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An Analysis of Fraud Occurrences Across Diverse Banking Operations in India

Angona Kashyap*

Abstract

Bank fraud involves using illegal methods to obtain funds or assets belonging to a financial institution. This study examined the trends and patterns of bank fraud in various banking operations over thirteen years, from 2011-12 to 2023-24. It aimed to analyse the occurrence of fraud, compare the level and variability of fraud across different sectors, and study the relation and impact of all banking sectors on the total fraud. Various descriptive statistics, along with correlation and regression analysis, were used to analyse the data. The data showed a steady increase in bank fraud, with bank advances, deposits, and card/ internet transactions experiencing continuous growth and the highest vulnerability. Off-balance sheet and foreign exchange frauds remain relatively low. The study emphasized the critical importance of proactive measures, customer education, employee training, and enhanced regulation to mitigate the rising risks associated with bank fraud.

Keywords: *Bank fraud management, Fraudulent transactions, Banking operations, Regulatory Compliance, Fraud Occurrences.*

INTRODUCTION

Bank fraud refers to the utilization of potentially unlawful methods to acquire funds, assets, or other property belonging to or under the control of a financial institution. It also encompasses the act of deceiving depositors by assuming a false identity as a bank or any other financial establishment with the intent to fraudulently obtain their money. It poses a significant and pressing concern, leading to substantial financial losses for individuals, businesses, and financial institutions. As technology advances and financial systems become increasingly interconnected, the threat of fraud has evolved and become more sophisticated, challenging banks to adopt proactive measures to protect themselves and their customers. Understanding the occurrence of fraud and its patterns across diverse banking operations is crucial for developing effective strategies to detect, prevent, and mitigate such risks. Fraudulent activities

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within the banking sector can manifest across various areas or operations, encompassing:

1. **Advances:** Pertaining to deceptive practices involving loans or credit facilities extended by banks to individuals or businesses.
2. **Card/Internet:** Involving fraud linked to credit or debit card transactions, as well as online or internet banking activities.
3. **Deposits:** Relating to fraudulent schemes targeting various deposit accounts, such as savings accounts or fixed deposits.
4. **Off-balance sheet:** Encompassing fraud associated with off-balance sheet transactions, such as derivatives, futures, options, and other financial instruments.
5. **Foreign exchange transactions:** Involving fraud concerning currency exchange or foreign exchange transactions.
6. **Cash:** Referring to fraudulent activities associated with cash handling, cash withdrawals, or currency transportation.
7. **Cheques/demand drafts, etc.:** Pertaining to fraud related to cheques, demand drafts, or other negotiable instruments.
8. **Inter-branch accounts:** Relating to fraud occurring in accounts maintained between different branches of the same bank.
9. **Clearing accounts:** Encompassing fraud associated with clearing accounts utilized for settling transactions between banks.
10. **Non-resident accounts:** Referring to fraud occurring in accounts held by non-resident individuals or entities.
11. **Other Operations:** Covering frauds that do not fall within any specific category mentioned above.

These diverse areas highlight the wide-ranging nature of fraudulent activities within the banking sector, necessitating comprehensive measures to combat and mitigate such risks effectively. This study aims to provide a comprehensive analysis of fraud occurrences across diverse banking operations, which will provide valuable insights for banking professionals, regulatory authorities, and researchers in their pursuit of creating more resilient and secure financial systems.

LITERATURE REVIEW

Bhargavi and Sravanthi (2023) investigate the causes and impact of scams and frauds in the banking industry, as well as the adequacy of Indian law in addressing banking frauds. It emphasizes the importance of implementing proactive measures to control and prevent fraud, along with the need for stricter legislation. By remaining vigilant and adhering to regulations, banks can effectively combat fraud and protect stakeholders. Preventive actions and heightened awareness play a crucial role in addressing these economic challenges.

Bhasin (2015) identifies the main contributors to banking sector fraud being poor employment practices, inadequate training, overburdened staff, weak internal

controls, and low compliance levels. The study recommends customer education, stronger laws, data analysis technologies, and fraud mitigation as the best practices. The RBI's Central Fraud Registry and Red Flagged Account target loan frauds and promote information sharing. Compliance with security controls varies across hierarchical levels, with managers exhibiting higher compliance compared to officers and clerks.

Soni and Soni (2013) examine the prevalence of fraud in Indian private and public sector banks, with a particular focus on online banking, ATM, card, and digital transactions. Private and foreign banks have shown a higher involvement in such frauds, despite efforts to enhance security measures. The study highlights the need for continued regulatory improvements and guidelines to address cyber fraud cases effectively. Further, the rapid adoption of technology in financial services has significantly boosted their development. However, heavy reliance on electronic tools and digital transactions has also exposed the financial sector to serious threats. The rise of online and cyber transactions has led to an increase in banking scams, causing substantial financial losses for individuals and institutions.

Srinivas (2023) analyses the rise in fraud cases within the banking sector over a period of years. Private sector banks lead in fraud amounts, followed by financial institutions. The total number of fraud cases from 2018 to 2022 was 32,880, with a compound annual growth rate of 11.38%. The study states that the Reserve Bank of India needs to take proactive measures to protect customers and enhance security against evolving fraud techniques facilitated by technology.

RESEARCH GAP

After going through an extensive literature review, it can be seen that although various studies have examined fraud occurrences in the Indian banking sector, most of them have focused on specific dimensions such as loan fraud, digital payment fraud, or compliance-related issues. However, very few studies have undertaken a comprehensive operation-wise analysis covering multiple banking functions simultaneously. There is a lack of holistic research that compares fraud patterns across diverse operational areas over an extended period. This gap highlights the need for a broader and integrated assessment of fraud occurrences across banking operations.

CONTRIBUTION OF THE STUDY

This study contributes to the existing literature by offering a complete operation-wise analysis of fraud occurrences in the Indian banking sector over a period of 13 years. The previous studies examined isolated fraud types for shorter periods. This study compares trends across a wide range of banking operations to identify systematic vulnerabilities and long-term patterns. Additionally, the study employs correlation and regression techniques to examine how each banking operation influences the overall level of fraud, which provides an analytical depth that is largely absent in earlier studies. It also highlights the areas that are more prone to fraud occurrences and where attention is required. By integrating descriptive statistics, growth

indicators, and impact analysis, the study offers a broad and more meaningful understanding of fraud dynamics. This enhances its relevance for policy formulation and risk management.

RESEARCH OBJECTIVES

1. To analyse the trends in fraud occurrences within various banking operations over a period of 13 years i.e., from 2011-12 to 2023-24.
2. To compare the level and variability of fraud across different banking operations.

RESEARCH QUESTIONS

1. What has been the annual growth rate of bank fraud in India over the past thirteen years?
2. Among the different sectors of banks, which sector exhibits a higher occurrence rate of fraud?

RESEARCH METHODOLOGY

Sources of Data

The study is exclusively based on secondary data obtained from Reports on Trends and Progress of Banking in India, annual publications of the Reserve Bank of India (RBI), published research papers, journals, and credible websites related to the Indian banking sector. These sources provide consistent and year-wise information on fraud occurrences across various banking operations.

Period of The Study

The analysis covers a period of thirteen years, from 2011-12 to 2023-24. This timeframe enables the identification of long-term patterns and fluctuations in fraud occurrences across India's banking sector.

Variables used in the Study:

This study focuses on analysing fraud occurrences across different banking operations. The specific banking operations are classified by the Reserve Bank of India (RBI). They are:

- Bank Advances (BA),
- Card and Internet Transactions (CI),
- Bank Deposits (BD),
- Off-balance sheet Items (OBS),
- Foreign Exchange Transactions (FET),
- Bank Cash (BC),
- Cheques, and Demand Draft (CDD),
- Inter-branch Accounts (IBA),

- Clearing Accounts (CA)
- Non-Resident Accounts (NRA)
- Other Operations (OO).

These variables collectively represent the major operational areas where banking frauds are reported in India.

Tools and Techniques used for Analysis

A combination of descriptive and inferential statistical tools has been used to analyse the data:

- A simple percentage analysis has been used to determine the share of each operational category in total fraud.
- Annual growth rate (AGR) has been used to examine the year-wise changes in fraud occurrences across various operations.
- Descriptive statistics, including Mean (MEAN) and Standard Deviation (SD), have been used to measure the average level of fraud and extent of variability within each banking operation.
- Correlation and Regression Analysis have been used to assess the relationship between different operational variables and the impact of fraud occurrences in every operation on the total banking fraud.
- Trend analysis has been used to identify the long-term movement and direction of fraud across banking operations.

All these statistical analyses were carried out using MS Excel and SPSS, ensuring a systematic organization and accurate interpretation of data.

DATA ANALYSIS AND INTERPRETATION

The data analysis and interpretation section is divided into four sections. The first section presents the total number of bank fraud cases and the corresponding amounts reported over thirteen years. Additionally, it provides the annual growth rates of these frauds throughout the same duration. The second section focuses on bank fraud in various sectors, outlining their individual percentages concerning the total number of frauds. The third section deals with the average and variability of bank fraud in each sector, utilizing means and standard deviations. Lastly, the fourth section includes a correlation and regression analysis between all the variables.

Section A: Total Fraud in Banks

In this section, comprehensive data on total bank frauds reported over thirteen years, ranging from 2011-12 to 2023-24, is presented along with its growth rates.

Table 1 presents the total bank frauds reported each year from 2011-12 to 2023-24, including the number of fraud cases and the corresponding monetary amount

involved. It also shows the annual growth rates for both fraud cases and the amounts throughout this period. Additionally, the Average Annual Growth Rate (AAGR) is calculated for the entire duration, reflecting the overall trend of fraud in terms of cases and monetary impact.

Table 1: GRAND TOTAL BANK FRAUDS				
Year	Absolute Figures		Annual Growth Rate	
	No. of frauds	Amount of fraud (Rs. In Crores)	No. of frauds	Amount of fraud
2011-12	4,091	4,497	-	-
2012-13	4,236	8,665	4%	93%
2013-14	4,302	10,093	2%	16%
2014-15	4,644	19,456	8%	93%
2015-16	4,690	18,698	1%	-4%
2016-17	5,071	23,928	8%	28%
2017-18	5,916	41,167	17%	72%
2018-19	6,797	71,503	15%	74%
2019-20	8,702	1,85,391	28%	159%
2020-21	7,358	1,37,828	-15%	-26%
2021-22	9,009	43,571	22%	-68%
2022-23	13,537	23,863	50%	-45%
2023-24	36,066	13,175	166%	-45%
AAGR			25%	29%

Source: Report on Trends and Progress of Banking in India, RBI, and Computed Data in MS Excel.

Observation: The table reveals a consistent upward trend in bank fraud from 2011-12 to 2023-24, indicating a growing concern for the banking sector. The number of fraud cases and the corresponding amounts have steadily increased, with fraudsters targeting larger sums of money. However, the number of frauds has increased to 36,066 in recent years, while the amounts involved have decreased. This highlights the need for stronger security measures within the banking industry. The annual growth rates of bank fraud vary, with fluctuations in both the number and amount of fraud. The AAGR for the number of frauds is 25%, while for the amount of frauds, it is 29%. This emphasizes the urgency for proactive measures to mitigate the increasing risks associated with bank fraud. Investment in robust fraud prevention, customer education, employee training, and enhanced regulation is vital to address this challenge effectively.

Section B: Sectoral Segmentation of Bank Frauds

This section provides a comprehensive analysis of bank fraud in different sectors. The tabular formats display the percentage share of each sector's fraud over thirteen years, offering insights into the distribution of fraudulent activities across the bank during the entire decade.

1. Frauds In Bank Advances

Table 2 provides a thirteen-year overview (2011-12 to 2023-24) of bank fraud related to bank advances. It includes yearly data on the number of reported frauds, the corresponding amount in crores of Rupees, and the percentage of frauds in relation to total reported cases.

Table 2: BANK FRAUDS IN BA		
Year	No. of frauds	Amount of frauds (Rs. In Crores)
2011-12	1,953 (48)	3,552 (79)
2012-13	2,087 (49)	6,530 (75)
2013-14	1,985 (46)	8,334 (83)
2014-15	2,256 (49)	17,123 (88)
2015-16	2,120 (45)	17,367 (93)
2016-17	2,320 (46)	20,556 (86)
2017-18	2,525 (43)	22,558 (55)
2018-19	3,602 (53)	64,508 (90)
2019-20	4,607 (53)	1,81,865 (98)
2020-21	3,496 (48)	1,36,429 (99)
2021-22	3,745 (42)	41,485 (95)
2022-23	4,063 (30)	22,421 (94)
2023-24	4,124 (11)	11,017 (84)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: Over the years, bank fraud in bank advances has been on the rise, with a notable increase in reported frauds and their values in 2018-19 and 2019-20. During these years, high-value fraud cases were recorded, amounting to 64,508 crores and 1,81,865 crores, respectively. The percentage of fraud out of the total reported cases varies yearly, indicating the importance of risk management and fraud detection mechanisms for banks.

2. Frauds In Card and Internet Transactions

Table 3 presents data on bank fraud in card and internet transactions in India from 2011-12 to 2023-24. It includes the number of reported frauds and the corresponding amount in Crores of rupees for each year.

Table 3: BANK FRAUDS IN CI		
Year	No of frauds	Amount of frauds (Rs. In Crores)
2011-12	629 (15)	23 (0.51)
2012-13	793 (19)	49 (0.57)
2013-14	978 (23)	54 (0.54)
2014-15	845 (18)	52 (0.27)
2015-16	1,191 (25)	40 (0.21)
2016-17	1,372 (27)	42 (0.18)
2017-18	2,059 (35)	110 (0.27)
2018-19	1,866 (27)	71 (0.10)
2019-20	2,677 (31)	129 (0.07)
2020-21	2,545 (35)	119 (0.09)
2021-22	3,596 (40)	155 (0.36)
2022-23	6,699 (49)	277 (1.16)
2023-24	29,082 (81)	1,457 (11.06)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: Bank fraud related to card and internet transactions has steadily increased over the years, growing from 629 frauds in 2011-12 to 29,082 frauds in 2023-24, which can be attributed to the popularity of digital banking in recent years. Although the amount involved in these frauds fluctuates yearly, the rising percentages of fraud out of the total reported cases indicate an increasing focus of fraudsters on card and internet transactions. Educating customers about safe banking practices and raising awareness about potential risks is crucial in combating this trend.

3. Frauds In Bank Deposits

Table 4 presents data on bank frauds related to bank deposits in India from 2011-12 to 2023-24, including the number of reported frauds and their corresponding amounts in crores of rupees.

Table 4: BANK FRAUDS IN BD		
Year	No of frauds	Amount of frauds (Rs. In Crores)
2011-12	857 (21)	219 (4.9)
2012-13	791 (19)	291 (3.4)
2013-14	774 (18)	331 (3.3)
2014-15	875 (19)	437 (2.2)
2015-16	759 (16)	809 (4.3)
2016-17	693 (14)	903 (3.8)
2017-18	691 (12)	457 (1.1)
2018-19	593 (9)	148 (0.2)
2019-20	530 (6)	616 (0.3)
2020-21	504 (7)	434 (0.3)
2021-22	471 (5)	493 (1.1)
2022-23	652 (5)	258 (1.1)
2023-24	2,002 (6)	240 (1.8)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: Over the thirteen years (2011-12 to 2023-24), bank deposit frauds in India showed fluctuations with a general decrease in reported cases from 857 to 504 till 2020, but with a drastic increase to 2,002 in 2023-24. The amounts involved in these frauds varied over the years, with a range from 219 crores to 903 crores. Recent years have witnessed a decline in reported amounts, with the lowest being 148 crores in 2018-19. Bank deposit frauds accounted for a significant proportion of overall reported frauds, ranging from the lowest of 5% to 21% during this period.

4. Frauds In Bank Off-Balance Sheet

Table 5 presents data on the "off-balance sheet" category of bank frauds spanning thirteen years (2011-12 to 2023-24). It includes the number of reported frauds, their percentage in relation to total frauds, and the corresponding monetary amount involved.

Table 5: BANK FRAUDS IN OBS		
Year	No of frauds	Amount of frauds (Rs. In crores)
2011-12	5(0.12)	373(8.29)
2012-13	18(0.42)	1,527(17.62)
2013-14	15(0.35)	1,088(10.78)
2014-15	10(0.22)	699(3.59)
2015-16	4(0.09)	132(0.71)
2016-17	5(0.10)	63(0.26)
2017-18	20(0.34)	16288(39.57)
2018-19	33(0.49)	5538(7.75)
2019-20	34(0.39)	2445(1.32)
2020-21	23(0.31)	535(0.39)
2021-22	21 (0.23)	1,077 (2.47)
2022-23	14 (0.10)	285 (1.19)
2023-24	11 (0.03)	256 (1.94)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: The table data indicate that off-balance-sheet bank frauds in India are relatively infrequent compared to overall banking activities. The percentage of such frauds each year remains consistently below 1%, suggesting effective risk mitigation by banks. The number of frauds and the amount involved vary from year to year, with the highest amount recorded in 2017-18 (Rs. 16,288 crores) and the lowest in the very recent year 2023-24 (Rs. 256 crores).

5. Frauds In Bank Foreign Exchange Transactions

Table 6 presents data on the "foreign exchange transactions" category of bank fraud over thirteen years (2011-12 to 2023-24). It includes the number of reported frauds, their percentage in relation to total frauds, and the corresponding monetary amount involved.

Table 6: BANK FRAUDS IN FET		
Year	No of frauds	Amount of frauds (Rs. In Crores)
2011-12	22(0.54)	130(2.89)
2012-13	10(0.24)	98(1.13)
2013-14	9(0.21)	144(1.43)
2014-15	16(0.34)	899(4.62)
2015-16	17(0.36)	51(0.27)
2016-17	16(0.32)	2,201(9.20)
2017-18	9(0.15)	1426(3.46)
2018-19	13(0.19)	695(0.97)
2019-20	8(0.09)	54(0.03)
2020-21	4(0.05)	129(0.09)
2021-22	7 (0.08)	7 (0.02)
2022-23	13 (0.10)	12 (0.05)
2023-24	19 (0.05)	38 (0.29)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: The table data reveal that bank frauds in foreign exchange transactions form a small proportion of India's overall foreign exchange activities. The low percentage of fraud indicates the secure conduct of most of the foreign exchange transactions. The highest number of frauds occurred in 2011-12 (22) and the lowest in 2020-21 (4). The highest fraudulent amount was in 2016-17 (Rs. 2,201 crores), while the lowest was in 2020-21 (Rs. 7 crores).

6. Frauds In Bank Cash

Table 7 presents data on bank frauds in the "cash" category spanning thirteen years (2011-12 to 2023-24). It includes the number of reported frauds, their percentage in relation to total frauds, and the corresponding monetary amount involved.

Table 7: BANK FRAUDS IN BC		
Year	No of frauds	Amount (Rs. In Crores)
2011-12	173(4.23)	20(0.44)
2012-13	140(3.31)	23(0.27)
2013-14	145(3.37)	24(0.24)
2014-15	153(3.29)	43(0.22)
2015-16	160(3.41)	22(0.12)
2016-17	239(4.71)	37(0.15)
2017-18	218(3.68)	40(0.10)
2018-19	274(4.03)	56(0.08)
2019-20	371(4.26)	63(0.03)
2020-21	329(4.47)	39(0.03)
2021-22	649 (7.2)	93 (0.21)
2022-23	1,485 (10.97)	159 (0.67)
2023-24	484 (1.34)	78 (0.59)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: The reported bank frauds in the "cash" category exhibit yearly variations. The highest number of frauds occurred in 2022-23 (1,485 cases), while the lowest was in 2012-13 (140 cases). Regarding the amounts involved, the highest was also in 2022-23 (Rs. 159 crore), and the lowest was in 2019-20 and 2020-21 (both Rs. 39 crore). The percentage of fraud out of the total remained relatively consistent, fluctuating between 3.31% to 4.71%, while it increased to 1.97% in 2022-23. Despite changing absolute numbers, the proportion of fraud concerning total transactions remained steady over the years.

7. Frauds In Bank Cheque/Demand Draft

Table 8 presents data on bank frauds in the "Cheque/Demand draft" category over thirteen years (2011-12 to 2023-24). It includes the number of reported frauds, their percentage in relation to total frauds, and the corresponding monetary amount involved.

Table 8: BANK FRAUDS IN CDD		
Year	No of frauds	Amount (Rs. In Crores)
2011-12	172(4.20)	40(0.89)
2012-13	141(3.33)	22(0.25)
2013-14	180(4.18)	19(0.19)
2014-15	254(5.47)	26(0.13)
2015-16	234(4.99)	25(0.13)
2016-17	235(4.63)	40(0.17)
2017-18	207(3.50)	34(0.08)
2018-19	189(2.78)	34(0.05)
2019-20	201(2.31)	39(0.02)
2020-21	163(2.22)	85(0.06)
2021-22	201 (2.23)	158 (0.36)
2022-23	118 (0.87)	25 (0.10)
2023-24	127 (0.35)	42 (0.32)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: Bank fraud cases related to Cheques and Demand Drafts have shown fluctuations without a consistent increasing or decreasing trend. The total amount involved in these cases has also varied over the years, but the fluctuations appear less pronounced compared to the number of fraud cases. The years 2014-15 to 2016-17 saw relatively higher numbers of fraud cases and larger amounts involved in 2020-21 and 2021-22. The percentage figures in the bracket suggest a downward trend in recent years, indicating a decreasing proportion of cheque and Demand Draft-related frauds to the total frauds reported.

8. Frauds In Bank Inter-Branch Accounts

Table 9 presents data on bank frauds in the "Inter-Branch Accounts" category over thirteen years (2011-12 to 2023-24). It includes the number of reported frauds, their percentage in relation to total frauds, and the corresponding monetary amount involved.

Table 9: BANK FRAUDS IN IBA		
Year	No of frauds	Amount (Rs. In Crores)
2011-12	24(0.59)	8(0.18)
2012-13	6(0.14)	3(0.03)
2013-14	7(0.16)	1(0.01)
2014-15	4(0.09)	0
2015-16	4(0.09)	10(0.05)
2016-17	1(0.02)	0
2017-18	6(0.10)	1(.0002)
2018-19	3(0.04)	0
2019-20	2(0.02)	0
2020-21	2(0.03)	0
2021-22	3 (0.03)	2 (0.005)
2022-23	3 (0.02)	0
2023-24	29 (0.08)	10 (0.08)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: Over the thirteen years (2011-12 to 2023-24), bank frauds in Inter Branch Accounts varied in number, ranging from 1 to 29 cases, with corresponding amounts ranging from Rs. 0 to Rs. 10 Crores. The trend indicates a decrease in both the number of fraud incidents and amounts, with some fluctuations. The percentage of these frauds out of the total remained relatively low, ranging from 0.02% to 0.18%. A relatively small portion of banking fraud is being attributed to Inter-Branch Accounts. However, it can be seen as increasing in the very recent years.

9. Frauds In Bank Clearing Accounts

Table 10 presents data on bank frauds in the "Clearing Accounts" category over thirteen years (2011-12 to 2023-24). It includes the number of reported frauds, their percentage in relation to total frauds, and the corresponding monetary amount involved.

Table 10: BANK FRAUDS IN CA		
Year	No of frauds	Amount (Rs. In Crores)
2011-12	38(0.93)	31(0.68)
2012-13	36(0.85)	7(0.08)
2013-14	36(0.84)	24(0.23)
2014-15	29(0.62)	7(0.03)
2015-16	17(0.36)	87(0.46)
2016-17	27(0.53)	6(0.02)
2017-18	37(0.63)	6(0.01)
2018-19	24(0.35)	209(0.292)
2019-20	22(0.25)	7(.004)
2020-21	14(0.19)	4(.003)
2021-22	16 (0.18)	1 (0.002)
2022-23	18 (0.13)	3 (0.01)
2023-24	17 (0.05)	2 (0.02)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: The number of fraud cases in the "Clearing Accounts" category shows no consistent trend over the specified period, and there is no steady increase or decrease in the fraud amounts either. While the number of frauds may decrease in some years, individual frauds can have a significant financial impact, as seen in 2018-19 and 2015-16. In 2018-19, despite a low number of fraud cases (24), the total amount involved was substantial (Rs. 209 crores). This emphasizes the importance of continuous vigilance by banks, as even fewer frauds can still result in significant financial damage. Bank fraud in clearing accounts remains a concern for the banking sector.

10. Frauds In Bank Non-Resident Accounts

Table 11 presents data on bank frauds in the "Non-Resident Accounts" category over thirteen years (2011-12 to 2023-24). It includes the number of reported frauds, their percentage in relation to total frauds, and the corresponding monetary amount involved.

Table 11: BANK FRAUDS IN NRA		
Year	No of frauds	Amount (Rs. In Crores)
2011-12	11(0.27)	3(0.06)
2012-13	17(0.40)	3(0.03)
2013-14	38(0.88)	10(0.09)
2014-15	23(0.50)	8(0.04)
2015-16	8(0.17)	9(0.04)
2016-17	10(0.20)	3(0.01)
2017-18	6(0.10)	5(0.01)
2018-19	3(0.04)	0
2019-20	8(0.09)	1(.001)
2020-21	1(0.01)	0
2021-22	1 (0.01)	2 (0.005)
2022-23	2 (0.01)	1 (0.002)
2023-24	6 (0.02)	2 (0.02)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of fraud out of the total in that particular year.

Observation: From 2011-12 to 2023-24, bank frauds in Non-Resident Accounts fluctuated but remained relatively low in number and amount. The reported frauds increased from 11 cases in 2011-12 to a peak of 38 cases in 2013-14 before decreasing. The highest amount involved was Rs. 10 crores in 2013-14, followed by a decline in subsequent years. In the last few years, both the number of fraud cases and the amounts involved have been relatively low. The data suggests that bank fraud in Non-Resident Accounts was not a significant concern for Indian banks during this period, with percentages consistently below 1%.

11. Frauds In Bank Other Operations

Table 12 presents data on bank frauds in the "Other Operations" category over thirteen years (2011-12 to 2023-24). It includes the number of reported frauds, their percentage in relation to total frauds, and the corresponding monetary amount involved.

Table 12: BANK FRAUDS IN OO		
Year	No of frauds	Amount (Rs. In Crores)
2011-12	207(5.06)	98(2.18)
2012-13	197(4.65)	112(1.29)
2013-14	135(3.14)	64(0.63)
2014-15	179(3.85)	162(0.83)
2015-16	176(3.75)	146(0.78)
2016-17	153(3.02)	77(0.32)
2017-18	138(2.33)	242(0.59)
2018-19	197(2.90)	244(0.34)
2019-20	242(2.78)	172(0.09)
2020-21	277(3.76)	54(0.04)
2021-22	299 (3.32)	98 (0.22)
2022-23	470 (3.47)	422 (1.77)
2023-24	165 (0.46)	33 (0.25)

Source: Report on Trends and Progress of Banking in India, RBI.

Note: Figures in the brackets indicate the percentage of frauds out of the total in that particular year.

Observation: The number of bank frauds in other operations fluctuates without a consistent trend over the years. The highest number of frauds occurred in 2022-23 (470 cases), followed by a gradual decline in 2023-24 (165 cases). The amount involved in frauds increased until 2017-18 (Rs. 242 Crores) but decreased from 2018-19 onwards, reaching the lowest amount of Rs. 54 Crores in 2020-21. However, it had the highest in 2022-23 with Rs. 422 crores. The data suggests that while the number of fraud cases varies, there is no consistent increase or decrease over the years. However, there appears to be a decline in the amount of money involved in reported frauds after the peak in 2022-23, potentially indicating improved detection and prevention measures.

Section C: Average and Variability of Bank Fraud

This section conducts an analysis of bank fraud in different sectors using statistical measures such as mean and standard deviation. The mean calculates the average percentage of fraud in each sector, while the standard deviation measures the variability or dispersion of fraud percentages within each sector.

Table 13 provides the distribution of the average percentage of bank fraud and variability in the percentages of fraud across different sectors. Each category represents a specific type of bank fraud.

Table 13: AVERAGE AND VARIABILITY OF BANK FRAUD		
Sectors	Mean	Standard deviation
BA	43.22%	11.18%
CI	32.70%	17.23%
BD	11.94%	6.05%
OBS	0.25%	0.15%
FET	0.21%	0.15%
BC	4.48%	2.34%
CDD	3.16%	1.55%
IBA	0.11%	0.15%
CA	0.45%	0.30%
NRA	0.21%	0.26%
OO	3.27%	1.13%

Source: Computed in MS Excel

Observation: The analysis reveals that the "Advances" sector has the highest average bank fraud percentage at 43.22%, indicating significant concern in loans and credit-related frauds. The "card and internet" sector exhibits higher variability (17.23%) in credit/debit card and internet-based fraud, possibly due to evolving techniques. Sectors "Deposits" and "Others" have moderate mean percentages (11.94% and 3.27%) and lower variability (6.05% and 1.13%), showing notable but comparatively less variation in fraudulent activities. Sectors with minimal percentages and low variability ("off-balance sheet," "foreign exchange transactions," "Inter-branch accounts," "Clearing accounts," and "Non-resident accounts") suggest the successful implementation of secure systems in these areas, resulting in fewer fraud instances.

Section D: Relation And Impact of Each Sector on the Total Bank Fraud

This section conducts a comprehensive analysis of the relationship between all variables and the Grand Total Fraud. It explores the impact of each variable on the Grand Total Frauds using correlation and regression analysis. This analysis helps identify significant factors contributing to fraud trends, assisting in developing effective strategies for fraud prevention and risk management in the banking sector.

Table 14 shows the correlations between each pair of variables, including total frauds (the dependent variable) and several other independent variables.

Table 14: CORRELATIONS													
	BA	CI	BD	OBS	FET	BC	CDD	IBA	CA	NRA	OO	Total	
Pearson Correlation	BA	1	.494	0.072	.617*	-0.31	.612*	-0.028	-.694#	-.607*	.560*	.583*	
	CI	.494	1	.881#	.107	0.299	.297	.676*	-0.396	-0.235	0.02	.994#	
	BD	.072	.881#	1	-.384	.569*	-.04	.823#	-0.043	0.099	-0.31	.830#	
	OBS	.617*	-.107	-.384	1	-.689#	.076	-0.376	-0.166	-0.262	0.182	-.039	
	FET	-.31	.299	.569*	-.689#	1	-0.09	.629*	0.179	0.069	-.231	0.251	
	BC	.612*	.297	-0.04	0.076	-0.09	1	-0.528	-0.495	-0.449	.902#	0.379	
	CDD	-.386	-.512	-.349	-.143	.069	-.528	1	0.113	0.191	-.477	-.536	
	IBA	-.028	.676*	.823#	-0.376	.629*	-.087	-0.433	1	0.168	-0.239	.628*	
	CA	-.694#	-.396	-.043	-0.166	0.179	-.495	0.113	1	.620*	-0.51	-.456	
	NRA	-.607*	-.235	0.099	-0.262	0.069	-.449	0.191	0.039	1	-.487	-.294	
	OO	.560*	0.02	-0.31	0.182	-0.231	.902#	-0.477	-0.51	-0.487	1	0.112	
	Total	.583*	.994#	.830#	-0.039	0.251	0.379	-0.536	-0.456	-0.294	0.112	1	
Sig. (1- tailed)	BA		0.086	0.816	0.025	0.303	0.026	0.192	0.008	0.028	0.046	0.037	
	CI	0.086		0	0.728	0.321	0.325	0.074	0.18	0.439	0.948	0	
	BD	0.816	0		0.195	0.043	0.897	0.243	0.001	0.889	0.749	0.303	0
	OBS	0.025	0.728	0.195		0.009	0.806	0.642	0.206	0.587	0.387	0.551	0.899
	FET	0.303	0.321	0.043	0.009		0.77	0.823	0.021	0.559	0.822	0.449	0.408
	BC	0.026	0.325	0.897	0.806	0.77		0.063	0.776	0.123	0	0.202	
	CDD	0.192	0.074	0.243	0.642	0.823	0.063		0.139	0.532	0.099	0.059	
	IBA	0.927	0.011	0.001	0.206	0.021	0.776	0.139		0.583	0.432	0.022	
	CA	0.008	0.18	0.889	0.587	0.559	0.085	0.712	0.583	0.024	0.075	0.118	
	NRA	0.028	0.439	0.749	0.387	0.822	0.123	0.532	0.899	0.092	0.092	0.33	
	OO	0.046	0.948	0.303	0.551	0.449	0	0.099	0.432	0.075	0.716		
	Total	0.037	0	0	0.899	0.408	0.202	0.059	0.118	0.33	0.716		

Source: Computed in SPSS

* Correlation is significant at the 0.05 level (2-tailed).

Correlation is significant at the 0.01 level (2-tailed).

Table 15 provides an overview of the regression model's goodness-of-fit statistics. It also provides important statistics to assess the overall statistical significance of the regression model. It assesses how well the predictor variables collectively predict the dependent variable.

Table 15: Regression Analysis				
Fraud Areas	R	R Square	F	Sig.
BA	0.583	0.34	5.664	0.037
CI	0.994	0.988	870.005	0
BD	0.83	0.689	24.319	0
OBS	0.039	0.002	0.017	0.899
FET	0.251	0.063	0.741	0.408
BC	0.379	0.143	1.84	0.202
CDD	0.536	0.288	4.439	0.059
IBA	0.628	0.394	7.147	0.022
CA	0.456	0.208	2.88	0.118
NRA	0.294	0.086	1.04	0.33
OO	0.112	0.012	0.139	0.716

a. Dependent Variable: Total

b. Predictors: (Constant), OO, CI, OBS, NRA, CA, FET, CDD, IBA, BC, BA, BD

Interpretation: It can be seen from the correlation as well as the regression analysis that the Card and Internet (CI) sector shows the strongest positive correlation with total frauds ($R=0.994$, $p<0.01$). It explains 98.8% of the variation in the total fraud through regression ($R\text{-squared } 0.988$, $p=0.000$), highlighting that it is the most significant contributor to overall fraud in banks.

Bank deposits (BD) ($R=0.830$, $R\text{ square}=0.689$, $p=0.000$) and inter-branch accounts ($R=0.628$, $R\text{ square}=0.394$, $p=0.022$) also show a strong and significant relationship with total bank frauds. This indicates that both these areas also have a substantial impact.

Bank advances (BA) show a moderate but significant correlation with total bank frauds ($R=0.583$, $R\text{-squared}=0.34$, $p=0.037$). However, other areas like Off-balance sheet (OBS), Other operations (OO), and Non-resident accounts (NRA) show very weak or non-significant correlations as well as regression results. This suggests that these areas have a very minimal influence on the total bank frauds.

Notably, Bank Cash (BC) and Clearing Accounts (CA) highlight moderate correlations but do not achieve statistical significance in regression analysis. Therefore, the analysis reveals that digital channels and bank deposit-related areas are highly vulnerable to fraud. So, the prevention efforts should be prioritised in these areas for maximum impact.

CONCLUSION

Over the period of thirteen years, bank frauds have steadily increased, both in terms of the number of cases and the amount involved. The annual growth rates fluctuate, but the overall trend is upward, emphasizing the need for stronger security measures. Bank advances, card or internet transactions, and deposits show continuous growth in fraud. However, off-balance sheet and foreign exchange frauds are relatively low. The data highlights the importance of proactive measures to combat evolving fraud risks and safeguard the banking sector's integrity. By addressing vulnerabilities and continuously updating security measures, banks can effectively mitigate the risks associated with various types of bank fraud. In conclusion, the data emphasises the utmost significance of implementing strong fraud detection and prevention measures, providing customer education, conducting employee training, and enhancing regulatory oversight to address the rising risks of bank fraud. The analysis further reveals the diverse nature of fraud across different sectors, emphasizing the necessity for targeted strategies and persistent efforts to protect the integrity of the banking system. Proactive measures are vital to effectively combat the evolving challenges posed by fraudulent activities.

SUGGESTIONS

The following suggestions have been proposed to address the increasing fraud occurrences in Indian banks:

- The banks should prioritise using real-time monitoring tools and automated alerts for highly fraud-prone banking operations like Advances, Card and Internet transactions, and deposits.
- Regular digital fraud awareness campaigns for customers using card and Internet operations should be strengthened.
- Banks should adopt stricter verification of borrowers, stronger collateral valuations, and periodic post-sanction monitoring of loan accounts, as bank advances account for a larger share of fraud.
- Different bank operations contribute unevenly to total fraud, so bank employees should be trained to identify specific patterns in each operation rather than using generic checks.
- Considering the upward long-term fraud trend, the banks must invest in AI automated reconciliation systems to identify irregular transactions early.
- Periodic audits and independent checks of areas with low risk should continue to prevent future huge fraud occurrences.

LIMITATIONS AND FUTURE SCOPE OF THE STUDY

The study entirely relies on secondary data collected from RBI and published reports, which may not reflect undetected or unreported fraud. The analysis is limited to the operational categories defined by the Reserve Bank of India, and the qualitative or behavioural aspects of fraud are beyond the scope of the study. The findings of this

study are based on national-level data and do not provide bank-wise or region-wise comparisons.

Future studies may include primary data from banking officials and customers to understand the behavioural factors behind fraud. Moreover, a comparative analysis of different types of banks or a region-wise fraud pattern can provide deeper insights. Additionally, a bank-wise case study approach may help to identify operational weaknesses and strengthen fraud management practices.

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Role of Behavioural Finance and its Impact on Investors' Decision Making

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Abstract

Since the 2008 Global Crisis, there has been a great deal of extreme volatility in the financial markets. One of the main factors influencing market fluctuations has been investor sentiment. Studying how emotions like fear, greed, and anticipation affect investing decisions seems crucial in this situation. The field of behavioural finance, which is still developing, investigates how psychological factors influence decision-making in uncertain situations. This study aims to investigate the influence of six identified and most prevalent behavioural biases: Overconfidence, Loss Aversion, Herding, Anchoring, Mental Accounting, and Representativeness bias. Primary data was collected by distributing questionnaires to 96 respondents, out of which the sample was finalised at 94 respondents, divided into two sub-samples of young investors (41) aged below 30 years, having experience of less than 3 years of investing, and experienced investors (53) aged above 30 years with more than 3 years of investing experience. The findings from the study revealed that out of the six biases, both investor types were equally affected by the presence of Loss Aversion, Herding, and Representativeness Bias, whereas the young investors were more likely to exhibit Overconfidence, Anchoring, and Mental Accounting Bias.

Keywords: *Overconfidence, Loss Aversion, Herding, Anchoring, Mental Accounting, Representativeness.*

INTRODUCTION

Behavioural Finance is an emerging concept that can sometimes be considered as a sub-branch of behavioural economics. It deals with the study of investors' psychology and its role in making various financial decisions (Kapoor & Prasad, 2017). Psychological factors play a dominant role in decision-making regarding investment in the securities market. Classical investment theories explain how investors will always act in a manner to maximise their gain, but there are a lot of financial market anomalies that cannot be explained by the traditional theories to a large extent (Kharib & Malik, 2014). The concept of behavioural finance thus becomes important as it can explain the reasons for the investors taking any such irrational decision.

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Conceptual Framework

According to the APA Dictionary of Psychology, “Behavioural Finance is a field, closely related to behavioural economics, that studies the impact of emotion, cognitive biases, and other psychological factors on financial decision making and hence on financial markets. In particular, behavioural finance emphasises the role such factors play in irrational investment behaviour (e.g., under- or overreaction to financial information) and its consequences in market fluctuations (e.g., financial bubbles, panics).

The concept of behavioural finance explains that investment decisions are greatly influenced by psychological factors of human beings, such as fear, hope, loss, optimism, and pessimism. This is where it differs from traditional finance, which assumes that human beings are always in control of their emotions and take rational decisions. But in reality, human beings are also affected by various psychological and emotional factors, as a result of which they may take certain irrational investment decisions. Behavioural finance explains the reasons for investors not to behave quintessentially. Some recent studies reveal that the average investors base their decisions on emotions and herd behaviour instead of logic, as the fear of losing money is three times more than the joy of earning it. Behavioural finance gained importance in the 1970s as a new area of research due to the opinion that investors rarely behave according to the assumptions in the traditional finance theories.

Some of the commonly encountered biases of behavioural finance include the following types:

Overconfidence Bias: The tendency to assume a false and misleading assessment of one’s own skills, intellect and talent is what can be termed as overconfidence. Overconfidence is a cognitive bias that manifests through excessively positive self-perceptions or optimism, wherein individuals overestimate their abilities and the accuracy of their predictions. (Szyszka, 2013)

Loss Aversion Bias: Loss Aversion is the tendency to avoid losses over achieving equivalent gains. The psychological effects of experiencing a loss or even facing the possibility of a loss might even induce risk-taking behaviour that could make realised losses even more likely or more severe. This overwhelming fear of loss can cause the investors to behave irrationally, E.g., holding a stock for too long.

Herding Bias: Herding is a term frequently used in behavioural finance to describe the connection in trades brought on by the investor contacts. The less experienced investors would try to emulate the actions of successful financial investors and experts as they lack the credibility to rely on their own knowledge (Chiang & Zheng, 2010). Herding behaviour can be dangerous to financial stability during times of market turmoil since it can cause initial shocks to be amplified and aggravated by the pro-cyclical market processes. (Demirer & Kutan, 2006)

Anchoring Bias: The anchoring bias is based on the fact that the first or initial information about the price of a product creates an anchor in our minds. The term

“anchoring” refers to a frequent human propensity to base too many of their decisions on a single characteristic or piece of knowledge. Investors have a history of being hesitant to adapt as new information becomes available. Investors are occasionally shown to be persistent in their beliefs despite the availability of new facts (Lord et al, 1979).

Mental Accounting Bias: Mental Accounting was coined by Richard Thaler and defined by Thaler (1999) as the “Set of cognitive operations used by individuals and households to organize, evaluate, and keep track of financial activities”. The collection of cognitive processes that people and families employ to organise, assess, and keep track of their financial actions is known as mental accounting. People began to tend to divide their money into various accounts for some arbitrary reasons as a result of this. People frequently attribute various purposes to various asset groups, which has an adverse and frequently irrational impact on their consumption decisions and other behaviours.

Representativeness Bias: Gilovich et al (1983) define Representativeness as “an assessment of the degree of correspondence between a sample and a population, an instance and a category, an act and an actor or, more generally, between an outcome and a model.” Representativeness is judgement based on stereotypes like investor’s recent success will tend to continue in the future as well. The tendency of the investors to make their decisions based on experiences is termed as stereotype (Shefrin, 2000). While making investments sometimes the individual investors tend to attribute good characteristics of the company directly to good characteristics of the stock. This may lead to very poor investments in the future more often than not. ((Lakonishok et al, 1994)

OBJECTIVES OF THE STUDY

- To analyse the important factors that influence the investment decision of investors.
- To assess the influence of six identified behavioural biases and their effect on investment.
- To analyse whether young and experienced investors exhibit behavioural biases differently.

LIMITATIONS OF THE STUDY

This study is subject to several limitations. First, it relies on self-reported questionnaire data, which may not accurately reflect investors’ actual behaviour during real market stress, as many behavioural biases operate subconsciously. Second, the sample was restricted to investors in Guwahati, limiting the generalisation of the findings to the wider Indian investor population. Third, the final sample size of 94 respondents, along with uneven response distribution across categories, may have reduced the statistical strength of the Chi-Square analysis. The classification of investors into only two groups based on age and experience may also simplify behavioural differences that could arise from factors such as income,

financial literacy, and investment exposure. Finally, the cross-sectional design reflects behaviour at only one point in time and cannot account for changes in behavioural biases across different market conditions or as experience accumulates.

LITERATURE REVIEW

The behavioural theory that demonstrates how human behaviour affects investment decisions develops as a contrary method rather than an additional assumption. This section of the literature review aims to provide a concise overview of pertinent research findings on behavioural finance and how it affects investment decision-making.

One of the very first literatures in the field of behavioural finance was given by Kahneman and Tversky (1979) in the form of prospect theory. This theory claims that people have an irrational inclination to be less eager to gamble when they will win than when they will lose. This theory clarifies a few mental states that affect how people make investing decisions, such as regret aversion, loss aversion, and mental accounting. Sahi (2016) in her study tries to investigate the investor's prejudices and determine whether or not they are connected to people's financial satisfaction. The findings demonstrated a positive and significant connection between financial satisfaction levels and overconfidence bias, dependence on expert bias, and self-control bias. Under specific control circumstances, an association between a few additional biases and financial contentment was also identified. Kandpal and Mehrotra (2018), in their study, attempted to analyse the behaviour of investors towards investment patterns and factors to be taken into consideration while making those decisions. The findings from the study revealed that factors like goals in life, spending habits, expenses, income, perception towards investments, lifestyle changes, time period, nature towards investment, thought process, natural habits, study of one's financials, risk bearing capacity, liquidity, expected return and linking of the investment with the goals has a lot of influence in making wise investment decisions. Isidor and Christie (2018), in their study, explained the anomalies in the stock market from the behavioural finance perspective. Short-term momentum was characterised as an anomaly since investors didn't react quickly enough due to their conservative inclination. Due to representativeness bias, investors overreacted, which caused the long-term reversal anomaly. The weekend anomaly was also attributed to the representativeness bias as an aberration. The explanation for the value premium paradox was that it was a product of people's optimistic views of growth stocks and gloomy views of value stocks. Thus, this research sheds light on the psychological biases that contribute to the stock market's aberrant behaviour and go unaccounted for by traditional financial theories.

Upadhyay and Shah (2019) in their study attempted to investigate the major influences of certain behavioural finance concepts such as overconfidence, perception, representativeness, anchoring, cognitive dissonance, regret aversion, narrow framing, and mental accounting, on the decision-making process of individual investors in the stock market in Ahmedabad. The findings showed that investors

are not always rational, and biases have some effect on their investment decisions in varying proportions. Dhruvajyoti Sharma et. al (2022) in one of the recent studies attempted to conduct a study on the bases and paradigms of Behavioural Finance. For this purpose, they conducted a detailed review of the literature to study the different dimensions and views regarding behavioural finance. The objective of this study was to contribute to the development of a framework for various approaches that can serve as a foundation for future research in the field.

RESEARCH GAP

Although extensive literature highlights the role of behavioural biases in shaping investment decisions, limited empirical evidence compares how these biases differ across investor groups classified by age and experience. Existing studies often treat investors as a homogeneous group, overlooking variations in susceptibility to specific biases. This study addresses this gap by examining six key behavioural biases among young and experienced investors within the context of an emerging market.

RESEARCH METHODOLOGY

The study follows a descriptive research design to examine behavioural biases influencing investment decisions. Primary data were collected through a structured questionnaire administered to investors in Guwahati, while secondary data were sourced from journals, articles, and research papers. Judgment sampling was adopted to ensure the inclusion of respondents who met the specific criteria of age and investing experience, which were essential for comparing young and experienced investors. The final sample consisted of 94 investors who satisfied these criteria. Data were analysed using tables and charts in Microsoft Excel, and associations between variables were tested using the Chi-Square technique.

RESEARCH HYPOTHESIS

Based on the objectives of the study and the behavioural finance framework, the following hypotheses were developed to examine the association between investor characteristics and the selected behavioural biases

H₁: *There is a significant association between investors' experience and the level of risk undertaken by them.*

H₂: *Young investors are more likely to exhibit Overconfidence bias compared to experienced investors.*

H₃: *There is no association between investor types in exhibiting Loss Aversion bias.*

H₄: *There is no association between investor types in exhibiting Herding bias.*

H₅: *There is no relationship between investor types and Anchoring bias*

H₆: *Young investors are more likely to exhibit Mental Accounting bias compared to experienced investors.*

H₇: *There is no association between investor types in exhibiting Representativeness bias.*

DATA ANALYSIS AND INTERPRETATION

Table 6.1(a): Age of Respondents

Years of Experience	Respondents	Percentage
Below 1	4	4%
1 to 2	9	9%
2 to 3	17	18%
3 to 4	13	14%
4 to 5	29	30%
Above 5	24	25%
Total	96	100%

Table 6.1(b): Years of Experience of Investment

Age (in Years)	Respondents	Percentage
Below 20	12	13%
20-30	29	30%
30-40	24	25%
Above 40	31	32%
Total	96	100%

Source: Created by Author

Interpretation

From the above Table 6.1(a) and Table 6.1(b), we see that the total respondents are classified on the basis of age groups and years of investigating in the stock market. From Table 6.1(a), we see that 13 percent of the total respondents were below the age group of 30, as they have just started investing in these new arenas. 30 percent of respondents were in the age group 20-30 years, and 25 percent were in the age group of 30-40 years. The highest number of respondents, i.e., 32 percent, belong to the above 40 years of age group category, as they were investing in the stock market for a longer period of time. Correlating with the age group, the researcher depicts the years of investment experience in Figure 6.1(b). From table 6.1(b), it can be interpreted that almost 45 percent of the total respondents had experience of investing in the stock market for a period below 4 years which can be classified as: 4 percent had experience of below 1 year, 9 percent and 18 percent had experience of around 2 years and 3 years respectively and 14 percent had experience of about 4 years. The remaining 55 percent of respondents had the experience of investing in the stock market for 4 years and above, where 30 percent had experience of 4 to 5 years, and 25 percent had experience of more than 5 years.

The total number of responses collected by the questionnaire was 96. After carefully analysing the above two tables, the researcher trimmed down the sample into two sub-samples based on her judgement:

- The first sample comprises respondents who are below 30 years of age and have experience of investment of less than 4 years
- The second sample comprises respondents aged above 30 years and having investment experience of more than 4 years.

Out of these, 2 respondents who were above 30 years of age but had experience of less than 4 years were omitted using judgment criteria, which makes the final sample count to 94 respondents that will be further used for the study. The final sample profile is filtered and depicted in the following table.

Table 6.2: Profile of Final Sample Respondents

Experience	Age >30	Age <30	Total
Up to 4 years	41	-	41
4 years and above	-	53	53
Total	41	53	94

Source: Created by Author

What is your most preferred form of investment instrument?

Table 6.2(a): Table showing the preferred form of investment for young investors

Preferred form of Investment	No of Respondents
Shares and Stocks	17
Mutual Funds	15
Derivatives	6
Gold	0
Foreign Exchange	3
Total	41

From Table 6.2(a), we can see that shares and stocks are the most preferred form of investment for the young investors having experience of less than 4 years, followed by mutual funds. Derivatives is also another option that is considered for investment by young investors and also for foreign exchange.

Source: Created by Author

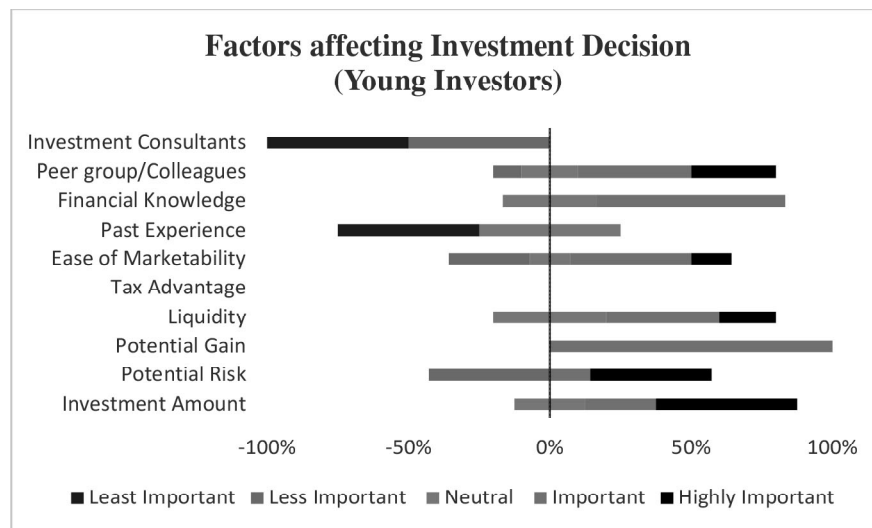
Table 6.2(b): Table showing the preferred mode of investment for experienced investors

Preferred form of investment	No of Respondents
Shares and Stocks	20
Mutual Funds	13
Derivatives	4
Gold	11
Foreign Exchange	5
Total	53

From Table 6.2(b), it can be interpreted that shares and stocks are the most preferred investment type for the experienced investors as well followed by mutual funds and gold. 4 and 5 experienced investors out of the total invested in derivatives and foreign exchange as investment avenues.

Source: Created by Author

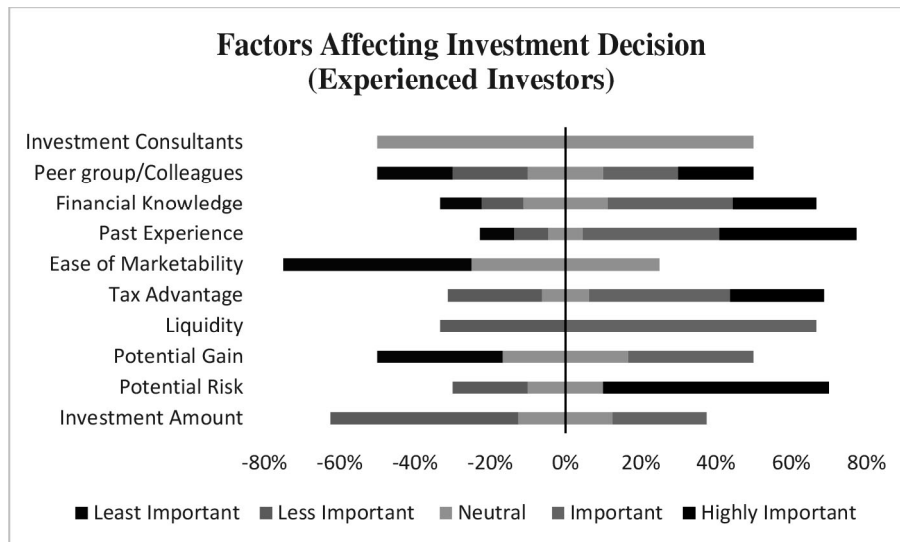
Figure 6.3 (a): Figure showing factors that imply investment decision for Young Investors



Source: Created by Author

From Figure 6.3(a), the researcher depicts the various factors that have an implication on the investment decision-making for the young investors. The highly anticipated factors that have a major impact include the amount of investment, followed by the potential risk, advice from peer groups and colleagues, financial knowledge and liquidity. Tax advantage is a factor that is considered important by young investors, as well as past experience, as they are themselves quite new in the market. Also, the young investors follow their gut and research before investing and don't rely much on the investment consultants. Ease of marketability, liquidity and potential gain are also some of the factors that are given considerable importance by the young investors.

Figure 6.3(b): Figure showing Factors that have an implication in Investment Decision for Experienced Investors



Source: Created by Author

From Figure 6.3(b), the various factors that imply the investment decision for the experienced investors are shown. Potential risk from a particular investment avenue, followed by experience and financial knowledge, are the most sought factors before making a decision. Tax advantage before making any investment, and advice from peer groups and colleagues is also taken into account. Relying on investment consultants as well as the amount of investment doesn't hold much importance before making the investment decision. Liquidity, Ease of marketability, and potential gain are also some factors that hold a considerable amount of importance.

Methods used for Analysis and Hypothesis Testing: Chi-Square Test for Independence

Chi-Square test is a non-parametric statistical test used to find an association between two variables. It is used to test whether two classifications of the sample are independent or not. Generally, it can be applied only to discrete data; however, continuous data can also be tested using the Chi-Square test by classifying it as discrete data and labelling them using nominal variables (Maxwell,1971)

The formula for the Chi-Square Test is as follows:

$$X^2 = \sum (O-E)^2/E$$

Where O = Observed frequencies

E= Expected frequencies

$\sum$ = the “sum of”

Lists of hypotheses formulated for the study

1. H_0 : There exists no significant association between investors’ experience and the level of risk undertaken by them

H_1 : There exists a significant relationship between investors’ experience and the level of risk undertaken by them

Table 6.4(a): Contingency Table showing the association between investors’ experience and level of risk

Levels of Risks	Observed Values			Expected Values		
	Young Investors	Experienced Investors	$X^2=(O - E)^2/E$	Young Investors	Experienced Investors	$X^2=(O - E)^2/E$
Low Risk	7	15	0.70	9.60	12.40	0.54
No Risk	0	8	3.49	3.49	4.51	2.70
High Risk	21	23	0.17	19.19	24.81	0.13
Very High Risk	13	7	2.10	8.72	11.28	1.62
Total	41	53	6.46	41	53	11.45

Observation:

Level of significance: (0.05) 5%

Chi Square Test	
X ²	11.45
df	3
p-value	0.01

Since the p-value (0.01) is less than the level of significance (0.05), the null hypothesis is rejected. Hence it is concluded that there is a significant association between the investor's experience and the level of risk undertaken by them.

Table 1.4(b): Chi Square Test: Risk Level

2. H₀: Young investors are not likely to be more overconfident than experienced investors

H₁: Young investors are likely to be more or less overconfident than experienced investors

Table 6.5 (a): Contingency Table showing Overconfidence Bias and Investors' Experience

OVERCONFIDENCE BIAS	Observed values			Expected Values		
	Young Investors	Experienced Investors	X ² =(O-E) ² /E	Young Investors	Experienced Investors	X ² =(O-E) ² /E
Overconfident	17	3	7.85	8.72	11.28	6.07
Slightly Overconfident	9	5	1.37	6.11	7.89	1.06
Confident	10	23	1.34	14.39	18.61	1.04
Slightly Diffident	4	14	1.89	7.85	10.15	1.46
Diffident	1	8	2.18	3.93	5.07	1.69
Total	41	53	14.63	41	53	11.32

Observation:

Level of significance: (0.05) 5%

Since the p-value (0.0003) is less than the level of significance (0.05), the null hypothesis is rejected. Hence it can be concluded that the young investors are likely to be more overconfident than the experienced investors

Table 6.5(b): Chi-Square Test: Overconfidence Bias

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- 3. H_0 :** There is no association between investor types and Loss Aversion Bias
 H_1 : There is association between investor types and Loss Aversion Bias

Table 6.6 (a): Contingency table showing Loss Aversion Bias and Investors' Experience

LOSS AVERSION BIAS	Observed Values			Expected Values		
	Young Investors	Experienced Investors	$X^2=(O-E)^2/E$	Young Investors	Experienced Investors	$X^2=(O-E)^2/E$
Very Easy	6	7	0.02	5.67	7.33	0.01
Easy	8	8	0.15	6.98	9.02	0.12
Average	9	14	0.11	10.03	12.97	0.08
Difficult	10	13	0.0001	10.03	12.97	0.0001
Very Difficult	8	11	0.01	8.29	10.71	0.01
Total	41	53	0.28	41	53	0.22

Observation:

Level of Significance: (0.05) 5%

Since the p-value (0.97) is more than the level of significance (0.05), the null hypothesis is retained. Hence, it can be included that there is no association between investor types and loss aversion bias. Thus, both investor types are equally likely to exhibit loss aversion bias.

Table 6.6(b): Chi-Square Test: Loss Aversion Bias

Chi-Square Test for Loss Aversion Bias	
X ²	0.5052
Df	4
p-value	0.97

4. H_0 : There is no association between investor types and Herding Bias

H_1 : There is an association between investor types and Herding Bias

HERDING BIAS	Observed Values			Expected Values		
Basis	Young Investors	Experienced Investors	$X^2=(O-E)^2/E$	Young Investors	Experienced Investors	$X^2=(O-E)^2/E$
Self	18	20	0.12	16.57	21.43	0.09
Brokers/ Friends	10	19	0.55	12.65	16.35	0.43
Media/Experts	13	14	0.13	11.78	15.22	0.10
Total	41	53	0.80	41	53	0.62

Table 6.7(a): Contingency Table showing Herding Bias and Investor' Experience

Observation:

Level of Significance: (0.05) 5 %

Chi Square Test for Herding Bias	
X^2	1.43
Df	2
p-value	0.49

Since the p-value (0.49) is greater than the level of significance (0.05), the null hypothesis is retained. Hence it can be concluded that there is no association between investor types and herding bias. Thus, both types of investors are equally likely to exhibit herding behaviour.

Table 6.7(b): Chi-Square Test: Herding Bias

5. H_0 : There is no relationship between investor types and Anchoring bias

H_1 : There is a relationship between investor types and Anchoring Bias

ANCHORING BIAS	Observed Values			Expected Values		
	Young Investors	Experienced Investors	$X^2=(O-E)^2/E$	Young Investors	Experienced Investors	$X^2=(O-E)^2/E$
Never	3	15	3.00	7.85	10.15	2.32
Rarely	7	26	3.80	14.39	18.61	2.94
Sometimes	15	6	3.72	9.16	11.84	2.88
Usually	9	4	1.96	5.67	7.33	1.51
Always	7	2	2.41	3.93	5.07	1.86
Total	41	53	14.88	41	53	11.51

Table 6.8(a): Contingency table showing Anchoring Bias and Investors' Experience

Observation

Level of Significance: (0.05) 5%

Chi-Square Test for Anchoring Bias	
X^2	26.4
df	4
p-value	0.00003

Since the p-value (0.00003) is less than the level of significance (0.05), the null hypothesis is rejected. Hence, it can be concluded that there is a relationship between Investor types and anchoring Bias. Thus, both the investor types are likely to respond differently to this bias. Young investors are more affected by its presence and base their decisions on it, compared to experienced investors who rarely depend on anchoring factors to make their decisions.

Table 6.8(b): Chi-Square Test: Anchoring Bias

6. H_0 : Both investor types are equally likely to be subjected to Mental Accounting Bias

H_1 : Young investors are more likely to exhibit Mental Accounting Bias compared to experienced investors

MENTAL ACCOUNTING BIAS	Observed Values			Expected Values		
	Young Investors	Experienced Investors	$X^2=(O-E)^2/E$	Young Investors	Experienced Investors	$X^2=(O-E)^2/E$
Yes	18	11	2.26	12.65	16.35	1.75
No	7	23	2.83	13.09	16.91	2.19
Sometimes	16	19	0.04	15.27	19.73	0.03
Total	41	53	5.13	41	53	3.97

Table 1.9(a): Contingency Table showing Mental Accounting Bias and Investor Experience**Observation**

Level of Significance: (0.05) 5%

Chi-Square Test for Mental Accounting Bias	
X ²	9.10
df	2
p-value	0.01

Since the p-value (0.01) is less than the level of significance (0.05), the null hypothesis is rejected. Hence, it can be concluded that both investor types are not equally likely to be subjected to Mental Accounting Bias. And we accept the alternative hypothesis which states that young investors are more likely to be affected by the mental accounting bias.

Table 6.9(b) Chi-Square Test: Mental Accounting Bias

7. **H₀**: There is no association between investor types and Representativeness Bias

H₁: There is an association between investor types and Representativeness Bias

REPRESENTATIVENESS BIAS	Observed Values			Expected Values		
Degrees of Representativeness	Young Investors	Experienced Investors	$X^2 = (O - E)^2 / E$	Young Investors	Experienced Investors	$X^2 = (O - E)^2 / E$
Never	5	9	0.20	6.11	7.89	0.16
Really	8	6	0.59	6.11	7.89	0.45
Sometimes	10	17	0.27	11.78	15.22	0.21
Usually	12	14	0.04	11.34	14.66	0.03
Always	6	7	0.02	5.67	7.33	0.01
Total	41	53	1.11	41	53	0.86

Table 6.10(a): Contingency Table showing Investors' Experience and Representativeness Bias**Observation**

Level of Significance: (0.05) 5%

Chi-Square Test for Representativeness Bias	
X ²	1.97
df	4
p-value	0.74

Since the p-value (0.74) is more than the level of significance (0.05), hence the null hypothesis is retained. Thus, it can be concluded that there is no association between investor types and representativeness bias i.e., both the investor types are equally likely to get affected by representativeness bias. Both young and the experienced investors depend on the past records and performances of a particular company or stock before investing.

Table 6.10(b): Chi-Square Test: Representativeness Bias

FINDINGS

- From the above analysis, the researcher has firstly classified the sample into two sub-samples based on investing experience, where the first sample consists of 41 respondents aged below 30 years, having an experience of less than three years in the market, and the other consists of 53 respondents aged above 30 years and having investing experience of more than 3 years.
- As per the study, the most preferred mode of investment for both young and experienced investors is the stock market, followed by mutual funds and derivatives to a certain extent. Gold is a mode of investment preferred by only experienced investors in this case.
- When surveyed about the factors that imply an investment decision, it was found that the amount of investment holds importance for the younger investors, combined with the potential risk and financial knowledge. Tax advantage was a factor that didn't have a bearing at all on their decision.
- For the experienced investors, the factors that hold considerable importance in their decision to invest include potential risk, experience, and financial knowledge. Advice from peer groups and colleagues, and tax advantages are also considered while taking the investment decision.
- Apart from the above factors, potential gain, ease of marketability, and liquidity are some factors that have a notable bearing on the investment decision of both the young and experienced investors.
- Another important finding from the study was to analyse the relation between the investor types and the level of risk undertaken by them. Using the Chi-Square test, it was found that there was a significant relationship between the level of risk and the investor's experience, as the p-value was less than the level of significance. The young investors comparatively were willing to take higher risk as per our analysis.
- As per the second hypothesis, the overconfidence bias was tested. Since the p-value was less than the level of significance, hence the null hypothesis was rejected. Thus it was concluded that the young investors were more overconfident than the experienced investors.
- The next two biases that were tested using the Chi-Square test were the Loss Aversion Bias and Herding Bias. The p-value in both cases was more than the level of significance (0.05), as a result of which the null hypothesis was retained.

Hence, it was concluded that both investor types equally exhibited loss aversion bias and herding bias.

- Anchoring and Mental Accounting biases were the next biases that were tested using the Chi-Square test. As the p-value in both biases was less than the level of significance, the null hypothesis was rejected. Thus, there was a significant difference between the investor's experience and the biases, and it can be concluded that the young investors responded to these biases and were more affected compared to the experienced investors.
- Finally, the sixth identified bias i.e., Representativeness Bias, was tested, where the null hypothesis was retained as the p-value was more than the significance level. Hence, it was concluded that both young and experienced investors exhibited similar behaviour when subjected to representativeness bias.

DISCUSSION

The results of the study highlight clear behavioural differences between young and experienced investors. Young investors displayed higher levels of overconfidence, anchoring, and mental accounting biases, indicating greater susceptibility to cognitive distortions during decision-making. In contrast, both investor groups exhibited comparable levels of loss aversion, herding, and representativeness biases, suggesting that certain emotional tendencies persist irrespective of investing experience. The significant association between experience and risk-taking further reinforces the idea that maturity in the market enhances risk assessment ability. Overall, the findings support behavioural finance theories that psychological factors strongly shape investment behaviour and that these biases vary across demographic and experiential segments.

CONCLUSION

Behavioural finance is a concept that has gained considerable recognition as a vital investment tool worldwide. The concept came into relevance during the 1980s studies the effect of psychology on decision making. It explains how different investors interpret new information differently and act accordingly. It tries to supplement and add to the already existing financial theories by taking into consideration the premise that human behaviour differs according to situations, and it cannot be rational at all times. The level of risk undertaken by investors, as well as the factors that lead to choosing a preferred mode of investment, depends upon the age as well as experience of the investors. Investment decisions in general are largely affected by various micro and macro variables like inflation, demand and supply, money supply, bull and bear trends in the stock market, regulatory authorities, etc. Apart from these, investment decisions are also affected by psychological biases of individual investors, like overconfidence bias, herding behaviour, loss aversion bias, anchoring bias, etc. All these factors trigger a sense of irrationality among the investors, which leads them to take biased decisions while investing in the market, which may cause them huge

losses in the future. This study particularly aims to test the presence of six identified and most popular biases in the field of behavioural finance and the reaction of the two groups of investors to such biases.

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Uncertainty Quantification of Risk to Human Health Due to Heavy Metal Content in Drinking Water Using Probability Theory: A Case Study in Ingestion

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Abstract

The main aim of risk assessment is to determine the potential detriment to human health from exposure to a substance or activity that, under plausible circumstances, can cause harm to human health. Risk assessment models involve inputs that may not be precisely known (Red-Horse & Benjamin, 2004). The uncertainty of the inputs gets propagated to the output risk. So, we need to quantify the uncertainty to be aware of the risk involved in any decision-making process. Uncertainties can be modeled and analyzed using different theories, viz. Probability theory, Possibility theory, Evidence theory, etc. Modeling of an uncertain parameter depends on the nature of the information available (Baudrit et al, 2006). In this paper, the author considered uncertainty quantification of parameters in the case of radiological risk assessment.

The author has analyzed the propagation of the risk in terms of Probability theory. If parameters used in the prescribed model are random in nature and follow a well-defined distribution, then probabilistic is the most suitable and well-accepted approach. In this study, advanced probabilistic techniques p-box method, are applied to estimate the radiological risk due to ingestion.

Keywords: Risk Assessment, Uncertainty, Variability, Probability theory, p-box.

INTRODUCTION

Human beings are always exposed to radiation either from natural or anthropogenic sources in the environment. While there have been natural nuclides since the beginning of the Earth's existence, manmade nuclides have been released from nuclear installations and fallouts from nuclear tests and nuclear accidents. Also, produced water is the most significant source of waste generated in the production phase of oil and gas operations (Shuai Zhang et al, 2023). Once discharged into the ocean, several heavy metals and polycyclic aromatic hydrocarbons in produced water may introduce toxicity and bioaccumulation in marine organisms. These

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compounds are harmful to human health, and therefore, humans can be affected through the intake of such water. Consequently, we can say that human health can also be indirectly (or directly) affected through different pathways such as inhalation, ingestion, submersion, and dermal contact.

When hazardous substances are released into the environment, an evaluation is necessary to determine the possible impact such substances may have on human health and other biota. For this purpose, risk assessment is performed to quantify the potential detriment to humans and evaluate the effectiveness of proposed remediation measures. The assessment is performed using 'models' and a 'model' is a function of parameters, which are usually affected by aleatory and epistemic uncertainty (Ferson et al, 2003). Aleatory uncertainty and epistemic uncertainty are two distinct facets of uncertainty in risk assessment. Aleatory uncertainty arises from heterogeneity or the random character of natural processes, while epistemic uncertainty arises from the partial character of our knowledge of the natural world. Epistemic uncertainty can be reduced by further study, while aleatory uncertainty cannot be reduced. Here, we have considered that parameters are affected by epistemic uncertainty.

If the representation of the input parameters of the risk model is in a probabilistic sense, the output risk distribution may reflect probabilistic information. Resalable and sufficient data is required to estimate and characterize the probability distribution of the input variables. Exposure Pathways:

An exposure pathway is any route that a chemical may travel from an environmental source to a receptor. An exposure mainly chemical source, release mechanism (e.g., leaking, leaching, wind erosion), a transport and/or exposure medium (e.g., air, water, soil, sediment, food), an exposure points with receptors present or potentially present (actual location where exposure is possible), and a route of entry (inhalation, ingestion, dermal contact) (Karanki et al, 2009).

In this case study, the author takes an ingestion risk model and evaluates the ingestion risk for heavy metals, mainly Zn, Cu, Ni, Pb, and As, to assess the human health from drinking water contaminated.

PROBABILITY BOX (P-BOX) METHOD

If the cumulative distribution functions for some variable lie on or between two monotonic curves, then these curves form a box that can be called a probability box or p-box for that variable. A real-valued random variable is characterized by its distribution function, which is a monotonically increasing function from the real numbers into the interval $[0, 1]$ such that the value of the function at negative infinity is zero and the value of the function at positive infinity is one. A probability box or "p-box" consists of a pair of such functions that are used to circumscribe an imprecisely known distribution function F .

Suppose $\overline{F}$ and $\underline{F}$ are nondecreasing functions from the real line $\mathbb{R}$ into $[0, 1]$ and $\underline{F}(x) \leq \overline{F}(x)$ for all $x \in \mathbb{R}$. Let $[\overline{F}, \underline{F}]$ denote the set of all nondecreasing functions

F from the reals into $[0, 1]$ such that $\underline{F}(x) \leq F(x) \leq \overline{F}(x)$. When the function $\overline{F}$ and $\underline{F}$ circumscribe an imprecisely known probability distribution, we call $[\underline{F}, \overline{F}]$, specified by the pair of functions, a "Probability box" or "P-box" for that distribution. This means that, if $[\underline{F}, \overline{F}]$ is a P-box for a random variable X whose distribution F is unknown except that it is within the P-box, then $\underline{F}(x)$ is a lower bound on $F(x)$ which is the (imprecisely known) probability that the random variable X is smaller than x . Likewise, $\overline{F}(x)$ is an upper bound on the same probability [3]. In the probability box $[\underline{F}, \overline{F}]$, the gap between $\overline{F}$ and $\underline{F}$ reflects the incomplete nature of the knowledge, or in other words, it gives the amount of epistemic uncertainty.

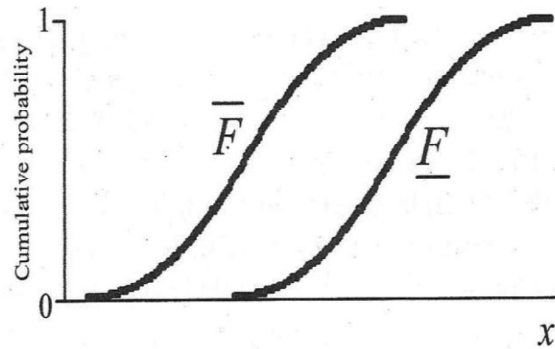


Fig. 1: p-box with upper and lower bounds

The idea of p-boxes is that the output p-box will contain all possible output distributions that could result from the input distributions, assuming the distributions of the random quantities actually lie in their respective p-boxes. We can use a p-box to circumscribe the uncertainty about a probability distribution in the same way that an ordinary interval is used to circumscribe uncertainty about a scalar number. If the probability distribution is completely specified, these bounds are coincident. A p-box represents both uncertainty and variability at the same time.

There are two kinds of p-box. One is a parametric p-box, and the other is a nonparametric p-box. For parametric models where the distribution is specified, but the parameters of the model are described by intervals. Such a type of p-box is called a parametric p-box. But some p-boxes do not need a large amount of information. Such types of p-box can be constructed based on namely minimum, maximum, mean, median, mode, variance, percentile, etc. This type of p-box is called a nonparametric p-box.

Probability boxes can be used wherever a probability distribution can be used. P-boxes can be freely combined with scalars, intervals, and probability distributions in mathematical expressions. It is not needed whether a variable is a precisely specified

distribution or only bounds on a possibility distribution. Advantages of P-boxes are that there is a method for combining P-boxes for different random quantities without assuming anything about the dependence between random quantities, and they are useful tools for risk and sensitivity analysis.

A CASE STUDY ON HUMAN HEALTH RISK DUE TO HEAVY METAL.

In this case study, the author has considered some realistic data form (Saikia, 2012). From the prescribed data, the author has taken the data in terms of minimum, most likely, and maximum value of activity of the heavy metals Zn, Cu, Ni, Pb, and As in two sources of water, one is tubewell water, and the other source is from a ring well, PWS, and supply water. Using this data, calculate the health risk for the heavy metal by the p-box Method and compare the total risk of these two sources.

Since nothing is known about the nature of the parameters of the concentration, we can model them as probabilistic. In probabilistic terms, the standard way of modeling such a parameter is a p-box, with minimum and maximum values. This representation has only epistemic uncertainty. Here we have used the Risk Calc Software for calculation (Ferson, 2002).

Table 1: Values of heavy metal content in water (Saikia, 2002)

Heavy metal	Tube well water		Ring well, PWS, and supply water		Representation
	Min	Max	Min	Max	
Zn	0.55	3.91	0.09	2.20	p-box
Cu	0.013	0.049	0.014	0.178	p-box
Ni	0.019	0.084	0.011	0.076	p-box
Pb	0.03	0.40	0.02	0.23	p-box
As	0.006	0.118	0.002	0.069	p-box

Table 2: Intake of water (L/Year) (As per FGR-13)

Min	Most likely Value (MLV)	Max	Representation
803	1095	1482	Triangular distribution

Table 3:Risk factor (As per FGR-13)

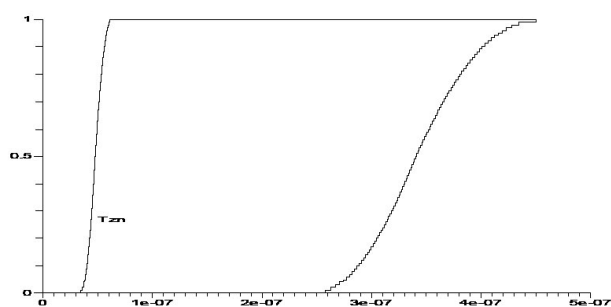
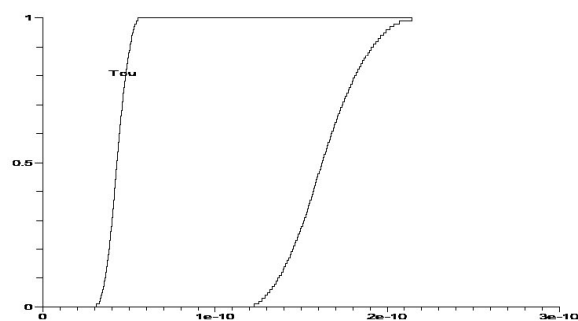
Heavy metal	Risk factor
Zn	7.77E-11
Cu	2.95E-12
Ni	4.54E-11
Pb	1.15E-12
As	2.29E-12

RESULTS AND DISCUSSIONS

The author has considered the following model for risk assessment.

Risk due to ingestion of water:

$\text{Risk(/Yr)} = \text{water activity (Bq/L)} \times \text{water intake (L/Yr)} \times \text{Risk factor(/Bq)}.$

**Fig.2 Risk due to Zn in Tube well water****Fig.3 Risk due to Cu in Tube well water**

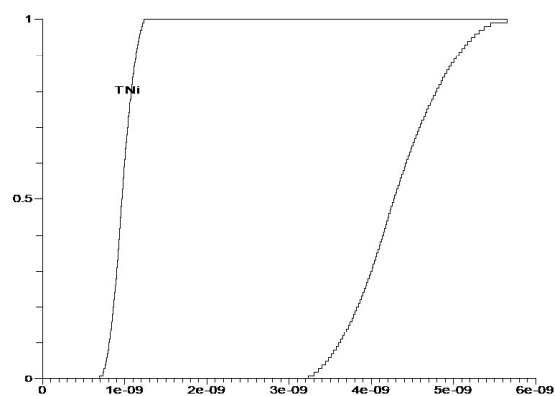


Fig.4 Risk due to Ni in Tube well water

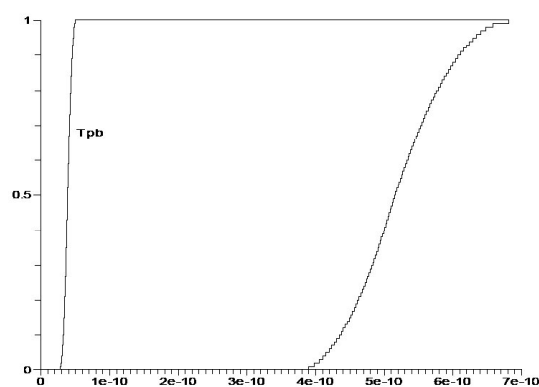


Fig.5 Risk due to Pb in Tube well water

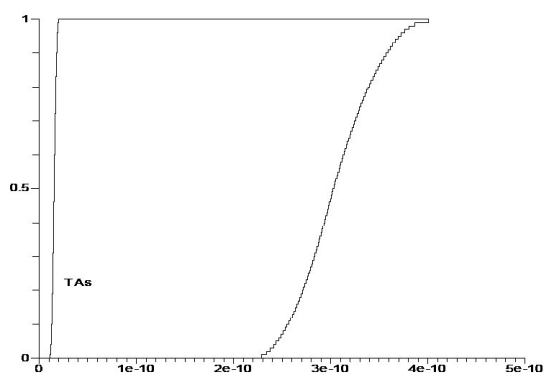


Fig.6 Risk due to As in Tube well water

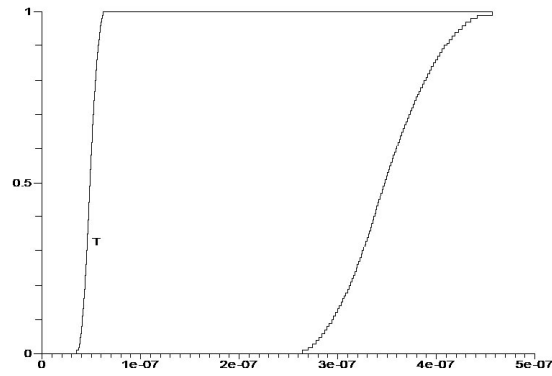


Fig.7 Total Risk(T) due to Tube well water

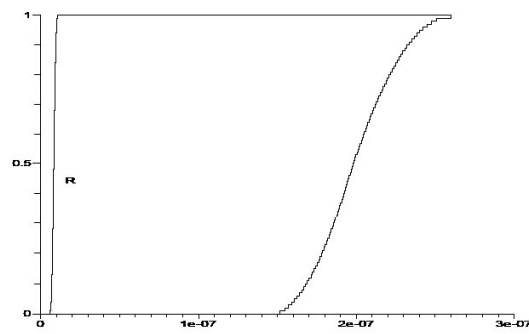


Fig.8 Total Risk(R) due to Ring well,

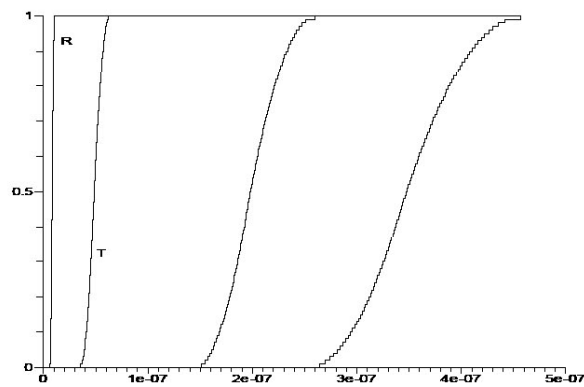


Fig.9 Comparisons of Total Risk(T &R) PWS and supply water

The objective of the uncertainty analysis is to quantify uncertainty in model output. Quantification of uncertainty helps in effective uncertainty management and increases confidence in the results. Here, we compare the risk for heavy metals contained in Tube well water and water from the Ring well, PWS, and supply water. Fig. 2 and Fig. 3 show the risk due to Zn and Cu in tube well water. The risk due to heavy metal Ni is shown in Fig. 4. Figs. 5 and 6 show the risk due to Pb and As in tube well water. Fig. 7 represents the total risk T, i.e., risk due to all the heavy metals Zn, Cu, Ni, Pb, and As contained in tube well water. Similarly, we can evaluate the total risk R for the ring well, PWS, and supply water, which is shown in Fig. 8. Fig. 9 shows the comparison of both the risk T and R. The red fig. indicates the total risk due to tube well water, and in blue figure indicates the total risk due to ring well, PWS, and supply water. In the Fig. 7, the resultant p-box gives the range in the interval $[3.50784e-08, 4.5719e-07]$, and mean as $[4.9069824e-08, 0.0000004]$. In the Fig. 8, the resultant p-box gives the range in the interval $[6.07171e-09, 2.59851e-07]$ and mean as $[8.4934774e-09, 0.0000002]$. From the figure, we observe that uncertainty in risk calculation is higher in the case of tube well water as compared to the water source of ring well, PWS, and supply water. The findings from this study can be immensely valuable for decision-makers seeking to formulate more effective strategies to reduce the risk to human health due to heavy metal content in drinking water.

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Analyzing the Relationship between NPAs and Profitability in Indian Banking: A Sectoral Comparison

Santanu Nandan Kashyap*

Abstract

Nonperforming assets (NPAs) have also become the most pressing problem in the Indian banking sector. High NPAs reduce financial strength and liquidity and affect profitability. The current study examines the nexus between NPAs and profitability in both sectors of Indian banks (i.e., public and private sectors). The numerical values obtained from RBI publications, banks' annual reports, and academic journals for 2023-2025 have been used for this research as secondary data. Gross NPA, Net NPA, Return on Assets, and Return on Equity are examined to determine the relationship between NPAs and Banks. This observation uncovers a high negative correlation between NPAs and profitability. Public sector banks provide evidence of greater vulnerability than private sector banks, primarily due to the vulnerability to large infrastructure loans and governance inefficiencies. The study highlights that it is crucial to bring down NPAs by leveraging technological credit tracking, Insolvency and Bankruptcy Code (IBC) frameworks, and careful risk management to revive profitability and stability in Indian banking.

Keywords: *Non-Performing Assets, Profitability, Return on Assets, Return on Equity, Banking Risk Management.*

INTRODUCTION

The banking industry plays a crucial role in channeling financial resources and facilitating the smooth running of the economy. Banks extend loans to customers, firms, and governments, stimulating investment and consumption. Nonetheless, loaning involves default risk by nature. Loan defaulter, unpaid credit card debt, and nonperforming mortgages are examples of nonperforming assets.

A Nonperforming asset is a loan or credit that ceases to generate income for the Bank. However, the current policy introduced a new time span for NPA. A loan becomes a nonperforming asset when interest or principal remains overdue for over 90 days (RBI, 2010). Non-performing Assets (NPAs) are loans or advances issued by banks or financial institutions that no longer bring in money for the lender since the borrower has failed to make payments on the principal and interest of the loan for at least 90

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days. A debt that has been past due and unpaid for a predetermined period is known as a nonperforming asset (NPA) (Groww, 2025).

There are three types of NPA according to the RBI Master Circular (2010):

- Sub-standard Assets: Remain NPA for less than 12 months.
- Doubtful Assets: Remain NPA for more than 12 months.
- Loss Assets: Identified as uncollectible and of little value.

Profitability measures, such as Return on Assets (ROA) and Return on Equity (ROE), reflect how efficiently banks generate returns from their assets and shareholders' investments. High NPAs reduce interest income, increase provisioning costs, and reduce profitability.

According to a report written by Mittal (2025), the NPA crisis in India refers to the surge in bad loans held by banks, particularly public sector banks, due to borrower defaults. This crisis has been caused by economic slowdowns, aggressive lending practices, and project delays. The impact of the NPA crisis has been significant, with banks facing reduced profitability and limited lending capacity. In turn, NPAs have affected economic growth and eroded investor confidence in the banking sector.

To address the NPA crisis, the Indian government and regulatory bodies have implemented several measures. These include the establishment of Debt Recovery Tribunals as well as the SARFAESI Act that works on the Insolvency and Bankruptcy Code (Padhya & Sahoo, 2023). The National Asset Reconstruction Company Ltd. (NARCL) has been set up to enquire into and resolve stressed assets. Thus, the NPA crisis has highlighted the requirement for robust credit appraisal and risk management practices in banks. By addressing the root causes of the crisis and implementing effective measures, India can reduce NPAs and promote financial stability.

LITERATURE REVIEW

Numerous studies have examined the impact of Nonperforming Assets (NPAs) on banking performance. Ganesan and Santhanakrishnan (2013) stated that NPAs reduce banks' lending capacity and pose systemic economic risks.

Rising NPAs negatively affect the profitability of the Banks. It particularly affects Return on Assets (ROA) and Return on Equity (ROE) in public sector banks as well as private banks. The RBI's Financial Stability Report (2018) highlighted the alarming levels of NPAs in sectors such as infrastructure, steel, and power, which have eroded banks' profitability and capital adequacy.

It was found that poor credit appraisal and political interference are some key factors contributing to high NPAs in public sector banks. In a more recent study, Jayakkodi and Rengarajan (2016) demonstrated a strong negative correlation between Gross NPAs (GNPA) and ROA in both public and private banks. However, the Insolvency and Bankruptcy Code (IBC) has been effective in improving recovery rates and

reducing stressed assets. It leads to a potential solution to the NPA challenge (Padhya & Sahoo, 2023).

RESEARCH GAP

The relationship between Nonperforming Assets (NPAs) and the profitability of Indian banks, particularly in the public and private sectors, has been explored in various studies. However, there are still some gaps that need to be addressed:

Limited scope in terms of time frame: Many studies focus on specific periods, such as pre- or post-liberalization, but few examine the long-term impact of NPAs on bank profitability, especially in the context of recent economic developments.

Comparative analysis between public and private sector banks: While some studies compare NPAs and profitability between public and private sector banks, few delve deeper into the differences in NPA management practices, risk assessment, and recovery strategies between these two types of banks.

Macroeconomic factors influencing NPAs: Research on the macroeconomic variables (such as GDP growth, inflation, interest rates, etc.) on NPAs and their relation to bank profitability is limited (IEEE xplore).

Bank-specific factors contributing to NPAs: There is scope for further investigation into the role of bank-specific factors. It includes credit appraisal processes, loan portfolio composition, and risk management practices.

Impact of regulatory changes: More exploration is necessary to understand the effects of regulatory changes, such as the Insolvency and Bankruptcy Code (IBC) and RBI's guidelines on NPAs, bank profitability, and management.

Sector-wise analysis: A sector-wise analysis of NPAs (i.e., priority sector lending, large corporate loans, and retail loans) is capable of providing valuable insights into the roots of NPAs and their impact on bank profitability.

OBJECTIVES OF THE STUDY

1. To analyze the trend of nonperforming assets (NPAs) in Indian banks from 2015 to 2023.
2. Comparison of the effect of NPAs on the profitability of Indian public and private sector banks.
3. To suggest solutions for improved NPA management and higher profitability for Indian banks

RESEARCH METHODOLOGY

Research Design

This study uses descriptive and analytical research designs to calculate the secondary data and investigate the impact of nonperforming assets (NPAs) on banks'

profitability. The descriptive design helps to describe the trends and patterns in NPAs and profitability, whereas the analytical design enables the examination of the relationship between these variables.

Data Collection

The Secondary data were collected from the following sources:

1. Financial Stability Reports (2015-2023), RBI
2. Annual reports of selected banks (SBI, PNB, ICICI Bank, HDFC Bank)
3. Economic Surveys by the Ministry of Finance
4. Journals, articles, and newspapers

These sources provide reliable and authentic data, enabling a well-defined analysis of the impact of NPAs on bank profitability.

Sampling Technique

The purposive sampling technique is used, which is instrumental in this study, as it enables the researcher to focus on banks with significant NPA issues and examine the impact on their profitability. The study uses well-known representatives of two public sector banks (SBI and PNB) and two private sector banks (HDFC and ICICI). This technique allows for the selection of banks that are representative of the Indian banking industry and have a significant impact on the economy.

Variables taken for the study are

- Independent Variable: NPAs (measured by Gross NPA ratio and Net NPA ratio)
- Dependent Variable: Profitability (measured by Return on Assets and Return on Equity)

Tools for Analysis

The study employs the following tools:

- Ratio analysis to assess NPAs and profitability trends
- Correlation analysis to measure the relationship between NPAs and profitability
- Comparative analysis between the private and public sector banks

These tools enable a thorough examination of the data and provide insights into the impact of NPAs on bank profitability.

RESULTS AND ANALYSIS

Trend of NPAs (2015-2023)

The analysis reveals that:

- Public Sector Banks (PSBs) such as SBI and PNB showed high GNPA ratios, reaching 10-12% in 2018, before declining to 5-6% by 2023 due to government-led recapitalization and IBC recoveries.
- Private Sector Banks such as HDFC and ICICI maintained relatively lower GNPA levels (1-3%).

Year	GNPA of a public sector bank	GNPA of a private sector bank	ROA of public sector bank (%)	ROA of private sector bank(%)
2015	6.0	2.0	0.5	1.5
2016	7.0	2.5	0.4	1.6
2017	9.0	3.0	0.2	1.5
2018	11.0	3.0	0.1	1.4
2019	12.0	2.5	0.0	1.5
2020	10.0	2.0	0.1	1.6
2021	8.0	1.8	0.3	1.7
2022	7.0	1.7	0.5	1.8
2023	6.0	1.5	0.7	1.9

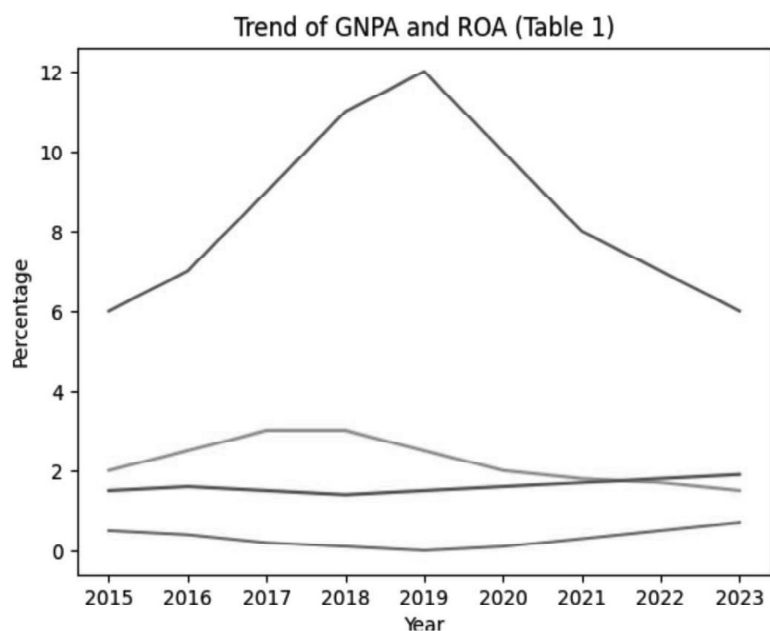


Table 2: GNPA Trends in public and private sector banks (2015-2023)

Bank type	GNPA Trend
Public sector banks	Peaked at 10-12% (2018), declined to 5-6%(2023)
Private sector banks	Maintained a relatively low GNPA level (1-3%)

The high GNPA ratios in PSBs indicate significant asset quality issues, while the decline in GNPA ratios post-2018 suggests the effectiveness of government initiatives and IBC recoveries.

Profitability Trends

The analysis shows that:

- Public Sector Banks experienced a decline in ROA, falling close to zero in 2018 when NPAs peaked, before improving slightly post-2020 with declining NPAs.
- Private Sector Banks maintained stable profitability, with ROA between 1% to 2%.

Table 3: ROA trends in public and private sector banks (2015-2023)

Bank type	ROA Trend(2015-2023)
Public sector banks	Declined to 0% in 2018, a slight recovery post-2020
Private sector banks	Stable ROA between 1-2%

The decline in ROA in PSBs indicates the significant impact of NPAs on profitability. The stable profitability of private sector banks suggests their resilience to NPA shocks.

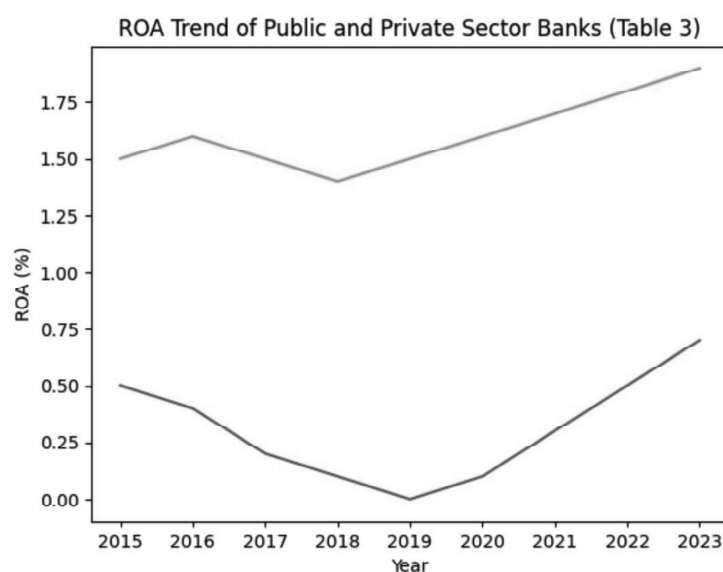


Table 4: Correlation between GNPA and ROA (public sector bank

Year	X	Y	x ²	y ²	xy
2015	6.0	0.5	36.0	0.25	3.0
2016	7.0	0.4	49.0	0.16	2.8
2017	9.0	0.2	81.0	0.04	1.8
2018	11.0	0.1	121.0	0.01	1.1
2019	12.0	0.0	144.0	0.0	0.0
2020	10.0	0.1	100.0	0.01	1.0
2021	8.0	0.3	64.0	0.09	2.4
2022	7.0	0.5	49.0	0.25	3.5
2023	6.0	0.7	36.0	0.49	4.2
Σ	76.0	2.8	680.0	1.3	19.8

Correlation**Given:**

$$\Sigma x = 76, \Sigma y = 2.8, \Sigma x^2 = 680, \Sigma y^2 = 1.3, \Sigma xy = 19.8, n = 9$$

Mean values:

$$\bar{x} = \frac{76}{9} = 8.44, \bar{y} = \frac{2.8}{9} = 0.311$$

Correlation coefficient r :

$$r = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}} r = \frac{9(19.8) - (76)(2.8)}{\sqrt{[9(680) - 76^2][9(1.3) - 2.8^2]}} r = \frac{178.2 - 212.8}{\sqrt{[6120 - 5776][11.7 - 7.84]}} r$$

$$= \frac{-34.6}{\sqrt{[344][3.86]}} = \frac{-34.6}{\sqrt{1328.84}} = \frac{-34.6}{36.45} = -0.949$$

Correlation coefficient (r) = -0.949This shows a **strong negative correlation** between x and y .**Regression equation of y on x**

$$b_{yx} = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{n\Sigma x^2 - (\Sigma x)^2} b_{yx} = \frac{178.2 - 212.8}{6120 - 5776} = \frac{-34.6}{344} = -0.1006$$

$$= 0.311 + 0.849 = 1.16$$

Regression equation: $y = 1.16 - 0.10x$

Table 5: Correlation between GNPA and ROE (private sector bank)

Year	X	Y	X ²	Y ²	xy
2015	2.0	1.5	4.0	2.25	3.0
2016	2.5	1.6	6.25	2.56	4.0
2017	3.0	1.5	9.0	2.25	4.5
2018	3.0	1.4	9.0	1.96	4.2
2019	2.5	1.5	6.25	2.25	3.75
2020	2.0	1.6	4.0	2.56	3.2
2021	2.0	1.7	4.0	2.89	3.4
2022	1.7	1.8	2.89	3.24	3.06
2023	1.5	1.9	2.25	3.61	2.85
Σ	20.2	14.5	47.64	23.57	32.96

Correlation:

Mean values:

$$\hat{x} = \frac{20.2}{9} = 2.244, \hat{y} = \frac{14.5}{9} = 1.611$$

Correlation coefficient :

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Substitute values:

$$r = \frac{9(32.96) - (20.2)(14.5)}{\sqrt{[9(47.64) - 20.2^2][9(23.57) - 14.5^2]}}$$

Compute step by step:

$$r = \frac{296.64 - 292.9}{\sqrt{[428.76 - 408.04][212.13 - 210.25]}} r = \frac{3.74}{\sqrt{[20.72][1.88]}} = \frac{3.74}{\sqrt{38.95}} = \frac{3.74}{6.24} = 0.599$$

Correlation coefficient (r) = 0.599

! This indicates a **moderate positive correlation** between x and y.

Regression equation of y on x

$$h_{yx} = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2} h_{yx} = \frac{178.2 - 212.8}{6120 - 5776} = \frac{-34.6}{344} = -0.1006 a = \hat{y} - h_{yx}\hat{x}$$

$$= 0.311 - (-0.1006)(8.44) = 0.311 + 0.849 = 1.16$$

Regression equation: $y = 1.205 + 0.181x$

The correlation analysis reveals a strong negative correlation between GNPA and ROA (-0.76) and a moderately negative correlation between GNPA and ROE (-0.69). This indicates that an increase in NPAs significantly reduces profitability.

The negative correlation between NPAs and profitability highlights the need for effective NPA management strategies to maintain financial stability and profitability in the banking sector.

Table 6: Correlation Result

Correlation pair	Value	Nature of the relationship
GNPA vs ROA	-0.95	Strong negative correlation
GNPA vs ROE	-0.59	Moderately negative correlation

DISCUSSION

The results validate that NPAs are a significant driver of bank profitability in India. Public sector banks are hit harder with political interference in lending, poor recovery processes, and higher exposure to infrastructure projects. Private sector banks, however, adhere to more rigorous credit appraisal systems and have different types of loan books, which insulate them from high NPAs.

NPAs negatively affect bank profitability through decreased income from interest, provisioning costs, higher operating expenses, and stretched capital adequacy. High NPAs decrease lending ability, investor confidence, and regulatory attention. Effective management of NPAs is essential to ensure profitability, financial health, and business expansion. Like India, other countries like the USA, China, South Korea, Portugal, Ireland, Greece, and Japan also have the NPA problem in their countries.

Key Reasons for NPAs in India

There are many reasons why India's Nonperforming Assets (NPAs) are going up. A slowdown in the economy has hurt businesses' profits, making it hard for them to pay off their debts, especially in areas like infrastructure, real estate, power, and manufacturing. During the boom of the mid-2000s, banks, especially those in the public sector, made risky loans without properly checking the borrower's credit. This, along with weak assessment systems, meant that loans were given out without properly checking the borrower's credentials or the project's viability. High-profile frauds and willful defaults by businessmen like Vijay Mallya, Nirav Modi, and Mehul Choksi showed even more problems with banking supervision. Land acquisition problems, regulatory hurdles, and lawsuits often cause delays in infrastructure projects, which can hurt cash flow and the ability to pay back loans. Borrowers have also had a hard time paying back loans because of changes in the global market and prices of goods that change quickly. Also, weak legal recovery methods, even with

the SARFAESI Act and debt recovery tribunals, make it take longer to get back loans. The situation has gotten worse because of lending to high-risk areas like agriculture and MSMEs, a bad credit culture, the misappropriation of funds, and a lack of monitoring of how the money is used. Lastly, political interference and crony capitalism in public sector banks have caused loans to be approved under pressure for companies with bad credit histories, which has made the NPA crisis much worse.

Impact of NPAs on the Profitability of Public Sector Banks

Nonperforming Assets (NPAs) seriously impact the profitability of Indian public sector banks. NPAs result in the depreciation of interest income, higher Provisioning, and higher operational expenses, and thus affect profitability adversely. Public sector banks struggle with NPAs because of willful defaults, weak credit appraisal processes, and project implementation lags. Nevertheless, public sector banks still suffer from high NPAs, which affect their financial performance and sustainability.

Impact of NPAs on the Profitability of Private Sector Banks

In India, although their NPA management practices are effective, private sector banks face the challenge of NPAs as well as public banks. It impacts private sector banks' profitability by reducing interest income and increasing provisioning requirements. However, private sector banks have been more efficient in adopting technology-driven solutions. They also perform risk management practices to reduce NPAs. The efficiency of private sector banks in managing NPAs has been relatively better than that of public sector banks (Mohan, 2022).

Comparative Impact on Profitability

Both Indian private and public sector banks are affected by NPAs. However, the extent of the problem appears to vary, considering the differences among their risk management practices and business models. Public sector banks are more prone to NPAs because of their penchant for priority sector and government-guided lending. It incurs lower quality on the asset for them. Private sector banks, however, enjoy greater autonomy over their lending strategies and can more efficiently deal with NPAs. As a whole, NPAs are a formidable challenge for the profitability and sustainability of both public and private sector Indian banks.

FUTURE SCOPE

The study of the relationship between nonperforming Assets and the profitability of both public and private banks of India can be used in many ways. Several promising research avenues that can help deepen the understanding in both NPAs and bank profitability include comparative studies related to NPA management practices in developed countries to glean best practices and policy lessons; use of machine learning

and predictive modeling for the detection of early warning signs and pre-emptive interventions; investigations on the role of digitalization using AI, blockchain, and advanced data analytics in reducing NPAs and improving operational efficiency; analysis of the relationship between ESG factors and NPAs to identify sustainable practices which will lower credit risk; and rigorous analysis pertaining to the impact of the COVID-19 pandemic on NPAs and bank profitability, along with strategies for managing stressed assets in a post-pandemic economy.

POLICY IMPLICATIONS

This study helps to inform policymakers on the effectiveness of recent policies' regulatory frameworks and helps to provide advice to improve NPA. This study helps to provide insights to bankers to strengthen banks' risk management practices, and those practices help reduce NPAs. Credit appraisal processes: By taking help of this study, policymakers can develop more effective credit appraisal processes that help to minimize NPAs.

Practical Applications

This study can be useful to reduce NPAs and increase profitability. That indirectly contributes to the financial stability of banks by identifying potential risks and giving suggestions to mitigate those risks. That indirectly supports the growth in the economy.

CONCLUSION

The study examined the relationship between Nonperforming Assets (NPAs) and bank profitability in Indian banks. A comparison between Public and Private sector banks from 2015 to 2023 was taken into consideration, which leads to a high negative correlation between NPAs and profitability, particularly affecting public sector banks. Reduction in lending capacity in sectors like infrastructure, manufacturing goods, and services causes a gradual decline in Bank profitability. It slows economic growth, leading to depressed employment and investor sentiment. Therefore, to mitigate the negative impact of NPAs, banks should strengthen risk management systems, including credit grading and risk analysis. Focusing on improving recovery mechanisms and judicial procedures for NPA resolution is an important task for the Bank. The Insolvency and Bankruptcy Code has shown promise, but further improvements are required for effective reduction of NPAs. By minimizing NPAs, banks can increase lending, facilitate investment, and support economic development. Nowadays, technological advancements (machine learning and AI) also help in detecting potential NPAs.

SUGGESTION

To reduce nonperforming Assets (NPAs) in a country, the government and the Reserve Bank of India (RBI) have implemented several measures.

Regulatory Measures: The Insolvency and Bankruptcy Code (IBC) provides for a comprehensive framework in terms of facilitating the reorganization and insolvency resolution of corporate entities, partnership firms, and individuals in a time-bound manner, with the intent of enhancing efficiency in debt recovery and promoting financial discipline. The SARFAESI Act grants the right to banks and financial institutions to take possession of and sell secured assets of defaulting borrowers without intervention by courts, ensuring faster recovery of dues. Debt Recovery Tribunals have also been established as specialized judicial bodies to handle cases pertaining to loan defaults by customers, thus helping and enabling banks to recover their dues through legal channels in a more effective and efficient manner.

Institutional Reforms: The setup of the “bad bank,” or the National Asset Reconstruction Company Ltd, essentially aims at the management and resolution of stressed assets through the acquisition of nonperforming loans from banks and their subsequent recovery or resolution. In tandem, the India Debt Resolution Company Ltd plays a very important role in facilitating the sale and resolution of these stressed assets in the market for cleaning up bank balance sheets and strengthening the entire financial system.

Recovery Mechanisms: Lok Adalats help in the amicable settlement of low-value NPA cases through conciliation between banks and borrowers, thus saving much time and money by avoiding lengthy legal procedures. One-Time Settlements refer to a process whereby banks can enter into direct negotiations with borrowers to arrive at a single lump-sum amount to close the account, in order to save on protracted litigation and ultimately enhance recovery. This is also complemented by the introduction of e-auction portals like BAANKNET, which aims to bring more transparency and efficiency into the selling of attached properties by allowing wider participation and greater discovery of prices in recovery.

Best Practices for Banks: Banks can adopt different proactive strategies to prevent the rise of NPAs. Diversification in loan portfolios helps reduce the potential concentration risks by spreading exposures across various sectors or categories of borrowers. Adoption of more stringent lending norms on robust credit appraisal and follow-up systems ensures that loans are granted on sound financial reasoning. Improved monitoring of loan performance enables banks to track early warning signals of stress and undertake timely corrective action. Proactive engagement with borrowers promotes better communication, thus enabling banks to address the potential default risk early and facilitate timely recoveries through collaborative solutions.

Government Support: Recapitalization of PSBs is a process of infusing more capital to strengthen their financial position and absorb the impact of NPAs more effectively. The government is also implementing comprehensive reforms in PSBs

to bring improvement in standards of governance, strengthen risk management frameworks, and improve operational efficiency to make them resilient, accountable, and competitive, with a view to creating a healthier and stable banking system.

By implementing these measures, India has seen a decline in NPAs, with gross NPAs reducing from 9.11% to 2.58% between March 2021 and March 2025.

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Working Hours, Labour Productivity, and Well-being: A Cross-country Analysis Using ILO and World Bank Data

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Abstract

This study investigates the relationship between labour productivity, working hours, and human well-being in industrialised and emerging nations. The impact of variations in working hours on life satisfaction and economic performance is examined using data from the World Bank, the International Labour Organisation (ILOSTAT), and the World Happiness Report. To comprehend these relationships, the study uses fundamental descriptive and correlation techniques. The findings indicate that nations with lower work hours typically have happier and more productive citizens. This implies that economic performance and well-being are negatively correlated with the number of working hours. The scatterplot study also shows that, especially in developing countries, working longer hours does not increase productivity beyond a certain point, while happiness significantly drops. Overall, the results show that sustainable productivity and improved quality of life can be attained more successfully by maintaining an acceptable and balanced level of working hours than by merely extending work hours.

Keywords: Working Hours, Labour Productivity, Human Well-Being, Life Satisfaction, Developing Countries, Sustainable Work Practices.

INTRODUCTION

In the contemporary global economy, the relationship between working hours, labour productivity, and human well-being has grown in significance for both researchers and politicians. People's working hours and working conditions are major concerns when it comes to social welfare and economic advancement. Long workdays were once frequently seen as an indication of diligence and advancement. Recent studies, however, cast doubt on whether working longer hours actually enhances quality of life or productivity. The COVID-19 pandemic has made this issue even more critical. The concept of productivity has evolved due to the advent of hybrid and remote employment, growing digital weariness, and rising mental health issues. Stress and a worse work-life balance have resulted from the blurring of the lines

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between personal and professional life. Because of this, a lot of people are starting to doubt the notion that working longer hours inevitably results in increased productivity. Occupational stress, which arises when job expectations surpass an individual's capacity for coping, plays a significant role in this relationship (Lazarus & Folkman, 1984). Both individuals and entire economies may be impacted by burnout, low motivation, and decreased performance brought on by overwork. In addition to the amount of time spent working, management techniques, workplace culture, and technology all affect productivity, which is sometimes expressed as GDP per hour worked or output per employee. Happiness, life satisfaction, and mental and physical health are all components of well-being. In this regard, the current study examines the relationship between average working hours, labour productivity, and well-being using data from the World Bank, the International Labour Organisation, and the World Happiness Report. The goal is to determine whether working longer hours improves or detracts from productivity and well-being and to propose work paradigms that support both human happiness and economic efficiency.

THEORETICAL AND EMPIRICAL BACKGROUND

Historical and Theoretical Perspectives

Wider discussions about productivity, social advancement, and quality of life have long been connected to changes in working hours. Zhang (2024) demonstrated how government policies, labour movements, and technology advancements have all influenced how long people work. Reducing working hours requires intentional policy action as well as changes in societal values; productivity increase alone cannot automatically accomplish this. The need for a better work-life balance is highlighted by the rise in efficiency and overwork brought about by algorithm-based management and remote work in the digital era. According to Caragea (2009), time is a crucial economic resource that links human well-being and economic growth.

Parallel institutional and societal changes are revealed by historical investigations. Marti (2024) demonstrated how the notion of productive labour has expanded as a result of ILO initiatives and international recognition of informal labour. According to Evans, Lippoldt, and Marianna (2001), laws, collective bargaining, and gender changes in the workforce have all contributed to a long-term decrease in working hours among OECD countries since 1870. These studies emphasise that coordinated structural change, not spontaneous market adjustment, is the cause of work-hour reductions.

Alongside these shifts, theoretical advancements have advanced. The Effort-Reward Imbalance (ERI) paradigm was strongly supported by Van Vegchel et al. (2005), who demonstrated that excessive effort coupled with low reward results in increased physical and mental strain. It is yet unclear, though, how these imbalances connect to lengthy workdays and various reward schemes. In general, the research considers working time to be a psychosocial and economic element that requires multifaceted analysis.

Working Hours and Productivity

In economic studies, the relationship between productivity and working hours has gained significant attention. While Cette, Drapala, and Lopez (2024) discovered that long-term productivity development can result in reduced working hours due to growing earnings, Ngai and Pissarides (2006) linked sectoral changes with adjustments in labour input. The long-held belief that working longer hours inevitably results in increased performance is now being contested by numerous studies. Golden (2012) examined international data demonstrating that while flexible work schedules increase productivity and job satisfaction, extended work hours lower production per hour due to weariness and lack of focus. Similar findings were discovered by Collewet and Sauermann (2017) among Dutch workers, demonstrating that productivity eventually drops. Even after taking worker participation into account, Okazaki et al. (2019) found the same pattern in Japan. More generally, Liu, Chen, and Gan (2019) shown that excessive work hours are associated with decreased productivity, a shorter life expectancy, and slower GDP development, particularly in emerging nations. All of these research point to the benefits of balanced work schedules for productivity and general wellbeing.

Occupational Stress, Well-being, and Work Hours

The topic of occupational stress has emerged as a crucial component of the conversation about working hours. Uehata (1991) examined Karoshi in Japan and found that both short-term and long-term stress were significant contributors to heart-related fatalities. Even after accounting for other work-related characteristics, Lee et al. (2017) discovered that Korean workers who put in more than 60 hours a week were significantly more likely to have high levels of stress. Additionally, Jeon et al. (2014) discovered that extended workdays result in presenteeism, which is the practice of employees working when ill and resulting in unreported productivity losses. The scope of this research has been broadened by recent investigations. According to Hong et al. (2022), Chinese couriers who worked long hours experienced higher levels of stress and depression, with stress serving as a mediator between long hours and poor mental health. A meta-analysis by Wong, Chan, and Ngan (2019) found that extended work hours are detrimental to both physical and mental health, particularly by increasing weariness. Stress reduction has been demonstrated by interventions such flexible work schedules (Jain & Batra, 2015) and frequent physical activity (Hu, Chen, & Cheng, 2016). According to Joseph and Thirumalai (2025), overwork results in hundreds of thousands of fatalities annually worldwide. There are still significant gender disparities. Many full-time employees, particularly married women, prefer shorter workdays, according to Stier and Lewin-Epstein's (2003) research, demonstrating persistent disparities in work-life balance. Overall, it is evident from the literature that extended workdays have a negative impact on happiness and health without increasing productivity.

Cross-Country and Emerging Perspectives

Comparative studies reveal that institutional and cultural contexts have a significant impact on how working hours impact wellbeing and productivity. In their comparison of Ukraine and the EU, Zelenko, Khandii, and Novikova (2024) discovered that even when workers put in lengthy hours, their well-being was diminished by irregular employment and lax labour laws. Kapo Wong et al. (2019) examined data from over 800,000 individuals and shown how the health effects of extended work hours are influenced by variables like gender, job type, and country environment. These detrimental impacts are more pronounced in men and in underdeveloped nations, according to Liu, Chen, and Gan (2019). Sustainability and environmental concerns have begun to be discussed in relation to working time in recent studies. Longer workdays, according to Devetter and Rousseau (2011), result in more energy-intensive lifestyles and a greater environmental effect. Rosnick and Weisbrot (2007) calculated that while shorter European-style hours could assist lower U.S. emissions, European countries' energy consumption could increase by 30% if they adopted American working habits. Shorter workweeks may balance employment, productivity, and environmental sustainability, according to Kallis et al. (2013). According to Emami, Ahmadi, and Ghaffari (2024), flexible work arrangements enhanced productivity and autonomy in Iranian public organisations, demonstrating that flexibility can boost rather than decrease efficiency.

Synthesis and Research Gap

Evidence now available suggests that intentional institutional decisions, rather than just technology innovation, are primarily responsible for improvements in well-being and decreases in working hours (Zhang 2024; Marti 2024). Excessive work hours have been linked to poor health outcomes and decreased productivity, according to numerous research (Golden 2012; Collewet & Sauermann 2017; Wong et al. 2019). Legal frameworks, collective bargaining processes, and cultural norms—all of which vary greatly among national contexts—further influence the relationship between working duration and welfare (Evans et al. 2001; Zelenko et al. 2024). However, there are still a number of research gaps. There are still few empirical studies that combine well-being and economic efficiency metrics across different institutional settings. There aren't many comparative cross-national evaluations, especially when it comes to developing economies. Further research is also needed to determine the long-term effects of flexible and digital work arrangements on productivity, stress, and health. Finding the economic and social circumstances in which balanced working hours may both boost national productivity and improve human well-being is the main challenge that lies ahead.

METHODOLOGY

Research Design

This study employs a quantitative, cross-sectional, and correlational research design based entirely on secondary data drawn from authoritative international sources. The analysis examines the interrelationships among average working hours, labour productivity, and human well-being across a diverse set of countries. The design is exploratory and empirical, aimed at identifying broad global patterns rather than establishing strict causality. The study is guided by the following objectives:

1. To analyze the relationship between average working hours and labour productivity across countries.
2. To examine the association between working hours and human well-being at the national level.
3. To explore the interlinkages between productivity and well-being outcomes in the context of working time.

All data management, statistical computations, and graphical representations were performed using Microsoft Excel, which provides robust functions for correlation analysis and visualization. The simplicity of the analytical approach ensures transparency, replicability, and accessibility for cross-national policy interpretation.

Data Sources and Variables

Variable	Indicator Description	Source	Latest Year Used
Average working hours	Average weekly hours actually worked per employed person	International Labour Organization (ILOSTAT)	2024
Labour productivity	GDP per hour worked (constant 2021 PPP US\$)	World Bank (World Development Indicators)	2024
Human well-being	National average happiness score (0–10 scale) based on life evaluations	World Happiness Report	2024

Every variable was chosen based on its cross-national coverage, conceptual clarity, and worldwide comparability. Cross-country comparability and consistent measurement are made possible by the use of these standardised international databases. The time dimension of work intensity is represented by average working hours, the efficiency dimension of output per unit of labour is captured by productivity, and the human result of socioeconomic performance is represented by well-being.

Sample and Period of Analysis

The study covers a sample of 24 countries, comprising an equal representation of developed and developing economies. The inclusion criteria were based on the availability of complete and recent data (2024) for all three key indicators. List of countries included in the analysis include United States, United Kingdom, Germany, France, Canada, Japan, Australia, Sweden, Netherlands, Italy, Spain and Switzerland as developed economies along with China, India, Brazil, Mexico, Indonesia, South Africa, Bangladesh, Vietnam, Kenya, Nigeria, Egypt and Philippines as developing economies. The selection of 24 countries was guided by three methodological considerations. First, only countries with complete and comparable data for all three variables—average working hours, labour productivity, and happiness scores—for the same reference year were included, ensuring internal consistency of the analysis. Second, the sample deliberately incorporates an equal representation of developed and developing economies to allow meaningful cross-country comparison across different institutional and income contexts. Third, the chosen countries collectively represent diverse labour market structures, cultural norms, and stages of economic development, enhancing the analytical breadth of the study while maintaining manageable sample size for transparent statistical interpretation.

Analytical Technique

The analysis followed a three-step procedure aligned with the study objectives. First, descriptive statistics such as mean, standard deviation, minimum, and maximum were computed to summarize variations in working hours, labour productivity, and well-being across countries. Second, pairwise Pearson correlation coefficients were calculated using MS Excel to examine the strength and direction of associations among the three variables—working hours and productivity, working hours and well-being, and productivity and well-being. Finally, graphical representations were developed through scatterplots with linear trendlines and R^2 values, as well as a bubble chart that simultaneously depicts all three indicators.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 presents the summary statistics for the three core variables—average working hours, labour productivity, and happiness scores—separately for developed and developing economies. The results reveal clear structural contrasts between the two groups.

Developed economies display substantially lower average working hours but higher productivity levels, indicating greater efficiency in output generation per hour worked. Conversely, developing economies record longer average working weeks yet considerably lower productivity, suggesting that extended work duration does not

necessarily translate into higher economic output. The mean happiness score also differs markedly, with developed countries reporting notably higher levels of well-being.

These patterns highlight the dual advantage of developed economies—fewer hours, higher productivity, and greater subjective well-being—underscoring the notion that economic maturity is accompanied by optimized rather than maximized labour input. The contrast reinforces the hypothesis that efficient work systems and supportive socio-economic institutions can yield both economic and psychological dividends.

Table 1: Mean, SD, Min, Max for both groups

Variable	Mean	Standard Deviation	Minimum	Maximum
<i>Developed Countries</i>				
Working Hours (weekly average)	35.01	1.84	31.20	37.60
Labour Productivity (GDP per hour, PPP \$)	75.64	10.51	53.70	90.40
Happiness Score (0–10 scale)	6.77	0.35	6.15	7.35
<i>Developing Countries</i>				
Working Hours (weekly average)	43.38	3.03	38.90	49.00
Labour Productivity (GDP per hour, PPP \$)	15.48	6.94	5.80	27.10
Happiness Score (0–10 scale)	5.34	1.06	3.82	6.98

Correlation Analysis

The correlation matrix (Table 2) summarizes the bivariate relationships among working hours, productivity, and happiness for the combined sample of 24 countries. The results reveal strong and consistent patterns.

Average working hours exhibit a strong negative correlation with labour productivity ($r = -0.857$), indicating that countries with longer working time tend to achieve lower output per hour worked. This finding empirically supports the diminishing returns hypothesis, wherein excessive labour time reduces efficiency due to fatigue, reduced engagement, and suboptimal task performance.

Similarly, the correlation between working hours and happiness is strongly negative ($r = -0.780$), implying that extended working hours are associated with lower subjective well-being. This result aligns with the Job Demands–Resources (JD-R) and Effort–Reward Imbalance (ERI) frameworks, both of which posit that persistent high demands coupled with inadequate recovery or reward erode well-being.

Finally, a positive relationship between productivity and happiness ($r = 0.725$) suggests that economies achieving higher productivity per hour also tend to report greater

well-being, possibly reflecting better working conditions, higher income levels, and enhanced social support structures.

Collectively, these correlations affirm the central argument that optimizing working time contributes simultaneously to economic efficiency and human flourishing, whereas overextension imposes dual economic and social costs.

In order to assess the statistical robustness of the observed relationships, significance levels for the correlation coefficients were also examined. The correlation between average working hours and labour productivity ($r = -0.857$) is statistically significant at the 1 per cent level ($p < 0.001$). Similarly, the association between working hours and happiness ($r = -0.780$) is highly significant ($p < 0.001$). The positive correlation between labour productivity and happiness ($r = 0.725$) is also statistically significant at the 1 per cent level. These results indicate that the reported correlations are unlikely to have occurred by chance.

Table 2: Correlation Matrix

Variables	Working Hours	Productivity	Happiness
Working Hours	1.000	-0.857	-0.780
Productivity	—	1.000	0.725
Happiness	—	—	1.000

Scatterplot Analysis

Figures 1 and 2 visualize the relationships between working hours and the two key outcome variables.

Figure 1 plots average working hours against labour productivity. The downward-sloping trendline confirms the strong inverse relationship observed in the correlation analysis. Although most countries conform to this pattern—where shorter working hours correspond to higher productivity—some exceptions appear. For instance, certain developed countries such as Japan or the United States exhibit moderately higher working hours than European counterparts while maintaining high productivity levels, reflecting cultural and institutional variations in work organization. Similarly, some developing nations demonstrate slightly higher productivity than expected for their working time, possibly due to structural differences or data-year alignment.

Figure 2 depicts the relationship between working hours and happiness scores, again showing a negative linear association. Countries characterized by shorter average workweeks (e.g., Sweden, Netherlands, Germany) cluster toward higher happiness levels, while those with longer hours (e.g., India, Bangladesh, Nigeria) report lower well-being scores. The slope of the trendline reinforces the proposition that beyond a certain threshold, longer working hours undermine psychological and social well-being.

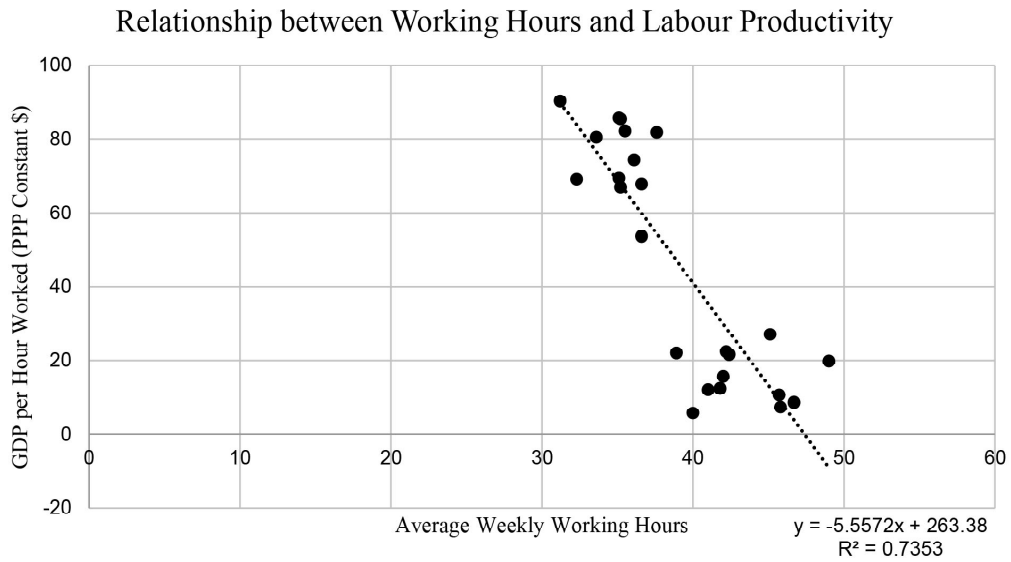


Figure 1: Working Hours vs Productivity

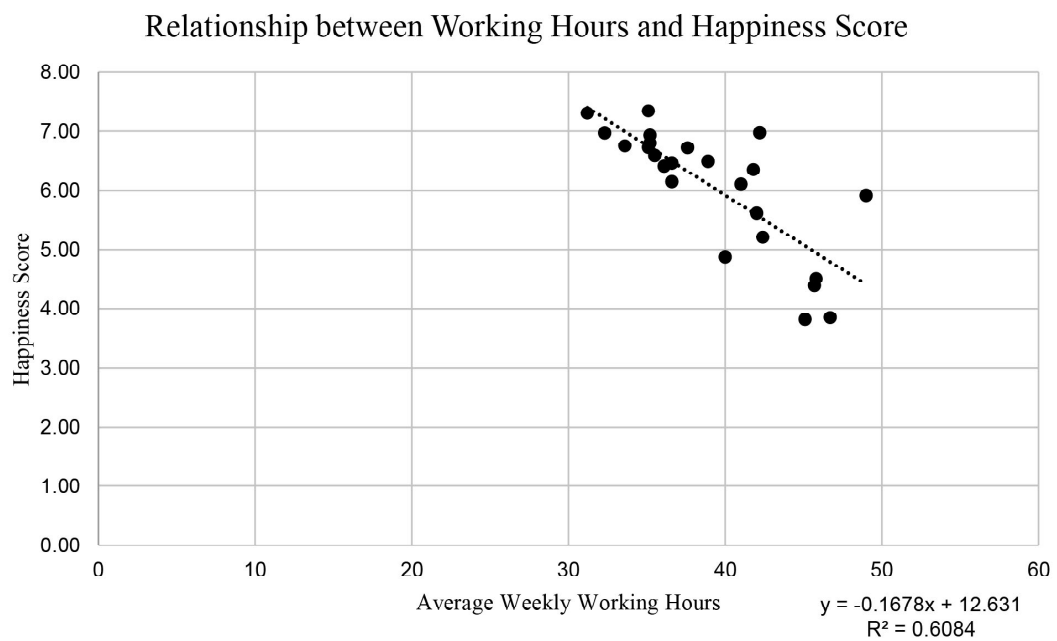


Figure 2: Working Hours vs Happiness

Across both figures, the presence of a few outliers does not alter the general conclusion: more work time does not necessarily mean greater productivity or happiness. The broad consistency between the numerical correlations and the visual trends strengthens the robustness of these findings. In figure 1 The regression equation ($y = -5.5572x + 263.38$; $R^2 = 0.7353$) indicates a strong negative relationship between average working hours and labour productivity. The negative slope suggests that for every additional hour worked per week, productivity decreases by approximately 5.56 units, while the high R^2 value (0.74) implies that variations in working hours explain nearly 74% of cross-country differences in productivity. In figure 2, The equation ($y = -0.1678x + 12.631$; $R^2 = 0.6084$) similarly shows a negative association between working hours and happiness. Each additional working hour per week corresponds to an estimated 0.17-point decline in average national happiness (on a 0–10 scale). The R^2 value (0.61) indicates that working hours account for about 61% of the observed variation in well-being across the sampled countries.

Simple Linear Regression Analysis

To statistically validate the relationship between working hours, labour productivity, and well-being, simple linear regression models were estimated using average weekly working hours as the independent variable. Two separate models were specified.

Model 1: Labour Productivity = $\beta_0 + \beta_1$ (Working Hours) + $\mathcal{E}$

Model 2: Happiness Score = $\beta_0 + \beta_1$ (Working Hours) + $\mathcal{E}$

The results of Model 1 indicate a strong negative relationship between working hours and labour productivity. The estimated regression coefficient (β_1 -5.56) suggests that an increase of one hour in average weekly working time is associated with a reduction of approximately 5.56 units in GDP per hour worked. The model explains a substantial proportion of the variance in productivity ($R^2 = 0.735$), confirming strong explanatory power at the cross-country level.

Model 2 similarly reveals a negative association between working hours and well-being. The regression coefficient (β_1 = -0.168) indicates that each additional working hour per week corresponds to a decline of about 0.17 points in national happiness scores (The model accounts for approximately 61 per cent of the observed variation in happiness ($R^2 = 0.608$)).

Although the cross-sectional nature of the data does not permit causal inference, the regression results reinforce the correlation findings and provide additional statistical validation of the inverse relationship between working hours, productivity, and well-being.

Discussion

The results together provide strong empirical support for the study's objectives. The observed relationships reveal a coherent and theoretically grounded pattern:

1. Longer working hours correlate with lower productivity and lower well-being, and
2. Higher productivity corresponds with greater happiness across countries.

These findings echo earlier studies emphasizing the non-linear relationship between time input and performance (Golden, 2012; Pencavel, 2015), and reaffirm the occupational stress pathways proposed in the JD-R and ERI models. The outcomes suggest that sustainable work outcomes depend not on the extension of labour time but on the intelligent organization of work—balancing demands with recovery, autonomy, and social support.

The distinction between developed and developing economies further underscores the importance of institutional context. Economies that have successfully transitioned to shorter working hours typically pair this with high skill intensity, strong labour protections, and inclusive social systems, enabling both higher output and improved well-being. In contrast, economies reliant on long working hours may face diminishing efficiency and increasing stress burdens.

Overall, the analysis demonstrates that the quality, not quantity, of working time determines the coexistence of productivity and well-being. This conclusion offers practical implications for policy reform, organizational design, and the pursuit of Sustainable Development Goal 8 of “Decent Work and Economic Growth.”

LIMITATIONS OF THE STUDY

Although there are a few limitations to be aware of, this study offers helpful cross-national insights into the relationship between working hours, productivity, and well-being. The research is based only on secondary data, which can differ in terms of reporting standards and quality amongst sources like the World Bank, ILO, and World Happiness Report. Only twenty-four countries were included, which restricts the conclusions' generalisability, especially for smaller or less well-documented economies. Since variables like labour laws, cultural norms, and technology may affect these correlations, the data show associations rather than causality. Furthermore, using national-level data could mask differences between nations. Notwithstanding these drawbacks, the study provides an insightful macro-level viewpoint that can guide additional in-depth research in the future.

CONCLUSION

The analysis shows that longer workdays are consistently linked to lower labour productivity and lower well-being in all nations. Shorter hours are associated with higher levels of happiness and productivity in developed economies, highlighting the fact that economic advancement is correlated with optimal, not prolonged, work hours. The results emphasise the need for policy to prioritise quality of labour over quantity

of hours, reaffirming that sustainable productivity and human welfare depend on balanced labour practices and supportive institutional frameworks. From a policy perspective, the findings underscore the need for governments and labour institutions to shift focus from maximizing working hours to optimizing work organization. Policies encouraging regulated working time, flexible work arrangements, and productivity-enhancing investments—such as skill development, digital infrastructure, and workplace well-being initiatives—can generate dual economic and social benefits. For developing economies in particular, labour reforms aimed at reducing excessive work hours without compromising income security may help break the cycle of low productivity and poor well-being. International labour standards, including those promoted by the ILO, can serve as a critical framework for aligning economic growth with decent work and human welfare.

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A Critical study on Shadow Banking with special reference to the financial performance of Non-Banking Financial Companies in India

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Abstract

Economic development of a country relies on the growth of the financial system, which paves the way for savings and investments. Financial institutions play a vital role in creating links between savers and investors. An essential function of any financial institution is to obtain surplus finance from the earners who have saved from their earnings and dispense it to the individuals who are in need for personal purposes or in business for capital investments. Both the Banking and the Nonbanking institutions serve this purpose for the economic development of the country. NBFCs vastly enhance their roles to provide financial needs even in the unbanked areas. These institutions help to reach a wider range of customers efficiently. The objective of the study is to analyse the financial health (including liquidity, solvency, and profitability position) of the four selected NBFCs during the last three financial years from financial year 2022-23 to 2024-25. The tool which is used to conduct the study is Ratio Analysis. The study reveals that the financial health of all the selected NBFCs are quite impressive, but in certain cases, the NBFCs maintain a high current ratio, which actually indicates improper management of assets of the company. The study also reflects that the NBFCs are mostly maintaining levered capital structure, which ultimately increases the financial risk of the firm.

Keywords: *Shadow Banking, NBFCs, Financial performance, Ratio, solvency, Liquidity, Profitability.*

INTRODUCTION

The term “Shadow bank” was coined by Paul Mc.Culley in 2007. It is a universal phenomenon. In the US it implies, nonbank financial institutions engaging in maturity transformations (i.e. use of short-term deposits to finance long-term loans). The Financial Stability Board defines shadow banking as the credit intermediation involving entities and activities (fully or partially) outside the regular banking system. Shadow banking activities include credit intermediation and liquidity and maturity transformation that take place outside the regulated banking system. In advanced economies, shadow banking is more of risk transformation through securitization,

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while in the economically backward economies where financial market is still in developing stage, the activities are more of supplementary to banking activities. The last two to three decades, the financial sector has witnessed a lot of changes and growing competition. This has caused banks to indulge in shadow banking. The question that arises now is whether we have shadow banks in India. The answer is yes. It is yes, because we have financial institutions which accept deposits and extend credit like banks, but we do not call them shadow banks rather we call them the Non-Banking Finance Institutions (NBFIs)

Financial system of a country plays an important role in the economic development by way of encouraging both savings and investments. Economic development relies on the growth of the financial system, which includes Financial Market, Financial Instruments, Financial Services and Financial Institutions. Among these, Financial Institutions play a vital role in creating links between the lenders and borrowers, paving way for the expansion of financial markets and related transactions. Both the Banking and the Non-Banking institutions serve this purpose for the economic development of the country. Bank is an institution who is licensed to accept deposits and lends loan, either directly or indirectly. It is regulated by the Central Bank of that particular country. Along with Banks, NBFCs contribute to the growth of financial sector and of economy.

Non-Banking institution is a financial institution which is neither fully licensed for banking activities nor supervised by any banking regulatory agencies. But it is to be registered under Companies Act, 1956. The responsibility of regulating and supervising the NBFC (Non-Banking Financial Company) is confided to DNBS (The Department of Non-Banking Supervision) under the regulatory - provisions contained under Chapter III B and C and Chapter V of the Reserve Bank of India Act, 1934.

REVIEW OF LITERATURE

Taxmann's (2013) *Statutory Guide for Non-Banking Financial Companies* provides a comprehensive overview of the regulatory framework applicable to NBFCs in India. The book outlines the legal provisions governing various categories of NBFCs and explains the rules related to their business operations, serving as an essential reference for understanding statutory compliance requirements in the sector.

Rajankshetrimayum (2014) highlighted the role of NBFCs as registered entities conducting financial activities similar to traditional banks. NBFCs engage in lending, acquisition of securities, leasing, hire purchase, and insurance services. Despite their functional similarity to banks, NBFCs cannot accept demand deposits, issue cheques, and deposits with them are not insured by the DICGC. The study emphasized the dual regulatory oversight by the RBI and SEBI and noted their significant contribution to rural and semi-urban financial inclusion as well as the development of small businesses and infrastructure.

Puliani and Puliani (2017) provided detailed explanations of terms used in banking and non-banking operations in their book *Manual of Non-Banking Financial Companies*. The book compiles circulars and directions issued by the Reserve Bank of India, offering insights into regulatory measures for controlling and supervising NBFCs.

Chaudhury and Sana (2020) conducted a study using a Fixed Effects Panel Regression model on 11 BSE-listed NBFCs. The findings revealed that an increase in total asset size negatively affects profitability, suggesting that loans or investments made by NBFCs may be of poor asset quality or have limited profit-generating capacity.

Vijay Kumar and Jain (2022) examined challenges faced by NBFCs following the IL&FS crisis and the COVID-19 pandemic. Their study identified deteriorating asset quality, declining profitability, and capital erosion due to sluggish industrial activity and higher provisioning. The authors also discussed corrective measures taken by NBFCs and regulatory interventions by the RBI to mitigate these risks.

Usha and Divya (2023) analyzed NBFC-D (deposit-taking) and NBFC-ND (non-deposit-taking) categories. The study concluded that both categories exhibit parallel growth trends, contributing jointly to financial inclusion and supporting broader economic development.

Venugopala Rao and Tadi (2023) investigated the influence of internal and macroeconomic variables on the profitability of listed NBFC-Ds in India. Their findings indicate that operating revenue, cash flow from financing activities, debt-equity ratio, and lending rates significantly impact profitability. Notably, the study found a negative relationship between the debt-equity ratio and profit levels, suggesting that higher leverage adversely affects financial performance.

RESEARCH GAP

From the reviewed literature, it is clear that most studies focus on laws related to NBFCs, the market for NBFCs, RBI circulars, financial performance of listed NBFCs, challenges due to IL&FS crisis and COVID-19, and growth patterns of NBFC-D and NBFC-ND. However, there is no study that specifically examines the overall financial performance, profitability position, asset quality, and growth of all NBFCs together. However, it is also clear that most studies are conducted on or before 2023, which indicates that the recent Financial Year 2023-24 and 2024-25 are not covered.

The present study is conducted based on the data of the last five financial years up to 2024-25 in order to examine the overall financial performance, including liquidity, solvency, and profitability status of the selected NBFCs.

OBJECTIVES OF THE STUDY

The present research is conducted based on the following objectives-

1. To know the liquidity position of NBFC.

2. To assess the long-term solvency position of NBFC.
3. To assess the profitability position of NBFC.

METHODOLOGY

This study is based on secondary data, which are collected from different websites, articles, research papers, company annual reports, etc. The study employed only a quantitative data collection technique, where only numerical figures from annual reports were collected and used. In order to conduct the study of shadow banking, four Non-Banking Financial Companies are selected. These four NBFCs are Bajaj Finserv Ltd, Muthoot Finance Ltd, IIFL Finance (India Infoline Limited), and Shriram Finance. Data are collected from the official websites of selected NBFCs. From their official websites, annual reports are collected, and important information (which is relevant for the study) is extracted from them. The study period for conducting the present study is the last five financial years, i.e., 2020-21, 2022-23, 2023-24, 2024-25. The tools and technique used in this study is Ratio Analysis. *Ratio analysis is a financial tool used to evaluate a company's performance* by examining key financial ratios related to profitability, liquidity, and solvency. Number of ratios are there under ratio analysis techniques, but for the present study, out of all ratios, only six ratios are used for assessing the company's financial health. The ratios are the Total asset to debt ratio, Debt Equity ratio, Proprietary ratio, Current ratio, Net profit ratio, and operating ratio.

ANALYSIS AND INTERPRETATION OF DATA

Liquidity Ratio

Liquidity is a very critical part of a business. Liquidity is required for a business to meet its short-term obligations. Liquidity ratios are a measure of the ability of a company to pay off its short-term liabilities. Liquidity ratios determine how quickly a company can convert its assets and use them to meet the dues that arise.

➤ **Current Ratio**

The current ratio is a liquidity and efficiency ratio that measures a firm's ability to pay off its short-term liabilities with its current assets. The current ratio is an important measure of liquidity because short-term liabilities are due within the next year.

$\text{Current Ratio} = \text{Current assets} / \text{Current Liabilities}$

Table 1:- Current Ratio of selected NBFCs

COMPANY		2020-21	2021-22	2022-23	2023-24	2024-25
Bajaj Finserv Ltd.	Current Assets	6400.21	7719.88	5602.75	18359	24055
	Current Liabilities	4838.76	4821.89	2502	8141.78	10561.23
	Current Ratio	1.32:1	1.60:1	2.23:1	2.25:1	2.27:1
Muthoot Finance Ltd	Current Assets	8040.20	10332.91	10930.11	6289.80	8357.88
	Current Liabilities	3417.16	2992.67	2970.42	3403.18	3963.61
	Current Ratio	2.35:1	3.45:1	3.68:1	1.84:1	2.10:1
IIFL	Current Assets	1012.20	1869.80	2054.33	1150.96	1596.76
	Current Liabilities	79.24	103.24	109.07	104.66	195.88
	Current Ratio	12.77:1	18.11:1	18.84:1	11.05:1	8.1:1
Shriram Finance	Current Assets	2838.7	3360.9	3471.69	11760.93	10526.43
	Current Liabilities	2542.04	2370.40	1161.20	1191.03	1161.37
	Current Ratio	1.17:1	1.41:1	2.98:1	9.87:1	9.05:1

Source : Annual Reports of selected NBFCs

Interpretation

From the above table of Current Ratio it is observed that, the current ratio of Bajaj Finserv is in increasing trend. In 2020-21 it was 1.32:1 but in last year it was increased to 2.27:1. The next company is Muthoot Finance, whose current ratio was better upto the financial year 2022-23 but it was decreased in next financial year. However, in last year their current ration shows positive result. The third company is IIFL which shows decreasing current ratio which depicts decreasing ability of company to pay its current obligations. The fourth company is Shriram Finance whose current ratio of last two years was very high as compared to the financial year 2022-23.

Solvency Ratio

Solvency ratios are a key component of the financial analysis which helps in determining whether a company has sufficient cash flow to manage the debt obligations that are due. Solvency ratios are also known as leverage ratios. It is believed that if a company has a low solvency ratio, it is more at the risk of not being able to fulfil its debt obligation and is likely to default in debt repayment.

➤ **Total assets to debt ratio**

The Total asset to debt Ratio of an organization gives an insight into the ability of an organization to meet its financial obligations. Total asset to debt Ratio also indicates how much the organization depends on its creditors and banks can use this when the organization applies for a credit facility. The Total asset to debt Ratio is a calculation formula and demonstrates the relationship between the various equity components.

$$\text{Total Assets to Debt Ratio} = \text{Total assets} / \text{Total debt}$$

Table 2: Total Asset to debt ratio of selected NBFCs

COMPANY		2020-21	2021-22	2022-23	2023-24	2024-25
Bajaj Finserv Ltd.	Total Assets	280164.32	333718.96	275228.67	537929.63	652231.61
	Total Debt	174749.12	213043.68	168398.25	223875.12	279919
	Ratio	1.60:1	1.57:1	1.63:1	2.40:1	2.33:1
Muthoot Finance Ltd	Total Assets	686414.46	763164.74	801489.20	964699.40	1328595.5
	Total Debt	497856.88	540453.35	554623.59	673844.86	985841.53
	Ratio	1.37:1	1.41:1	1.44:1	1.43:1	1.34:1
IIFL	Total Assets	15977.81	18042.37	21811.04	25446.72	28351.57
	Total Debt	13158.80	14107.20	13874.03	16646.84	18734.45
	Ratio	1.21:1	1.28:1	1.57:1	1.52:1	1.51:1
Shriram	Total Assets	82872.16	87413.80	86946.49	123159.98	145358.69
	Total Debt	69309.11	68391.01	65884.04	94586.77	108600.21
	Ratio	1.19:1	1.27:1	1.31:1	1.30:1	1.33:1

Source:- Annual Reports of selected NBFCs

Interpretation

The above table analyses the relation between total assets to total debt of four different NBFC's of India. Bajaj Finserv Ltd. shows that they have greater ability to meet its long term financial obligation as they have good amount of total assets. Similarly the table shows that the total assets of remaining three NBFC's are quite good so that they can meet their financial obligation easily. However one point is also noticeable that the ratios for remaining three companies are in decreasing trend specially in last 3 years. It indicates that the total debts for these companies are increases year by year.

➤ **Proprietary ratio**

The Proprietary ratio (also known as the equity ratio) is the proportion of shareholders' equity to total assets, and as such provides a rough estimate of the amount of capitalization currently used to support a business. If the ratio is high, this indicates that a company has a sufficient amount of equity to support the functions of the business, and probably has room in its financial structure to take on additional debt, if necessary. Conversely, a low ratio indicates that a business may be making use of too much debt or trade payable, rather than equity, to support operations (which may place the company at risk of bankruptcy).

$$\text{Proprietary Ratio} = \text{Proprietor's Fund} / \text{Total Assets}$$

Table 3:- Proprietary ratio of selected NBFCs

COMPANY		2020-21	2021-22	2022-23	2023-24	2024-25
Bajaj Finserv Ltd.	Proprietor's Fund	58293.98	66319.92	54371.98	128434.23	103775.85
	Total Assets	280164.32	333718.96	275228.67	537929.63	652231.61
	Ratio	0.20:1	0.19:1	0.19:1	0.23:1	0.15:1
Muthoot Finance Ltd	Proprietor's Fund	15575.02	18785.72	216657.52	251072.56	293666.59
	Total Assets	280164.32	333718.96	801489.20	964699.40	1328595.5
	Ratio	0.05:1	0.06:1	0.27:1	0.26:1	0.22:1
IIFL	Proprietor's Fund	2145.75	2703.60	5554.11	6438.05	7462.45
	Total Assets	159778.10	180423.77	21811.04	25446.72	28351.57
	Ratio	0.01:1	0.01:1	0.25:1	0.25:1	0.26:1
Shriram Finance	Proprietor's Fund	8274.29	11309.49	18923.23	24738.40	30325.04
	Total Assets	82872.16	87413.80	86946.49	123159.98	145358.69
	Ratio	0.09:1	0.12:1	0.21:1	0.20:1	0.20:1

Source:- Annual Report of selected NBFCs

Interpretation

The above table highlights the proprietary ratio of four Non-Banking Financial Companies. Here, it is observed that all the NBFCs have a lower amount of proprietary funds as compared to their total assets. The ratio for Bajaj Finserv is fluctuating in nature. The ratio for IIFL shows a stable relation between proprietary fund and total assets during the last 3 years, though initially they had a smaller amount of proprietary fund. But the ratio for the remaining two companies shows a positive result in their trend.

➤ Debt Equity Ratio

The debt-to-equity ratio (D/E) is a financial metric that compares a company's total liabilities to its shareholder equity, showing how much debt a company uses to finance its assets compared to owner capital. It is calculated by dividing total liabilities by shareholder equity. A higher ratio indicates a greater reliance on debt and potentially higher risk, while a lower ratio suggests a more financially secure position.

$$\text{Debt to Equity ratio} = \text{Debt} / \text{Equity (Shareholder's Fund)}$$

Table 4:- Debt-Equity ratio of selected NBFCs

COMPANY		2020-21	2021-22	2022-23	2023-24	2024-25
Bajaj Finserv Ltd.	Debt	174749.12	213043.68	168398.25	223875.12	279919
	Equity	58293.98	66319.92	54371.98	103775.85	128434.23
	Ratio	2.99:1	3.21:1	3.09:1	2.15:1	2.17:1
Muthoot Finance Ltd	Debt	497856.88	540453.35	554623.59	673844.86	985841.53
	Equity	15575.02	18785.72	216657.52	251072.56	293666.59
	Ratio	3.19:1	2.87:1	2.55:1	2.68:1	3.35:1
IIFL	Debt	13158.80	14107.20	13874.03	16646.84	18734.45
	Equity	2145.75	2703.60	5554.11	6438.05	7462.45
	Ratio	6.13:1	5.21:1	2.49:1	2.58:1	2.51:1
Shriram Finance	Debt	69309.11	68391.01	65884.04	94586.77	108600.21
	Equity	8274.29	11309.49	18923.23	24738.40	30325.04
	Ratio	8.37:1	6.04:1	3.48:1	3.82:1	3.58:1

Source:- Annual Report of selected NBFCs

Interpretation

The Debt–Equity ratio analysis of Bajaj Finserv Ltd., Muthoot Finance Ltd., IIFL, and Shriram Finance for the period 2020–21 to 2024–25 highlights significant variations in their capital structure and financial risk profiles. Bajaj Finserv Ltd. maintained a relatively stable and improving leverage position, with its Debt–Equity ratio declining from above 3:1 to around 2.17:1, indicating a strengthening equity base and prudent financial management. Muthoot Finance Ltd. showed a fluctuating trend, with an initial decline in leverage followed by an increase to 3.35:1 in 2024–25, suggesting a renewed dependence on debt financing and increased financial risk in recent years. IIFL demonstrated a substantial improvement in solvency, as its

Debt–Equity ratio reduced sharply from 6.13:1 to 2.51:1, reflecting effective deleveraging and enhanced financial stability. Shriram Finance, despite a noticeable reduction in leverage from very high levels, continued to operate with a comparatively high Debt–Equity ratio of 3.58:1, indicating continued reliance on debt financing. Overall, the analysis suggests that while all companies made efforts to strengthen their capital structures, Bajaj Finserv and Muthoot Finance exhibit comparatively lower financial risk, whereas IIFL and Shriram Finance remain more highly leveraged.

Profitability Ratio

Profitability ratios are a type of accounting ratio that helps in determining the financial performance of business at the end of an accounting period. Profitability ratios show how well a company is able to make profits from its operations.

➤ Operating Ratio

Operating ratio is referred to as the ratio that depicts the efficiency of the management by establishing a relationship between the total operating expenses with the net sales.

Operating ratio is used to determine the efficiency of the management with which it is possible to generate a certain level of sales or revenue. It also helps in establishing how the company's management is instrumental in reducing costs.

$$\text{Operating Ratio} = \text{Operating cost} / \text{Revenue from operation} * 100$$

Table 5:- Operating Ratio of selected NBFCs

COMPANY		2020-21	2021-22	2022-23	2023-24	2024-25
Bajaj Finserv Ltd.	Operating cost	13915	14670.62	25879.50	89016.06	110091.90
	Revenue from operation	60591.20	68438.98	41397.38	110381.91	133821.05
	Ratio	22.96%	21.43%	62.51%	80.64%	82.27%
Muthoot Finance Ltd	Operating cost	34160.77	35953.54	36009.61	31823.46	40110.44
	Revenue from operation	115345.63	121849.37	118976.38	150616.70	202141.65
	Ratio	29.61%	29.50%	30.26%	21.13%	19.84%
IIFL	Operating cost	1084.22	1041.11	1308.26	1515.93	1728.02
	Revenue from operation	1956.93	2087.12	2553.2a1	3121.02	3706.78
	Ratio	55.31%	49.88%	51.24%	48.57%	46.62%
Shriram Finance	Operating cost	16035.10	14921.20	7214.88	7528.90	8968.88
	Revenue from operation	43149.91	43288.11	21706.20	25344.25	30503.49
	Ratio	37.16%	34.46%	33.24%	29.70%	29.40%

Source:- Annual Reports of selected NBFCs

Interpretation

From the above table it is identifiable that since last five years all the selected NBFC response positively corresponding to their operating expenses. Bajaj Finserv Ltd. shows increasing trend in their operating ratio and they could generate huge revenue to cover its operating cost. However, for remaining three companies the trend is decreasing in nature. It indicates that some NBFC may faces certain challenges so that they are unable to control their operating cost. The data also indicate that the NBFC have set positive trend in revenue generation. But their revenue is not increasing like the increasing operating cost.

➤ Net Profit Ratio

Net Profit Ratio, also referred to as the Net Profit Margin Ratio, is a profitability ratio that measures the company's profits to the total amount of money brought into the business. In other words, the net profit margin ratio depicts the relationship between the net profit after taxes and net sales taking place in a business. It is a profitability ratio and hence, expressed in the form of percentages.

$$\text{Net Profit Ratio} = \text{Net profit after tax} / \text{Revenue from operation} * 100$$

Table 6:- Net Profit Ratio of selected NBFCs

COMPANY		2020-21	2021-22	2022-23	2023-24	2024-25
Bajaj Finserv Ltd.	Net profit after Tax	7367.38	8313.53	11507.69	15595.36	17557.64
	Revenue from operation	60591.57	68406.08	41397.38	110381.91	133821.05
	Ratio	12.15%	12.13%	27.80%	14.13%	13.12%
Muthoot Finance Ltd	Net profit after Tax	38188.70	40213.23	36697.66	53523.61	44675.94
	Revenue from operation	118976.38	150616.70	118976.38	150616.70	202141.65
	Ratio	32.09%	26.69%	30.84%	35.53%	22.10%
IIFL	Net profit after Tax	401.09	593.35	768.12	1016.55	976.50
	Revenue from operation	1956.66	2087.99	2553.21	3121.02	3706.78
	Ratio	20.51%	28.41%	30.08%	32.57%	26.34%
Shriram Finance	Net profit after Tax	682.20	680.31	3325.79	4573.36	5547.82
	Revenue from operation	4314.99	4328.81	21706.20	25344.25	30503.49
	Ratio	15.80%	15.71%	15.32%	18.04%	18.18%

Source:- Annual Report of selected NBFCs

Interpretation

The Net Profit Margin analysis from 2020–21 to 2024–25 shows clear differences in profitability among the selected companies. Muthoot Finance Ltd. consistently recorded the highest margins, indicating strong profitability despite some fluctuation in recent years. IIFL demonstrated a steady improvement in margins up to 2023–24, reflecting enhanced operational efficiency, though a slight decline was observed in 2024–25. Bajaj Finserv Ltd. maintained moderate and relatively stable margins, with a temporary spike in 2022–23, after which profitability normalized. Shriram Finance showed gradual improvement in net profit margins over the period, indicating better cost control and operational performance. Overall, Muthoot Finance remains the most profitable, while IIFL and Shriram Finance exhibit improving profitability trends.

FINDINGS

1. The liquidity position of all the selected NBFCs shows a positive result. It indicates that all the NBFCs have sufficient amounts of liquid assets to meet their short-term financial obligations.
2. The current ratio of NBFCs like IIFL and Shriram Finance presents higher current assets as compared to their current liabilities. That again indicates that these companies unnecessarily block a huge amount of funds in the name of current assets.
3. To identify the solvency position of selected companies, some ratios are calculated, like the total assets to debt ratio, Proprietary ratio, and Debt Equity ratio. The calculated ratio depicts a positive sign in the solvency position of the selected NBFC. It indicates that NBFCs have the financial strength to meet their long-term financial obligation.
4. The study reflects that all the NBFCs have a greater amount of total assets in their financial structure to cope with the financial obligation.
5. The study reveals that the selected NBFCs maintain a levered financial structure. They consider more debt funds in their capital structure (based on their risk-taking capacity) as compared to the equity fund, which is very risky for the NBFCs.
6. The proprietary ratio shows that the selected companies maintain a reasonable amount of proprietary funds as per their financial strength. It also makes them capable of taking more financial risk as per the requirement. It supports the company to maintain leverage in its financial structure.
7. The study reflects that all the Non-Banking Financial Companies are in a profitable position. In this competitive era, these companies give cutthroat competition to all the Banking companies.
8. The profitability positions of the selected companies are identified with the help of ratios like net profit ratio and operating ratio. In all the cases, the company's

profit and loss account gives a positive response to the net profit figure corresponding to operating expenses and total sales.

9. The company like Bajaj Fiserv and IIFL actually has great control on their operating expenses corresponding to revenue generated from operation.
10. The study reflects that controlling operating cost over revenue help them to maintain good amount of overall net profit after tax. The company like IIFL, Muthoot Finance shows greater amount of net profit after tax as they have high control on their operating expenses.

LIMITATIONS OF THE STUDY

1. The study is limited to a specific number of NBFCs only. Findings may not reflect the overall financial position of NBFCs.
2. The study is conducted based on basic statistical tool i.e., Ratio only.
3. The study faced time constraints, which limited the depth of data collection and analysis.

RECOMMENDATION

The concept of shadow banking is the network of financial activities that operate outside the traditional, highly regulated banking system, primarily through non-banking financial companies (NBFCs). These entities provide crucial services like lending for housing, small businesses, and personal needs. But the *shadow banking channel is in its evolutionary phase in India*. Then, it also gives good fight to the other banking organisations. Certain points that can be recommended to them are-

The company should give more emphasis on utilising its current assets. Unnecessarily having more current assets in the financial structure just creates idle funds, which does not give any benefit to the company. It shows inappropriate utilisation of funds. Usually ideal current ratio is considered as 2:1, but it obviously varies from organisation to organisation. It is recommended that they maintain a good range of current ratio. It should not be too high, it should not be too less.

The study reveals that all the NBFCs basically maintain a highly leveraged capital structure. It means they have more debt funds as compared to equity funds. But it is considerable that high debt in capital structure reflects a highly riskier capital structure as the company is in the obligation of regular payments of interest to the investors. Thus, it is advisable to rely on insider capital rather than outsiders' liability. Basically, they should maintain an optimum Debt Equity ratio by considering the fact of financial risk and risk-taking capability of the company.

DISCUSSION AND CONCLUSION

From this study, it is noticeable that NBFCs are performing well in this competitive era. They are strong enough in their profitability aspect, solvency position, and liquidity maintenance capacity. Practically, their flexible nature of operation and customer-friendly financial services help them a lot to maintain stable financial performance. Performance of NBFCs helps them to grow in the financial market, as well as it also has a positive impact on the country's GDP. At the same time, it also helps the public in easy access to financial services.

The analysis of the selected NBFCs indicates a generally strong financial position across liquidity, solvency, and profitability dimensions. All the companies demonstrate healthy liquidity levels, suggesting they maintain adequate liquid resources to meet short-term obligations. However, in some cases, particularly with IIFL and Shriram Finance, high current ratios may signal inefficiency in asset utilization, as excessive funds appear to be tied up in current assets.

The solvency evaluation reveals that the NBFCs possess a strong long-term financial standing. Ratios such as the Debt-Equity Ratio, Proprietary Ratio, and Total Assets to Debt Ratio indicate that these firms are capable of meeting long-term financial obligations. Despite maintaining a leveraged capital structure with higher dependence on debt, the companies seem to manage this risk effectively due to their strong proprietary funding and asset base.

Profitability analysis further supports the stable financial health of the NBFCs. All selected companies operate profitably, even in a competitive financial services environment. Firms like Bajaj Finserv, IIFL, and Muthoot Finance show strong control over operating expenses, which contribute significantly to their solid net profit figures. This efficient cost management, coupled with strong revenue generation, enhances their overall financial performance.

Overall, the discussion highlights that while the NBFCs are financially sound and competitive, attention to optimal asset utilization and debt management remains essential to sustain long-term stability and growth.

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A New Operation on Triangular Fuzzy Number for Solving Fuzzy Linear Programming Problem using Alpha-Cut Method

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Abstract

This paper proposes a new arithmetic operation on triangular fuzzy numbers for solving fuzzy linear programming (FLP) problems using the α -cut method combined with interval arithmetic. Unlike conventional approaches that rely on ranking functions or early defuzzification, the proposed method directly handles fuzziness through interval-based α -cuts, preserving uncertainty throughout the solution process. The methodology is computationally simple, transparent, and suitable for fully fuzzy linear programming problems where coefficients and constraints are represented by triangular fuzzy numbers. A numerical example is presented to demonstrate the applicability and effectiveness of the proposed approach, and its advantages over existing methods are discussed.

Keywords: Alpha-cut, Fuzzy Linear Programming, Interval Arithmetic, Triangular Fuzzy Number, Optimization

INTRODUCTION

Linear Programming (LP) is a fundamental optimization technique widely used in economics, engineering, management science, and operations research. Classical LP assumes that all parameters are precisely known. However, real-world decision-making problems often involve uncertainty, vagueness, or imprecise information. To address such situations, the concept of fuzzy sets introduced by Zadeh (1965) provides a useful mathematical framework.

Zimmermann (1978) extended LP into a fuzzy environment, leading to the development of fuzzy linear programming (FLP). Since then, several researchers have proposed methods for solving FLP problems using ranking functions, defuzzification techniques, and fuzzy arithmetic (Bellman and Zadeh, 1970; Maleki, 2000; Pandian and Jayalakshmi, 2010).

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Most existing methods either transform the fuzzy problem into a crisp LP at an early stage or depend heavily on ranking of fuzzy numbers, which may lead to loss of information. Motivated by these limitations, this paper introduces a new arithmetic operation on triangular fuzzy numbers based on α -cut and interval arithmetic. The proposed approach allows direct handling of fuzzy parameters and provides a simpler and more intuitive solution procedure.

The main contribution of this paper lies in: - Developing new arithmetic operations for triangular fuzzy numbers using α -cut based interval arithmetic. - Applying these operations to solve fully fuzzy linear programming problems. - Demonstrating the simplicity and effectiveness of the method through a numerical example.

PRELIMINARIES

Fuzzy Set

Let X be a universal set. A fuzzy set A in X is characterized by a membership function $\mu_A(x): X \rightarrow [0,1]$, where $\mu_A(x)$ denotes the degree of membership of x in A (Kaufman and Gupta, 1984).

Alpha-Cut of a Fuzzy Set

For a fuzzy set A and $\alpha \in [0,1]$, the α -cut of A is defined as:

$$A_\alpha = \{x \in X \mid \mu_A(x) \geq \alpha\}$$

The strong α -cut is defined as:

$$A_{\alpha^+} = \{x \in X \mid \mu_A(x) > \alpha\} \text{ (Zimmermann, 1978).}$$

Triangular Fuzzy Number

A fuzzy number $A = (a, b, c)$ is called a triangular fuzzy number (TFN) if its membership function is defined as:

$$\mu_A(x) = \begin{cases} \frac{x-a}{b-a} & , a \leq x \leq b \\ \frac{c-x}{c-b} & , b \leq x \leq c \\ 0 & \text{Otherwise} \end{cases}$$

The α -cut of a triangular fuzzy number $A = (a, b, c)$ is given by:

$$A_\alpha = [a + (b-a)\alpha, c - (c-b)\alpha]$$

INTERVAL ARITHMETIC

Interval arithmetic is a mathematical technique used to handle uncertainty and rounding errors by representing numbers as intervals rather than point values (Moore, 1966).

Let $[p, q]$ and $[r, s]$ be two intervals. The basic interval arithmetic operations are:

(i) Addition: $[p, q] + [r, s] = [p + r, q + s]$

(ii) Subtraction: $[p, q] - [r, s] = [p - s, q - r]$

(iii) Multiplication: $[p, q] \times [r, s] = [\min(pr, ps, qr, qs), \max(pr, ps, qr, qs)]$

(iv) Division: $[p, q] \div [r, s]$, provided $0 \notin [r, s]$

NEW ARITHMETIC OPERATIONS ON TRIANGULAR FUZZY NUMBERS USING ALPHA-CUT (Dutta et al. 2011)

Let $X = (a, b, c)$ and $Y = (p, q, r)$ be two triangular fuzzy numbers. Their α -cuts are:

$$X_{\alpha} = [a + (b-a)\alpha, c - (c-b)\alpha]$$

$$Y_{\alpha} = [p + (q-p)\alpha, r - (r-q)\alpha]$$

Addition

$$X + Y = [a + p + (b-a + q-p)\alpha, c + r - (c-b + r-q)\alpha]$$

Subtraction

$$X - Y = [(a - r) + (b - a + r - q)\alpha, (c - p) - (c - b + q - p)\alpha]$$

Multiplication

$$X \times Y = X_{\alpha} \times Y_{\alpha} \text{ using interval multiplication}$$

Division

$$X \div Y = X_{\alpha} \div Y_{\alpha}, \text{ provided } 0 \notin Y_{\alpha}$$

SOLUTION PROCEDURE FOR FUZZY LINEAR PROGRAMMING PROBLEM

The following assumptions and steps are used:

1. Represent all fuzzy coefficients by triangular fuzzy numbers.
2. Compute α -cuts of all fuzzy parameters.
3. Apply the proposed interval arithmetic operations.
4. Formulate the resulting interval-valued LP problem.
5. Solve the LP problem to obtain the optimal solution.

NUMERICAL EXAMPLE

Consider the fully fuzzy linear programming problem:

$$\text{Maximize } Z = 6x + 5y$$

Subject to:

$$[(1,2,3)+(3,4,5)]x + [(4,5,6)+(1,2,3)]y \leq [(12,14,16)+(16,18,20)]$$

$$[(1,2,3)+(3,4,5)]x + [(0,1,2)+(2,3,4)]y \leq [(14,16,18)+(18,20,22)]$$

$$x, y \geq 0$$

Applying α -cut and the proposed interval arithmetic operations, the fuzzy constraints are transformed into interval-valued constraints. Solving the resulting LP problem yields the optimal solution:

$$x = 6, y = 0, \text{Max } Z = 36$$

The result demonstrates that the proposed method is straightforward and avoids complex ranking procedures used in existing approaches.

CONCLUSION

This paper presents a new arithmetic operation on triangular fuzzy numbers using α -cut and interval arithmetic for solving fuzzy linear programming problems. The proposed approach preserves fuzziness throughout the solution process, avoids defuzzification and ranking methods, and simplifies computation. The numerical example illustrates the effectiveness and practical applicability of the method. The approach can be extended to other fuzzy optimization problems involving uncertainty and imprecision.

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The Role of Digital Marketing in Promoting Green Products and Influencing Consumer Buying Behaviour.

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Rohit Das**

Abstract

In today's digital era, marketing has evolved into a powerful tool for influencing consumer perception and purchasing decisions. With increasing global concern for environmental sustainability, digital marketing plays a crucial role in promoting green and eco-friendly products. This study examines how digital marketing strategies impact consumer awareness, attitudes, and buying behaviour toward green products. A quantitative research approach was adopted using both primary and secondary data. Primary data were collected through an online questionnaire from 56 respondents representing diverse demographic backgrounds. The findings reveal that social media advertising (35.7%) and influencer marketing (25%) are the most effective tools in promoting green products, while product quality (82.1%) and discounts (75%) are the key motivating factors for purchase. Consumers tend to trust and follow brands that demonstrate genuine environmental responsibility, though exposure to green product promotions remains limited. The study concludes that digital marketing significantly shapes consumer behaviour towards sustainable consumption by enhancing awareness, building brand trust, and promoting responsible purchasing. For greater effectiveness, marketers must ensure authenticity, transparency, and consistency in communicating their environmental values.

Keywords: *Digital Marketing, Green Products, Consumer Behaviour, Sustainability, Social Media Marketing, Influencer Marketing.*

INTRODUCTION

In the era of technology digital marketing plays an important role in our daily life. With growing environmental awareness, consumers are increasingly seeking sustainable and eco-friendly products, at the same time, digital marketing has emerged as a powerful tool for businesses to reach, educate and influence target audience. Since the 1990's and early 2000, these technologies have revolutionized traditional marketing approaches transforming both brand strategies and how consumers interact with companies. In recent years digital marketing is essential for promoting green and eco-friendly products, it helps raise awareness among

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consumers, and guides buying decisions towards greener options. Now days brands not only encourage responsible purchasing but also instil a mindset of sustainability and accountability among consumers.

Digital marketing campaign that promotes eco-friendly products emphasizes a brands environmental advantages and sustainable practices demonstrating a genuine commitment to green values. To successfully promote green products through digital marketing, emphasizes authenticity, transparency, and compelling storytelling. Showcase the environmental benefits and connect with eco- conscious consumers via appropriate channels. Leverage content marketing, social media and e mail campaign to inform and motivate audiences, while also prioritizing sustainable packaging and logistics.

Green marketing tools to promote green products such as eco-labels, green ads, and sustainable packaging are powerful steering for consumers towards eco-friendly choices. Their impact depends on how well they are resonating with the audience's environmental awareness and the relevance of the green benefit to the product category. When consumers encounter effective green marketing campaign - especially those that emphasizes environmental benefits and resonate with their personal values, become significantly more inclined to choose green products. Promoting green products through digital marketing it significantly impacts consumer buying behaviour by guiding purchase choices, building brand loyalty, and potentially encouraging a willingness to pay more for eco-friendly options. The success of these promotions depends on various factors, such as consumer awareness, trust in environmental claims, perceived quality and how well the product align with individual values.

Overall, digital marketing is the instrument to promote green products and shaping consumer behaviour towards sustainability. With the help of digital channels, companies can effectively highlight the benefits of eco-friendly products, foster consumer trust, increasing awareness and driving purchase intentions and encourage sustainable choices. However, for green marketing efforts to be successful and credible, they must be transparent, authentic, and supported by real product innovations. This will be helps prevent greenwashing and strengthens long term consumer loyalty.

This research explores how digital marketing strategies affect consumer perception, attitudes, and purchasing decisions regarding green products.

REVIEW OF LITERATURE

The rapid advancement of digital technologies has transformed business communication and created new avenues for promoting eco-friendly products. With rising global environmental awareness, researchers increasingly explore how digital marketing shapes consumer attitudes and purchasing behaviour toward green products. Studies show that social media, influencer marketing, SEO, and targeted campaigns significantly enhance consumer engagement. Simultaneously, green

marketing elements such as eco-labels, sustainable packaging, and transparent environmental claims strengthen consumer trust.

Existing literature suggests that combining digital tools with green marketing strategies effectively attracts environmentally conscious consumers. However, their impact varies depending on consumer awareness, digital literacy, brand credibility, and perceived value. Scholars also highlight challenges such as greenwashing and limited access in rural or low-income areas. Against this backdrop, the literature review summarises key research themes, including digital engagement, sustainability communication, green product adoption, and psychological drivers of eco-friendly purchasing behaviour. This provides the foundation for examining how digital marketing promotes green products and supports sustainable consumption.

Gupta (2025) explores how digital marketing tactics like social media ads, email campaigns, influencer marketing, and targeted promotions shape consumer engagement, brand loyalty, and purchasing decisions. The study highlights the power of digital marketing in enhancing interactions, especially with younger, tech-savvy audiences, by offering personalized experiences and convenience. However, challenges such as digital illiteracy, privacy concerns, and limited internet access in rural areas hinder the full potential of these strategies. Regional differences also influence how consumers respond to various digital channels, emphasizing the need for localized approaches. Aakanksha (2025) investigates how the rapid growth of internet access and online platforms has transformed consumer purchasing behaviour, shifting markets from traditional to more interactive and personalized strategies. The study shows how digital marketing, especially through social media and SEO, has become crucial in driving consumer engagement and helping businesses achieve their goals. Manokaran (2024) examines consumer purchasing habits toward green products, focusing on how awareness and motivations around sustainability influence buying decisions. The research finds that businesses embracing green marketing strategies-such as eco-friendly packaging and sustainable production-can enhance brand value and influence purchase intentions. Sharma (2025) discusses how social media platforms like Facebook, Instagram, and YouTube have become powerful marketing tools. Social media marketing (SMM) allows brands to build trust and influence buying behavior through influencer campaigns, interactive content, and targeted ads. Despite the growth of SMM, measuring its direct impact on consumer loyalty remains a challenge, with the study exploring the complexities of engagement and platform influence. Kashyap et al. (2018) discuss consumers' awareness of environmental issues and green marketing initiatives, noting that consumers with strong green values tend to prefer brands that emphasize sustainability. Prathap Kumar et al. (2024) explore how businesses use digital platforms to communicate sustainability, showing that digital green marketing is shaping consumer attitudes and purchase decisions in an increasingly environmentally aware market. Georgios (2018) investigates how factors like perceived value, brand consciousness, and consumer attitudes toward green products influence online

purchasing behaviour. The study finds that consumers' intent to buy green products online is driven by these factors, with demographic elements also playing a role. Shing & Selvasundaram (2024) highlight how information systems and digital marketing enhance sustainability communication, showing that engaging content and advanced digital tools can influence eco-friendly consumer actions. Parsetyo (2025) examines how green marketing and digital marketing impact impulsive buying, finding that eco-friendly features, sustainability promotions, and social media engagement significantly increase impulsive purchases. The combined effect of both green and digital marketing explains a large portion of the variance in impulsive buying. Finally, Armutcu & Zuferi (2023) extend the theory of planned behaviour (TPB) to include social media and digital marketing, showing that attitudes, subjective norms, and perceived behavioural control, alongside digital marketing interactions, significantly influence consumers' green product purchasing behaviour, though general social media use alone doesn't have the same effect.

STATEMENT OF THE PROBLEM

- Sustainability and environmental awareness are becoming increasingly important, yet many consumers still hesitate to adopt green products. This gap between awareness and actual purchase behaviour shows the need for stronger and more effective promotional efforts.
- Although digital marketing plays a major role in promoting eco-friendly products, its specific impact on influencing consumer decisions remains underexplored. This raises questions about how well current digital strategies drive sustainable consumption.
- Digital marketing has the potential to educate and encourage consumers toward green purchasing, but challenges persist-especially in reaching low-income and remote populations where awareness, access, and digital literacy are limited.
- This research is important for identifying effective digital marketing strategies-such as social media campaigns, influencer endorsements, and educational content-that can raise awareness, build trust, highlight eco-friendly benefits, and ultimately influence consumer buying behaviour toward green products.

RESEARCH OBJECTIVES

The growing importance of environmental sustainability has led businesses to increasingly adopt digital marketing as a strategic tool for promoting green and eco-friendly products. Although consumers are becoming more aware of environmental issues, their actual adoption of green products remains limited, largely due to insufficient exposure, lack of trust, and unclear communication of green benefits. In

this context, digital marketing plays a crucial role in shaping consumer awareness, influencing perceptions, and motivating purchasing decisions toward sustainable products. As per this paper, our research objectives are as follows:

- To examine the effectiveness of digital marketing strategies in promoting green products.
- To assess the impact of digital marketing on consumer awareness and attitudes toward green products.
- To evaluate the influence of digital marketing on consumer purchase decisions for eco-friendly products.
- To identify the most effective digital platforms and tools for promoting green products.

RESEARCH METHODOLOGY

This study follows a quantitative research approach using both primary and secondary data. The quantitative method was chosen to analyse measurable variables related to digital marketing tools, consumer awareness, and buying behaviour. The research aims to establish relationships between digital marketing practices and consumers' attitudes toward green products. The study uses a descriptive research design, as it seeks to describe and interpret the existing relationship between digital marketing and green consumer behaviour. The design helps to identify patterns, perceptions, and attitudes among consumers regarding how digital marketing influences their purchase decisions for eco-friendly products. The primary instrument used for data collection was a Google Form-based questionnaire. It consisted of:

- Demographic questions (age, gender, occupation, etc.)
- Questions on awareness of green products
- Questions on exposure to digital marketing tools (social media, influencer marketing, SEO, etc.)
- Likert-scale questions on perceptions, attitudes, and buying behaviour related to green products

Data Collection Techniques: Primary data were collected through a structured questionnaire distributed to respondents via online platforms. The questionnaire included both closed-ended and Likert-scale questions related to consumer perceptions, awareness, and motivations behind purchasing green products. Secondary data were gathered from journals, research articles, reports, and online sources such as Google Scholar, ResearchGate, and Wikipedia. These sources provided insights into the theoretical background, previous research findings, and global trends in digital and green marketing. The collected data were analysed using descriptive statistical methods, including frequency distribution and percentage analysis. The results were presented using bar charts and graphs to show patterns in respondents' opinions and

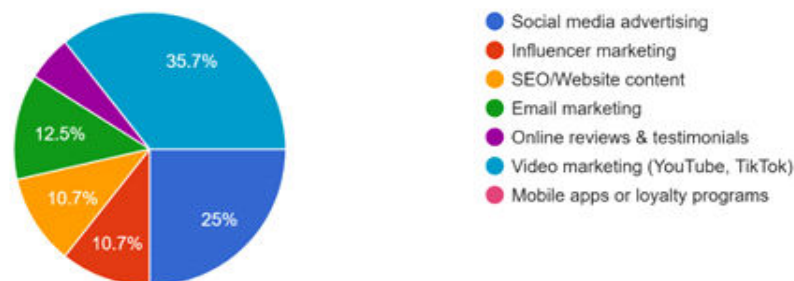
behaviours. Interpretation focused on identifying the most influential digital marketing channels and consumer motivation factors.

Sampling Technique & Sample Size: A non-probability convenience sampling technique was used. Respondents were selected based on their availability and willingness to participate in the survey. This approach was suitable for collecting data from diverse groups of consumers who are active on digital platforms. The study collected responses from 56 participants, representing various age groups and professional backgrounds. This sample size was adequate to analyse general consumer trends and attitudes towards digital marketing of green products.

INTERPRETATION

This study is based on primary data collected from 56 respondents through a structured Google Form questionnaire. The responses provide firsthand insights into consumer perceptions, attitudes, and behaviours related to digital marketing and green products. The following interpretation analyses these findings to understand key trends, preferences, and factors influencing consumer decisions in the context of sustainable product adoption.

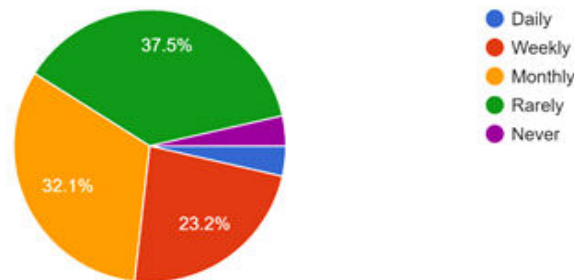
In your opinion, which digital marketing tools are most effective for promoting green products?
56 responses



Based on the survey of 56 responses, the most effective digital marketing tool for promoting green products is social media advertising, with 35.7% of the votes. This is followed by influencer marketing, which accounts for 25% of the responses. SEO/Website content was considered the third most effective tool at 12.5%. Email marketing and online reviews & testimonials were tied for the next most effective, both at 10.7%.

How often do you come across digital content about green or sustainable products?

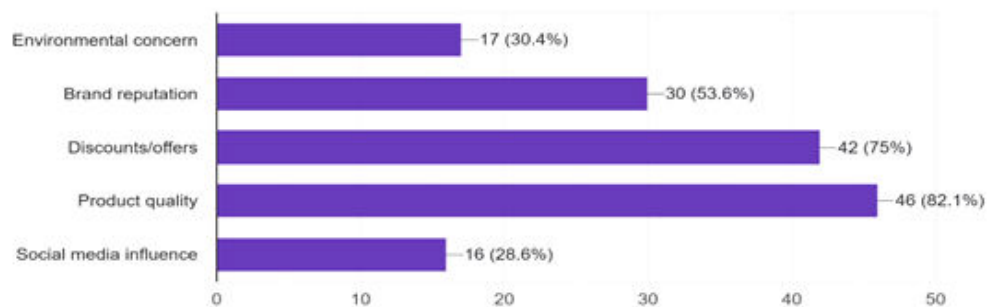
56 responses



Based on the survey of 56 responses, the majority of respondents encounter digital content about green or sustainable products on a less frequent basis. The largest portion of respondents (37.5%) indicated they "Rarely" come across such content, followed by 32.1% who see it "Monthly." A smaller percentage, 23.2%, reported seeing this content "Weekly." The remaining 7.2% of respondents are split between seeing it "Daily" and "Never."

Which factors most motivate you to buy green products promoted digitally?

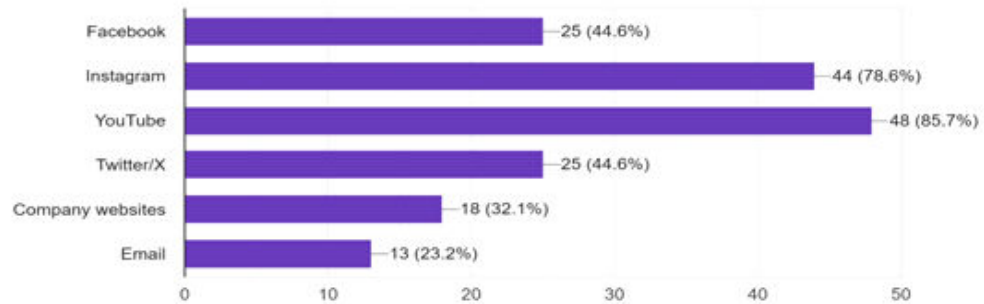
56 responses



Based on a survey of 56 responses, the factors that most motivate people to buy green products promoted digitally are primarily related to product quality and discounts. Product quality was the most significant factor, with 46 out of 56 respondents (82.1%) identifying it as a motivator. This was closely followed by discounts and offers, which was a motivating factor for 42 respondents (75%). Brand reputation was also a major influence, cited by 30 people (53.6%). Environmental concern and social media influence were less significant factors, with 17 respondents (30.4%) and 16 respondents (28.6%) respectively.

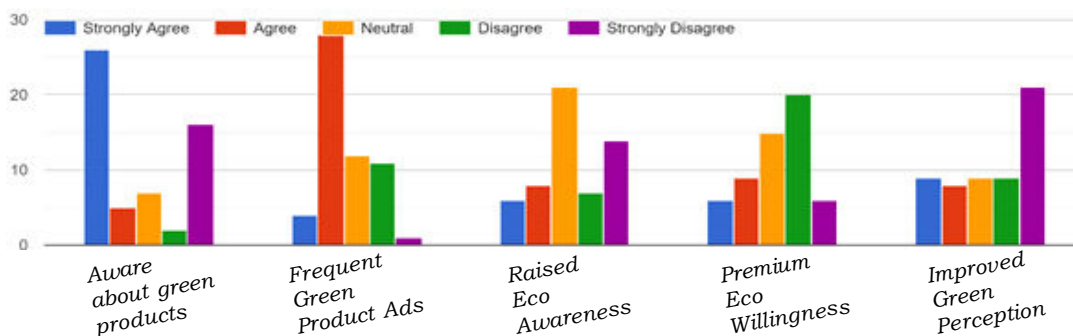
Which of the following platforms do you most frequently use to learn about green products?

56 responses



Based on a survey of 56 respondents, the provided bar chart shows the most frequently used platforms for learning about green products. The data indicates that Twitter/X is the most popular platform, with 48 responses (85.7%). Instagram is the second most popular with 44 responses (78.6%), followed by Facebook and YouTube, which are tied with 25 responses each (44.6%). Company websites and email are the least popular platforms, with 18 (32.1%) and 13 (23.2%) responses, respectively. The percentages add up to more than 100%, suggesting that respondents could select multiple platforms.

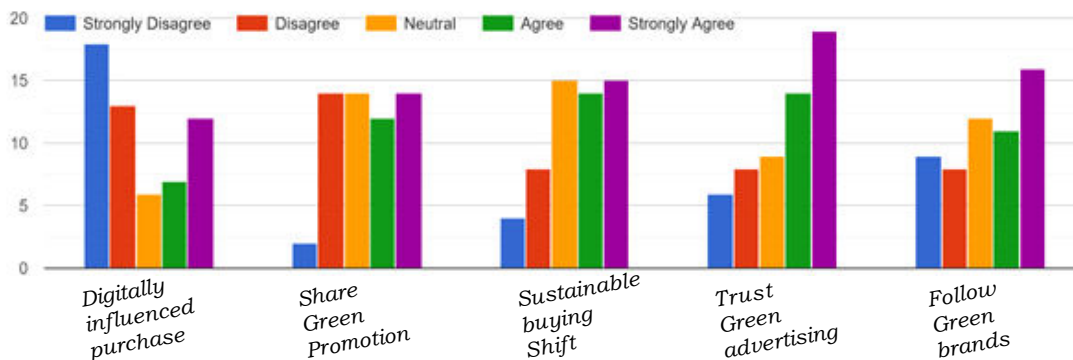
Please indicate your level of agreement with each statement by selecting the option that best represents your opinion.



The data shows that consumer awareness of green products is uneven-while many respondents are unfamiliar with eco-friendly options, a considerable number are well-informed. Visibility of green product advertisements online is generally low, indicating that digital marketing efforts for sustainability are not reaching most consumers. Although many participants remain uncertain about how strongly digital

marketing influences their awareness and behaviour, a notable portion does feel its impact. Willingness to pay a higher price for green products is moderate, with most consumers open to the idea but not fully committed. Despite these mixed responses, overall attitudes toward green products are strongly positive, suggesting that consumers value sustainability and are receptive to environmentally friendly options when information and visibility are improved.

Please indicate how strongly you agree or disagree with the following statements regarding your purchasing behavior influenced by digital marketing of green products.



The bar graph displays survey results on how digital marketing of green products influences purchasing behaviour. The data shows that for most statements, there is a mix of opinions, but with a tendency towards agreement. For the statement "I have purchased green products after seeing them advertised digitally.", there is a strong split between those who "Strongly Disagree" and those who "Agree" or "Strongly Agree." For the statement "I often share or recommend green product promotions I see online the highest number of responses are in the "Agree" and "Strongly Agree" categories. The statements "Digital marketing has changed my buying behaviour toward choosing more sustainable options" and "I trust digital advertisements that promote eco-friendly or sustainable products" also show a general trend towards agreement, with a significant number of people selecting "Agree" and "Strongly Agree." I am more likely to follow brands online that actively promote green and sustainable initiatives "has the highest number of "Strongly Agree" responses, indicating that a significant portion of respondents feel they are more influenced by digital marketing of green products.

LIMITATIONS OF THE STUDY

- The sample size (56 respondents) may not fully represent the entire consumer population.
- Responses are subject to individual perceptions and may include bias.

- The study is limited to online consumers with digital access, excluding those in rural areas with limited internet access.

FINDINGS

The survey results highlight several key insights into the effectiveness of digital marketing for green products. Social media advertising emerged as the most influential tool (35.7%), followed by influencer marketing (25%), while SEO content, email marketing, and online reviews played smaller supporting roles. Despite this, visibility of green product promotions remains limited, as most respondents reported seeing such content only rarely (37.5%) or monthly (32.1%), with very few encountering it daily. When it comes to purchasing decisions, consumers are primarily driven by product quality (82.1%) and discounts or offers (75%), with brand reputation also playing a notable role. Environmental concern and social media influence show comparatively lower impact. In terms of preferred platforms, Twitter/X (85.7%) and Instagram (78.6%) are the top choices for discovering green products, while Facebook, YouTube, company websites, and emails are less favoured. Overall, respondents generally agree that digital marketing enhances their awareness and influences their buying behaviour toward sustainable products, and many have previously purchased eco-friendly items after encountering online promotions. Although consumers tend to trust brands that are transparent about their sustainability efforts, a degree of scepticism remains due to concerns about greenwashing.

SUGGESTIONS

Companies should increase the reach and consistency of their green marketing efforts, as many consumers still rarely see promotions for eco-friendly products. Marketing messages need to clearly emphasize product quality, value for money, and genuine environmental benefits, since these factors most strongly influence purchase decisions. Social media should be used more effectively, supported by credible sustainability-focused influencers who can build trust and engagement, especially among younger audiences. Brands should also simplify their educational content so consumers can easily understand eco-friendly features, certifications, and long-term environmental impact.

To build lasting trust and avoid greenwashing, companies must be transparent and provide verifiable, evidence-based sustainability claims. Digital outreach should also be inclusive by targeting rural and low-access audiences using local languages and easy-to-understand formats. Finally, a well-integrated multi-channel approach—combining social media ads, SEO content, email marketing, influencer partnerships, and online reviews—will strengthen digital presence, boost credibility, and encourage more consistent engagement with sustainable products.

CONCLUSION

The study concludes that digital marketing plays a vital role in promoting green products and influencing consumer buying behaviour. Among various digital tools, social media advertising and influencer marketing are the most effective in spreading

awareness and motivating purchases. Consumers show a strong preference for brands that actively demonstrate their commitment to sustainability, although the frequency of exposure to green marketing remains limited. Product quality and economic value continue to be key decision drivers, which indicates that while environmental awareness is growing, practicality and trust still shape buying choices. Overall, the findings affirm that digital marketing can significantly contribute to promoting sustainable consumption if implemented with authenticity, consistency, and transparency. Hence, businesses must align their digital strategies with genuine eco-friendly practices to build long-term consumer trust and drive both environmental and commercial success.

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Understanding Research Trends on Self-Help Groups in India: A Bibliometric Study

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Dr. Bipanche Goswami**

Abstract

The study aims to identify the most influential sources, institutions, and countries contributing to Self-Help Group (SHG) research. It also examines the evolution of key themes and current research developments in the field. Additionally, it explores patterns of co-authorship among authors, organizations, and countries to understand collaborative research trends by using a bibliometric analysis of publications indexed in the Scopus database from 1983 to 2025. It includes different types of documents such as articles, reviews, book chapters, letters, conference papers, and editorials, but excludes engineering and computer science subjects. The aim is to understand how SHG research has developed over time, who the main contributors are, and what the key focus areas have been. Using a tool like Biblioshiny in R Studio, the study analyzes publication patterns, top authors, institutions, journals, and common research themes. This study analyzes research on Self-Help Groups (SHGs) from 1983 to 2025 and shows steady growth, especially after 2005. Most of the studies are journal articles written by groups of authors, with strong international collaboration. India leads in both the number of publications and their impact, supported by major institutions like the International Food Policy Research Institute. Common research themes include self-help, women's empowerment, microfinance, and poverty reduction.

Keywords: *Self-Help Groups (SHG), Bibliometric Analysis, Research Trends, Collaboration, Citation Analysis, India, Microfinance, Women Empowerment.*

INTRODUCTION

Self-Help Groups (SHGs) in India have emerged as a powerful model for addressing poverty, women's empowerment, and community development since the early 1990s. These grassroots institutions aim to provide access to microcredit, build social capital, and enhance financial inclusion for marginalized groups, especially rural women (Kabeer, 2005; Sharma & Parthasarathy, 2007). Government-backed programs such

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as NABARD's SHG-Bank Linkage initiative and community-based efforts by organizations like SEWA and the Rajiv Gandhi Mahila Vikas Pariyojana (RGMVP) have further strengthened the SHG movement (Drishti IAS, 2023; Wikipedia, 2024).

Numerous studies have examined the socio-economic outcomes of SHG participation. Research has shown that SHGs can improve women's income levels, participation in household and political decisions, and self-confidence (Aggarwal et al., 2021; Gharai & Kar, 2024). Furthermore, SHGs have contributed to achieving sustainable development outcomes, particularly in the areas of health, education, and economic resilience (Mahato et al., 2023).

Despite the growing body of work on SHGs, there is a limited systematic analysis of the research trends, thematic evolution, and collaborative patterns in SHG-related literature. Some recent efforts have used bibliometric tools to analyze women's empowerment and SHG studies in India, but these have often been narrow in scope or limited to specific journals or regions (Srivastava & Sharma, 2024; Panda et al., 2024).

To address this gap, the present study conducts a comprehensive bibliometric analysis of SHG-related literature in India published between 2000 and 2025, using the Scopus database. The analysis includes articles, reviews, book chapters, conference papers, letters, and editorials, but excludes the engineering and computer science domains to maintain focus on social sciences, economics, management, and development studies. Bibliometric tool Biblioshiny is used to analyze publication trends, top authors and institutions, major journals, citation patterns, keyword co-occurrence, and collaboration networks.

OBJECTIVES OF THE STUDY

1. To identify the most influential sources, organizations, and countries that published documents on self-help groups.
2. To analyze the development of foundational themes and present research development on self-help groups
3. To recognize co-authorship between authors, organizations, and countries and their research trends self-help group.

METHODOLOGY

This study uses a quantitative bibliometric analysis to explore how research on Self-Help Groups (SHGs) in India has developed over time. Data was collected from the Scopus database, covering the years 1983 to 2025, focusing on publications related to SHGs in India within social sciences, economics, development studies, and management. The search included keywords like "Self-Help Group," "SHG," "microfinance," "women empowerment," and "India" and excluded studies from engineering, computer science, and unrelated technical fields. Only English-language

documents such as articles, reviews, book chapters, conference papers, letters, and editorials were considered. The collected data was processed and analyzed using Biblioshiny, a tool within the Bibliometrix package in RStudio, which helped clean the data and generate useful charts and indicators. The study used several techniques, including measuring the number of publications per year, identifying top authors, journals, and institutions, tracking citation trends, and analyzing common keywords. It also applied Bradford's Law to find the most important journals and examined collaboration patterns among authors and institutions, including international partnerships. This approach helped to understand the key trends, themes, and contributors in SHG research in India.

RESULTS AND DISCUSSIONS

Table 1. Main Information about Data Considered

MAIN INFORMATION ABOUT DATA	
Timespan	1983:2025
Sources (Journals, Books, etc)	152
Documents	208
Annual Growth Rate %	4.36
Document Average Age	8.3
Average citations per doc	13.31
References	6947
DOCUMENT CONTENTS	
Keywords Plus (ID)	1191
Author's Keywords (DE)	583
AUTHORS	
Authors	610
Authors of single-authored docs	36
AUTHORS COLLABORATION	
Single-authored docs	39
Co-Authors per Doc	3.79
International co-authorships %	30.29
DOCUMENT TYPES	
Article	188
book chapter	6
conference paper	2
Editorial	1
Letter	3
Review	8

Source: Biblioshiny report

Interpretation: The database of the bibliometric analysis spans 1983-2025, and reveals a steady annual growth of 4.36%. From the above table, it has been observed that most of the publications are research articles, i.e., 188 out of 208. The database includes other types of documents like book chapters, conference papers, editorials,

letters, and reviews. The average age of the documents is 8.3, with an average cite score per document of 13.31, which is moderate. The 1191 keywords plus (ID) and 583 authors' keywords reveal that the research covers a wide range of topics. The database covers a total of 610 authors, out of which 36 are single-authored. The data reveals that there is a strong authors' collaboration, the average co-author per document is 3.79, and 30.29% are international co-authorships. Therefore, from the database, it has been observed that the trend of research on Self Help Group (SHG) is a well-established and evolving research domain.

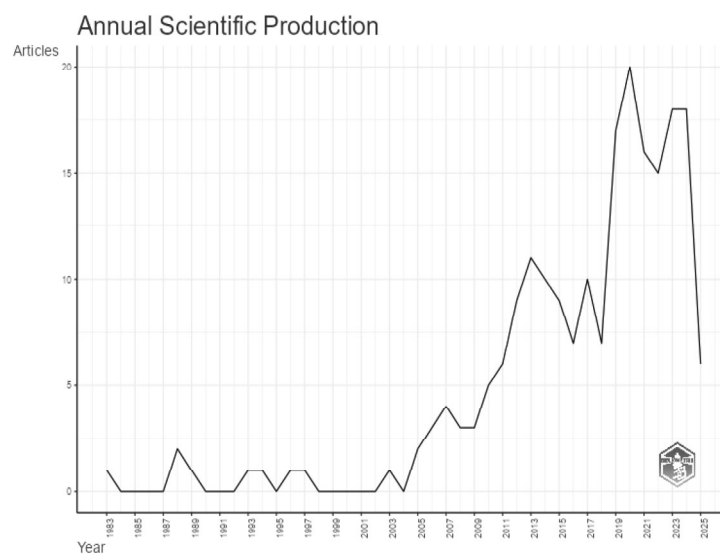


Figure 1: Annual Acentific Production of Articles relating to SHG

Interpretation: From the above figure, it has been observed that the trend of research on SHG, in the early years, i.e., 1983-2004, was very low with only a few publications. Around 2005, a noticeable increase began. The growth was steady till 2013, when the number of articles exceeded 10 for the first time. The annual scientific production of articles peaked between 2019-2021 and reached 20 articles in the year 2020. However, after 2021, the annual scientific production slightly declined, but again in 2023 and 2024, the number of articles was quite satisfactory. But in the year 2025 the annual scientific production declined significantly to 6.

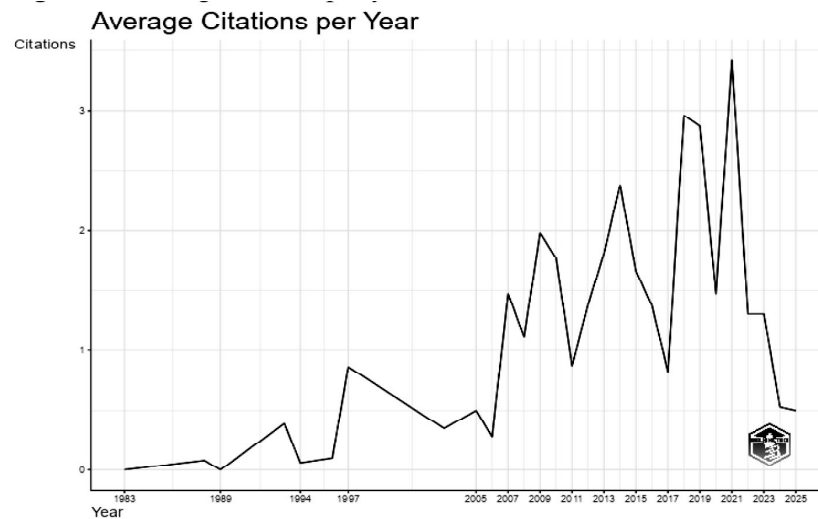


Figure 2: Average citation per year on SHG research

Interpretation: Figure 2 illustrates the trend of average citations per year for research on SHG from 1983 to 2025. During the initial period, i.e., from 1983 to 2005, the citation rate was very low, which was below 1, indicating a low impact on the publications during that period. From the year 2006, the citation increased and reached above 1. The average citation peaked during the years 2011, 2014, 2018, and reached its highest in the year 2021, and the average citation per year exceeded 3. From the figure, it has been observed that from the year 2022, the average citation per year started declining and by 2025, the average citation dropped to below 1, i.e., 0.5. Therefore, it has been observed that in recent times, the impact on research related to SHG has decreased.

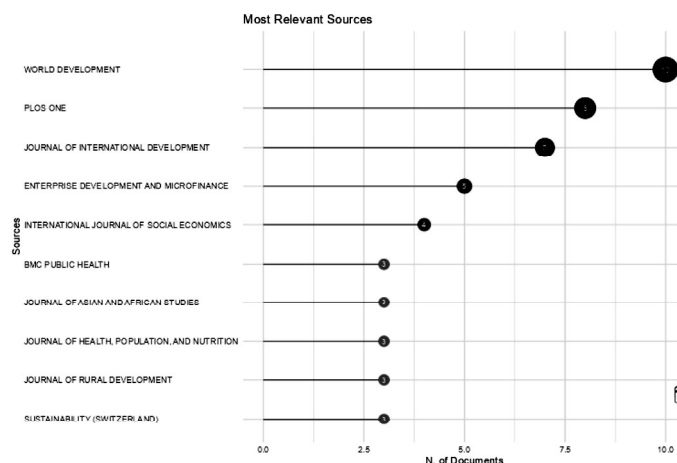


Figure 3: Most relevant sources of articles on SHG

Interpretation: From the above figure, it has been observed that the top journal and the most relevant source, contributing to this research field, is World Development, which contributed the highest number of publications, i.e., 10. The second most relevant source that contributed to this field of research is PLOS ONE, with 8 publications. It is followed by the Journal of International Development with 7 publications. Enterprise Development and Microfinance, and the International Journal of Social Economics also make a moderate contribution in this research field, with a number of publications, 5 and 4, respectively. The other journals, i.e., BMC Public Health, Journal of Asian and African Studies, Journal of Health, Population and Nutrition, Journal of Rural Development and Sustainability (Switzerland), each have contributed 3 publications in this research field.

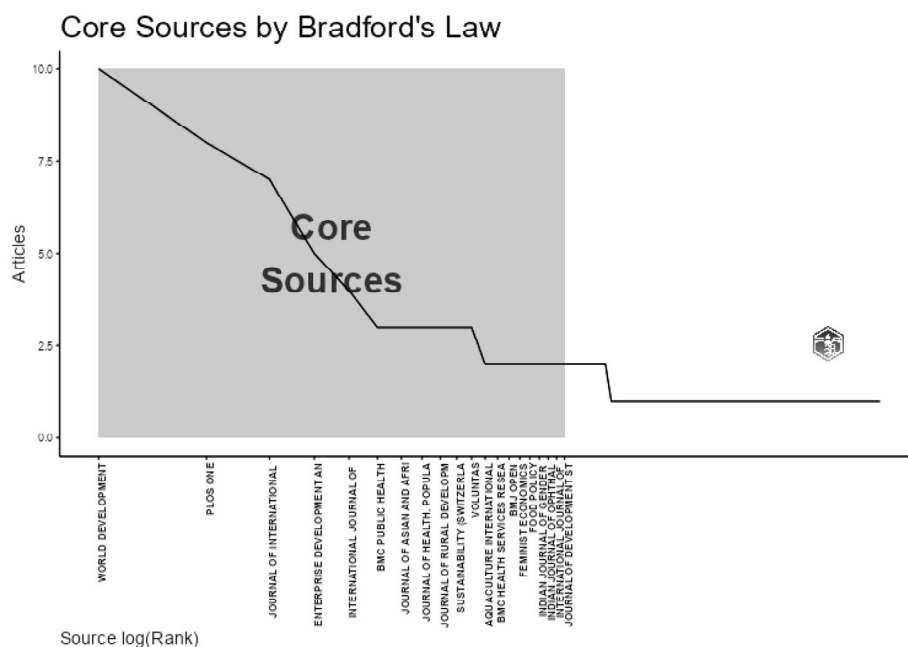


Figure 4: Core sources of journals by applying Bradford's Law

Interpretation: Figure 4 depicts the core sources of journals by applying Bradford's Law. The shaded area shows the core sources that contributed the highest number of research papers related to SHG. The journal titled World Development is in the top position, and it is followed by PLOS ONE, Journal of International Development, and many more journals that have a noticeable contribution towards the research field related to SHG. Beyond the shaded area, the number of articles contributed per journal dropped tremendously, with only one or two research articles.

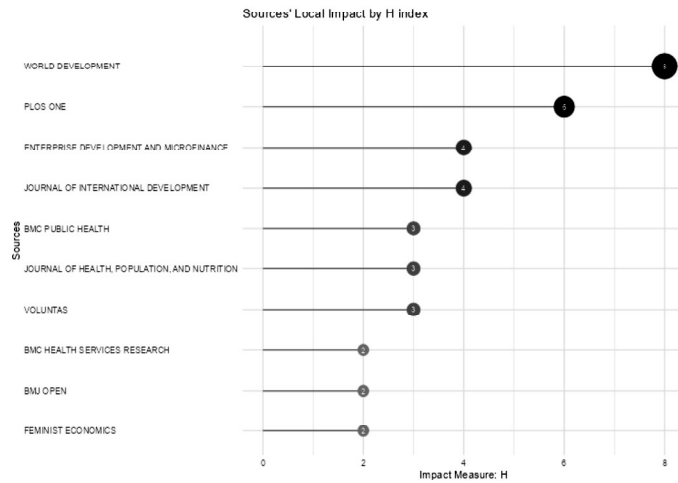


Figure 5: Top journals that published research papers related to SHG

Interpretation: Figure 5 depicts the top journal that published research papers related to SHG based on the citations received. The journal World Development is the most cited source, with a citation score of 8, indicating that it has high visibility and a strong influence in this field of research. PLOS ONE is another journal that also has a strong influence in this research field, with a citation score of 6. Among all other journals with moderate to low citation scores, World Development and PLOS ONE are the most influential sources, having a strong contribution in this research area.

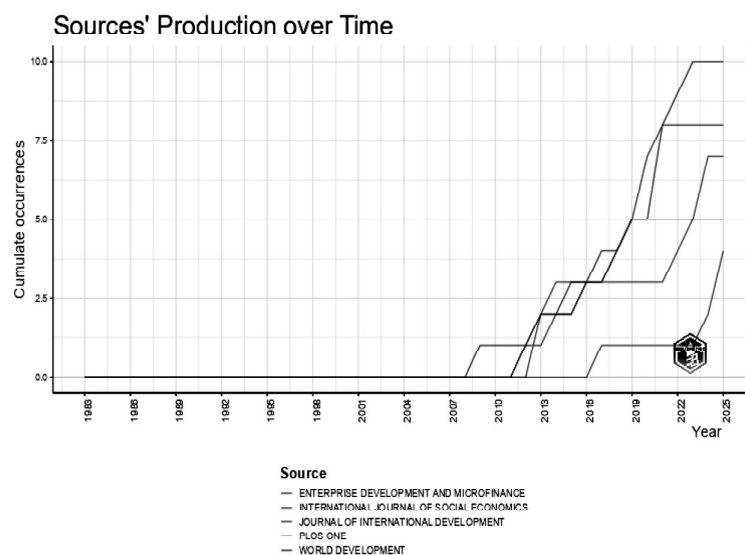


Figure 6: Articles related to SHG published by the top journals.

Interpretation: Figure 6 shows the cumulative number of articles related to SHG published by the top journals from 1983 to 2025. It has been observed from the figure that, till 2008, there was no significant contribution in this research area (SHG) from any of the listed journals. The journal World Development shows the highest cumulative production by reaching 10 articles by 2023. This journal plays the most dominant role in this research field. PLOS ONE and Journal of International Development show a steady growth with a cumulative number of articles published of 8 and 7, respectively.

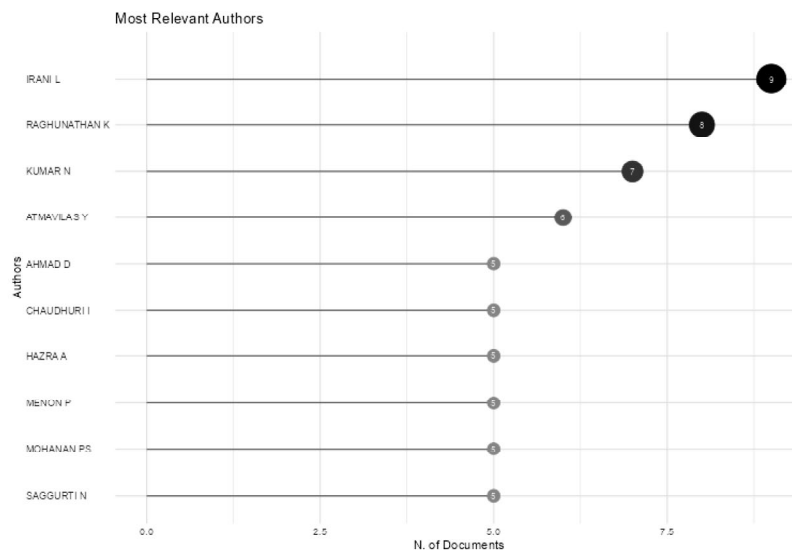


Figure 7: Most influential authors based on contribution to SHG-related research.

Interpretation: Figure 7 shows the most influential authors based on their contribution to this research field. It has been observed that Irani, L. is the leading author, making the highest contribution in this research field, with a score of 9. Raghunathan, K., Kumar, N., and Atmayibasy, Y. have a moderate contribution towards this research area with scores of 8, 7, and 6, respectively. Some other authors, namely Ahmad, D., Chaudhuri, I., Hazra, A., Mohanan, P.S., and Saggurtti, N. have equal and lower rates of contribution to this field of research (SHG).

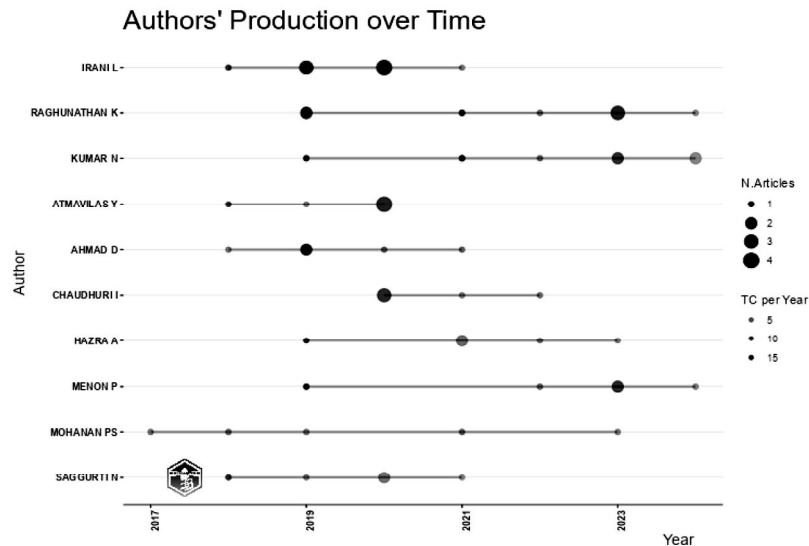


Figure 8: Authors' publications over time on SHG related research

Interpretation: Figure 8 depicts the authors' production over time. It has been observed that the productivity of Irani, L., and Raghunathan, K. was the most active as they consistently contributed multiple research papers related to SHG from 2017 to 2023. Kumar, N., and Atmavilas, Y., also contributed significantly towards this area of research. Other authors like Ahmad, D., Chaudhuri, I., Hazra, A., and Menon, P. have fewer contributions. Mohanan, P.S., and Saggurti, N. published their research papers in the early years. In recent years, their contributions towards this research area have decreased.

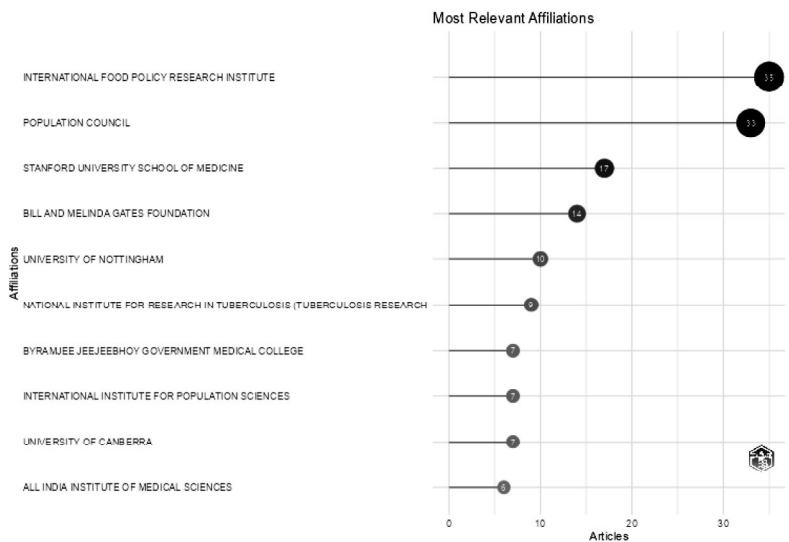


Figure 9: Number of articles published by various institutions.

Interpretation: The above figure-9 illustrates the number of articles published by various institutions. The International Food Policy Research Institute published the highest number of papers, i.e., 35 research papers related to SHG. The Population Council collaborated on 33 research papers. Stanford University School of Medicine and the Bill and Melinda Gates Foundation published a significant number of research papers, i.e., 17 and 14, respectively, on SHG. From the above figure, it has been observed that some other institutions also contributed moderately to publishing research articles related to SHG.

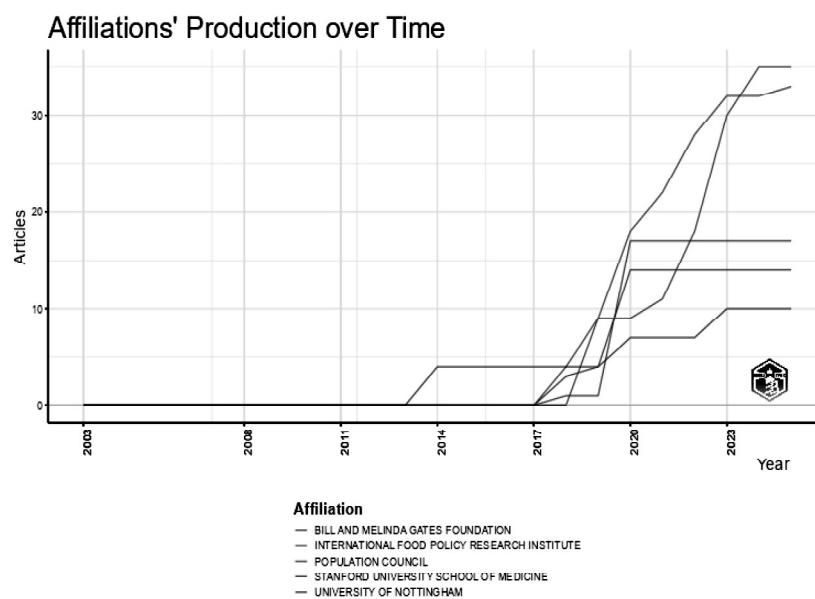


Figure 10: The research articles production of some affiliations.

Interpretation: Figure 10 demonstrates the research articles produced by some affiliations over the period. From the figure, it has been observed that the research output remained stagnant until 2016. From 2017, a notable increase in research outcomes was observed across all affiliations. The International Food Policy Research Institute and the Population Council show the highest growth in the production of research articles. Particularly after 2019, the growth is very high in the case of both affiliations. It has been observed from the diagram that other affiliations also show a moderate growth. The University of Nottingham shows the lowest growth (10 research articles) as compared to other affiliations.

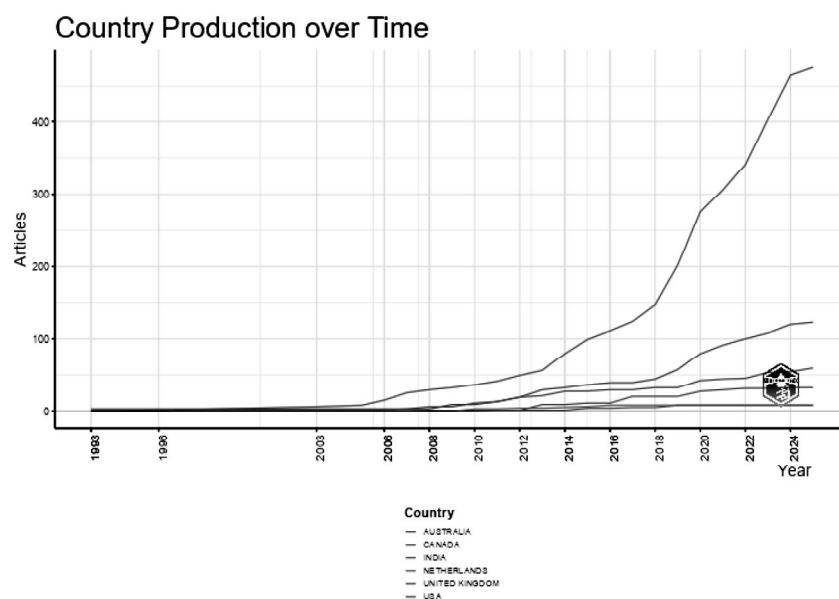


Figure 11: Country-wise production of research articles related to SHG

Interpretation: The above figure demonstrates the country-wise production of research articles related to SHG from 1983 to 2025. The production of research articles was minimal or stagnant until 2005 across all countries. After 2005, the production of research articles started to increase gradually in case of all countries, but particularly India's production of research articles on SHG was higher compared to other countries. Again, after 2015, the production of research articles by India was tremendous; it was skyrocketing in the years 2024 and 2025, i.e., 465 and 476, respectively. It has been observed that the production of research articles on SHG by India is the highest among all other countries. The USA also shows moderate growth and has reached 123 research articles by the year 2025. The United Kingdom is in third position in case of the production of research articles on SHG and has reached 59 articles by 2025. Other countries like Australia, Canada, and the Netherlands show lower and very slow growth in the contribution of research articles on SHG.

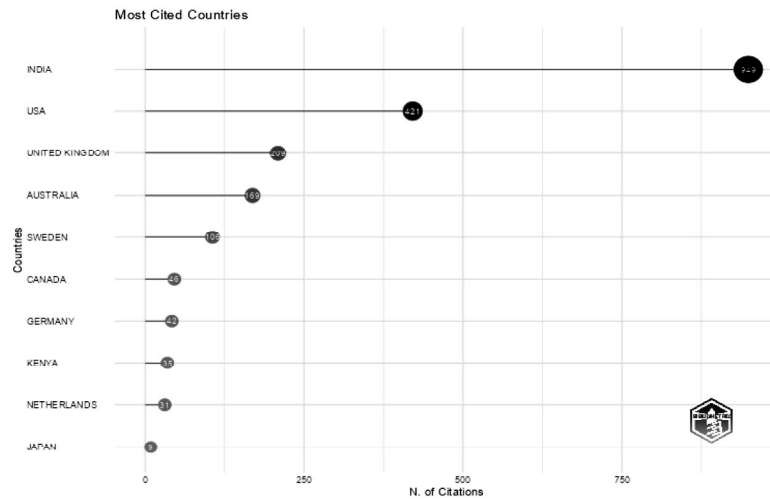


Figure 12: Most cited countries in the area of research related to SHG.

Interpretation: The above figure demonstrates the most cited countries in the area of research related to SHG. Here, it has been observed that among all the countries, India is in the highest position with 949 research articles. The USA and the United Kingdom are in the second and third positions with 421 and 209 articles, respectively. Australia and Sweden also have a moderate contribution in the area of research related to SHG, and the articles cited are 169 and 106, respectively. Other countries like Canada, Germany, Kenya, the Netherlands, and Japan have less number of citations in this area of research. Therefore, from the above figure, it has been observed that India is in a dominant position globally on the research area related to SHG.

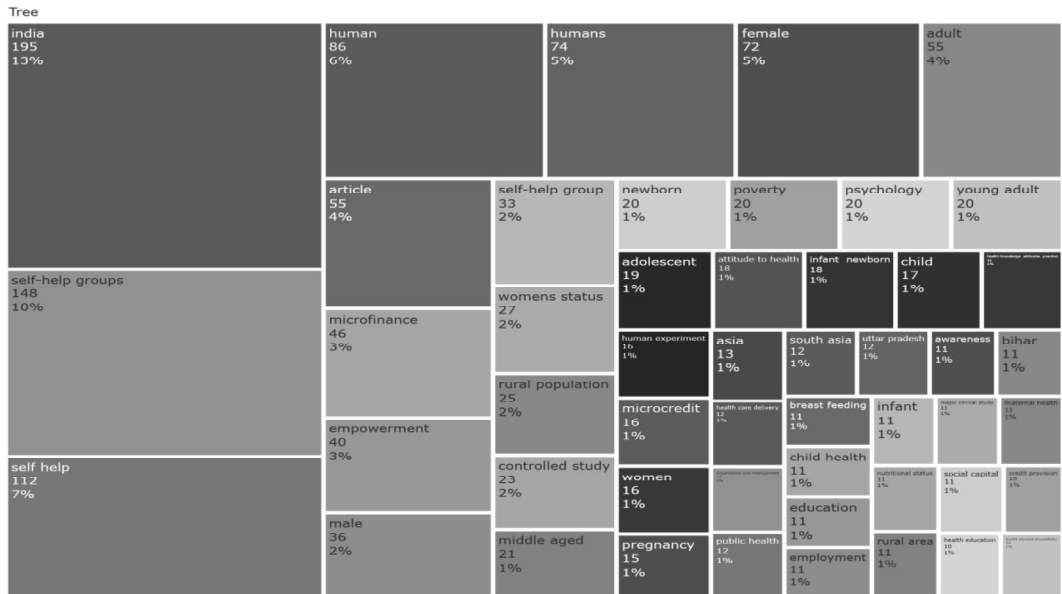


Figure 13: The keywords used and the frequency of using such keywords

Interpretation: The tree map demonstrates the keywords used and the frequency of use of such keywords in the research articles on SHG. The most commonly used keyword is 'India', i.e., 195 (13%). It indicates that India is the most prominent theme of the research papers. 'Self-help groups' is the next prominent keyword with a frequency of 148 (10%). 'Self-help' is in the third position, and the frequency of using it is 112 (7%). Some other popular keywords used in the research papers are 'human' (6%), 'microfinance' (3%), 'empowerment' (3%), 'rural population' (2%), 'microcredit' (1%), etc.

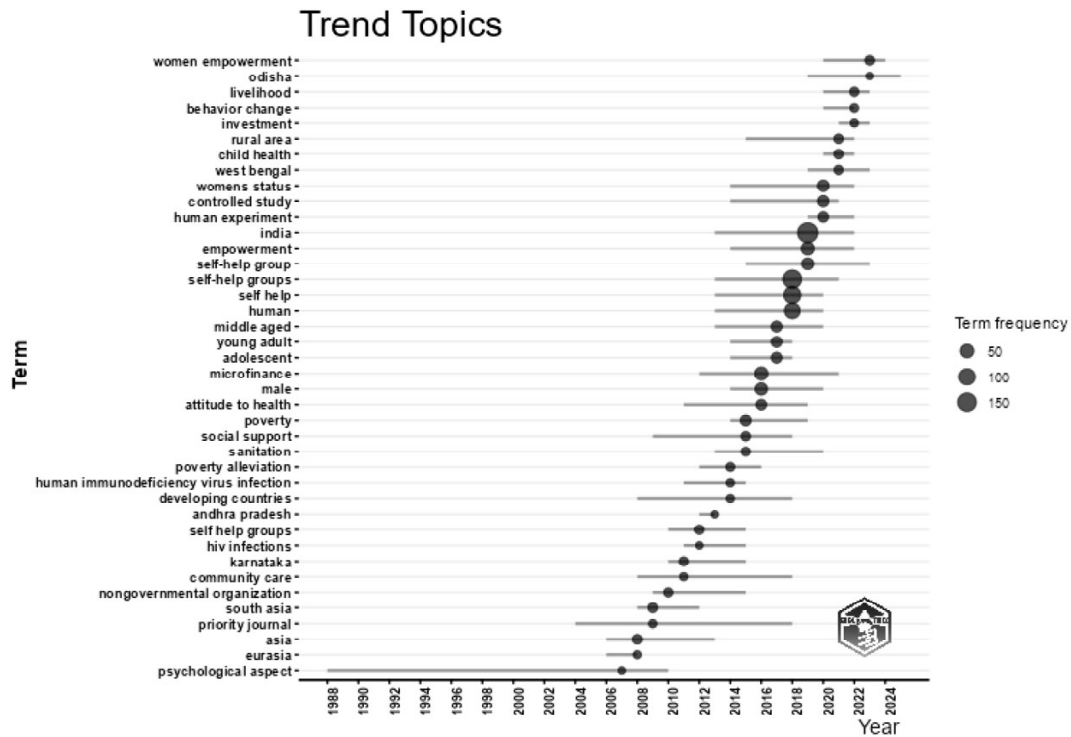


Figure 14: Trending topics on SHG throughout the period.

Interpretation: The above figure depicts the trending topics on SHG throughout the period from 1983 to 2025. The size of the dots in the figures shows the frequency of the research themes. Larger dots indicate higher-used themes of research on SHG. From 2006 to 2010, the themes like 'psychological aspect', 'Asia', and 'South Asia' were very prominent. After 2010 the terms like 'poverty alleviation', 'social support', 'developing countries', 'self-help group', etc. gained importance in this research area. After 2015, terms like 'women empowerment', 'behaviour change', 'human agreement', etc., were also used. the largest dots were observed in themes like 'India', 'self-help groups', 'employment', 'self-help', 'human', etc, which are more prominent themes of research in this field during the entire period of study.

CONCLUSION

The study of research on Self-Help Groups (SHGs) in India from 1983 to 2025 shows that this field has grown slowly in the early years but picked up speed after 2005. The highest research activity was between 2019 and 2021, although there has been a small fall in publications after that. Most studies are journal articles written by groups of authors, and there is a good level of teamwork, including collaborations between Indian and international researchers. India is the top country in the world for SHG research in both the number of studies and their impact. Well-known institutions such as the International Food Policy Research Institute, the Population Council, Stanford University School of Medicine, and the Bill & Melinda Gates Foundation have made major contributions. Many of these works have been published in respected journals like *World Development*, *PLOS ONE*, and the *Journal of International Development*. The research topics most often studied are women's empowerment, microfinance, self-help, poverty reduction, and rural development. In earlier years, studies mostly focused on local and small-scale impacts, but over time, the themes have expanded to include health, education, social change, and sustainable development. This shows that SHG research is becoming broader and more connected to different areas of development. However, the drop in publications and citations in recent years means that there is a need to bring new ideas into this field. Future research can explore digital technology for SHGs, climate change adaptation, post-pandemic recovery, and ways to strengthen SHG networks. These new directions will help keep SHG research relevant and useful for policy-making and for improving the lives of people, especially women in rural areas. In conclusion, SHG research in India has grown into a strong and important area of study with wide international interest. With fresh topics and stronger links between researchers, institutions, and communities, this field can continue to play a big role in promoting inclusive growth, women's empowerment, and sustainable development.

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Embodied Authority: A Study of Leadership Communication Through Body Language

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Abstract

Communication extends beyond words, as non-verbal communication always accompanies verbal expressions. The concept of non-verbal communication encompasses the unspoken language of body language, including gestures, expressions, and postures that profoundly influence interpersonal encounters. As such, the non-verbal communication is synonymous with body language. The non-verbal communication or the body language of a leader has a huge influence on the common mass. In this context, leadership communication is not only verbal articulation. The body language of a leader influences the public perception and emotional connection of the leader with the masses. Body language enables the leader to construct an image of authenticity, authority, and dominance. This paper examines the significance of body language in leadership communication and presents an analysis of one influential political leader of Assam, current Chief Minister Himanta Biswa Sarma. Drawing upon kinesics and proxemics non-verbal communication theory, the study examines how Himanta Biswa Sarma displays leadership, confidence, and voter connect through his body language aesthetics. The study has found a clear, dynamic, assertive, and emotionally charged body language style of the leader. The paper concludes with the idea that Himanta Biswa Sarma's performative body language reflected a populist, high-energy engagement that resonated deeply with the masses.

Keywords: *Body language, Kinesics, Proxemics, Gesture, Posture, Eye-Contact*

INTRODUCTION

Non-verbal Communication is an important aspect of interpersonal communication. According to Dr Albert Morabian, when we communicate, 38% is vocal (tone, voice, inflexion, volume, etc.), 55% is non-verbal, and 7% is the actual words. Various body language cues, such as gestures, expressions, postures, and eye contact, profoundly influence interpersonal encounters. Furthermore, the tone of voice, speed, pronunciation, intonation, etc., in verbal articulation have a significant role to play in communication.

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In the contemporary political landscape, leaders are not merely evaluated by what they say but by how they say it. This has enabled the initiation of the concept of leadership communication. As such, the non-verbal communication of a leader in the political rallies and meetings has an important role in defining the identity and personality of the leader. In the 2021 Assam Assembly Elections, the Bharatiya Janata Party (BJP) witnessed a shift in leadership dynamics with the transition from Sarbananda Sonowal to Himanta Biswa Sarma. In the post-2021 Assam Assembly Elections, Himanta Biswa Sarma was picked as the Chief Minister of Assam. Since then, Himanta Biswa Sarma has emerged as the official face and mouthpiece, and the leader with the power baton of the ruling BJP party in Assam. Notwithstanding his political and ideological affiliation as a political leader of the BJP, Himanta Biswa Sarma has been active in politics for the last three decades. He is considered one of the strongest political leaders in the state with a huge impact on the social fabric of the region. Not only as the CM of Assam, but he has also been the convenor of the National Democratic Alliance (NDA), a conglomeration of political parties in the Northeast, and actively involved in promoting the ideologies of the ruling BJP party in the centre and the various states of the Northeast. In such a context, the dynamic leadership and body language of Himanta Biswa Sarma have a tremendous impact on the political and social landscape of the society in the Northeastern part of the country.

In the discourse of communication, body language functions as a crucial semiotic system that communicates sincerity, dominance, empathy, and authority. The gestures, facial expressions, and postures that politicians exhibit often shape public interpretation of their authenticity and leadership charisma. Hence, analysing body language offers a deeper understanding of how leaders construct their political identity before the masses.

This paper seeks to study the leadership communication displayed by Himanta Biswa Sarma through his non-verbal communication. Through visual analysis of Himanta Biswa Sarma's political rallies and meetings in the publicly available YouTube videos, the paper explores the leader's body language as it has reflected his personal disposition, political strategy, and voter appeal. The selected videos are part of Himanta Biswa Sarma's speech in some political and public rallies in different parts of Assam in 2025.

OBJECTIVES OF THE STUDY

1. To analyse the major non-verbal communication traits of Himanta Biswa Sarma as a political leader.
2. To study how his body language reflected his leadership styles.
3. To examine how kinesic behaviour influenced audience perceptions.

METHODOLOGY OF THE STUDY

According to Pease and Pease (2017), "Body language is an outward reflection of a person's emotional condition. Each gesture or movement can be a valuable key to an emotion a person may be feeling at the time" (p. 11). A significant portion of communication is non-verbal, including facial expressions, gestures, and posture. The study of body language is known as Kinesics. According to anthropologist Ray Birdwhistell, kinesics is "A systematic study of those structured visible body movements and static positions which carry meaning in a communication system" (p. 9). He argues that kinesics includes the entire spectrum of body motion an individual displays in various circumstances. R.V. Vadi and K. Aruna define kinesics as "the various physical movements' studies, specifically the inner states of emotions expressed through different body language" (p.32). The kinesics encompasses four aspects of body language- facial expressions, gesture, postures, and physical appearance.

Proxemics is the study of how humans use and perceive space in interpersonal communication. American anthropologist Edward T. Hall, in the book titled *The Hidden Dimension* (1963), defined proxemics as "the interrelated observations and theories of man's use of space as a specialised elaboration of culture." He asserts that proxemics is the use of personal space, territory, and physical distance in interpersonal relationships. According to R.V. Vadi and K. Aruna, "Proxemics is the study of space language. It means how we communicate with the space around us. Proxemics has to be regarded as "Personal Space Language" (p. 34). In Non-verbal communication, there are four types of spaces: Intimate Space, Personal space, social space, and public space, which signify the optimum use of space around us that we use to communicate and establish various types of relationships with the individuals around us.

This study employs the parameters of kinesics and proxemics from non-verbal communication studies. It is conducted as a visual content analysis of YouTube videos featuring Himanta Biswa Sarma addressing political rallies and meetings in 2025. The selected videos include political rallies and public meetings of the ruling BJP party held in different parts of Assam during the year 2025. The YouTube videos were accessed on the official YouTube channel of Himanta Biswa Sarma, which has approximately 318,000 subscribers and 3.4k videos. The public rallies of the ruling BJP party were held across different regions of Assam between August and November 2025. The videos primarily document the Chief Minister Himanta Biswa Sarma's public appearances at MMUA (Mukhyamantrir Mahila Udyamita Abhiyaan) grant distribution ceremonies.

The selected YouTube video clips were analysed using the kinesics framework proposed by Ray Birdwhistell (1952) and Edward T. Hall's (1966) concept of proxemics, which examines the use of space in communication. Both kinesics and proxemics are significant analytical tools used to study non-verbal communication in individuals.

The kinesics category of non-verbal communication includes the following aspects of body language.

- Facial expressions, including smiles, eye contact, frowns, and emotional cues
- Gestures including hand movement, pointing, and open-hand signals
- Posture, including stance and body orientation
- Physical appearance

The selected video footages available on the YouTube platform were analysed to examine the nature of body language and non-verbal communication displayed by Himanta Biswa Sarma in terms of kinesics expressions and proxemics connections. The various non-verbal expressions and body movements of the speaker were viewed and analysed in detail. The study is descriptive and analytical in nature and is based on observation of kinesics expressions and proxemic spatial language as displayed by Himanta Biswa Sarma at public rallies and meetings.

Himanta Biswa Sarma: The Dynamic and Kinaesthetic Leader

In the political landscape of the entire Northeast region, Chief Minister Himanta Biswa Sarma has a significant influence. Since his first electoral debut as elected MLA of Jalukbari constituency from the state capital of Guwahati till his joining the BJP and becoming the Chief Minister of Assam in 2021, he has been able to display a mesmerising craft of statesmanship. He has emerged as a dynamic leader with a communication style that reflects his assertiveness, spontaneity, and popular appeal. In the social discourse of the entire Northeast region, his rhetoric and speeches are widely acclaimed by the common masses. However, at times his speeches are widely debated and discussed. Notwithstanding, his rhetoric on observations on different issues of the region has played an important role in moulding public discourse. He is highly communicative and often actively engages with the media. He is one of the most visible faces in the media from the ruling BJP party in the state of Assam. He is often seen announcing different policies and cabinet matters on the media platforms. His media presence and consistent sharing of his views on various social media platforms also contribute to his leadership image.

In leadership communication, open palm gesture, smile, eye contact, waving hand, and moving closer to the audience are a few important aspects. These are some of the hallmarks of non-verbal communication aesthetics. According to Allan Pease and Barbara Pease, "The hands have been the most important tools in human evolution, and there are more connections between the brain and the hands than between any other body parts" (p. 146). They argue that open palm has been associated with truth, honesty, allegiance, and submission, and hand gestures grab attention, increase the impact of communication, and help individuals retain more of the information they are hearing.

Our attitudes and emotions are continually revealed on our faces and we are completely unaware of it most of the time. Eye contact regulates conversation, gives

cues of dominance...the eyes can be the most revealing and accurate of all human communication signals because they are a focal point on the body. (Pease & Pease, p. 165)

In terms of non-verbal communication, Himanta Biswa Sarma has a distinct aura of his own. His embodied authority is performed through public persona and body language that he displays in various public platforms. His highly animated, assertive, and interactive body language embodies a "man of the people" personality of its own. Himanta Biswa Sarma's open arm gestures, frequent movement towards the crowd, and mimicking of local idioms in his political speeches enable him to project and embody a "man of the people" persona. His constant movements towards the edge of the stage, leaning forward to the audience, and informal addressing to the crowd projected a distinct aura of accessibility and emotional attachment. His performative body language helps him present a deliberate emotional connection with the audience. Furthermore, his constant head movements, childlike smiles, and gestures projected confidence and a mass leader's persona.

Himanta Biswa Sarma's body language projects him as a popular leader commonly accepted by the audience. His tremendous energy levels in political rallies function to lift his leadership persona and emotional attachment with the audience. In this context, Himanta Biswa Sarma's body language becomes performative and a display of embodied authority. His constant promotion of populist public policies and schemes through media interactions and public rallies has enabled him to establish himself as the leader of the masses. Media appearances of his also played a significant role in setting his agenda to project him as the saviour, the populist leader of the common people. The following table shows key kinesics and proxemics indicators as reflected in non-verbal leadership communication traits of Himanta Biswa Sarma.

Table 1: Key kinesics and proxemics indicators of Himanta Biswa Sarma's non-verbal communication

Type of Non-verbal Communication	Features	Meanings Expressed
Kinesics	Facial expressions	Expressive, dramatic, emotionally charged
	Gesture	Frequent, emphatic, crowd-oriented
	Posture	Expansive, animated, high-energy
	Physical Appearance	Charismatic, assertive
Proxemics	Physical distance with the audience	Personal, performative, frequent moving closer to audience in public rallies.

The embodied non-verbal communication of Himanta Biswa Sarma includes high-energy gestures, expression of emotion through facial expression and eye contact, and constant proximity to the crowd through reducing his distance from the crowd. His pointed fingers to the crowd, hand lifting while speaking, create emotional warmth and attachment with the audience. His emotionally charged smile reinforces his relatability with the crowd he is addressing in the public rallies and meetings. In his deliberation, the spontaneous and informal addressing of the crowd helps him connect more emotionally with the audience. All these non-verbal gestures reinforce an image of a dynamic and decisive leader of the common mass.

Himanta Biswa Sarmah's Non-Verbal Communication and Crowd Dynamics

Himanta Biswa Sarma exhibits a refined understanding of public body language and crowd psychology, which enables him to navigate rallies effectively. By deliberately moving closer to the audience, he reduces the symbolic distance between the leader and the populace, thereby reinforcing perceptions of accessibility and approachability. In his rallies, the leader elicits intense and enthusiastic responses from the public, with individuals actively seeking physical proximity through handshakes, close-range interactions, and selfies. Such behaviour reflects a strong emotional connection and a high level of public engagement rarely achieved in contemporary political leadership. His symbolic actions - such as the namaskar mudra, bowing before the public, and sustained hand-waving - function as powerful tools of non-verbal political communication. These gestures reinforce humility, respect, and inclusivity in his public leadership, thereby strengthening his emotional and symbolic connection with the masses. Individuals from diverse age groups actively surround him, often submitting applications and personal requests. This indicates a broad-based appeal that cuts across demographic boundaries and highlights his ability to engage directly with citizens at public gatherings.

Himanta Biswa Sarma's Digital Visibility and Media Outreach

Himanta Biswa Sarmah's public engagement is mediated through his official YouTube channel, Facebook page, Instagram profile, and X profile. His videos and posts often receive extensive viewership. These digital platforms function as strategic tools for enhancing public visibility beyond physical gatherings. His YouTube videos are viewed by thousands of people across diverse cultures and communities. The videos help him reach diverse demographic groups, including youth, urban professionals, and digitally connected rural audiences.

The YouTube videos uploaded on his official channel allow him a constant digital presence, thereby enabling him to disseminate policy initiatives and the developmental achievements of the ruling government. The regular dissemination of updates, live interactions, and visually mediated storytelling contributes to a perception of accessibility and transparency, fostering a sense of direct connection

between the leader and the public. Moreover, the interactive features of these digital platforms - through comments, shares, and real-time feedback - facilitate two-way political communication rather than one-way transmission of messages.

Implications of Leadership Performative Body language

The findings demonstrate that body language functions as political semiotics for leaders of political parties. Himanta Biswa Sarma's charismatic leadership persona is often displayed through his body language. It is his leadership connect through dynamic body language that enabled him to climb the height of success as one of the strongest politicians from entire Northeast region. In this context, leadership becomes performative with a charismatic body language that the audience can tune with. His non-verbal dominance in the political rallies and meetings could establish him as leader of the common mass, and a populist statesman that connects more with the populace. Furthermore, the televised relays of his speeches and public addresses could pull more audience in to the political party that he is affiliated with. Furthermore, Himanta Biswa Sarma's synergy in verbal expressions and non-verbal gestures becomes an embodied performance that the audience can strongly resonate with.

CONCLUSION

Himanta Biswa Sarma displays an energetic, emotive, and performative body language that expresses his populist leadership persona. His non-verbal communication is not only communication per se, but a performance that is attuned with his verbal expressions. His perfect synchronising of verbal rhetoric with non-verbal gestures reveals a very successful leadership communication. His non-verbal communication creates a spectacle of its own with which the audience immediately feels connected. His gestures, postures, expressions, and movements show an embodied authority, dynamism, and emotional expressiveness. This embodied communication significantly contributes to his popular mass appeal and appreciation from the common masses.

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From Bretton Woods to Digital Multipolarity: The Dollar's Enduring Power and the Prospects of the Indian Rupee

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Abstract

This paper traces the evolution of the U.S. dollar's global dominance from the Bretton Woods system to the present era of digital multipolarity. It argues that the dollar's endurance has depended not merely on formal convertibility or economic size but on institutional credibility, offshore liquidity networks, and technological adaptation. The study connects the historical formation of the Eurodollar market to the modern transformation of currency hierarchies shaped by sanctions, financial innovation, and digital currencies. Drawing upon data and literature from the International Monetary Fund (IMF), Bank for International Settlements (BIS), and Reserve Bank of India (RBI) spanning 1944-2025, it also examines the emerging internationalisation of the Indian rupee within a changing global monetary landscape. The paper concludes that the next phase of monetary power will be defined by a hybrid of trust-based liquidity and digital infrastructure, offering India a pathway toward regional financial leadership, if accompanied by deepened capital markets and policy prudence.

Keywords: Bretton Woods, Central Bank Digital Currency (CBDC), De-dollarisation, Digital multipolarity, Dollar dominance, Eurodollar, Global finance, Rupee internationalisation

INTRODUCTION

The U.S. dollar's global dominance is one of the defining features of the postwar world economy. Since the Bretton Woods Agreement of 1944, the U.S. dollar has been central to the international monetary order and became the anchor for reconstruction and recovery in Europe and Asia following World War II (Kindleberger, 1973). Initially linked to gold at a fixed rate of \$35 per ounce, the dollar's true global strength emerged through postwar reconstruction efforts, geopolitical leadership, and financial innovations such as the Eurodollar system, which enabled dollar liquidity beyond U.S. jurisdiction (Eichengreen, 2019). While the collapse of the gold-exchange standard in 1971 marked the end of formal convertibility, the dollar's dominance endured through its adaptability and deep integration into international financial networks.

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As the twenty-first century unfolds, the world is witnessing an emerging digital multipolarity—a system in which multiple powers, regions, and technologies shape monetary influence. This transformation is driven by digital currencies, real-time settlement systems, and shifting geopolitical alignments. The dollar's supremacy faces renewed scrutiny amid de-dollarisation efforts by states such as China, Russia, and members of the BRICS alliance (Jarrel, 2023). Simultaneously, India, with its expanding digital infrastructure and economic footprint, has begun advancing the international use of the rupee, supported by systems like the Unified Payments Interface (UPI) and the forthcoming e-rupee (RBI, 2025).

THEORETICAL FRAMEWORK

The evolution of global currency hierarchies can be understood through two foundational theories: Hegemonic Stability Theory and Currency Hierarchy Theory. Hegemonic Stability Theory, advanced by Charles Kindleberger (1973), posits that a stable international monetary order requires a dominant state to supply liquidity, act as a lender of last resort, and maintain open markets. The U.S. fulfilled this role after World War II, providing both economic leadership and institutional frameworks such as the International Monetary Fund (IMF) and the World Bank.

Building on this, Benjamin Cohen's (2015) Currency Hierarchy Model conceptualises global money as a tiered system—ranging from "top" (key) currencies to "peripheral" ones—based on convertibility, capital market depth, and political credibility. The dollar, at the apex, enjoys network effects that reinforce its use in trade, finance, and reserves. Lower-tier currencies, like the rupee, can rise in status only through sustained institutional trust, financial openness, and technological interoperability.

This theoretical background frames the comparative analysis that follows: the dollar's postwar hegemony, its adaptation through the Eurodollar system, and the rupee's cautious ascent amid digital transformation.

OBJECTIVES

The present paper aims to:

1. Trace the historical development of the U.S. dollar's global dominance from 1944 to 2025.
2. Assess emerging pressures on the dollar's dominance in a digitised, multipolar world.
3. Evaluate the Indian rupee's evolving international position.

RESEARCH QUESTIONS

The above objectives have been attempted to be fulfilled by exploring two intertwined questions:

1. What historical mechanisms has sustained the U.S. dollar's dominance?
2. Can India position the rupee as a credible regional or partial reserve currency in the new monetary landscape?

METHODOLOGY

This paper applies a historical-analytical and comparative framework, combining qualitative interpretation with descriptive data analysis. Secondary data sources include the IMF, BIS, RBI publications, and a selection of peer-reviewed literature.

The temporal scope spans three distinct periods:

1. Postwar Reconstruction (1944-1971): The gold-dollar standard under Bretton Woods.
2. Post-Bretton Woods Globalization (1971-2000): The rise of offshore dollarization and liberalized capital mobility.
3. Digital Multipolarity (2000-2025): The transition to regional diversification, digital finance, and emerging currency competition.

By examining these phases, the paper identifies how structural mechanisms such as offshore liquidity creation and digital integration provide lessons for the future internationalisation of the rupee.

DISCUSSION

Tracing Objective 1: Historical Evolution of the Dollar's Dominance

1. The Bretton Woods Foundation (1944-1971)

The 1944 Bretton Woods Agreement created a dollar-centered system designed to stabilise postwar economies through fixed exchange rates and gold convertibility. The dollar's linkage to gold, combined with U.S. industrial strength and the Marshall Plan aid - through which the U.S. exported dollars across a war-torn Europe, providing both reconstruction aid and liquidity necessary for global trade - institutionalised its role as the global reserve currency (Kindleberger, 1973). By 1950, the majority of global trade invoices were denominated in dollars, and U.S. financial assets represented nearly 60% of world holdings (Tooze, 2018). However, as foreign economies recovered, the growing demand for dollar liquidity began to outpace U.S. gold reserves. Thus, U.S. balance-of-payments deficits were effectively supplying global liquidity-a paradox later termed the "Triffin dilemma" (Eichengreen, 2019).

2. The Eurodollar Revolution

The Eurodollar market, emerging in the 1950s, marked a decisive shift in global finance. With the Cold War on, European and Soviet banks began holding dollar deposits in London to hedge U.S. regulations. These offshore dollars, unencumbered by domestic controls, enabled private credit creation outside the U.S. monetary base.

By 1963, Eurodollar deposits exceeded \$10 billion; by 1975, over \$150 billion, transforming London into the world's financial hub, dwarfing the official gold reserves of major economies (BIS, 2024).

The Eurodollar market acted not as a rival but as a dispersed form of dollar hegemony, establishing offshore dollar liquidity centers beyond U.S. regulatory reach and reinforcing America's financial dominance globally (European Parliament, 2025). After the 1971 Nixon Shock, the rise of Eurodollar markets and offshore liquidity flows continued to reinforce the dollar's global dominance even without gold backing (Quintana, 2025). The Eurodollar market demonstrated that global currency leadership depends less on formal rules and more on trust, credit depth, and the elasticity of liquidity provision.

3. The Post-Bretton Woods Globalisation (1971-2000)

The floating exchange rate era saw the dollar's value fluctuate, yet its centrality persisted. Oil trade invoicing, petrodollar recycling, and the growth of U.S. capital markets reinforced the currency's indispensability (Tooze, 2018). The deregulation of finance in the 1980s and 1990s further globalised the dollar through derivatives, sovereign bonds, and multinational corporate finance.

By 2000, the dollar accounted for nearly 70% of global reserves and 85% of foreign exchange transactions (BIS, 2024). Its liquidity and legal predictability created a self-reinforcing feedback loop- a hallmark of what Cohen (2015) describes as "path-dependent monetary power." The dollar's resilience was derived from a triple pillar of U.S. creditworthiness, financial system dominance, and technological-military strength (Jarrel, 2023). The post-Bretton Woods order thus reinforced monetary unipolarity. Despite the emergence of the euro in 1999, the network effects surrounding the dollar's liquidity made any rival system appear secondary (Jarrel, 2023).

Assessing Objective 2: Digital Multipolarity and the Contemporary Dollar Order

In 2025, the dollar continues to represent around 58-60% of official reserves, 80% of trade invoicing, and 90% of forex turnover (IMF, 2024; BIS, 2024). However, this quantitative dominance coexists with qualitative change. The rise of digital currencies, sanctions-driven diversification (U.S. sanctions on states like Russia and Iran spurring alternative payment systems), and regional payment systems suggest an incremental erosion of the dollar's monopoly power.

Table 1. Global Reserve Currency Composition (1944-2025)

Year	U.S. Dollar	Euro (and earlier ECU)	Pound Sterling	Japanese Yen	Chinese Yuan	Others
1944	~80%	-	~15%	-	-	~5%
1980	~70%	-	~10%	~5%	-	~15%
2000	~71%	~18%	~3%	~6%	-	~2%
2020	~59%	~21%	~4%	~6%	~2%	~8%
2025*	~58%	~20%	~4%	~5%	~3%	~10%

**Sources: IMF COFER Database (2024); BIS Triennial Survey (2024)*

Despite diversification, the dollar's resilience stems from three structural anchors:

(1) unmatched liquidity and depth of U.S. financial markets; (2) institutional transparency and rule of law; and (3) network externalities that make dollar-denominated trade efficient. Although the United States increasingly deploys the dollar as a geopolitical tool through sanctions, crises typically drive capital inflows to U.S. Treasury assets, reflecting a "flight-to-safety" dynamic that strengthens the dollar's dominance (Miran, 2025).

The digital transformation via Central Bank Digital Currencies (CBDCs) such as China's e-CNY and the EU's digital euro experiments with programmable payments and infrastructure that could bypass traditional SWIFT-dominated systems (European Central Bank, 2025). Meanwhile, the U.S. lags in CBDC deployment, relying on private innovation (stablecoins, tokenised deposits) to sustain digital dollar liquidity. The resulting system may evolve toward functional multipolarity, where multiple currencies coexist across specific digital ecosystems. Yet these technologies still rely overwhelmingly on dollar-denominated stablecoins. In that sense, the digital age has reinforced, rather than replaced, the structural dominance of the dollar.

Evaluating Objective 3: The Indian Rupee's Emerging Role

India's rupee, historically constrained by capital controls and limited convertibility, has begun a measured process of internationalisation. Bilateral rupee-settlement mechanisms with over 30 partner countries, including Russia, Sri Lanka, and Mauritius, now allow trade invoicing in rupees (RBI, 2025). These arrangements, though modest in scale, signal India's intent to expand the rupee's transactional role beyond South Asia.

Simultaneously, digital infrastructure - notably the Unified Payments Interface (UPI) and RuPay - has given India a first-mover advantage in payment interoperability. UPI's linkages with Singapore's PayNow and discussions with the UAE, Bhutan, and

France illustrate India's growing potential in cross-border digital payment integration (NITI Aayog, 2019; Ministry of Finance, India, 2023).

The e-rupee, launched in pilot form in 2023, complements this trajectory by creating a regulated digital alternative that could, in theory, support cross-border settlements without reliance on the dollar. However, its effectiveness depends on scalability, interoperability, and trust among trading partners. Internationalisation without sufficient domestic depth risks volatility, as China's gradual renminbi liberalisation strategy has shown (Jarrel, 2023).

Research Answer 1: Long-term Resilience of U.S. Dollar

Understanding currency dominance requires engaging Hegemonic Stability Theory (HST), which frames monetary hegemony as the outcome of a dominant power's leadership and provision of global financial stability (Kindleberger, 1973; Eichengreen, 2019). The dollar's "exorbitant privilege" derives from the United States' capacity to run persistent external deficits financed in its own currency. This position is locked in by network effects - deep liquidity, incumbency advantages, and the self-reinforcing use of dollar markets across trade and finance (Quintana, 2025; Miran, 2025). This framework explains why the dollar remains hegemonic despite challenges in the digital era and the challenges faced by emerging currencies like the rupee.

The long-term resilience of the dollar stemmed not from its convertibility to gold, but from the evolution of American-led finance and the rise of the Eurodollar market in the 1950s, which extended dollar liquidity offshore and operated largely outside direct U.S. regulatory control (Schenk, 1998).

Thus, the U.S. experience offers key insights for India's path forward:

- 1. Institutional Credibility:** The dollar's endurance owed much to U.S. political stability, independent central banking, and contract enforceability (Eichengreen, 2019). India can emulate these through predictable monetary frameworks and fiscal prudence.
- 2. Liquidity Networks:** Just as the Eurodollar market globalised dollar liquidity, the internationalisation of UPI and the e-rupee can create a new form of digital offshore liquidity - a "Euro-rupee" ecosystem enabling cross-border lending and trade settlement.
- 3. Safe Assets:** Treasury securities provided the backbone of dollar credibility. India's evolving government securities market should similarly aim to supply stable, liquid rupee-denominated assets attractive to foreign investors.
- 4. Geopolitical Strategy:** U.S. financial diplomacy post-1944 demonstrates how trade, security, and finance interlink. India's participation in BRICS, I2U2, and G20 frameworks can play a comparable role in shaping regional financial norms.

Research Answer 2: Barriers and Constraints to Rupee Internationalisation

Despite progress, the rupee's ascent faces structural impediments:

- 1. Partial Convertibility:** The rupee's current account convertibility is nearly complete, but capital account restrictions limit its use for investment flows. Rapid financial liberalisation in emerging markets like India risks speculative attacks and increased volatility (Reserve Bank of India, 2023; NITI Aayog, 2019).
- 2. Shallow Bond Markets:** India's government securities market, though expanding, remains less liquid than those of advanced economies. The absence of a large pool of rupee-denominated safe assets constrains reserve demand.
- 3. External Deficits:** Persistent current account and fiscal imbalances undermine confidence in the rupee's stability as a store of value.
- 4. Institutional and Diplomatic Balancing:** India's dual engagement - with the U.S. - led financial order and with BRICS - necessitates careful management to avoid geopolitical misalignment (Jarrel, 2023).
- 5. Regulatory Fragmentation:** Cross-border payment integration requires harmonised standards on data privacy, anti-money laundering compliance, and cybersecurity - areas still evolving in India's regulatory ecosystem.

These constraints suggest that rupee internationalisation must proceed incrementally, balancing ambition with macroeconomic prudence.

POLICY RECOMMENDATIONS

To enhance the rupee's global profile while preserving financial stability, five interlinked policy strategies are proposed (Jarrel, 2023; RBI, 2025):

- 1. Pace Convertibility Reforms:** India should pursue gradual capital account liberalisation, beginning with long-term investors and trade-related flows, while maintaining macroprudential buffers to prevent speculative movements.
- 2. Deepen Domestic Financial Markets:** It should expand the issuance of long-term government securities and corporate bonds to create a liquid pool of rupee-denominated assets that can attract foreign reserve holders.
- 3. Digital Integration and CBDC Linkages:** Accelerating cross-border UPI and e-rupee interoperability through partnerships with ASEAN, the Gulf, and Africa could establish the rupee as a preferred settlement currency in the Global South.
- 4. Strengthen Regional Financial Architecture:** Promoting a South-South clearing union or a BRICS multi-currency payment platform that includes rupee-denominated settlement windows.
- 5. Enhance Currency Diplomacy:** India should use G20 and BRICS forums to advocate for transparent CBDC norms and encourage regional adoption of Indian digital payment standards.

CONCLUSION

The U.S. dollar's longevity demonstrates that global monetary power is not static but institutional and adaptive. From the Bretton Woods system to the Eurodollar revolution, its supremacy has rested on liquidity, credibility, and innovation. As the world transitions toward digital multipolarity, these same foundations are being redefined through technology and geopolitics.

India's experience suggests that successful currency internationalisation in the twenty-first century will depend on a triad of monetary discipline, financial depth, and digital interoperability. The rupee is unlikely to replace the dollar, but it can evolve into a credible regional currency by 2040 if guided by calibrated liberalisation and strong institutional support.

Ultimately, the future of global finance may not be characterised by a single hegemon but by a constellation of interoperable currencies - each reflecting the digital and political capacities of its issuing state. In such a world, India's success will hinge on its ability to convert technological leadership into monetary trust, completing a long arc that began in the age of Bretton Woods and now extends into the realm of digital multipolarity.

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