding on the surface of nanostructure, which traps the excited electron-by-electron transfer mechanism [**42**]. The LOD for PNP calculated for various samples of ZnO as well as Ag-doped ZnO is also compared with the literature (**Table 2**).

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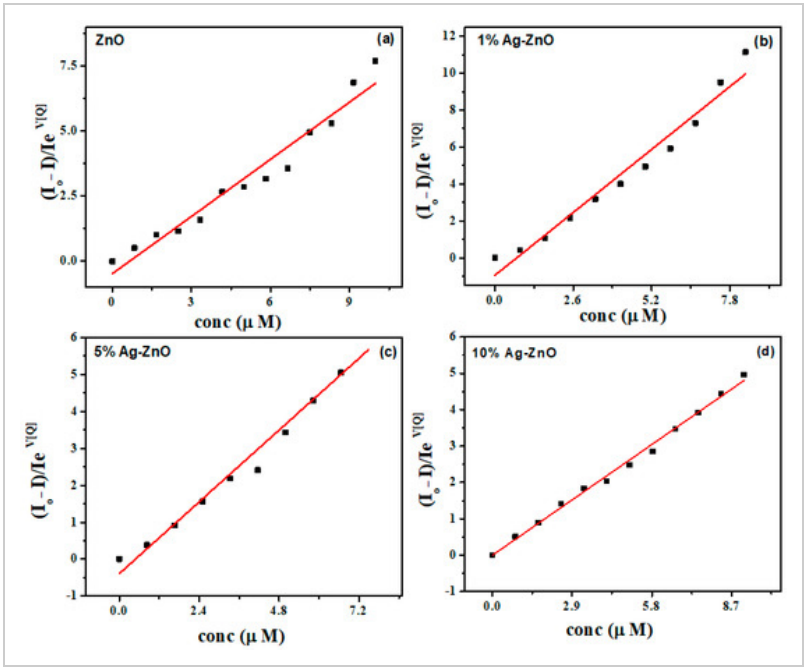
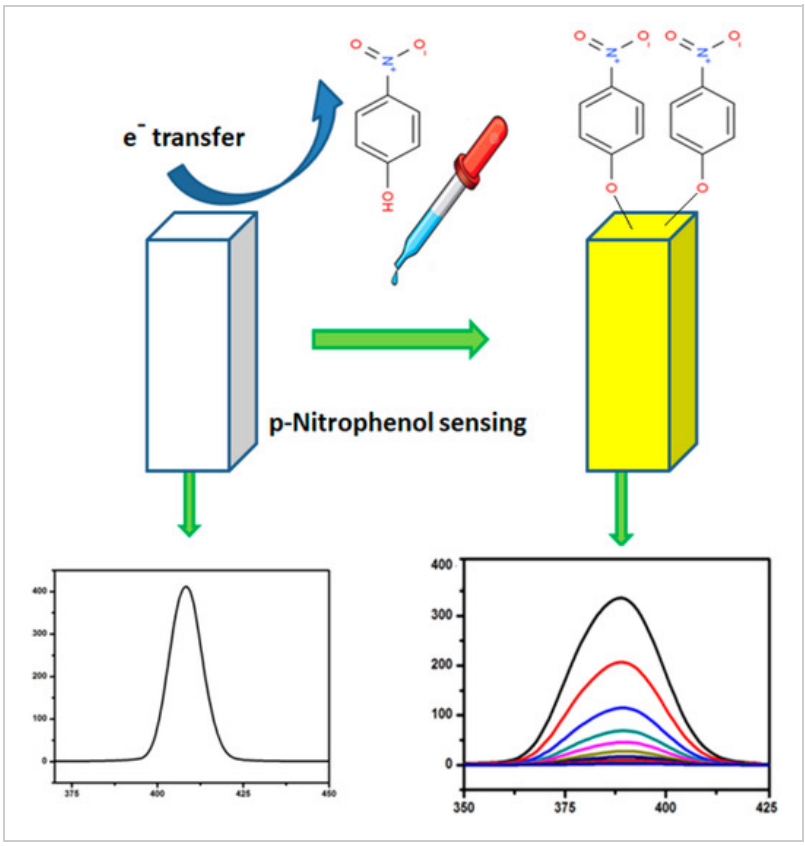


Figure 10. Modified Stern–Volmer plots of (**a**) ZnO, (**b**) 1% Ag-ZnO, (**c**) 5% Ag-ZnO and (**d**) 10% Ag doped ZnO nanostructures.



Scheme 1. Proposed mechanism for the photoluminescence sensing of PNP.

Table 2. Comparison of limits of detection (LODs) between synthesized Ag-ZnO nanostructures and various reported chemical sensors for PNP.

4. Conclusions

In summary, we successfully synthesized ZnO and Ag-doped ZnO nanostructures via a solution combustion process. The synthesized ZnO and Ag-ZnO nanostructures were characterized by using various characterization techniques, which revealed the large-scale synthesis of well-crystalline nanostructures and successful incorporation of Ag ions in the ZnO matrix, showing excellent chemical sensing properties. ZnO was found to show a low value of the limit of detection, i.e., 2.175 μM/L, for p-nitrophenol sensing; moreover, a sharp decrease in the limit of detection was observed with an increase in the concentration of silver ions, and the LOD value decreased to 0.669 μM/L for the 10% silver-doped zinc oxide. It is therefore concluded that Ag-doped ZnO shows a lower limit of detection as compared to pure ZnO for p-nitrophenol sensing. We observed a decrease in the particle size with an increasing Ag ion concentration, as well as the presence of silver also decreasing the electron hole recombination rate, which led to the enhancement of the surface area and Ag also behaving as an electron scavenger. Hence, there was an increase in the chemical sensing efficiency owing to the separation of charge carriers, resulting in the restriction of their recombination. It is concluded that Ag-doped ZnO nanostructures are promising candidates for the detection of p-nitrophenol.

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Supplementary Materials

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The following are available online at **https://www.mdpi.com/2227-9040/8/4/108/s1 (https://www.mdpi.com/2227-9040/8/4/108/s1)**. Figure S1: EDS of pure ZnO nanoparticle, Figure S2: EDS of 1% Ag-ZnO nanoparticle, Figure S3: EDS of 5% Ag-ZnO nanoparticle, Figure S4. EDS of 10% Ag-ZnO nanoparticle, Figure S5. Deconvoluted high-resolution XPS spectra for 1% Ag-ZnO powder sample.

Author Contributions

Experiments, D.T.; original draft writing, D.S., A.S., D.S.R.; data analysis, D.S., A.S., D.S.R.; review and editing, S.T. (Sourbh Thakur), N.T., T.T., M.A., S.T. (Sigitas Tamulevicius), S.K.S.; supervision, S.T. (Sourbh Thakur), D.S. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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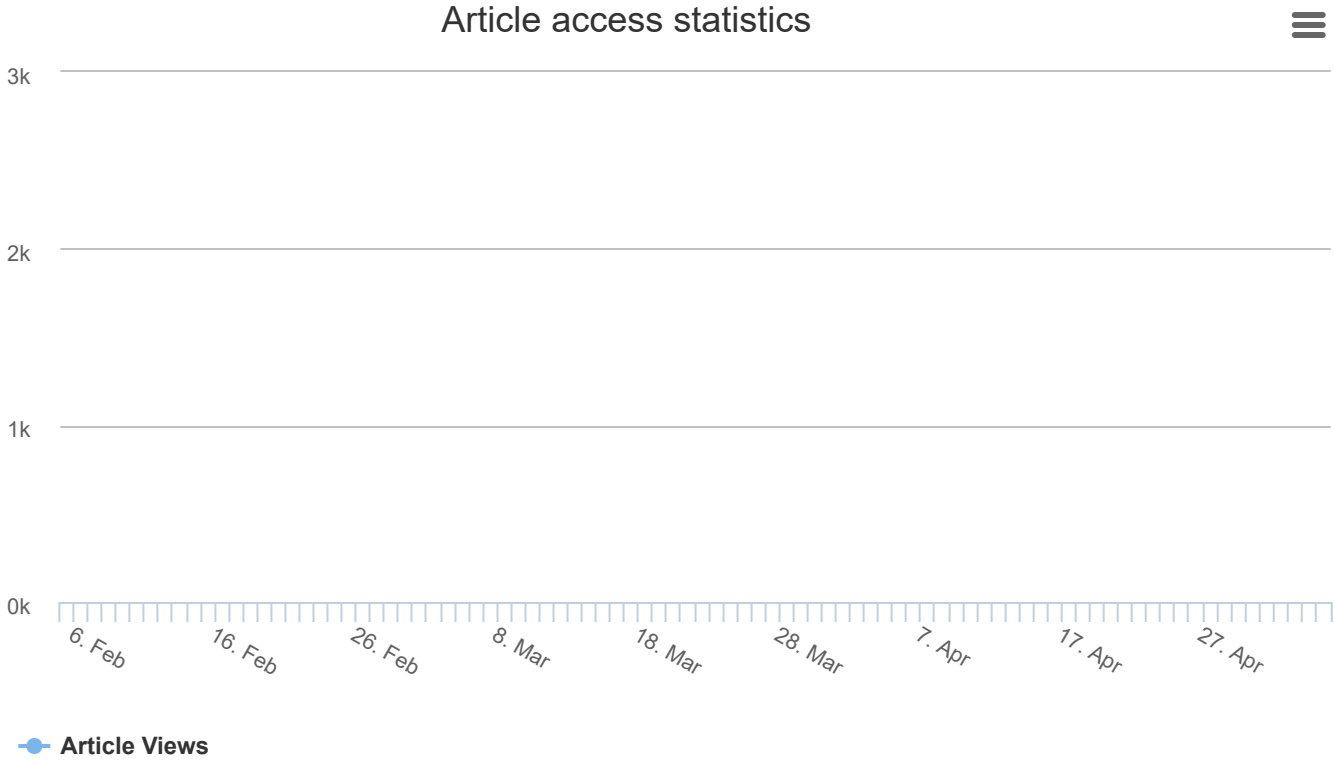

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Investigation of structural. dielectric. and magnetoelectric properties of $K_{0.5}Na_{0.5}NbO_3$–$MnFe_2O_4$ lead free composite system

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Abstract

In the present work, lead-free magnetoelectric composites $(1-x)K_{0.5}Na_{0.5}NbO_3$–$(x)MnFe_2O_4$ (x=0, 0.2, 0.4, 0.6, 0.8, and 1) synthesized by solid-state reaction route have been studied for their structural, dielectric, and magnetoelectric properties. The micro-structural analysis (XRD, FESEM, EDX, FTIR, and RAMAN spectroscopy) indicates the coexistence of diphase in the composites. Compared to the individual phases, composites exhibit better electrical properties such as low leakage current, high resistivity, high dielectric constant, and low dielectric loss. I–V characteristics reveal that the conduction behavior of the composites is ohmic in nature in whole tested electric field range at room temperature. The maximum value of dielectric constant is noticed for composite with 20wt% of $MnFe_2O_4$ among the composites. The complex modulus analysis reveals the presence of non-Debye type phenomenon with spreading of relaxation time in the composites. Nyquist plots reveal that the composites exhibit polydispersive Maxwell–Wagner relaxation. The magnetic measurements indicate that the magnetic behavior of the composites lies on the mass content of $MnFe_2O_4$ phase. The magnetization increases with $MnFe_2O_4$ weight percentage which provides information regarding the magnetoelectric effect (ME) coupling between the magnetostrictive ferromagnetic and ferroelectric phases. Furthermore, ME effect is evaluated as a function of applied magnetic field. The highest ME response of 2.02mV/cm-Oe is observed for composite with 80wt% content of $MnFe_2O_4$. Findings of this research make these composites worthy material for environment-friendly ME device applications.

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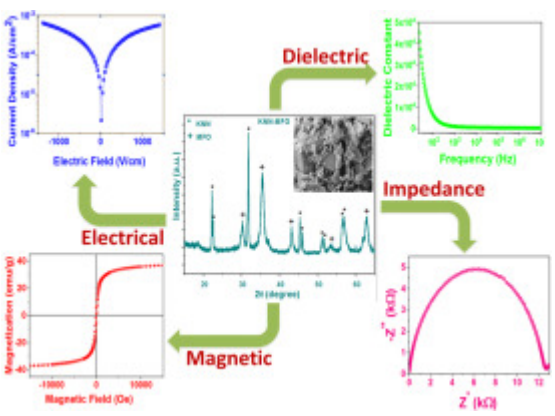

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Introduction

Multiferroics belong to a new family of composite materials which exhibit two or more ferroic order (magnetic, electric, or elastic) at the same time. The coupling between different ferroic order induces a new effect termed as magnetoelectric effect (ME). ME effect based materials have ability to induce magnetization by an external electric field or polarization by an external magnetic

field due to the cross coupling between electric and magnetic ordering. The ME phenomenon is observed in both single phase as well as composite materials. The natural single phase 'ME multiferroics' were studied to some degree in 1960s and 1970s, but then slowed down due to their rare availability in nature, low Curie temperature, and the weak ME coupling output at room temperature, which limit their practical applications [1], [2], [3]. Due to the scarcity of single-phase materials, a lot of research work has been proposed to fabricate an alternative artificial multiferroic composites by merging the physically separable ferromagnetic and ferroelectric phases together at room temperature. The collaboration between, and the developments in, many areas of theory and experiment have fuelled the interest in such ME multiferroic composites in recent years. Theoretical characterization (multi-scale computational modeling) of these ME multiferroic composites and advent of nanotechnology have provided the understanding of the factors that promote strong ME coupling between magnetic and ferroelectric order parameters [4]. The existence of strong ME coupling in multiferroic composites provides the opportunities for potential applications in spintronics, memory devices, magnetic sensors, transducer, phase shifters, waveguides, and energy harvester [5], [6], [7], [8]. Generally, in order to attain strong ME coupling strength in multiferroics, ferromagnetic and ferroelectric phases should have high magnetostriction and piezoelectric co-efficient, respectively. In addition, highly resistive materials are equally desirable in order to avoid leakage current [9].

Since, ME response in composites is found to be high. The most of these high performance ME multiferroics use lead zirconate titanate (PZT) as ferroelectric phase due to its good pyroelectric, ferroelectric, and piezoelectric properties [10]. However, devices made by PZT based ME composites have environmental limitations due to the strong toxic nature of lead. Moreover, the use of lead in many commercial materials and applications has been prohibited, owing to concern regarding the environment pollution and human health [3], [10], [11]. Today, research has been now focused on the development and synthesis of lead-free environmental friendly magnetoelectric ceramics with an improved ME coefficient. At present, barium titanate ($BaTiO_3$) - based ferroelectric materials are mainly used to fabricate lead free ME composites. $BaTiO_3$-based lead free ME composites such as $BaTiO_3/Ni(Co,Mn)Fe_2O_4$ [9], $Ni_{0.8}Zn_{0.2}Fe_2O_4/Ba_{0.6}Sr_{0.4}TiO_3$ [12], $Na_{0.5}Bi_{0.5}TiO_3/MnFe_2O_4$ [13], $BaTiO_3/Ni_{0.8}Zn_{0.2}Fe_2O_4$ [14], $Na_{0.5}Bi_{0.5}TiO_3/Ni_{0.25}Mg_{0.5}Zn_{0.25}Fe_2O_4$ [10], and $CuFe_2O_4/BaTiO_3$ [15] have been reported. However, in order to obtain well dense $BaTiO_3$- based ME composite, it needs to sinter at a very high temperature (~1400°C), which is larger than the sintering temperature for spinel ferrite nano-materials. Furthermore, iron ions of magnetic phase get diffused into ferroelectric phase of $BaTiO_3$ at high sintering temperature, which decreases the Curie temperature of $BaTiO_3$, thus resulting in poor thermal stability [12]. Therefore, lead-free perovskite ceramics, $K_{1-y}Na_yNbO_3$ (KNN) is one of the best potential alternative to the $BaTiO_3$-based lead-free ME composites due to its excellent properties such as high Curie temperature (495°C), high piezoelectric properties (piezoelectric coefficient d_{33} =416 pC/N, planar coupling coefficient $k_P \approx 54\%$), biocompatibility, and more safe to human health [16], [17], [18]. $K_{1-y}Na_yNbO_3$ is a blend of potassium niobate (ferroelectric) and sodium niobate (anti-ferroelectric), and forms a morphotropic phase boundary near y=0.5 [19]. KNN has an orthorhombic perovskite structure at room temperature [3]. Among ferromagnetic ceramics, $MnFe_2O_4$ (MFO) ferrite having inverse spinel cubic symmetries exhibits excellent size dependent magnetic properties, high resistivity, high curie temperature, and high magnetostriction coefficient ($\lambda \sim -35\times10^{-6}$) [20], [21], [22]. Hence, MFO is a promising ferromagnetic material for growing ME composites.

The KNN-ferrite based ME composites studied are $CoFe_2O_4/K_{0.5}Na_{0.5}NbO_3$ [19], (1-x)[$K_{0.5}Na_{0.5}NbO_3$]-x[$Co(Mg_{0.05}Fe_{1.95})O_4$] [23], (1-x)$K_{0.5}Na_{0.5}NbO_3$-(x)$Ni_{0.5}Zn_{0.5}Fe_2O_4$ [24], $[Li_{0.06}(Na_{0.52}K_{0.48})_{0.94}]NbO_3/Ni_{0.9}Co_{0.1}Cu_{0.1}Fe_{1.9}O_4$ [25]. As per best of our knowledge, the investigation of multiferroism in KNN and MFO based ME composites are not reported yet. In the present study, an attempt has been made to synthesize (1-x)KNN-(x)MFO (x=0, 0.2, 0.4, 0.6, 0.8, and 1) composites using solid state sintering route having KNN and MFO as constituent of electric and magnetic order, respectively. The structural, electrical, dielectric, and magnetoelectric properties of KNN-MFO composites were investigated for the first time.

Section snippets

Experimental detail

Multiferroic KNN-MFO composites were prepared by solid state sintering method. Initially, the polycrystalline nanoparticles of ferroelectric KNN with basic composition of $K_{0.5}Na_{0.5}NbO_3$ were groomed by solid state reaction route. Briefly, analytical grade K, Na, and Nb acetate precursors were weighed according to required stoichiometry, and were mixed and ground in an agate mortar and pestle for 4h. After this, a solid mixer was submitted to calcine in a muffle furnace at 750°C for 4h to…

Structural and micro-structural analysis

Fig. 1 depicts the XRD patterns of bare KNN, bare MFO, and composites of KNN-MFO. It is noticed that only the expected diffraction peaks of KNN and MFO can be detected in their individual phase as well as in their composites without any trace of foreign phases.

Rietveld refinement was performed using FullProf program for further analysis of crystal structure. For refinement purpose, constituent phases were used from the available crystallography open database i.e. the COD-1011245 [27] and…

Conclusion

We have successfully groomed a lead free $(1-x)K_{0.5}Na_{0.5}NbO_3–(x)MnFe_2O_4$ composites by solid-state reaction technique. The KNN and MFO phases coexist in the composites which were successfully confirmed from XRD, FE-SEM, EDX, FTIR, and RAMAN analysis. The frequency dependent dielectric behavior of the composites is assigned to the Maxwell–Wagner polarization, activated by the presence of heterogeneity in the composites. With the addition of MFO content in bare KNN, the DC resistivity of the…

CRediT authorship contribution statement

Kiran: Methodology, Investigation, Formal analysis, Writing - original draft, Writing - review & editing. **Krittika Thakur**: Methodology, Investigation. **Sanjeev Kumar**: Methodology, Investigation. **Shammi Kumar**: Methodology, Resources. **Nagesh Thakur**: Conceptualization, Supervision, Validation, Visualization, Writing - review & editing.…

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

Acknowledgements

The authors are thankful to Dr. R.K. Kotnala and Dr. Jyoti Shah, CSIR-National Physical Laboratory, New Delhi, India, for ME measurements. We would like to acknowledge National Institute of Technology Hamirpur, India for providing FTIR and RAMAN facilities. One of the authors, Kiran is thankful to Dr. Surender Lal and Mr. Ajeet Kumar for data fitting and fruitful discussion.…

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...The GO and MFO were separately prepared using improved Hummer's and sol-gel auto combustion techniques, respectively. The details of these synthesis techniques have been reported elsewhere [7,15]. For the synthesis of MFO@GO composites, the bare MFO synthesized by the sol-gel auto combustion method was decorated with different GO contents (10, 20, 30, and 40 wt%) by ultrasonication treatment....

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Structural, dielectric, and magnetic properties of reduced graphene oxide-wrapped MnFe<inf>2</inf>O<inf>4</inf> composites synthesized by in-situ sol-gel autocombustion method

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...It is seen that the magnitude of current density (J) increases with the applied electric field (E). The sharp sloppy current density in the low-field region is credited to the ohmic conduction mechanism, whereas less steep current density in the high electric field region is related to the space charge-limited conduction mechanism [19]. We observed that the leakage current density for MFO@rGO composites is one order higher than the bare MFO (Table 2)....

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Bi<inf>3.4</inf>Eu<inf>0.6</inf>Ti<inf>3</inf>O<inf>12</inf> /Ni<inf>0.7</inf>Cu<inf>0.3</inf>Fe<inf>2</inf>O<inf>4</inf> films annealed under different atmosphere with enhanced magnetoelectric coupling effect

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Effect of particle size of ferroelectric phase on multiferroic properties of MnFe<inf>2</inf>O<inf>4</inf>–PbZr<inf>0.52</inf>Ti<inf>0.48</inf>O<inf>3</inf> multiferroic liquid

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Physica B: Condensed Matter

Volume 610, 1 June 2021, 412803

Study of energy release in Fe_2O_3/Al nano-thermite with graphene as an additional fuel

Priya Thakur [a], Vimal Sharma [b], Nagesh Thakur [a]

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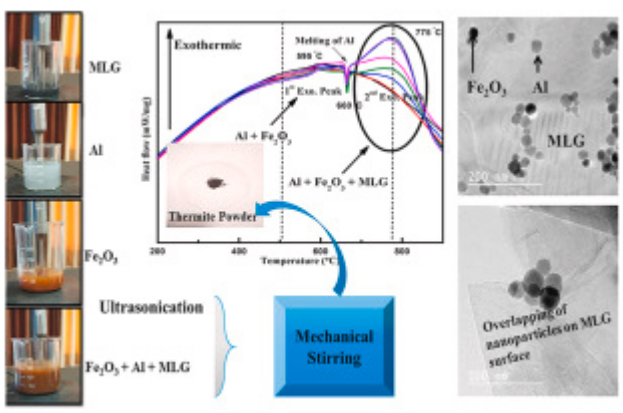
Abstract

In nano-thermites, due to improper contacts between the reactants in solid-state reaction, the complete energy release during redox-reaction is still challenging. Here, Fe_2O_3/Al nano-thermite is synthesized with different weight fraction of multi-layered graphene (MLG) nanoplatelets by physical mixing technique. X-ray diffraction reveals that the synthesis method does not change the phase of reactants. The morphology of nano-thermite is examined by scanning electron microscopy and transmission electron microscopy which reveals that MLG nanoplatelets are homogeneously dispersed in the samples. Structural stability of MLG nanoplatelets present in nano-thermite is observed by Raman spectroscopy. The nano-thermite reaction is analyzed by differential scanning calorimetry. The results show that an increase in MLG content in nano-thermite sample Al/Fe_2O_3, from 0wt% to 12wt% is responsible for increase in the corresponding exothermic enthalpy from 71J/g to 1537J/g. On the contrary, ignition temperature and activation energy of these samples get reduced with increasing MLG.

Graphical abstract



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Credit author statement

Priya Thakur: Methodology, Manuscript Writing-Original draft preparation. Dr. Vimal Sharma: Visualization, Reviewing, Editing and Supervision. Dr. Nagesh Thakur: Reviewing and Supervision.…

Sample preparation

Physical mixing method was adopted to synthesize nanopowders of Al/MLG/Fe_2O_3 thermites. This method involves the mixing of nanopowder of metal oxide, aluminium and MLG nanoplatelets in inert liquid using ultrasonic probe sonicator ((MAC-MSW347).

The ultrasonic waves help to break up the agglomerates and assist better mixing of fuel and oxidizer. The main advantage of this method is low-temperature synthesis which maintains chemical stability and chemical composition of constituents during the…

Structural and morphological analysis of Al/MLG/Fe_2O_3 nano-thermites

XRD pattern of (MLG, Al and Fe_2O_3) and Al/MLG/Fe_2O_3 nano-thermite with different weight percent of MLG (0–12 wt%) are shown in Fig. 1, Fig. 2. In the diffractograms (Fig. 1) only diffraction lines for α-Fe_2O_3 (PDF No. 39–1346) and Al (PDF no. 85–1327) and MLG (PDF No. 01–0646) are identified. In Fig. 2, it is evident that with an increase in the concentration of MLG in the Al/MLG/Fe_2O_3 thermite from (0–12 wt%), the graphitic peak around 26.4° (002) starts appearing. It is important to note that …

Conclusions

The Al/MLG/Fe_2O_3 nano-thermite samples are successfully synthesized by using physical mixing and ultrasonication techniques. The morphology study of prepared samples reveals the homogenous mixing of fuels (MLG, Al) and metal oxide (Fe_2O_3). Spectroscopy study shows the structure of MLG nanoplatelets, which remains stable during the whole synthesis process. The exothermic enthalpy of thermite reaction is observed to increase by increasing the weight content of MLG nanoplatelets in the Al/Fe_2O_3…

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

Acknowledgements

The authors would like to thanks Institute Instrumentation Centre (IIC), Indian Institute of Technology Roorkee for thermal characterization and Sophisticated Analytical Instrumentation Facility (SAIF), Punjab University for the structural characterizations.…

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Self-assembly preparation of advanced metastable MCo<inf>2</inf>O<inf>4</inf>/GO/Al (M=Cu, Mg, Zn, Ni) nanothermites to realize large heat release, stable combustion and high safety
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> *Citation Excerpt :*
>
> …Compared with the ignition processes of MCo2O4/GO/Al, the combustion processes of MgCo2O4/Al and NiCo2O4/Al are relatively intense. The above results suggest that GO plays a role in stabilizing combustion and improving the ignition performance via shortening the ignition delay time [46,47]. The flame propagation distance and the corresponding time interval are used to determine the flame propagation speed, and the ignition data are obtained and listed in Table 2.…

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> …Metal oxides can be used to modify nAl powder, which is commonly employed to make core-shell metastable composites [15]. For example, the prepared Al-Fe2O3 with core-shell structure by a sol-gel method can reduce the oxidization of nAl and increase its heat release [16], but the combustion agglomeration has not been significantly reduced. In fact, the modification layer on the Al surface is to prevent the molten Al reunion, so the size of large aggregates is also limited by the original Al particle size.…

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Direct ink writing of nAl/pCuO/HPMC with outstanding combustion performance and ignition performance
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> …Energetic materials are substance that can undergo a violent oxidation–reduction reaction and release a large amount of energy under a certain external energy stimulation [1–3].…

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Exothermic behaviour of aluminium and graphene as a fuel in Fe_2O_3 based nanothermite

Priya Thakur, Vimal Sharma and Nagesh Thakur

From the journal Zeitschrift für Naturforschung A
https://doi.org/10.1515/zna-2021-0051

Abstract

The main frontier of this research is to study the influence of multi-layer graphene (MLG) and aluminium as a fuel in Al/Fe_2O_3 and MLG/Fe_2O_3 nanothermites, fabricated by physical mixing and ultrasonication techniques. To study the structural and energy release properties, prepared samples were characterized by XRD, FESEM, EDS, FTIR, Raman spectroscopy and DSC. The X-ray diffraction (XRD) technique showed that all the phases remain intact during the synthesis. Field emission electron microscopy (FESEM) micrographs displayed the surface morphology of the samples, and besides this, energy dispersive spectroscopy (EDS) was used to check the elemental composition of samples. Raman spectroscopy revealed that the ultrasonication waves did not deteriorate the aromatic structure of graphene sheets. Fourier transform infrared spectroscopy (FTIR) spectra were used to observe the information about various functional groups present in the thermite samples. The exothermic energy released by the thermite reaction in both the samples was investigated by differential scanning calorimetry (DSC) and the observed values of energy release for Al/Fe_2O_3 and MLG/Fe_2O_3 are 215 J/g and 1640 J/g.

Keywords: energetic materials; energy release; multi-layered graphene; physical mixing; thermite reaction

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Author contribution: All the authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

Research funding: None declared.

Conflict of interest statement: The authors declare no conflicts of interest regarding this article.

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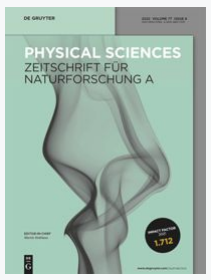

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Announcements

A Constitutive Modeling and Experimental Effect of Shock Wave on the Microstructural Sub-strengthening of Granular Copper

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Abstract

Micro-sized copper powder (99.95%; O≤0.3) has been shock-processed with explosives of high detonation velocities of the order of 7.5km/s to observe the structural and microstructural sub-strengthening. Axisymmetric shock-consolidation technique has been used to obtain conglomerates of granular Cu. The technique involves the cylindrical compaction system wherein the explosive-charge is in direct proximity with the powder whereas the other uses indirect shock pressure with die-plunger geometry. Numeric simulations have been performed on with Eulerian code dynamics. The simulated results show a good agreement with the experimental observation of detonation parameters like detonation velocity, pressure, particle velocity and shock pressure in the reactive media. A pin contactor method has been utilized to calculate the detonation pressure experimentally. Wide angled x-ray diffraction studies reveal that the crystalline structure (FCC) of the shocked specimen matches with the un-shocked specimen. Field emissive scanning electron microscopic examination of the compacted specimens show a good sub-structural strengthening and complement the theoretical considerations. Laser diffraction based particle size analyzer also points towards the reduced particle size of the shock-processed specimen under high detonation velocities. Micro-hardness tests conducted under variable loads of 0.1kg, 0.05kg and 0.025kg force with diamond indenter optical micrographs indicate a high order of micro-hardness of the order of 159H_v. Nitrogen pycnometry used for the density measurement of the compacts shows that a compacted density of the order of 99.3% theoretical mean density has been achieved.

Keywords: Shock waves, Wide angle x-ray diffraction, Microstructure, FE-SEM, Laser diffraction, Microhardness

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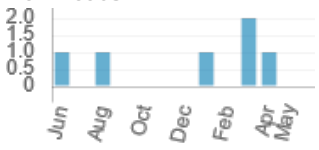

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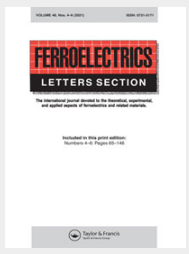

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Research Article

Optical induction in $K_{0.5}Na_{0.5}NbO_3$ ferroelectric ceramic at low calcination temperature by sol-gel route

Shammi Kumar, Mamta Shandilya & Nagesh Thakur

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Abstract

$K_{0.5}Na_{0.5}NbO_3$ ceramic was synthesized at low calcination temperature by sol-gel route. Structural properties of ceramic were investigated by X-ray diffractometer, FESEM and FTIR spectrometer. Electro-optical properties of ceramic were investigated by UV-Vis and PL spectrometer. Dielectric nature of ceramic was studied at different frequencies and temperatures which disclosed that ceramic has maximum dielectric permittivity at 500 KHz. AC conductivity analysis shows negative temperature coefficient of resistance behavior. Leakage current was studied up to 180 V which shows low value of leakage current at room temperature. Ferroelectric nature was analyzed at different electric fields (5–20 $kVcm^{-1}$) at 50 Hz.

Keywords: Sol-gel route | optical band gap | photoluminescence;dielectric constant | hysteresis loop

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Effect of alkali metal (Na, K) ion ratio on structural, optical and photoluminescence properties of $K_{0.5}Na_{0.5}NbO_3$ ceramics prepared by sol–gel technique

SHAMMI KUMAR & NAGESH THAKUR

Bulletin of Materials Science **44**, Article number: 51 (2021)

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Abstract

The method of preparation and its processing parameters have a strong effect on the structure and non-linear properties of the materials. A sol–gel technique is highly favoured owing to its lower production temperature, nanoparticle size, inter-diffusion of cations and cost-effectiveness. Sodium potassium niobate (KNN) is the most capable environmentally friendly material, which has been studied for the last decades as a promising candidate among all lead-free perovskites materials. In this article, we have prepared KNN ceramics by using the wet chemical sol–gel route. To control the volatility of (Na, K) ions at higher production temperature, we have added 10–20% (Na, K) alkali metal in the precursor solution. The phase investigation and crystalline character of the ceramics have been analysed by X-ray diffractometer. Raman spectroscopy analysis disclosed that pure KNN ceramic has a better crystalline and perovskite structure. FTIR analysis is done to analyse the presence of the functional group in the wavenumber range of 4000–500 cm^{-1}. The surface microstructure analysis and morphology of the KNN ceramics have been studied by using field emission scanning electron microscopy techniques. Further, the optical and photoluminescence behaviour has been studied at room temperature to know its practical applications in various electro-optic device applications.

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Microscopic study of the shell structure evolution in isotopes of light to middle mass range nuclides

Virender Thakur, Pankaj Kumar, Suman Thakur, Smriti Thakur, Vikesh Kumar, Shashi K. Dhiman

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Abstract

Shell structure evolution in isotopes (even Z and even N) of Silicon (Si), Sulphur (S), Argon (Ar) and Calcium (Ca) has been analysed. We have used both Relativistic Hartree-Bogoliubov theory and Non-Relativistic Hartree-Fock-Bogoliubov theory for the theoretical calculations of the physical observables of interest. We have employed the model based on Relativistic Hartree-Bogoliubov theory with the density dependent effective interactions of meson exchange and point coupling types. Calculations based on Hartree-Fock-Bogoliubov theory are carried out with different skyrme forces and their sensitivity has been tested. Physical observables of interest include binding energies, single neutron separation energies, two-neutron separation energies, shell closure parameter D_n (Z, N) and differential variation dS_{2n}(Z, N) based on two neutron separation energy. Our theoretical results gives indication of shell closure at neutron number N =14 and neutron number N = 20 for the nuclei of Silicon (Si). Shell closures at neutron numbers N = 14, 20 and neutron number N = 28 are observed for Sulphur (S) nuclides. Argon (Ar) and Calcium (Ca) isotopes also provides the signature of shell closures at neutron numbers N = 20 and neutron number N = 28.

Introduction

One of the key problem in nuclear physics is the understanding of atomic nucleus due to the complexity of the many body system. Certain configurations of nucleons (magic numbers) in nucleus are observed to be more stable (magic nuclei). The study of those special nuclei (magic nuclei) near the dripline is an active and open area of research in the field of nuclear structure physics [1]. The nuclei which are away from the β-stability line, play an important role in the understanding of nuclear physics. The production of the new isotopes [2], [5] in recent years has revived a great interest in nuclear structure models. This has also provoked the facilities like radioactive ion beam (RIB) technologies, ultrasensitive and sophisticated detectors as well [3], [4]. Till today, very little information is available about those nuclei which are lying near driplines (exotic or halo nuclei).

It is also true that the undiscovered nuclei that are stable and forms bound system are very large in number and we can not study all of them but we are able to make an effective step by examining a few of them. We have chosen Silicon (Si), Sulphur (S), Calcium (Ca) and Argon (Ar) nuclei for our study as a lot of research work already has been done on these mentioned nuclei recently [2], [39], [22]. The microscopic study of nuclei is of great interest for astrophysics field also. As Silicon (Si), Sulphur (S), Argon (Ar) and Calcium (Ca) nuclides also become experimentally accessible, so they can prove to be a testing ground for the study of exotic nuclei. In light to middle mass nuclei, the departure from the regular magic numbers and arrival of new magic numbers between the region of drip lines and the line of the stability is compelling problem in the nuclear structure physics, especially of exotic nuclei [6], [7]. The conventional or the regular picture of the magic numbers to which we are generally familiar, is no longer valid to the many exotic nuclides both in theoretical and experimental extractions as reported in ref. [8], [9], [10], [11], [12], [13], [14]. Some of the authors in references [49], [50], [51], [53] have examined theoretically and experimentally, the indication of the Neutron number N = 34 as the shell closure in the isotopes of Ca and Ti. HFB theory has been continuously used to study the nuclear structure properties of various nuclides which are part of the periodic table [45], [46], [47], [48].

To study the physics of shell structure evolution in exotic neutron-rich and magic-nuclei of Silicon (Si), Sulphur (S), Argon (Ar) and

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Calcium (Ca) isotopes away from the stability line, we have performed our theoretical calculations with Hartree-Fock-Bogoliubov (HFB) theory enriched by the Skyrme effective interactions [15], [16]. The nuclear many-body dynamics can also be understood very well by using Covariant Density functional theory and its successes and the applications can be found in references [52]. CDFT is the more general expression and it simply means 'covariant density functional theory', i.e. density functional theory in a covariant form. On the other hand, RHB is the relativistic version of Hartree-Fock-Bogoliubov theory introduced originally for a non-relativistic Hamiltonian. As we distinguish in the non-relativistic case Hartree-Fock, Hartree+BCS and full Hartree-Bogoliubov (or HF, HF+BCS, HFB) models, we also distinguish in the relativistic case RMF, RMF+BCS and RHB models. All of these are special cases of CDFT. In our manuscript, Relativistic Hartree-Bogoliubov (RHB) model [54] with density dependent effective interactions of types point coupling (DD-PCX [36] and DD-PC1 [30]) and meson exchange (DD-ME2 [29]). Effective interactions are employed with the inclusion of separable pairing interaction [17], [18], [35]. RHB theory has been tested several times and its successes involes the appreciable description of nuclei near the drip lines (exotic nuclides) [55], [56], [57], [58], [60]. It has also been used to study the deformed exotic nuclides as reported in references [61], [62], [63], [64]. Studies related to the shell structure and shell closure based on Covariant DFT are also available in literature [65], [66], [67]. All these studies make this theory really a promising one to investigate the many body systems. In this presented work, we have theoretically calculated the results for Single neutron separation energies, two neutron separation energies and shell closure parameters.

The organisation of the presented paper is as follows. An overview of HFB theory and RHB theory with employed effective interactions is presented in Section 2. In the Section 3, the results for our theoretical calculations are shown and also compared with the recently experimental data. The results in the present work are summarized in Section 4.

Section snippets

Theoretical framework

This presented work is carried out with the use of the theoretical models based upon Hartree-Fock-Bogoliubov [19], [20], [15] and Relativistic Hartree Bogoliubov (RHB) Theory [21]. A brief discussion of these models is given below.…

Numerical details

The theoretical calculations are carried out within the framework of HFB theory and RHB theory discussed briefly in the previous section. HFB Calculations are carried out for different skyrme parameterizations by using the HFB code [15] with harmonic oscillator basis. RHB calculations are computed with DIRHB code [17]. Spherical approximation is adopted for the nuclear shape in our RHB and HFB calculations with the center of mass correction $E_{cm} = -P_{cm}^2/2Am$, where P_{cm} is the total momentum of…

Results and discussions

We present our computed results of Binding Energies, single neutron separation energies S_n(Z, N), shell closure parameter $D_n(Z,N)$, two neutron separation energies S_{2n}(Z, N) and the differential variation of the two-neutron separation energy $dS_{2n}(Z,N)$ for the isotopic chains of Si, S, Ar and Ca nuclides.…

Conclusions

We have got some of the very important conclusions based upon our theoretical estimations presented in this paper by employing Nuclear Density Functionals based on Relativistic-Hartree-Bogoliubov (RHB) and Hartree-Fock-Bogoliubov (HFB) theory with the different parameterizations discussed briefly in the previous sections. The evolution of shell structures in the even-even isotopes of Silicon, Sulphur, Argon and Calcium has been extensively analysed. The physical quantities such as $D_n(N)$ and dS_{2n}…

Declaration of Competing Interest

This Statement is to certify that all Authors have seen and approved the manuscript being submitted. We warrant that the article has not received prior publication and is not under consideration for publication elsewhere. On behalf of all co-authors, The corresponding Author shall bear full responsibility for the submission.…

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...Many theoretical models like the self-consistent mean-field models with the Skyrme and the Gogny force [4–7], relativistic mean-field (RMF) model [8–11] and the IBM (interacting boson model) [12,13] are used to understand the evolution of structure in these nuclei. The nuclear density functional theories are used to understand nuclear many-body dynamics for an appreciable description of the nuclei near drip lines [14–20]. Recently, a dual-shell mechanism for the phenomenon of shape coexistence is introduced which include all mass regions [21], which predicts that shape coexistence cannot appear everywhere on nuclear chart, but only within the islands of shape coexistence whose limits are determined through group theoretical arguments without any free parameters....

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Abstract

We have done the microscopic study of neutron-rich odd-odd iodine isotopes within the framework of projected shell model. Odd-odd nuclei are the best candidates for studying possible structure variations away from the valley of stability. We used the projected shell model, in which the deformed Nilsson single-particle states are being used for the construction of model basis. We studied the band properties of odd-odd I (Z= 53) isotopes with neutron numbers N= 75, 77, 79, 81, 83 and 85. Using model analysis, we presented the low-lying positive- and negative-parity states of these nuclei. In these isotopes, the band structures have been analyzed in terms of quasi-particle configurations and comparative presentation of yrast levels is discussed. The phenomenon of yrast energy splitting is also studied in this work.

Keywords: Projected shell model ▪ band structure ▪ yrast line ▪ yrast energy splitting

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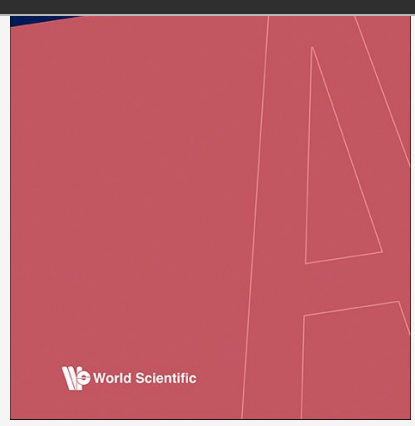

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PAPER

Microscopic study of shape evolution and ground-state properties of Iodine isotopes

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Abstract

In this paper, we investigated the shape evolution and ground-state properties of $^{108-144}$I isotopes using Hartree–Fock-Bogoliubov Model while employing the axially deformed single-particle harmonic oscillator basis for the expansion of quasiparticle wave functions. We have used SKP and UNEDF2 models to perform the theoretical calculations. We have presented the shape evolution and final values of the quadrupole deformation parameter β_2 of iodine isotopes. We have used the final values of the β_2 for studying the ground-state properties of the iodine isotopic chain. The investigated ground-state properties are the nuclear electric quadrupole moment, single-particle energy levels, the binding energy per nucleon, pairing energy, one-neutron separation energy, two-neutron separation energy, nuclear charge radius, neutron rms radius, proton rms radius, and neutron skin thickness. After using the SKP parameterization on ^{109}I, we have observed the shape coexistence of prolate and oblate shape. Similarly, after using the UNEDF2 parameterization on ^{110}I, ^{112}I, ^{114}I, ^{115}I, ^{116}I, ^{117}I, ^{118}I, and ^{119}I, we discover the shape coexistence of prolate and oblate shape.

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Nuclear shape evolution and shape coexistence in Zr and Mo isotopes

Pankaj Kumar, Virender Thakur, Smriti Thakur, Vikesh Kumar & Shashi K. Dhiman

The European Physical Journal A **57**, Article number: 36 (2021)

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Abstract

The phenomena of shape evolution and shape coexistence in even–even $^{88-114}$Zr and $^{90-116}$Mo isotopes are studied by employing covariant density functional theory (CDFT) with density-dependent point-coupling parameter set, DD-PCX, and with separable pairing interaction. The results for the rms deviation in binding energies, two-neutron separation energy, the differential variation of two-neutron separation energy, and rms charge radii, as a function of neutron number, are presented and compared with available experimental data. In addition to the oblate–prolate shape coexistence in $^{96-110}$Zr isotopes, the correlations between shape transition and discontinuity in the observables are also examined. A smooth trend of charge radii in Mo isotopes is found to be due to the manifestation of triaxiality softness. The observed oblate and prolate minima are related to the low single-particle energy level density around the Fermi level of neutron and proton, respectively. The rapid shape transition in Zr isotopes near $N \approx 60$ is identified to be caused by the evolution of the shell structure associated with massive proton excitations to $1\pi g_{9/2}$ orbit. The present calculations also predict a deformed semi-bubble structure in the ^{100}Zr isotope.

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This manuscript has associated data in a data repository. [Authors' comment: Some of the data are given in the Tables of this article. However, all the data are available upon request by contacting the corresponding author.]

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ABSTRACT

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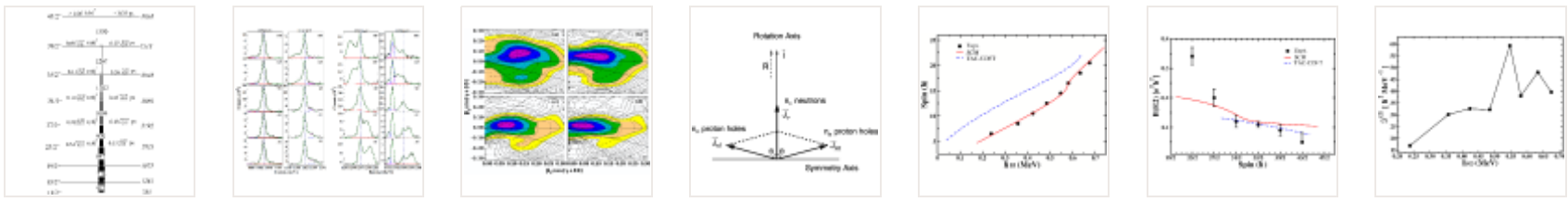
ABSTRACT

Lifetime measurements have been carried out for the levels of the negative parity yrast sequence in $^{103}\mathrm{Pd}$ nucleus using the Doppler shift attenuation method. The levels were populated via $^{94}\mathrm{Zr}\left(^{13}\mathrm{C},\ 4n\gamma\right)^{103}\mathrm{Pd}$ fusion-evaporation reaction at a beam energy of 55 MeV. De-exciting γ rays were detected by utilizing the Indian National Gamma Array. The extracted transition probabilities and other auxiliary observations indicate that the sequence may be resulting from the antimagnetic rotational (AMR) motion of valence nucleons. The key characteristic feature of the AMR motion is the steady decrease of the $B(E2)$ transition probability with spin, which is seen in the present measured transitions for $^{103}\mathrm{Pd}$. The experimental results are compared with the theoretical predictions of tilted axis cranked approach based on the covariant density functional theory. It is noted that the properties of the AMR band structure for $^{103}\mathrm{Pd}$ predicted in this model analysis are in good agreement with the present experimental findings. Further, semi-classical particle-rotor model has been employed to substantiate the AMR interpretation of the observed band structure in $^{103}\mathrm{Pd}$ and it is shown that results are similar to the band structures observed in the neighboring isotopes, which have also been considered as candidates for AMR motion.



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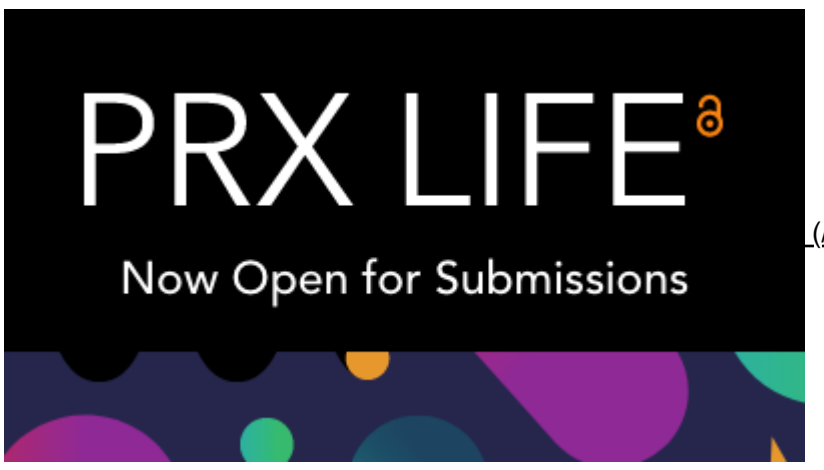

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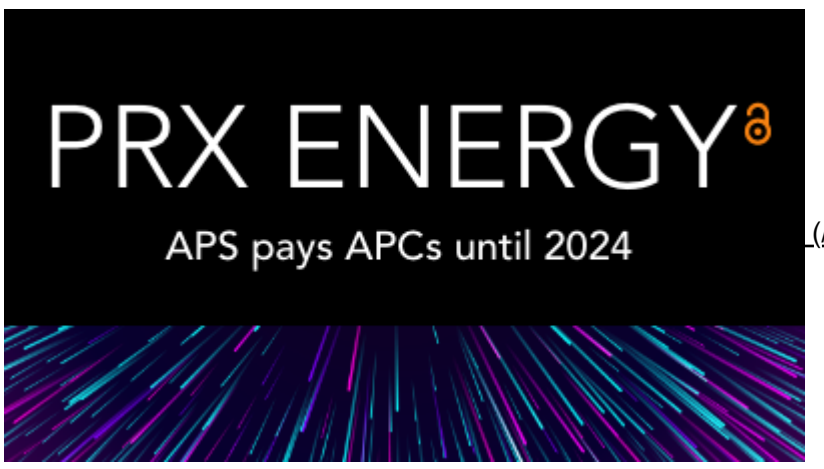

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EVOLUTION OF NUCLEAR SHAPES IN LIGHT NUCLEI FROM PROTON- TO NEUTRON-RICH SIDE

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The relativistic Hartree–Bogoliubov (RHB) model with density-dependent meson-exchange interaction and separable pairing is employed to study the shape evolution and shape coexistence in Mg ($Z = 12$), Si ($Z = 14$), S ($Z = 16$), and Ar ($Z = 18$) isotopes from proton-rich side to neutron-rich side. A sudden shape transition is observed in these isotopic chains. A reasonable agreement of quadrupole deformation is found with the finite range droplet model (FRDM). Our findings of binding energies, quadrupole deformation parameter, charge radii, and isotope shifts are also in good agreement with the results of Hartree–Fock–Bogoliubov calculations based on the D1S-Gogny force. In addition to shape evolution, the disappearance of $N = 28$ shell closure and onset of deformation is also observed towards the neutron-rich side. The modification of $N = 28$ shell gap is related to the quadrupole excitations across it. The present calculations infer the neutron drip line at ^{40}Mg.

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1. Intoduction

The study of nuclei far from the β-stability line (exotic nuclei) is a devoted part of modern nuclear-structure studies. The limit of nuclear existence is reached while going away from the stability line. Nuclear drip lines form the edges of the nuclear chart and are defined as limits beyond which a single nucleon becomes unbound in the nuclear ground state. The advancement in Radioactive Ion Beam (RIB) facilities and sensitive detection technologies has made it accessible to study the structure and properties of these nuclei.

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The evolution of ground-state shape from proton-rich side to neutron-rich side is a frontier area in nuclear physics. The shape evolution in isotonic or isotopic chains has been investigated consistently by various theoretical and experimental techniques. The results obtained from the electron and in-beam spectroscopy experiment reveal the prolate-spherical shape coexistence for ^{44}S, with intruder configuration being the ground state [1, 2]. This intruder ground state was predicted to be due to the quadrupole excitation across the $Z = 14$ and $N = 28$ shell gaps. An exhaustive study of the evolution of shapes and other ground-state properties in light nuclei is done in Ref. [3]. They have employed relativistic mean-field (RMF) theory with NL-SH force and with BCS pairing in the calculations. The nuclear deformation in light even–even isotopes has been investigated with the Hartree–Fock–Bogoliubov (HFB) model using SLy4 Skyrme parameterization [4]. The relation between single-particle motion and potential energy surfaces has been studied by taking deformation into account. The large-amplitude collective dynamics of shape phase transition in the low-lying states of $^{30-36}$Mg and shape coexistence in excited 0^+ state in ^{32}Mg has been investigated in Refs. [5, 6], respectively. The study of shape evolution for $^{28-42}$Si isotopes has been done within the framework of the Skyrme–Hartree–Fock model by employing BCS approximation for the pairing channel [7]. Shape coexistence and triaxial deformation in Ne, Na, Mg, and Al isotopes have also been studied by Davies *et al.* [8]. One of the prominent subjects in the study of nuclear structure of exotic nuclei, in the light region, is the evanescence of the traditional magic numbers and the emergence of new ones. The weakening of the $N = 28$ shell closure and the development of deformation has been observed in low-energy Coulomb excitation experiments [9–11]. Their study indicated a prolate shape of the ^{44}Ar nucleus by calculating B(E2) values and the spectroscopic quadrupole moment of the 2_1^+ state from the differential Coulomb excitation cross sections. Many theoretical studies have been done on the shape evolution in $N = 28$ isotones and reduction of shell gaps [12–15].

The nuclear density functional theories have been used to understand nuclear many-body dynamics for an appreciable description of nuclei near the drip lines [16–22]. The RHB model has been employed to study shell structure of Si, S, Ar, and Ca isotopes in recent papers [18–20]. In these papers, binding energies and their derivative properties have been studied by taking considering spherical symmetry. Their results indicate the presence of $N = 14$ sub-shell closure and also reproduce the traditional magic numbers ($N = 8$, 20, and 28). However, to throw some light on the effect of deformation on light nuclei from proton to neutron-rich side, we have performed quadrupole constrained RHB calculations using density-dependent meson exchange (DD-ME2) parameter set [23] with pairing interaction which is

separable in momentum space. An extensive study of shape evolution and shape coexistence is done for Mg, Si, S, and Ar even–even isotopes. The other ground-state observables are also studied. The present calculations do not provide any indication about $N = 14$ sub-shell closure in these isotopes rather, the disappearance of $N = 28$ shell closure is observed. In the present manuscript, we have briefly presented the impact of deformation on the shell structure of even–even Mg, Si, S, and Ar isotopes.

The organization of this paper is as follows: A brief description of the RHB model with meson-exchange coupling and with separable pairing is presented in Section 2. Results and discussion for shape evolution and various ground-state observables, compared with experimental data, are presented in Section 3. Finally, the concluding remarks of the present analysis are given in Section 4.

2. Theoretical framework

Self-consistent mean-field (SCMF) models provide a very successful tool to study nuclear ground-state properties and excited-state properties from the valley of β-stability to the nuclear drip lines throughout the entire nuclear chart. These models are based on the nuclear energy density functionals (EDF) in which the nucleons are treated as independent particles moving inside the nucleus under the influence of potentials that are derived from such functionals [24]. In the relativistic case, the nucleons are treated as Dirac spinors that interact by the exchange of virtual mesons, as described by Refs. [25–29].

2.1. Lagrangian density for the meson exchange models

The total Lagrangian density of mesons exchange model can be written as [23, 30]

$$\begin{aligned}\mathcal{L} \;=\; & \sum_i \bar{\psi}_i(i\gamma_\mu\partial^\mu - m)\psi_i + \tfrac{1}{2}\partial_\mu\sigma\partial^\mu\sigma - \tfrac{1}{2}m_\sigma^2\sigma^2 - \tfrac{1}{2}\Omega_{\mu\nu}\Omega^{\mu\nu} \\ & + \tfrac{1}{2}m_\omega^2\omega_\mu\omega^\mu - \tfrac{1}{4}\vec{\boldsymbol{R}}_{\mu\nu}\vec{\boldsymbol{R}}^{\mu\nu} + \tfrac{1}{2}m_\rho^2\vec{\rho}_\mu\cdot\vec{\rho}^\mu - \tfrac{1}{4}\boldsymbol{F}_{\mu\nu}\boldsymbol{F}^{\mu\nu} \\ & - g_\sigma\bar{\psi}\psi\sigma - g_\omega\bar{\psi}\gamma^\mu\psi\omega_\mu - g_\rho\bar{\psi}\vec{\tau}\gamma^\mu\psi\cdot\vec{\rho}_\mu - e\bar{\psi}\gamma^\mu\psi A_\mu\,, \end{aligned} \tag{1}$$

where m denotes the bare mass of nucleon and ψ denotes the Dirac spinors. m_σ, m_ω, m_ρ are masses of σ, ω, ρ mesons with corresponding coupling constants g_σ, g_ω, g_ρ for the mesons to the nucleons, respectively. $\Omega_{\mu\nu}$, $\vec{R}_{\mu\nu}$, $F_{\mu\nu}$ are field tensor of the vector fields ω, ρ, and the photon. Arrows denote isovectors and boldface symbols are used for vectors in ordinary space.

From the Lagrangian density in Eq.(1), one can obtain the Hamiltonian density $\mathcal{H}(\boldsymbol{r})$ and hence obtain the total energy which depends on the Dirac spinors and the meson fields by integrating the Hamiltonian density over the r-space [31]

$$\begin{aligned}\mathcal{E}_{\mathrm{RMF}}\left[\psi,\bar{\psi},\sigma,\omega^{\mu},\vec{\rho}^{\,\mu},A_{\mu}\right] &= \int \mathrm{d}^3r\mathcal{H}(\boldsymbol{r}) = \sum_{i=1}^{A}\int \mathrm{d}^3r\psi_i^{\dagger}(\boldsymbol{\alpha p}+\beta m)\psi_i \\ &+\frac{1}{2}\int \mathrm{d}^3r\left((\nabla\sigma)^2+m_{\sigma}^2\sigma^2\right)-\frac{1}{2}\int \mathrm{d}^3r\left((\nabla\omega)^2+m_{\omega}^2\omega^2\right) \\ &-\frac{1}{2}\int \mathrm{d}^3r\left((\nabla\rho)^2+m_{\rho}^2\rho^2\right)-\frac{1}{2}\int \mathrm{d}^3r(\nabla A)^2 \\ &+\int \mathrm{d}^3r\left(g_{\sigma}\rho_s\sigma+g_{\omega}j_{\mu}\omega^{\mu}+g_{\rho}\vec{j}_{\mu}\cdot\vec{\rho}^{\,\mu}+ej_{p\mu}A^{\mu}\right). \end{aligned} \tag{2}$$

The single-nucleon Dirac equation is derived by variation of the energy density functional (2) with respect to $\bar{\psi}$ and takes a simple form that includes only the vector potential $V(\boldsymbol{r})$ and the effective mass $M^*(\boldsymbol{r}) = m + g_{\sigma}\sigma$

$$\{-i\boldsymbol{\alpha}\nabla+\beta M^*(\boldsymbol{r})+V(\boldsymbol{r})\}\psi_i(\boldsymbol{r}) \;=\; \epsilon_i\psi_i(\boldsymbol{r})\,. \tag{3}$$

The vector potential reads

$$V(\boldsymbol{r}) = g_{\omega}\omega+g_{\rho}\tau_3\rho+eA_0+\Sigma_0^{\mathrm{R}}\,, \tag{4}$$

where Σ_0^{R} denotes the rearrangement term arising from the density dependence of the vertex functions (g_{σ}, g_{ω} and g_{ρ}) and is defined as

$$\Sigma_0^{\mathrm{R}} = \frac{\partial g_{\sigma}}{\partial\rho_v}\rho_s\sigma+\frac{\partial g_{\omega}}{\partial\rho_v}\rho_v\omega+\frac{\partial g_{\rho}}{\partial\rho_v}\rho_{tv}\rho\,. \tag{5}$$

ρ_{tv} denotes the isovector density which is the difference between the proton and the neutron vector density. The functionals are described by density-dependent coupling constants $g_i(\rho)$ (for $i = \sigma,\omega,\rho,\delta$). The coupling of σ field and ω field to the nucleon field is given by [32–34]

$$g_i(\rho) = g_i(\rho_{\mathrm{sat}})f_i(x) \quad \text{for} \quad i=\sigma,\omega \tag{6}$$

with

$$f_i(x) = a_i\frac{1+b_i(x+d_i)^2}{1+c_i(x+d_i)^2} \tag{7}$$

which is a function of $x = \rho/\rho_{\mathrm{sat}}$. Here, ρ_{sat} ($= 0.152$ fm^{-3}) is the baryon density at saturation in symmetric nuclear matter.

For density dependence of ρ-meson coupling, Dirac–Brueckner suggested the functional form [35], given by

$$g_{\rho}(\rho) = g_{\rho}(\rho_{\mathrm{sat}})\mathrm{e}^{-a_{\rho}(x-1)}\,. \tag{8}$$

The isovector channel is parameterized by $g_{\rho}(\rho)$ and a_{ρ}.

2.2. Relativistic Hartree–Bogoliubov approximation with a separable pairing interaction

The incorporation of pairing correlations is important to understand the structure phenomena in open shell nuclei quantitatively [36, 37]. The formulation of RHB model is found to be a relativistic extension of the HFB model in which mean-field and pairing correlations are treated self-consistently. The RHB model provides a unified description of particle–hole (*ph*) and particle–particle (*pp*) correlations on a mean-field level by using the average self-consistent mean-field potential that encloses the long-range *ph* correlations and a pairing field potential which sums up the *pp* correlations. In the RHB model, density matrix in the presence of pairing can be generalized in two densities, the normal density $\hat{\rho}$, and pairing tensor $\hat{\kappa}$. The relativistic Hartree–Bogoliubov energy density functional can be written as

$$E_{\mathrm{RHB}}[\hat{\rho},\hat{\kappa}] = E_{\mathrm{RMF}}[\hat{\rho}] + E_{\mathrm{pair}}[\hat{\kappa}]\,, \tag{9}$$

where $E_{\mathrm{RMF}}[\hat{\rho}]$ is the nuclear energy density functional and is given in Eq. (2). The pairing part of RHB functional is given by

$$E_{\mathrm{pair}}[\hat{\kappa}] = \frac{1}{4}\sum_{n_1 n_1'}\sum_{n_2 n_2'} \kappa^*_{n_1 n_1'} \left\langle n_1 n_1' \middle| V^{\mathrm{PP}} \middle| n_2 n_2' \right\rangle \kappa_{n_2 n_2'}\,, \tag{10}$$

where $\left\langle n_1 n_1' | V^{\mathrm{PP}} | n_2 n_2' \right\rangle$ are the matrix elements of the two-body pairing interaction, and indices n_1, n_1', n_2, and n_2' denote quantum numbers that specify the Dirac indices of the spinor. The quasiparticle wave functions U_k and V_k are obtained by the variational principle from the solution of relativistic Hatree–Bogoliubov equations. In coordinate representation

$$\begin{pmatrix} h_{\mathrm{D}} - m - \lambda & \Delta \\ -\Delta^* & -h^*_{\mathrm{D}} + m + \lambda \end{pmatrix} \begin{pmatrix} U_k(r) \\ V_k(r) \end{pmatrix} = E_k \begin{pmatrix} U_k(r) \\ V_k(r) \end{pmatrix}. \tag{11}$$

In the self-consistent relativistic mean-field calculation, $\hat{h}_{\mathrm{D}}$ is the single-nucleon Dirac Hamiltonian and m is the mass of nucleon. The λ chemical potential is determined by the particle number subsidiary condition such that the expectation value of the particle number operator in the ground state equals the number of nucleons. The pairing field Δ reads

$$\Delta_{n_1 n_1'} = \frac{1}{2}\sum_{n_1 n_2'} \left\langle n_1 n_1' \left| V^{\mathrm{PP}} \right| n_2 n_2' \right\rangle \kappa_{n_2 n_2'}. \tag{12}$$

The pairing force is separable in momentum space and in r-space has the form of

$$V^{\mathrm{PP}}\left(\boldsymbol{r_1}, \boldsymbol{r_2}, \boldsymbol{r_1'}, \boldsymbol{r_2'}\right) = -G\delta\left(\boldsymbol{R} - \boldsymbol{R'}\right) P\left(\boldsymbol{r}\right) P(\boldsymbol{r'})\,, \tag{13}$$

where $\boldsymbol{R} = \frac{1}{\sqrt{2}}(\boldsymbol{r_1} + \boldsymbol{r_2})$ and $\boldsymbol{r} = \frac{1}{\sqrt{2}}(\boldsymbol{r_1} - \boldsymbol{r_2})$ represent the center of mass and the relative coordinates, respectively, and the form factor $P(\boldsymbol{r})$ is of the Gaussian form written as

$$P(\boldsymbol{r}) = \frac{1}{(4\pi a^2)^{3/2}} \mathrm{e}^{-r^2/2a^2} . \tag{14}$$

The two parameters G and a have been adjusted to reproduce the density dependence of gap at the Fermi surface. The values of these parameters in the present work are taken as $G = 728$ MeV fm^3 and $a = 0.644$ fm for protons and neutrons. It is derived in Refs. [36, 38–40] calculated with the DIS Gogny force. The pairing force has a finite range and also it conserves translational invariance due to the presence of the factor $\delta(\boldsymbol{R} - \boldsymbol{R'})$. Even though this force is not completely separable in coordinate space, however, the anti-symmetrized *pp* matrix elements can be represented as a sum of a finite number of separable terms in the harmonic oscillator basis

$$\left\langle n_1 n_2 \left| V^{\mathrm{PP}} \right| n_1' n_2' \right\rangle_a = \sum_N W^{N*}_{n_1 n_2} W^N_{n_1' n_2'} . \tag{15}$$

The pairing field Δ, in this case, takes the form

$$\Delta_{n_1 n_2} = \sum_N P_N W^{N*}_{n_1 n_2} \quad \text{with} \quad P_N = \frac{1}{2} \mathrm{Tr}\left(W^N \kappa\right) , \tag{16}$$

and finally, the pairing energy in the nuclear ground state is given by

$$E_{\mathrm{pair}} = -G \sum_N P^*_N P_N . \tag{17}$$

The total energy E_{tot} [MeV] for the nuclear system with A (mass number) nucleons can be calculated as [41]

$$E_{\mathrm{tot}} = E_{\mathrm{RMF}} + E_{\mathrm{pair}} + E_{\mathrm{cm}} . \tag{18}$$

Here, E_{cm} accounts for the center-of-mass correction and is given as $E_{\mathrm{cm}} = -\frac{\langle \boldsymbol{P}^2 \rangle}{2Am}$, where $\langle \boldsymbol{P} \rangle = \sum_i^A \boldsymbol{p_i}$ is the total momentum of the nucleus in the center-of-mass frame with A nucleons [42].

2.3. Details of calculations

The pairing correlations play an important role in the understanding of ground-state properties of the open-shell nuclei. Pairing has been included in the relativistic Hartree–Bogoliubov model in the form of simple constant

gap approximation, where the pairing gap Δ is obtained from odd–even mass differences. The input parameters required to carry out explicit numerical calculations are [26]: *(i)* the baryon and meson masses m, m_σ, m_ω, and m_ρ; *(ii)* the coupling constants of the meson fields to the nucleons g_σ, g_ω, and g_ρ; *(iii)* the number of oscillator shells for fermions and bosons (N_F and N_B); *(iv)* the basis parameters used for the expansion of the Dirac spinor and the meson fields. The meson masses and the coupling constants, calculated using χ^2 fitting procedure, for the DD-ME2 interaction are

$$\begin{aligned} M &= 939 \text{ MeV}, & m_\sigma &= 550.1238 \text{ MeV}, & m_\omega &= 783 \text{ MeV}, \\ m_\rho &= 763 \text{ MeV}, & g_\sigma &= 10.5396, & g_\omega &= 13.0189, \\ g_\rho &= 3.6836. \end{aligned}$$

For the calculations of the shape evolution and ground-state properties, we have used the DIRHBZ numerical code developed by Nikšić *et al.* [31].

In the mean-field formalism, the maximum number of harmonic oscillator shells in the expansion of fermion and boson fields have to be used to achieve a reliable convergence. However, the computation time increases dramatically with the increase in number of shells. This problem can be tackled by limiting the number of shells, that can be done by studying the convergence behavior. In the present work, we have chosen $N = 28$ isotones of Mg, Si, S, and Ar to obtain the reliable values of binding energy per nucleon, charge radius ($R_{\rm ch}$), and quadrupole deformation parameter (β_2) by performing calculations with the number of oscillator shells ranging from $N_F = N_B = 12$–20. Figure 1 presents the results of total binding energy, binding energy per nucleon (E/A), charge radius ($R_{\rm ch}$), and quadrupole deformation parameter, β_2 (*optimized for each constrained value of deformation parameter*) as a function of the number of oscillator shells ($\boldsymbol{N}$). The variation of binding energy with an increase in number of oscillator shells is 0.12% for ^{40}Mg while, this variation is around 0.03% for $N = 28$ isotones of Si, S, and Ar. The increase of $N_F = N_B$ from 12 to 20 changes the E/A by about 0.12–0.03% and $R_{\rm ch}$ by 0.14–0.06%, while quadrupole deformation parameter β_2 by 2–4% for these isotones of $N = 28$. Therefore, to save computation time and to obtain reasonably converging mean-field solutions, 12 major oscillator shells are adopted in the present study.

In principle, the harmonic oscillator (HO) basis has served as an extremely useful tool in the nuclear structure study. However, for weakly bound systems with large spatial extension, it does not work due to its localization [43]. One has to use extremely large major oscillator shells to reproduce the density of a weakly bound nucleus, which is not feasible in practice (see Figs. 1 and 2 in Ref. [43]). The RHB equations are solved in coordinate space for the description of halo nuclei [44–46]. Later on, it was

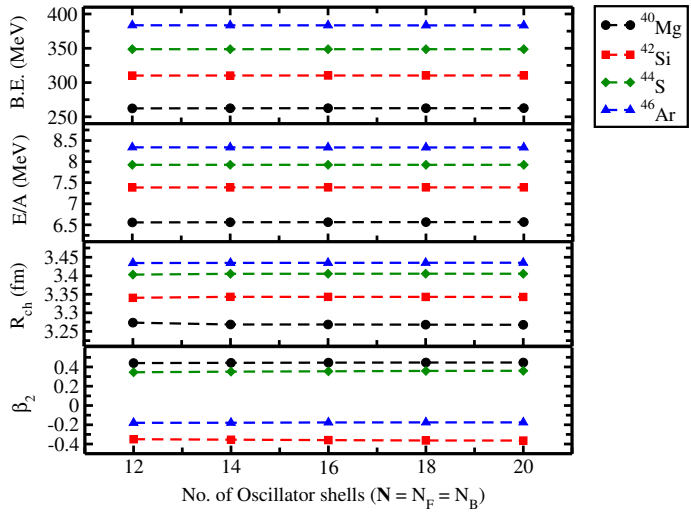

Fig. 1. The results of convergence study of the total binding energy, binding energy per nucleon, charge radii ($R_{\rm ch}$), and quadrupole deformation parameter (β_2) for $N=28$ isotone of Mg, Si, S, and Ar nuclei as a function of oscillator shells ($\boldsymbol{N}=N_F=N_B$).

observed that the solution of RHB equations in Woods–Saxon (WS) basis provides a successful description of drip-line nuclei [47–50] where the radial wave function has a proper asymptotic behavior at a large distance from the center. Therefore, the WS basis is recommended over the HO basis for solving RHB equations in weakly bound systems.

3. Results and discussion

3.1. Quadrupole deformation and shape coexistence

The main purpose of the present work is to study the deformation systematics in light nuclei from proton-rich side to neutron-rich side. We have performed axially constrained RHB calculations using DD-ME2 parameter set for the entire isotopic chain of Mg, Si, S and Ar to obtained the variation of binding energies with respect to quadrupole deformation parameter β_2. In mean-field approximations, the quadrupole deformation parameter β_2 is related to intrinsic quadrupole moment Q_{20} and is defined as

$$\beta_2 = \sqrt{\frac{5\pi}{9}}\frac{Q_{20}}{AR_0^2}, \tag{19}$$

with $R_0 = 1.2A^{1/3}$. The resulting plots of total energy *versus* quadrupole deformation are called potential energy curves (PECs). The analysis of

shape evolution starts with a self-consistent relativistic Hartree–Bogoliubov (RHB) calculation of quadrupole binding energy curves. It has been studied in Ref. [50] that at the local minimum in the PEC, the constrained and the unconstrained solutions are identical. One would have the same ground state with the self-consistent unconstrained calculations. Sometimes, however, the constrained calculations are also necessary for a soft PEC, or if many local minima are close to each other. We have used a small step of deformation in the present calculations to obtain the ground state of various nuclei. Due to this small deformation step, the ground state can be found to be very close to the real ones obtained by unconstrained calculations.

Figures 2–5 show the potential energy curves (PECs) for even–even isotopes of Mg, Si, S, and Ar, respectively. The energies are normalized with respect to the total energy of the absolute minima. Figure 2 presents the PECs for Mg isotopic chain which starts from $N = 8$ shell closure. The deformed shapes are seen to evolve between the shell closures. In Fig. 2, the potential energy curve for ^{20}Mg has a spherical shape which is expected for magic neutron number $N = 8$. A sudden shape transition from spherical to prolate is observed as one moves from ^{20}Mg to ^{22}Mg. A large prolate deformation minimum ($\beta_2 = 0.5$) is seen for ^{22,24}Mg nuclei. The shape becomes oblate for ^{26}Mg and a spherical shape is restored for ^{32}Mg due to $N = 20$ shell closure. On moving towards the more neutron-rich side, a prolate min-

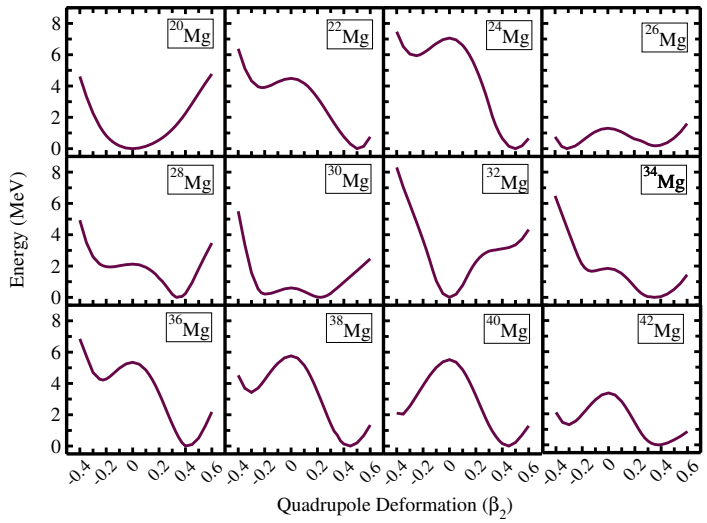

Fig. 2. The potential energy curves (PECs), calculated using the RHB model, as a function of the quadrupole deformation parameter, β_2, for Mg isotopes. For each nuclei, the energies are normalized with respect to the binding energy of the absolute minima.

imum is seen for $^{34-40}$Mg isotopes with quadrupole deformation between $\beta_2 \approx 0.35$–0.45. An oblate–prolate shape coexistence is also observed for ^{26}Mg and ^{30}Mg isotopes.

The PECs for the even–even isotopes of Si are shown in Fig. 3. It can be observed that most of the Si isotopes favor an oblate shape minimum on moving away from $N = 8$ shell closure. ^{26}Si have a ground-state prolate minimum with quadrupole deformation $\beta_2 = 0.40$ coexisting with an almost degenerate oblate minima with $\beta_2 = 0.30$. In addition to this, the isotopes ^{24}Si, ^{26}Si, ^{30}Si, ^{38}Si and ^{40}Si show the phenomena of shape coexistence. The study of shape evolution for S isotopic chain starts from ^{26}S ($Z = 16$,

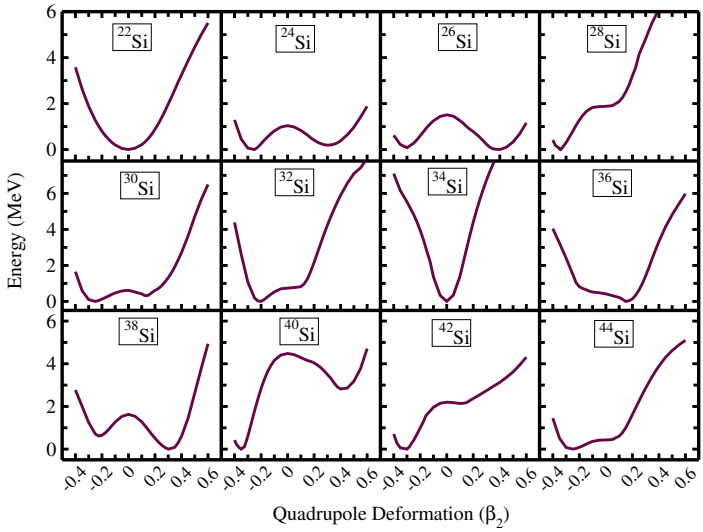

Fig. 3. The same as described in the caption of Fig. 2 but for Si isotopes.

$N = 10$) which exhibits very small prolate deformation. A sudden rise in the quadrupole deformation parameter is observed on moving from ^{26}S to ^{28}S, see Fig. 4. It is interesting to observe a staggering behavior of β_2 on moving towards $N = 20$ shell closure. The sign of the deformation parameter changes in each step with an increase in neutron number. A spherical shape is observed for ^{36}S as expected due to the magic neutron number, $N = 20$. The potential energy curves show a prolate ground-state minimum from $^{38-46}$S isotopes. The shape again becomes oblate for $^{48-52}$S isotopes. It is worth to note that the ground state the minimum for ^{56}S is spherical in the potential energy curve supporting the presence of $N = 40$ sub-shell closure. In addition to these shape transitions, an oblate–prolate shape coexistence is also seen for many sulfur isotopes. Figure 5 presents the PECs for Ar isotopic chain. The chain of isotopic study starts from $Z = 10$

and terminates at $N = 40$. It can be observed from the figure that most of the Ar isotopes are oblate in their ground state. A spherical ground-state shape is observed for nuclei with neutron numbers $N = 20$ and $N = 40$.

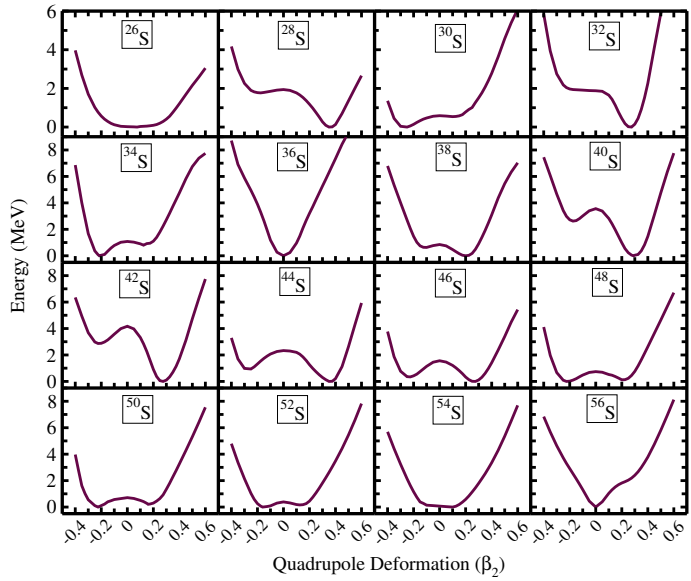

Fig. 4. The same as described in the caption of Fig. 2 but for S isotopes.

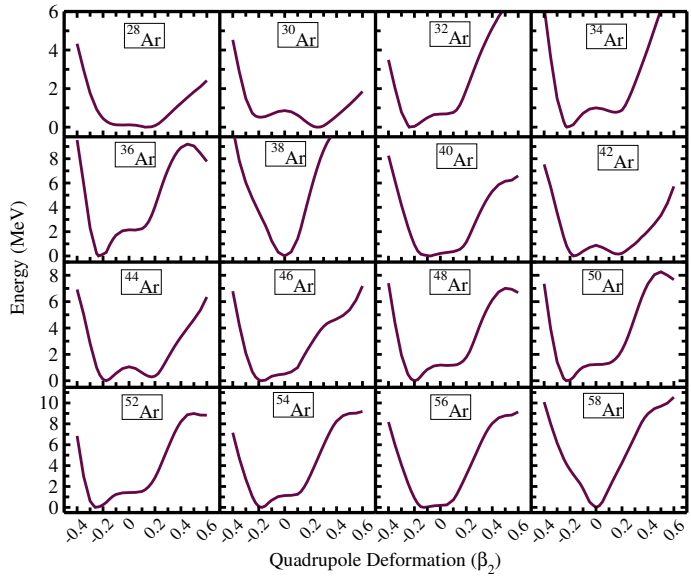

Fig. 5. The same as described in the caption of Fig. 2 but for Ar isotopes.

It should be noted that some of the shape coexisting nuclei with axial deformation might correspond to a triaxial ground state. However, to investigate it, one has to consider the triaxial degree of freedom in the calculations. The RMF approach with triaxiality was firstly developed by Koepf and Ring [51]. The beyond-RMF study done by Yao *et al.* [52] found the triaxial ground state for ^{26}Mg. In the Gogny-HFB calculations, a considerable triaxial ground-state deformation is observed for ^{24}Si and ^{44}Ar [53]. A recent study of light nuclei by Wang *et al.* [54] found a triaxial ground state in shape-coexisting nuclei ^{38}Si, ^{46}S and ^{48}S. However, their results indicate that the triaxiality effect on the mean-field part of nuclear binding energy in these nuclei is marginal.

In Figs. 2–5, the disappearance of $N = 28$ shell closure is also observed. The $N = 28$ isotones, ^{40}Mg, ^{42}Si, ^{44}S, and ^{46}Ar, have some finite deformations indicating the disappearance of $N = 28$ shell closure. An interesting case of study is seen for ^{44}S (an isotone of $N = 28$) which shows an oblate–prolate shape coexistence. This observation is in agreement with the experimental observation [55, 56] and with the predictions of various theoretical results [12–14].

The overall calculated results of binding energies, quadrupole deformation parameter, and charge radii for even–even isotopes of Mg, Si, S, and Ar nuclei are summarized in Tables I–IV. These results are calculated using axially constrained RHB calculations with pairing force which is separable in momentum space. The findings of nuclear observables with DD-ME2 interaction are compared with the results of the HFB model with D1S-Gogny interaction [53] and with the available experimental data [57–60]. The use of different interactions between the nucleons leads to the variation in the ground-state shapes in the two models. The study of nuclear drip lines is itself a very broad and interesting area. Different theoretical models have remarkably divergent predictions about neutron drip lines [61]. Considering the case of Mg isotopes, different neutron drip line predictions have been proposed. According to the study done in Ref. [62], the heaviest magnesium isotope observed is ^{40}Mg, while the drip line is found at ^{42}Mg in some recent studies [63, 64]. A recent study done using the deformed RHB theory in continuum predicts ^{46}Mg as a drip-line nucleus [65]. In our present study, the neutron drip line in Mg isotopic chain is predicted for the ^{40}Mg nucleus subjected to a negative value of two-neutron separation energy ($S_{2n}(Z,N) = E_{\rm b}(Z,N) - E_{\rm b}(Z,N-2)$) for ^{42}Mg. In terms of the chemical potential (λ_n), the separation energy can be written as $S_{2n} \approx -2\lambda_n$ [61]. A positive value of λ_n ($= 0.6293$) for ^{42}Mg results in the negative value of S_{2n}, leading to an unbound system. On the proton-rich side, the stability of a nuclei can be investigated by calculating two-proton separation energy ($S_{2p}(Z,N) = E_{\rm b}(Z,N) - E_{\rm b}(Z-2,N)$). The negative values of S_{2p}

for ^{22}Si,^{26}S, ^{28}Ar and for ^{30}Ar nuclei indicate these systems to be unstable/unbound to the proton emission. Nuclei with small values of S_{2n} and S_{2p} exhibit the characteristics of a somewhat loosely bound system. It can be observed that the neutron-rich nuclei ^{56}S, in the sulfur isotopic chain, have a very low value of two-neutron separation energy (S_{2n}) leading to an unbound system.

TABLE I

The binding energy (in MeV), the quadrupole deformation parameter β_2, and root-mean-square charge radii $R_{\rm ch}$ for the ground states and a few intrinsic excited states of $^{20-42}$Mg isotopes compared with that of D1S-Gogny [53] and with available experimental data [57–60].

Nuclei	DD-ME2			D1S-Gogny [53]			Experiment [57–60]		
	B.E.	β_2	$R_{\rm ch}$	B.E.	β_2	$R_{\rm ch}$	B.E.	β_2	$R_{\rm ch}$
^{20}Mg	133.79	0.0	3.119	136.22	0.0	3.01	134.47	0.440	
^{22}Mg	165.65	0.500	3.091	166.25	0.500	3.08	168.58	0.570	
^{24}Mg	193.73	0.500	3.072	193.25	0.537	3.10	198.26	0.609	3.057
^{26}Mg	211.75	−0.310	3.046	212.39	−0.309	3.05	216.68	0.489	3.034
	211.57	0.350	3.047						
^{28}Mg	228.08	0.335	3.071	228.49	0.0	3.02	231.63	0.503	
^{30}Mg	239.19	0.225	3.093	239.35	0.030	3.07	241.64	0.415	
	238.98	−0.200	3.092						
^{32}Mg	250.17	0.0	3.108	248.04	0.0	3.12	249.72	0.501	
^{34}Mg	254.16	0.350	3.180	252.43	0.393	3.20	256.71	0.553	
^{36}Mg	259.44	0.400	3.215	256.75	0.418	3.24	260.80	0.500	
^{38}Mg	261.34	0.450	3.257	258.71	0.418	3.26			
^{40}Mg	262.31	0.440	3.283	259.08	0.434	3.28			
^{42}Mg	261.08	0.375	3.293						

The stability of a nucleus is directly related to its binding energy and is also an important quantity to test a parameter set. The r.m.s. deviation of binding energies and charge radii is defined as

$$(\sigma_{\rm rms})_{\rm BE} = \sqrt{\sum_{i=1}^{n} \frac{\left(E_i^{\rm Exp} - E_i^{\rm Cal}\right)^2}{n}},$$
$$(\sigma_{\rm rms})_{R_{\rm ch}} = \sqrt{\sum_{i=1}^{n} \frac{\left(R_i^{\rm Exp} - R_i^{\rm Cal}\right)^2}{n}}, \tag{20}$$

where n is the number of nuclei for which the r.m.s. deviation is calculated. The r.m.s. deviations of binding energy for these nuclei with DD-ME2 parameter set are 3.0006 MeV, 3.7455 MeV, 3.8978 MeV, and 3.2174 MeV for Mg, Si, S, and Ar isotopic chain, respectively. It can be observed from

TABLE II

The same as in Table I, but for $^{22-44}$Si isotopes.

Nuclei	DD-ME2			D1S-Gogny [53]			Experiment [57–60]		
	B.E.	β_2	$R_{\rm ch}$	B.E.	β_2	$R_{\rm ch}$	B.E.	β_2	$R_{\rm ch}$
^{22}Si	132.82	0.0	3.283						
^{24}Si	167.80	−0.250	3.175	169.93	−0.229	3.13	172.01	0.245	
	167.61	0.300	3.208						
^{26}Si	200.83	0.400	3.187	202.31	−0.324	3.15	206.05	0.439	
	200.76	−0.300	3.153						
^{28}Si	231.62	−0.350	3.156	231.58	−0.370	3.17	236.54	0.407	3.122
^{30}Si	250.15	−0.250	3.151	251.64	0.0	3.10	255.62	0.311	3.134
	249.83	0.125	3.108						
^{32}Si	268.02	−0.200	3.165	267.57	0.010	3.15	271.41	0.228	
^{34}Si	283.83	0.0	3.174	281.14	0.0	3.20	283.43	0.183	
^{36}Si	290.41	0.150	3.207	289.19	0.0	3.21	292.01	0.265	
^{38}Si	297.67	0.300	3.265	296.12	0.285	3.27	299.93	0.255	
	297.09	−0.225	3.253						
^{40}Si	303.67	−0.300	3.300	302.18	−0.277	3.30	306.47	0.370	
	302.96	0.325	3.302						
^{42}Si	310.21	−0.350	3.340	308.15	−0.332	3.34			
^{44}Si	311.41	−0.300	3.346	309.29	−0.258	3.33			

Tables I–IV that there are only a few experimental data, for charge radii, available for Mg, Si, and S isotopes which would not be sufficient to calculate the r.m.s. deviation of charge radii ($(\sigma_{\rm rms})_{R_{\rm ch}}$). However, the value of $(\sigma_{\rm rms})_{R_{\rm ch}}$ for Ar isotopic chain is 0.0211 fm. The values of r.m.s. deviations of binding energy and charge radii are found to be comparable to the D1S-Gogny force.

In the PECs of these isotopic chains, a sudden shape transition is observed. Mainly, the Mg and Si isotopes show a sudden rise in deformation with the addition of neutrons. The origin of deformations is related to the evolution of the shell structure of single-particle orbitals. The nuclei with a magic number of nucleons (neutron or/and proton) form a closed shell which implies a spherical shape. However, this picture of spherical shape gets altered if the single-particle orbits are partially filled or by the excitation of nucleons to higher orbitals. To throw some light on the phenomena of nuclear deformation, we have shown, in Fig. 6, the neutron and proton single-particle energy levels for ^{20}Mg and ^{22}Mg. According to Jahn–Teller effect [66], the regions of low-level density around the Fermi surface favor the onset of deformation and are related to the ground-state minima in the potential energy curves. The upper two panels of Fig. 6 show single neu-

TABLE III

The same as in Table I, but for $^{26-56}$S isotopes.

Nuclei	DD-ME2			D1S-Gogny [53]			Experiment [57–60]		
	B.E.	β_2	$R_{\rm ch}$	B.E.	β_2	$R_{\rm ch}$	B.E.	β_2	$R_{\rm ch}$
^{26}S	167.33	0.050	3.350	170.95	0.0	3.29			
^{28}S	205.31	0.350	3.296	207.11	0.127	3.25	209.41	0.265	
^{30}S	238.19	−0.250	3.265	240.15	0.030	3.21	243.68	0.339	
^{32}S	265.49	0.275	3.261	266.32	−0.030	3.23	271.78	0.301	3.261
^{34}S	287.06	−0.215	3.291	287.59	0.0	3.27	291.84	0.250	3.285
	286.23	0.125	3.275						
^{36}S	307.03	0.0	3.293	306.31	0.0	3.30	308.71	0.157	3.298
^{38}S	318.70	0.200	3.318	318.59	0.101	3.32	321.05	0.247	
	318.12	−0.100	3.311						
^{40}S	331.51	0.290	3.344	329.93	0.245	3.35	333.17	0.284	
^{42}S	341.60	0.275	3.359	339.79	0.301	3.39	344.12	0.300	
^{44}S	348.67	0.345	3.403	347.42	−0.242	3.39	351.82	0.258	
	347.83	−0.300	3.385						
^{46}S	353.24	0.275	3.411	352.91	−0.200	3.40			
	352.90	−0.225	3.405						
^{48}S	357.19	−0.225	3.431	356.93	0.0	3.39			
	357.06	0.200	3.419						
^{50}S	359.87	−0.225	3.468	358.11	0.0	3.42			
	359.66	0.160	3.437						
^{52}S	361.60	−0.160	3.484	357.07	0.0	3.46			
	361.44	0.125	3.472						
^{54}S	361.98	0.100	3.508						
^{56}S	362.24	0.0	3.542						

tron and proton levels corresponding to spherical configuration with $\beta_2 = 0$ for the ^{20}Mg nucleus. A large gap between the last occupied ($1p_{1/2}$) and the first unoccupied ($1d_{5/2}$) neutron orbits is observed. The ^{20}Mg nucleus has a neutron shell closure at $N = 8$. All neutron orbits below the Fermi level are occupied which leads to a spherical shape. The lower two panels of Fig. 6 present the neutron and proton single-particle energy levels in the ^{22}Mg nucleus as functions of the axial deformation parameter β_2. The solid curves present levels with positive parity and dashed curves denote levels with negative parity. Fermi levels are denoted by a thick black line. A large shell gap with $0.50 \leq \beta_2 \leq 0.55$ is observed around the Fermi level in the plots of single-particle energies for neutron and proton, respectively. The proton shell gap, however, is more pronounced than the neutron shell gap favoring the minima in the PEC of ^{22}Mg. This large proton shell gap is mainly formed by two levels split from the degenerate $1\pi d_{5/2}$ state favoring

TABLE IV

The same as in Table I, but for $^{28-58}$Ar isotopes.

Nuclei	DD-ME2			D1S-Gogny [53]			Experiment [57–60]		
	B.E.	β_2	R_{ch}	B.E.	β_2	R_{ch}	B.E.	β_2	R_{ch}
^{28}Ar	162.44	0.125	3.506						
^{30}Ar	204.01	0.250	3.444						
	203.55	−0.200	3.430						
^{32}Ar	242.77	−0.240	3.381	244.13	−0.130	3.36	246.40	0.261	3.347
^{34}Ar	273.76	−0.225	3.382	275.35	0.020	3.35	278.72	0.235	3.365
	273.08	0.150	3.369						
^{36}Ar	302.69	−0.235	3.396	302.40	−0.180	3.37	306.72	0.257	3.391
^{38}Ar	326.52	0.0	3.387	326.64	0.0	3.39	327.34	0.159	3.403
^{40}Ar	341.92	−0.075	3.396	343.10	0.0	3.39	343.81	0.252	3.427
^{42}Ar	357.04	−0.175	3.414	357.77	0.053	3.41	359.34	0.273	3.435
	356.88	0.175	3.413						
^{44}Ar	370.93	−0.175	3.424	371.02	0.081	3.42	373.73	0.246	3.445
	370.64	0.175	3.423						
^{46}Ar	383.54	−0.180	3.434	382.66	0.0	3.43	386.92	0.196	3.438
^{48}Ar	391.57	−0.200	3.468	391.25	−0.190	3.48		0.228	
^{50}Ar	398.48	−0.230	3.504	398.30	0.0	3.47			
^{52}Ar	404.25	−0.260	3.547	402.08	0.0	3.50			
^{54}Ar	408.21	−0.175	3.556	404.33	0.0	3.54			
^{56}Ar	410.96	−0.125	3.582	405.62	0.0	3.57			
^{58}Ar	414.04	0.0	3.606	405.80	0.0	3.61			

the deformation, *i.e.*, the filling of [220]1/2 and [211]3/2 orbitals of $1d_{5/2}$ sub-shell, which are downsloping. However, the filling of [202]5/2 orbital of $1d_{5/2}$ sub-shell leads to a decrease in deformation due to its upsloping character. This decrease in deformation can be observed for the ^{26}Mg nucleus. Further, moving along the Mg isotopic chain, the deformation increases due to the mixing or special superpositions of single-particle states. The same can be said for Si isotopes. Thus, these ideas propose a simple comprehension of the several mechanisms leading to deformation in these isotopic chains.

In Fig. 7, the isotopic evolution of deformation parameter β_2 as a function of neutron number, N, is shown for all the isotopes of Mg, Si, S, and Ar. The comparison of the calculated values of the deformation parameter is done with the finite range droplet model (FRDM) and with available experimental data. In this figure, the progress of deformations with the neutron number, which is already seen in Figs. 2–5, is more apparent. In the Mg isotopic chain, all isotopes except ^{26}Mg have been shown to possess a prolate shape. The ^{20}Mg and ^{32}Mg nuclei have spherical shapes due

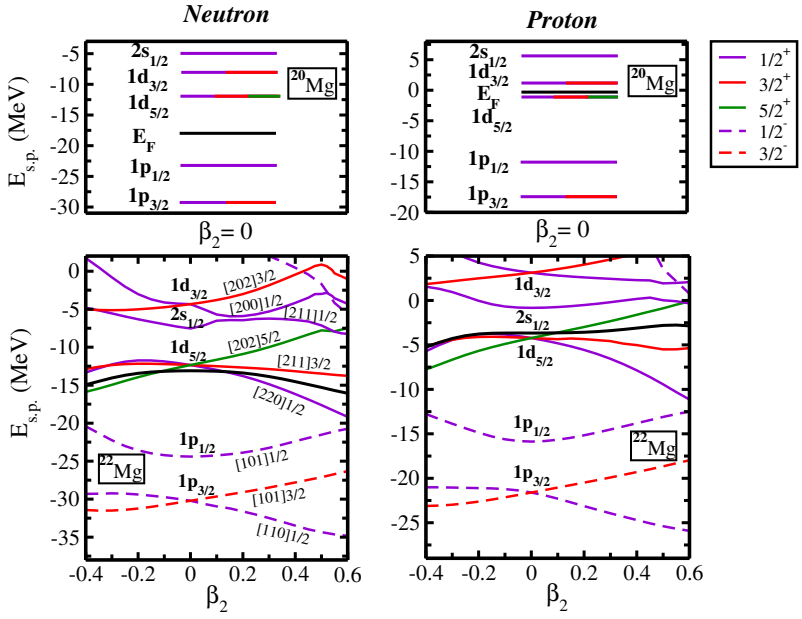

Fig. 6. Neutron and proton single-particle energy levels for ^{20}Mg and ^{22}Mg.

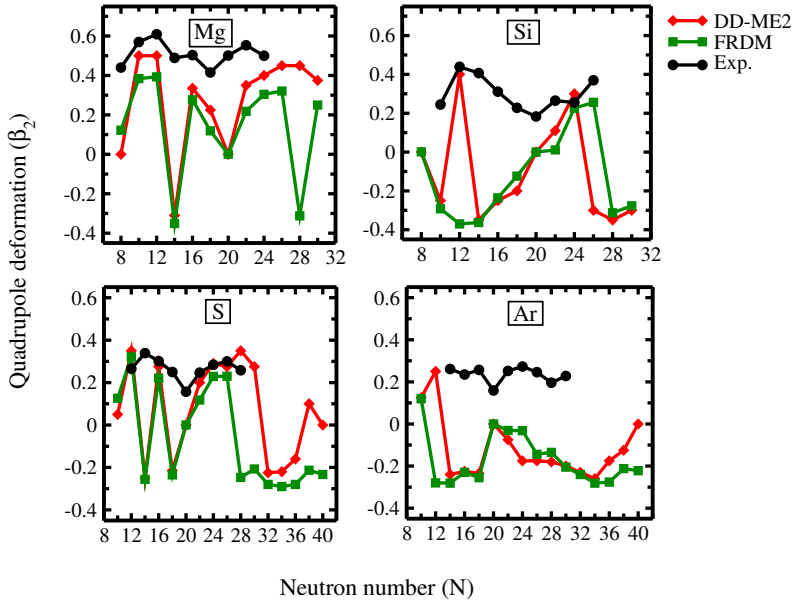

Fig. 7. The quadrupole deformation parameter (β_2) with respect to neutron number is plotted for Mg, Si, S and Ar isotopes. The comparison is made with FRDM data.

to the presence of $N = 8$ and $N = 20$ shell closures, respectively. Large prolate deformation is observed as one moves away from $N = 8$ shell closure. The nuclei above $N = 20$ shell closure also show a significant large deformation ($\beta_2 \sim 0.4$). It has been also noted that the Mg isotope with $N = 28$ shell closure takes a very large deformation ($\beta_2 \sim 0.45$), forced by a neutron mean-field, indicating the disappearance of shell closure and shell effect at $N = 28$. The Si isotopes are predicted to have large prolate as well as oblate deformations near the proton- and neutron-rich side. The disappearance of $N = 28$ shell closure is also visible in ^{42}Si, as it has a significant oblate deformation ($\beta_2 = -0.35$). A variety of shape transitions is seen throughout the S isotopic chain. A staggering type behavior of deformation parameter is observed up to $N = 20$ shell closure, indicating the softness of these isotopes. A large prolate deformation is observed on moving towards neutron-rich side which further becomes small on approaching neutron subshell closure at $N = 40$. Most of the Ar isotopes are seen to have an oblate ground state with a spherical shape at $N = 20$ shell closure and $N = 40$ sub-shell closure. The predictions of deformations in these isotopic chains are found to be in good agreement with that of the finite range droplet model and with experimental data.

In Fig. 8, we have presented the nuclei exhibiting the shape coexistence using the RHB model with DD-ME2 interaction. On the vertical axis, the energy difference between the prolate minima and oblate minima is shown. A positive value of ΔE implies that the prolate minima are more pronounced

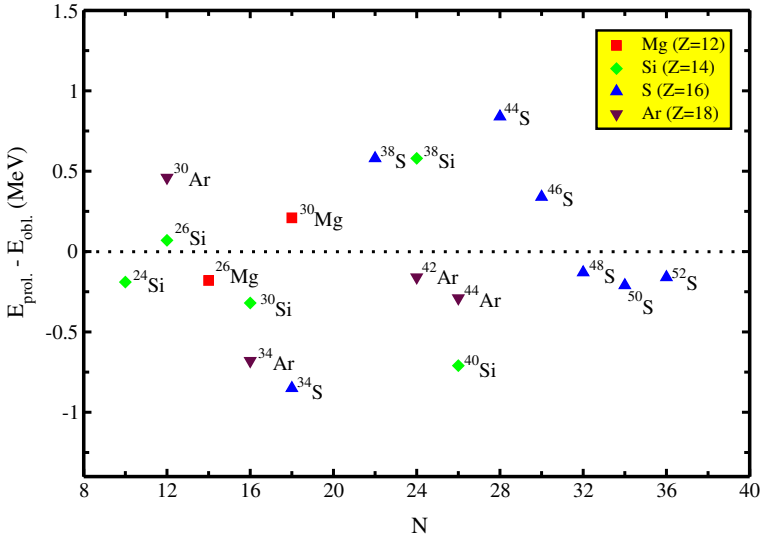

Fig. 8. The energy difference between prolate and oblate minima is plotted for shape coexisting candidates of Mg, Si, S and Ar isotopes.

than the oblate minima, while a negative value indicates that the oblate minima are deepest than the corresponding prolate minima. In the Mg chain presented here, the prolate shape is the lowest energy state. However, the ^{26}Mg and ^{30}Mg isotopes exhibit shape coexistence with $|\Delta E| = 0.2$ MeV. Many Si isotopes also show the shape coexistence phenomenon. The nuclei ^{24}Si, ^{26}Si, ^{30}Si, ^{38}Si, and ^{40}Si have almost degenerate prolate and oblate minima. Except for ^{26}Si and ^{38}Si, the other Si isotopes are oblate in the lowest energy state coexisting with a prolate minimum. Several isotopes of S that show the shape coexistence are: ^{34}S, ^{38}S, ^{44}S, ^{46}S, ^{48}S, ^{50}S, and ^{52}S. The positive value of ΔE for ^{38}S, ^{44}S, and ^{46}S indicates the prolate ground state for these nuclei. On the other hand, a negative value of ΔE for ^{34}S, ^{48}S, ^{50}S, and ^{52}S implies the oblate ground state. The value of ΔE is found to be very small for the ^{48}S, ^{50}S, and ^{52}S nuclei indicating the softness of these nuclei. Finally, the ^{30}Ar, ^{34}Ar, ^{42}Ar, and ^{44}Ar nuclei have also been found to be shape coexisting nuclei in the Ar isotopic chain. Except for ^{30}Ar, other nuclei have the oblate ground state coexisting with prolate minima a few keV above the lowest minima.

Figure 9 presents the isotope shifts for Mg, Si, S and Ar isotopic chains. The isotope shift for each isotopic chain is calculated relative to the mean-square nuclear charge radii of the reference nuclei with $N = 20$, given as

$$\delta \left\langle r_{\mathrm{ch}}^2 \right\rangle^{20,N} = \left\langle r_{\mathrm{ch}}^2 \right\rangle^{N} - \left\langle r_c^2 \right\rangle^{20} , \tag{21}$$

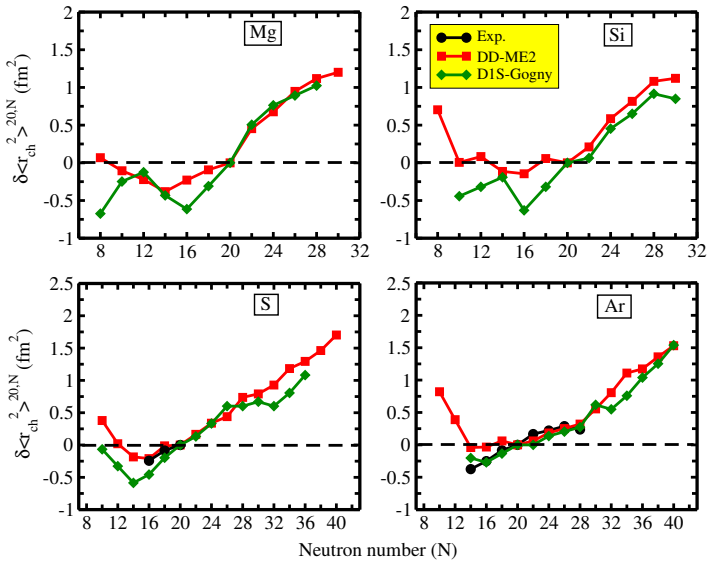

Fig. 9. Isotope shift for Mg, Si, S and Ar isotopes, calculated using the RHB model are compared with results of D1S-Gogny [53] and with experimental data [60].

where $\langle r^2_{\rm ch}\rangle$ is the mean-square charge radii of nuclei calculated from charge radius ($R_{\rm ch}$) given in Tables I–IV. A parabola like behavior of isotope shifts is observed for all isotopic chains. The minima in the isotope shifts correspond to nuclei near the stability line. In Fig. 9, the ^{26}Mg, ^{30}Si, ^{32}S and ^{34}Ar nuclei show the minima in the isotope shifts. Moreover, these nuclei have smaller charge radii even as compared to the lighter neighbors. The isotope shift is observed to rise considerably towards the proton-rich side. This rise in isotope shift to the extreme left or towards the proton-rich side indicates the swelling of charge radius due to large proton skin. The trend of isotope shifts, in the present study, is compared with the results of HFB calculations using the D1S-Gogny force and with available experimental data.

3.2. Single-particle energy spectra of $N = 28$ isotones

The emergence of collectivity and shape coexistence phenomenon in the nuclei can be understood by the evolution of neutron and proton single-particle energy levels with quadrupole deformation and the occurrence of gaps around the Fermi level. The regions of low-level density favor the onset of deformation as explained in the Jahn–Teller effect [66]. The ground-state minima in the potential energy curve are associated with the effect of low-level density around the Fermi surface. The feature of deformation occurrence in the $N = 28$ isotones can be ascribed to the possibility of quadrupole correlations between the occupied and valence states.

Figures 10–13 present the neutron and proton single-particle energy levels for $N = 28$ isotones, calculated using the RHB model with DD-ME2 interaction. The increase in neutron $N = 28$ shell gap [55] and the near degeneracy of the $d_{3/2}$ and $s_{1/2}$ proton orbitals can be seen in these figures. In Fig. 10, the gap between occupied and unoccupied neutron levels is around $\beta_2 \approx -0.37$ favoring an oblate shape, while on the proton side, this gap is around $\beta_2 \approx 0.44$ which favors the onset of prolate deformation. The proton shell gap is more pronounced than the neutron gap leading to the prolate ground state of ^{40}Mg. The picture of magic nucleus [67] in ^{42}Si seems to be broken, in Fig. 11, as a large neutron and proton shell gaps are observed on the oblate side which results in the pronounced oblate minimum at $\beta_2 \approx -0.35$. In ^{44}S, the largest gap between neutron states is around $\beta_2 \approx -0.30$, that is, on the oblate side (left panel of Fig. 12). In the proton energy level spectra, the largest gap is found on the prolate side with deformation around $\beta_2 \approx 0.35$ (right panel of Fig. 12). The formation of the oblate neutron and prolate proton shell gaps is the origin of the coexistence of deformed shapes in ^{44}S (*cf.* Fig. 4). Finally, a large spherical gap is observed between occupied and unoccupied neutron levels, as shown in the left panel of Fig. 13. For proton states, the largest gap is observed around

$-0.23 \leq \beta_2 \leq -0.17$, that is, on the oblate side. The competition between the spherical shape favored by neutron states and the oblate shape favored by proton states leads to the shallow extended oblate minimum shown in Fig. 5.

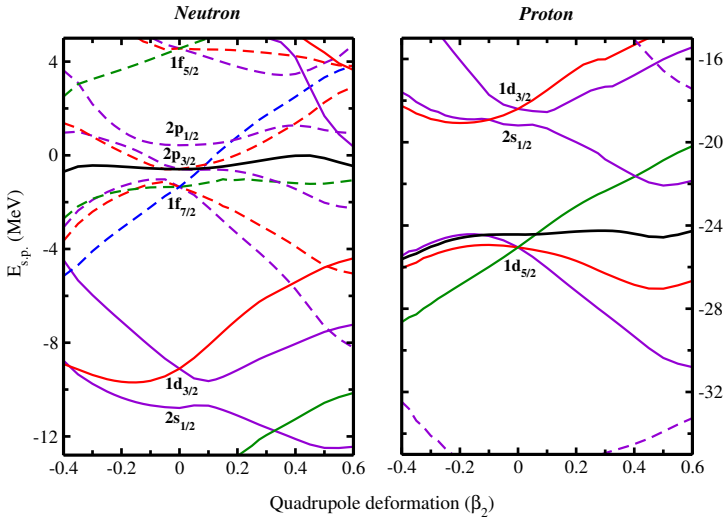

Fig. 10. Neutron and proton single-particle energy levels of ^{40}Mg as a function of quadrupole deformation parameter β_2. Solid curves present levels with positive parity, and dashed curves denote levels with negative parity. The thick black line denotes the corresponding Fermi energy levels.

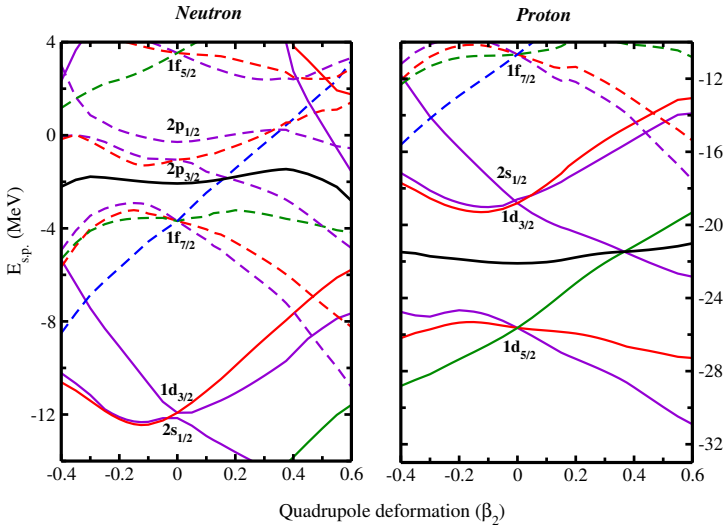

Fig. 11. The same as described in the caption of Fig. 10 but for the ^{42}Si nucleus.

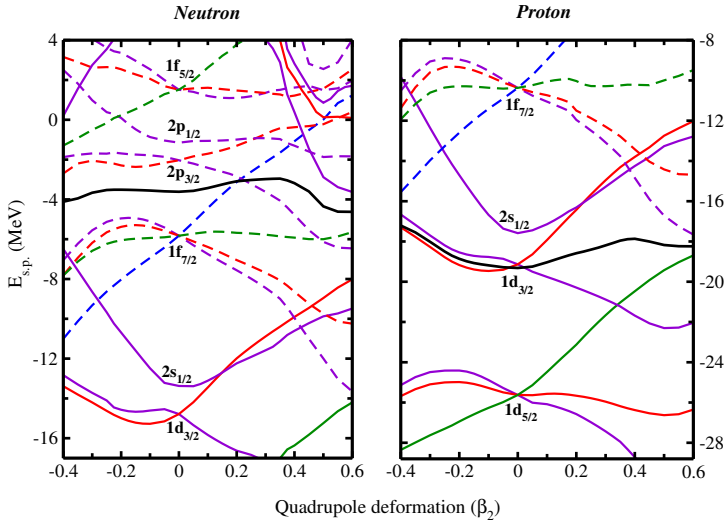

Fig. 12. The same as described in the caption of Fig. 10 but for the ^{44}S nucleus.

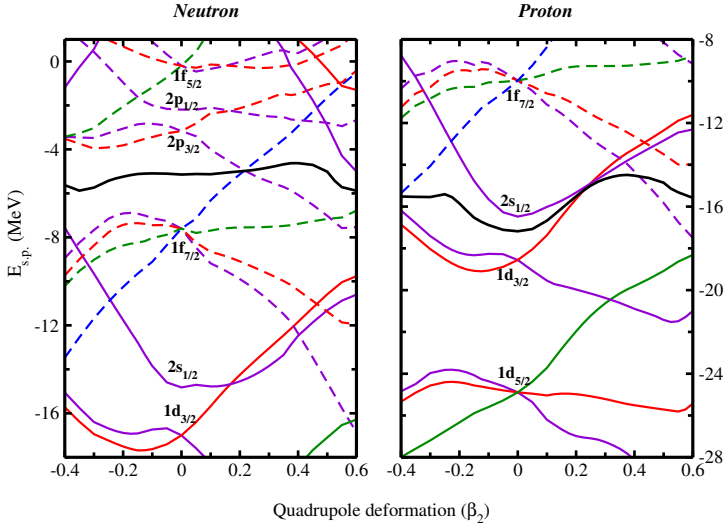

Fig. 13. The same as described in the caption of Fig. 10 but for the ^{46}Ar nucleus.

In Table V, the theoretically calculated neutron $N = 28$ spherical shell gaps, and the corresponding quadrupole deformation parameter for the minima of potential energy curves of ^{40}Mg, ^{42}Si, ^{44}S, ^{46}Ar, and ^{48}Ca are shown. A clear reduction of the spherical $N = 28$ shell gap is seen as one moves towards the proton-deficient side. It can be observed from Table V that the spherical gap between doubly magic ^{48}Ca and ^{46}Ar decreases from 4.8706

to 4.4351 MeV, which is in good agreement with experimental data [56, 68]. The theory and experiment, both points toward a strong disruption of the $N = 28$ spherical gaps as the isotones become more neutron-rich. It was shown in the RHB study of neutron-rich $N = 28$ isotones that the relativistic mean-field model reproduces the $N = 28$ shell gap due to the inclusion of the spin-orbit interaction and the isospin dependence of this term [22]. The removal of protons from a nucleus stimulates the energy change of the neutron levels due to the proton–neutron interaction. Experimentally, indirect evidence of the erosion of the gap has been obtained by following the evolution of excitation energies of the 2_1^+ state and the E2 transitions in $N = 28$ isotones and neighboring nuclei [55, 56]. The present findings of erosion of $N = 28$ shell gap in light nuclei are consistent with the results of RHB calculations with density-dependent point coupling (DD-PC1) interaction [12] and with other theoretical models.

TABLE V

Theoretically calculated neutron $N = 28$ spherical energy gaps, and the corresponding values of ground-state minima of the quadrupole binding energy maps of ^{40}Mg, ^{42}Si, ^{44}S, ^{46}Ar, and ^{48}Ca.

Nucleus	$\Delta^{\text{sph}}_{N=28}$	β_2 [min]
^{40}Mg	1.8314	0.440
^{42}Si	2.7369	−0.350
^{44}S	3.7923	0.345
^{46}Ar	4.4351	−0.180
^{48}Ca	4.8706	0.0

4. Conclusion

In the present work, we have done self-consistent calculations using the relativistic Hartree–Bogoliubov (RHB) model with density-dependent meson exchange (DD-ME2) interaction. The pairing correlations have been taken into account by employing an interaction that is separable in momentum space. An extensive study of shape evolution and other ground-state properties has been done for Mg, Si, S, and Ar isotopic chains by taking axial symmetry into account. The study has covered complete isotopic chains from proton-rich side to neutron-rich side. The PECs gives a clear picture of shape evolution and shape transition for even–even isotopes of Mg, Si, S, and Ar. A sudden shape transition and large deformation are observed for these isotopic chains even near the nuclear drip lines. A positive value of chemical potential (λ_n) and negative value of two-neutron separation energy (S_{2n}) is predicted for ^{40}Mg which indicates a neutron drip line nucleus. Our

calculations also indicate the drip line for ^{56}S due to a very small value of S_{2n}. In the present work, the proton drip line is observed for the ^{24}Si, ^{28}S, and for ^{32}Ar nucleus in these chains. Some isotopes of Mg, Si, S, and Ar isotopic chains are seen to exhibit well-deformed oblate–prolate shape coexistence with an energy difference of a few keV. A strong shell effect has been observed in these isotopic chains as the nuclei with the magic number of neutrons, $N = 8$ and 20, show a spherical shape. The ^{56}S and ^{58}Ar nuclei are observed to be spherical in their ground state indicating the presence of $N = 40$ sub-shell closure. However, the shell effects are washed out for the $N = 28$ magic number, as it shows different properties. It has been observed from the present study that the isotones of $N = 28$ magic number show a well-deformed minimum rather than spherical minima. The reduction of neutron shell gap between ^{48}Ca and ^{40}Mg favors the occurrence of particle–hole excitations between the occupied and valance orbits. An interesting case of ^{44}S nuclei is studied as this nucleus with $N = 28$ shows a strong prolate- and oblate-shape minima coexisting in the ground state. In conclusion, we can say that the deformation effect cannot be neglected in the structural characterization of light nuclei.

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Shape transitions and shell structure study in zirconium, molybdenum and ruthenium

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Abstract

In the present work we have studied the shape evolution and ground state properties like binding energies, shell closure parameter, neutron separation energies, nuclear size and neutron skin thickness in the even-even isotopes of Zirconium, Molybdenum and Ruthenium. Our theoretical results are compared with the available experimental data as well as theoretical extractions. The theoretical calculations are done by using the well known density dependent meson exchange model DD-ME2 and density dependent point coupling models DD-PC1 and DD-PCX.

Introduction

The ground states of Zr, Mo and Ru isotopes are weakly deformed for neutron number ranging from N = 50 - 60, but as N = 60 is approached and crossed they undergo strong shape transitions from nearly spherical to well deformed prolate or oblate deformations. The evidence for these shape variation includes the 2^+ lifetime measurements [1] and the presence of triaxiality in Mo isotopes have also been identified [2] from spectroscopic studies of high-spin states. The heavier isotopes of Zr nuclei around $A \sim 100$ show axially symmetric well deformed shape. It has been suggested that above this region the N = 82 shell closure might be quenched away from stability which is predicted by many models [3], but the experimental evidences found are still weak. To explore the structural evolution in the nuclei far from the valley of stability, nuclear binding energies and charge radii are considered to be most sensitive observables. The presence discontinuities in the systematics of a particular mass region and the abrupt change in root-mean-square (rms) radius of the charge distributions indicate the structural changes related to the nuclear deformation.

Many theoretical models like the self-consistent mean-field models with the Skyrme and the Gogny force [4], [5], [6], [7], relativistic mean-field (RMF) model [8], [9], [10], [11] and the IBM (interacting boson model) [12], [13] are used to understand the evolution of structure in these nuclei. The nuclear density functional theories are used to understand nuclear many-body dynamics for an appreciable description of the nuclei near drip lines [14], [15], [16], [17], [18], [19], [20]. Recently, a dual-shell mechanism for the phenomenon of shape coexistence is introduced which include all mass regions [21], which predicts that shape coexistence cannot appear everywhere on nuclear chart, but only within the islands of shape coexistence whose limits are determined through group theoretical arguments without any free parameters.

In the present work, we present a systematic study of shape transition and ground state properties such as binding energies, shell closures (D_n), two neutron separation energies (S_{2n}), differential variation in two neutron separation energies (dS_{2n}), nuclear root mean square radius (R_{rms}), nuclear charge radius (R_c), neutron skin thickness (Δr_{np}) for even-even isotopes of Zr, Mo and Ru. The theoretical calculations carried out within the framework of Relativistic Hartree Bogoliubov model using code DIRHB [22] by employing the density independent Relativistic Nuclear Density Functional (RMF-NDF) based on Meson Exchange model parameters DD-ME2 [23] and Point Coupling model parameters DD-PC1 [24] and DD-PCX [25] with a separable pairing interaction [26]. The calculations are performed by taking axial symmetry in account and the deformation ranges from -0.4 to 0.4 for each system. The number of oscillator shells (number of fermions and number of bosons) are taken to be 12 and center of mass correction is $E_{cm} = -P_{cm}^2/2Am$; P_{cm} is the total momentum of the nucleus with A nucleons. Separable pairing interaction

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MeVfm^3 and pairing width is taken to be a=0.644 fm in the p-p channel of Relativistic Hartree Bogoliubov

model.

This paper is organized as follows: An outline of the relativistic self-consistent mean field models is presented in section 2. Results and discussions for the potential energy curves, size of the nucleus, rms radius, charge radii, neutron skin thickness for various isotopes. Lastly, the conclusions drawn from our present studies are presented in section 4.

Section snippets

Theoretical framework

Self-consistent mean-field (SCMF) models provide a noteworthy tool to study nuclear structure properties throughout the nuclear chart. The models are based on nuclear energy density functionals which provide an accurate description of ground state properties of atomic nuclei ranging from relatively light mass to superheavy systems, and also from the valley of β-stability to the particle drip-lines. A particular class of SCMF structure models which is based on relativistic (covariant) energy…

Potential energy curves

Shape is one of the most fundamental properties of nuclei and quadrupole deformation parameter β_2 reflects the shape of the nuclei. The potential energy surfaces obtained from self-consistent relativistic mean-field model give promising results for ground state like non-relativistic theory [30]. Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5, Fig. 6, Fig. 7, Fig. 8, Fig. 9 present the potential energy surface as a function of β_2 in the isotopes of Zr, Mo and Ru nuclei. The ground state of a system is…

Conclusions

In the present research work, we have theoretically computed the potential energy surfaces and ground state properties of even-even isotopes of Zr, Mo and Ru using Relativistic nuclear density functional based on Meson Exchange model parameters DD-ME2 and Point Coupling model parameters DD-PC1 and DD-PCX. The results obtained from the theoretical calculations are compared with the experimental data, wherever available and theoretical results complements experimental data reasonably well.

We…

CRediT authorship contribution statement

Smriti Thakur: Conceptualization, Investigation, Methodology, Resources, Visualization, Writing – original draft, Writing – review & editing. **Pankaj Kumar:** Methodology, Resources, Writing – review & editing. **Virender Thakur:** Resources, Writing – review & editing. **Vikesh Kumar:** Resources, Writing – review & editing. **Shashi K. Dhiman:** Conceptualization, Methodology, Supervision, Validation.…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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Abstract

In this paper, we have examined the nuclear structural properties of $^{190–210}$Au isotopes within the framework of the Hartree–Fock–Bogoliubov Model. For the theoretical calculations, we have used the UNEDF2 and SKP interactions. The studies include the shape evolution, quadrupole deformation parameter β_2, nuclear electric quadrupole moment Q(b), single-particle energy levels, the binding energy per nucleon, nuclear charge radius, neutron rms radius, proton rms radius and neutron skin thickness. To analyze the accuracy of our theoretical results, we have presented the comparative analysis with experimental data and finite-range droplet model calculations. The adequate resemblance with experimental data is supporting our studies. We observe the oblate-prolate shape coexistence for ^{190}Au, ^{193}Au and ^{195}Au using the UNEDF2 interaction.

Keywords: Hartree–Fock–Bogoliubov theory ▪ quadrupole deformation ▪ nuclear electric quadrupole moment ▪ single-particle energy levels ▪ binding energy per nucleon ▪ charge radius ▪ neutron skin thickness

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Possibility of deformed dual bubble-like structure in light nuclei

Pankaj Kumar, Virender Thakur, Vikesh Kumar & Shashi K. Dhiman

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Abstract

The nuclei with a depressed central nucleonic density (bubble nuclei) are studied. The relativistic Hartree-Bogoliubov model with density-dependent meson-exchange interaction has been used to explore the possibility of deformed dual bubble-like structures in light nuclei, which are experimentally accessible. In dual bubble nuclei, the central densities for both proton and neutron deplete simultaneously. The unoccupancy of low angular momentum states for proton and neutron orbitals plays a vital role in the formation of bubble structures. We find favorable candidates around N or/and $Z = 14$ exhibiting a deformed dual bubble-like structure.

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Impact of Nuclear Deformation on Neutron Dripline Prediction: A Study of Mg Isotopes

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ABSTRACT

We have employed the relativistic Hartree-Bogoliubov (RHB) model with density-dependent meson-exchange interaction and separable pairing to investigate neutron dripline mechanisms for heavy Mg isotopes. In the present study, ^{40}Mg is predicted to be dripline nuclei. The calculations are carried out by taking axial deformation into account. An investigation of shape transition is also done for even-even $^{32\text{-}42}$Mg isotopes. Our prediction for neutron dripline for ^{40}Mg is consistent with some recent studies.

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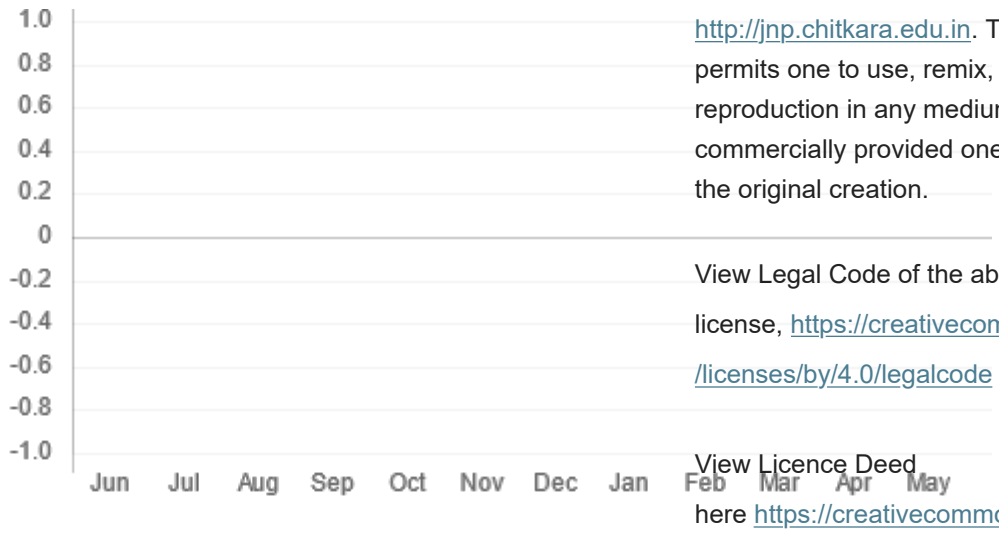

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Nuclear Shape Evolution in Palladium Isotopes

January 2021 · Acta Physica Polonica Series B 52(12):1433
DOI:10.5506/APhysPolB.52.1433

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Abstract

The phenomena of shape evolution and shape coexistence are studied in even–even 86-134Pd isotopes by employing the relativistic Hartree–Bogoliubov (RHB) model by employing density-dependent point-coupling parameter sets DD-PC1 and DD-PCX with separable pairing interaction. Our findings of binding energies, quadrupole deformation parameter, charge radii, and two-neutron separation energies as a function of neutron number N are compared with available experimental data and various theoretical models. Our theoretical results predict prolate-oblate shape coexistence in 108Pd isotope.

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Vol. 52 (2021) *Acta Physica Polonica B* No 12

NUCLEAR SHAPE EVOLUTION IN PALLADIUM ISOTOPES

Smriti Thakur†, Pankaj Kumar, Virender Thakur
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(Received May 25, 2021; accepted October 10, 2021)

The phenomena of shape evolution and shape coexistence are studied in even–even $^{86-134}$Pd isotopes by employing the relativistic Hartree–Bogoliubov (RHB) model by employing density-dependent point-coupling parameter sets DD-PC1 and DD-PCX with separable pairing interaction. Our findings of binding energies, quadrupole deformation parameter, charge radii, and two-neutron separation energies as a function of neutron number N are compared with available experimental data and various theoretical models. Our theoretical results predict prolate–oblate shape coexistence in ^{108}Pd isotope.

DOI:10.5506/APhysPolB.52.1433

1. Intoduction

It is known that nuclei lying near shell closure $Z = 50$ exhibit shape transitions and shape coexistence [1, 2] with the increase in neutron number. Radioactive Ion Beam (RIB) facilities and sensitive detection technologies have opened new possibilities to study the structure and properties of various exotic nuclei. The nuclei in this mass region exhibit a rapid change of nuclear shapes with competing spherical, axially symmetric prolate and oblate, and triaxial shapes, resulting in shape instabilities and coexistence of nuclear shape transitions in isotopic chains [3]. In addition to structural richness, another interesting characteristics of this region is its involvement in the astrophysical rapid neutron capture process (also called r-process), one of the main nucleosynthesis mechanisms which leads to the production of heavy neutron-rich nuclei in the universe [4, 5].

† Corresponding author: thakursmriti14@gmail.com

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... Further corroboration of the predictions of the dual shell mechanism was provided by various relativistic microscopic calculations [241][242] [243] [244][245][246], as well as by calculations using the Bohr Hamiltonian [246,247] and the IBM [248]. ...

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NUCLEAR STRUCTURE INVESTIGATION OF EVENEVEN Mo, Ru, Pd AND Cd ISOTOPES

January 2015

Meriem Ouhachi · M. R. Oudih · Mohamed Fellah · Nassima Hosni Allal

The nuclear structure of even-even Mo, Ru, Pd and Cd isotopes, starting from the proton-rich side up to the neutron-rich side, is investigated within the Hartree-Fock-Bogoliubov theory by using the SkP and SLy4 Skyrme interactions. Calculated values of various physical quantities such as binding energy, two-neutron separation energy, proton and neutron root mean square radii and quadrupole ... [Show full abstract]

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Evolution of Nuclear Shapes in Light Nuclei from Proton- to Neutron-rich Side

January 2021 · Acta Physica Polonica Series B

Pankaj Kumar · Virender Thakur · Smriti Thakur · [...] · Shashi K. Dhiman

The relativistic Hartree–Bogoliubov (RHB) model with density-depen- dent meson-exchange interaction and separable pairing is employed to study the shape evolution and shape coexistence in Mg (Z = 12), Si (Z = 14), S (Z = 16), and Ar (Z = 18) isotopes from proton-rich side to neutron-rich side. A sudden shape transition is observed in these isotopic chains. A reasonable agreement of quadrupole ... [Show full abstract]

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Shape transitions and shell structure study in zirconium, molybdenum and ruthenium

June 2021 · Nuclear Physics A

Smriti Thakur · Pankaj Kumar · Virender Thakur · [...] · Shashi K. Dhiman

In the present work we have studied the shape evolution and ground state properties like binding energies, shell closure parameter,neutron separation energies, nuclear size and neutron skin thickness in the even-even isotopes of Zirconium, Molybdenum and Ruthenium. Our theoretical results are compared with the available experimental data as well as theoretical extractions. The theoretical ... [Show full abstract]

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RMF-based Microscopic Study of Ground-state Properties and Nuclear Shape Transitions in Even–Even Po...

January 2022 · Acta Physica Polonica Series B

Virender Thakur · Vikesh Kumar · Shashi K. Dhiman · [...] · Pankaj Kumar

Ground-state properties of even–even isotopes of polonium (Po) have been studied. The physical observables of our interest include quadrupole deformation and shape transitions, binding energies, charge radii, and neutron skin thickness. Theoretical results for the differential variation dS 2n (Z, N) based on two-neutron separation energy are also presented. Theoretical calculations are carried ... [Show full abstract]

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Nuclear shape evolution and shape coexistence in Zr and Mo isotopes

January 2021 · European Physical Journal A

Pankaj Kumar · Virender Thakur · Smriti Thakur · [...] · Shashi K. Dhiman

The phenomena of shape evolution and shape coexistence in even–even \(^{88-114}\)Zr and \(^{90-116}\)Mo isotopes are studied by employing covariant density functional theory (CDFT) with density-dependent point-coupling parameter set, DD-PCX, and with separable pairing interaction. The results for the rms deviation in binding energies, two-neutron separation energy, the differential variation of ... [Show full abstract]

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Volume 830, 25 July 2020, 154687

Sol-gel synthesized Ba-Nd-Cd-In nanohexaferrites for high frequency and microwave devices applications

Rohit Jasrotia [a b], Virender Pratap Singh [a b c], Bhawna Sharma [d], Ankit Verma [d], Pooja Puri [e], Rajesh Sharma [a b], Mahavir Singh [f]

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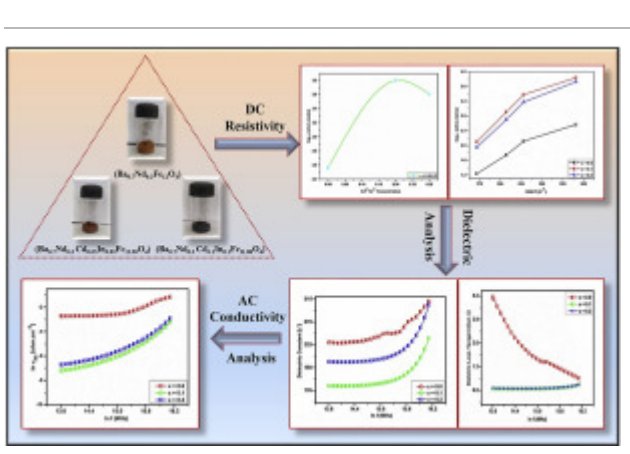
Abstract

Nanocrystalline cadmium and indium substituted barium M-type hexagonal ferrite-based nanomaterials were prepared via sol-gel auto-combustion technique for studying the electrical, dielectric and conductivity characteristics of prepared samples such as dc resistivity, dielectric constant (ε'), dielectric loss (tan δ) and ac conductivity (σ_{ac}) with the usage of different characterizing techniques like keithley 2611 two probe system and impedance analyzer. The room temperature dc resistivity of synthesized samples increases for lower concentrations i.e. x=0.1 of Cd^{2+}/In^{3+} but for the higher concentrations i.e. x=0.2, it starts decreasing consequently. The temperature dependent dc resistivity also showing a decreasing trend as a function of temperature which continuously indicating the semi-conducting behaviour of BaM hexagonal nanohexaferrites. The room temperature dielectric characteristics was investigated as a function of logarithmic frequency and it can be explained on the basis of Maxwell Wagner model and space chare polarization. From the dielectric measurements, the dielectric constant (ε') was found to be increasing with the increasing logarithmic frequency working as good energy storage material. The dielectric loss (tan δ) was found to be decreasing for the undoped sample (x=0.0) but for the undoped samples (x=0.1–0.2), it starts increasing in a very minute manner. Therefore, such materials of high increasing dielectric constant with minute values of dielectric losses make it suitable for the high frequency, energy storage and microwave devices application.

Graphical abstract



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Introduction

Hexagonal ferrites are taking a lot of scientific interest by the researchers and scientists due to its various versatile properties such as superparamagnetic nature, quantum size and magnetic tunnelling effect, larger surface to volume ratio, chemical stability, non-toxic behaviour, easy to synthesize and moreover, applications in the field of energy and memory storage devices, nanoelectronics, recording media, radar and communication system, biomedicine, water purification [[1], [2], [3]]. Among the various ferrite-based

nanomaterials, nanomaterials with the hexagonal structure are called as hexaferrites represented by the chemical formula $MFe_{12}O_{19}$ (M=Ba, Sr, Pb etc.) whose crystal structure is same as that of magnetoplumbite. BaM is a type of hard ferrite based nanomaterial which is occupying technologically attention in the field of nanoscience and nanotechnology such as magnetic storage devices, recording media, microwave devices and permanent magnets due to its various properties such as high resistivity, chemical stability, high saturation magnetization, high remanent magnetization, high coercivity and low dielectric losses [4]. Now, a, days, researchers are working on various parameters in order to improve the electrical properties and to decrease the dielectric losses of synthesized specimens such as synthesis techniques, use of metallic and rare earth metal dopants, control particle and grain size, sintering and calcination temperature, chemical composition and fine powders [[5], [6], [7], [8], [9], [10], [11]]. A number of synthesis techniques were used for preparing the BaM hexagonal nano-ferrites such as sol-gel, auto-combustion, hydrothermal, co-precipitation, micro-emulsion, ceramic, ball-milling etc. out of which sol-gel auto-combustion is one of the best environment friendly method as it provides high quality magnetic nanoparticles with various properties like better distribution of nanoparticles, easy preparation and fine powders [[12], [13], [14], [15], [16], [17], [18], [19], [20]]. Jasrotia et al. (2019) synthesized a series of $Ba_{0.7}Nd_{0.3}Cd_{0.5x}In_{0.5x}Fe_{12-x}O_{19}$ (x=0.0, 0.1, 0.2, 0.3) nanohexaferrites with the usage of sol-gel auto-combustion method for reporting the structural and magnetic properties. XRD study reveals the formation of single-phase hexagonal structure with some impurity phase [21]. Yasmin et al. (2018) synthesized Gd^{3+} and Zn^{2+} doped calcium barium nanohexaferrites with the help of sol-gel auto-combustion technique for studying the structural and dielectric measurements of synthesized specimens [22]. Xu et al. (2011) synthesized Nd^{3+} substituted barium Z-type hexagonal nanomaterials by solid-state reaction for investigating different structural, dielectric and magnetic properties of prepared specimens [23]. Ashima et al. (2012) prepared Cd^{2+} and Sr^{2+} substituted Barium hexagonal nanoferrites by commercial solid-state reaction for analyzing the structural, dielectric and magnetic properties of synthesized samples [24]. Charalampos et al. (2010) synthesized dysoprium and gadolinium doped barium hexaferrite by using chemical co-precipitation method for studying its magnetic and dielectric properties in the high GHz frequency range [25]. Jasrotia et al. (2020) synthesized cadmium and indium substituted BaM nanohexaferrites having chemical composition $Ba_{0.7}Nd_{0.3}Cd_{0.5x}In_{0.5x}Fe_{12-x}O_{19}$ (x=0.0, 0.1, 0.2, 0.3) by sol-gel auto-combustion technique for studying the Raman spectrum of prepared specimens [26]. Tadjarodi et al. (2013) reported the structural, morphological, magnetic and microwave characteristics of conducting and magnetic polyaniline nanocomposites which contains nanorods and nanoparticles with a chemical composition of $Ba_{0.69}Sr_{0.17}Cd_{0.07}Zn_{0.07}Fe_{12}0_{19}$ synthesize via insitu polymerization. The present investigation showed that the synthesized composites have maximum reflection loss of 16dB make it suitable for microwave devices [27]. Saini et al. (2016) reported the structural, morphological and dielectric investigations of indium doped Ni–Zn–Cu nanosized spinel ferrites with the nominal composition Ni0.5Zn0.3Cu0.2InxFe2-xO4 (x=0.02–0.4) up to high GHz frequency range. XRD patterns showed the formation of single-phase spinel cubic structure. In the present investigation, high values of magnetic permeability (μ') with very small magnetic losses were observed. In addition to this, a miniaturization parameter equal to 12.32 and normalized impedance factor of 1.23 were calculated make it suitable as magnetic nanomaterial for miniaturized antenna application in the very high MHz frequency range [28]. In the present research work, we are using cadmium and indium as dopants in synthesizing the Ba–Nd M-type hexagonal nano-ferrites with chemical composition $Ba_{0.7}Nd_{0.3}Cd_{0.5x}In_{0.5x}Fe_{12-x}O_{19}$ (x=0.0–0.2) by sol-gel auto-combustion technique in order to observe the impact of Cd^{2+} and In^{3+} ions on the electrical and dielectric measurements of Ba–Nd hexaferrite. In this research work, a novel achievement has been found that the increase of dielectric constant with the increasing frequency which has not been found right yet and this make it suitable for the high frequency and microwave devices application.

Section snippets

Materials used

Ba–Nd M-type hexagonal ferrites of nominal composition $Ba_{0.7}Nd_{0.3}Cd_{0.5x}In_{0.5x}Fe_{12-x}O_{19}$ (x=0.0, 0.1, 0.2) were synthesized by sol-gel auto-combustion technique in which the AR graded metal nitrates such as Barium nitrate ($Ba(NO_3)_3.9H_2O$), Neodymium nitrate ($Nd(NO_3)_3.6H_2O$), Cadmium nitrate ($Cd(NO_3)_2.4H_2O$), Indium nitrate ($In(NO_3)_3.xH_2O$), Ferric nitrate ($Fe(NO_3)_3.9H_2O$) and Citric acid ($C_6H_8O_7$)) were used as starting precursors along with Ethylene glycol ($C_2H_6O_2$) as gel precursor for the…

Electrical study

Hexagonal ferrites have high values of electrical resistivity (10^{-2}-$10^{8}\Omega$cm) depending upon the number of parameters such as calcination and sintering temperature, choice of dopants, type of nanoparticle fabrication techniques. The variation of room temperature dc resistivity (log ρ) as a function of Cd^{2+}/In^{3+} concentration for the $Ba_{0.7}Nd_{0.3}Cd_{0.5x}In_{0.5x}Fe_{12-x}O_{19}$ (x=0.0, 0.1, 0.2) nanomaterials are presented in Fig. 1. The calculated values of room temperature dc resistivity (ρ) and log…

Conclusion

Form the given investigations, it was concluded that.

1. The cadmium and indium doped barium nanohexaferrites with chemical composition $Ba_{0.7}Nd_{0.3}Cd_{0.5x}In_{0.5x}Fe_{12-x}O_{19}$ (x=0.0, 0.1, 0.2) were successfully prepared by sol-gel auto-combustion technique.…

2. The room temperature dc resistivity of synthesized samples increases for lower concentrations of Cd^{2+}/In^{3+} but for the higher concentrations i.e. x=0.2, it starts decreasing consequently. The temperature dependent dc resistivity also showing a…

…

CRediT authorship contribution statement

Rohit Jasrotia: Data curation, Writing - original draft. **Virender Pratap Singh:** Conceptualization, Methodology, Supervision. **Bhawna Sharma:** Visualization, Investigation. **Ankit Verma:** Validation. **Pooja Puri:** Validation. **Rajesh Sharma:** Writing - review & editing. **Mahavir Singh:** Software.…

Declaration of competing interest

There are no conflicts of interest for publishing this research article.…

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Citation Excerpt :

...The researchers and scientists pointed out that since the discovery of hexaferrites, also known as hexagonal ferrites, in the 1950s at the Philips laboratory, the demand for hexagonal ferrites has increased in the industry due to their excellent traits such as high saturation magnetization (Ms) [1], large coercivity (Hc) [2], large magnetocrystalline anisotropy (K1) [3], low-cost material [4] and high chemical stability [5]. Therefore, due to these excellent traits, the hexagonal ferrites are studied at a rapid pace for multifunctional technological applications [6] such as permanent magnets [7,8], high-density and low-density recording media [5,9], high-frequency [10], microwave devices, [11], humidity and biosensors [2,12], electromagnetic shielding, [13] etc. There are numerous factors such as crystallite size, grain size, calcination temperature and time, dopant type, site occupancy by dopants, adopted synthesis route, and many more, which could be responsible for improving the magnetic properties of hexaferrites [14]....

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Effect on Magnetic, morphological and structural properties of Zn²⁺-Zr⁴⁺ substituted SrM for permanent magnet based appliances
2022, Journal of Magnetism and Magnetic Materials

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...The 24 Fe3+ ions present are responsible for M−type hexaferrites possessing good magnetic properties. However, the total magnetic character of these hexaferrites is reduced by the presence of two crystallographic sites 4f2 and 4f1 with spins in the downward direction [11-15]. High magnetic saturation and coercivity are required for permanent magnet applications....

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Robust and sustainable Mg<inf>1-x</inf>Ce<inf>x</inf>Ni<inf>y</inf>Fe<inf>2-y</inf>O<inf>4</inf> magnetic nanophotocatalysts with improved photocatalytic performance towards photodegradation of crystal violet and rhodamine B pollutants
2022, Chemosphere

Citation Excerpt :

...Mg nanoferrites can be prepared by microwave, sol-gel, hydrothermal, auto-combustion, citrate-precursor, co-precipitation techniques and many

more (Jasrotia et al., 2021c). Sol-gel is an effective tool for preparing high-quality magnetic nanoparticles (Jasrotia et al., 2019a) (Jasrotia et al., 2020d). Nguyen et al. (2019) utilized this technique to synthesize Mg nano-ferrites and reported their photocatalytic performance towards methylene blue with 89.73% efficiency for 4 h in visible light (Nguyen et al., 2019)....

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Influence of Ni doping on physical properties of $La_{0.7}Sr_{0.3}FeO_3$ synthesized by reverse micelle technique

Abdullah Ameen Saad Hassan, Wasi Khan, Shahid Husain, Pooja Dhiman, Mahavir Singh & Meznah M. Alanazi

Journal of Materials Science: Materials in Electronics **32**, 3753–3765 (2021)

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Abstract

In the present work, a series of Ni-doped $La_{0.7}Sr_{0.3}FeO_3$ perovskite nanostructures with chemical composition $La_{0.7}Sr_{0.3}Fe_{1-x}Ni_xO_3$ (x = 0.0, 0.01 and 0.04) were synthesized by the reverse micelle (RM) technique. The X-ray diffraction (XRD) analysis verifies good crystallinity and an orthorhombic crystal structure of the samples. The remarkable growth of the crystallites was observed in increasing the amount of Ni doping. The morphology, topography, and chemical composition were investigated through field emission scanning electron microscope (FESEM) equipped with an energy dispersive X-ray spectrometer (EDS). The FESEM/EDS measurements confirm uniform morphology and interconnected nature of the particles with relevant elements. The Fourier transform infrared (FTIR) spectra further demonstrate the perovskite structure through Fe/Ni–O asymmetric stretching and deformation of Fe/Ni–O–Fe/Ni bending vibrations in the lattice. A systematic reduction in the bandgap (E_g) is noticed upon the Ni doping in $La_{0.7}Sr_{0.3}FeO_3$, as estimated from the UV/visible spectra by employing the Tauc's relation. A distinct behaviour of dielectric properties was revealed as a function of frequency and temperature for all the samples. The dielectric constant (ε'), dielectric loss ($\tan\delta$), and ac conductivity (σ_{ac}) were measured at selected frequencies and temperatures. The results signify that the dielectric nature was frequency-dependent and thermally stimulated. The magnetic properties at room temperature indicate weak ferromagnetism with gradual increase in the maximum magnetization and coercivity with the increase in Ni concentration.

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Investigation of structural, optical, electrical and magnetic properties of Fe doped La0.7Sr0.3MnO3 manganites

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Abstract

In this work, the physical properties of nanocrystalline samples of La0.7Sr0.3Mn1-xFexO3 (0.0 ≤ x ≤0.20) perovskite manganites synthesized by the reverse micelle (RM) technique have been explored in detail. The phase purity, crystal structure and crystallite size of the samples are ensured by the X-ray diffraction (XRD) data and Fourier transform infrared (FTIR) spectroscopy. All samples are found in rhombohedral crystal structure and crystallite size increases with the increase in Fe content in La0.7Sr0.3MnO3. The scanning electron micrographs (SEM) exhibit smooth surface morphology and non-uniform shape of the particles. The optical properties are studied by UV-visible absorption spectroscopy that reveals a decrease in the absorbance and optical band gap with the increase in Fe content in La0.7Sr0.3MnO3 compound. The temperature dependent resistivity measurements reveal semiconducting nature of x = 0 and x = 0.1 samples up to studied temperature range, while a metal to insulator transition is observed at the higher doping of Fe. Magnetic studies reveal weak ferromagnetism in all the samples and a reduction in the maximum magnetization with the increase in Fe content. A close correlation between electrical transport and magnetic properties is observed with the doping of Fe ion in La0.7Sr0.3MnO3 at Mn site. These results advocate strong interactions associated with the double exchange mechanism among Fe3+ and Mn3+ ions.

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... Å [31,32]. The d x of LSMO can be calculated by the formula d x = 6 M/N a V cell , where M is the molar mass of LSMO, and V cell is the unit cell volume of LSMO [33] . The calculated d x value is 6.43 g/cm 3 , close to the XRD density in LSMO standard PDF card (No: 51-0409). ...

Effect of Pressure on Magnetic Properties of CoFe2O4/La0.7Sr0.3MnO3 Composite

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... There are different methods for obtaining materials with a porous structure, in which the use of surfactants is very common [31]. Hassan et al [32] . used the reverse micelle (RM) synthesis pathway with CTAB to synthesize nanomaterials from the La 0.7 Sr 0.3 MnO 3 system, due to the possibility of obtaining homogeneity at the atomic scale, adequate distribution of particle sizes, and phase stabilization. ...

PrMnO3 porous nanostructures: Synthesis and structural, optical and magnetic properties

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C.J. Aguilar · Edgar Eduardo Mosquera Vargas · Francisco Gracia · Jorge RODRIGUEZ Paez

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... These mixed oxides show changes in their resistance due to the application of external magnetic fields (giant magnetoresistance). Additionally, this type of structure allows obtaining phases with unusual spin value, charge, crystal lattice, and orbital order, in which groupings of competing phases can coexistfor example, ferromagnetic, paramagnetic and anti-ferromagnetic phases [20] [21] [22][23]. Therefore PSMOs, given their magneto-transport properties, are creating a great deal of interest in their technological potential, with the fields of superconductivity, ferroelectricity, and thermoelectricity to the fore. ...

Mixed oxides of the Pr 1 − x Sr x Mn O 3 (0.1 ≤ x ≤ 0.5) system synthesized by a chemical route: Structural, electric and magnetic characterization

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... , etc., have been investigated to prepare LSMO. Besides synthesis techniques, several studies have been devoted to improving the magnetocaloric properties of La 0.7 Sr 0.3 MnO 3 perovskites by doping different elements on different sites, such as Nd[28],[29], Ca[30] on La sites, and Co[31] and Fe [32] on Mn sites. Recently, it is reported that in multiphase composite materials, the temperature dependence of −S M curve broad- ...

Magnetocaloric Study of La0.45Nd0.25Sr0.3MnO/MO (MO = CuO, CoO, and NiO) Nanocomposites

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... Among the perovskite manganites, La 1−y Ca y MnO 3 has received enormous research attention; this is attributed to the fact that the sudden decrease of resistivity under a magnetic field and sufficiently excellent magnetoresistance (MR) make this material suitable for a variety of manganite sensors, including magnetic read-heads [9, 10] , magnetic actuators [6,11], magnetic random access memories [12,13], etc. However, the relatively low values of MR and AMR under small magnetic field hinder its practical application, and researchers have focused on improving the MR and AMR in the last two decades through metal-doping [14], rare earth-doping [15], and optimization of the sintering temperature [16]. ...

Silver addition in polycrystalline La0.7Ca0.3MnO3: Large magnetoresistance and anisotropic magnetoresistance for manganite sensors

Article

Jun 2021 · J ALLOY COMPD

Sheng'An Yang · Qingming Chen · Yunrui Yang · Ji Ma

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... La 0.7 Sr 0.3 Fe 1-x Ni x O 3 (LSFNO) with nominal concentrations of Ni (i.e. x = 0, 0.01 and 0.04) were prepared by the reverse micelle (RM) process [22] . All high purity nitrate precursors of La, Sr, Fe and Ni were used without further purification. ...

Influence of Ni doping on physical properties of La0.7Sr0.3FeO3 synthesized by reverse micelle technique

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Crystalline Structure, Surface Morphology of Perovskite Manganites Nd0.75Na0.25Mn1-yFeyO3

Chapter

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January 2001 · Journal of Solid State Chemistry

W. Boujelben · Abdelwaheb Cheikhrouhou · J. C. Joubert

The praseodymium deficiency effects on the structural, magnetic, and electrical properties of the lacunar perovskite manganite oxides Pr{sub 0.7-x}{open_square}{sub x}Sr{sub 0.3}MnO{sub 3} (0{le}x{le}0.23) have been investigated. This study is of great interest because it gives more information on the role of the Mn cation oxidation degree. Powder X-ray diffraction patterns are indexed in the ... [Show full abstract]

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Published: 29 September 2020

Analysis of sintering temperature effects on structural, dielectric, ferroelectric, and piezoelectric properties of $BaZr_{0.2}Ti_{0.8}O_3$ ceramics prepared by sol–gel method

Sarita Sharma, Hakikat Sharma, Shammi Kumar, Shilpa Thakur, R. K. Kotnala & N. S. Negi

Journal of Materials Science: Materials in Electronics **31**, 19168–19179 (2020)

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Abstract

This article describes preparation of Barium (Zirconium) Titnate ($BaZr_{0.2}Ti_{0.8}O_3$) ceramics by the sol–gel technique and its structural, dielectric, ferroelectric, and piezoelectric properties investigated with sintering temperature variation. The phase and microstructure analysis of the sintered ceramics was carried out by X-ray diffraction method (XRD) and scanning electron microscopy (SEM), respectively. XRD analysis revealed structural transformation from cubic to tetragonal phase with increase in sintering temperature. Dielectric properties have been measured with variation of frequency up to 1 MHz and with temperature up to 200 °C. The BZT ceramics exhibit diffuse phase transition with normal ferroelectric behavior. Hysteresis loop measurements disclosed that BZT ceramics have good ferroelectric nature with saturation at higher applied electric fields. Leakage current density show negative temperature coefficient resistance (NTCR) behavior. The highest value (261 pC/N) of piezoelectric coefficient (d_{33}) has been obtained for BZT ceramic sintered at 1400 °C and revealed that ceramics have great potentials for electronic industry based on sensor technology.

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Structural, Magnetic, and Electrical Properties of (1-x) Na0.5Bi0.5TiO3 –(x) NiFe2O4(x = 0.1, 0.3, 0.5, 0.7, and 0.9) Multiferroic Particulate Composite

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Abstract and Figures

Multiferroic composites consisting of Na0.5Bi0.5TiO3(NBT) and NiFe2O4(NFO) phases have been synthesized by using sol-gel and metal-organic decomposition (MOD) methods. The X-ray diffraction (XRD) and scanning electron microscopy (SEM) results confirm NBT and NFO phase formation in all composite samples without the presence of any intermediate phases. The phonon vibrational modes of the composite samples are detected by Raman spectroscopy over wavenumber regions from 100 to 1000 cm−1 at room temperature. The dielectric constant and dielectric losses are measured over a wide range of frequencies from 1 kHz to 1 MHz at room temperature. Room temperature magnetization measurements confirm the ferromagnetic behavior of all the composite samples. The observed values of coercivity are significantly lower and lie between 9.5 and 49 Oe only, which signifies the soft magnetic behavior of samples. The highest leakage current density value (3.39 × 10−6) has been observed for 50NBT-50NFO composite in I–V measurements. The present study reveals that NBT-NFO composites could be potential lead-free multiferroic composites and provide an alternative for designing environment-friendly devices.


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ORIGINAL PAPER

Structural, Magnetic, and Electrical Properties of (1-x) $Na_{0.5}Bi_{0.5}TiO_3$ –(x) $NiFe_2O_4$(x = 0.1, 0.3, 0.5, 0.7, and 0.9) Multiferroic Particulate Composite

Shilpa Thakur[1] · Kusum Parmar[1] · Sarita Sharma[1] · N. S. Negi[1]

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Abstract

Multiferroic composites consisting of $Na_{0.5}Bi_{0.5}TiO_3$(NBT) and $NiFe_2O_4$(NFO) phases have been synthesized by using sol-gel and metal-organic decomposition (MOD) methods. The X-ray diffraction (XRD) and scanning electron microscopy (SEM) results confirm NBT and NFO phase formation in all composite samples without the presence of any intermediate phases. The phonon vibrational modes of the composite samples are detected by Raman spectroscopy over wavenumber regions from 100 to 1000 cm^{-1} at room temperature. The dielectric constant and dielectric losses are measured over a wide range of frequencies from 1 kHz to 1 MHz at room temperature. Room temperature magnetization measurements confirm the ferromagnetic behavior of all the composite samples. The observed values of coercivity are significantly lower and lie between 9.5 and 49 Oe only, which signifies the soft magnetic behavior of samples. The highest leakage current density value (3.39×10^{-6}) has been observed for 50NBT-50NFO composite in I–V measurements. The present study reveals that NBT-NFO composites could be potential lead-free multiferroic composites and provide an alternative for designing environment-friendly devices.

Keywords X-ray diffraction · Composite · Magnetic hysteresis · Dielectric properties

1 Introduction

Multiferroics with magnetic and electric orders occurring simultaneously have received great research attention due to their wide range of technological applications such as multi- composites have been developed to achieve superior properties compared with those observed in the individual components [6, 7]. Multiferroic composites exhibit a strong magnetoelectric effect due to product property, which arises from coupling between magnetostrictive and piezoelectric effect

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magnetization by external electric field and variation of polarization in response to magnetic field show unexpected devel- is different from single-phase multiferroic materials, which can be described as the deformation of the magnetic phase which is trans- phase, produc- osition of two mposites has n induction of eld or magne-

... The M − H curve depicts the spontaneous magnetization due to the presence of the ferrimagnetic ferrite phase. Due to the presence of the ferroelectric phase, which is typically nonmagnetic and acts as the pinning centre of domain walls in composites, all of the composites have magnetically soft characteristics, with smaller coercive field (H c), remnant magnetization (M r), and saturation magnetization (M s) than pure CCFO [52]. Table 2, which depict the typically soft magnetic character of the composites. ...

be ween magnetic and electric fields, the artificial multiferroic tization and vice versa. It has been concluded that the ME effect is directly influenced by piezoelectric and magnetostrictive strengths or respective performance of ferroelectric and ferromagnetic phases respectively. It means that the coupling effect depends greatly on the properties of the respective components. Furthermore, the concept of composite materials having piezoelectric and magnetic coexisted phases such as $BiFeO_3$–$Pb(Zr_{0.52}Ti_{0.48})O_3$ [11], $Pb_{0.99}[Zr_{0.45}Ti_{0.47}$

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... Here, M s is the saturation magnetisation, H c is the coercivity and 0.96 is a constant [45, 46]. The squareness factor is also known as reduced magnetisation whose value varies between 0 and 1. ...

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Na0.5Bi0.5TiO3 (NBT) and CoFe2O4 (CFO) ceramics were synthesized by sol–gel and metallo – organic chemical solution methods respectively. Structural, electrical, dielectric and magnetic properties of (1-x) NBT-(x) CFO (x = 0.1, 0.2) multiferroic particulate composite prepared by mixing NBT and CFO powders in required stoichiometric concentration were studied. The presence of ferroelectric (NBT) ... [Show full abstract]

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Co0.5Ni0.5Fe2O4(CNFO) were prepared by chemical coprecipitation method and the particles were tuned by varying annealing temperature (400, 500, 600, 700 and 800 °C), and on this basis, CNFO/Ba0.85Sr0.15TiO3 (BST) composites were prepared by sol–gel method. Effects of CNFO particle size on the microstructure, dielectric and multiferroic properties were systematically investigated and discussed. ... [Show full abstract]

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Multiferroic composites of x Ni0.5Zn0.5Fe1.9O4-d−(1-x) Na0.5Bi0.5TiO3 (x NZF−(1-x) NBT, where x = 0.05, 0.15 and 0.25 mole fraction) were synthesized by spark plasma sintering (SPS) in conjunction with high-energy ball milling. The presence of NZF and NBT phases in the composites was confirmed by X-ray diffraction. The dielectric constant was studied as a function of frequency (0.5 kHz - 1 MHz) ... [Show full abstract]

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Doping Effect of Cobalt on Various Properties of Nickel Oxide Prepared by Solution Combustion Method

Khem Raj Sharma & N. S. Negi

Journal of Superconductivity and Novel Magnetism **34**, 633–645 (2021)

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Abstract

Pure and cobalt-doped (Co-2 to 10 mol%) nickel oxide (NiO) powder samples were prepared by solution combustion method and annealed at 600 °C for 2 h. The crystalline and structural properties were characterised by using X-ray diffraction (XRD) and Raman spectroscopy. Field emission scanning electron microscope (FESEM) and energy-dispersive spectroscopy (EDAX) techniques were used to study the surface morphology and characteristic elements present in samples. Higher value of retentivity (12.20×10^{-2} emu/g) and coercivity (900 Oe) is found for 10 mol% Co-doped NiO, which is much higher than pure NiO. Such properties improve the magnetic memory and hardness of a magnetic material. A decrease in an optical band gap from 2.67 to 2.05 eV was observed for pure and Co-doped (2 to 10 mol%) NiO powder samples, which is quite useful in optoelectronic devices. Maximum value of conductivity ($11.23 \times 10^{-6}\ \Omega^{-1}\ cm^{-1}$) and dielectric constant (204) is found for Co 6 mol%-doped NiO. All the measurements were recorded at room temperature so as to utilise them for device fabrication readily. A significant improvement in magnetic, optical and dielectric properties was observed for NiO with increasing concentration of cobalt, which makes it a better choice for spintronic, optoelectronic, magnetic and storage devices.

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Data Availability

Yes, data and material are available.

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Ethics declarations

Conflict of Interest

The authors declare that they have no conflict of interest.

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Not applicable.

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Influence of phase dominance on structural, magneto-dielectric, magnetic-electric properties of $(Ba_{0.85}Ca_{0.15}Zr_{0.1}Ti_{0.9})O_3$-$CoFe_2O_3$ composites

Sarita Sharma, Shilpa Thakur, J. Shah, R. K. Kotnala & N. S. Negi

Journal of Materials Science: Materials in Electronics **32**, 6570–6585 (2021)

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Abstract

In this work, lead-free (1-x) $Ba_{0.85}Ca_{0.15}Zr_{0.1}Ti_{0.9})O_3$–$xCoFe_2O_3$ (BCZT-CFO, x = 00, 0.2,0.8 and 1) multiferroic composites have been prepared by chemical solution technique and sintered at 1300 °C. The article is focused on a systematic study of phase dominance effect on structure, microstructure, dielectric, magneto-dielectric, magnetic, electric, and magneto-electric properties of the BCZT-CFO composites. The XRD study confirms perovskite phase in BCZT, cubic spinal phase in CFO and mixed structural evolution in composite samples without any traceable secondary phase formation. William-Hall equation has been used to evaluate strain kinetics in pure and composite samples. The scanning electron micrographs show dispersion of smaller BCZT grains in larger CFO grains matrix. The dense microstructure has been observed for composite sample with ferrite phase dominance. The room temperature dielectric study reveals frequency-dependent dielectric dispersion characteristics for composites and pure CFO. The enhanced dielectric properties are observed for composite sample with ferroelectric phase dominance. The room temperature magneto-dielectric behavior has been observed for lead-free multiferroic composites. Under magnetic study, observed typical ferromagnetic M-H hysteresis loop reveals presence of long-range ferromagnetic ordering in pure CFO as well as in composite samples. The highest value of Ms ~ 38.2 emu/g and M_r = 1.2 emu/g has been measured for ferrite phase dominant composite sample. Higher coercive field H_c value has been observed for composite with ferroelectric phase dominance. Leakage current characteristic has been investigated at and above room temperature for prepared samples. The composite with ferrite phase dominance has shown higher leakage current characteristics. The enhanced magento-electric coupling coefficient has been measured for composite with higher ferrite phase concentration.

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Research Article

Enhanced dielectric and ferroelectric properties of chemical solution processed lead-free $Ba_{1-x}Ca_xZr_{0.1}Ti_{0.9}O_3$ thin films

Hakikat Sharma, Kamlesh Kumar Maurya, Jyoti Shah, Ravinder K. Kotnala & Nainjeet Singh Negi

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Abstract

Lead-free $Ba_{1-x}Ca_xZr_{0.1}Ti_{0.9}O_3$ thin films were deposited by sol-gel synthesis route. Dielectric studies demonstrate that the BCZT film for $x = 0.15$ exhibits a high dielectric constant ε'~5838 and a low loss tan δ~0.070 at 10 kHz. The BCZT thin films exhibited ferroelectric properties with a high saturation and remnant polarization P_s~25.5 μC/cm^2 and P_r~13.8 μC/cm^2, respectively, and a low coercive field E_c~15.04 kV/cm observed for sample with $x = 0.15$. The enhanced dielectric and ferroelectric properties at $x = 0.15$ may be due to its morphotropic phase boundary composition.

Keywords: Lead-free ferroelectrics | BCZT thin films | dielectric ferroelectric properties

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Research articles

Structural, magnetic, magneto-dielectric and magneto-electric properties of (1-x) $Ba_{0.85}Ca_{0.15}Ti_{0.90}Zr_{0.10}O_3$ – (x) $CoFe_2O_4$ lead-free multiferroic composites sintered at higher temperature

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Abstract

Here in this article synthesis of lead-free magnetoelectric composites (1-x) $Ba_{0.85}Ca_{0.15}$ $Ti_{0.9}Zr_{0.1})O_3$ - $xCoFe_2O_3$ (BCTZ-CFO, x =0.4, 0.5, and 0.6) is reported. Structural, magnetic, dielectric, magnetodielectric and magnetoelectric properties of lead-free BCTZ-CFO composites sintered at higher sintering temperature have been systematically investigated. The piezoelectric (ferroelectric) phase has been synthesized using the sol–gel route, while Metallo-organic decomposition (MOD) route was employed to prepare piezomagnetic (ferrite) phase. The structural and microstructural properties were studied using X-Ray diffraction and Scanning electron Microscope respectively acknowledged the presence of two distinct phases as ferrite and ferroelectric in composite samples. The dense microstructure and larger average grain size were observed for samples with higher ferrite phase content. Long-range magnetic order was observed under magnetic study for all-composites. The magnetic properties enhanced for composites prepared with higher ferrite phase content. Dielectric properties were studied at room temperature and enhanced dielectric constant has been observed for samples with higher ferroelectric phase content, while minimum dielectric loss was observed for sample with 50/50 ferrite/ferroelectric phase composition. The magnetodielectric response has been also investigated for all ME composites. Leakage current characterization has been also discussed at and above the room temperature. The magneto-electric coupling response was measured of all composites. The higher value of magneto-electric coupling coefficient has been observed for 0.5BCTZ-0.5CFO composite due to maximum possible ferrite-ferroelectric hetero-structure phase contact area.

Introduction

Ferroelectric and ferromagnetic materials have been extensively studied over more than last five decades because of their various technological applications in electronic industries. With the development of electronic techniques and growing industrial demands, tremendous research has been carried out to realize the significance of ferroelectric and ferromagnetic materials in a new technological era [1], [2]. Ferroelectricity and ferro magnetization aretwo primary and exotic properties of ferroelectric and ferromagnetic materials respectively, wherein, the polarization is controlled by the electric field, and magnetization is controlled by the magnetic field. However, the cross-coupling between these two ferroic properties has established a new direction to further explore and investigate these materials. The phenomenon of cross-coupling provides possibility of electrically controlling magnetization and magnetically controlling polarization in multiferroic materials. The multiferroics are the class of materials in which two or more ferroic orders occur simultaneously and are potential futuristic multifunctional systems for designing novel electronic devices. The diverse multifunctional application of multiferroic materials includes magneto-electric sensors, oscillators, phase shifters, magnetoelectric (ME) resonators, memory devices; magnetoelectric random access memory (MeRAM), and multiple state memory devices [3], [4], [5], [6], [7], [8].

The magnetoelectric (ME) coupling effect usually occurs either in single-phase multiferroics or in artificially designed composite materials. However, single-phase materials exhibit weak magnetoelectric response and show multiferroic properties much below room temperature thus provide no significant practical applications [9], [10], [11]. In artificially designed multiferroic composites,

the ME coupling arises due to strain mediated interaction at interface of two coupled material having different ferroic orders. It means those multiferroic composites exhibit product property of two ferroic orders present in constituent phases. One of the important issues in designing multiferroic composite is the selection of constituent phase e.g. ferroelectric and ferromagnetic systems. Usually, ferroelectric phase having a remarkable high piezoelectric coefficient and ferromagnetic phase with a high magnetostriction coefficient are preferred in order to designed multiferroic composites with maximum possible ME response. Most extensively studied multiferroic composites are designed with lead-based ferroelectrics due to their high piezoelectric coefficient e.g. $CoFe_2O_4$–PZT, $BiFeO_3$-$PbTiO_3$, $[Pb(Fe_{0.5}Nb_{0.5})O_3]$1-x-$[Co_{0.65}Zn_{0.35}Fe_2O_4]$, $PbMg_{1/3}Nb_{2/3}O_3$-$PbTiO_3$, $PbZr_{0.65}Ti_{0.35}O3$-x$BaFe_{12}O_{19}$, $NiFe_2O_4$–PZT, and x$PbTiO_3$-(1-x)$SrFe_{12}O_{19}$. [12], [13], [14], [15], [16], [17]. However, lead and lead-based materials own serious threat to the environment and human health because of toxic PbO release during processing. Several international bodies have already restricted the use of lead-based materials [18]. The world-wide research work on ferroelectrics has been now shifted to search for lead-free systems comparable with PZT. On the other hand, the development of lead-free multiferroic composites is still at the infancy stage. Among lead-free perovskites, $BaTiO_3$ based systems emerge as preferable ferroelectric phases in designing multiferroic composites due to their environmental friendly processing and sintering suitability. $BaTiO_3$ and its derivatives are now established as potential lead-free ferroelectric materials having piezoelectric coefficient comparable to lead based PZT ceramics. Ren et al. [19] reported that $Ba_{0.85}Ca_{0.15}Ti_{0.90}Zr_{0.10}O_3$ (BCTZ) exhibits piezoelectric coefficient value d_{33}~620 pC/N due to morphptropic phase boundaries (MPB) structural evolution similar to lead-based PZT system. In addition, BCTZ has excellent mechanical coupling behaviour and is suitable for strain mediation at interface [20], [21]. On the other hand, CFO is a well-studied ferromagnetic material and this ferrite has been extensively employed in designing lead-based multiferroic composites. Besides high magnetostriction characteristics, CFO possesses magneto anisotropy, excellent magnetic properties, and high thermal stability [22], [23].

In our previous reported research work we developed the same composite systems i. e (1-x)$Ba_{0.85}Ca_{0.15}Ti_{0.90}Zr_{0.10}O_3$ – (x) $CoFe_2O_4$ (BCTZ-CFO) with× =0.1, 0.3, 0.5, 0.7, and 0.9 by chemical solution methods sintered at lower temperature 1050℃ for 2 h [24]. Crystal structure, multiferroic, dielectric and electromagnetic properties were investigated in that article. However, in BCTZ system usually show enhanced structural and electric properties at higher sintering temperature and therefore in the present work properties also remain sensitive to sintering temperature. In order to meet the requirement of device applications structural and physical properties of BCTZ-CFO systemhave been ameliorated by increasing the sintering time from 2 h to 5 h and temperature from 1050 ℃ to 1300 ℃. In the present article, we have reported synthesis and properties of (1-x) $Ba_{0.85}Ca_{0.15}Ti_{0.90}Zr_{0.10}O_3$ – (x) $CoFe_2O_4$, (x=0.4, 0.5 & 0.6) composites. Here, BCTZ phase has been synthesized using the same chemical solution methods; sol–gel technique has been used to develop BCTZ phase and MOD chemical solution process was used to synthesize CFO phase. The structural, microstructural, magnetic, dielectric, and magnetoelectric properties have been systematically investigated. As expected the physical properties of BCZT-CFO composite have been intensified in later case. For 0.5BCTZ-0.5CFO sample value of dielectric constant (at 1 MHz) enhances from 92 to 294, while dielectric loss declines from 0.4 to 0.03. Saturation magnetization (M_s) rises from 19.8 emu/g to 28.8 emu/g. Surge in the value of electromagnetic coupling coefficient from 0.63 mV/cmOe to 1.99 mV/cm.Oe is a major breakthrough in our present work.

Section snippets

Experimental procedure

$(Ba_{0.85}Ca_{0.15}Ti_{0.9}Zr_{0.1})O_3$ (BCTZ) ceramics were prepared by the sol–gel method. First, the required amount of barium acetate was taken in a beaker and dissolved in solvent 2-ethyl hexanoic acid. The precursor was heated up to temperature 100 ^{0}C. As the precursor was completely dissolved, an appropriate amount of calcium acetate was added to it. Similarly, after complete dissolution of calcium acetate, an appropriate amount of zirconium (IV) acetylacetonate (all are from Merck, made in Germany)…

Xrd

The combined plot of diffraction patterns of BCTZ-CFO composite samples sintered at temperature 1300 °C is shown in Fig. 1. The XRD patterns reveal presence of well-defined crystalline reflection lines corresponding to both constituent phases of the composite samples. The reflection lines in XRD patterns are indexed with tetragonal structure with space group symmetry of P4mm (JCPDS card no. 05-0626) for BCTZ [27] and cubic spinel structure with space group symmetry Fd$\bar{3}$m**Fd$\bar{3}$m** (JCPDS card no.…

Conclusion

In the present work, various properties such as structural, magnetic, dielectric, and Magento-electric properties have been studied for (1-x) $Ba_{0.85}Ca_{0.15}Ti_{0.90}Zr_{0.10}O_3$ – (x) $CoFe_2O_4$ (x=0.4, 0.5, 0.6) multiferroic composites sintered at higher temperature of 1300 ^{0}C.

Efficacy of higher temperature on the structural and physical properties is observed in the present study in comparison to the low temperature. Because, temperature plays the vital role in structural development. The physical…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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Magnetoelectric coupling and energy harvesting in 2/3Pb(Mg<inf>1/3</inf>Nb<inf>2/3</inf>)O<inf>3</inf>-1/3PbTiO<inf>3</inf>: CoFe<inf>1.97</inf>RE<inf>0.03</inf>O<inf>4</inf> (RE = La³⁺ and Eu³⁺) composites

2023, Journal of Magnetism and Magnetic Materials

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A review on lithium doped lead-free piezoelectric materials

2022, Materials Today Communications

Citation Excerpt :

...However, oxygen-ion conductivity can be improved by adding a dopant element into the A site or B site of this perovskite material [52]. BCTZ is Barium Titanate based material with doping or substitution of Calcium at the A site and Zirconium at the B site that shows an excellent piezoelectric property [53], which is a high piezoelectric coefficient value (d33 =500–650 pC/N) [34,54–61] due to a morphotropic phase boundary [62] that has been constructed from tricritical triple point [9,63,64], has large remnant polarisation [65] and a low coercive field [65], which makes this material one of the promising materials. Recently, however, a low Curie temperature (Tc = 83–100 ºC) was found to be the drawback for this material [66–68]....

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Enhanced performance of magnetoelectric voltage coefficient in giant magnetostrictive (Ni<inf>0.7</inf>Mg<inf>0.3</inf>Fe<inf>2</inf>O<inf>4</inf>)/piezoelectric (BaZr<inf>0.2</inf>Ti<inf>0.8</inf>O<inf>3</inf>) composites

2022, Solid State Communications

Citation Excerpt :

...The multiferroics are the class of materials in which two or more ferroic orders occurs simultaneously and are potential futuristic multifunctional systems for designing novel electronic devices. The diverse multifunctional application of multiferroic materials includes magneto-electric sensors, oscillators, phase shifters, magnetoelectric (ME) resonators, memory devices, magnetoelectric random access memory (MeRAM), and multiple state memory devices [35]. Therefore, it is particularly very important to select functional materials with good flexibility and excellent mechanical, electrical and magnetic properties of ferromagnetic and ferroelectric phases of multiferroic composites [34]....

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Investigation on the dielectric and magnetic properties of perovskite-spinel (KNbO<inf>3</inf>-NiFe<inf>2</inf>O<inf>4</inf>) composites

2022, Materials Research Bulletin

Citation Excerpt :

...Further, it is an excellent candidate for technologically important applications such as high-density data storage, sensors, spintronics, contrasting agent for magnetic resonance imaging, ferrofluids, magnetic drug delivery, transformer cores, and high-frequency devices [9]. Therefore, research effort has been made for the preparation of multiferroic bi-phase composites based on perovskite and spinel ferrites using various experimental methods [5–13]. Among the existing sample preparation methods, the conventional solid-state reaction method is considered as an easy-to-handle, economic, high yield method with low environmental pollutions, without the need for hazardous solvents during the preparation of nanocomposites....

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Investigations of room temperature multiferroic and magneto-electric properties of (1-φ) PZTFT-φ CZFMO particulate composites

2023, Journal of Applied Physics

Ba<inf>0.85</inf>Ca<inf>0.15</inf>Zr<inf>0.1</inf>Ti<inf>0.90</inf>O<inf>3</inf>/CoFe<inf>2</inf>O<inf>4</inf>/Ba<inf>0.85</inf>Ca<inf>0.15</inf>Zr<inf>0.1</inf>Ti<inf>0.90</inf>O<inf>3</inf>Nanoscale Composite Films with 2-2 Connectivity for Magnetoelectric Actuation

2022, ACS Applied Nano Materials

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Research article

Tuning the dielectric, ferroelectric and electromechanical properties of $Ba_{0.83}Ca_{0.10}Sr_{0.07}TiO_3$–$MnFe_2O_4$ multiferroic composites

Ceramics International, Volume 46, Issue 6, 2020, pp. 7576-7585

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Research article

Structural, dielectric, magnetic and magnetoelectric properties of the PFN-PT/$Co_{1-x}Ni_xFe_2O_4$ multiferroic composites

Journal of Magnetism and Magnetic Materials, Volume 549, 2022, Article 169017

Show abstract

Research article

Strong converse magnetoelectric effect in (Ba,Ca)(Zr,Ti)O_3 - $NiFe_2O_4$ multiferroics: A relationship between phase-connectivity and interface coupling

Acta Materialia, Volume 144, 2018, pp. 305-313

Show abstract

Research article

Magnetoelectric and magnetodielectric coupling in partially Ni-doped $CoFe_2O_4$ and 0.15($Ba_{0.7}Ca_{0.3}TiO_3$)–0.85($BaZr_{0.2}Ti_{0.8}O_3$) composites prepared via clean microwave sintering

Journal of Alloys and Compounds, Volume 849, 2020, Article 156599

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Research article

Magneto-electric properties of x$Ni_{0.7}Zn_{0.3}Fe_2O_4$ – (1-x)$BaTiO_3$ multiferroic composites

Ceramics International, Volume 44, Issue 1, 2018, pp. 683-694

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Research article

A phenomenological approach to study the magnetoelectric (ME) response of lead free magnetostrictive $NiFe_2O_4$–Piezoelectric $BaZr_{0.2}Ti_{0.8}O_3$ particulate composites

Solid-State Electronics, Volume 184, 2021, Article 108110

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Materials Science and Engineering: B

Volume 265, March 2021, 115014

Optical anisotropy in bare and janus tellurene allotropes from ultraviolet to visible region: A first principle study

Ritika Rani [a], Munish Sharma [b], Raman Sharma [a]

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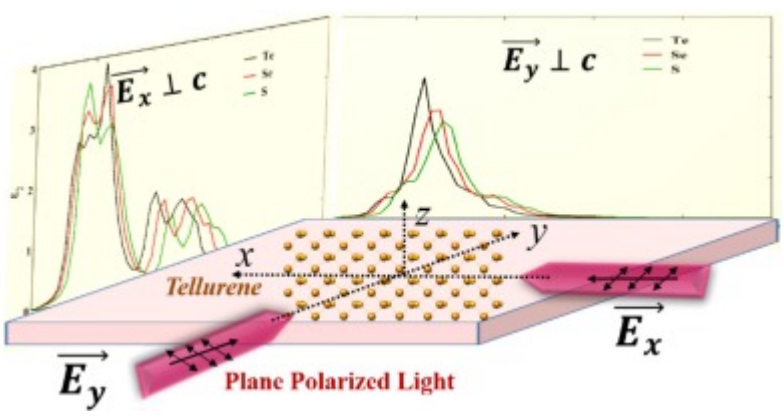
Abstract

In this study, we report presence of optical anisotropy in very recently synthesized mono-elemental layered tellurene structures. Our results based on Density Functional Theory, reveal energetic and kinetic stability of five bare and janus tellurene allotropes. Graphene like tunable linear dispersion (Dirac cone) has been observed for σ tellurene. Optical response of bare and janus tellurene allotropes show that α, σ, γ allotrope are optically isotropic in nature whereas, β, δ and η allotropes are anisotropic. A blue shift in imaginary part of dielectric function and electron energy loss spectra has been observed for janus tellurene as compared to bare tellurene for E||c as well as E⊥c. The plasmon resonance have been observed about 7eV in α, γ and η while β, δ, and σ show plasmon resonance above 10eV. Tellurene mono-layers show optical anisotropy in UV–Vis region indicating its usefulness as photo-diodes, photo-catalysts, and photo-detectors.

Graphical abstract



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Introduction

Two-dimensional (2D) materials have undergone a rapid pace of development since the discovery of graphene [1]. The success of graphene have motivated scientific community to devote efforts to explore other 2D materials which are similar to graphene having inherent electronic and physicochemical properties [2]. A number of 2D materials beyond graphene have been predicted and synthesized such as hexagonal boron nitride (h-BN) [3], TMD's [4], phosphorene [5], gallium sulphide [6] etc. Among these 2D materials, MoS_2 has been identified, both experimentally and theoretically as a promising material for various applications. The inherent direct band gap of 1.80eV can be tuned by controlling the number of layers [7], electric field [8], mechanical strain [9], etc. Furthermore, it has been reported experimentally [10], [11] and theoretically [12] that TMD's based janus structures break the inversion symmetry that results in structural anisotropy leading to interesting properties such as large piezoelectricity[10] and Rashba spin splitting [13], [14].

Very recently, chalcogenide mono-elemental layered structures called 'Tellurene' have been successfully synthesized [15], [16], [17] which show structural analogy to TMD's. Experimentally, tellurene has been found to exhibit high on/off ratio [18], excellent photoconductivity [19], non-linear optical response [20], high thermoelectric [21] and piezoelectric [22], [23] properties. These properties make tellurene a potential candidate for variety of applications such as FET [18], photo-detectors [24], batteries [25] etc. Various distinct layered phases of Te have been predicted depending upon orientation of cleavage plane e.g. α (1T-MoS_2 like), tetragonal β and γ phase (2H MoS_2 like) [15]. Recently, two more stable allotropes of tellurene have been predicted namely δ and η-tellurene [26] and a new stable phase of monolayer tellurene has been synthesized on Cd-terminated CdTe wafer surfaces [27]. Besides, ongoing experimental and theoretical studies on tellurene, no particular attention has been given to understand optical properties of tellurene in distinct phases. In this work, we explore structural, electronic and optical properties of six different phases of tellurene and its janus allotropes. Janus structures have been chosen as they offer an advantage of good growth control and more feasible fabrication. The density functional theory (DFT) has been employed to study bare and janus tellurene allotropes with the aim to study i) structural properties of bare and janus tellurene allotropes, ii) modulation in electronic band structure, carrier effective masses, iii) tunability in optical properties including static dielectric constant, imaginary part of dielectric function and electron energy loss spectra.

Section snippets

Simulation details

A Vienna ab-initio Simulation Package (VASP) [28] has been used to get optimized geometry structures of 2D tellurene within the framework of density functional theory (DFT). The exchange–correlation energies were treated using generalized gradient approximation within Perdew-Burke-Ernzerhof parameterization [29]. The plane wave cut-off energy of 400eV has been used. The atomic positions were fully optimized until the forces on all atoms were less than 10^{-6}eV/Å. The energy convergence criteria …

Structural properties

The geometric structures for six different allotropes of two-dimensional tellurene have been depicted in Fig. 1. Out of six different allotropes α and γ have honeycomb-like geometry and β, δ, η and σ have non-honeycomb geometry. The α and γ phases have 1T and 2H MoS_2 like structure containing three atoms in a unit cell. The central Te atom in α and γ phase have larger coordination number as compared to top and bottom atom in a monolayer. It results in dual nature (metallic and semiconducting)…

Conclusions

The Density Functional Theory (DFT) has been employed to study structural, electronic and optical properties of bare and janus tellurene allotropes. We find α, β, δ, η and σ tellurene allotropes energetically and kinetically stable. The γ allotrope show energetic stability but found kinetically instable due to out-of-plane vibrations which are expected to be stabilized on suitable substrate. Bare and janus tellurene allotropes exhibit versatile electronic properties ranging from semiconductor…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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Role of environmental oxygen and water in the electronic and optical properties of sigma tellurene
2023, Physica E: Low-Dimensional Systems and Nanostructures

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Metal-semiconductor interface study in bilayer heterostructure of Tellurene and TeSe<inf>2</inf>
2023, Materials Today: Proceedings

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Pressure induced modulations in the optoelectronic properties of Hg<inf>2</inf>Cl<inf>2</inf> compound: Insights from the first-principle calculations
2022, Materials Science and Engineering B: Solid-State Materials for Advanced Technology

> *Citation Excerpt :*
>
> ...Moreover, tunable electronic structures and high efficiency obtained by introducing superalkali and superhalogen into AMX3-type perovskites had also been estimated from the first-principle calculations [25]. Thus the results of the first-principle calculations alone or in unison with the experimental observations not only provide strong foundations for the futuristic applications of these materials in optoelectronic devices but also help to explore the underlying physics that drive their optical responses [26–41]. Fig. 6 shows the theoretically simulated electronic band structures of the tetragonal (I4/mmm) and orthorhombic (Cmcm, Pnma) phases of the Hg2Cl2 crystal under ambient and external pressures respectively....

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Stability, tunneling characteristics and thermoelectric properties of TeSe<inf>2</inf> allotropes

2022, Materials Science and Engineering B: Solid-State Materials for Advanced Technology

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>
> ...The TeSe2 layer thickness has been found to be maximum of 3.78 Å for η allotrope and minimum of 1.66 Å for σ allotrope. The layer thickness is generally less than that observed in tellurene allotropes [36]. Note that α, γ allotrope exhibit isotropic nature while β, δ, η and σ exhibit anisotropic nature....

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Plumbene: A next generation hydrogen storage medium

2021, International Journal of Hydrogen Energy

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>
> ...In the past decade, interest in 2D materials has grown rapidly since the discovery of graphene [1]. Various elemental 2D materials like silicene, germanene, stanene, arsenene, antimonene, bismuthene and tellurene have been studied experimentally as well as theoretically [2–4]. 2D materials offer precise layered structures, large surface area and tremendous physio-chemical properties [5–8] which make them potential candidate for application in different fields....

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Hexagonal warping effect in the Janus group-VIA binary monolayers with large Rashba spin splitting and piezoelectricity

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Eur. Phys. J. B (2021) **94**: 99
https://doi.org/10.1140/epjb/s10051-021-00102-1
Regular Article - Computational Methods

Twisted helical armchair graphene nanoribbons: mechanical and electronic properties

Rajesh Thakur[1a], P. K. Ahluwalia[1], Ashok Kumar[2], Munish Sharma[3] and Raman Sharma[1]

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Abstract

The Hydrogen and Fluorine planar armchairs graphene nanoribbons (H **&** F AGNRs), subjected to twist deformation within fixed periodic boundary conditions. H-AGNRs is highly elastic in nature, though passivation with Fluorine does induce the plasticity when twisted beyond threshold torsional strain. This plasticity attributes to the wider bond length distribution suggests distortion of benzo-rings. The bandgap response to the effective strain of narrow GNRs $N = 6, 7,$ and 8 get arranged as (*i*) monotonously increasing for $q = 0, 2$ and (*ii*) decreasing for $q = 1$; here, $q = mod\,(N, 3)$ in effective strain space $(\theta^2 \Sigma^2)$. The effective strain space is found to be more appropriate for gauging the response of torsional strain. This trend has also been observed for Fluorine passivated AGNRs; however, because of higher sensitive response to torsional strain, the bandgap of N =7 F-AGNRs drops from $E_g \simeq 0.95\mathrm{eV}$ to $E_g \simeq 0.05\mathrm{eV}$ at extreme torsional strain forming Dirac cone at $\pm K$ allows dissipationless transport to charge carriers of high kinetic energy at low bias.

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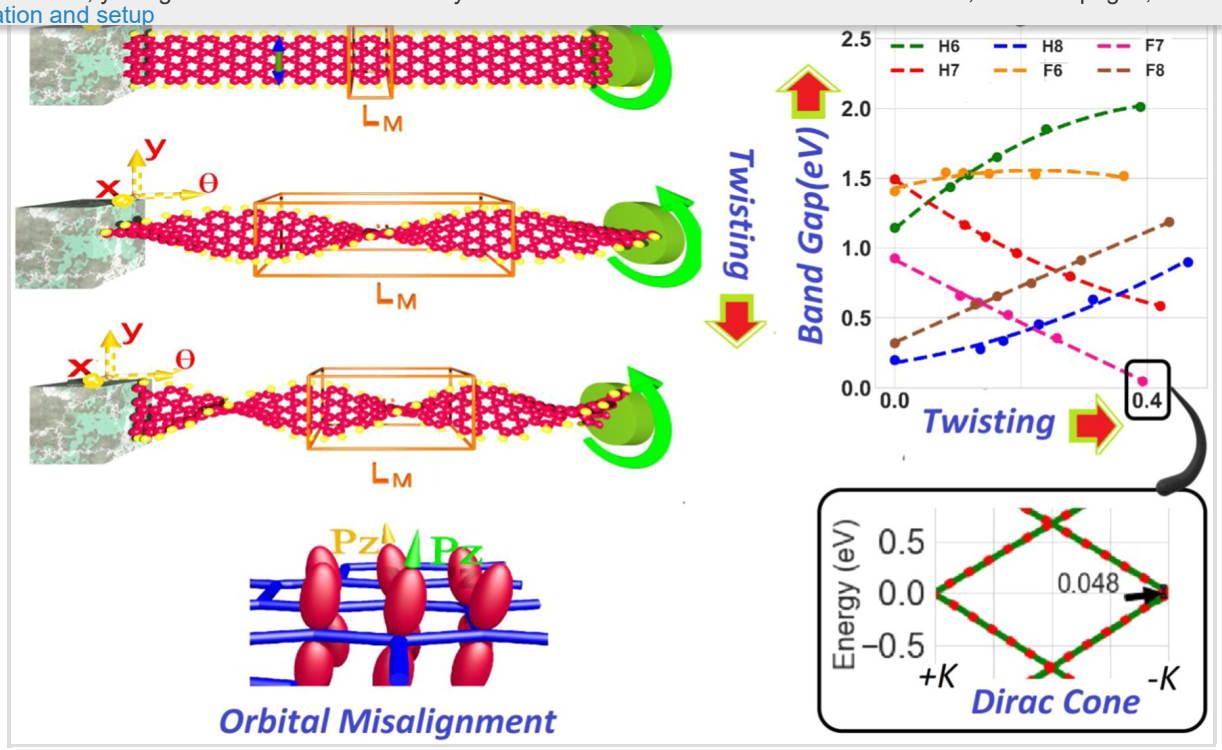

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NAM & New Information and Communication Order

Dr. Yog Raj

Information and Communication Technology (ICT) has the potential to make the world a better place and contribute immensely to the attainment of the Sustainable Development Goals, particularly, in the developing world.

Non-Aligned Movement has always supported the implementation of Information and Communication Technology (ICT), the use of which has effectively changed the world, especially in current senerio. But due to this "digital revolution", many adverse elements have also become active ever since the use of internet entered the public domain. The digital revolution has changed the way people shape their daily lives, and helped pave the way for growth and economic development. With this background, NAM has urged for the world leaders to enforce the results of the World Summit on Information Society. NAM also believes in the use of the ICTs to enhance the implementation and following of a democratic way of governing, equality and the rule of law at national, internal and regional level.

Since 1970s, NAM members began raising their voice against the Western dominated information and communication system. They have protested against the quantitative as well as qualitative imbalance in the international flow of information, inequalities in communication capabilities, allocation of radio frequencies and geo-stationary orbits, disparity in communication tariffs and barriers to scientific and technical information.

The NAM countries have felt the need to alter this serious imbalance in the sphere of information and mass media, and bring about greater reciprocity in the flow of information. They have underlined the need to reaffirm their national, cultural identities.

It was this understanding that led the Algiers conference (1973) to moot the idea of a non-aligned news pool. The Algiers summit conference gave the first impetus to third world's demand for the movement for a fair deal in the vital area of international communication system. There, the delegates decided that the developing countries should get together and adopt joint measures to promote mutual exchange of ideas inspired by the following principles:

a) reorganization of existing communication networks which were inherited from the colonial past,

b) an initiative for joint measures to revise current institutional agreements with the aim of revising the tariffs for new reports and facilitating faster and cheaper communications,

c) urgent measures to accelerate the process of collective acquisition of communication satellites and elaboration of a code of conduct for regulating the manner of their use,

d) closer contacts between information agencies, universities, libraries, planning and research bodies and other institutions with a view to carry out an exchange of experiences and technological knowhow and ideas.

The conference decided that the Secretary General of the UN should be called upon to set up a special department for studies regarding non-alignment in the university which the UN proposed to create. Likewise, the developing countries should themselves encourage similar studies at their universities and scientific institutions. The Non-aligned nations should exchange and disseminate information on mutual achievements in all domains, through newspaper, journals, radio, television and information media in their countries. They should formulate plans to share experiences in this sphere by organizing exchange visits of delegations of specialists in the information media, as well as by an exchange programme of photographs, cultural delegations and art festivals.

The March 1976 Tunis symposium organized by the non-aligned countries puts it rightly that, "it was the duty of the non-aligned countries to alter the imbalanced situation (in respect of area of communication) to decolonize information and to conceive of a new world order for information".[3] Attended by fourty non-aligned countries, the symposium made detailed recommendations that are as follows:

1. to urge the countries with adequate information agencies to collaborate with other countries to help them form their own information agencies either by training personnel or by providing material support for the setting up of technical organs,

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Challenges Faced by Teachers During Covid-19 Pandemic

Dr. Yog Raj

A Serious situation the world has faced, a virus is spreading very fast almost in every country leaving millions infected and thousands of dead. The whole aspects of life have been affected, health, economy, travels, manufacturing, trade and education is not exception. Universities cancelled face-to-face study, cancelled study-abroad programme, forced students to leave dorms and in some cases students in off- campus housing, too, were asked to vacate and moved to online teaching. Meanwhile scheduled conferences and seminars have been cancelled and almost every sports event or even practice have also been put on hold. The Corona virus pandemic has upended the world's education system, as most school, colleges and universities in almost every country have closed their doors for extended periods to combat the spread of the virus. Millions of students across the world have been infected by the COVID-19 virus.

The **COVID-19 pandemic**, also known as the **Corona virus pandemic**, is an ongoing global pandemic of Corona virus disease 2019 (COVID-19), which is caused by severe acute respiratory syndrome Corona virus 2 (SARS-CoV-2). The virus was first identified in December 2019 in Wuhan, China. The World Health Organization diest pandemics in history.

The severity of COVID-19 symptoms is highly variable, ranging from unnoticeable to life-threatening. COVID-19 transmits when people breathe in air contaminated by droplets and small airborne particles. The risk of breathing these in is highest when people are in close proximity, but they can be inhaled over longer distances, particularly indoors. Transmission can also occur if splashed or sprayed with contaminated fluids, in the eyes, nose or mouth, and, rarely, via contaminated surfaces. People remain contagious for up to 20 days, and can spread the virus even if they do not develop any symptoms.

Recommended preventive measures include social distancing, wearing face masks in public, ventilation and air-filtering, hand washing, covering one's mouth when sneezing or coughing, disinfecting surfaces, and monitoring and self-isolation for people exposed or symptomatic. Several vaccines have been developed and widely distributed since December 2020. Current treatments focus on addressing symptoms, but work is underway to develop medications that inhibit the virus. Authorities worldwide have responded by implementing travel restrictions, lockdowns and quarantines, workplace hazard controls, and business closures. Numerous jurisdictions have also worked to increase testing capacity and trace contacts of the infected.

The pandemic has resulted in significant global social and economic disruption, including the largest global recession since the Great Depression of the 1930s. It has led to widespread supply shortages exacerbated by panic buying, agricultural disruption, and food shortages. However, there have also been decreased emissions of pollutants and greenhouse gases. Numerous educational institutions and public areas have been partially or fully closed, and many events have been cancelled or postponed. Misinformation has circulated through social media and mass media, and political tensions have been exacerbated. The pandemic has raised issues of racial and geographic discrimination, health equity, and the balance between public health imperatives and individual rights.

The world as we know it has changed in the blink of an eye. Schools closed overnight students were liberated from schools (But confirmed to their homes), and parents had to grapple with keeping children productive at home. But the mission of our Education system is to overcome learning crisis and reduce negative impact of this pandemic on learning and schooling. The education system has faced huge challenges due to the COVID-19 pandemic. Teachers have also to face a lot of challenges and problems.

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विनोद कुमार शर्मा, पीएचडी शोधार्थी,
योग अध्ययन विभाग, योग अध्ययन विभाग, हिमाचल प्रदेश विश्वविद्यालय, हिमाचल प्रदेश विश्वविद्यालय।

चौरासी लाख योनियों में भटकता हुआ जीव जब मनुष्य देह को प्राप्त करता है तो वह परमात्मा को प्राप्त कराने वाली सीढ़ी पर पहुंचता है। मनुष्य देह में ही जीव कर्म करने में स्वतंत्र है। जीव अधिक पुण्य अर्जित करता है तो वह स्वर्ग को प्राप्त करता है और स्वर्ग से अर्जित पुण्य क्षीण होने पर पतित होता है :–

'ते तं भुक्त्वा स्वर्गलोकं विशालंक्षीणे पुण्ये मर्त्यलोकं विशन्ति।'[1]

यदि जीव अधिक पाप करता है तो उसे तिर्यक योनि में जाना पड़ता है वहां भी जीव नूतन कर्म नहीं कर सकता केवल किए गए पाप कर्मों को ही भोक्ता है और यदि पुण्य कर्म अधिक होते हैं तो स्वर्गलोक की प्राप्ति होती है परन्तु दोनों ही योनियों में कर्म करने की स्वतंत्रता नहीं है। कर्म करने की स्वतंत्रता केवल मनुष्य देह में ही जीव को प्राप्त होती है इसलिए मनुष्य देह कीसंतों ने प्रशंसा की है।

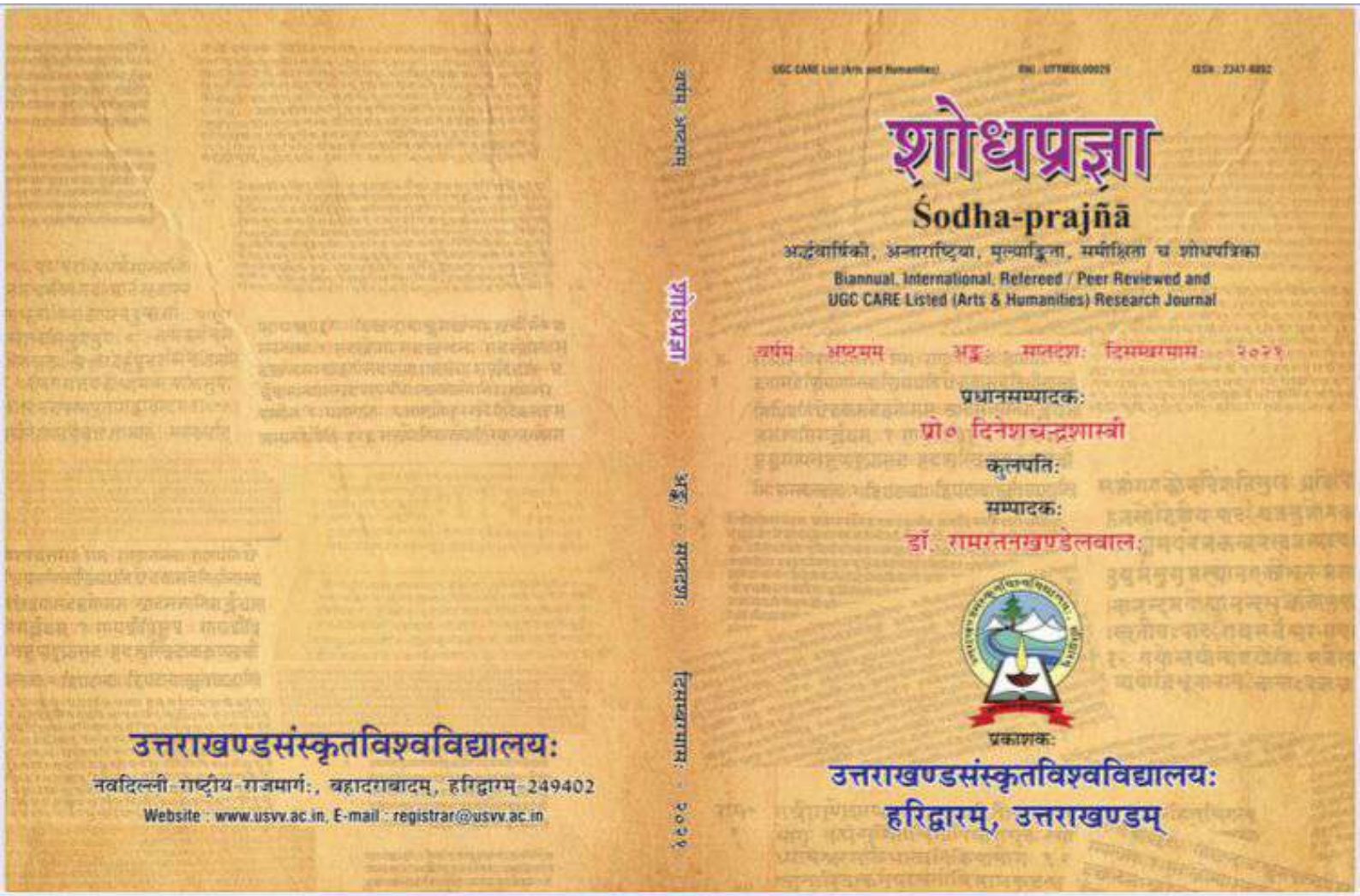
चौपाई :– बड़े भाग मानुष तनु पावा। सुर दुर्लभ सब ग्रंथन्हि गावा।।
साधन धाम मोक्ष कर द्वारा।पाइ न जेहि परलोक सँवारा।।[2]

श्री रामचरितमानस में तुलसीदास ने बड़े सुंदर ढंग से वर्णन किया है कि यह शरीर बड़े ही भाग्य से मिलता है सद ग्रंथों ने यही कहा है कि यह शरीर देवताओं को भी दुर्लभ है अर्थात कठिनता से प्राप्त होता है यह साधन का धाम है अर्थात मनुष्य देह से ही साधन किया जा सकता है।

योग साधना में साधन बहुत प्रकार के हैं जिनमें अष्टांग योग, ज्ञान योग, कर्म योग व भक्ति योग और इसके अतिरिक्त कई अन्य प्रकार के योग साधन भी हैं परंतु मनुष्य का मन–बुद्धि इन साधनों में लगे या यूं कहें कि मनुष्य आत्म कल्याण के मार्ग पर प्रेरित हो इसके लिए सत्संग का विशेष महत्व है सत्संग अर्थात संतों का संग, श्रेष्ठ पुरुषों का संग, सत्य का संगव स्वाध्याय आदि सत्संग कहलाता है। मनुष्य सत्मार्ग पर चले इसके लिए सत्संग बहुत ही आवश्यक है। सत्संग के प्रभाव को विभिन्न ग्रंथों में विस्तार पूर्वक कहा है। तुलसीदास जी कहते हैं कि :–

चौपाई :– सठ सुधरहिं सतसंगति पाई। पारस परस कुधात सुहाई।।[3]

दुष्ट भी सत्संगति पाकर सुधर जाते हैं जैसे पारस केस्पर्श से लोहा सुहावना हो जाता है। यह सत्संग का ही प्रभाव ही की कोई दुरात्मा भी सत्संग के प्रभाव से पुण्यात्मा बना जाता है क्षणभर के सत्संग से मनुष्य में सद्बुद्धि का प्रादुर्भाव हो जाता है और मनुष्य अपने आत्म कल्याण के मार्ग पार अग्रसित हो जाता है।



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शोधप्रज्ञा

Śodha-prajñā

अर्द्धवार्षिकी, अन्तराष्ट्रिया, मूल्याङ्किता, समीक्षिता च शोधपत्रिका

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कुलपतिः

सम्पादकः
डॉ. रामरतनखण्डेलवालः



प्रकाशकः
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घेरण्ड संहिता में वर्णित योगासनों में योग चिकित्सा का स्वरूप

कुमारी शिल्पी[1]
शोधार्थी (पीएचडी रिसर्च स्कॉलर) योग अध्ययन विभाग
हिमाचल प्रदेश विश्वविद्यालय, शिमला
डॉ अर्पिता नेगी[2]
सहायक आचार्या, योग अध्ययन विभाग
हिमाचल प्रदेश विश्वविद्यालय शिमला

शोध संक्षेप :–

प्रस्तुत शोधपत्र में घेरण्ड संहिता में वर्णित योग चिकित्सा के स्वरूप को स्पष्ट करने का प्रयत्न किया गया है क्योंकि योग चिकित्सा के बहुआयामी स्वरूप को वर्तमान में समझना अत्यन्त आवयश्यक है जबकि हम एक ऐसी जीवनशैली व समय में जीवन यापन कर रहे है जहां शारीरिक व मानसिक रोग होना एक सामान्य सी बात हो गयी है योग चिकित्सा का स्वरूप भी उतना ही पौराणिक है जितना कि योग स्वयं। प्रस्तुत शोध में घेरण्ड संहिता में वर्णित आसनों में स्पष्टतः रोग निवारण के लिए आसन करने के नियम बताये गये है इस शोध पत्र में यह जानेगे कि किस आसन विशेष से हम अपने रोगी शरीर को स्वस्थ व पुर्नस्थापित कर सकते है।

मूल शब्द – योग, योग चिकित्सा, आसन

प्रस्तावना :–

आसन का शाब्दिक अर्थ है – बैठना या बैठने की विशेष प्रक्रिया'। महर्षि पतञ्जलि ने अष्टांग योग में (यम, नियम, आसन, प्रणायाम, प्रत्याहार, धारणा, ध्यान) समाधि में आसन का तृतीय स्थान दिया उसके साथ ही गोरक्षनाथ जी ने षड्गयोग में आसन का प्रथम स्थान दिया इसी प्रकार घेरण्ड संहिता में भी सप्त साधन को साधन के लिए तृतीय स्थान पर आसनों का वर्णन है। योग सूत्र में आसन की परिभाषा **स्थिर सुखं आसनम्**[2]जिस शारीरिक स्थिति में आप स्थिर रह सकें और सुख का अनुभर करें, वह आसन हैं आसनों को दो भागों में विभक्त किया गया है गतिशील आसन व स्थिर आसन

17 वीं शताब्दी ने महर्षि घेरण्ड द्वारा रचित 'घेरण्ड संहिता' में आसनों की महत्ता बतायी गयी है।[3]

महर्षि घेरण्ड ने राजा चण्डकपालि को शारीरिक स्थिरता के लिए 32 आसनों की शिक्षा दी एवं आसनों की महत्ता को बताते हुए महर्षि घेरण्ड ने बताया कि आसनों के अभ्यास से शारीरिक एवं मानसिक कष्टों से मुक्ति मिलती है। आसन वही जिसको आसानी से किया जा सके और जो शरीर के लिए लाभकारी हो।

आसन के मुख्यतः लाभ शरीर को सुदृढ़ एवं लचीला बनाना है। आसन मुख्यतः हमारे पेशी तंत्र पर कार्य करके शरीर एवं इन्द्रियों सामञ्जस्य स्थापित करते है और आंतरिक अंगों की मालिश कर उनकी कार्य क्षमता का बढ़ाते हैं।

महर्षि घेरण्ड ने जिस प्रकार योगासनों का अभ्यास बताया है वह आसन की अन्तिम स्थिति है तथा व्यक्ति विशेष द्वारा अपने शरीर की क्षमता अनुसार प्रकारन्तरों का अभ्यास करते हुए उस अन्तिम स्थिति को प्राप्त करने के निर्देश बताये गये है।

महर्षि घेरण्ड रचित 'घेरण्ड संहिता' में आसनों का अभ्यास–2 में सम्मिलित किया गया है जो 'आसन प्रकरण' नाम से प्रचलित है।

महर्षि ने स्पष्टतः बताया कि आसनों का अभ्यासशरीर शुद्धिकरण के बाद एवं प्राणायाम से पूर्व करना ही लाभप्रद हैं। शरीर में उत्पन्न सूक्ष्म प्रभावों के साथ आसन के अभ्यास से शरीर में दृढता एवं स्थिरता आती है।

शरीरमाद्यं खलु धर्मखाधानम् शरीर के माध्यम से ही मनुष्य सभी धर्मों को साध सकता है। आसन के बारे में महर्षि घेरण्ड ने लिखा श्लोक –

आसनानिसमस्तानि यावन्तो जीवजन्तवः।
चतुरशीति लक्षाणि शिवेन कथितानि च।। 1।।

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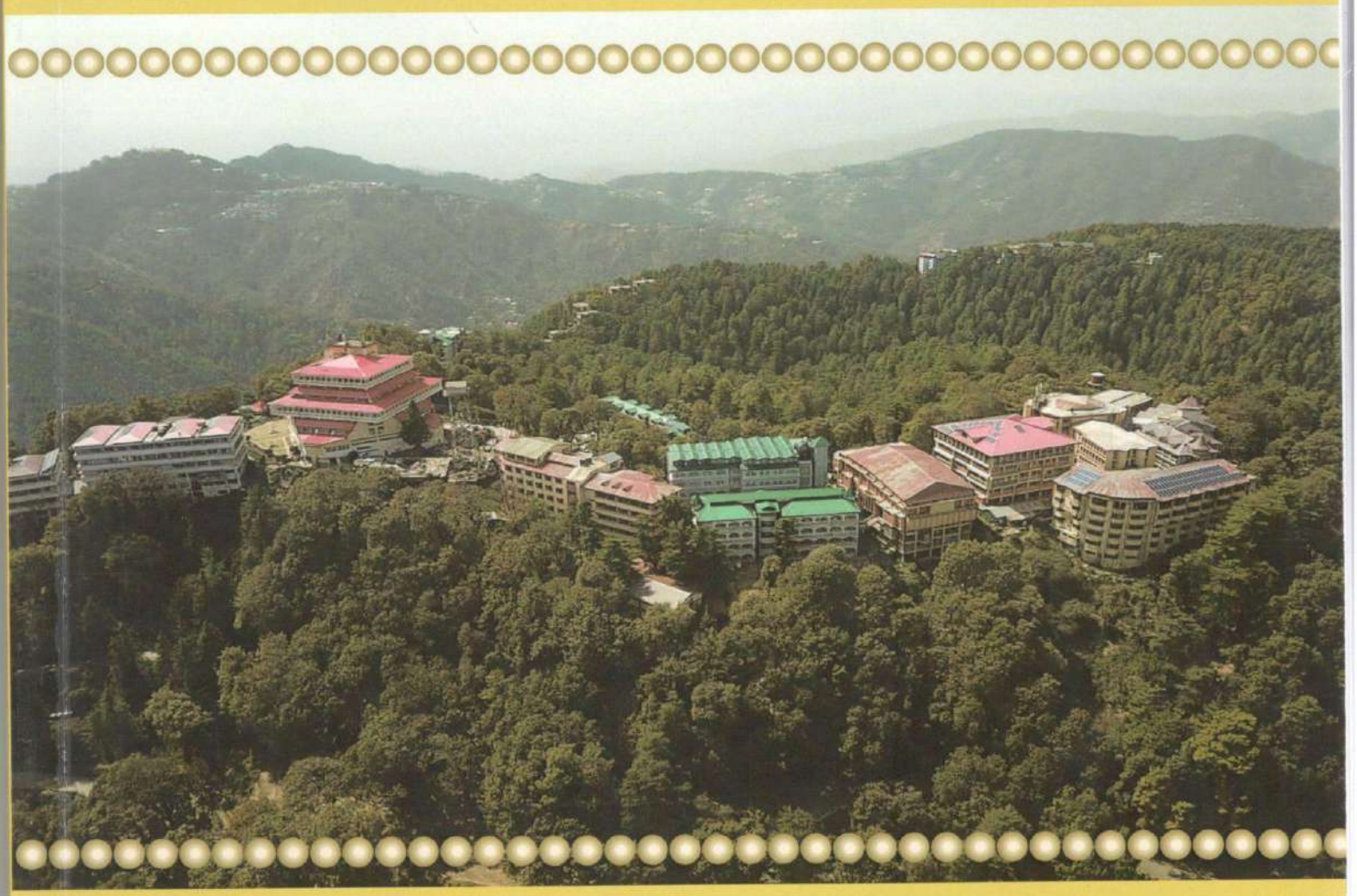

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CONCEPTUAL UNDERSTANDING OF YOGA AND YOGIC PERSONALITY DEVELOPMENT WITH SPECIAL REFERENCE IN ŚRĪMADBHAGAVADGĪTĀ

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Assistant Professor,
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Yoga and Yogic Personality

The scientific evidence of *Yoga Sādhnā* (Yoga practice) is traced back to Indus Valley Civilization which is *Vaidic* age before the Morden civilization started to flourish in the Indus subcontinent. In archaeological excavations made in the Indus Valley at *Harappā* and *Mohenjo-Daro* a figure is found that archaeologists believe represents a *Yogī* sitting in *Dhyāna* (Meditation) with *Yogic* posture. The figure is shown sitting in cross-legged traditional *Yogāsana* with its hands resting on its knees. According to Indian mythology Lord *Ādinātha* , the other name for Lord *Śiva* is believed to be the founder of *Yoga* and *Yogic* Traditions and *Pārvati* his divine consort first disciple of *Yoga Sādhnā.*

The word *Yoga* has been derived from *Sanskrit* grammar the verb root √*Yuj* in a Sanskrit grammar In *Sanskrit* literature on *Yoga* seems to use the word in all the three senses. √*Yuj Samādhau* – Integration, √*Yuj Saṃyamane* – Control √*Yujir Yoge* – Joining So far, the first two meanings are concerned; all the literatures and schools of *Yogic Sādhnā-s* have unanimously accepted these meanings. *Patañjali*, the first systematize of the Yogic discipline seem to accept the meaning of *Yoga* as integration–since the first commentator of *Pātañjalayogasūtram* on *Vyāsa* in his commentary writes: *Yogaḥ Samādhiḥ* i.e. *Yoga* is *Samādhi. Patañjali* does not subscribe to the other meaning of √*Yuj* i.e.*Yujir Yoge* 'joining'. This is mainly because *Patañjali-s* philosophy is based on *Sāṁkhyan* metaphysics and *Sāṁkhyan* believes in separation of *Puruṣa* from that of *Prakṛti*. With which *Puruṣa* has wrongly got itself identified. Similarly *Patañjali* considers *Draṣṭā* Seer Principle to be separated from *Dṛśya* (Seen Principle) with which it has got identified. Thus separation of these two principles is supposed to be *Yoga.* We also find meaning of *Yoga* as separation in *Śrīmadbhagavadgī. Yoga* helps in the co-ordination and control of the subtle forces within the Body. *Yoga* brings in perfection, peace and everlasting happiness; one can even have increased energy, vigour, vitality, longevity, resistance, calmness, and good sleep at times by the *Yogic Abhyāsa* (Practice). The *Yoga Abhyāsa* will help people to control the emotions and passions and resistance power increases and removes the disturbing elements from Mind. The aim of *Yogic Sādhanā-s* (Practices) is to overcome all kinds of sufferings that lead to a sense of freedom in every walk of life with holistic health, happiness and harmony. *Yogic Sādhanā-s* is practiced with a therapeutic intention in the form of *Yogic* Therapy, it can help prevent and aid recovery from Physical and Mental ailments. The continuous practices of *Yoga Abhyāsa* (practices) have much effect on the Human Body and Mind such as: All round health fitness, Weight loss, Stress relief, Inner peace, improved immunity, living with greater awareness, Better relationships, increased energy, Better flexibility and posture, Better intuition etc. It's all kind of Development in Morden life that is called Personality. The benefits accrued by being a regular practitioner are numerous. Some very discernible ones are – improvement a health, Protection from strength, improvement or Physical strength, protection from injury and detoxify the Body. In Modern era *Yoga Sādhanā and Yogic* Therapy is gaining among mainstream medical

RELEVANCE AND UTILITY OF YOGA EDUCATION IN TEACHER EDUCATION- THE FUTURE AHEAD

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ABSTRACT

Teacher education programme is related to the development of teacher proficiency and competence that would enable and empower the teacher to meet the requirements of the profession and face the challenges therein. On the other hand, Yoga is "Union" in love between the individual consciousness and Supreme Consciousness i.e. between Soul and God. In modern times Yoga is seen as the science of possibilities, the knowledge that enables the latent powers within oneself to be manifested in the outside and thus helpful in dealing with crucial problems of human life. Therefore, after the popularization of holistic health promotion potentials of Yoga practices among masses, certain other applied aspects of the Yogic system concerned with human resource development, have remained to be substantiated scientifically. That is why modern educationists are taking keen interest in improving the quality of education with the help of Yoga education. Education system, not only in India, but in the modern globalizing world also is in great need of taking help of Yoga and its applied areas. It is seriously being felt that besides the development of national strength and scientific mentality among the students, the aim of education should be the liberation of mind and soul as well; an area which can be deftly dealt with through Yoga. The time has arrived when Yoga should be the essential part of the core curriculum for teacher education programmes as they are at the root of the entire education system.

Key words: *Yoga Education, Teacher Education, Yogic Lifestyle.*

Introduction

1. Teacher Education

The education of teachers is an integral part of the educational system in any country. An educational institution performs a significant function of providing learning experiences to lead its students from the darkness of ignorance to the light of knowledge. The key personnel in the institutions, who play an important role to bring about this transformation, are teachers. As stated by NCTE (1998) in Quality Concerns in Secondary Teacher Education, "The teacher is the most important element in any educational program. It is the teacher who is mainly responsible for implementation of the educational process at any stage."

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RELATIONSHIP OF CREATIVITY TRAITS WITH ACADEMIC PERFORMANCE OF PUPIL TEACHERS OF PHYSICAL EDUCATION

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Abstract
The study analyzes the relationship of creativity traits with academic performance of pupils' teachers of Physical Education. The sample of present study were 100 subjects included male (n=50) and female (n=50) students of B. P. Ed and M. P. Ed Programs of Panjab University, Chandigrah. In order to accomplish the targets a standardized inventory developed by Purohit, 1997 was utilized to investigate the level of creativity traits of pupil teachers. Academic performance of the students was measured form the last semester result declared by Panjab University Chandigarh. The result shows that male pupil teachers of physical education are more openness, freedom, conflict and risk taking and less challenges and liveliness. There exists a significant relationship of academic performance with openness, conflict traits and risk-taking of creativity among male pupil teachers of physical education. Female pupil teachers of physical education possess more freedom, openness, and risk taking and less challenges, liveliness and conflict traits. There exist a significant relationship of academic performance and openness and risk-taking traits among female pupil teachers of physical education.

Introduction

Creativity implies in a real sense, "make", "creation" or "inventive power" and "capacity to make new works". It is generally another idea, particularly connected with the idea of creative mind (Nami et al 2014). Innovativeness is a capacity to consider things in better approaches to accomplish strange and special arrangements in problems (Saif, 2008). As per Akinboye (2003), without innovativeness, an individual can't get to the totality of information and assets accessible, however is secured up old propensities, structures, examples, ideas and discernments.

This is the reason that innovativeness, generative impression, useful and design thinking in addition to advancement should shape the premise of any education for practical turn of events. There are hopeful individuals who express normal considerations, who are propelling and motivating others. Individuals are creative, innovative daring people and contenders. In any case, their quality is distinctive in degree starting with one individual then onto the next. Creativity is discovering ideas or relationship among existing and new ideas or revising what is known to discover what isn't known (Arya et al 2016). Creativity is the ability of a person to solve a problem in creative manner. With the use of creative knowledge one can solve specific problems. Creativity energizes the group of ideas, which we need regularly. Creativity is characterized as the innovative human credits and characteristics concerned about creative mind, imaginativeness, extemporization, knowledge, establishment and interest the regular, tricky, virtuoso and ability of individuals (Lloyd 2008).

A few experts center around innovativeness as intellectual abilities while different gatherings know it as an aptitude which is established in character. While in the meaning of Boden, innovativeness alludes to making the new conclusions that should be appealing and justifiable. Also; Court knows innovativeness as human intellectual ability which helps individuals to apply their reasoning and start sentiments and goal (Simpson, 2012). Creativity has the power to change society, and make an individual go over his or her comfort zone and explore risks (Csikszentmihalyi, 1996). Furthermore, people who are high in creativity are adaptable not only regarding novelty but also in the adaptation of the known facts to fit novel solutions (Csikszentmihalyi, 1996). This all leads to considering creativity as a practical, valuable, and needed characteristic for the individual as well as society. As per the statement of San'chez-Ruiz (2011) creativity is a multidimensional marvel with numerous powerful factors comprising of character attributes, intellectual limits, psychological strategies and "inspiration" and it is showed up in social relationship anyway it is a private matter.

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INJURY PROFILE OF PANJAB UNIVERSITY MALE WRESTLERS

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Abstract:

The current investigation gives information with respect to the injury profiling of male grapplers. The information was gathered through self-made questionnaire from the grapplers of Panjab University Chandigarh. A questionnaire was administered to 50 male wrestlers to assess the nature and kinds of injury, follow up of restoration, how much time training and competition missed. Percentage method was used as statistical measure for the analysis of data. The kind of injury experience by male grapplers was 36% ligament, 40% tendon related and 24% dislocation. Ligament and tendon related injury were the most well-known in wrestling. The best number of injuries were shoulder, knee, elbow and wrist. The level of shoulder injury and knee was 66% and 64%, respectively. Wrist and elbow injury in wrestling was 12% and head injury and lower leg injury were 6%. There were the variations of injuries rate in wrestling. The most happening injury was shoulder and knee injury in wrestling. Most injuries happened due to ill-advised preparing plan, ill-advised warm up, doesn't went to specialist, doesn't taken any clinical help and doesn't follow the correct recovery program. The shoulder and knee injury were re-happened as a result of inappropriate development of rehabilitation program.

Keywords: Injury, Wrestlers and Rehabilitation

Introduction:

Wrestling is a physical combat sport. It is one of the oldest sports not only in India but also in the World. Wrestling has evolved into a highly intense and technical, international sports today. Wrestling is a form of grappling type techniques such as clinch fighting, throws and takedowns, joint locks, pins and other grappling holds. A wrestling bout is a physical competition, between two (occasionally more) competitors or sparring partners, who attempt to gain and maintain a superior position.

As a combat and contact game, all body parts are associated with the different snapshots of assault and protection, expanding the danger of injuries. At the 2008 Beijing Olympic Games, wrestling enlisted 32 injuries among 343 competitors in 406 matches with a rate pace of 9.3 injuries per 100 competitors and 7.9 injuries per 100 matches (Akbarnejad and Sayyah, 2012). At the Rio Olympic Games, out of 352 grapplers, 22 injuries happened during 410 matches, relating to a rate pace of 6.2 injuries per 100 grapplers (7.1% male; 4.4% female) and 5.4 % per 100 matches. Identified with the styles, the injury event was 22.7% in female wrestling, 36.4% in freestyle, and 40.9% in Greco-Roman (Shadgan, Molnar, Sikmic, and Chahi, 2017). Similar authors notice that injury rates have been diminishing in Olympic wrestling (Beijing 2008 (9.3%), London 2012 (12%), and Rio 2016 (6.2%).

In spite of reducing injury rates, it is as yet fundamental to investigate how training cycles, mentors, and competitors' attributes may help in forestalling and advancing a safer and solid games practice. Injury event is arbitrary and unmanageable, and there is no uncertainty about its effect on competitors' wellbeing, execution, and sports insight. Proof based exploration uncovers that present day games advances a culture of competition and succeeding at all expense; in Olympic wrestling, this inclination demonstrates that competitors see themselves committed to contend in any event, when harmed, endorsing a culture that advances pain standardization (Hoppis, 2012). A similar authors noticed that grapplers are needed to treat by mentors, colleagues, and directors in any event, when harmed, explicitly 44.6% from mentors and 55.9% from actual coaches. These discoveries infer that grapplers' career quality, wellbeing, and positive experience are in danger since such practices and convictions increment the danger of making a pattern of re-incidence because of a lacking recovery process (Hoppis, 2012; Nor, 2001).

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RELATIONSHIP OF BODY COMPOSITION AND EMOTIONAL INTELLIGENCE WITH COMPETITION PERFORMANCE OF ALL INDIA INTER-UNIVERSITY SPRINTERS

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Dr. Sanjay Sharma**
Dr. Manohar Lal***

ABSTRACT

The purpose of present research is relationship of body composition and emotional intelligence with competition performance and making a comparison between high achievers (n=8) and low achievers (n=15) sprinters of All India inter-university in body composition and emotional intelligence. In order to evaluate emotional intelligence, the scale developed by Hyde, Pethe, and Dhar was used. The measurements of body composition characteristics were done with the help of Body Composition Monitor having Scale HBF-361. To find out the relationship of body composition and emotional intelligence with competition performance, product moment co-efficient of correlation method was applied. To determine the significance of difference between means of high achievers and low achievers researcher's applied independent 't' test. The results indicated that there is a significant and negative correlation of competition performance with body mass index and emotional intelligence among the 100m sprinters, and shown insignificant relationship with body fat percentage, skeletal muscle mass, visceral fat and basal metabolic rate. Findings further revealed that high achievers sprinters were significantly possessed lesser body fat percentage and visceral fat, and greater skeletal muscle mass as compared to low achievers 100m sprinters. It has been also found that high achievers 100m sprinters were significantly emotionally more intelligent as compared to low achievers. However, in case of BMI and basal metabolic rate they do not show significant difference between them.

Keywords : Body composition, Emotional intelligence, Competition performance and sprinters.

Introduction

Sprint running includes several athletic events, in which the distance to be covered is equal to or less than 400 m. In particular, the 100 m races are among the most popular since they are part of the official Summer Olympics program. Even if sprint running has been extensively evaluated in biomechanical terms (Hunter JP et al. 2004 and Slawinski J et al. 2010), there is a need of focus on the possible correlation between anthropometry, emotional intelligence with performances.

Body composition is a significant part, of physical wellness and in making competitor's profiles and conditioning programs. It consists of fat and fat free mass. Notwithstanding, numerous multiple times substantially more time is spent on expanding the physical fitness of competitors without thinking about of their body organization and healthful status (Popovic et al., 2013). High body mass, whether it is due to increased body fat or decreased lean body mass affects aerobic performance. Kiflu et al (2012) reported that sports performance such as speed, endurance and jumping ability are all negatively affected by a high level of relative fat in the body. Weyand and Davis (2005) differentiate athletes on the basis of competing in different distances and found an inverse relationship between running distance and body mass index (BMI). Among the sprinters of same stature and body fat ratio, having a generally enormous body weight seems to enhance running performance, proposing that

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Existential Ironies and the Dictates of Bureaucracy: A Study of Franz Kafka's *The Metamorphosis*

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In the literary lineages of Europe in the twentieth century, Franz Kafka has been acknowledged as the representative writer of existential thought. Kafka was not only aware of the long tradition of the philosophy, which examined the core concerns of human existence; rather he was well versed with the philosophical writings in this regard when he had embarked on writing. In his essay "Franz Kafka and Existentialism", Jay Ciaccio refers to Kafka's familiarity with Kierkegaard, who had philosophically articulated the issues of existentialism far earlier than the twentieth century existentialist philosophers, as follows: "Kafka had read Kierkegaard, identified with his ideas, and incorporated them in his work..." (Ciaccio, 77) Viewed from diverse perspectives, Kafka emerges as an existentialist writer who sought to give literary expression to the existentialist questions relating to guilt, freedom, absurdity, among others. More often than not, Kafka has hence also been studied in a comparative framework placing him vis-à-vis Dostoyevsky, Albert Camus, and Samuel Beckett. Jay Ciaccio remarks about Kafka: "However, no author has portrayed existentialism as clearly and creatively as Franz Kafka...A great many of his stories revolve around man's existence and its meaning, or lack thereof, and his characters endure punishment without ever understanding the nature of their guilt..." (Ciaccio, 77) Kafka's long story "The Metamorphosis" portrays many strains of the existential anguish and irony. Identifying this story as an epitomic representation of the existential literature, Ciaccio underlines: "Perhaps no other story so clearly displays Kafka as an existentialist writer than "The Metamorphosis"." (Ciaccio, 77)

The idea of absurdity constitutes one among many notions which the existential thought is based upon. Kierkegaard attempted to use the idea of absurdity philosophically and at many places in his narratives, Kafka undertakes to represent the absurdity which surrounds and confounds the reality of human life. Jay Ciaccio comments: "Kierkegaard frequently asserted his belief in the absurdity of the world, and

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Kafka employed this notion in his art. The concept of absurdity is one of the elements which seems to unify all his works, and is indeed the most recognizable aspect of his style." (Ciaccio, 77) The notion of absurdity has been well articulated by Kafka in his story "The Metamorphosis". Jay Ciaccio points out: "The absurdity of "The Metamorphosis" is what first grabs the reader's attention. "As Gregor Samsa awoke one morning from uneasy dreams he found himself transformed in his bed into a giant insect." (Kafka 854) Within the first sentence of the story Kafka has transported us to the world of the absurd. All that is familiar and known to us is discarded, and a dream logic now prevails." (Ciaccio, 77)

A dream-like consciousness of reality underscores the idea of absurdity. Gregor Samsa, the protagonist of *The Metamorphosis*, has suddenly changed into a huge insect and like any other human being he resists believing this transformation. The dream-like element in this transformation baffles him, for he does not want to accept it. It appears even 'non-sense' to him to find himself so totally changed. He tells himself: "How about if I sleep a little bit longer and forget all this nonsense..." (Kafka, 16) He asks himself: "What's happened to me?...It wasn't a dream." (Kafka, 15) Even though awareness lingers in him not to believe this dream-like reality, he has no escape from it and he is consigned to accept this non-sense, this dream thwarting all rational notions about the reality. Along with this incredible transformation comes a conflict of perceptions about the self. He finds himself lying hapless as an insect in the bed, but the urgency of catching the early morning train to his firm has held him in grip. The animal existence and the human existence merge into his confused consciousness of the self. He thinks: "First of all though, I've got to get up, my train leaves at five." (Kafka, 17) The strenuous effort to arrange the strain emerging from the baffled state of his being, when he swings between the animal existence of an insect struggling hard to get down from his bed and the human state of being conscious about reporting punctually at his firm, characterizes the absurdity which stares Gregor Samsa in his face. The confusion and perplexity has been transported to the level of his consciousness of time also. He used to get up in time daily hearing the loud sound of the alarm-clock. When he looks at the alarm-clock, which shows that it was half-past six, the sense of confusion, perplexity and doubt overpowers him all of a sudden. He is at a loss to state categorically to himself whether he could really have overheard the loud sound of the alarm-clock. His predicament, however, lies also in his inability to be sure about the soundness of the sleep and he seeks to attribute his being late in waking up to this non-ordinary inability. Kafka writes about Gregor Samsa's perplexed and absurd condition: "It was half-past six and the hands were quietly moving forward, it was even later than half past six, more like quarter to

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seven. Had the alarm clock not rung? He could see from the bed that it had been set for four o'clock as it should have been; it certainly must have rung. Yes, but was it possible to quietly sleep through that furniture-rattling noise? True, he had not slept peacefully, but probably all the more deeply because of that?" (Kafka, 18) Being forced to see the complex and confounding interrelation between the 'apparent' and the 'actual' reality underlines the absurd in the story.

The pain about the sorrowful state of the self, which is entangled in the disassociation between the 'real' and the 'doubt on the real', highlights the anguish of an absurd existence, which Gregor Samsa is exposed to suddenly. While he is yet in the bed and planning to get down, his mother comes to him and reminds him of catching the morning-train. He answers to his mother, but doing so he is terrified to hear his own voice, which sounds somehow unfamiliar to him. Thus, the flux-like consciousness takes him in its stride and he yields to it. Kafka describes this situation: ""Gregor," somebody called-it was his mother-"it's quarter to seven. Didn't you want to go somewhere?" That gentle voice! Gregor was shocked when he heard his own voice answering, it could hardly be recognized as the voice he had had before. As if from deep inside him, there was a painful and uncontrollable squeaking mixed in with it, the words could be made out at first but then there was a sort of echo which made them unclear, leaving the hearer unsure whether he had heard properly or not." (Kafka, 19) The fleeting line of demarcation between the 'appearance' and 'reality' so deeply jolts Gregor Samsa that the idea of restoring the apparent illusory sensibilities to reality constantly crosses through his mind. Sensing the appearance to be illusory and trying to be able to restore it to normalcy constitutes yet another dimension of the absurd in this story. Explicating the situation of Gregor Samsa in such a quagmire, Kafka writes: "At times like this he would direct his eyes to the window and look out as clearly as he could, but unfortunately, even the other side of the narrow street was enveloped in morning fog and the view had little confidence or cheer to offer him. "Seven o'clock, already," he said to himself when the clock struck again, "seven o'clock, and there's still a fog like this." And he lay there quietly a while longer, breathing lightly as if he perhaps expected the total stillness to bring things back to their real and natural state." (Kafka, 23)

Through this story Kafka has also tried to uncover the insensitiveness of the bureaucratic machinery, which always seeks to ignore the truthfulness behind the painful human existence. Kafka describes how the delay in catching the morning train led to the arrival of the chief clerk to the house of Gregor Samsa.

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While Gregor was still trying his hard to move himself in his bed and get down from his bed, his sister comes close to his door to inform him that the chief clerk had come to meet him only. Kafka describes, from the right-hand room his sister was whispering to inform him of the situation: "Gregor, the chief clerk is here."(Kafka, 25-26) Not only is his sister, his father also worried to see the clerk who had come to know about the delay in the departure of Gregor. His father approaches from the other side to his room to intimate him about the inquiring clerk. Kafka describes: ""Gregor," said his father now from the left-hand room, "the chief clerk has come round and wants to know why you didn't leave on the early train." (Kafka, 26) Sudden, though purposed arrival of a bureaucratic-superior to his house unsettles the family-members of Gregor and they come out with the excuses concerning the delay in the departure of Gregor to his office that day. Both, mother and father of Gregor plead before the chief clerk that Gregor has not been well. In the words of Kafka: ""He isn't well," said his mother to the chief clerk,, while his father continued to speakthrough the door. "He isn't well, please believe me. Why else would Gregor have missed a train! The ladonly ever thinks about the business." (Kafka, 26) Gregor's sister grows sad and skeptic about the future of the financial stability of the family as a fall-out of the event. She starts crying in her room, which can be heard by Gregor. Gregor reflects on her crying: "And why was she crying? Was it because he had not got up, and had not let the chief clerk in, because he was in danger of losing his job, and if that happened his boss would once more pursue their parents with the same demands as before?" (Kafka, 27)

In a bureaucratic-machinery, which is based on the division and stratification of positions, one person is always at the receiving end. In this story, Kafka has described how Gregor stands at the receiving end. The chief clerk dictates the terms and asserts that slight inconveniences must not obstruct the professional goals of the official duties. The fact that Gregor is not well does not concern him at core and he constantly reminds Gregor of the official tasks and assignments awaiting disposal in the firm. He does not want to take Gregor's inability to catch the early train seriously. He tells Gregor's mother indifferently: "Well I can't think of any other way of explaining it, Mrs. Samsa...I hope it's nothing serious. But on the other hand, I must say that we people in commerce ever become slightly unwell then, fortunately or unfortunately as you like, we simply have to overcome it because of business considerations." (Kafka, 27) Behind these words lurks the sheer insistence on the sanctity of bureaucratic rules governing the terms of employment in the firm and the same is brought to the notice of Gregor when the clerk turns to Gregor in conversation. Kafka describes how the clerk addresses to

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Gregor: ""Mr. Samsa," the chief clerk called now in a lower voice, "what is wrong? You barricade yourself in your room, give us no more than yes or no for an answer...and...you fail to carry out your business duties in a way that is quite unheard of." (Kafka, 28) So, Gregor's real inability to go office that day is an illustration of 'neglecting business duties' in the eyes of the clerk, as is so common a practice in a bureaucratic set-up which is not only based on inequality, rather also on the very legitimation of that inequality. The chief-clerk continues his conversation to Gregor and he wants an explanation from Gregor for his inability to go office: "I'm speaking here on behalf of your parents and of your employer, and really must request a clear and immediate and explanation...This morning, your employer did suggest a possible reason for your failure to appear, it's true-it had to do with the money that wasrecently entrusted to you-but I came near to giving him my word of honor that that could not be the right explanation. But now that I see your incomprehensible stubbornness I no longer feel any wish whatsoever to intercede on your behalf. And nor is your position all that secure...Your turnover has been very unsatisfactory of late." (Kafka, 29) Precisely because Gregor's family is laden with debt, the clerk has liked to associate his absence from office with the cash-payments entrusted to Gregor. A doubt financial in nature has been cast on Gregor with reference to the indebtedness of his family. Through this story, Kafka reveals how bureaucracy turns blind eye to the misery of the people expecting nothing other than unswerving professional commitment to the duties of the office.

The existential analysis of this story would entail a study of the reflection of Kafka on the issue of alienation through the narrative centering on Gregor Samsa. Charles I. Glicksberg stated about the interrelation between existentialism and the theme of alienation: "Existentialism expresses the alienation of modern man, his spiritually orphaned state, his incapacity to make any viable affirmations." (Glicksberg, 233) In *The Metamorphosis*, the transformation of Gregor into an insect is not only indicative of the inability of Gregor to humanly bear the pains and suffering of human existence, rather it also marks the beginning of a yawning gap between him and other human beings around him, as his existence means now an animal existence. This moment is the inauguration of the wretchedness of the alienation which slowly separates him from the others, even from his own family members. When Gregor unlocks his door and appears before his family members and the chief-clerk who has come to inquire about his delay, all are shocked to see him struggling as an insect on the floor. Gregor pleads to the chief-clerk, invoking him to empathize with his condemned condition: "Please, don't go away, at least first say something to show that you grant that I'm at least partly right." (Kafka, 36) The possibility

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of empathizing with Gregor gradually dwindles with all. The chief-clerk separates himself from Gregor and leaves the room to get out of the house where Gregor lives. Kafka describes: "But the chief clerk had turned away as soon as Gregor had started to speak, and with protruding lips, only stared back at him over his trembling shoulders as he left." (Kafka, 36)

No one else than Gregor understands that it is the accumulated anxieties, pains and complaints over the years which has incapacitated him to exist as the human being and even though he can think and speak, he must come to terms with the transformation which has occurred unbelievably to him. Putting across his opinion about his sorrowful state to the chief-clerk, he says: "And you're also well aware that we travellers spend almost the whole year away from the office, so that we can very easily fall victim to gossip and chance and groundless complaints, and it's almost impossible to defend yourself from that sort of thing, or if at all it's when we arrive back home exhausted from a trip, and that's when we feel the harmful effects of what's been going on without even knowing what caused them." (Kafka, 36) Gregor's transformation entailed that he could not be understood by his words. His attempt to communicate fails, his sister wonders at his voice and she implores her mother to send for the doctor. Kafka narrates ""Mother?" his sister called from the other side..." You'll have to go for the doctor straight away. Gregor is ill...Did you hear the way Gregor spoke just now?" (Kafka, 31) And in an indifferent gesture, as if Greor is none to him anymore, the chief-clerk confirmed: "That was the voice of an animal..." (Kafka, 31).

The pangs of alienation became all the more clear to Gregor, when he realized the melting away of the emotional affection of his father towards him. His father was panicked the way the chief-clerk had swiftly left the house. His father thumped his feet and drove Gregor back to his room. Kafka depicts this growing distance between Gregor and his father: "The flight of the chief clerk seemed, unfortunately, to put Gregor's father into a panic as well. Until then he had been relatively self controlled, but now, instead of running after the chief clerk himself, or at least not impeding Gregor as he ran after him, Gregor's father seized the chief clerk's stick in his right hand,...picked up a large newspaper from the table with his left, and used them to drive Gregor back into his room, stamping his foot at him as he went. Gregor's appeals to his father were of no help, his appeals were simply not understood, however much he humbly turned his head his father merely stamped his foot all the harder." (Kafka, 39) At this point of time, Gregor became fully cognizant of the total alienation from his family members and others

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around him. He reflected: "The previous morning while the doors were locked everyone had wanted to get in there to him, but now, now that he had opened up one of the doors and the other had clearly been unlocked sometime during the day, no-one came, and the keys were in the other sides." (Kafka, 44)

The idea of freedom is closely related to the existential consciousness. Jay Ciaccio comments: "For a man to truly exist, as Sartre believed, he must assert his freedom." (Ciaccio, 78) In the story *The Metamorphosis*, Gregor Samsa is led to live a sense of freedom out of love for the other. Otherwise confined to his room as an insect, he inches towards the living room exercising big effort just to see his sister Grete playing violin. Music draws him out from the dinginess of darkness, but more so his intense desire to see his sister playing on the notes of violin. Kafka describes: "His sister began to play; father and mother paid close attention, one on each side, to the movements of her hand. Drawn in by the playing, Gregor had dared to come forward a little and already had his head in the living room." (Kafka, 83) Quite often, the confines of his room pressed hard against Gregor's conception of free space devoid of choking limitations. He would prefer shifting his chair close to window and look out into the open from the window, and thus gain a sense of freedom. Kafka narrates: "He would often lie there the whole night through, not sleeping a wink but scratching at the leather for hours on end. Or he might go to all the effort of pushing a chair to the window, climbing up onto the sill and, popped up in the chair, leaning on the window to stare out of it. He had used to feel a great sense of freedom from doing this..." (Kafka, 54) Some critics, for example Jay Ciaccio, have argued that in this story, Gregor also tries to come into the way of the freedom of others. Jay Ciaccio argues: "In Gregor Samsa we see a man whose mere notion of freedom is utterly distorted. He not only misconstrues his own freedom, but that of others, as can be seen in his desire to possess his sister: "He would never let her out of his room, at least, not so long as he lived..." (Ciaccio, 78) But one must not lose sight of Gregor's desire to let the capabilities of his sister fully blossoming. In possessing such a desire, he retains within himself a sense of responsibility to ensure free development of the potentials to his sister. A person aware of such responsibility must also know the worth of freedom. Kafka writes about Gregor who wanted Grete to visit conservatory: "He never wanted to let her out of his room...She would sit beside him on the couch with her ear bent down to him while he told her how he had always intended to send her to the conservatory." (Kafka, 85)

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Research Article

Insight into intermolecular interactions and hydration properties of biologically active amino acids in aqueous solutions of cefepime: volumetric, compressibility and viscometric studies

Suvarcha Chauhan, Neetika Kumari & Lalita Pathania

Pages 1853-1866 | Received 23 Dec 2019, Accepted 13 Jun 2020, Published online: 16 Jul 2020

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Abstract

The measurement of density, speed of sound and viscosity of an amino acid and its dipeptide i.e., glycine and glycylglycine in aqueous solution of antibiotic drug cefepime has been carried out at various temperatures. The density and speed of sound data has been used to obtain partial molar volume(V_φ^o) , partial molar expansion coefficient($\frac{\partial V_\varphi^o}{\partial T}$)$_p$, second derivative($\frac{\partial^2 V_\varphi^o}{\partial T^2}$)$_p$, hydration number ($\eta_H$), isentropic compressibility(κ_s), partial molar isentropic compressibility($\kappa_{\varphi,s}^o$), partial molar volume of transfer($\Delta_{tr}\ V_\varphi^o$) and partial molar isentropic compressibility of transfer($\Delta_{tr}\ \kappa_{\varphi,s}^o$) . The viscosity data have been used to calculate the viscosity B–coefficients, its temperature derivative dB/dT, viscosity B–coefficient of transfer ($\Delta_{tr}\ B$) and various thermodynamic parameters of activation of viscous flow i.e., $\Delta\ \mu_1^{o*}$, $\Delta\ \mu_2^{o*}$, $\Delta\ S_2^{o*}$ and $\Delta\ H_2^{o*}$ for amino acid/peptide in cefepime solutions. The dependence of these parameters upon concentration and temperature clearly suggests the role of amino acid/peptide and cefepime in solute-solvent interactions.

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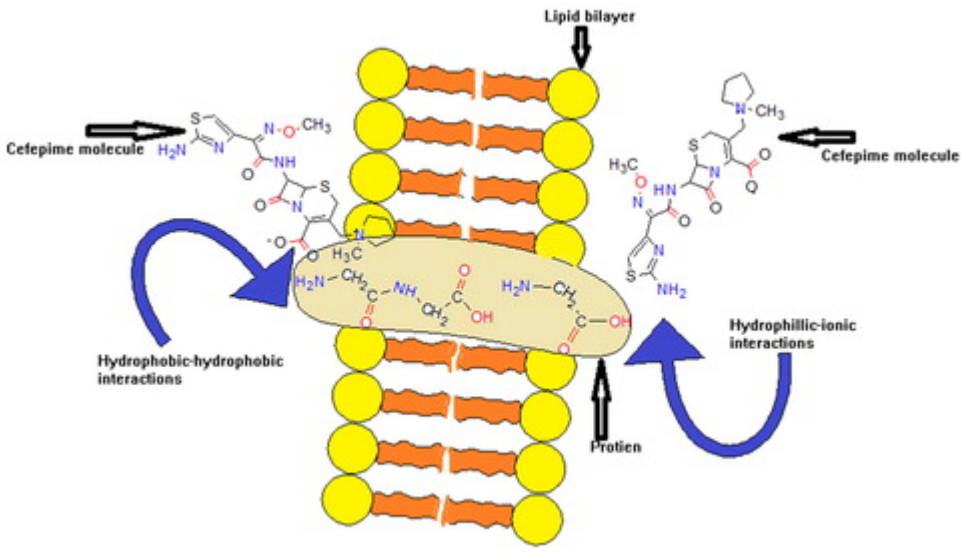
solute in the studied ternary system in order to deduce important information regarding drug-amino acid/peptide interactions.



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Articles

Study on aggregation properties and interactive nature of bile salts in the presence of drugs: a comparative approach

Kuldeep Singh & Suvarcha Chauhan

Pages 57-67 | Published online: 15 Sep 2020

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ABSTRACT

Aggregation mechanism of two structurally different bile salts (bio-surfactants) in the absence and presence of drugs has been analysed through a conventional technique i.e. surface tension measurement. The anionic bile salts, namely sodium cholate (NaC) and sodium deoxycholate (NaDC), have been used to accomplish this study in the presence of metformin hydrochloride (anti-diabetic drug) and ceftriaxone sodium (antibiotic drug). The effect of hydrophobicity of the constituents and temperature has been analysed by carrying out surface tension measurement at different temperatures and various concentrations of both the components. The results of surface tension measurements have been interpreted in terms of various interactions that may be present in the system and the alteration in micellar behaviour of bile salts has been discussed by determining their critical micelle concentration (*CMC).* Moreover, the information on energetic micellasaion has also been grasped from various thermodynamic parameters evaluated for the system. The study may be considered to be a step to help pharmaceutical industries in terms of utilisation of cholanology to defeat solubility/permeability complications during drug formulations.

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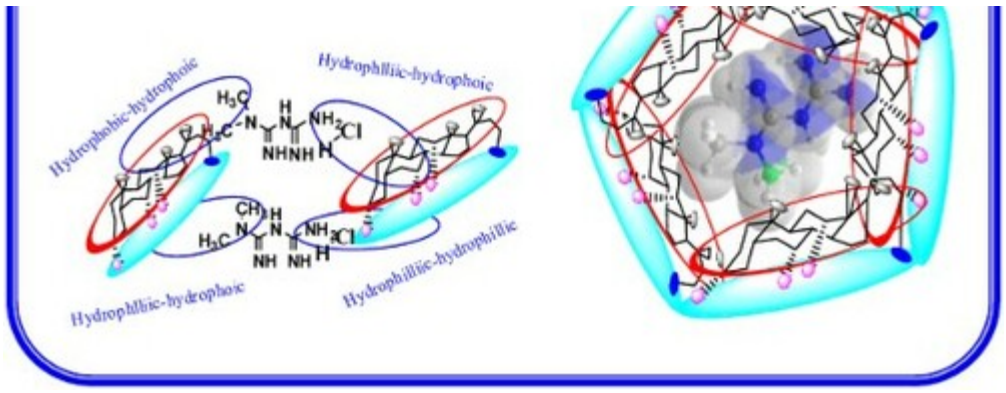

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Additional information

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Interactional Behavior of Sodium Cholate and Sodium Deoxycholate in the Presence of Ceftriaxone Sodium: Volumetric, Compressibility, Viscometric, and Proton Nuclear Magnetic Resonance Studies

Kuldeep Singh* and Suvarcha Chauhan

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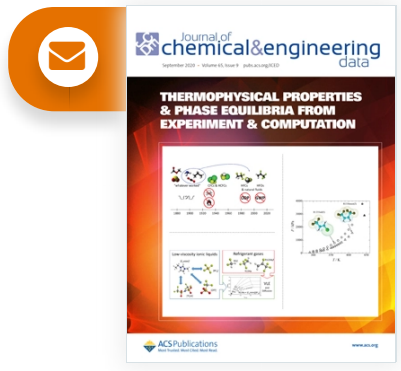

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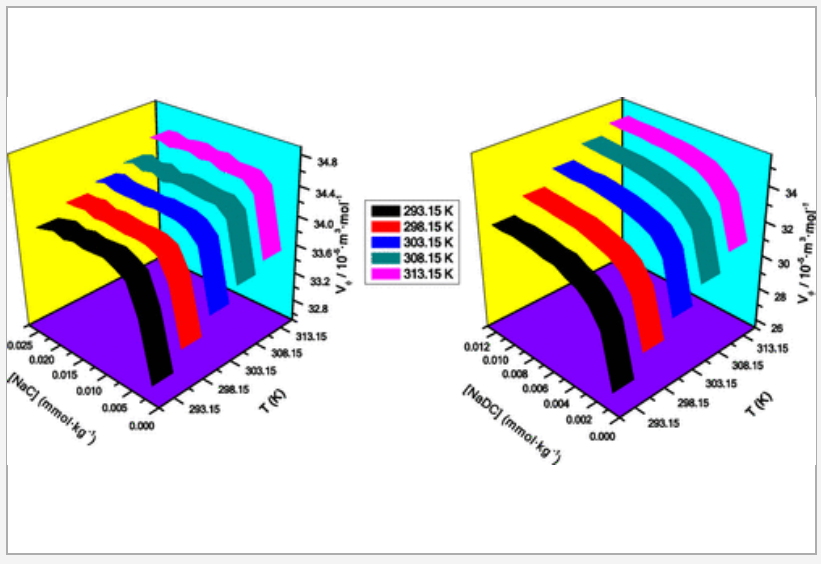
SUBJECTS: Anatomy, Pharmaceuticals, Salts, Sodium, Sound velocity

Abstract

Interactional behavior of bile salts, namely, sodium cholate (NaC) and sodium deoxycholate (NaDC), in the presence of an antibiotic drug, ceftriaxone sodium (Cft-Na), at different temperatures has been analyzed through volumetric, compressibility, viscometric, and proton nuclear magnetic resonance (^{1}H-NMR) studies. The volumetric and compressibility parameters have been calculated with the help of measured density (ρ) and speed of sound (u). Also, the knowledge on intermolecular interactions present in a ternary system consisting of bile salts in aqueous solution of drug has been procured from viscometric measurements. The variation in strength of the present intermolecular interactions in the system with temperature and concentration has been analyzed by carrying out the experiments at different temperatures, i.e., 293.15, 298.15, 303.15, 308.15, and 313.15 K, and drug concentrations, i.e., 0.005, 0.010, and 0.050 mol·kg^{-1}. The results have been interpreted by considering the cosphere overlap model, which confirm the presence of hydrophobic and hydrophilic interactions in the system. Also, the information obtained from density, speed of sound, and viscometric studies has been strengthened by analyzing the ^{1}H-NMR spectra. The study may be helpful in utilization of bile salts in pharmaceutical industries as a penetration enhancer.



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Highly Selective and Rapid Naked-Eye Colorimetric Sensing and Fluorescent Studies of Cu^{2+} Ions Derived from Spherical Nanocellulose

Bhagat Ram, Shivani Jamwal, Sunita Ranote, Ghanshyam S. Chauhan*, and Rohini Dharela

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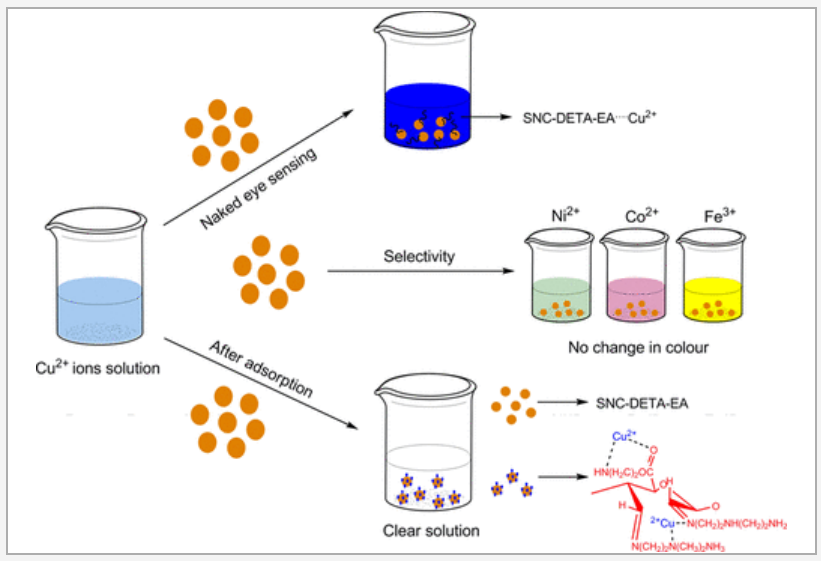
Abstract



Nanocellulose has emerged as the most promising sustainable nanomaterial to develop cost-effective smart materials for various applications with consequential positive environmental impact. In the present study, we report spherical nanocellulose (SNC) modified with diethylenetriamine (DETA) and/or ethanolamine (EA) (SNC-DETA, SNC-EA, and SNC-DETA-EA) as Cu^{2+} ion sensors. Structure dependence of the sensing properties is the highlight of this work, as SNC-DETA-EA and SNC-DETA showed colorimetric naked-eye and fluorescent activity, with the former showing the same at very low ion concentrations with high selectivity, whereas SNC-EA lacked the same. The solution color changed rapidly to deep blue, and the fluorescence intensity was quenched when the ion concentration increased in the range 0.5–100 ppm, thus facilitating dual-channel ion detection. SNC-DETA-EA showed 1.03 ppm or a 1.622×10^{-5} M limit of detection and high Cu^{2+} ion uptake with maximum Langmuir capacity (q_m) of 212.76 mg/g.

KEYWORDS: spherical nanocellulose, Cu^{2+} ion sensor, reversibility, fluorescence quenching, adsorption capacity

Supporting Information

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- Surface charge studies of sensing material; Cu^{2+} ion maximum adsorption capacity evaluated with the effect of different operating parameters along with a limit of detection study, XRD, SEM, TEM images, and photographs of the naked-eye samples, MALDI-TOF, and mass spectra (PDF)

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International Journal of Biological Macromolecules
Volume 158, 1 September 2020, Pages 521-529

Improving activity and stabilization of urease by crosslinking to nanoaggregate forms for herbicide degradation

Shivani Jamwal, Sunita Ranote, Umesh Dautoo, Ghanshyam S. Chauhan

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Highlights

- Carrier-free urease immobilization was carried out using crosslinking method.
- Crosslinked urease was converted into their nanoaggregates (CLUNAs).
- CLUNAs have high activity, stability to temperature and pH variation than free form.
- Nanoaggregates have high storage stability and reusability up to 10 repeat cycles.
- Nanoaggregates effectively bio degrade isoproturone, a herbicide.

Abstract

Bioremediation is the most effective green protocol for degradation of environmental contaminants. Present study involves carrier free urease immobilization with synthesis of its new crosslinked aggregates using two different crosslinkers, divinyl benzene (DVB) and tripropyleneglycol dimethacrylate (TPGDA) via free radical mechanism. Resulting crosslinked ureases were further converted to nanoform (CLUNAs) using solvent evaporation technique. The activity of free and the crosslinked ureases was studied as a function of operational parameters viz. temperature (20–80), pH (2–11) and substrate concentration (5–20 mM) using urea as substrate at contact time of 10 min. Storability study of the pristine urease and CLUNAs was carried out for 40 days, and the CLUNAs were reused in 10 repeat cycles to assess their reusability. Isoproturone degradation was studied under the above-cited range of pH and temperature and results were recorded after 24 h.

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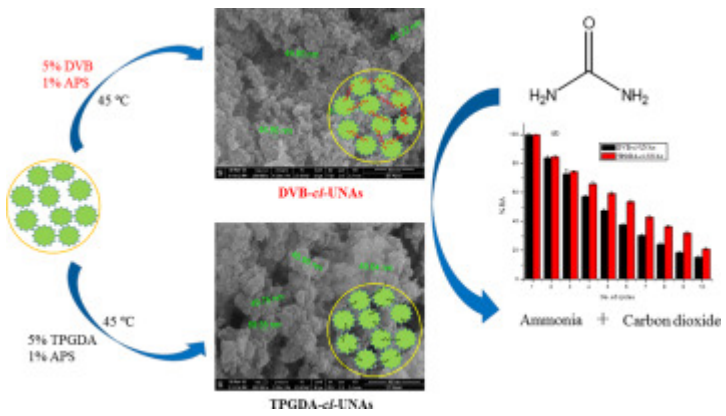

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Bioremediation; Immobilization; Crosslinked urease; Nanoaggregates; Isoproturone degradation

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Journal of Molecular Liquids

Volume 316, 10 October 2020, 113833

Temperature dependent micellar behaviour of sodium cholate and sodium deoxycholate in the presence of ceftriaxone sodium: A physicochemical study

Kuldeep Singh, S. Chauhan

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Abstract

The micellar behaviour of two bio-surfactants, namely sodium cholate (NaC) and sodium deoxycholate (NaDC) in the presence of antibiotic drug viz. ceftriaxone sodium (Cft-Na) has been characterized physicochemically. The aim has been achieved via utilizing conventional conductivity and spectroscopic techniques i.e. UV–Vis and fluorescence probe studies. The knowledge on the alteration in the aggregation mechanism of the studied bile salts induced by Cft-Na has been accessed by means of determining one of the most promising parameters of micellar system called critical micelle concentration *(CMC)* from conductivity studies. The applicability and acceptability of this conventional technique has been confirmed by determining *CMC* with the help of modern spectroscopic techniques i.e. UV–Vis and fluorescence studies. The effect of temperature and drug concentration has also been analyzed by carrying out the studies at different temperatures and concentrations. The variation in the *CMC* and thermodynamic parameters calculated for the ternary (water + drug + NaC/NaDC) system has been elucidated in terms of assorted interactions that are present in the system by making use of charged pseudo-phase separation model. The spontaneity in micellization has been found in the presence of drug for the present system. The results of this study are relevant to pharmaceutical industries.

Introduction

Pharmacological action of drug is observed when it becomes available to the body by means of its absorption from the gastrointestinal tract (GIT). However, the physiological action of the drug i.e. pharmacokinetic and pharmacodynamic depends upon various factors such as physical state of the drug, route of administration including the anatomic and physiological nature of the application site, desired pharmacodynamic effect, the physicochemical properties of the drug molecule, nature of the excipients of the product and method of manufacturing etc. In addition, drug absorption is known to depend strongly upon the interplay between solubility, the dissolution rate and permeability of the drug molecules. The drug molecules may have high/low permeability and solubility in body fluids [1]. Moreover, the extent of drug absorption/bioavailability is greatly influenced by the administration route. Of the main drug administration routes such as injection or oral; the latter one is the most common and used more frequently. For drugs in tablet or capsule form, there are two distinct processes associated with absorption: dissolution and permeation across intestinal membrane depending on the relative magnitude of rate of these processes. However, poor drug solubility in gastrointestinal tract and hence, its low absorption/permeability into the cell membrane is a complex phenomenon [2]. The aforesaid facts advocate that drug solubility and permeability in body fluids should be reasonable in order to achieve significant pharmacological action of drug. Hence, it becomes not only extremely crucial but also equally important to overcome solubility/permeability problem of drugs so as to formulate better pharmaceutical formulation and ultimately, improve drug therapy.

It is, therefore, critical in modern pharmaceutical development to utilize drug solubility-enhancement technologies or methods to ensure better therapeutic effect of those drugs that are having low solubility/permeability in body fluids. In this regard, pharmaceutical professionals use different modes such as the utilization of inclusion of bio-compatible compounds like cyclodextrin, surfactant/bio-surfactant (bile salt) micelles, microemulsions or liposome formulations in drug procreation to overcome permeability and solubility issues [3,4]. Of these, however, bile salt micelles are used most frequently, and have gained

significant attention [5]. Micelles, aggregated structures of the amphiphilic molecules such as surfactants that are formed at a minimum surfactant concentration called critical micelle concentration *(CMC)* possess remarkable physicochemical properties like morphology, size, thermal and kinetic stability etc. The process of formation of micelles (micellization) has been known to alter by varying experimental conditions like temperature, pressure, pH, ionic strength of solution, presence of foreign substances like electrolytes, bio-molecules (carbohydrate, amino acid, protein etc.), drugs, surfactants/bio-surfactants, co-solvents etc. [[6], [7], [8], [9], [10], [11], [12], [13]]. Interestingly, the hydrophobic nature of micelles (interior) is responsible for the fact that they may be used in drug delivery as solubility/permeability enhancer. Thus, it would be interesting to characterize drug-bile salt system so as to make use of cholanology (bile salts) in pharmaceutical science by carrying out physicochemical studies on drug-bile salt system.

Bile salts/acids/biosurfactants are naturally occurring amphiphilic molecules present in vertebrates, including humans. The bile salts are obtained as the main products of cholesterol metabolism in the liver, stored in the gallbladder and then secretions are poured through the bile duct in intestine [14]. Structurally, they possess rigid steroid rings with methyl groups that constitute hydrophobic (convex) surface on one side whereas, stretchy segment with hydroxyl groups giving rise to hydrophilic (concave) facade [[15], [16], [17]]. The unique structure of bile salt encourages them to aggregate (micelle formation) with different shapes through different mechanism. The primary and secondary model as put forward by Small [18] that invokes stepwise aggregation of bile salts is most widely accepted model. In addition to this, Fisher's model suggested dimer formation, possessing rod-like structure [19]. Disc-like shape for bile salt aggregates has been recommended by Kawamura [20], and Warren [21], suggested a helical type shape for bile salts aggregate. Sodium cholate (NaC) and sodium deoxycholate (NaDC) (Scheme 1) that are sodium salts of cholic acid and deoxycholic acid respectively have been taken into consideration for this study in continuation to our previous reports [22,23] that may strengthen our knowledge on micellar mechanism of bile salts in drug-bile salts system by taking ceftriaxone sodium as model drug.

Ceftriaxone sodium (Cft-Na) (Scheme 2) is a third-generation cephalosporin antibiotic, and has broad-spectrum activity against Gram-positive and Gram-negative bacteria. It is often used for the treatment of community-acquired or mild-to-moderate healthcare-associated pneumonia and is also a choice for treatment of bacterial meningitis [24]. Chemically, (6*R*,7*R*)-7-[[(2Z)- (2-aminothiazol-4-yl)(methoxyimino)acetyl]amino]-3-[[(2-methyl-6-oxido-5-oxo-2,5-dihydro-1,2,4-triazin-3-yl)sulphanyl]methyl]-8-oxo-5-thia-1-azabicyclo[4.2.0]oct-2-ene-2-carboxylate, disodium salt, sesquatehydrate, with the chemical formula, $C_{18}H_{16}N_8Na_2O_7S_3$,3.5 H_2O, and a calculated molecular weight of 661.59g/mol. Ceftriaxone is a cephalosporin beta-lactam antibiotics used in the treatment of bacterial infections usually caused by susceptible, gram positive organism. Its antibacterial action is produced through the inhibition of bacterial cell synthesis [25]. Although wealth of literature is available on drug- bile salts system, but still it requires more elaborative knowledge on micellar behaviour of bile salts in such systems. The information procured from this study may be helpful in practicing and carrying out the safe trails of bile salts in new pharmaceutical formulation in future so as to conquer the solubility/bio-availability teething troubles in pharma-industries.

Section snippets

Material

The detail of chemicals used i.e. sodium cholate (NaC) and sodium deoxycholate (NaDC), ceftriaxone sodium (Cft-Na) and pyrene etc. have been given in Table 1. Both the bile salts have been used after re-crystallized from ethanol for carrying out experiments. The process followed for the re-crystallization has already been described in our previous paper [26], however, Cft-Na have been used as such without any pre-treatment. A.R. grade pyrene has been used as probe for analyzing fluorescence and …

Conductivity studies

The measurement of specific conductance, one of the best and highly efficient methods used for the elucidation of the process of micellization of amphiphiles has been used for the determination of critical micelle concentration *(CMC)* of bile salts in the presence of antibiotic drug. The *CMC* of sodium cholate and sodium deoxycholate in presence of Cft-Na has been determined by utilizing conductometry. The values of specific conductivity, κ for the experimented sample in 0.005, 0.010, and…

Conclusion

In the present communication, effect of antibiotic drug viz. ceftriaxone sodium (Cft-Na) on the miceller behaviour of bile salts namely sodium cholate (NaC) and sodium deoxycholate (NaDC) has been analyzed. The main outcome of the study is that the micellization of bile salts is greatly affected by temperature and drug content and is favoured in the presence of drug as can be publicized from the *CMC* values determined from conductivity, fluorescence and UV–Visible probe studies. The *CMC* values…

CRediT authorship contribution statement

Kuldeep Singh: Methodology, Data curation, Writing - original draft, Writing - review & editing, Visualization, Investigation. **S. Chauhan:** Conceptualization, Supervision.…

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

Acknowledgement

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Study on aggregation properties and interactive nature of bile salts in the presence of drugs: a comparative approach

Kuldeep Singh & Suvarcha Chauhan

Pages 57-67 | Published online: 15 Sep 2020

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ABSTRACT

Aggregation mechanism of two structurally different bile salts (bio-surfactants) in the absence and presence of drugs has been analysed through a conventional technique i.e. surface tension measurement. The anionic bile salts, namely sodium cholate (NaC) and sodium deoxycholate (NaDC), have been used to accomplish this study in the presence of metformin hydrochloride (anti-diabetic drug) and ceftriaxone sodium (antibiotic drug). The effect of hydrophobicity of the constituents and temperature has been analysed by carrying out surface tension measurement at different temperatures and various concentrations of both the components. The results of surface tension measurements have been interpreted in terms of various interactions that may be present in the system and the alteration in micellar behaviour of bile salts has been discussed by determining their critical micelle concentration (*CMC).* Moreover, the information on energetic micellasaion has also been grasped from various thermodynamic parameters evaluated for the system. The study may be considered to be a step to help pharmaceutical industries in terms of utilisation of cholanology to defeat solubility/permeability complications during drug formulations.

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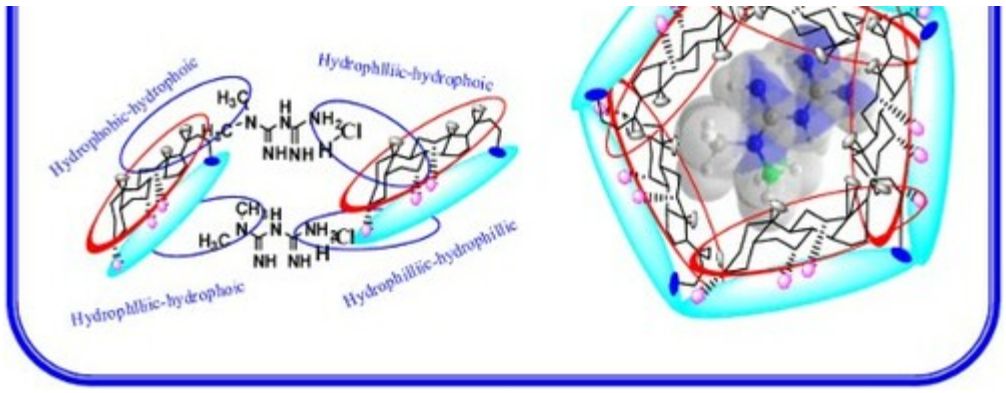

KEYWORDS: Tensiometry | micellar behaviour | critical micelle concentration | Thermodynamics

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Additional information

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Carbohydrate Polymer Technologies and Applications

Volume 1, 25 December 2020, 100017

Synthesis and characterization of the azadirachta indica gum–polyacrylamide interpenetrating network for biomedical applications

Baljit Singh, Man Mohan, Baldev Singh

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Highlights

- Azadirachta indica –polyacrylamide hydrogels were pH responsive.
- Mesh size of hydrogel reduced at higher acrylamide content.
- The release of methyl prednisolone followed non-Fickian diffusion mechanism.
- The drug release profile was best fitted in Korsmeyer-Peppas kinetic model.
- The hydrogel showed non haemolytic, mucoadhesive and antioxidant nature.

Abstract

Herein this present work, graft copolymerization of the polyacrylamide onto azadirachta indica gum polysaccharide was carried out in the presence of crosslinker to form the interpenetrating network structure in hydrogels for use in biomedical applications. The crosslinked polymers were characterized by cryo-SEM, AFM, FTIR, and ^{13}C-NMR and swelling studies. The cryo SEM images confirmed the porous crosslinked network in polymers formed by covalent linkage. The change in polyacrylamide and crosslinker content during the formation of the gel has influenced the porosity which was inferred from the swelling and network parameter evaluation of the hydrogels. The cross linking density 0.81×10^{-5} molcm^{-3} and mesh size 63.0nm of hydrogels was found in pH 7.4 buffer. The methyl prednisolone released followed non-Fickian diffusion mechanism. The biocompatibility of grafted/crosslinked polymers was inferred from results of thrombogenicity (59.54 ± 4.08%) and haemolytic index (3.12 ± 0.52%). The antioxidant nature was confirmed from the DPPH radical scavenging assay (49.24 ± 8.57%). Overall, the modification of the gum led to the formation of hydrogels to be used in drug carrier for the colonic ailments.

Previous Next

Keywords

Azadirachta indica gum; Biocompatibility; Grafting; Hydrogels; drug delivery

1. Introduction

Typesetting math: 100% ica gum, commonly known as neem gum, is a natural exudate obtained from the azadirachta indica plant of

family Meliaceae. It is a complex hetero-polysaccharide which consist of glucosamine, mannose, arabinose, galactose, fucose, xylose and glucose (Vijayavaniand Vidyavati,2018). It has been used in various food and pharmaceutical formulations (Mukherjeeand Srivastava,1955). It is used as gelling agent (Ogunjimiand Alebiowu,2013), emulsifier (Rishabhaetal., 2017), antioxidant (Rishabhaetal., 2017), thickener and film forming agent (Kulkarnietal., 2013) in pharmaceutical formulations due to its water solubility and swell-able nature (Kouletal., 1990). It has been well recognized for anti-inflammatory and anti oxidant activity (Rouzeretal., 2009; Rishabhaetal., 2017). It increases viscosity of continuous phase, significantly reduces surface tension and improves the flow properties of the excipients (Rishabhaetal., 2017). It has also showed the substrate specific proteolytic activity under wide range of pH and temperature conditions (Nayaketal., 1979). Comparative analysis of physicochemical properties of gum obtained from India indicated that one gram of gum consists of moisture content (11.9–13.9%), specific optical rotation (-45° to -62°), nitrogen content (3.7–6.0%), protein (23.2–41.9%), uronic acid (28.3–31.4%), and the number average molecular weight of the gum was observed to be in the range from 5×10^{5} g/mol to 13.0×10^{5} g/mol (Moniemetal., 2018; Andersonand Hendrie,1971). The Azadirachta indica gum was obtained from Azadirachta indica trees and further processed it into powder for various applications (Moniemetal., 2018).

Graft copolymerization of the poly(AAm) onto gum polysaccharides has been reported for specialty applications (DaSilva etal., 2007; Monjezietal., 2018; Sharmaetal., 2018). During grafting reactions, addition of crosslinker has formed grafted crosslinked product that has been used as drug release vehicle (Maiaetal., 2012). These polymeric networks have been exploited for colonic drug delivery (Anjumetal., 2015). Nowadays, the site specific drug delivery carriers are well explored to facilitate the rapid onset and to minimize the side effects of the conventional formulations (Sardoetal., 2019).The drug loaded polysaccharide hydrogels has improved the colonic ailments by maintaining the concentration within therapeutic level for a long period beside several other advantages (Janaetal., 2019; Nayakand Hasnain,2019).These biodegradable gels have ability to hydrate that makes penetration of colonic fluid containing various digestive enzymes into drug formulation, degradation of the polysaccharide matrix and target specific drug release during the improvement in gastrointestinal tract (GIT) (Sinhaand Kumria,2001; Chourasiaand Jain,2004).These drug delivery carriers also provide the controlled and site specific drug delivery beside their colonic microbial degradation (Simonsenetal., 1995).

The polymers based drug delivery carriers prevent the dissolution of drug in the stomach until reaching the GIT due to their tunable composition and dissolution in GIT fluid (Guoetal., 2019). The Crohn's disease, ulcerative colitis and inflammatory bowel disease are some of the most common chronic inflammatory diseases associated with the GIT which have been treated with anti-inflammatory and immunosuppressive agents (Arbizuand Nurko,2015). Methyl prednisolone drug has also been used to treat these colonic ailments. It is a well known fact that colonic problems required long term treatment, therefore sustained drug delivery system of the methyl prednisolone is one of the options to reduce its negative aspects of its conventional drug formulations (Lautenschlageretal., 2014; Huanbuttaetal., 2016). In view of the above facts, in the present work, methyl prednisolone containing azadirachta indica gum polysaccharide and polyacrylamide based hydrogels have been designed as tune able colonic drug carrier by using graft copolymerization reactions.

2. Experimental

2.1. Materials and methods

Acrylamide (AAm) [Merck Specialties Pvt. Ltd., Mumbai-India], Ammonium persulfate (APS) [Fischer Scientific Mumbai India], NN-methylenebisacrylamide (NNMBA) [Acros Organics- New Jersey USA], and methyl prednisolone [Neon Laboratory Ltd. Mumbai India] were used as received. Azadirachta indica gum was obtained from the Neoteric DCBA Ideas Gandhipuram, Coimbatore, Tamil Nadu-India.

2.2. Synthesis of azadirachta indica-*cl*-poly(AAm) polymers

The synthesis of the azadirachta indica-cl-poly(AAm) polymers was carried out by free radical copolymerization method. The solution of known gum content (12.0% w/v) and monomer acrylamide [AAm] (1.13 mole/L) was mixed in the reaction system. Then the solutions of definite concentration of initiator ammonium persulfate [APS] (2.19×10^{-2} mole/L) and cross linker [NNMBA] (0.65×10^{-2} mole/L) were added to the reaction content containing gum and acrylamide solution. This reaction content was stirred at 110rpm speed at room temperature (28 ± 2^{O}C) to get homogeneous reaction mixture. The polymerization reaction was done at 65°C for 3 h in water bath and then after completion of grafting/ crosslinking reaction, washing of polymers was carried out with distilled water to remove the soluble fractions left in the crosslinked polymer matrix followed by drying in air oven at 45 ± 1^{O}C to get constant weight. The crosslinked network structure of hydrogel with optimum porosity was obtained by varying the monomer [AAm] from 0.56 to 2.82 mole/L and crosslinker [NNMBA] from 0.65×10^{-2} –7.13×10^{-2} mole/L from the results of swelling, gel strength and surface morphologies of the hydrogel after 24 h of swelling. The optimum conditions were obtained as [AAm]=1.13 mole/L , and [NNMBA]=0.65×10^{-2} mole/L, gum=12% (w/v) and [APS]=2.19×10^{-2} mole/L. The grafting of the vinyl monomer onto gum was carried out and grafting efficiency was evaluated using following equation [Grafting efficiency

Typesetting math: 100%

(%)=(W_1-W_0)/W_2×100], wherein W_0 weight of gum, W_1 weight of grafted co-polymer and W_2 weight of acrylamide. In the case of azadirachta indica-cl-poly(AAm) based optimized polymer, grafting efficiency was observed to be 87.5%. The crosslinked product was formed by performing the grafting reaction in the presence of crosskinker NNMBA for designing the hydrogels for specialty applications.

2.3. Characterizations

The cross-linked azadirachta indica-cl-poly(AAm) polymer samples were characterized bycryo-SEM [Jeol (JSM 7600) scanning electron microscope (Japan)], AFM [AFM (NT-MDT, RUSSIA)], FTIR [Agilent K8002AA Carry 600 FTIR], and solid state ^{13}C-NMR [BRUKER DSX-300 solid state NMR spectrometer].

2.4. Swelling and network parameters studies

The swelling of azadirachta indica-cl-poly(AAm) hydrogels and network parameters including mesh size /cross-linking density were determined by taking swelling by applying gravimetric method (Singh,2007). Network parameters of hydrogels were evaluated from the swelling data using Flory-Rehner equation (Bajpaiand Singh,2006; Aithaletal., 1990).The brief procedure for the evaluation of Flory-Huggins interaction parameter (χ), and mesh size (ξ) of the hydrogelshas been discussed elsewhere (Singhand Singh,2017).

2.5. Drug release studies

The loading of drug methyl prednisolone into hydrogels was carried out in drug solution of definite concentration (500 micrograms/mL) by swelling equilibrium method(Singhand Singh,2017).The diffusion mechanism for swelling/drug release was evaluated using power law expression ($M_t/M_\infty=kt^n$) given by Ritger and Peppas (Ritgerand Peppas,1987a;b).The best fit kinetic model was evaluated by putting the release profile data in various kinetic models (Shoaibetal., 2006; Dashetal., 2010).The release of drug methyl prednisolone from drug encapsulated azadirachta indica-cl- poly(AAm) gel was determined from the reference curve of the drug using UV-visible spectrophotometer.

2.6. Blood compatibility studies

The blood compatibility of azadirachta indica-*cl*-poly(AAm) hydrogels was studied by evaluating thrombogenic and hemolytic potential (ISO 10993-4, TC 194, 2004; ASTM F 756-00, 2000). Thrombogenicity was determined by the evaluation of thrombus formation on polymer surface and test was carried out by the gravimetric method in triplicate.

$$\text{Thrombose}(\%) = \left[\frac{\text{Mass test sample} - \text{Mass of } (-) \text{ control}}{\text{Mass of } (+)\text{control} - \text{Mass of } (-) \text{ control}}\right]$$

Hemocompatibility testing is an imperative method for medical devices intended for direct or indirect blood exposure. The haemolytic potential of the material is defined as the measure of the extent of haemolysis that may be due to the material when it comes in contact with blood. The haemoglobin released by haemolysis was measured by the optical densities (OD) of the supernatants at max 540 nm using a UV–vis spectrophotometer.

$$\text{Haemolytic Index}\left[\frac{(\text{OD of sample} - \text{OD of negative control})}{(\text{OD of positive control} - \text{OD of negative control})}\right]$$

2.7. Antioxidant activity

Antioxidant activity of azadirachta indica-*cl*-poly(AAm) polymers was evaluated by 2,2 -diphenyl - 1 - picrylhydrazyl (DPPH) radical scavenging assay and Folin -Ciocalteu (F -C) reagent assay (Gorczycaetal., 2014; Curcioetal., 2009). In case of DPPH radical scavenging assay, 0.4 g of polymer sample was placed in methanolic solution (100 mM) of DPPH radical (as test experiment) and DPPH solution without polymer was taken as control. The reaction mixtures were kept in dark and the absorbance was measured at λmax 517 nm after 24 h using a UV-vis spectrophotometer. In F-C reagent assay, antioxidant capacity of polymer was expressed as gallic acid equivalent. Polymer sample of 0.1 g was placed in de-ionized water for 1 h and it was removed and fresh 6 mL water was added followed by 1 mL F-C reagent. After 3 min, 3 mL of 2% Na_2CO_3 was added and content was kept at 37 °C for 2 h with intermittent shaking. Absorbance was measured at λ_{max} 760 nm against control (treated similarly but without polymer). All the tests were carried out in triplicate.

$$\%\ \text{inhibition} = \left[\frac{\text{Control} - \text{Test}}{\text{Control}}\right] \times 100$$

2.8. Mucoadhesion studies

Mucoadhesion of the azadirachta indica-*cl*-poly(AAm) hydrogel with the intestinal mucosa was analyzed by texture analyzer (Eouanietal., 2001). The tissue was equilibrated in simulated intestinal fluid for 15 min at 37 °C before placing it onto the holder

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stage of the mucoadhesive holder. The probe attached with polymer was then moved downward to make the contact with goat intestine mucosa with fixed time and contact force. The probe was subsequently withdrawn at a test speed 0.1 mm/s. The maximum force required to separate the probe from the goat mucosa (i.e. maximum detachment force; F_{max} in N) was directly recorded in the instrument and the total amount of force involved in the probe withdrawal from the tissue (work of adhesion; W_{ad}) was then calculated from the area under the force versus distance curve in N mm.

2.9. Gel strength of the hydrogels

Gel strength of azadirachta indica-*cl*-poly(AAm) was determined by texture analyzer.Gel strength was taken after 24 swelling of the crosslinked hydrogels. After a trigger force of 5 g was attained, the probe then proceeds to penetrate into the gel to a depth of 5 mm. At this depth, the maximum force reading (i.e. the resistance to penetration) was obtained as the 'gel strength' of the sample.

3. Results and discussion

3.1. Characterizations

3.1.1. Cryo-Scanning electron micrograph (Cryo-SEM)

The highly porous structural morphology of the swelled azadirachta indica-*cl*-poly(AAm) hydrogel was clearly visible in the Cryo-SEM images (Fig. 1). The different polymeric chains are crosslinked and network structure is formed. The porous nature of the polymer matrix is useful for drug delivery applications (Soleetal., 2019).

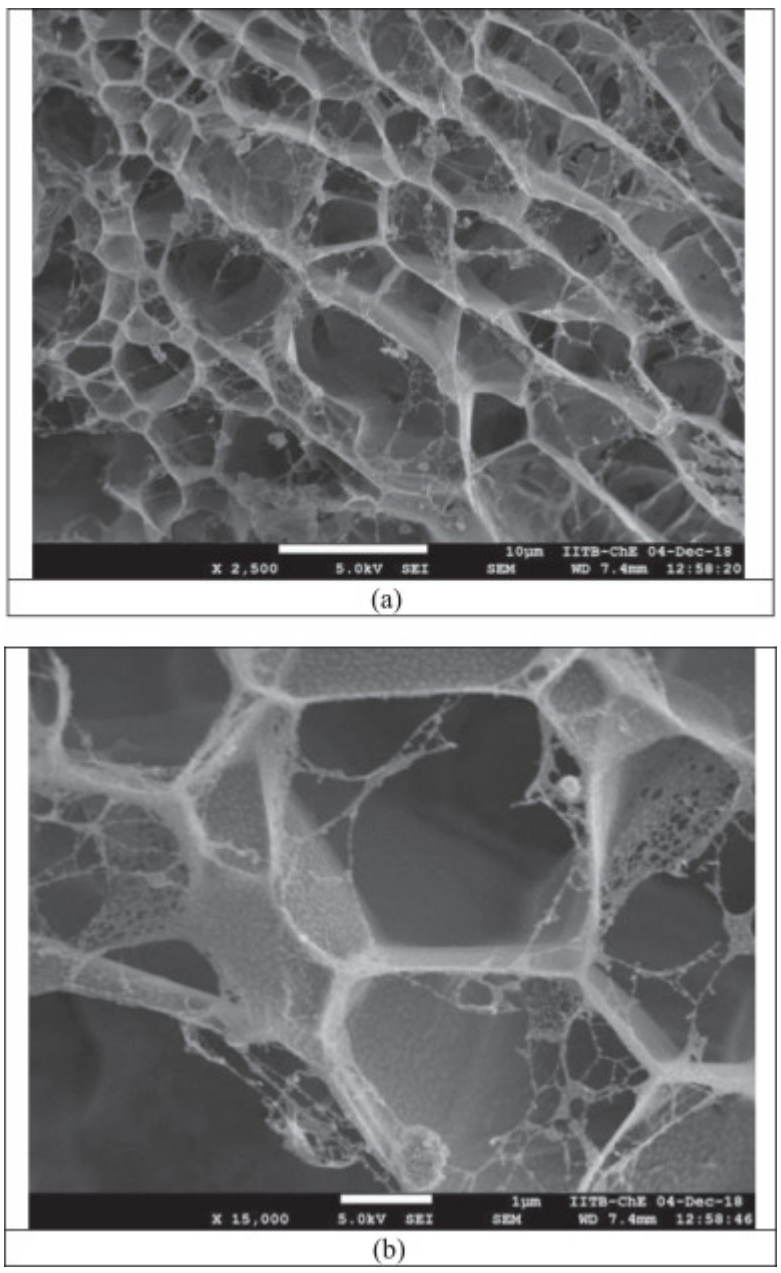

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Fig. 1. Cryo-SEM images of swelled hydrogels at different magnifications ((a) 2500, (b) 15000) for 1 µm.

3.1.2. Atomic force microscopy (AFM)

The micromechanical properties of the azadirachta indica-*cl*-poly(AAm) polymer surface was examined through AFM image (Fig. 2). The appearance of small valleys in the form of crest and trough on the scanned area indicated structural heterogeneity in the polymeric sample. The polymer sample showed root mean square roughness 26.770 nm over an area (2×2 µm) while the average surface roughness was recorded as 19.032 nm (Benninatto etal., 2019).

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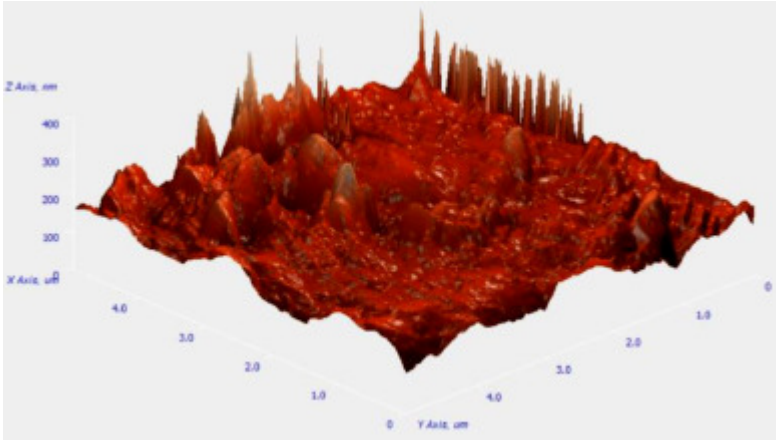

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Fig. 2. AFM image of dry Azadirachta indica -*cl*-poly(AAm) polymer sample.

3.1.3. Fourier Transform Infrared spectra (FTIR)

FTIR of azadirachta indica gum and crosslinked hydrogels are shown in Fig.3. In case of FTIR of gum the absorption bands were observed at 3406 cm^{-1} (due to –OH stretching vibrations in the gum polysaccharide), at 2931 cm^{-1} (-C-H stretching mode of $-CH_3$ groups in the gum), at 2121 cm^{-1} (due to overtones of -C-O stretching vibrations), at 1738 cm^{-1} and 1627 cm^{-1} (due to C=O stretching vibrations of carboxylic acid and amide present in the gum). The absorption peaks at 1421 cm^{-1} (due to C-H deformation of methylene groups in the gum), and at 1248 cm^{-1} (due to C-O-C asymmetric stretching vibrations) were observed (Phadkeetal., 2015; Veluswamyetal., 2015). In case of FTIR of azadirachta indica-*cl*-poly(AAm) polymer, absorption bands at 3404 cm^{-1} (due to -OH stretching vibrations in the gum polysaccharide), at 2929 cm^{-1} (due to -C-H stretching mode of $-CH_3$ groups in the gum) and at 2154 cm^{-1} (due to overtones of -C-O stretching vibrations) were noticed. A broad band at 1668 cm^{-1} (due to overlap of -C=O stretching vibrations of free carboxylic acid of gum and -C=O stretching vibrations of amide linkage in the gum and poly(AAm)) were observed. The bands at 1452 and 1421 cm^{-1} (due to C-H deformation of methine and methylene groups present in gum and poyacrylamide), at 1353 and 1325 cm^{-1} (due to asymmetric/symmetric stretching vibrations of C-N functional group in the gum and poly(AAm)), were found along with the band at 1248 cm^{-1} (due to C-O-C asymmetric stretching vibrations) (Moharrametal., 1996; Veluswamyetal., 2015).

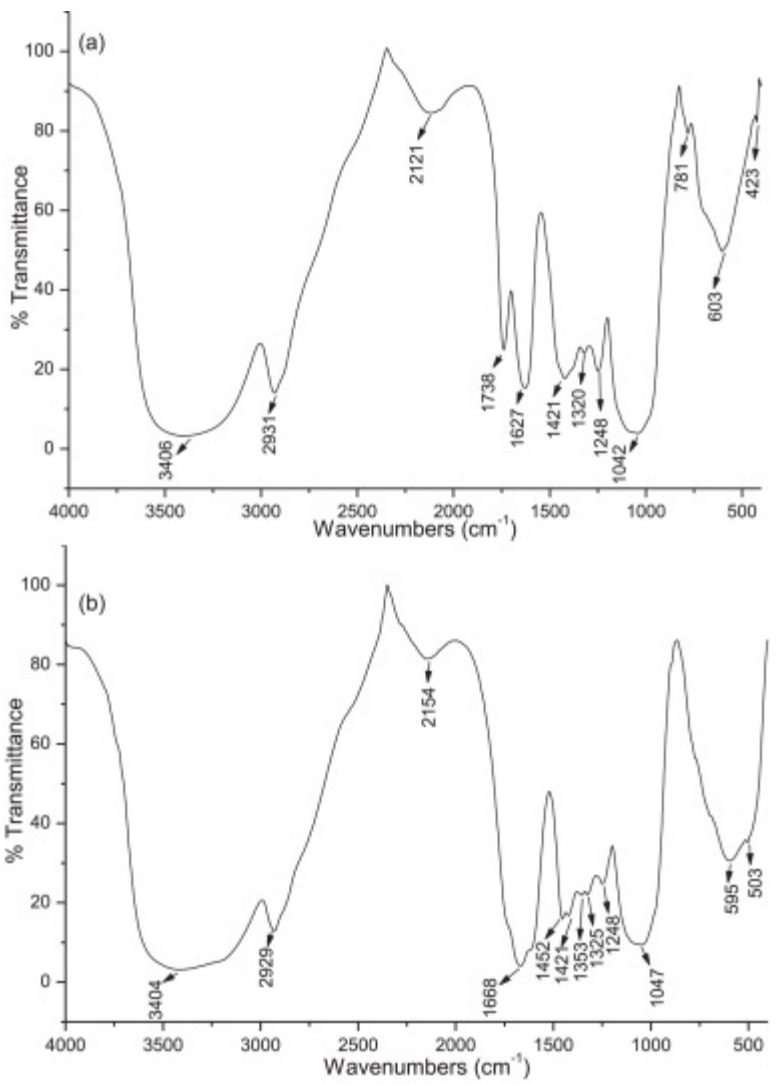

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Fig. 3. FTIR spectra of dry samples of (a) Azadirachta indica and (b) Azadirachta indica -*cl*-poly(AAm) polymers.

3.1.4. ^{13}C-Nuclear magnetic resonance spectra (^{13}C-NMR)

Typesetting math: 100% gum and azadirachta indica-*cl*-poly(AAm) are presented in Fig.4. The ^{13}C NMR spectra of gum showed peaks at

171.870 ppm and 169.904 ppm [due to **C**=O of uronic acid], at 110.171 ppm and 105.813 ppm [due to C-1 (anomeric cartbon) of 1-6 and 1-4-linked α-arabinofuranose residues], at 79.236 ppm [due to C-3 and C-4 of terminal α-arabinofuranose residues], at 72.741 [due to C-6 of 1-6 –linked α-arabinofuranose residues], at 63.854 ppm [due to C-5 of terminal α-arabinofuranose residues] and at 21.553 ppm [due to $-CH_3$ of fucose].^{13}C-NMR spectra of azadirachta indica-*cl*-poly(AAm) polymer showed peaks at 179.817 ppm [due to **C**=O of poly(AAm) and uronic acid of the gum], between 112.393-104.531 ppm [due to C-1anomeric cartbon of 1-6 and 1-4-linked α-arabinofuranose residues of the gum], at 81.031 ppm [due to C-3 and C-4 of terminal α-arabinofuranose residues], at 73.169 ppm [due to C-6 of 1-6 –linked α-arabinofuranose residues inthe gum], at 64.110 [due to C-5 of terminal α-arabinofuranose residues], at 42.234 ppm [due to methyne group (CH_2=CH-) of poly(AAm)] and peak at 21.297 ppm [due to -CH_3 of fucose present in gum] (Fujiwaraetal., 1982).The main peaks of the monomer AAm around 130 and 133 ppm (due to two sp^2 hybridized carbons i.e. CH_2=CH-) were disappeared with polymerization indicating absence of un-reacted monomer left in the polymer matrix (Senetal., 2009).

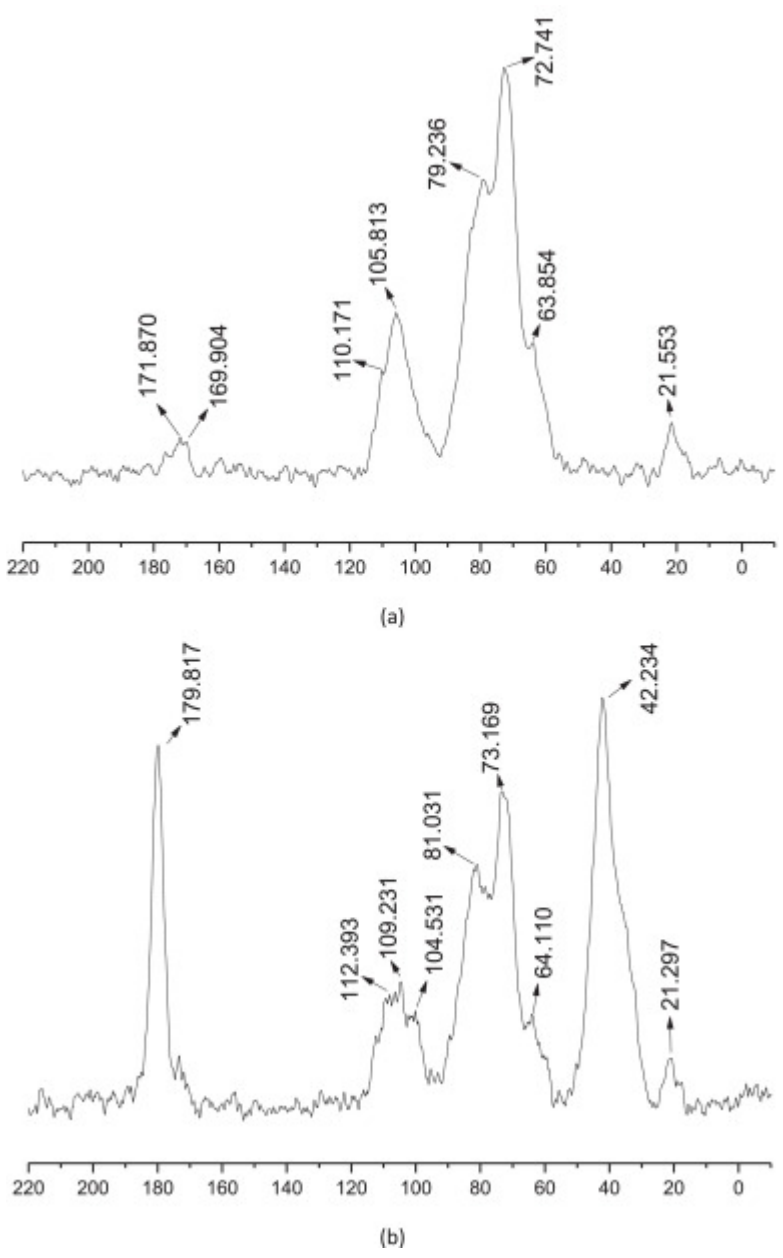

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Fig. 4. ^{13}C-NMR spectra of dry samples of (a) Azadirachta indica and (b) Azadirachta indica-*cl*-poly(AAm) polymers.

3.2. Swelling and network parameters studies

The effect of change in monomer (AAm) and crosslinker (NNMBA) concentration during copolymerization reaction on the mesh size and network density of the hydrogel matrix was evaluated by taking the swelling of the grafted product formed by varying the [AAm] (from 0.56–2.82 mole/L) (Fig. 5, Table 1).The swelling of the azadirachta indica-*cl*-poly(AAm) hydrogels first enhanced (from 4.58±0.47 to 6.27±0.21 g/g of gel) with rise in [AAm] (from 0.56 to 1.17 mole/L) in solution and thereafter swelling decreased with AAm content. The increase in monomer content after certain limit the further addition has increased the crosslinking density that reduced the water uptake by the polymer matrix.

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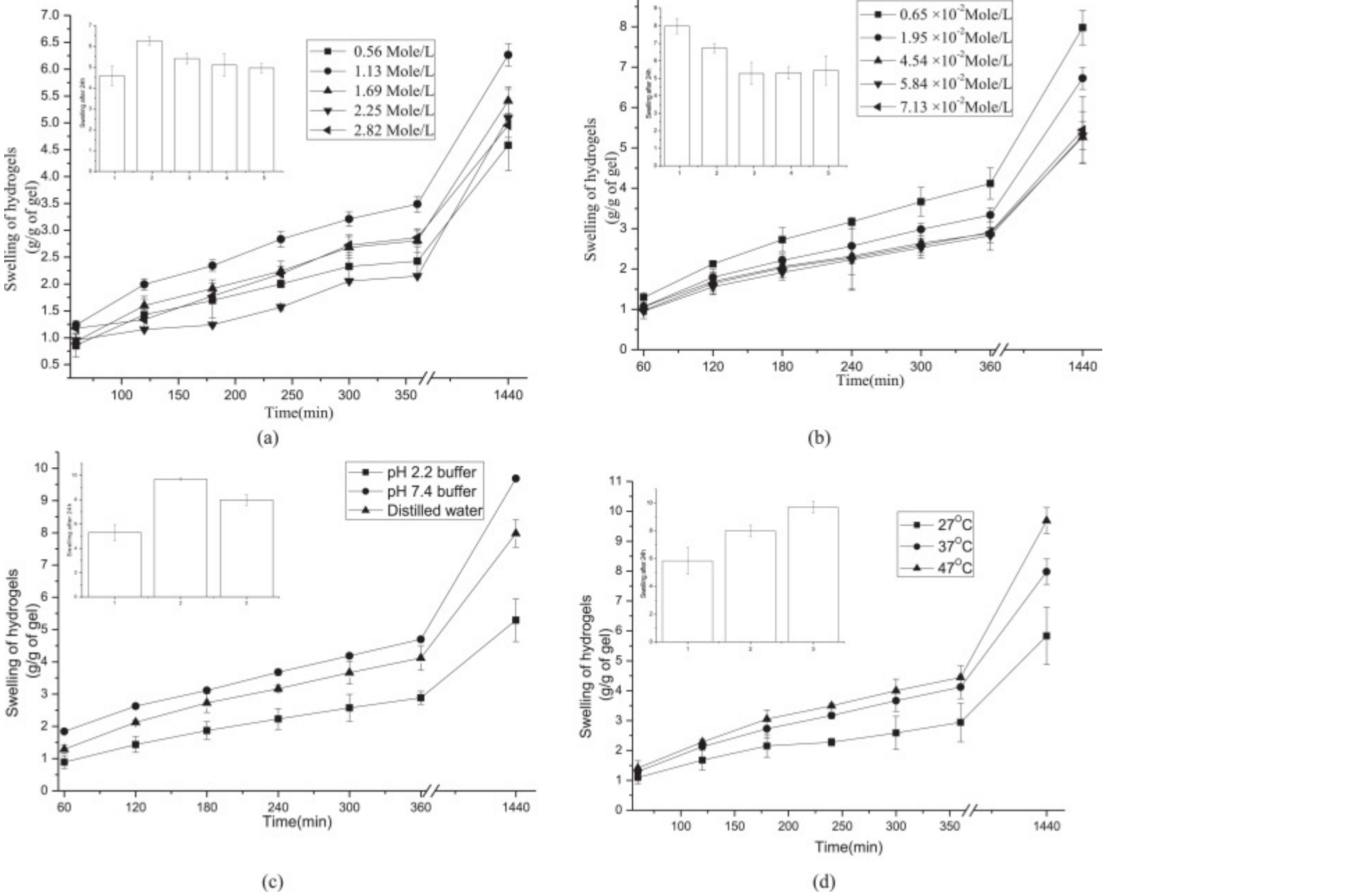

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Fig. 5. Effect of (a) [AAm] (b) [NNMBA], (c) pH and (d) temperature of swelling medium on swelling of Azadirachta indica-*cl*-poly(AAm) hydrogels.

Table 1. Results of diffusion exponent 'n', gel characteristic constant 'k' and various diffusion coefficients for the swelling of Azadiracta indica-*cl*-poly(AAm) hydrogels.

S. No.	Parameters	Diffusion exponent 'n'	Gel characteristic constant 'k'×10^2	Diffusion coefficients (cm^2/min)		
				Initial D_i×10^5	Average D_A×10^3	Late time D_L×10^5
Effect of AAm (Mole/L)						
1.	0.56	0.52	2.50	07.26	1.54	09.99
2.	1.13	0.50	2.74	07.66	1.60	11.13
3.	1.69	0.54	2.09	12.91	2.43	16.47
4.	2.25	0.55	1.65	18.28	3.11	14.46
5.	2.82	0.49	3.02	07.46	1.32	12.55
Effect of NNMBA (Mole/L ×10^2)						
6.	0.65	0.57	1.82	3.43	0.65	4.38
7.	1.95	0.57	1.66	4.01	0.68	4.48
8.	4.54	0.52	2.40	1.92	0.38	2.64
9.	5.84	0.53	2.21	2.89	0.51	3.70
10.	7.13	0.53	2.27	2.07	0.36	2.64
Effect of swelling medium						
11.	pH 2.2 buffer	0.56	1.87	02.90	0.51	04.09

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S. No.	Parameters	Diffusion exponent 'n'	Gel characteristic constant 'k'×10^2	Diffusion coefficients (cm^2/min)		
				Initial D_i×10^5	Average D_A×10^3	Late time D_L×10^5
12.	pH 7.4 buffer	0.52	2.18	03.03	0.53	03.04
13.	DW	0.57	1.82	03.43	0.65	04.38
Effect of temperature						
14.	27°C	0.58	2.35	02.69	0.52	03.31
15.	37 °C	0.57	1.82	03.43	0.65	04.38
16.	47 °C	0.60	1.33	02.81	0.54	03.22

The swelling of the hydrogels in general decreased due to increase in crosslinking density with the change in crosslinker [NNMBA]. Similarly, grafting reaction of monomer acrylamide onto chitosan along with the addition of NNMBA crosslinker formed hydrogels where the decrease in swelling with increase in crosslinker concentration was observed. At the same time higher content of NNMBA has not much influenced swelling due to rise in cross-linking and hydrophilicity simultaneously. This has also led to the competition between polymer-polymer interactions and polymer-solvent interactions. Swelling of hydrogels was found higher in pH 7.4 buffer (9.68±0.06g/g of gel) as compared to the pH 2.2 buffer (5.29±0.66g/g of gel) due to ionic repulsions among the ions formed after partial ionization of the polymer matrix in pH 7.4 buffer. Furthermore, the higher swelling at 45 °C temperature may be because of rise in segmental mobility and rate of diffusion. The diffusion exponent (swelling curve of water uptake vs time) indicated that hydrogels swelled with non-Fickian diffusion mechanism.

These swelling trends of hydrogels were also evident from the results of the network parameters wherein the value of the mesh size (ξ) reduced from 31.72 nm to 20.52 nm after forming the pore of optimum size with increase in [AAm] in the reaction system (Table 2). The increase in crosslink density (ρ) with rise in monomer content from 1.36×10^5 to 4.10×10^5 mol/cm^3 was also observed.At the same time the, values of the ρ increased (from 1.32×10^5 to 13.98×10^5 mol/cm^3) and ξ decreased (from 43.31 nm to 14.66 nm) with increase in [NNMBA]. The rise in crosslinks in the hydrogel has decreased the mesh size and molecular weight between two crosslinks that led to the decrease in the water content in the gel. The Flory Huggin interaction parameter gave an idea about the interaction of the hydrogel with solvent molecules. In the present study, it was observed that the values for Flory Huggin interaction parameter were less than 1 indicating the random arrangement of the water molecules in the network within the polymeric units. Similarly, it was observed that polymer volume fraction values were inversely proportional to mesh sizes of the polymer throughout experimental analysis. At higher pH and temperature of swelling medium, the cavitations in the polymer matrix increased and elasticity decreased (Lietal., 2006).

Table 2. The network parameters of Azadiracta indica-*cl*-poly(AAm) hydrogel as a function of different parameters.

Parameters	Density 'd_p' (g/cm^3)	Polymer volume fraction (ϕ)	Slope $\left(\frac{d\phi}{dT}\right)$	Flory-Huggins interaction parameter, (χ)	Mol. wt. between two neighboring crosslinks, $\overline{M}_c$ (g/mol)	Crosslink density, ρ × 10^5 (mol/ cm^3)	Mesh size, (ξ) (nm)
Effect of AAm (Mole/L)							
0.56	1.18	0.156	-0.0012	0.4929	7191.5	16.46	11.19
1.13	1.02	0.135	-0.0030	0.5399	52385	01.95	31.72
1.69	0.71	0.206	-0.0037	0.5780	52116	01.36	27.44
2.25	0.96	0.169	-0.0034	0.5575	45976	02.09	27.52
2.82	1.03	0.164	-0.0028	0.5473	25021	04.10	20.52
Effect of NNMBA (Mole/L ×10^2)							
0.65	1.08	0.103	-0.0028	0.5268	81853	01.32	43.31
1.95	1.16	0.113	-0.0026	0.5283	61037	01.89	36.27
4.54	1.18	0.138	-0.0024	0.5321	29855	03.94	23.73
5.84	0.74	0.203	-0.0033	0.5711	21166	03.47	15.58
7.13	1.41	0.115	-0.0007	0.4488	10070	13.98	14.66
Effect of swelling medium							

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Parameters	Density 'd_p' (g/cm^3)	Polymer volume fraction (ϕ)	Slope $\left(\frac{d\phi}{dT}\right)$	Flory-Huggins interaction parameter, (χ)	Mol. wt. between two neighboring crosslinks, $\overline{M}_c$ (g/mol)	Crosslink density, ρ × 10^5 (mol/ cm^3)	Mesh size, (ξ) (nm)
pH 2.2	1.08	0.229	-0.0037	0.5894	46882	1.35	25.14
pH 7.4	1.08	0.079	-0.0026	0.5179	148491	0.81	63.80
DW	1.08	0.103	-0.0028	0.5268	81853	1.32	43.31
Effect of temperature							
27 °C	1.08	0.136	-0.0028	0.5367	38437	2.81	27.03
37 °C	1.08	0.103	-0.0028	0.5268	81853	1.32	43.31
47 °C	1.08	0.086	-0.0028	0.5226	141380	0.96	60.39

3.3. Drug release studies

The release profile of the methyl prednisolone from the drug containing polymers indicated the pH responsive behavior of the hydrogel during drug release studies in different pH buffers (Fig6.,Table3). The drug release results were corresponding to the swelling results of the hydrogels. The higher release of methyl prednisolone in 7.4 buffers was also on the basis of larger mesh size of the hydrogel (68.80nm) in 7.4 buffer as compared to the pH 2.2 pH buffer (i.e. 25.14nm). The drug loading into hydrogels used in drug release study was 57.44±5.52%.The results of the release profile also indicated the slow release of drug without burst effect in later stages. The methyl prednisolone drug released with non-Fickian diffusion wherein the rate of drug solvent and rate of polymer chain relaxation are almost same. Drug release profile was bested fitted in Korsmeyer Peppas kinetic Model from drug loaded polymers. Moradi etal. (Moradietal., 2020) have also reported similar type of kinetic model for the drug release from the chitosan based hydrogels. The slow controlled and sustained release of drug was due to various supramolecular interactions. Various drug polymer interactions present in the methyl prednisolone loaded azadirachta indica-cl-poly(AAm) hydrogels shown in scheme1.

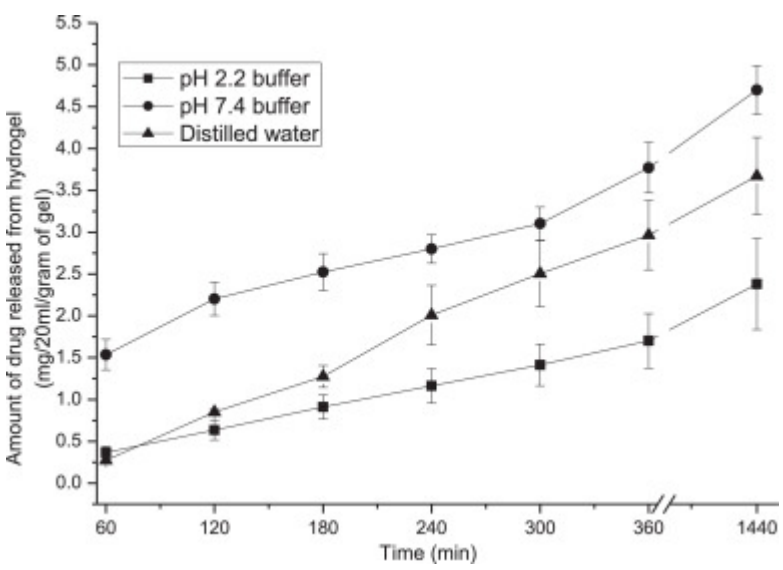

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Fig. 6. Release profile curve of methyl prednisolone drug from Azadirachta indica-*cl*-poly(AAm) hydrogels.

Table 3. Results of diffusion exponent 'n', gel characteristic constant 'k', various diffusion coefficients and release kinetic parameters for the release of drugs from drug loaded Azadiracta indica-*cl*-poly(AAm) hydrogels.

Release medium	Diffusion exponent 'n'	Gel Characteristic constant 'k'×10^2	Maximum amount of released drug, C_{max} (mgL^{-1})	Constant of the kinetic of release, K_{rel}×10^5 (s^{-n})	Initial release rate, r_o×10 (mgL^{-1})	Diffusion coefficients (cm^2/min)		
						Initial D_i×10^5	Average D_A×10^5	Late time D_L×10^5
pH 2.2buffer	0.85	0.46	145.138	0.65	0.1363	08.72	4.65	6.41
Distilled water	0.71	1.27	106.270	06.5	0.7352	05.29	9.83	6.63

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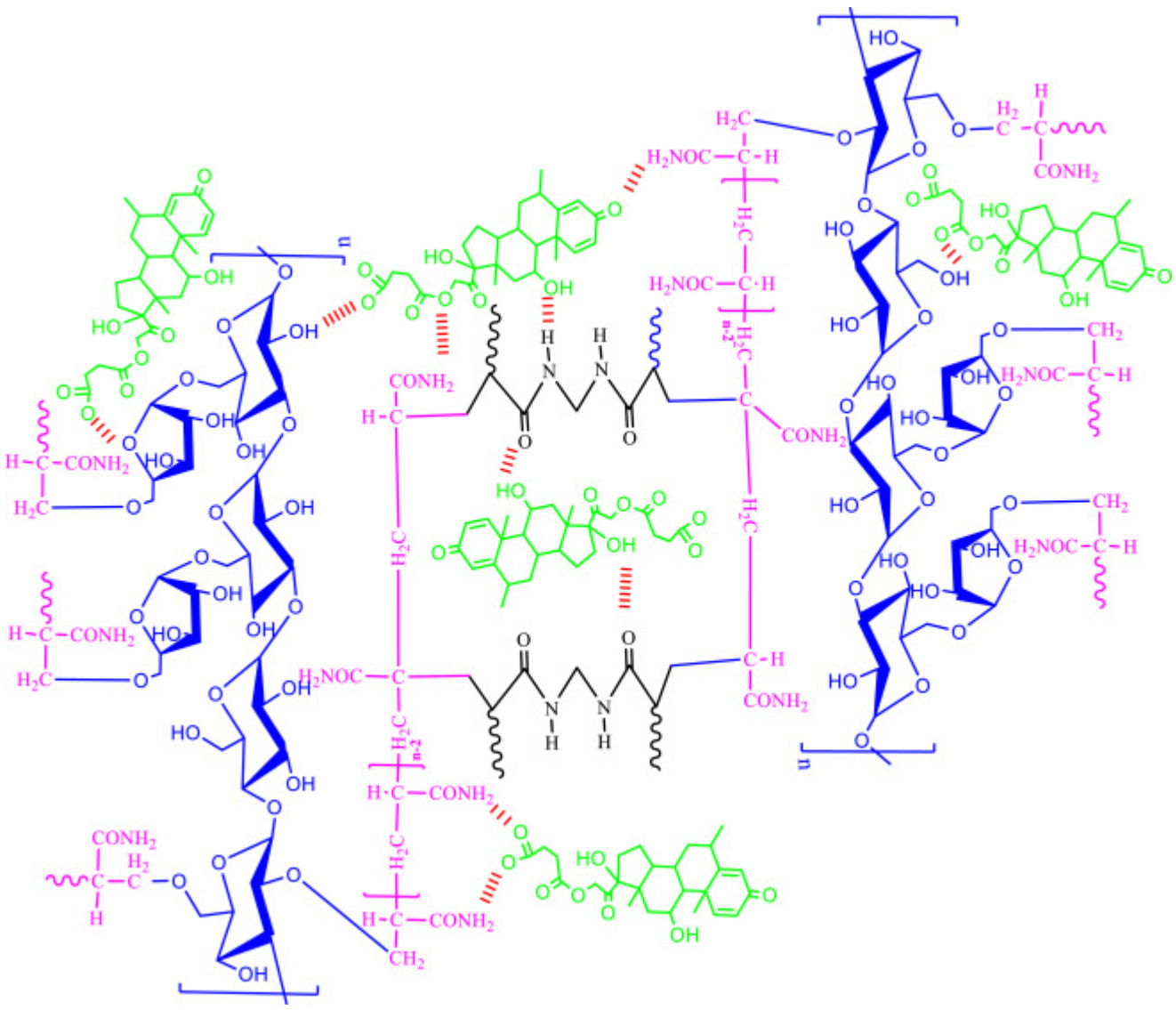
Release medium	Diffusion exponent 'n'	Gel Characteristic constant 'k'×10^2	Maximum amount of released drug, C_{max} (mgL^{-1})	Constant of the kinetic of release, K_{rel}×10^5 (s^{-n})	Initial release rate, r_o×10 (mgL^{-1})	Diffusion coefficients (cm^2/min)		
						Initial D_i×10^5	Average D_A×10^5	Late time D_L×10^5
pH 7.4buffer	0.98	0.24	122.249	17.4	2.6033	15.34	4.40	9.30



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Scheme 1. Various drug polymer interactions present in the methyl prednisolone loaded azadirachta indica-cl-poly(AAm) hydrogels.

It has also been reported that the azadirachta indica gum itself has anti-inflammatory effect due to inhibition activity of pro-inflammatory enzyme by its various constitute compounds that stop the synthesis of prostaglandins which is responsible for tissue inflammation (Tillayetal., 2001; Vijayavaniand vidyavanti,2018). Overall, various inflammations occurred in the colon will be taken care by the slow release of anti-inflammatory drug methyl prednisolone in the colon and microbial degradation of the gum in colon. Hence, this synergic effect of methyl prednisolone drug released from the drug carrier polymer and degradation of the polymer carrier in colon can enhance the therapeutic potential besides overcoming the side effect associated with its conventional drug formulations.

3.4. Blood compatibility studies

The results of the thrombogenicity showed that the weight of clot formed (0.197±0.03g per2mL) and thrombose percentage (59.54±4.08%) (Table4) showed non-thrombogenic nature of hydrogels and it is required for the material to be used in biomedical applications. Alexandre and coworkers (Alexandreetal., 2015) have also confirmed less thrombogenicity of the polysaccharide (dextran) based hydrogel as compared the glass.The haemolytic index value (3.12±0.514%.) was less than 5% that indicated safe nature of drug delivery carrier or biomaterials (Rayetal., 2010). Pectin based porous and non-porous polymers prepared for drug delivery application have showed thrombogenicity 76.93% and 74.79%, respectively and these polymers have been classified in non-thrombogenic nature of the matrials (Moghaddametal.(2019)). Moringa oleifera based polymer showed good biocompatibility due to non thrombogenic and non haemolytic nature. The hydrogel was found to have 33.33% thrombus formations and 1.8% haemolytic potentials (Parwanietal.2016). The results of hemolysis assay of chitosan based partially and fully crosslinked polymeric hydrogels showed hemolytic potential (1.82±0.07) and (1.60±0.007) respectively which has been found within the acceptable limit of 5% (Radhakrishnan,Jose, & Kurup,(2015). In another research report, xanthan gum based polymer composites

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showed haemolysis values less than 5%. Different factors such as hydrophilicity, chemical composition, surface topologies and morphologies have been observed for haemolytic potency of the dressing surface (Raafatetal.(2018).

Table 4. Results of thrombogenecity, haemolytic potential, antioxidant activity, mucoadhesion test, and gel strength of hydrogels.

Biocompatibility			
Thrombogenicity	**Weight of blood clot (g)0.197 ± 0.03**	**Thrombose%59.54 ± 4.08**	**InferenceNon-Thrombogenic**
Haemolysis	OD at λ_{max}=540nm	Haemolytic Index (%)	Inference
	1.841 ± 0.020	3.12 ± 0.517	Non-haemolytic
Antioxidant activity			
F-C reagent assay	Weight of hydrogel (g)	Gallic acid equivalent (µg)	Inference
	0.3	27.9 ± 6.25	Antioxidant
DPPH radical scavenging	Time (h)	Scavenging (%)	Inference
	1	13.96 ± 0.48	Antioxidant
	2	15.42 ± 0.63	
	4	17.87 ± 1.70	
	8	32.37 ± 2.45	
	12	49.24 ± 8.57	
Mucoadhesion			
Mucoadhesion	Peak Detachment force F_{max} (N)	Work of adhesion, W_{ad} (Nsec)	Inference
	0.059 ± 0.007	0.337 ± 0.032	Mucoadhesive nature
Swelling and gel strength in different medium			
	pH 2.2 buffer	pH 7.4 buffer	Distilled water
Swelling(g/g of gel)	5.29 ± 0.66	9.68 ± 0.06	7.98 ± 0.42
Gel strength(Nmm)	5.12 ± 0.52	1.27 ± 0.33	2.79 ± 0.24
Swelling and gel strength at different temperatures			
	$27^{O}C$	$37^{O}C$	$47^{O}C$
Swelling(g/g of gel)	5.83 ± 0.96	7.98 ± 0.42	9.69 ± 0.43
Gel strength(Nmm)	5.11 ± 0.12	2.79 ± 0.24	1.12 ± 0.59

3.5. Antioxidant activity

The antioxidant activity in Folin–Ciocalteu (F-C) reagent assay showed antioxidant activity was 27.9±6.25µg gallic acid equivalent for polymer while from DPPH radical scavenging assay, it was 49.24±8.57% scavenging (Table4). Antioxidants scavenge excess free radicals and protect the biological system from oxidative damage. The antioxidant nature of the polymer samples was due to the presence of gum in the polymer matrix. The natural gums were also reported to have antioxidant properties (Nietal., 2019). Tang etal. (Tangetal.(2019)) have prepared alginate/PVA hydrogels and their antioxidant activity was observed 66±7% in DPPH radical scavenging assay. Antioxidant activity was due to the presence of large number of phenolic groups in the polysaccharide (Kaolaoretal.(2019)). Similarly inulin based polymeric hydrogels showed 74% antioxidant potential for DPPH assay (Spizzirrietal.(2011)). Natural polysaccharides have polyphenol with many hydroxyl groups in the structure. Experimental study showed that Azadirachta indica gum has compounds such as polyphenols that easily scavenged free radicals by deprotonation to a free radical in order to remove odd electron, which was responsible for the radical's reactivity (Malviya,Sharma, & Dubey. 2017).Similar enhancement in the antioxidant activity was also reported when other phenolic compounds such as proanthocyanidins were present in the gum polysaccharides (Raschipetal.2020).

3.6. Mucoadhesion studies

The gels mucoadhesion with intestinal mucus membrane showed peak detachment force (F_{max}) and work of adhesion 0.059±0.007N and 0.337±0.032Ns respectively (Table4). Thus hydrogels were mucoadhesive in nature that can improve the residence time of colonic drug carrier in colon (Kumaraswamyand Giri,2019).The use of mucoadhesive drug delivery is advantageous for controlled drug release at a specific site of the body. It has been confirmed that the mucosal membrane drug delivery carrier increase the residence time of the drug delivery device at the site that in turn make site

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specific drug release (Singhand Singh,2019). It has been found that higher extent of the crosslinking in the hydrogels improved mucoadhesion due to increase in forces of attraction between gels and mucosal membranes. On the other hands it has also been observed that in crosslinked polymer mucoadhesiveness was more as compared to individual polymers (Lietal.(2019)).

3.7. Gel strength of the hydrogels

The trends of the gel strength were corresponding to the swelling trends of the polymers but reverse in order i.e. higher swelled polymers with less strength. The reduction in gel strength was observed with increase in pH and temperature. Martín-Illana and coworkers (Martín-Illanaetal.(2019)) synthesized pectin, chitosan and hydroxypropylmethyl cellulose based gels. The results of the gel strength studies showed that the polymers show strength in the range 1.21±0.19 N to 6.48±0.26N used for drug delivery applications. Li and coworkers (Lietal., 2019) showed that higher crosslinking in the polymer enhance the gel strength due to increase in forces of attraction between various constituents present in the gel. They have also inferred that after grafting/crosslinking the gel strength of the backbone enhanced (Table4).

4. Conclusions

The modification of the azadirachta indica gum through graft co-polymerization in the presence of crosslinker has formed the crosslinked polymer network structure which was porous and it was confirmed from the cryo SEM images of the hydrogel. The content of the crosslinker NNMBA and monomer AAm during formation of the gel has influenced the porosity which was inferred from the swelling results of the hydrogel. Moreover, the network parameters like mesh size and crosslinking density was also supported this observation. The methyl prednisolone drug released polymers with non-Fickian diffusion mechanism without burst effect in slow manner and approached Korsmeyer-Peppas kinetic model. The biocompatibility of grafted gum was inferred from results of thrombogenicity (59.54±4.08%) and haemolytic (3.12±0.517%). The antioxidant nature was confirmed from the DPPH assay (49.24±8.57%). Overall, grafting of poly(AAm) onto gum has formed the hydrogels which could be applied in various biomedical applications including drug carrier for the colonic ailments.

Declaration of Competing Interest

There are no conflicts to declare.

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Synthesis and Characterization of Psyllium Polysaccharide–Poly(2-hydroxypropyl methacrylate)–Poly(acrylamide) Hydrogels for Use in Sustained Drug Delivery Applications

Baljit Singh, Suresh Kumar, Rajneesh, Man Mohan & Divya

Polymer Science, Series B **62**, 685–696 (2020)

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Abstract

Psyllium has been explored for various food and pharmaceutical applications. Recently, its therapeutic action against cancer has been reported. Hence, herein in this research it has been modified to develop hydrogels through graft copolymerization reaction for use as sustained drug delivery carriers for anti-cancer drug “5-fluorouracil” (FU) to enhance the therapeutic potential. Synthesis of hydrogels was carried out by grafting of poly(2-hydroxypropyl methacrylate) and poly(acrylamide) onto psyllium in the presence of crosslinker. Polymers were characterized by cryo-SEM, AFM, XRD, ^{13}C-NMR, and TGA techniques, beside evaluation of swelling, drug release, blood compatibility, mucoadhesion, antioxidant properties and gel strength of the hydrogels. The porous network structure with rough surface was observed in cryo-SEM and AFM images of the samples. Release of FU from psy-*cl*-poly(HPMA-co-AAm) polymer occurred with non-Fickian diffusion in sustained manner. These hydrogels were mucoadhesive (work of adhesion = 8.45 ± 0.32 N mm), non-haemolytic (haemolytic index = 1.05 ± 0.07%), and antioxidant (with 19.12 ± 0.14% inhibition in DPPH assay) in nature, therefore they could be used as slow drug delivery carriers for ailments associated GIT system.

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Ethics declarations

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Graft copolymerization of polyvinylpyrollidone onto *Azadirachta indica* gum polysaccharide in the presence of crosslinker to develop hydrogels for drug delivery applications

Baljit Singh, Baldev Singh

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Highlights

- Polysaccharide gels were obtained by graft polymerization technique.
- Gels showed pH responsive swelling and drug release.
- The composition of the PVP in the hydrogel influenced the porosity.
- Drug release occurred by non-Fickian diffusion mechanism and best fitted in Korsmeyer-Peppas kinetic model.
- Hydrogels showed mucoadhesive and non haemolytic behaviour.

Abstract

In this work, *graft*-copolymerization of poly vinylpyrollidone onto *Azadirachta indica* gum polysaccharide in the presence of crosslinker has been carried out to prepare the hydrogel for use in drug delivery. The polymers were characterized by cryo-SEM, AFM, FTIR, and ^{13}C NMR. The gel strength, cross-link density, mesh size, thrombogenicity, antioxidant and mucoadhesion properties of the gum-PVP hydrogels were determined along with the evaluation of drug release profile of methyl prednisolone, a colonic anti-inflammatory agent, from the drug loaded hydrogels. Cryo SEM images showed the porous crosslinked structure of the polymer network. The drug release from the polymer followed non-Fickian diffusion mechanism. The polymers showed 71.47 ± 4.63% haemo-compatibility and 05.52 ± 0.59 Nmm gel strength. The value of DPPH radical scavenging assay (73.16 ± 04.85%) indicated that the gum-PVP polymers are antioxidant. The results of biocompatibility, antioxidant activity, mucoadhesion and drug release properties of the polymers inferred the use of this drug carrier for colonic drug delivery.

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Keywords

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Physico-chemical Characteristics of Amino Acids in Aqueous Solution of Amikacin Sulphate

Authors Authors and affiliations

Poonam Chaudhary, Suvarcha Chauhan, Vivek Sharma, Kuldeep Singh and Ahmad Umar

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Abstract

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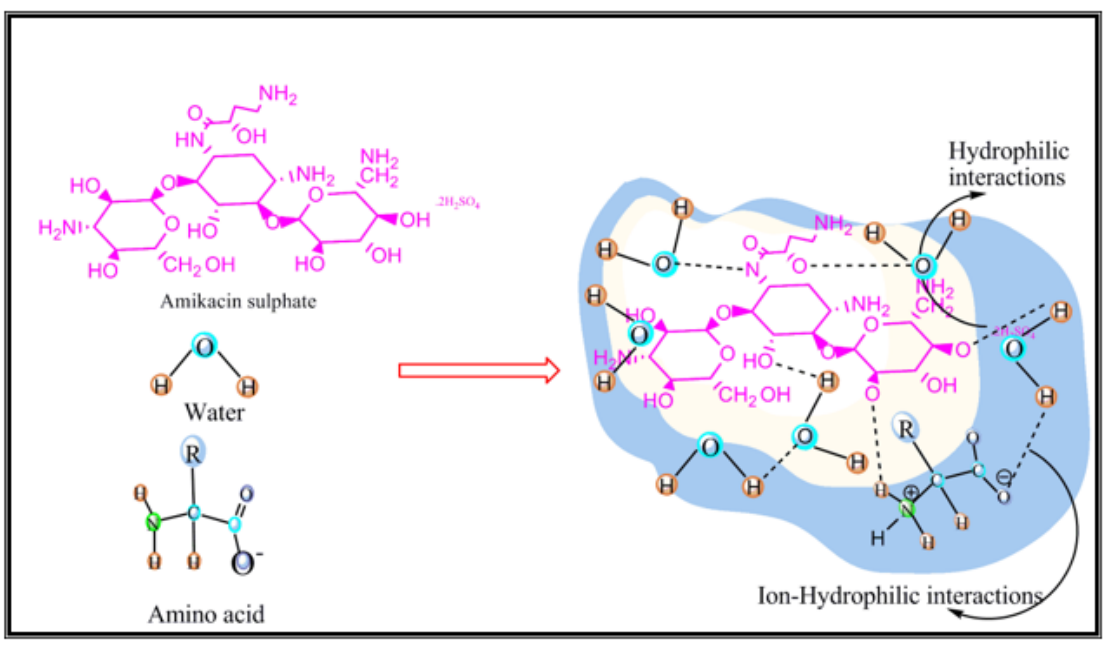
The interactions in aqueous solutions of alanine, arginine, glutamine and histidine (0.02-0.20) mol·kg^{-1} in different concentrations of aqueous drug (0.001, 0.005, and 0.010) mol·kg^{-1} have been studied over temperature range 293.15 to 313.15 K with an interval of 5K by using density, speed of sound and viscosity measurements. The density and speed of sound data have been used to calculate various parameters viz. apparent molar volume, partial molar volume, apparent molar isentropic compressibility, partial molar isentropic compression etc. The density and speed of sound data have been used to calculate various parameters. These interactions have been interpreted in terms of the presence of different kinds of intermolecular interactions in (amikacin sulphate + water + amino acid) system i.e. ion-ion and ion-hydrophilic interactions, dominate over the ion-hydrophobic interactions. Moreover, viscosity data have been analyzed by employing Jones-Dole equation and information on solute-solute and solute-solvent interactions have been extracted. Also, transition state theory has been applied to evaluate thermodynamic activation parameters and more disordered transition state due to rupture and distortion of intermolecular forces in the system have been observed. For the studied ternary systems, the absorption spectra have also been recorded. Moreover, the amino acids act as efficient structure maker in amikacin sulphate solution.



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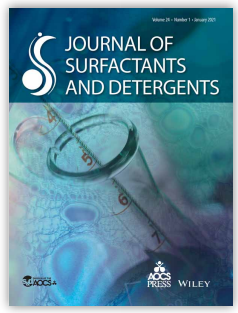

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Original Article

Aggregation and Adsorption Behavior of Cationic Surfactants (Cetyltrimethylammonium Bromide and Dodecyltrimethylammonium Bromide) in Aqueous Solutions of Antibiotic Drug (Amikacin Sulphate) at Different Temperatures

Suvarcha Chauhan, Poonam Chaudhary, Vivek Sharma

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Abstract

Conductivity and spectroscopy techniques have been accomplished to comprehend the mechanism of supramolecular assembly of cetyltrimethylammonium bromide (CTAB) and dodecyltrimethylammonium bromide (DTAB) in aqueous solution of amikacin sulphate (0.001, 0.005, and 0.010 mol kg^{-1}). For CTAB, the normal boost of the CMC value with rise in temperature manifests the significant role of aquaphilic dehydration. However, the aquaphobic dehydrations become prominent with temperature and depict typical U-shaped behavior of CMC for DTAB. The thermodynamic parameters of micellization have been derived from CMC values. The outcomes have been conferred in terms of solvation of hydrophobic part of surfactants by hydrophobic part of amikacin sulphate and micellization becomes more favorable for surfactant with more hydrophobic character in the presence of drug. The alteration in micro-environment of the ternary (drug/surfactant/water) system has been explained in terms of fluorescence emission intensity of surfactant solutions which has been found to decrease by the addition of drug. The obtained absorbance spectrum by varying concentrations of surfactant/drug affords noteworthy information regarding the diverse interactions in studied systems. Moreover, the exhaustive understanding of surfactant micellar behavior have been discussed in consideration of use of surfactants as drug delivery agents and hence to amplify drug bioavailability consequently remodeling its treatment efficacy.

Related | Information

Conflict of Interest

The authors declare that they have no conflict of interest.

Citing Literature

Supporting Information

Filename	Description
jsde12462-sup-0001-supinfo.doc Word document, 165.5 KB	**Table S1:** Conductivity, $\kappa(\mu Scm^{-1})$ of CTAB and DTAB in pure water and aqueous solutions of Amikacin sulphate at different temperatures (K).

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CARBOHYDRATE POLYMER TECHNOLOGIES AND APPLICATIONS (DEC 2021)

Designing moringa gum-sterculia gum-polyacrylamide hydrogel wound dressings for drug delivery applications

Baljit Singh, Vikrant Sharma, Rohit and Ajay Kumar

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Abstract

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Herein this manuscript the potential of moringa gum and sterculia gum polysaccharides has been explored for developing the hydrogel wound dressing for better wound care. The polysaccharide gum and polyacrylamide network structure was formed through grafting and crosslinking polymerization. The cryo-SEM and AFM of the films indicated the porosity in the polymer films and roughness of the polymer surface. The polymers were also characterized by FTIR, and 13C NMR studies. The release of the antibiotic drug levofloxacin from polymer dressings occurred with non-Fickian diffusion mechanism. The blood compatibility, wound fluid absorption, antioxidant activity, mucoadhesion and mechanical properties were evaluated along with O2 and H2O permeability. The drug released fitted in Korsmeyer-Peppas kinetic model. The hydrogel films were permeable to O2 and H2O vapor and impermeable to microbes in open environment and showed high wound fluid absorption, mucoadhesion and antioxidant activity.

Moringa gum Sterculia gum Levofloxacin Wound dressing Drug delivery

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Chemical Physics Letters

Volume 779, 16 September 2021, 138875

Research paper

Gamma radiation formation of sterculia gum-alginate-carbopol hydrogel dressing by grafting method for use in brain drug delivery

Baljit Singh, Ajay Kumar, Rohit

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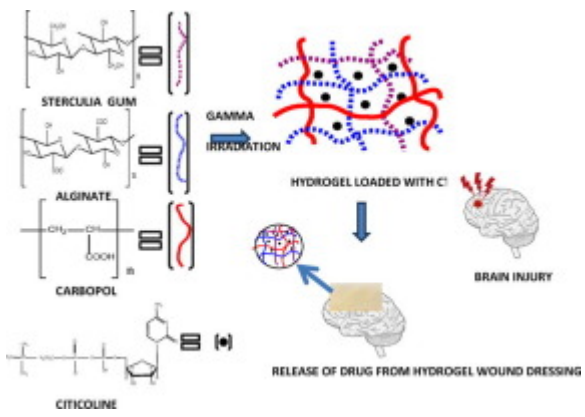
Abstract

As the brain injury causes persistent neurological disorders that lead to the loss of neuron functions. The blood–brain-barrier limits the bioavailability of drugs required in therapeutic level. Hydrogel dressing can provide the localized drug release to the injured brain tissues that can reduce the limitations of the other drug delivery formulations. In the present article, sterculia gum and alginate polysaccharides were explored to form hydrogel dressing by radiation method for use in brain drug delivery. These dressings were characterized by AFM, XRD, FTIR, and ^{13}C NMR. The content of the artificial cerebrospinal fluids absorbed by sterculia-alginate dressing was 19.60±0.35 g. The release of citicoline drug, a nerve regenerative agent, occurred in controlled manner through Fickian mechanism and followed first order kinetic model. The porous dressings were permeable to O_2 and H_2O and were biocompatible and antioxidant. Since the hydrogel dressings were prepared by radiation method so the resultant material was pure and sterile and could be explored for its application in brain drug delivery during brain injury.

Graphical abstract



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Introduction

Brain injury is one of the persistent neurological disorders that lead to the loss of neuron cells, their functions, and interconnections. The repair of injured neurons is very complicated and offers numerous challenges. The low bioavailability of drugs to reach the brain due to the blood–brain-barrier (BBB) require high amount of drugs to patient in order to reach brain more efficiently [1]. Drug delivery localized into brain bypass BBB and increase drug dose to the cells in the brain and avoid systemic side effects [2], [3]. The blend hydrogels can provide localized drug release to the injured spinal cord [4]. Various polysaccharides based hydrogels have been applied in brain drug delivery devices due to their ability to deliver therapeutics directly into the brain and spinal cords [5]. Polysaccharides based hydrogels formed by the radiation method by the grafting of hydrophilic polymers onto

polysaccharide backbone are pure and additive free. The sterilization and synthesis of hydrogels occurred simultaneously and these hydrogels can be used can be used in biomedical applications. The crosslinking density of the polymer network is controlled by varying the irradiation dose [6], [7].

Polysaccharide based gels have been explored for brain drug delivery and nerve regenerative engineering. Alizadeh and coworkers [8] designed biocompatible agarose/alginate/chitosan polysaccharide based hydrogels by cryo-gelation process for the treatment of neural disorder. The slow release of drug dexamethasone was occurred from the cryogels due to supramolecular interactions of drug with various pendant function groups present in the polymer matrix. Inject-able polysaccharide based hydrogels loaded with therapeutic agents have also been applied in brain drug delivery systems for various CNS ailments. The release of drugs occurred from the implant for longer period of time [9]. In a research report, memantine (drug for Alzheimer's disease) was orally administered in a rat model using chitosan based material synthesized by gamma radiation. The drug has been effectively transported to the brain and has improved the behavioral performance [10]. The release of paclitaxel from the tumor responsive tunable dextran polymeric scaffold has been reported to improve survival of rats [11]. The hydrogels protect the brain during traumatic brain injury due to their elastic nature [12]. The porous hydrogels can be used as material for neural tissue culture and can also provide support for growth of scar tissue and axonal growth during brain injury [13], [14], [15]. Chitosan and poly(vinyl alcohol) polymer matrix showed good ability to support cell viability without any significant cytotoxic effects [16].

Sterculia gum is a hydrophilic polysaccharide extracted from stem of *Sterculia urens* and composed of glucuronic, galacturonic, rhamnose and other residues. It has been applied in designing of drug delivery systems and release was occurred in controlled manner [17], [18]. Its therapeutic potential has also been reported for treatment of constipation [19], diarrhea [20], irritable bowel syndrome, and diverticulitis [21], [22]. On the other hand, alginate hydrogels promote axonal re-growth and elongation [23]. Alginate sponges filling in the gap of spinal cord injury has improved the axonal re-growth in the CNS of young adult rats and porous alginates sponges disappear within a few months after implantation [24], [25]. Alginate derived from brown algae and composed of β-D-mannuronic acid and guluronic acid [26]. Alginate-polyacrylamide hydrogels were elastic and were applied for traumatic brain injury and these gels have improved the injury [27].

The present study, an attempt has been made to design the citicoline loaded sterculia–alginate and carbopol hydrogels for use in brain drug delivery system. The citicoline has been applied as therapeutic agent during brain injury for the nerve regeneration and it has also been used other neurodegenerative diseases [28]. Its topical application has improved the functional recovery and has promoted the regeneration of injured nerves in rats [29]

Section snippets

Materials and methods

Sterculia gum [Sigma-Aldrich, Munich, Germany, CAS No. 9000–36-6, molecular weight 9,500,000 (app).], sodium alginate [LobaChemie Pvt. Ltd. (Mumbai, India), CAS No. 9005–38-3, MW 37–196 kDa], carbopol [LobaChemie Pvt. Ltd. (Mumbai, India), CAS No. 9003–01-4, MW 104,400 gm/mole (App], glycerol [S. D. Fine Chemical Ltd., Mumbai India, CAS No. 56–81-5,)] and Citicoline [BiosansLifecare-Kandivali, Mumbai, India] were used for the formation of drug loaded polymers.…

Synthesis of sterculia/alginate-cl-carbopol polymers

The synthesis of sterculia…

Atomic force microscopy (AFM)

The AFM average surface roughness of sterculia/alginate-cl-carbopol hydrogel film was 3.977 nm (Fig. 1). The polymer matrix could be helpful in regeneration of neural tissue. It has been reported that the surface roughness promotes the neural differentiation of human stem cells [45]. In one research report, Deligianni and coworker [46] had also showed that the surface roughness enhances adhesion, proliferation and differentiation of cell on human bone marrow.…

X-ray diffraction study

In case of X-ray spectra of gum…

Conclusions

It is concluded from the above results that composition of the sterculia/alginate-cl-carbopol hydrogel dressing has influenced the crosslinking density and swelling. The one gram of sterculia/alginate-cl-carbopol hydrogel dressing absorbed 19.60±0.35 g artificial cerebrospinal fluids. The citicoline drug release was occurred in slow manner with Fickian mechanism and was best fitted in first order kinetic model. The polymer films were found permeable to O_2 (8.33±0.1 mg/L) and H_2O…

CRediT authorship contribution statement

Baljit Singh: Conceptualization, Supervision, Visualization. **Ajay Kumar:** Investigation, Software. **Rohit:** Methodology, Data curation, Writing – original draft.…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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Tailoring and evaluating poly(vinyl sulfonic acid)-sterculia gum network hydrogel for biomedical applications

2022, Materialia

Citation Excerpt :

...Further, there was no peak observed in the range 130–135 ppm, which demonstrated that the polymerization of vinylic groups of vinyl sulfonic acid occurred i.e conversion of sp2 carbon to sp3 carbon [CH2=CHX to -(-CH2-CHX-)n-] during graft co-polymerization reactions into grafted polymer. Alternatively, in case of SG, peak at 173.58 ppm (due to C = O group of galactouronic acid), 101.54 ppm (due to C-1 of rhamnopyranose rings), 73.08 ppm (due to ring carbons i.e. C-2, C-3, C- 4 and C-5 of galactopyranose ring), 63.25 ppm (due to C-6 of galactopyranose residues), and

peak 21.89 ppm (due to –CH3 of the rhamnose residues) were observed [47]. TGA- DSC of polymers indicated the change in mass and heat flow with rise in temperature during decomposition temperature (DT), respectively (Fig.4)....

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Research article

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International Journal of Biological Macromolecules, Volume 88, 2016, pp. 586-602

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Design of dietary fiber azadiracta indica gum based hydrogels for use in drug delivery

Baljit Singh , Baldev Singh

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Abstract

Keeping in view the therapeutic importance of dietary fiber azadiracta indica gum in anti-inflammatory action, in the present work, gum has been modified to develop the drug delivery carrier for methyl prednisolone used for treatment of inflammatory colonic ailments to enhance its potential. Hydrogels were formed gum polysaccharide by modified by grafting and crosslinking method. Polymers were characterized by cryo-SEM, AFM, FTIR, and ^{13}C-NMR. The cryo-SEM images confirmed the porous network structure of the hydrogels. The results showed that porosity and crosslinking density of hydrogels were influenced by the content of the monomer AAc and crosslinker NNMBA. The polymeric gels were found to have non-haemolytic (haemolytic index=3.36±1.20%), and antioxidant nature (DPPH radical scavenging=76.88±10.16%). The gel strength of the gels was 9.41±0.46Nmm. The release of methyl prednisolone was found with non-Fickian diffusion mechanism. Overall, gum based hydrogels were pH responsive and could be explored to design of colon drug delivery system for colonic ailments .

Previous Next

Keywords

Azadirachta indica gum; Graft copolymerization; Hydrogels; Drug delivery

1. Introduction

The azadirachta indica gum is a hydrophilic natural exudate of a plant *Azadirachta indica* that belongs to galactan gum family. It is a complex hetero-polysaccharide that contains D-glucose, D-glucuronic acid, L-arabinose, xylose, L-fucose and mannose Mukherjee & Srivastava(1955). The rheological properties of azadirachta indica gum showed that the number average molecular weight 6.4×10^5–12.0×10^5 g/mol and results also indicated Newtonian behavior of the gum solutions with intrinsic viscosity 24–36cm^3g^{-1} (Moniem,Hassan, & Osman, 2018). Azadirachta indica gum is commonly known as neem gum which has been well reported for its therapeutic potential including antioxidant, antifungal and anti-inflammatory actions. It has been used in various pharmaceutical applications such as an emulsifier, gelling agent and film forming agent (Moniem,Hassan, & Osman, 2018; Malviya,Sharma, & Dubey, 2017).

Azadirachta indica gum has been used in food and pharmaceutical formulations due to its anti-inflammatory properties (Fujiwara,etal. 1984), antitumor activity (Fujiwara, etal., 1982) and proteolytic activity (Nayak,Rao, & Pattabiraman, 1979). It has also been reported for its food packaging (Ogunjimi, & Alebiowu,2013), and drug delivery (Malviya,Sharma, & Dubey, 2018) applications. The content of the gum has influenced the flow properties of the excipients used in pharmaceutical and food applications (Ogunjimi, & Alebiowu,2013). Neem gum has also showed the proteolytic activity at wide range of pH while tested with casein and albumin substrates and gum solutions hydrolyzed casein (Nayak,Rao, & Pattabiraman, 1979). The grafting polyacrylamide on to gum has improved the release profile of the drug formulations (Malviya,Sharma, & Dubey, 2018). The ospheres of the gum formed by ionotropic gelation while applied in drug delivery has improved the mean

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residence time and relative bio-availability times (Vijayavani, & Vidyavathi,2018). Kulkarni,Yunus, & Dehghan(2013) synthesized azadirachta indica gum based film for controlled delivery of ciprofloxacin drug and it has been found that degradation of the film was not occurred due to sufficient mechanical strength from the coated tablet formulation. At the same time gum film has improved the moisture sensitivity of the drug.

Recently, the designing polysaccharide gum based hydrogels drug delivery carriers have been well explored along with their other biomedical applications (Shimono,Takatori, & Masumi, 2002; Jain,Gupta, & Jain, 2007; Sunetal., 2020). Polysaccharide gums generally have been applied as disintegrant, suspending agents, emulsifying agent and as binders in pharmaceutical industry (Goswami, & Naik,2014). Polysaccharide based hydrogels have been formed by modification through grafting and crosslinking (Mahdavinia,Pourjavadi, Hosseinzadeh & Zohuriaan, 2004). Addition of polyacrylic acid polymers onto polysaccharides through grafting formed pH responsive gels with improved swelling and gel strength (Chaudhuri,Mandal, Dey, & Chakrabarty, 2020). The introduction of crosslinking junctions provides mechanical stability to hydrogels during their large changes in volume (Akhtar,Hanif, & Ranjha, 2015). Some crosslinking agents become part of the final structure, whereas others can be washed out of the polymer matrix after mediating the crosslinking reactions (Duquette, & Dumont,2019). These gels are also used as sponges and bandages for the treatment of wounds (Horietal., 2019; Kumaretal., 2019). The poly(acrylic acid) based polymers are pH responsive and have been used in the colon specific delivery carriers (Li,Wu, Wang, & Duan, 2006). Huang,Yu, & Xiao(2007). have found that pH of the medium has imparted a strong influence on drug release and dissolution rate of the formulations. In the treatment of colonic ailments such as crohn disease and ulcerative colitis, administration of methyl prednisolone (MP) at a large and frequent dose for an extended period is required; therefore the specific drug delivery of MP is desired (Lautenschläger,Schmidt, & Fischer, 2014; Huanbutta,Sangnim, Limmatvapirat, Nunthanid, & Sriamornsak, 2016; Chauhan,Naruka, Rathore, & Badadwal, 2010). The polymers based drug delivery carriers prevent the dissolution of drug in the stomach until reaching the gastro- intestinal tract Friend(2005). The oral route for delivering drugs is the most effective route for colon specific drug delivery applications (Patil, & AMiji,1996). Polysaccharide based gels have capability to be used for colon-targeted drug delivery through the oral administration because of their microbial degradability in colonic environment (Madan,Gundala, Baruah, Nagaraju, & Yates, 2014; Yadav,Sand, Mishra, & Behari, 2010).

In the present work, polysaccharide Azadirachta indica gum and polyacrylic acid based hydrogels were prepared for use as colon drug delivery carrier for the slow and sustained release of a drug methyl prednisolone (MP) for the treatment of colonic ailments. These hydrogels were prepared by graft copolymerization of acrylic acid onto gum in the presence of crosslinker. MP is a synthetic corticosteroid drug mainly used as anti-inflammatory and immunosuppressive agent (Lautenschläger,Schmidt, & Fischer, 2014; Huanbutta,Sangnim, Limmatvapirat, Nunthanid, & Sriamornsak, 2016). It has been used to treat a number of different diseases such as arthritis, inflammatory bowel disease, inflammation, asthma, severe allergies, and adrenal problems.

2. Experimental

2.1. Materials and methods

Azadirachta indica gum polysaccharide [Neoteric DCBA Ideas Gandhipuram, Coimbatore, (Tamil Nadu, India)], Acrylic acid (AAc) [Merck Specialties Pvt. Ltd., Mumbai-India], Ammonium persulfate (APS) [Fischer scientific, Mumbai India], NN-methylenebisacrylamide (NNMBA) [Acros organics-New Jersey USA] and methyl prednisolone (MP) [Neon Laboratory Ltd. Mumbai India] were the materials used in the present research work.

2.2. Synthesis of Azadirachta indica-*cl*-poly(AAc) polymers

The synthesis of polymer matrix was carried out by grafting of acrylic acid onto azadirachta indica gum by chemical copolymerization method in the presence of crosslinker NNMBA. Definite concentration of gum (12% m/v) and monomer AAc (1.75 mol/L) were taken in a reaction system in the presence of definite content of initiator [APS] (2.19×10^{-2} mol/L) and [NNMBA] (0.65×10^{-2} mol/L). Then reaction content was stirred at 110 rpm with an over-head stirrer for 3 h at 25 °C. Thereafter, it was heated at 65 °C for 3 h and after washing with distilled water it was dried to get the product that was named as azadirachta indica-*cl*-poly(AAc) polymers. The polymer matrix was optimized by varying the [AAc] (from 0.58 to 2.91 mol/L) and [NNMBA] (from 0.65×10^{-2} to 7.13×10^{-2} mol/L) during the formation of polymers. The optimum conditions on the basis swelling and mechanical strength were found as azadirachta indica=12%m/v, AAc=1.75 mol/L, APS=2.19×10^{-2} mol/L and NNMBA=0.65×10^{-2} mol/L.

2.2. Characterizations

Cryo-SEM images of swelled and freeze dried polymer in liquid nitrogen at −190 °C were taken on Jeol (JSM 7600) scanning electron microscope (Japan) equipped with Quroum (UK) PP3000 t cryo attachment. AFM of dry polymer film was taken on AFM (NT-MDT, RUSSIA) in contact mode to see the average surface roughness. FTIR of dried powdered samples was taken in KBr pellets on Agilent K8002AA Carry 600 FTIR instrument. The solid state ^{13}C-NMR of dry sample of polymer was carried on BRUKER DSX-300 solid

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state NMR spectrometer.

2.3. Physiochemical and mechanical properties of the hydrogels

Swelling studies of the polymer sample were carried out in different media by method by gravimetric method Singh(2007). Known weight of the hydrogel was taken and immersed in excess of the solvents for different time intervals at 37°C. The hydrogels were then removed, wiped with tissue paper to remove excess of solvent and weighed immediately. Difference in the weight gave the gain in weight at different time intervals. Buffer solutions of pH 2.2 and pH 7.4 were prepared according to the procedure reported in Indian Pharmacopoeia Pharmacopoeia(1985). Buffer solution of pH 2.2 was prepared by taking 50 mL of 0.2 M KCl and 7.8 mL of 0.2N HCl in volumetric flask to make a volume of 200 mL with distilled water. Buffer solution of pH 7.4 was prepared by taking 50 mL of 0.2 M KH_2PO_4 and 39.1 mL of 0.2N NaOH in volumetric flask to make a volume of 200 mL with distilled water.

The loading and release of drug was evaluated from standard curves of the drug methylprednisolone. The methodology of loading and release was same as reported in Singh, & Singh(2017). The calibration curves for the drug methyl prednisolone were prepared in distilled water (λ_{max}=248 nm), pH 2.2 buffer (λ_{max}=248 nm) and pH 7.4 buffer (λ_{max}=249 nm) to determine the content of drug release from drug loaded polymers in different mediums. The hydrogels were allowed to swell in the drug solution of a known concentration (500 µg/ml) for 24 h at 37 °C and then were dried to obtain the drug loaded polymers. The drug loading was carried out in large number of samples by using UV Spectrophotometer at λ_{max}=248 nm and then samples of constant loading were taken for drug release studies. Diffusion of drug was evaluated by using Ritger and Peppas, 1987a, Ritger and Peppas, 1987b power law expression. The best fit kinetic model for the drug release was evaluated from different kinetics models (Shoaib,Tazeen, Merchant, & Yousuf, 2006; Dash,Murthy, Nath, & Chowdhury, 2010).

Network parameters (polymer volume fraction in the swollen state (ϕ), molecular weight between two neighbouring cross-links ($\overline{M_c}$), Flory-Huggins interaction parameter (χ), cross-link density (ρ), and mesh size (ξ) were determined by evaluating the swelling method (Singh, & Singh,2017; Bajpai, & Singh,2006; Aithal,Aminabhavi, & Cassidy, 1990). The $\overline{M}_c$ determined from Flory-Rehner equation (i).

$$\overline{M}\,c = -\mathrm{d_p}\nu_{\mathrm{m},1}\phi^{1/3}\left[\ln(1-\phi)+\phi+\chi\phi^2\right]^{-1} \quad \text{(i)}$$

Here, d_p was density of polymer,$\nu_{m.1}$ was the molar volume of the swelling agent, which is distilled water in present case. From the observed ϕ and $\overline{M}_c$values, the further cross-link density (ρ), and mesh size were calculated using equations (ii-iii).

$$\rho = \frac{dp}{(\overline{Mc})} \quad \text{(ii)}$$

$$\xi = \frac{0.071(\overline{Mc})^{1/2}}{(\phi)^{1/3}} \quad \text{(iii)}$$

Blood compatibility of gels in terms of thrombogenicity and haemolytic potential was evaluated (Labarre,2001; dos Santosetal., 2006; Pinto etal., 2010). The evaluation of thrombus formation on polymeric surfaces was carried out by gravimetric method (Labarre,2001; dos Santosetal., 2006). Polymers of fixed weight [0.3 g] were kept in excess of PBS at 37 °C for 24 h. After that PBS was removed and 2 mL of citrated blood and 0.2 mL of 0.1 M $CaCl_2$ were placed on the surface of each polymer. The clotting process was stopped by adding distilled water (10 mL) after 45 min. Clots were fixed using 36–38% formaldehyde solution, dried and finally weighted. The positive and negative control was taken as glass beaker with absence of sample and glass beaker with absence of sample and blood respectively. The thrombose percentage (%) was calculated as follow (eqn. iv):

$$\textbf{Thrombose}(\%) = \left[\frac{\text{Mass of test sample}-\text{Mass of }(-)\text{control}}{\text{Mass of }(+)\text{control}-\text{Mass of }(-)\text{control}}\right]\times 100 \quad \text{(iv)}$$

In the case of haemolysis polymers of fixed weight (0.3 g) were placed in beaker and PBS was added. After 24 h of incubation at 37 °C, the PBS was removed and 1 mL of citrated blood was added to each sample containing fresh 7 mL PBS and maintained at 37 °C for 3 h. Positive and negative controls were prepared by adding the same amount of citrated blood to 7 mL of water and PBS, respectively. Each tube was gently inverted twice to maintain contact of the blood with the material. After incubation, each fluid was transferred to a suitable tube and centrifuged at 10^4 rpm for 15 min. The hemoglobin released by haemolysis was measured by the optical densities (OD) of the supernatants at λ_{max} 540 nm using a UV–visible spectrophotometer. The percentage of haemolytic index (%) was calculated as follows (eqn. v)

$$\textbf{Haemolytic Index} = \left[\frac{(\text{OD of sample} - \text{OD of negitive control})}{(\text{OD of positive contol} - \text{OD of negitive control})}\right]\times 100 \quad \text{(v)}$$

Mucoadhesion of hydrogels with mucosal membrane of the goat intestine was determined (Hirun,Tantishaiyakul, Sangfai, Ouiyangkul, & Li, 2019). Antioxidant activity of gels was analyzed by DPPH (2,2-diphenyl-1,5-picrylhydrazyl) radical scavenging assay and Folin-Ciocalteu (F-C) reagent assay (Gorczycaetal., 2014; Curcioetal., 2009). Gel strength was measured by using texture

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f the hydrogels was evaluated using an alcohol displacement method (Martinez-Ibarraetal.2019).

3. Results and discussion

3.1. Characterizations

Cryo-SEM images showed the topographic features of Azadirachta indica-*cl*-poly(AAc) hydrogels. In Cryo-SEM images, the three dimensional spherical porous network of hydrogels were observed (Fig. 1). The presence of porous network with high crosslining density can help in controlled and sustained drug delivery from the drug loaded polymers for a longer time period (Mannaetal., 2019). AFM indicated the micromechanical properties of the polymer surface (Fig.2). The three dimensional image of polymer obtained through AFM, showed the presence of some small valleys on the scanned area which indicated structural heterogeneity in the polymeric sample and presence of the roughness on the polymer surface. The root mean square roughness over an area (2×2μm) was found 8.563nm for the polymer and the average surface roughness was found to be 7.183nm (Bahrami,Bailly, & Nysten, 2019).

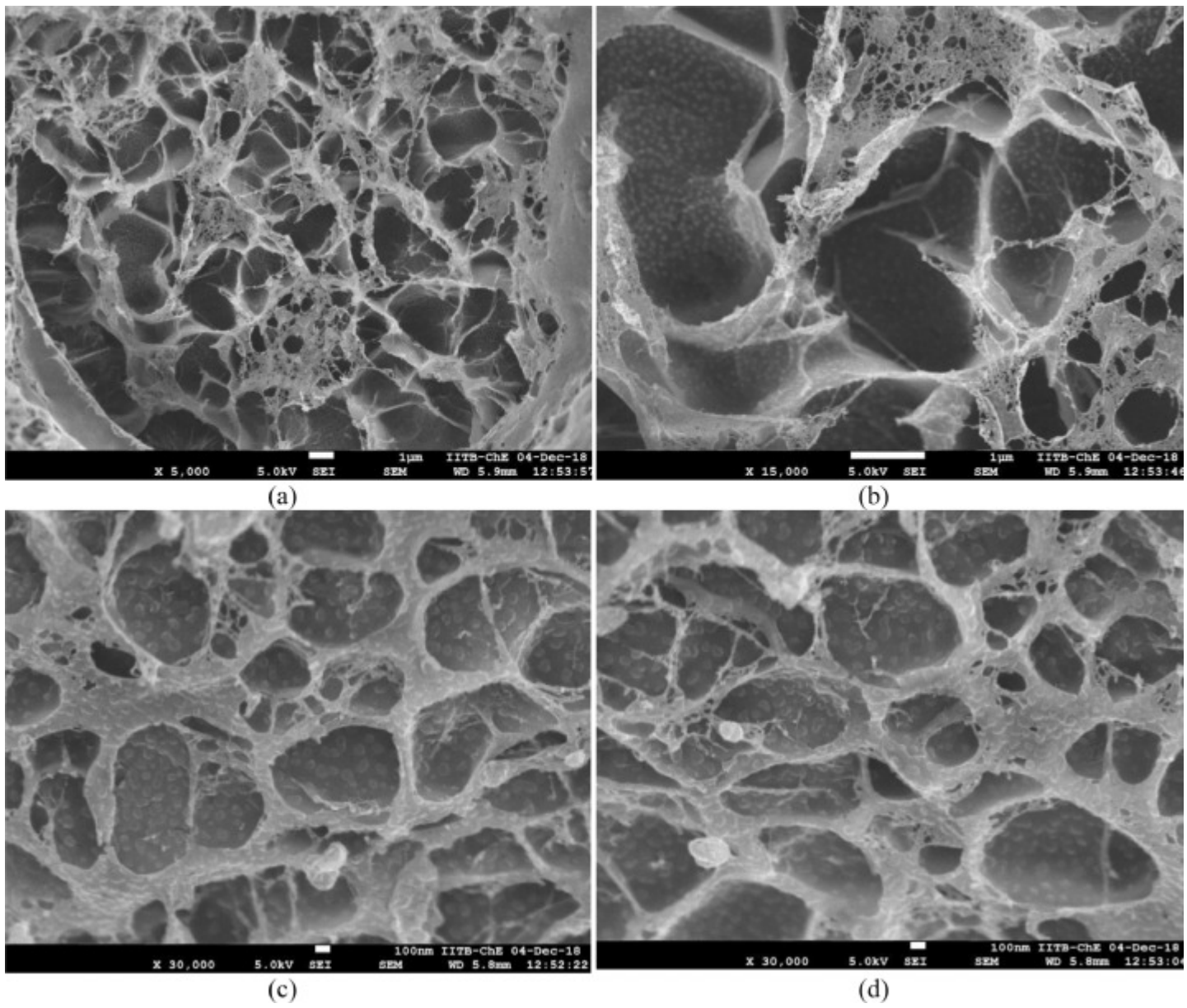

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Fig. 1. Cryo-SEM images of swelled hydrogels at different magnifications ((a) 5000, (b) 15000 and (c, d) 30000) for 1μm.

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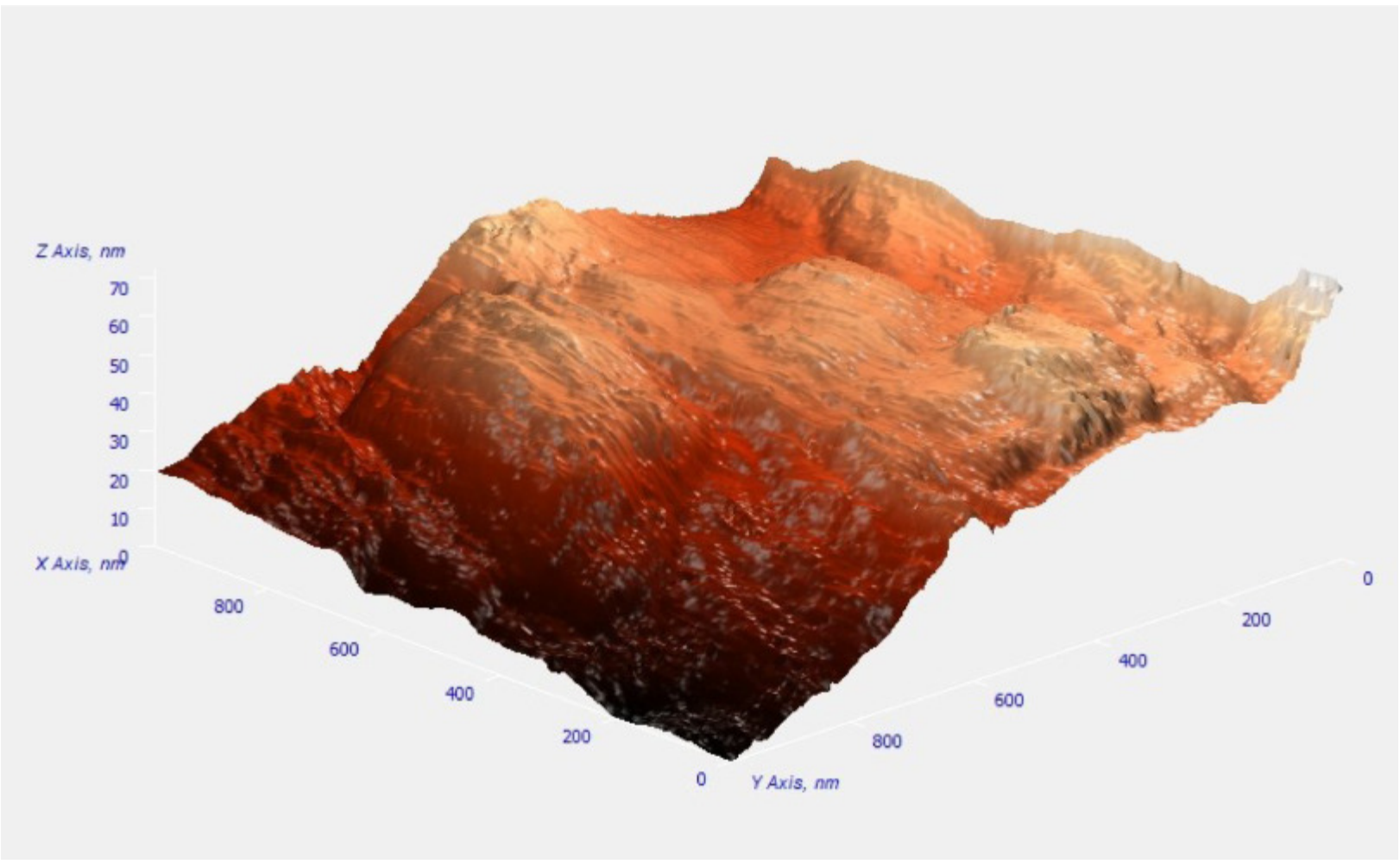

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Fig. 2. AFM image of dry sample of hydrogel in semi-contact mode.

FTIR of gum and Azadirachta indica-*cl*-poly(AAc) polymers are shown in Fig.3. In FTIR of crosslinked polymer showed absorption bands at 3429 cm^{-1} (due to -OH stretching vibrations of the gum polysaccharide and poly(AAc)), 2933 cm^{-1} (due to -C-H stretching vibration mode of CH_2 groups), at 1729 cm^{-1} (due to C=O stretching vibration of carbonyl groups) at 1453 cm^{-1}(due to C-H deformation of methine (CH) groups in the poly(AAc),1408 cm^{-1}(due to C-H deformation of methylene (CH_2) groups in the gum and poly(AAc)), at 1248 cm^{-1} and 1043 cm^{-1} (due to C-O-C asymmetric stretching and bending vibrations (Velusamy,Das, Pachaiappan, Vaseeharan, & Pandian, 2015) Phadke etal. (Phadkeetal., 2015) showed that bands at 1600–1770 cm^{-1} were due to carbonyl (-C=O) stretching of the azadirachta indica gum . It was observed that in the range of 3500–3000 cm^{-1} there is broadening of the bands in the crosslinked polymeric structure as compared to azadirachta indica gum which indicates the crosslinking of the free hydroxyl groups in the polysaccharide gum.

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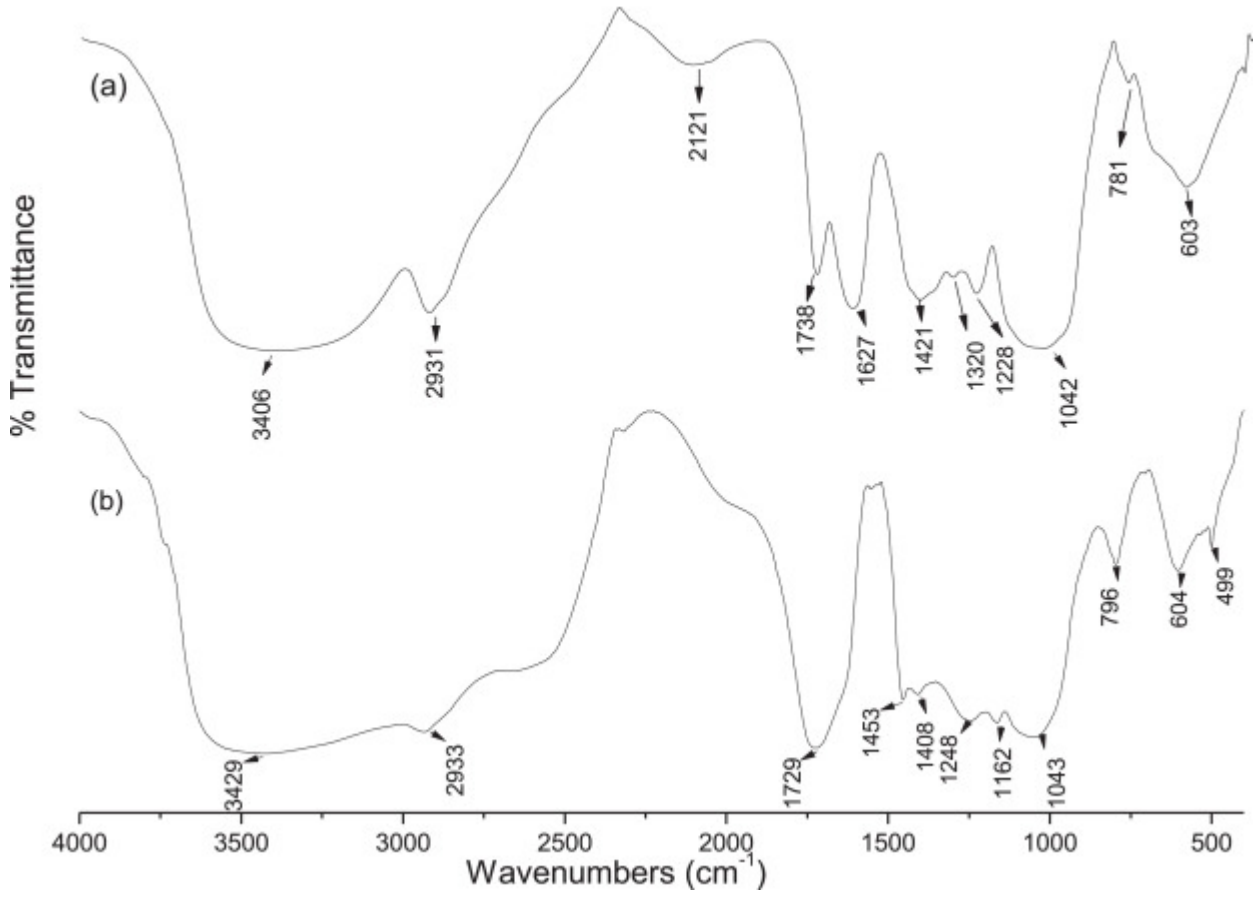

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Fig. 3. FTIR spectra of dry samples of (a) Azadirachta indica and (b) Azadirachta indica-*cl*-poly(AAc) hydrogels.

The ^{13}C-NMR spectra of Azadirachta indica-*cl*-poly(AAc) polymer (Fig.4) showed intense characteristic peaks at 178 ppm (due to carbonyl carbons in gum (glacturonic acid) and poly(AAc)), peaks in the range 111–98 ppm (due to anomeric carbons (C-1) linked α-1-4 and α-1-6 glycosidic linkage in the gum), peak at 79 ppm (due to C-4 in arabinofuranose in the gum), at 72 (due to C-6 in arabinofuranose in the gum), and at 63 ppm (due to C-5 in arabinofuranose in the gum). An intense band 42 ppm (due to methylene group (-**C**H$_2$)) attributed polymerization of AAc to poly(AAc). Peaks at 22 ppm and 18 ppm (due to methyl carbon (**C**H$_3$) of pyranose residues in the gum) were also observed. It has been reported in literature and Fujiwara et al. (Fujiwara et al., 1982) have examined the ^{13}C-NMR spectra of azadirachta indica gum and found that the peaks in the range 111–98 ppm was due to anomeric carbons (C-1) linked α-1-4 and α-1-6 glycosidic linkage in the gum, peak at 85–73 ppm was due to C-4 and C-3 in arabinofuranose in the gum, at 71–60 ppm were due to C-6 and C-5 in arabinofuranose in the azadirachta indica gum. Sarkar,Mandre, Panda, Pal(2013) synthesized amylopectin grafted with poly (acrylic acid) based polymer and it was observed through ^{13}C-NMR spectra that the peak around 180–170 ppm correlated to the carboxyl carbon, which is present in the spectrum of acrylic acid. In the ^{13}C-NMR spectra it was observed that upon functionalization there is an increase in the intensity of the peak at 178 ppm in the polymer due to presence of poly(AAc).

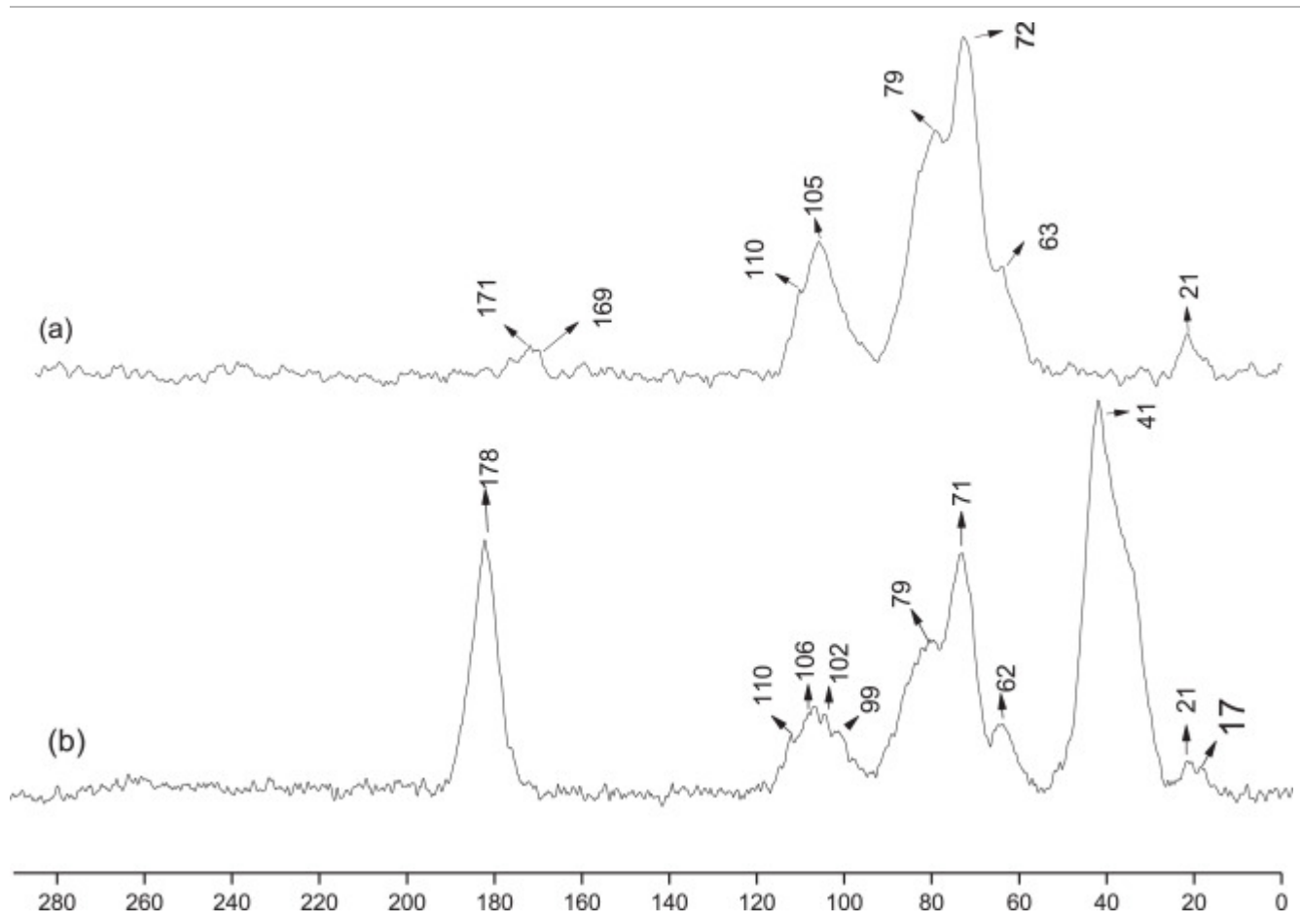

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Fig. 4. ^{13}C-NMR spectra of dry samples of (a) Azadirachta indica and (b) Azadirachta indica-*cl*-poly(AAc) polymers.

3.2. Swelling studies

The effect of varying [AAc], [NNMBA], pH and temperature of medium on the swelling of the hydrogels was described in Fig.5 and Table1. The swelling firstly increased (from 2.79±0.13g/g of gel to 4.78±0.38g/g of gel) with increase in [AAc] from 0.58to1.75mol/L. Further increase of the [AAc] (from 1.75 to 2.91 mol/L) decreased the swelling (from 4.78±0.38g/g of gel to 2.37±0.52g/g of gel) of the hydrogels. The water sorption of the hydrogel was due to formation of the hydrophilic polymeric chains network wherein the higher crosslinking density at higher monomer concentration was responsible for the decrease in swelling Nesrinne, & Djamel(2017). The results of swelling of hydrogels formed with varying [NNMBA] indicated the decrease in swelling (from 6.56±0.28g/g of gel to 3.89±0.20g/g of gel) with increase in [NNMBA] from (0.65×10^{-2} to 7.13×10^{-2}mol/L). This may be due to increases in extent of cross linking with increase in crosslinker during the polymerization process. The results of influence of nature of swelling medium and temperature indicated higher swelling of the polymer matrix at higher pH and temperature. This may be due to ionic repulsion of the constituted ions (-COO^{-}) after partial hydrolysis of the polymer at higher pH values (Risbud, & Bhonde,2000). The enhancement in water uptake by gels with rise in temperature of swelling medium was due to increase in polymer chains mobility. The swelling behaviour of the hydrogel at various pH mainly depends on the ionized pendant carboxylic groups and the electrostatic repulsive forces in the hydrogel. The degree of ionization strongly influences swelling and hydrophilicity of the polymers (Sun,Wang, Jing, & Mohanathas, 2013).

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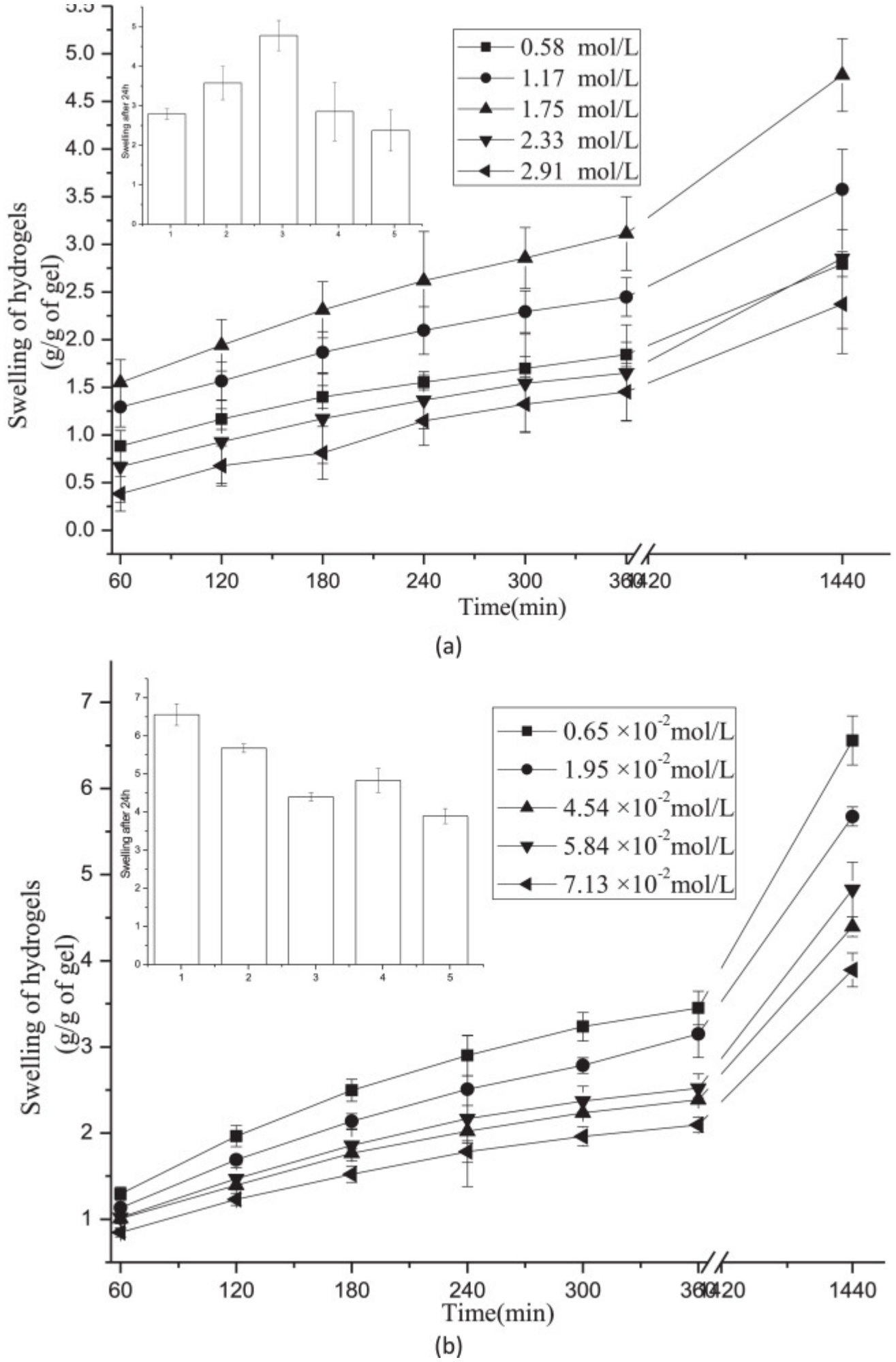

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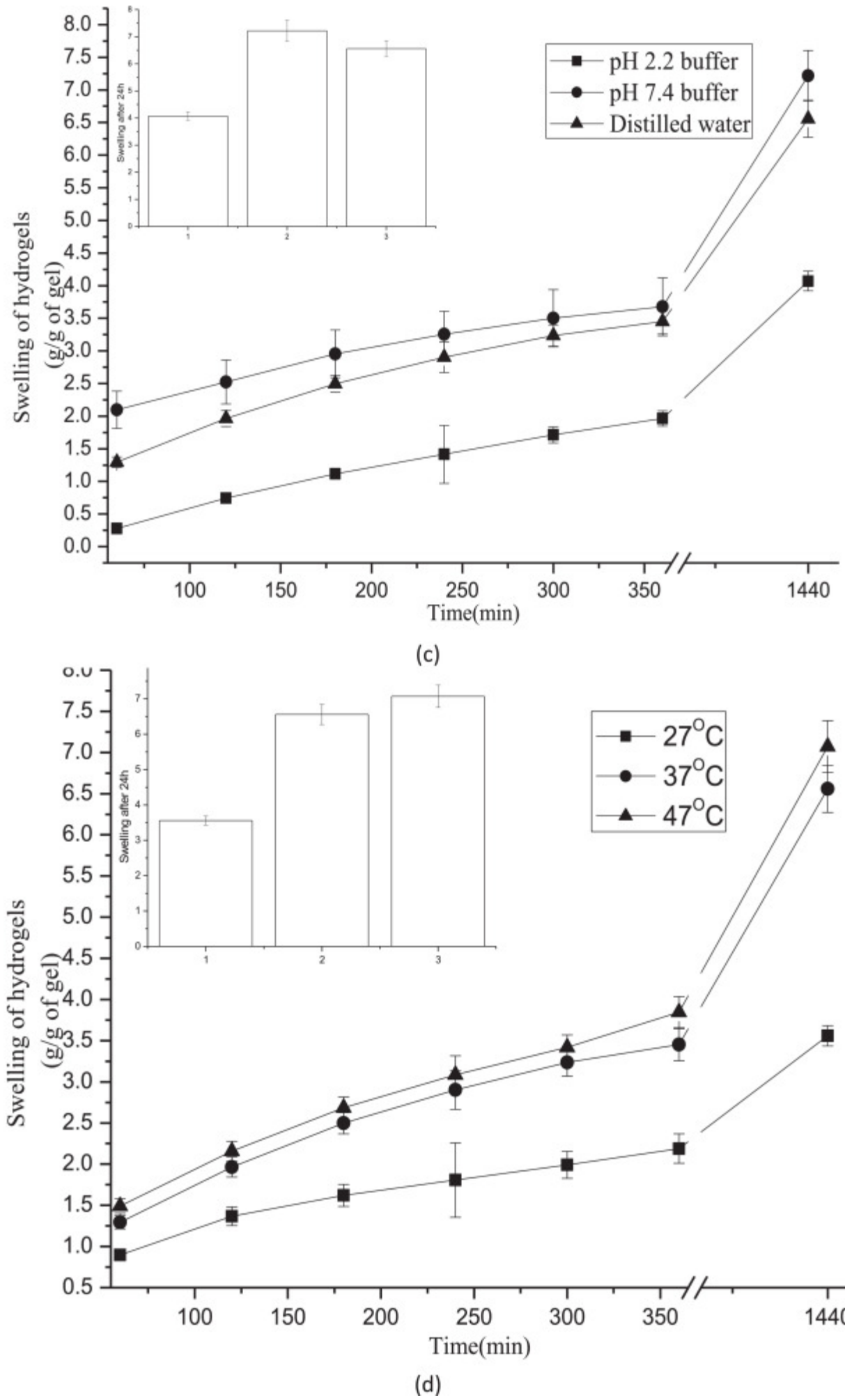

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Fig. 5. Effect of [AAc] (5a), [NNMBA] (5b), pH of swelling medium (5c) and temperature (5d) of swelling medium on swelling of Azadirachta indica-*cl*-poly(AAc) hydrogels.

Table 1. Results of diffusion exponent 'n', gel characteristic constant 'k' and various diffusion coefficients for the swelling kinetics of Azadiracta indica-*cl*-poly(AAc) hydrogels.

S. No.	Parameters	Diffusion exponent 'n'	Gel characteristic constant'k'× 10^1	Diffusion coefficients(cm^2/min)		
				Initial $D_i \times 10^5$	Average $D_A \times 10^3$	Late time $D_L \times 10^5$
Effect of AAc (Mole/L)						
1.	0.58	0.33	0.93	05.11	02.37	14.19
2.	1.17	0.33	0.95	05.93	02.71	17.18
3.	1.75	0.38	0.64	13.14	04.27	28.99

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S. No.	Parameters	Diffusion exponent 'n'	Gel characteristic constant'k'× 10^1	Diffusion coefficients(cm^2/min)		
				Initial $D_i \times 10^5$	Average $D_A \times 10^3$	Late time $D_L \times 10^5$
4.	2.33	0.44	0.42	15.04	03.76	25.90
5.	2.91	0.56	0.21	14.91	03.04	28.52
Effect of NNMBA (Mole/L ×10^2)						
6.	0.65	0.51	0.27	02.47	0.52	03.38
7.	1.95	0.52	0.25	03.28	0.67	06.06
8.	4.54	0.46	0.35	03.04	0.67	04.38
9.	5.84	0.49	0.30	03.11	0.66	04.14
10.	7.13	0.48	0.32	03.19	0.67	04.56
Effect of swelling medium						
11.	pH 2.2 buffer	0.82	0.03	04.38	0.57	04.63
12.	pH 7.4 buffer	0.39	0.05	02.54	0.62	02.80
13.	DW	0.51	0.27	02.47	0.52	03.38
Effect of temperature						
14.	27°C	0.42	0.48	02.54	0.71	04.91
15.	37°C	0.51	0.27	02.47	0.52	03.38
16.	47°C	0.49	0.29	03.82	0.62	03.97

3.3. Determination of network parameters of the hydrogels

The results of network parameters of Azadirachta indica-*cl*-poly(AAc) polymers are given in Table2. The effect of [AAc] on network parameters shows that $\overline{M}_c$ and ξ increased (from 28804g/mol to 87604g/mol and 20.47nm to 31.90nm) firstly and then decreased (from 87604g/mol to 8734.0g/mol and 31.90nm to 10.46nm) with increase in [AAc] (from 0.58 to 2.91mol/L) during the formation of the hydrogels. While crosslink density ρ firstly decreased (from 3.83×10^5 to 0.71×10^5mol/cm^3) and then increased (from 0.71×10^5mol/cm^3 to 13.18×10^5mol/cm^3). These trends of various network parameters were described on the basis of swelling results. It was observed that with increase in swelling of the gels the mesh size ξ increased and vice versa. While opposite trends of crosslinking density ρ was observed. The increase in crsslinker content [NNMBA] during the formation of the hydrogels decreased $\overline{M}_c$ and ξ (from 78528 to 8386.5g/mol and 38.82nm to 10.47nm) respectively. While ρ increased (from 1.24×10^{-5} to 9.63×10^{-5}mol/cm^3). This may be due to increase in crosslinking and decrease in swelling of the hydrogels with increase in [NNMBA]. Both, pH and temperature of the swelling medium influenced the network parameters. The molecular weight between two crosslinks and mesh size was found higher at higher pH and temperature. During network parameter evaluation some irregular trends were observed. This may be due to simultaneous increase in hydrophilicity of the gum-polyacrylic acid gels and increase in crosslinking of the gels with change in monomer concentration. The lower value of crosslink was also reported by Xue,Champ, & Huglin(2001) in case of acrylic acid based hydrogels where small change in value has been observed with change in crosslinker concentration. Overall, it was inferred from these results that monomer and crosslinker content and pH of swelling medium has influenced the mesh size and crosslinking density of the hydrogels.

Table 2. The network parameters of Azadiracta indica-*cl*-poly(AAc) hydrogel as a function of different parameters.

Parameters	Density'd_p' (g/cm^3)	Polymer volumefraction(ϕ)	Slope $\left(\frac{d\phi}{dT}\right)$	Flory-Huggins interaction parameter,(χ)	Mol. wt. between two neighboring crosslinks, $\overline{M}_c$ (g/mol)	Crosslink density,ρ × 10^5(mol/cm^3)	Mesh size,(ξ)(nm)
Effect of AAc (Mole/L)							
0.58	1.104	0.204	-0.0032	0.5707	28804	3.83	20.47
1.17	0.911	0.232	-0.0036	0.5904	51087	1.78	26.10
1.75	0.619	0.286	-0.0036	0.6209	87604	0.71	31.90
2.33	1.021	0.241	-0.0033	0.5905	24609	4.14	17.89

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Parameters	Density'd_p' (g/cm^3)	Polymer volumefraction(ϕ)	Slope $\left(\frac{d\phi}{dT}\right)$	Flory-Huggins interaction parameter,(χ)	Mol. wt. between two neighboring crosslinks, $\overline{M}_c$ (g/mol)	Crosslink density,ρ × 10^5(mol/cm^3)	Mesh size,(ξ)(nm)
2.91	1.152	0.250	-0.0026	0.5827	8734.0	13.18	10.46
Effect of NNMBA (Mole/L×10^2)							
0.65	0.971	0.135	-0.0034	0.5436	78528	1.24	38.82
1.95	0.984	0.151	-0.0030	0.5456	37646	2.61	25.90
4.54	1.022	0.182	-0.0028	0.5547	20421	5.01	17.92
5.84	0.975	0.173	-0.0024	0.5440	14481	6.74	15.33
7.13	0.807	0.239	-0.0027	0.5787	8386.5	9.63	10.47
Effect of swelling medium							
pH 2.2	1.185	0.171	-0.0023	0.5415	16939	6.99	16.65
pH 7.4	0.898	0.133	-0.0037	0.5454	120403	0.75	48.27
DW	0.971	0.135	-0.0034	0.5436	78528	1.24	38.82
Effect of temperature							
27 °C	0.971	0.221	-0.0034	0.5803	25744	3.77	18.83
37 °C	0.971	0.135	-0.0034	0.5436	78528	1.24	38.82
47 °C	0.971	0.126	-0.0034	0.5412	106229	0.91	46.16

3.4. Blood compatibility

The results of the thrombogenicity and haemolytic index value for Azadirachta indica-*cl*-poly(AAc) hydrogels are given in Table4. The thrombose percentage was observed 80.8±4.64% for Azadirachta indica gum hydrogels. These results indicated that these hydrogels can be classified as non-thrombogenic materials and could be explored for forming the colon specific drug delivery systems. The haemolysis value of the material was observed 3.36±1.20% which is less than 5% and the polymer has been considered as safe (according to ISO document 10993-32002) for use in biomedical applications (Guptaetal., 2019).

3.5. Antioxidant activity

The results of the antioxidant activity of the polymers obtained from Folin-Ciocalteu (F-C) reagent assay showed that hydrogels showed antioxidant activity that was equivalent to 24.86±3.83 µg gallic acid hydrogels. The DPPH radical scavenging assay for the hydrogels at different time intervals (12h) showed 76.88±10.16% scavenging for hydrogels (Table4). Antioxidant materials scavenge excess of free radicals and protect the body from oxidative degradation. Polysaccharide based biopolymers were reported highly antioxidant due to presence of various free radical scavengers (Afinjuomoetal.2019). The hydrogels in the present studies were synthesized by using azadirachta indica gum (1.7×10^{-4}mol/L), AAc=1.75mol/L, APS=2.19×10^{-2}mol/L and NNMBA=0.65×10^{-2}mol/L.

3.6. Mucoadhesion

Mucoadhesion results of Azadirachta indica gum based hydrogels with intestinal mucus membrane in terms of peak detachment force (*Fmax*) and work of adhesion given in Table4. The F_{max} and work of adhesion values were 0.105±0.025 N, and 0.567±0.417 Nsec, respectively. Hydrogels were found to be mucoadhesive in nature. Bioadhesion in the drug delivery carrier has improved the performance of the drug delivery system by extending the mean residence time of colon (Reddy,Holbrook, Gizurarson, & Kristmundsdottir, 2019). It is also advantageous for site specific drug delivery. It is found that the mucosa can rise the residence time of the drug delivery device at the site of captivation in the body which in turn results in the sustained action of the nonspecific drugs to the target sites (Liangetal., 2019). Duanetal.(2016) have designed the chitosan- alginate based mucoadhesive hydrogels for colonic drug delivery for the treatment of inflamed colon.

3.7. Mechanical strength

Effect of [AAc] on gel strength was determined and gel strength of hydrogels first decreased (from 19.08±2.14Nmm to 11.31±1.61Nmm) then increased (from 11.31±1.61Nmm to 19.19±2.46Nmm) with increase in [AAc] . On the other hand, with increase in crosslinker content the mechanical strength of the hydrogels enhanced (from 09.41±0.46Nmm to 27.61±1.03Nmm) e mechanical strength of the gel decreased at higher pH and temperature of the medium due to higher swelling

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of the hydrogels (Table4). As swelling increased gel strength decreased and vice versa. The higher swelling causes loosening of the polymeric network, that results in decrease in gel strength of the polymer matrix (Kumarasamy, & Giri,2019). It has been found that crosslinking in polysaccharide has improved the stability and mechanical strength of the hydrogels. The drug released of longer period from the hydrogel formulation for longer time and polymer matrix did not release drug immediately during their journey to colon (Das, & Subuddhi,2013).

The nature of the monomer also influenced the physiochemical and mechanical properties of the hydrogels. The gel strength was found higher (9.41±0.46Nmm) in Azadirachta indica -poly(AAc) based hydrogels as compared to Azadirachta indica - poly(AAm) based hydrogels (2.79±0.24Nmm). The grafted and crosslinked product formed by the grafting of polyacrylic acid onto Azadirachta indica gum showed higher free radical scavenging ability as compared to the grafted product formed by the polyacrylamide. In acrylamide based hydrogels it has been observed 49.24±8.57%, while DPPH radical scavenging ability of Azadirachta indica -poly(AAc) hydrogels was found to be 76.88±10.16% (Singh,Mohan, & Singh, 2020).

3.8. Porosity

Porosity measurement helps in studying internal pore morphology which in turn determines the drug absorption and drug release properties of the hydrogel matrix. For Azadirachta indica-*cl*-poly(AAc) hydrogel matrix showed values of porosity 5.93%. Polymers with smaller pore sizes can holds drug molecules for longer period of time, making Azadirachta indica-*cl*-poly(AAc) a suitable candidate for drug delivery applications. Siangsanoh,Ummartyotin, Sathirakul, Rojanapanthu, & Treesuppharat(2018) observed that porosity of the hydrogels largely affects the drug release patterns from the drug loaded hydrogels. It helps in release of drug in controlled manner for a longer period of time. Saraydın,Karadag, Işıkver, Şahiner, & Güven(2004) observed that concentration of crosslinker influenced the swelling behaviour of the polymeric hydrogels due to change in the porosity of the of the hydrogel network. The increase in concentrations of the cross linkers leads to decrease in the swelling of the polymeric hydrogels due to increase in extent of cross linking and decrease in the porosity of the hydrogel. The stability of the hydrogels is an important characteristic of ideal biomedical materials. The low stability of the hydrogels limit their use in biomedical applications including drug delivery and appropriate stability aids in controlled and sustained drug delivery (Huang etal., 2011).

3.9. Drug loading and release studies

The release profile of methyl prednisolone from the drug loaded Azadirachta indica-*cl*-poly(AAc) polymers was determined in pH 2.2 buffer, distilled water and pH 7.4 buffer solutions (Fig.6 and Table3). The release of drug from the drug containing polymer was found more in pH 7.4 buffer (61.36±7.53%) as compared to the pH 2.2 buffer (22.01±1.31%). These results were inferred from the higher swelling abilities of the polymer matrix in pH 7.4 buffers as compared to other mediums. The higher swelling was due to increase in mesh size due to ionic repulsion of the ions formed in the polymer matrix in pH 7.4 buffer solution (Baietal., 2018). This led to release of higher drug content from the polymer matrix into the solutions. Similar observation has been made by Sun etal. (Sun,Wang, Jing, & Mohanathas, 2013) in case of hemicelluloses and polyacrylic acid based drug delivery system. Seeli, & Prabaharan(2017) designed gum grafted polymethacrylic acid based colon specific drug delivery system for ibuprofen. The higher degree of drug release was found in intestinal pH medium. The several drugs loaded hydrogels were prepared and for each release medium hydrogels of constant loading were taken. The drug loading of methyl prednisolone into polymeric hydrogels was observed 65.02±4.11%. The porous nature of the polymer allowed slow release of drug from the drug delivery carrier due the presence of various supra-molecular interactions that was also responsible for holding drug molecules in the matrix.

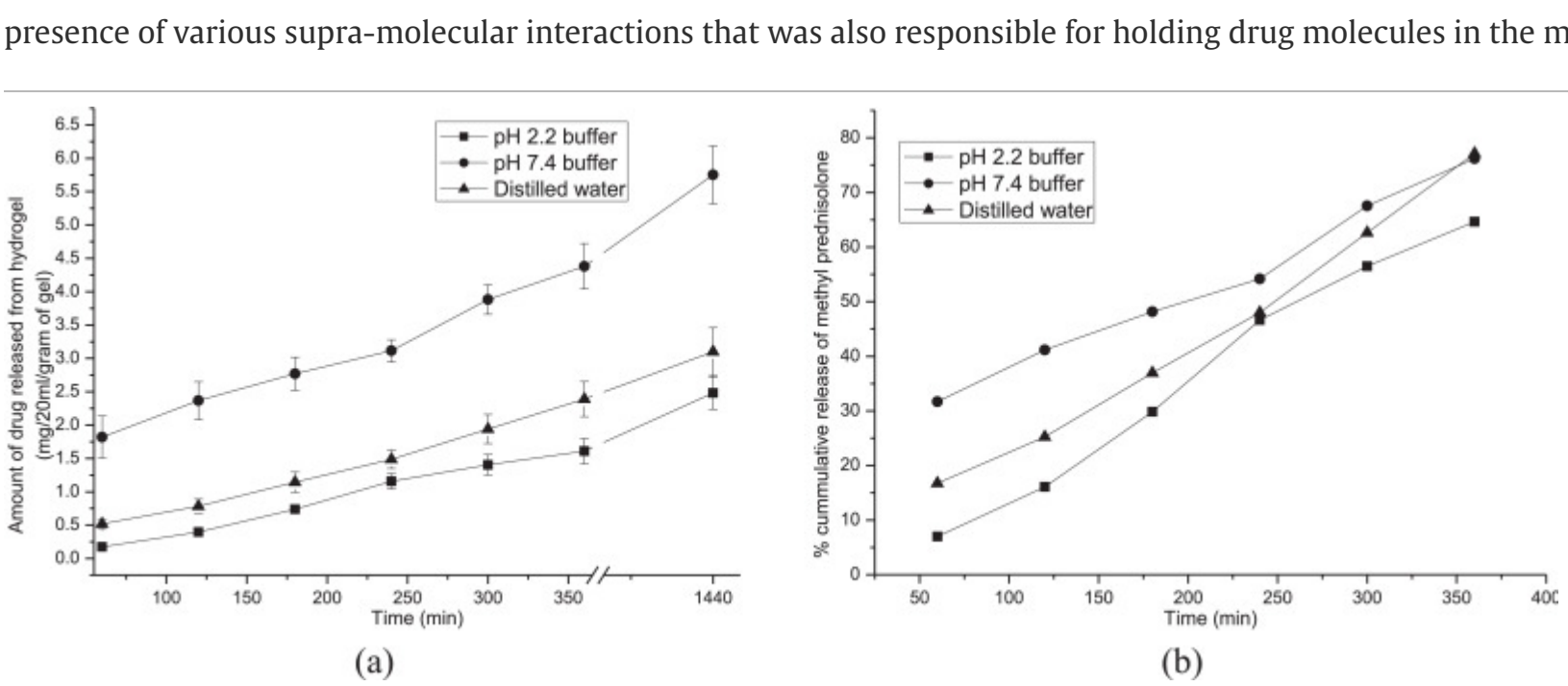

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Fig. 6. Release profile of drug (6a) and cumulative release of drug (6b) from Azadirachta indica-*cl*-poly(AAc) hydrogels.

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Table 3. Results of diffusion exponent 'n', gel characteristic constant 'k', various diffusion coefficients, release kinetic parameters and correlation coefficients of different models for release profile of drugs from Azadiracta indica-*cl*-poly(AAc) hydrogels.

		pH 2.2 buffer	pH 7.4 buffer	Distilled water
Diffusion exponent 'n'		0.95	0.63	0.86
Gel Characteristic constant 'k'×10^2		0.24	1.86	0.46
Initial release rate, r_o (mgL^{-1})		1.99	1.03	3.11
Diffusion coefficients (cm^2/min)	**Initial D_i×10^5**	9.20	8.73	9.31
	Average D_A×10^5	03.64	13.54	04.21
	Late time D_L×10^5	05.38	10.62	07.02
Zero order	R^2	0.9857	0.9854	0.9795
	K_o (min^{-1})	0.9432	1.2509	1.0195
First order	R^2	0.9836	0.9355	0.9121
	K_1 (min^{-1})	1.2105	0.9042	1.2197
Higuchi	R^2	0.9735	0.9506	0.9435
	K_H ($min^{-1/2}$)	0.6746	0.9875	0.7374
Korsmeyer-Peppas	R^2	0.9916	0.9860	0.9769
	K_{KP}×10(min^{-n})	0.0003	0.0427	0.0046
Hixon-Crowell	R^2	0.9881	0.9577	0.9467
	K_{HC} ($min^{-1/3}$)	2.8440	2.5741	2.8098

Table 4. Results of thrombogenicity, haemolytic potential, antioxidant activity, mucoadhesion test, swelling studies and gel strength of Azadiracta indica-*cl*-poly(AAc) hydrogels.

Biocompatibility study			
Thrombogenicity	Weight of blood clot (g)0.261±0.023	Thrombose %80.8±4.64	InferenceNon-Thrombogenic
Haemolysis	OD at λ_{max}= 540 nm1.8482±0.039	Haemolytic Index (%)3.36±1.20	InferenceNon-haemolytic
Antioxidant activity			
F-C reagent assay	Weight of hydrogel (g)0.3	Gallic acid equivalent (µg)24.86±3.83	InferenceAntioxidant
DPPH radical scavenging	Time (h)124812	Scavenging (%)16.82±02.3534.35±02.2262.73±07.0176.68±07.2776.88±10.16	InferenceAntioxidant
Mucoadhesion study			
Mucoadhesion	Peak Detachment force F_{max} (N)0.105±0.025	Work of adhesion,W_{ad} (Nsec)0.567±0.417	InferenceMucoadhesive nature
Swelling and gel strength in different medium			
	pH 2.2 buffer	pH 7.4 buffer	Distilled water
Swelling(g/g of gel)	04.07±0.15	07.22±0.39	06.56±0.28
Gel strength(Nmm)	16.40±2.21	07.06±0.49	09.41±0.46
Swelling and gel strength at different temperatures			
	27^OC	37^OC	47^OC
Swelling(g/g of gel)	03.56±0.12	06.56±0.28	07.07±0.31
Gel strength(Nmm)	17.74±1.53	09.41±0.46	07.42±0.80

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ertinent to mention here that there exist different intermolecular interactions, like electrostatic, dipole-dipole

interaction and hydrogen bonds, between dug and polyacrylic acid /polysaccharides which are also responsible for make it suitable candidate for pharmaceutical preparations particularly in slow the drug delivery systems (Huang,Yu, & Xiao, 2007). The values of diffusion exponent (n) indicated non-Fickian diffusion mechanism for methyl prednisolone release from the polymer matrix solutions and release profile of the methyl prednisolone from polymer matrix was best fitted Korsmeyer-Peppas model.

Wangetal.(2016) synthesized chitosan-based colon targeted drug delivery device for the treatment of inflammatory bowel disease. The results of the study showed that polymer released a high amount of 65.6% drug in stimulated colonic fluid as compared to gastric fluid with enhanced bioavailability of the drug in the colon makes it suitable for colon drug delivery applications. Similar observations have been made by Youetal.(2015) for the cumulative release of drug from xanthan gum based hydrogel prepared for colonic drug delivery applications. The results of the study showed that 70 % drug release occurred within 4h.

Keeping in view the variety of pH within the digestive system, in the present work release profile of the drug MP was carried out in pH 2.2 and 7.4 buffer. In general, pH in the stomach acidic in nature, ranges from 1.5 to 3.5 and increases to 5.5–6.8 in the small intestine. The pH is 6.4 in the ascending colon, rises in the transverse colon, and approaches neutrality (pH 7.0) in the descending colon Scheline(1973). Fig.6 a indicated the release profile of drug and Fig.6b showed cumulative release of drug from Azadirachta indica-*cl*-poly(AAc) hydrogels. The material prepared from the gum-polyacrylic acid based hydrogel was explored for its potential for drug delivery applications to treat inflammatory colonic diseases after release of methyl prednisolone drug from the loaded hydrogels. The poly(acrylic acid) based polymers have been reported as pH responsive and have been used in the colon specific delivery carriers (Li,Wu, Wang, & Duan, 2006). The swelling and release of drug in this medium was carried out to find the pH responsive nature of the hydrogels. The higher swelling at pH 7.4 was found due to ionic repulsions of the ions formed at higher pH solution that indicated the pH responsive behavior of the materials.

The drug delivery carrier based on gum polysaccharide will degrade in the GIT. Polysaccharide metabolism has a great importance in the large intestine due to presence of vast majority of saccharolytic microorganisms in the gastrointestinal tract. On the basis of substrate available, chemical structures and compositions as well as the biochemical characteristics and catabolite regulatory mechanisms different bacterial species participate in degradation of the polymer matrix which including hydrolysis, depolymerization and fermentation of the substrates (Macfarlane & Macfarlane,1997). This leads to release of entrapped drug molecules from the polymer matrix. The gum polysaccharide-based drug delivery carriers are generally degraded to smaller absorbable molecules. At the same time, it is important to make sure that the monomers are non-toxic in nature. In the present case the polymer matrix is gum-polyacrylic acid which is known to be biodegradable, biocompatible and non-toxic. Drug delivery carrier for colon drug delivery system firstly, need to be remained intact when traveling through the upper GI tract in order to protect the incorporated drugs from chemical and enzymatic degradation. Secondly, they should be able to release the incorporated drugs upon reaching the colon segment of the lower gastrointestinal tract. Furthermore, the released drugs need to be absorbed at an efficient rate in the gastrointestinal tract in order to be therapeutically effective (Sinha & Kumria,2001).

4. Conclusions

It is concluded from the above results that porosity and crosslinking density of Azadirachta indica-*cl*-poly(AAc) hydrogels were influenced by the content of the monomer AAc and crosslinker NNMBA. This observation was also inferred from the swelling trends of the hydrogels. The release of methyl prednisolone was found with non-Fickian diffusion mechanism and release was best fitted with Korsmeyer-Peppas model. The polymeric gels were found to have non-haemolytic (haemolytic index=3.36±1.20%), and antioxidant nature (DPPH radical scavenging=76.88±10.16%). The gel strength of the gels after swelling was 9.41±0.46Nmm. Azadirachta indica gum based hydrogels were pH responsive and could be explored to design effective colon specific drug delivery. Overall, the slow release of methyl prednisolone from the neem gum based hydrogels will reduce the side effects of the conventional formulation and enhance the therapeutic potential of the drug for methyl prednisolone for colonic inflammatory ailments.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Research Article

Design of Cellulose Derivative and Alginate Based Smart Polymers to Develop Stomach Specific Floating Drug Delivery System

Author(s): Vikrant Sharma* and Jogindera Devi

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Abstract

Background: Polysaccharide based gastro-retentive drug delivery systems (GRDDSs) can retain in the gastric fluid of stomach for a longer time and release the entrapped drug in a controlled and localized manner, which can ensure optimal drug concentration at the site of action with improved bioavailability and reduced side effects of acid-suppressive drugs like ranitidine.

Objective: The objective of the present study was to design smart polymers for gastro-retentive drug delivery of ranitidine through ionic-gelation of carboxymethyl cellulose (CMC) and sodium alginate (ALG).

Methods: The optimal reaction conditions for the synthesis of beads were evaluated by varying reaction parameters during synthesis and were obtained as CMC = 1.5% (w/v), ALG = 0.5% (w/v) and CaCl2= 0.1 M with maximum equilibrium swelling ratio (2922.50 ± 0.90)%. The drug loading was carried out by simultaneous and swelling equilibrium methods. Beads were characterized by SEM, PXRD, FTIR, TGA, bead size and swelling studies.

Results: Increase in Ca2+ ions and ALG concentration resulted in a decrease in swelling capacity and an increase in bead size. Beads got collapsed in phosphate buffer solution and swelling occurred through the non-Fickian diffusion mechanism. Floating beads with (51.05 ± 0.25)% entrapment efficiency for the simultaneous drug loading method exhibited the Fickian diffusion mechanism and best fitted in the Higuchi model. The diffusion coefficient and initial rate of drug release in simulated gastric fluid demonstrated swelling controlled gastro-retentive release of ranitidine.

Conclusion: These smart polymeric beads have the potential to use as a promising candidate for the design of GRDDSs for the treatment of gastric ulceration and gastro-oesophageal reflux disease.

Keywords: Fickian diffusion, floating beads, ranitidine, smart polymers, stomach specific drug delivery, GRDDSs.

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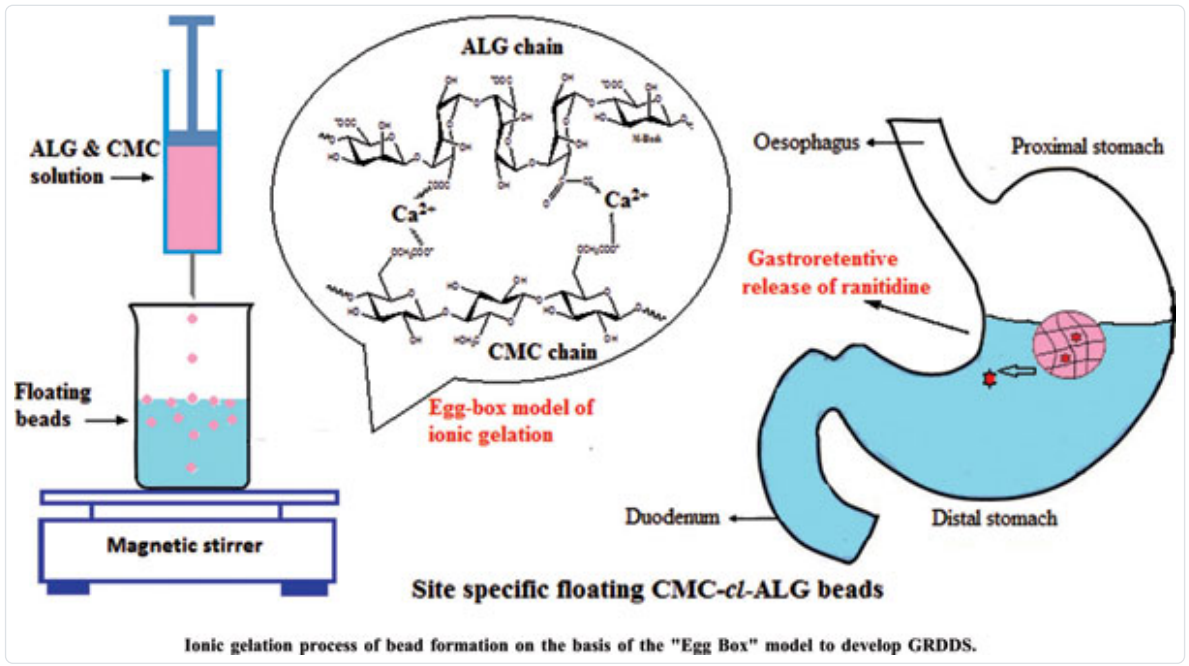

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Journal of Molecular Liquids

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Effect of Choline-based ionic liquid (Cholinium ethanoate) on volumetric and acoustic properties of aliphatic amino acids (glycine and L-alanine) at T = (288.15, 298.15, 308.15 and, 318.15) K

Harpreet Kaur [a], Ramesh C. Thakur [b], Vivek Singh Pathania [c], Shrutila Sharma [c]

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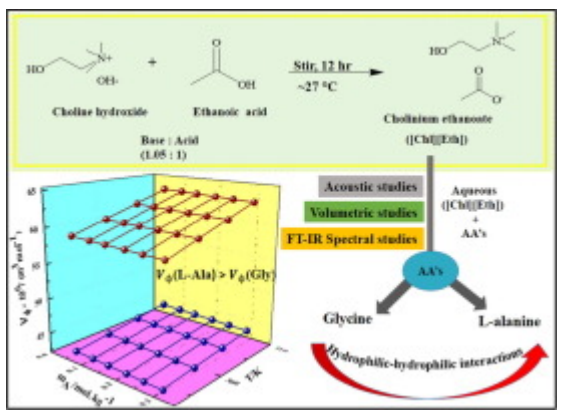
Abstract

In the present work, choline based ionic liquid, Cholinium ethanoate ([Chl][Eth]) has been synthesized and various thermophysical parameters for glycine and L-alanine in synthesized choline based IL have been calculated from density (ρ) and speed of sound (u) values at different concentrations and temperatures (288.15–318.15) K by keeping an interval of 10K. Hepler constant is used to predict the structure maker/breaker behavior of solute in aqueous IL. The interaction coefficients have also been determined using the transfer volumes. To validate the results obtained from thermodynamic parameters, FT-IR spectroscopy has been carried out. The theoretical and experimental results were used to deduce the interactions present in the present ternary systems and effect of temperature and alkyl chain length on the measured parameters has also been discussed.

Graphical abstract

Interactions between aliphatic amino acids (Glycine and L-alanine) with IL (Cholinium ethanoate).



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Introduction

Ionic liquids are grasping the attention of researchers from last few decades as they are proved to be promising substitutes of the customary solvents and have excellent properties such as thermal stability and low vapor pressure but in many studies few of the solvents of this class have been proved toxic, carrying antimicrobial influence on the environment along with the adverse effects on the flora and fauna [1], [2]. Therefore, the claim that ILs are green solvents should be carefully evaluated and considered from an environmental perspective. Ionic liquids having well-recognized imidazolium, pyridinium to phosphonium, pyrrolidium, ammonium, cholinium and, sulphonium cation with a variety of anions have ample applications in catalysis, electrochemistry, carbohydrate chemistry, enhance oil recovery, drug delivery, surface-active agents as well as in pharmaceutical, biomedical and

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cosmetic industry [3], [4], [5], [6], [7], [8]. Ionic liquids are organic molecules with large cations and small anions having the significant feature of tailoring their properties by varying the anion [9]. Ionic liquids possess chemical stability, low melting point, high ionic conductivity, solubility, negligible volatility, flame retardacy, moderate viscosity, and high polarity. Looking at their remarkable properties it is not irrational to label ionic liquids as 'Solvents of future' [10], [11], [12]. Ionic liquids undergo intermolecular interactions with polar substances including biomolecules, solubilizes them as the former hold mutual electrostatic interaction as well as repulsion of charged moieties that assist in solubilization. Though ionic liquids are potential candidates in various fields but recent toxicological studies show that not all ionic liquids are non-toxic and biodegradable [13], [14]. Usually, ionic liquids with halogen as anion are toxic and are harmful to biological systems and our environment. Hence, biocompatible ionic liquids that have ions derived from natural products must be used instead of recklessly used toxic ionic liquids. Choline cation based ionic liquids have been found notably biodegradable and environmentally benign. Choline is a quaternary ammonium salt and is generally associated with counter ions (hydroxide, chloride, and tartrate). In 1998, the National Academy of Sciences (NAS) enlisted choline in the list of human vitamins as a nutrient (vitamin B). Rogers Sheldon E-Factor for Choline chloride approaches zero as waste products are not produced during its synthesis [15]. Choline acts as a precursor molecule for acetylcholine that is a neurotransmitter that aids in muscle control. Choline cation is present in two classes of phospholipids namely phosphatidylcholine and sphingomyelin that are existent in cell membranes. Because of their miscibility with organic solvents/water and designability choline based ionic liquids are used in organic synthesis, organic reactions, deep eutectic solvents (DES), biomass conversion, and anti-cancer agents. Currently, Choline-based ionic liquids are used in new drug delivery systems [16], [17], [18]. The Cholinium cation can be combined with alkanoate anions to form novel choline based ionic liquids [19]. Cholinium based ionic liquids intensify the structural stability and biological activity of proteins [20], [21]. Since proteins have complex structures, therefore amino acids referred to as building blocks of proteins are studied intensively for understanding the denaturation of proteins, their hydration, and aggregation. Understanding of the interactions among ILs and amino acids will assist in optimizing pharmaceutical procedures besides operations in bio-tech industries where ILs are known to be consumed as solvents [22], [23]. Thermodynamics along with supplementary microscopic studies of amino acids with choline based ILs can convey indispensable information about the interactions present between various constituents in a ternary mixture [24], [25]. Considering this, the present study is an attempt to analyze various thermodynamic and acoustic parameters which have been carried out for glycine and L-alanine in aqueous Cholinium ethanoate [Chl][Eth] [m_{IL} = (0.01, 0.03 and 0.05) mol.kg^{-1}] at atmospheric pressure and varying the temperatures. Various parameters like partial and apparent volumes, transfer volumes, interaction coefficients (pair and triplet) have been used to explain the various interactions present and consequence of alkyl chain length of amino acids on the solvation behavior. Further, the inferences made by thermodynamic studies have also been confirmed using FTIR spectroscopy.

Section snippets

Chemicals

Specifications of all the chemicals used in carrying out the experimental work are mentioned in Table 1. Prior to use, Glycine and L-alanine were dried in a vacuum and also stored over P_2O_5 in a vacuum desiccator for 2 days. The ionic liquid [Chl][Eth] was synthesized in the laboratory from ethanoic acid (mass fraction purity≥0.99) and choline hydroxide (with purity of 46 wt% in H_2O) are purchased from Sigma Aldrich. All the procured chemicals are used as such without any further purification.…

Results and discussion

In this work, the densities (ρ) of amino acids (glycine and L-alanine) have been measured in m_{IL} = (0.01, 0.03 and 0.05) mol.kg^{-1} of aqueous [Chl][Eth] at concentrations of amino acids ranging from (0.05 to 0.30) mol.kg^{-1} and experimental temperatures (T=288.15 K–318.15 K) with interval of 10 K. The experimental density values of the system studied have been listed in Table 2. The data of density of other choline based ionic liquids (choline alkanoates) is provided in Table 2 [26]. As the…

Conclusion

For the amino acids (glycine and L-alanine), the density and speed of sound data have been measured in aqueous ([Chl][Eth]) solutions. Various parameters including partial molar volume and apparent molar volumes have been calculated to infer the type of interactions present in the ternary systems. From the results obtained for V_ϕ and V_ϕ^0 it can be concluded that the solute–solvent interactions are prevalent in the systems under study. From transfer volumes, it has been determined that…

Declaration of Competing Interest

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A comparative analysis of volumetric, viscometric and conductometric properties of Triethylmethylammonium Tetrafluoroborate (TEMABF<inf>4</inf>) and Tetraethylammonium Tetrafluoroborate (TEABF<inf>4</inf>) in pure propylene carbonate (PC) and binary aqueous propylene carbonate solvents
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Journal of Molecular Liquids, Volume 283, 2019, pp. 133-146

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Research article

Volumetric, viscosity and ultrasonic studies of solute-solute and solute-solvent interactions of glycine and diglycine in water and in aqueous citric acid at different temperatures

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Investigation of molecular interactions of the drug Diclofenac Sodium Salt in water and aqueous sorbitol systems at different temperatures (305.15 K–315.15 K)

Journal of Molecular Liquids, Volume 289, 2019, Article 109479

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Research article

Volumetric, acoustic and viscometric studies of solute-solute and solute-solvent interactions of isoniazid in aqueous-glucose/sucrose solutions at temperatures from 293.15 K to 318.15 K

The Journal of Chemical Thermodynamics, Volume 133, 2019, pp. 123-134

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Journal of Molecular Liquids

Volume 341, 1 November 2021, 117344

Current trends in protein-surfactant interactions: A review

Ishrat Fatma [a], Vivek Sharma [b], Ramesh Chand Thakur [c], Ashish Kumar [a]

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https://doi.org/10.1016/j.molliq.2021.117344

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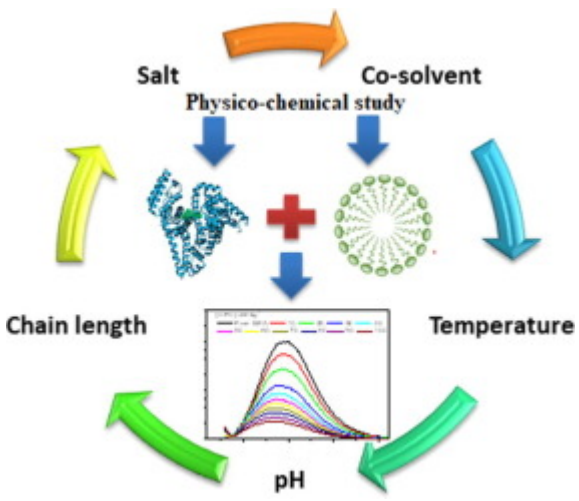
Abstract

The protein-surfactant interactions have been investigated for a long time due to their increased effectiveness in cleanliness and industrial processes. Moreover, Covid-19 outbreak has revolutionized the significance of protein-surfactant interactions, as soaps were proved the best cleansers and safe during this period. In this review article, an overview of physico-chemical aspects of protein-surfactant interactions along with various techniques has been discussed. In addition, the effect of different factors such as co-solvent, temperature, pH, chain length of surfactants, salt, and their impact on critical micelle concentration (CMC) of surfactant, structure, binding, thermodynamic parameters, and stability was also explained. This review will help the scientific community in understanding how to improve the effectiveness and applications of proteins and surfactants in pharmaceutical and other industries as protein-surfactant interactions can explain the significant phenomena of hydrophobic and electrostatic interactions.

Graphical abstract



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Introduction

Protein-surfactant interactions have been studied for a long time. Anson [1] was the first scientist who introduces this important topic into spotlight and found out that denaturation of proteins is done by surfactants at a very lower concentration than that of chemical denaturants like urea. An increased interest in this topic can be assigned to the accessibility of new experimental methods to study the protein-surfactant interactions and their implementation results in formulation of detergents, food emulsion, pharmaceutical, cosmetic products, etc. In addition, this topic plays an important role in other fields like protein-surfactant absorption at interface [2] as well as in relatively complex biological phenomena especially in biological membrane [3], [4].

In the eighteenth century, Antoine Fourcroy and others identified proteins as a group of well-defined molecules, which have the

capability to coagulate and flocculate in the presence of heat or acid. Proteins are the unique molecules that play an important part in each one of the biological processes occurring in living creatures [5]. Their behavior may be influenced by their interactions with the nearby region. To assimilate the function of protein in living organisms [6], it is important to investigate the thermodynamics of the native structure of protein [7]. Proteins are the naturally occurring polypeptides that consist of α-amino acids arranged in chains or in a folded form. There are two types of conformations shown by proteins i.e. native conformation and random coil conformation. The main difference between native and random coil conformation is that in native conformation; chain-chain contact is thermodynamically favored whereas in random coil conformation; chain solvent contact is thermodynamically favored. Generally, various intermolecular forces are liable for maintaining the structure and conformation of proteins, which include hydrophobic, ionic, electrostatic, and van der Waals forces of interactions. Disulphide bond is also responsible for the conformation of proteins. The amount of the free energy that maintains the native structure of a protein is about 9–17 kcal Mol^{-1} and this energy is easily controlled by minor perturbation in the surrounding components like temperature, pH, pressure, ligand, surface charge density, and hydrophobicity. All these components can disturb the various types of interactive forces that are responsible for protein stability [8]. Denaturation of proteins in the aqueous medium is an elemental biological phenomenon, which is not fully understood and remains a subject of boundless analysis [9]. To identify the impact of various denaturing agents on proteins, it is very necessary to recognize the interactions of these additives with proteins in aqueous medium [10]. The individual interaction of water with several functional groups present on the protein leads to the development of the stable folded structure of proteins in aqueous medium [11]. The commonly used proteins for physico-chemical studies include bovine serum albumin (BSA) and lysozyme.

In 1929, Kurt von Neergaard started the tale of a surfactant when he filled a porcine lung with an isotonic gum solution to abolish surface tension of the air tissue interfaces [12]. Surfactants are the surface-active agents, which consist of polar hydrophilic head (lipophobic) and non-polar hydrophobic tail (lipophilic) i.e. they are amphiphilic in nature [13]. Because of the presence of hydrophilic group, surfactants are soluble in aqueous medium. It is the hydrocarbon tail of the surfactant, which is responsible for its biodegradability. Surfactants are considered as the compounds that are responsible for adjusting the surface and interfacial tension [14]. Some important properties like critical micelle concentration (CMC), charge, hydrophile-lypophile balance (HLB), aggregation number and chemical structure make them good emulsifying, dispersing, and foaming agent [15], [16], [17].

In aqueous medium, surfactants behave as monomers, but at critical micelle concentration (CMC), they combine spontaneously to form micelle, and this phenomenon is known as micellization [18]. Development of micelle occurs due to the dual nature of surfactant molecule due to which hydrophilic head remains emerged in water, whereas hydrophobic tail remains away from water, so the monomer concentration remains essentially constant and approximately equal to the CMC [19], [20], [21]. Micelle is divided into three regions (Fig. 1) i.e., outer region, palisade region, and the core [22].

Surfactants are classified into two main types based on their head groups, whether they are charged or neutral. Charged surfactants include cationic and anionic; neutral surfactants include non-ionic and zwitter-ionic [23] (Fig. 2).

Cationic surfactants contain a positively charged head group; anionic surfactants contain a negatively charged head group as a result of which these are ionizable in water. Non-ionic surfactants are non-ionizable in water because of the lack of charge in their head groups whereas zwitter-ionic surfactants contain both positively and negatively charged head groups. The most commonly used surfactants include cetrimide (cationic), ethers of fatty alcohols (nonionic), and N-alkyl betaines (amphoteric) (Table 1, Table 2, Table 3, Table 4).

Surfactants have been used as detergents and cleansing agents for a very long time. The physico-chemical characteristics of a detergent enable it to use in many forms, mainly in powdered and liquid form. The main function of all the cleaning agents is to remove the greasy substance from any surface to make it clean and shiny. This process occurs due to the presence of a polar hydrophilic head and a non-polar hydrophobic tail, which allows the formation of a bridge between water and grease. The greasy stuff is trapped by the hydrophobic part whereas hydrophilic part remains emerged in water due to this dispersion occurs which results in the formation of an oil-in-water emulsion. In this form, it can be rinsed off by water. Out of different types of surfactants, anionic surfactants are used as wetting agents, whereas cationic surfactants are used in hair products. Cationic surfactants are considered as fabric softeners. Non-ionic surfactants are used in different types of cleaning agents such as in shampoo, hand wash, lotion and so on. Amphoteric surfactants are used in various skincare products and acid metal cleaners [24], [25], [26]. Surfactants are also used for bioremediation. Bioremediation is a process in which microorganisms act as transformers in the presence of surfactants. Sodium dodecyl sulfate has been used for enhancing the bioremediation rate of hexavalent chromium in the presence of sugar cane bagasse [27]. Surfactants have been used in drug delivery systems where they act as carriers or vehicles for various hydrophobic drugs. Hydrophobically modified dextrans have been used in this process because of their biodegradable nature [28]. Dendrimer–surfactant aggregates play an important role in acting as carriers for different hydrophobic drugs like the antibacterial drug sulfamethoxazole (SMZ). Span (20,40) and Tween (20,40) surfactants are also considered as drug carriers [29], [30].

Surfactants are also responsible for the modification of some important phenomena such as disintegration and diffusion of drugs.

Furthermore, surfactant also plays an important role during transportation of drugs across membranes. Recently, a new surfactant called as novel based bola surfactant is identified which has been used as drug carriers for tumor cells [31]. Surfactants have been used in various oxidative transformations where the micelle plays an important role in identifying the reaction rates. The enhancement of micelle-based transformation occurs because of some collision frequencies among micelle. The interactions between a surfactant and activated complex are responsible for various micellar catalysis. Surfactants have been used as a catalyst in many organic reactions in aqueous medium in to restrict the usage of various organic solvents [32].

Recently, a new class of surfactant called bio-surfactants have been introduced which are commercially used because of their ecofriendly nature and easy availability. They are categorized as low mass (glycolipids, lipolipids) and high mass (polymeric surfactants). They may be neutral as well as anionic. Low mass surfactants are responsible for decreasing the interfacial tension because of which they are used as emulsifiers. High mass surfactants include proteins that show molecular interactions with lipids up to certain degrees. They show a wide range of applications in the food industry, where they act as antimicrobials and emulsifiers (polysaccharides). One of the most important example of bio-surfactants, which have been used in food and pharmacy, is rhamnolipids obtained from P. aeruginosa [33], [34]. Besides this, surfactants have been used in paints and coatings where they serve as dispersants (polyacrylates), wetting agents (sulfosuccinates), and defoamers (metal soaps) [35]. Because of their increasing usage, much attention should be paid towards the production of low-cost and eco-friendly surfactants. The chemistry behind the application of surfactants is widely spread, which needs further research to unveil those properties which enable their usage in various new fields.

Section snippets

Protein-surfactant interactions

The analysis and knowledge of protein-surfactant interactions play a considerable part in improving the effectiveness and application of proteins in pharmaceutical and other industries because surfactants may increase the physico-chemical properties of proteins [36], [37], [38], [39], [40], [41]. Moreover, it plays a significant role in explaining the process of hydrophobic-electrostatic interactions [42]. The hydrophobic effect causes protein folding [43], [44], [45], [46] whereas the…

Techniques used for studying protein-surfactant interactions (Table 5)

Out of the above-mentioned techniques (Table 5), the most commonly used ones are described below.…

Factors affecting protein-surfactant interactions

Various factors which shows significant effects on protein-surfactant interactions are mentioned below (Fig. 16).…

Conclusion

An ample amount of research has been done on protein-surfactant interactions due to their increased effectiveness in cleanliness and the industrial sector. The present review put light on protein-surfactant interactions through certain techniques. Moreover, this article explains how different factors such as co-solvent, temperature, pH, chain length, and salt cause various changes during protein-surfactant interactions. Literature survey indicates that in the presence of co-solvent, the…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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Biophysical investigation of the interaction between NSAID ibuprofen and cationic biodegradable C<inf>m</inf>-E2O2-C<inf>m</inf> gemini surfactants
2023, Journal of Molecular Liquids

Citation Excerpt :

...The reason for this decrease in CMC can be attributed to the amphiphilic nature of IBF (Fig. 1, it has a small, rigid hydrophobic part and forms aggregate at higher concentrations). It is well known that due to their high electrostatic interaction in an aqueous medium and the enhanced activity of the surface, mixed systems of amphiphiles are of remarkable interest [28,50,51]. The phase behavior of amphiphile mixes is actively influenced by strong electrostatic interactions and the amphiphile content....

Show abstract

Influence of HSA on micellization of NLSS and BC: An experimental-theoretical approach of its binding characteristics
2022, Journal of Molecular Liquids

Citation Excerpt :

...This is due to its immense solicitations in drug production that endures its edging towards biological area. The biological significance of proteins

> can be identified from their capacity to work as hormones as well as transmitters in central nervous system of living organisms [23-28]. Proteins are also utilized to stabilize as well as to improve the various characteristics of detergents [29]....

Show abstract

Fundamental investigation of bio-surfactants-assisted harvesting strategy for microalgae

2022, Biomass and Bioenergy

> *Citation Excerpt :*
>
> ...As a comparison, the presence of rhamnolipids led to higher conductivity at all tested conditions when compared with BSA. Furthermore, conductance analysis can be used to understand the thermodynamic property of micelles formations such as the standard free energy and from previous study conductance can determine the CMC of surfactants [35,36]. Fig. 3 represents the zeta potential of BSA and rhamnolipids in DI water at different concentrations....

Show abstract

On the equilibrium surface tension of aqueous protein solutions – Bovine serum albumin

2022, Journal of Molecular Liquids

> *Citation Excerpt :*
>
> ...The surface-active nature of proteins plays a crucial role in numerous industrial and scientific applications such as the formulation of functional food emulsions [1,2], performance of heat exchangers in dairy factories [3], surface properties of organic thin films [4,5], and the development of artificial lung surfactants [6–8]....

Show abstract

Preparation and Characterization of Gluten/SDS/Chitosan Composite Hydrogel Based on Hydrophobic and Electrostatic Interactions

2023, Journal of Functional Biomaterials

Role of Polyanions and Surfactant Head Group in the Formation of Polymer–Colloid Nanocontainers

2023, Nanomaterials

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Molecular binding interaction of pyridinium based gemini surfactants with bovine serum albumin: Insights from physicochemical, multispectroscopic, and computational analysis

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, Volume 250, 2021, Article 119350

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Physicochemical nature of sodium dodecyl sulfate interactions with bovine serum albumin revealed by interdisciplinary approaches

Journal of Molecular Liquids, Volume 340, 2021, Article 117185

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Binding of cationic C_m-E2O-C_m gemini surfactants with human serum albumin and the role of β-cyclodextrin

Journal of Molecular Liquids, Volume 312, 2020, Article 113365

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Colloids and Surfaces B: Biointerfaces, Volume 132, 2015, pp. 313-321

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Micellar properties of pluronics in combination with cationic surfactant and interaction with lysozyme: Thermodynamic evaluation

Journal of Molecular Liquids, Volume 359, 2022, Article 119303

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The Journal of Chemical Thermodynamics

Volume 158, July 2021, 106433

Effect of α–amino acids (glycine, L-alanine, L-valine and L-leucine) on volumetric and acoustic properties of aqueous 1-Butyl-3-propylimidazolium bromide at T=(288.15, 298.15, 308.15, 318.15) K

Harpreet Kaur [a], Ramesh Chand Thakur [a], Harsh Kumar [b], Arjuna Katal [b]

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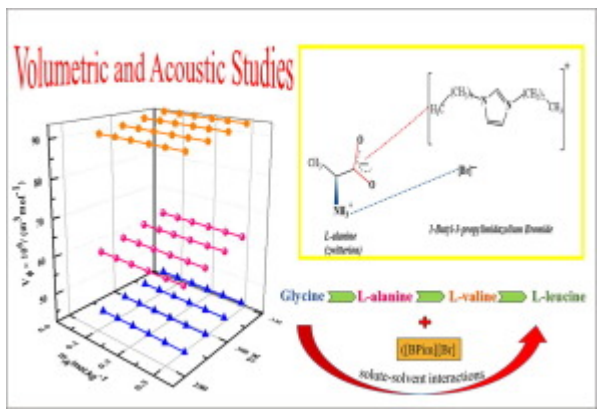
Abstract

In this experimental work, values of density and speed of sound of some α–amino acids viz.; glycine, L-alanine, L-valine and L-leucine with different molal concentrations of IL; 1-Butyl-3-propylimidazolium bromide ([BPim][Br]) at four working temperatures and experimental pressure p=0.1 MPa have been determined. Using the corresponding data, different thermo physical parameters like apparent molar volume (V_ϕ), partial molar volume (V_ϕ^0), standard partial molar volume of transfer (ΔV_ϕ^0), apparent molar isentropic compression ($K_{\phi,s}$), partial molar isentropic compression ($K_{\phi,s}^0$) and partial molar isentropic compression of transfer ($\Delta K_{\phi,s}^0$) have been calculated. Interaction coefficients have been determined using McMillan–Mayer theory and IR spectral studies have also been performed to validate the results obtained. The structural behaviour of all the α–amino acids (α-AAs) under consideration in ([BPim][Br]) and various types of interactions occurring in the ternary systems have been predicted from the results of various parameters.

Graphical abstract



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Introduction

Proteins are highly composite molecules present in all living organisms. Proteins are the biomolecules that are vital for human life. They are the building blocks of living beings and play a significant role in the body of living beings [1]. Proteins participate in DNA replication, transcription, catalysis, assists in digestion and acts as messenger to transmit signals so as to synchronize biological activity among various cells, tissues and organs [2]. Also, proteins are being used in making fibers. These constructs are promising in tissue engineering and wound healing applications due to their biocompatibility and biodegradability [3], [4]. Proteins are biomaterials as well as bio catalysts having plenty of assists while considering the challenges occurring worldwide as it assists in minimalizing the environmental effects along with evolving a circular economy [5], [6]. Chemically, proteins are composed of

amino acids that are the building blocks of these versatile macromolecules [7]. The interactions of these complex biomolecules with the adjacent environment affect their conformational characteristics. These interactions exist among the solvent ions and the protein molecules [8], [9]. The chemistry, stabilization and destabilization of proteins is greatly effectuated by the some of the additives [10]. To utilize these biocompatible scaffolds efficiently, knowledge about their structure and interactions with its surrounding is essential but due to their complex structure, it turns out to be quite challenging. Hence their monomeric subunits, the amino acids, are being studied intensively. Solvation of the molecules is necessary for many biological processes that result in the volume change. The protein's conformational stability depends on the different interactions present among the amino acids and the functional groups of the solvents in which they are being dissolved [11], [12]. The α-amino acids have an amine and carboxylic functional groups along with an alkyl side chain and alteration in the alkyl group number in the side chain influences the thermo physical properties of amino acid significantly. The study of thermophysical and transport properties of amino acids in solvents helps in understanding the presence of various types of interactions as well as conformational stability of proteins in that particular solvent [13], [14], [15].

Looking at the impacts of conventional solvents on the environment there is a need for eco-friendly solvents that can replace the traditional solvents efficiently. Ionic liquids turned out to be promising alternatives in the field of amino acids, carbohydrate chemistry, solution thermodynamics, electrochemistry, polyelectrolytes, colloid and surfaces and pharmaceuticals. Ionic liquids due to their unique properties like tailoring its structure by varying anion or cation, low melting points, high viscosity, thermal stability, miscibility with water, and negligible vapor pressure have an ample number of uses [16], [17], [18], [19], [20]. In order to design the ILs as per our requirement, it is necessary to have a deep knowledge of their thermodynamic and physicochemical properties, with the additives. ILs also possess mutual electrostatic interaction and repulsion of charged particles due to which they can solubilize polar substances [21], [22]. Considerate knowledge of the interactions of the ILs with α-amino acids would benefit in optimizing the various pharmaceutical processes and operations in bio-tech industries r [23], [24]. A thorough insight of the phase behaviour of the components in a mixture (amino acid+water+IL) is crucial for understanding of the molecular mechanisms in order to govern extractions from a particular media as well as a bioreaction process where ILs can be utilized as solvents. Thermodynamics besides complementary microscopic data for aqueous ILs solutions are thus indispensable information source, especially for systems comprising of sugars, fermentation metabolites, salts, amino acids and enzymes. Generally amino acids exist in the biological media in aqueous phase and influence the mutual solubility of IL and water. In the present study, investigation of molecular mechanisms underlying the behaviour of the ionic liquid (1-butyl-3-propylimidazolium bromide) when AAs are present and further discussion of the influence of the chemical structure of these bio molecules on the interactions established by them with the species present in the solution. The system under investigation is focused on gaining information about solvation behaviour of amino acids that in turn influence the activity, stabilization and recovery of biomolecules in these solvents [25].

Although interactions of ILs with the amino acids are being studied extensively and the data reported earlier mainly deals with the measurement of thermodynamic and acoustic parameters of amino acids in aqueous solution of imidazolium based ILs containing $-CH_3$ at position 1 and effect of variation of number of alkyl groups at position 3 of the imidazolium cation [26], [27]. In the present study, the number of alkyl groups at position 1 are also increased along with that of position 3 and various interactions occurring between the ternary systems containing aqueous solutions of the synthesized IL ([BPim][Br]) (molality (mIL) = (0.01, 0.03 and 0.05) mol kg^{-1}) and α-amino acids (glycine, L-alanine, L-valine and L-leucine) have been determined at various temperatures and atmospheric pressure.

Section snippets

Chemicals

1-Butyl-3-propylimidazolium bromide used in the present study, was synthesized in the laboratory. 1-Butylimidazole (Sigma Aldrich, mass fraction purity 0.99) and 1-Bromopropane (Sigma Aldrich, mass fraction purity 0.99) were used to synthesize ([BPim][Br]).), acetonitrile (Loba Chemie Pvt.Ltd.) and ethyl acetate (Loba Chemie Pvt.Ltd. were also used in the synthesis of ([BPim][Br]). The α–amino acids (HIMEDIA Laboratories Pvt. Ltd. India, mass fraction purity 0.99.) were desiccated and kept over …

Density and speed of sound data

The density (ρ) and speed of sound (u) values of α-AAs (glycine, L-alanine, L-valine and L-leucine) are measured in different molal concentration (0.01, 0.03 and 0.05) mol·kg^{-1} of aqueous solutions of ([BPim][Br]) at various temperatures are listed in Table 2. From analysis of density and speed of sound data it is evident that the values of density increase as the concentration of AAs and the ionic liquid increases whereas it decreases with rise in temperature. The speed of sound values…

Conclusion

Densities and speed of sounds of glycine, L-alanine, L-valine and L-leucine were obtained in 0.01, 0.03 and 0.05 mol/kg aqueous solution of ([BPim][Br]) at four equidistant temperatures. Based on the various thermophysical parameters calculated using the density and speed of sound data, several types of interactions have been predicted present in the ternary systems (AA+IL+water). The positive values of V_ϕ and the negative values of $K_{\phi,s}$ indicate the presence of solute–solvent interactions…

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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Phase behaviour of the ternary systems $Rb_2SO_4(1)$-$RbBr(2)$-$H_2O(3)$/$Cs_2SO_4(1)$-$CsBr(2)$-$H_2O(3)$ at T=288.15, 298.15, 308.15 K

The Journal of Chemical Thermodynamics, Volume 158, 2021, Article 106468

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Research article

Thermodynamics and phase transitions in $[La(Gly)_3{\cdot}2H_2O](ClO_4)_3$

The Journal of Chemical Thermodynamics, Volume 158, 2021, Article 106453

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Density and viscosity behaviour of $EBPBF_4$, $TBPBF_4$ and $HBPBF_4$ in acetonitrile solutions at different temperatures at T=(293.15–323.15) K

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Temperature dependent volumetric and acoustic properties of some amino acids in aqueous solutions of an antidepression drug

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Physicochemical study on molecular interactions of ternary aqueous solution containing ionic liquid 1-octyl-1-methylpyrrolidinium bromide and amino acid/glycyl dipeptide at various temperatures

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Investigations on molecular interaction of some amino acids with the drug levofloxacin in aqueous solution by volumetric and acoustic methods at different temperatures

The Journal of Chemical Thermodynamics, Volume 105, 2017, pp. 94-104

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THE INDIAN JOURNAL OF SOCIAL WORK

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WOMEN'S PARTICIPATION IN PANCHAYATI RAJ INSTITUTIONS: A PERSPECTIVE FROM JAMMU REGION IN JAMMU AND KASHMIR

Ashwani Kumar

ABSTRACT

Men dominated Panchayati Raj Institutions until the 73rd Amendment of 1993, which mandated 33 percent reservation to women. The provisions of the 73rd Amendment were available to women in Jammu and Kashmir from 2003, owing to its limited constitutional autonomy under Article 370. This reservation provided an opportunity to a large number of women from the state to participate in the panchayat elections in 2011. This article studies the awareness level and participation of the newly elected women panchayat members in Panchayati Raj Institutions. The author also studies the socioeconomic, political and socio-cultural factors that impact women panchayat members in carrying out their regular activities.

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Psycho Social Issues of Tobacco Marketing: An Observational Study at Point of purchase

Dr. VineyDhiman, Dr. AnupamaBharti

Abstract

Background of the Study: Tobacco is at the centre of the contradictions inherent in the evolving process of globalization. It is where the goals of a set of multinationals are clearly in conflict with public health and welfare and where globalization of values such as accountability and corporate responsibility are under severe pressure. The transformation of marketing and promotion of harmful commodities, such as tobacco products, is one important component of globalized public health threats. The industry looks towards the creation of new brands, products and variety in the market. Today's youth is attracted to such a flavored product which is dressed up with brightly colors and attractive packing. Given the harmful influence of tobacco advertising and promotion on current, potential, and former smokers, marketing regulation is a necessary component in the effort to combat the global tobacco epidemic. Objectives: The current research work provides a general review of emerging promotional channels, such as packaging, viral marketing. Secondly to analyzed the violation under smoke free act (COTPA, 2003) by these promotional approaches. Methodology:Study Areas:This survey was conducted in two cities of Punjab state namely Bathinda and jalandhar city Study Design: The research used descriptive research design in the study. Method of data collection: Observation and interview technique were used for the data collection. Observations like display of advertisement, variety of smoked and smokeless tobacco products and use of any promotion were noted. The information was collected from tobacco vendors based on convenient sampling.These included temporary kiosk, permanent kiosk and permanent shops. These observations were noted according to the various sections like 7, 8 and 9 of Cigarettes and Other Tobacco Products (Prohibition of Advertisement and Regulation of Trade and Commerce, Production, Supply and Distribution) Act, 2003. Results: The results of the present study illustrate that cigarette &bidi packs and smokeless tobacco products were carried out the flavored properties, with catching tag lines, attractive packaging and lastly dull warning images on the packs of both segments, advertised at point of purchase locally. Number of flavored, foreign, Indian brand and locally manufactured cigarettes packs were available and sold at point of purchase. These products with attractive packing packages attract the young population and these approaches leads to lifetime addiction and affected with tobacco related diseases.

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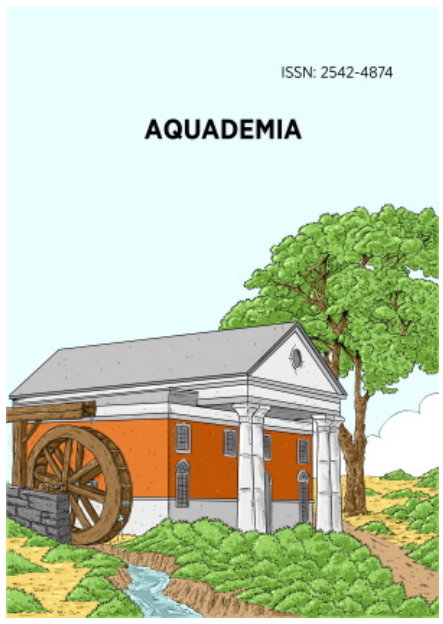

Research Article

The Role of "Medical Social Worker" in Cardiovascular Thoracic Surgery

Viney Dhiman [1] *, Anupama Bharti [2] *

More Detail

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ABSTRACT

Cardiovascular system is relating to the circulatory system of human body, which comprises the heart and blood vessels and carries nutrients and oxygen to the tissues of the body and removes carbon dioxide and other wastes from them. It plays an important role in helping the human body to meet the demands of activity, exercise, including maintains body temperature and stress. Captivatingly, by reason of some dysfunctional in body function lead to cardiovascular disease that especially involve narrowed or blocked blood vessels that can make cause to a heart attack, chest pain or stroke too. And Cardiothoracic Vascular surgery is related with surgery of thorax which entails with great complications somehow. Work carried out by trained personnel with the aim of alleviating the conditions of those people in a community suffering from any disease that personnel factually Social worker particularly who engage in medical practice. Supplementary, Medical Social Worker can perform their appreciable role in pre-operative stage, at operative stage, post-operative stage, at managing post-operative outcomes and notwithstanding retraction in pre-position of thoracic surgery of patient who unusually effected from cardiovascular disease. In this paper attempt has been made to analyses role of Social Worker in thoracic surgery. The present paper has been portrayed in two parts, parts one related with general description and part II related with specialized approach.

Keywords: cardiovascular, disease, operative stage, medical social worker

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IMPACT OF FOLK MEDIA ON RURAL DEVELOPMENT

Dr. Vikas Dogra*
Mr. Krishan Gopal Thakur**

ABSTRACT

In this paper an attempt has been made to critically analgise the role of traditional media on rural development. Folk media is one of the vehicles for social change and nation building. The present paper examines the role of folk media in the present scenario. Traditional Folk Media is a term used to denote 'people's performances'. It describes folk dance, rural drama and musical variety of the village people. This term speaks of those performing arts which are cultural symbols of a people. Traditional folk media are personal forms of communication and entertainment. These forms of art are a part of the way of life of a community and provide acceptable means of bringing development issues into the community on its own terms. Therefore, we need to keep our traditional media alive by continuously and cautiously safeguarding and preserving from the adverse effects of globalization. This paper will discuss the use of folk media, either in their traditional rural settings or when adapted to mass media to bring about social awareness of government development plans.

Keywords : Folk Media, Rural Development, Awareness and Rural Drama.

Introduction

Traditional media are of various kinds and vary from place to place, culture to culture and region to region, but in all these forms the purpose remains the same, that is to inform, educate and entertain the audiences for generating awareness among them about various development issues, including health and family welfare, rural development, agriculture, social aspects etc. Different methods of traditional media are predominantly used in different parts of the country according to the pulse of the audiences. India is a treasure-house of people's performing arts. Conventionally the traditional folk performances have been theme-carriers, usually carrying themes of morality. They have served as night schools in rural areas. Among the rural performances the flexible ones like the puppet play and katha-kirtan have shown their capacity to absorb any modern message and reflect it in terms that are easily understood by the village masses. Several song types have handled vital contemporary themes like the green revolution, scientific temperament, eradication of illiteracy and superstition, family welfare, health and sanitation. When handled with care and consideration, the folk media have proved themselves to be meaningful and effective tools of communication and development. During the past four or five decades, they have slowly acquired a functional dimension without losing their cultural roots. After the freedom struggle National Government started a full-fledged Song and Drama Division in 1954, with the objective of identifying, training and utilising the services of traditional folk performers to inform the rural masses about the planning and development programmes of the country. A decade later, the Amarnath Vidyalankar Committee, which was appointed to assess the communication potential of different information media, recorded that, 'From the point of view of its great appeal to the masses and its quality of touching the deepest emotions of the illiterate

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