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National Level Interdisciplinary & Multidisciplinary Conference
on

## VISION OF THE MILLENNIUM INDIA 2047: ROLE OF HUMANITIES, SCIENCE & COMMERCE

Special Issue
Vol. 7 No. 9
January – February 2026

Chief Editor
Dr. Indrajeet Ramdas Bhagat
Professor, Faculty of Commerce

Organized by
Marathwada Shikshan Prasarak Mandal's
RAJMATA JIJAU MAHAVIDYALAYA KILLE-DHARUR, DIST. BEED, MS

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## Good Wishes Message

**Hon. Shri Prakash Dada Solunke**
**President, Marathwada Shikshan Prasarak Mandal, Chhatrapati Sambhajinagar**

It gives me immense pleasure to express my heartfelt greetings to Rajmata Jijau Mahavidyalaya, Kille Dharur, for organizing the One Day National Conference on 6 February 2026 under the guidance of Marathwada Shikshan Prasarak Mandal, Chhatrapati Sambhajinagar. Academic conferences of this nature play a vital role in nurturing intellectual curiosity, promoting research culture, and strengthening the academic ecosystem of higher education institutions.

In the present era of rapid transformation, the theme "Vision of the Millennium – India 2047: Role of Science, Humanities and Commerce" is both timely and inspiring. The future of India depends not only on technological advancement but also on ethical values, social awareness, and economic innovation. By integrating science, humanities, and commerce, this conference creates a meaningful platform for holistic thinking and national development.

I am delighted to note that the conference has received an overwhelming response with more than 215 research papers submitted from across India. Such enthusiastic participation demonstrates the growing commitment of academicians and researchers toward quality research and knowledge creation. These scholarly contributions will generate academic awareness, encourage innovative approaches, and address contemporary challenges relevant to society and the nation.

The presence of distinguished guests such as the Honorable Vice-Chancellor Dr. Valmik Sarvade of Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar, and keynote speaker Dr. Anurag Shrivastava, Indore, will certainly add intellectual value to the conference proceedings. Their guidance will inspire young researchers and faculty members to pursue excellence in teaching and research.

Such national-level academic forums provide participants with opportunities for professional growth, networking, and collaborative research. They help scholars broaden perspectives, share best practices, and build confidence in presenting innovative ideas at a wider platform.

Marathwada Shikshan Prasarak Mandal has always emphasized academic quality, social responsibility, and research-oriented education. The efforts of the Principal, organizing committee, coordinators, faculty members, and staff of Rajmata Jijau Mahavidyalaya, Kille Dharur, deserve special appreciation for their dedication and teamwork in making this event possible.

I extend my sincere congratulations to all contributors, researchers, and participants for their valuable involvement. I am confident that this conference will be academically fruitful and will contribute meaningfully to the vision of a progressive and developed India.

I wish the One Day National Conference a grand success.

## Good Wishes Message

**Hon. Satish Bhau Chavan**
**Secretary, Marathwada Shikshan Prasarak Mandal, Chhatrapati Sambhajinagar**

The One Day National Conference organized by Rajmata Jijau Mahavidyalaya, Kille Dharur, under the aegis of Marathwada Shikshan Prasarak Mandal, Chhatrapati Sambhajinagar, scheduled on 6 February 2026, is a significant academic initiative aimed at strengthening research culture and intellectual engagement in higher education. Such national-level platforms encourage scholars and academicians to exchange ideas, promote innovation, and contribute meaningfully to the academic community. I sincerely appreciate the efforts of the organizing committee for undertaking this valuable initiative.

As India progresses towards the vision of a Developed India 2047, the theme "Vision of the Millennium – India 2047: Role of Science, Humanities and Commerce" is highly relevant and forward-looking. The integration of scientific research, human values from humanities, and innovative practices in commerce is essential for holistic national development. This conference provides an appropriate platform for interdisciplinary dialogue and critical reflection, which will help shape future academic and social perspectives.

The conference has received an impressive response from across the country, with more than 215 research papers submitted from different states of India. This enthusiastic participation reflects the national recognition of the conference and the commitment of researchers toward academic excellence. These contributions will enhance academic awareness and stimulate innovation in research by addressing contemporary issues, opportunities, and solutions relevant to nation-building.

The presence and guidance of the Honorable Vice-Chancellor Dr. Valmik Sarvade, Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar, and the keynote speaker Dr. Anurag Shrivastava, Indore, will certainly inspire the participants and enrich the intellectual environment of the conference. Their experiences and insights will motivate young researchers and faculty members to pursue quality research with a broader vision.

Participation in this national conference will provide scholars, teachers, and researchers with opportunities for academic networking, professional development, and the exchange of innovative ideas. Such platforms help in building confidence, strengthening research skills, and creating meaningful academic collaborations at the national level.

Marathwada Shikshan Prasarak Mandal has always been committed to promoting quality education, research, and social responsibility. The initiative taken by Rajmata Jijau Mahavidyalaya, Kille Dharur, reflects this vision and dedication. I congratulate the Principal, organizing committee, faculty members, and staff for their sincere efforts.

I extend my best wishes to all the dignitaries, researchers, faculty members, and participants for the grand success of this One Day National Conference. May this academic gathering contribute significantly to knowledge creation and the vision of a progressive and developed India.

## Message from the Principal & Organising Chief

It is a matter of great pride and pleasure for me to welcome all the delegates, academicians, researchers, and participants to the One Day National Conference organized on 6 February 2026 at Rajmata Jijau Mahavidyalaya, Kille Dharur, under the aegis of Marathwada Shikshan Prasarak Mandal, Chhatrapati Sambhajinagar.

In today's knowledge-driven world, academic institutions must move beyond traditional teaching and actively promote research, innovation, and interdisciplinary dialogue. The theme "Vision of the Millennium – India 2047: Role of Science, Humanities and Commerce" reflects the nation's aspiration to build a progressive, inclusive, and globally competitive India. This conference provides a meaningful platform to deliberate on how education, research, and social responsibility can collectively shape the future of our country.

I am pleased to note that this conference has received an overwhelming response with more than 215 research papers from across India. Such enthusiastic participation highlights the strong research culture among scholars and faculty members. These contributions will certainly generate academic awareness, promote innovative thinking, and provide solutions to emerging challenges in education, economy, and society.

The presence of eminent dignitaries like Hon'ble Vice-Chancellor Dr. Valmik Sarvade, Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar, and keynote speaker Dr. Anurag Shrivastava, Indore, will enrich the intellectual environment of this conference. Their insights and experiences will motivate young researchers to pursue excellence in scholarship and professional development.

This national conference is not merely an academic event but a platform for collaboration, networking, and exchange of ideas among researchers from diverse disciplines. It encourages participants to broaden perspectives, strengthen research skills, and contribute meaningfully to national development.

Hon. Shri Prakash Dada Solunke, President, and Hon. Shri Satish Bhau Chavan, Secretary, Marathwada Shikshan Prasarak Mandal, deserve special appreciation for their visionary leadership, continuous encouragement, and strong institutional support that made this national academic initiative possible.

I would also like to place on record my special appreciation for Prof. Dr. Indrajeet Ramdas Bhagat for his visionary initiatives and untiring efforts in conceptualizing, coordinating, and strengthening the academic framework of this conference. His dedicated role in organizing the event and ensuring the quality publication of research papers has significantly contributed to the scholarly value and national visibility of this programme.

I also appreciate the committed efforts of the organizing committee, coordinators, editors, faculty members, non-teaching staff, and student volunteers whose teamwork has made this event possible.

I extend my best wishes to all presenters, participants, and organizers. I am confident that this One Day National Conference will be academically rewarding and will leave a lasting impact on research, innovation, and institutional growth.

With warm regards and best wishes for the grand success of the conference.

**Dr. Gopal Kakade**
Principal & Organising Chief
Rajmata Jijau Mahavidyalaya, Kille Dharur

## Massage from Editor's Desk

It gives me immense pleasure to share my thoughts on the occasion of the One Day National Conference organized by Rajmata Jijau Mahavidyalaya, Kille Dharur, under the aegis of Marathwada Shikshan Prasarak Mandal, Chhatrapati Sambhajinagar. The successful conceptualization of this conference has been possible because of the constant support and encouragement of the Honorable President Shri Prakash Dada Solunke, the respected Secretary Shri Satish Bhau Chavan, the members of the Local Management Committee, the Principal Dr. Gopal Kakade, Vice Principals Dr. Milind Gaikwad and Prof. Dr. Mahadev Jogade, Head of the English Department Dr. Balaji Navale, and all my esteemed colleague faculty members. Their guidance, cooperation, and confidence have played a vital role in shaping this national-level academic initiative.

This conference has received an overwhelming response from across India, with more than 215 research papers and academic contributions submitted by scholars, teachers, and researchers from different states. Such enthusiastic participation itself reflects the academic credibility and national relevance of this conference. These papers will certainly enhance academic awareness and encourage innovation in research by presenting new ideas, contemporary issues, and practical solutions relevant to national development.

As the Editor of the Conference Proceedings, I feel honoured to undertake the responsibility of editing, reviewing, organizing, and publishing all the research papers received for this conference. My sincere effort is to ensure that every contribution is presented in a systematic, high-quality, and academically meaningful form so that the work of researchers reaches a wider scholarly community. Research is not merely documentation; it is a process of knowledge creation that contributes to society, education, and nation-building. With this perspective, the editorial and publication work is being carried out with due care, academic integrity, and professionalism.

I extend my heartfelt congratulations to all the participating professors, researchers, academicians, and contributors who have responded positively to this national conference. Through your scholarly writings, you have strengthened the culture of research and intellectual dialogue. The ideas presented through these papers will be useful in shaping future academic policies, curriculum development, and research directions.

National conferences such as this provide a platform for confidence building, exchange of ideas, interdisciplinary interaction, and professional collaboration. The response received for this one-day national conference is truly encouraging and will inspire the organization of many more meaningful academic activities in the future.

Finally, I once again congratulate all researchers, faculty members, and organizers associated with this conference and convey my best wishes for their continued academic growth and success.

**Dr. Indrajeet Ramdas Bhagat**
Chief Editor and Conference Director
Professor, Commerce & Management
Rajmata Jijau Mahavidyalaya, Kille Dharur

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# Global Geopolitical Uncertainties and Their Implications for the Indian Mutual Fund Industry: A Descriptive Analysis

**Dr. Nitin Dhawale**

*Assistant Professor, Department of Commerce, Sunderrao Solanke Mahavidyalaya, Majalgaon, Dist. Beed (MS)-431131*

***Corresponding Author – Dr. Nitin Dhawale***

**DOI - 10.5281/zenodo.18503797**

***Abstract:***

*Uncertainties in global geopolitics such as the Russia-Ukraine War, conflicts in the Middle East, tension between the US and China, and Trade Policy of President Trump in the US have contributed to market volatility and have impacted investor behaviour in the Indian market. This paper attempts to analyse the effect of such global incidents on the Indian Mutual Fund sector using secondary data. It helps conclude that there is pressure in the short term, but growth is possible in the longer term*

***Keywords: Geopolitical Risks, Indian Mutual Funds, AUM Growth, FII Flows, Market Volatility***

## Introduction:

Uncertainties in geopolitics have escalated since 2022 due to conflicts such as Ukraine-Russia and Israel-Hamas. In the Indian scenario, these developments occur at a time of strong growth in the mutual fund sector, with AUM totalling ₹80.23 trillion in December 2025, which is three times as much as it was in 2020. This kind of descriptive analysis helps examine how such uncertainties influence influx, outflow, and performance. These trends have been analysed until January 2026.

## Review of Literature

Studies have underlined the inverse relationship between geopolitical events and the commitment of investors in emerging markets. Kaushik (2022) reports that because of dependence on oil imports, the war between Russia and Ukraine led to sharp declines in Indian stocks. According to a report by ICRA Analytics (2025), equity mutual fund redemptions jumped 71% over five years amidst trade wars and tensions. S&P Global (2025) identifies some of the risks associated with US-Chinese relations that continue to affect supply chains and inflation in the Asia-Pacific.

The Economic Survey 2025 recorded an increase in India's Geopolitical Risk Index to 133.6, which put pressure on FDI flows and accounted for capital outflows. A study based on the strategies of FII proved reduced inflows of equity during high GPR Index periods. Wellington (2026) stressed the focus on national security during the rise of multipolar conflict. From these works, volatility has been transmitted from FIIs and commodities to mutual funds.

## Objectives

Following are the objectives of the research paper:

1) To explain the major geopolitical events in the world and their influence on the transmission of global events to the Indian mutual funds.
2) To analyse the trends in AUMs, FII flows, and sector-wise effects using descriptive data.

3) To identify the mitigation practices for fund managers and investors.

**Methodology:**

This descriptive analysis will use secondary data obtained from the AMFI reports and Economic Times as well as global risk outlooks (2022-2026), as conducting surveys is not feasible under the present scope of the paper. Data will include parameters such as the AUM, net inflows/outflows, Nifty/Sensex performance, and FII flows around major occurrences like Russia-Ukraine Crisis (since 2022), Increased Middle East Tensions (since 2024), US Elections (in 2024), and Trade Tariffs (in 2025).

**Analysis & Interpretation:**

**Key Geopolitical Events:**

Important developments are Russia-Ukraine War, Middle East conflicts (Israel and Hamas, potential oil supply risks), US-China trade tension, and Trump Tariffs post-re-election in 2024. The GPR Index of India jumped significantly, associated with sharp increases in FII selling and redemptions.

| Event | Period | Key Impact on India |
|---|---|---|
| Russia-Ukraine War | Feb 2022-2026 | Oil price spike, stock market drop |
| Middle East Conflicts | Oct 2024- | 45% oil imports at risk, inflation pressure |
| US Trade Tensions | 2025-2026 | FII outflows, 71% redemption rise economictimes+1 |
| Venezuela Escalation | Jan 2026 | Sensex fell 200+ points |

**AUM and Inflow Trends:**

Indian MF AUM clocked a growth of 21% at ₹ 81 trillion in 2025, while growth slowed down to 18% YoY in Q4 due to uncertainties. Equity inflows drop 6% MoM to ₹ 28,054 crore in Dec 2025, a YoY fall of 32%, reflecting caution.

| Year | Avg. AUM (₹ trillion) | Equity Net Inflows (₹ crore, CY) | YoY Growth |
|---|---|---|---|
| 2024 | 68 | ~4.1 lakh (est. Dec) | 23% |
| 2025 | 80.23 | 3.03 lakh | 18-21% |

Domestic SIPs were the buffer, but the outflows in FII subdued the growth.

**Performance Correlation:**

Equity funds experienced turbulence, with Nifty falling during the outbreaks in the Middle East and fears of tariffs between US nations. political shocks led to an outflow, yet hybrid funds recorded a record value of ₹8.83 lakh crore AUM in Mar 2025. FIIs lowered investment, which was negatively correlated with rises in GPR. Flexi-cap received ₹80,978 crore, mid/small-cap, shifting away from export sectors.

**Findings**:

Geopolitical risks led to 71% higher redemptions and a 32% decrease in yo-yo flow for FIIs/oil price inflation in the latter part of 2025. The AUM has tripled since 2020 but has been moderating with 18% AUM growth, with equity volatility rising. Strength demonstrated in domestic flows, with hybrid funds. No long-term course correction, but short-term jitters.

**Conclusions:**

The world's global risks continue to pressure Indian mutual funds, but overall system support in India will help achieve the ₹100 trillion mark in the next decade. It is advisable that investors diversify their portfolios and opt for domestic-oriented schemes rather than global ones. Risk disclosure could improve as GPR increases in the future.

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# The Role of the Indian Lab-Grown Diamond Industry in the Indian Economy: An Empirical and Analytical Study

**Dr. Gautamkumar P. Kanani**
*Assistant Professor Shree J.D. Gabani Commerce and S.A.S. College of Management, Surat*
***Corresponding Author – Dr. Gautamkumar P. Kanani***
**DOI - 10.5281/zenodo.18503838**

***Abstract:***

*The lab-grown diamond (LGD) industry has emerged as one of the most transformative segments within India's gems and jewellery sector. With advances in Chemical Vapor Deposition (CVD) and High-Pressure High-Temperature (HPHT) technologies, India has rapidly positioned itself as a global hub for lab-grown diamond manufacturing, processing, and exports. This paper examines the economic role of the Indian lab-grown diamond industry through an in-depth analysis of its contribution to GDP, exports, employment generation, technological innovation, sustainability, and regional development, with a special focus on Surat, Gujarat. Using a descriptive and analytical research methodology based on secondary data from government publications, industry reports, trade bodies, and academic studies, the research highlights both the growth potential and structural challenges of the sector. The study finds that while the LGD industry significantly strengthens India's export competitiveness and aligns with sustainability goals, it also faces issues related to price volatility, labour displacement, skill transition, and global competition. Policy recommendations are proposed to ensure inclusive and sustainable growth of the industry within the Indian economy.*

***Keywords: Lab-Grown Diamonds, Indian Economy, Exports, Employment, Sustainability, Surat Diamond Industry***

## Introduction:

India's gems and jewellery industry has historically been one of the most significant contributors to foreign exchange earnings, employment, and regional industrial development. Traditionally dominated by natural diamond cutting and polishing, the sector has undergone structural transformation over the past decade due to technological advancements and changing consumer preferences. Among the most notable developments is the rapid emergence of the lab-grown diamond (LGD) industry.

Lab-grown diamonds are chemically, physically, and optically identical to natural diamonds but are produced in controlled laboratory environments using advanced technological processes. These diamonds offer advantages in terms of cost efficiency, environmental sustainability, ethical sourcing, and supply chain transparency. As global consumers increasingly prioritize sustainability and affordability, LGDs have transitioned from being perceived as substitutes to becoming mainstream alternatives in fine jewellery.

India's role in this transformation is particularly significant. Leveraging its established expertise in diamond processing, low-cost skilled labour, and export-oriented ecosystem, India has become a dominant player in the global LGD value chain. Surat alone accounts for the majority of the world's cutting and polishing of both natural and lab-grown diamonds. Consequently, the LGD industry is no longer merely a technological novelty but a strategic economic

sector with implications for industrial growth, employment, trade balance, and sustainability.

This research paper aims to analyze the role of the Indian lab-grown diamond industry in the Indian economy through a comprehensive economic and policy lens.

**Review of Literature:**

**1.Global Evolution of the Lab-Grown Diamond Industry:** Previous studies highlight that the global lab-grown diamond market has expanded rapidly since 2015, driven by improvements in CVD technology, declining production costs, and increased acceptance by luxury brands and millennials. Market research reports indicate that lab-grown diamonds now account for nearly **10% of global diamond jewellery sales**, with projections reaching **15–20% by 2030**.

**2.India's Strategic Position:** Academic and industry literature consistently recognizes India as a critical hub in the global diamond ecosystem. According to trade publications, India processes over **90% of the world's diamonds by volume**, a capability that has been seamlessly extended to lab-grown diamonds. Studies emphasize Surat's cluster-based industrial structure, which facilitates rapid technology diffusion and economies of scale.

**3.Economic and Employment Impact:** Research by policy think tanks and trade associations indicates that the LGD sector has created new employment opportunities in engineering, machine operations, quality control, and digital grading. However, some scholars caution that the transition from natural to lab-grown diamonds may suppress wages for traditional artisans, necessitating skill upgrading and policy intervention.

**Research Objectives:**

1. To analyze the growth and structure of the Indian lab-grown diamond industry
2. To assess its contribution to GDP, exports, and foreign exchange earnings
3. To evaluate employment generation and labour market implications
4. To examine sustainability and technological innovation aspects
5. To identify challenges and future prospects of the industry

**Research Methodology:**

**Research Design:** The study adopts a **descriptive and analytical research design** based on secondary data. This approach is appropriate for evaluating macro-economic contributions, industry trends, and policy impacts.

**2.Data Sources:** Data have been collected from:

- Ministry of Commerce and Industry (Government of India)
- Gem & Jewellery Export Promotion Council (GJEPC)
- Reserve Bank of India (RBI)
- Industry reports (ICRA, KPMG, Deloitte)
- Academic journals and conference papers
- Reputed financial newspapers and trade magazines

**3.Period of Study:** The study primarily covers the period **2018–2025**, with future projections up to **2032**.

**Structure of the Indian Lab-Grown Diamond Industry:**

**1.Production Technologies:** India's LGD production relies primarily on **CVD technology**, which allows scalability, better quality control, and suitability for gem-grade diamonds. HPHT technology is also used, particularly for industrial and seed diamonds. The cost of producing one carat of LGD in India is estimated to be **30–40%**

**lower** than in developed economies, giving India a strong competitive advantage.

**2.Industrial Clusters:** Surat, Mumbai, and parts of Maharashtra form the core LGD clusters. Surat alone hosts thousands of small and medium enterprises engaged in growing, cutting, polishing, and grading lab-grown diamonds.

**Contribution to the Indian Economy:**

**Contribution to GDP:**

The gems and jewellery sector contributes approximately **7% to India's GDP**. While LGDs constitute a smaller share within this, their rapid growth rate suggests increasing macro-economic significance. Estimates indicate that LGDs account for **8–10% of polished diamond output**, with rising value addition due to branding and finished jewellery exports.

**Export Earnings:**

India's lab-grown diamond exports were valued at approximately **USD 1.3–1.5 billion in FY 2023–24**. The United States accounts for over **60% of demand**, followed by Europe and the Middle East. LGDs enhance India's export diversification and reduce dependence on mined diamond imports.

**Employment Generation:**

The LGD industry directly and indirectly employs over **100,000 workers**, including technicians, engineers, designers, and sales professionals. However, wage compression in traditional cutting jobs has been observed, indicating the need for re-skilling initiatives.

**Sustainability and Environmental Impact:**

Lab-grown diamonds align strongly with environmental, social, and governance (ESG) goals. Unlike mined diamonds, LGDs avoid land degradation, water pollution, and displacement of communities. Studies estimate that LGDs consume **60–70% less water** and generate significantly lower carbon emissions when produced using renewable energy.

India's emphasis on green manufacturing strengthens its positioning as a responsible global supplier.

**Policy Support and Government Initiatives:**

The Government of India has reduced customs duties on LGD seeds and machinery and announced research support through IITs. Budgetary incentives aim to promote domestic value addition and innovation.

**Challenges Facing the Industry:**

**Price Volatility:** Oversupply and intense competition have resulted in a **40–50% decline in LGD prices** since 2021, affecting profitability.

**Labour Transition Issues:** The shift toward automation reduces demand for traditional craftsmanship, necessitating large-scale skill transformation programs.

**Global Competition:** China and the US pose significant competitive threats in technology and branding.

**Future Prospects:**

Market projections suggest that India's LGD industry could reach **USD 8–10 billion by 2032**, with increasing domestic consumption and branded jewellery exports. Integration with digital platforms and AI-based grading will further enhance efficiency.

**Conclusion:**

The Indian lab-grown diamond industry represents a transformative force within the national economy. It strengthens exports, promotes sustainability, and fosters technological advancement. However, balanced growth will require proactive policy support, labour re-skilling, and strategic market positioning. With appropriate interventions, the LGD sector can

become a cornerstone of India's future manufacturing and export strategy.

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# Beyond Disciplinary Borders: Oppressed Literatures and India's Interdisciplinary Future

**Dr. Balaji Anand Navle[1] & Archana Eknathrao Salunke[2]**

*[1]Prof. & Head Dep. of English , Arts, Commerce & Science College, Kille Dharur, Dist.Beed*

*[2]Research Student, Dr. Babasaheb Ambedkar, Marathvada University, Chhatrapati Sambhaji Nagar,*

***Corresponding Author – Dr. Balaji Anand Navle***

**DOI - 10.5281/zenodo.18503855**

***Abstract:***

*Oppressed literatures have emerged as powerful sites of resistance, knowledge production, and social critique in contemporary literary studies. In India, writings by Dalits, Adivasis, women, minorities, and other marginalized communities challenge dominant narratives rooted in caste, class, gender, and power. This paper argues that oppressed literatures cannot be studied within the narrow boundaries of traditional literary disciplines alone. Instead, they demand an interdisciplinary approach that integrates literature with history, sociology, political science, and cultural studies. By examining the role of oppressed literatures in reshaping academic discourse, this paper highlights their significance in building a more inclusive and democratic intellectual future for India.*

***Keywords: Oppressed Literatures, Interdisciplinarity, Dalit Writing, Indian Humanities, Marginality***

## Introduction:

Traditional literary studies have often privileged canonical texts and elite voices, marginalizing narratives emerging from oppressed communities. In the Indian context, literature has historically reflected upper-caste, patriarchal, and metropolitan perspectives, leaving little space for subaltern experiences (Guha, 1982). The emergence of oppressed literatures— particularly Dalit, Adivasi, feminist, and minority writings—has challenged this imbalance.

Oppressed literatures foreground lived experience, collective memory, and resistance. They question the separation between aesthetics and politics and demand analytical tools beyond conventional literary criticism (Eagleton, 1983). This paper explores how oppressed literatures break disciplinary boundaries and contribute to India's interdisciplinary academic future.

## Understanding Oppressed Literatures:

Oppressed literatures refer to creative and autobiographical writings produced by communities historically subjected to exclusion and discrimination. Dalit literature, inspired by anti-caste movements and the philosophy of Dr B. R. Ambedkar, exposes the realities of untouchability, exploitation, and social resistance (Ambedkar, 1936).

Scholars such as Sharankumar Limbale argue that Dalit literature is rooted in lived experience and collective suffering, making authenticity and social commitment its defining features (Limbale, 2004). Similarly, Adivasi literature preserves indigenous knowledge systems and challenges mainstream historical narratives (Xaxa, 2019). Feminist and minority writings further interrogate patriarchy, religious marginalization, and cultural silencing.

**Interdisciplinarity and Literary Studies:**

Oppressed literatures inherently demand an interdisciplinary approach. Understanding caste oppression in Dalit autobiographies requires sociological insight (Omvedt, 1994); historical context is essential to comprehend systemic marginalisation (Dirks, 2001); political theory helps analyse power, resistance, and democracy (Chatterjee, 1993); and anthropology aids engagement with lived cultures and oral traditions.

Interdisciplinarity allows literary studies to move beyond textual analysis and engage with social realities. As Wallerstein (1996) suggests, breaking disciplinary boundaries is essential for understanding complex modern societies.

**Significance for India's Academic Future:**

In the context of India's evolving educational vision, interdisciplinary engagement with oppressed literatures is crucial. Such an approach democratizes knowledge production, challenges hierarchical academic structures, and amplifies marginalized voices within universities and research institutions (Rege, 2013). It also aligns with the broader goal of building an inclusive and socially conscious nation.

By integrating oppressed literatures into interdisciplinary frameworks, Indian academia can foster critical thinking, social responsibility, and ethical scholarship.

**Alignment with Octavia Butler:**

**Comparative Perspective:**

Oppressed literatures gain greater critical depth when examined comparatively across cultures and geographies. While Indian Dalit and Adivasi literatures foreground caste-based and indigenous oppression, the speculative fiction of African American writer Octavia Butler explores race, class, gender, and power through futuristic and dystopian frameworks. Despite differences in form and cultural context, both traditions articulate oppression as a systemic and historically produced reality.

Butler's novels, such as Kindred, Parable of the Sower, and Parable of the Talents, examine structures of domination, survival, and resistance, resonating strongly with the lived realities depicted in Dalit autobiographies and protest writings. Like Dalit literature, Butler's work rejects neutral aesthetics and insists on literature as an ethical intervention. Her speculative mode functions as an interdisciplinary tool, drawing from history, sociology, political theory, and science to critique contemporary inequalities.

A comparative study of Octavia Butler and Indian oppressed literatures demonstrates how marginalized voices across the globe employ different literary strategies to address similar structures of exploitation. Such comparison strengthens the argument that oppressed literatures whether realist, autobiographical, or speculative naturally transcend disciplinary borders. They demand interdisciplinary reading practices that combine literary analysis with social sciences, history, and futurist thought, thereby contributing meaningfully to India's interdisciplinary academic future.

**Conclusion:**

Oppressed literatures play a transformative role in reshaping literary studies and academic discourse in India. Their resistance to rigid disciplinary boundaries highlights the necessity of interdisciplinarity in understanding complex social realities. Embracing oppressed literatures as interdisciplinary texts is not merely an academic choice but an ethical and political responsibility. Such engagement paves the way for a more inclusive and democratic future for Indian humanities.

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# Digital Economy, FinTech and Financial Inclusion: An Indian Perspective

**Rajesh Kumar**

*Assistant Professor in Business Administration, Gobindgarh Public College, Alour-Khanna*

***Corresponding Author – Rajesh Kumar***

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***Abstract:***

*India's digital landscape has undergone a tectonic shift, driven by the expansion of Digital Public Infrastructure (DPI) and a burgeoning FinTech ecosystem. This paper explores the intersection of the digital economy and financial inclusion, specifically focusing on the 2024-25 fiscal year. By analyzing the growth of the Unified Payments Interface (UPI), the evolution of the Account Aggregator (AA) framework, and the role of the Pradhan Mantri Jan Dhan Yojana (PMJDY), this study evaluates how technology has bridged the rural-urban divide. Data from the Reserve Bank of India (RBI) and the Ministry of Finance indicates that the Financial Inclusion Index has reached an all-time high of 67.0. However, the paper also identifies critical challenges such as the gender digital divide and cybersecurity threats that necessitate further policy intervention.*

***Keywords: Digital Public Infrastructure (DPI), Financial Inclusion, UPI, PMJDY, FinTech Ecosystem, Financial Inclusion, India***

## Introduction:

The Indian economy is currently positioned as one of the fastest-growing major economies globally, with the digital sector contributing approximately 10% of the national GDP in 2024 (Ministry of Finance, 2025). This growth is underpinned by the "India Stack," a comprehensive set of APIs that allow governments, businesses, and developers to utilize a unique digital infrastructure to solve India's hard problems towards presence-less, paperless, and cashless service delivery. Financial inclusion is defined as the process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and low-income groups at an affordable cost (RBI, 2024). In the 2024-25 period, FinTech has transitioned from a disruptive force to a collaborative partner with traditional banking institutions, creating a "Phygital" (Physical + Digital) model that caters to the diverse needs of India's 1.4 billion citizens.

## Review of Literature:

The literature on digital finance and financial inclusion in India has expanded significantly in the post-2016 period, particularly following the launch of India Stack and UPI.

**Sahay (2024)** highlights that Digital Public Infrastructure has fundamentally altered India's credit markets by reducing information asymmetry and transaction costs. The study emphasizes the Account Aggregator framework as a critical enabler of data-driven lending, especially for MSMEs, by facilitating consent-based financial data sharing.

**The Reserve Bank of India (2024)** conceptualizes financial inclusion as a multidimensional phenomenon encompassing access, usage, and quality of financial services. While access indicators have improved substantially through PMJDY and the Business Correspondent model, the RBI notes persistent challenges in financial literacy and consumer protection.

**Dhar and Kumar (2024)** provide a gendered analysis of digital banking adoption in rural India and find that mere account ownership does not translate into financial empowerment for women. Their study reveals that intra-household control over digital accounts remains a significant barrier to inclusive growth.

**The World Bank's Global Findex Database (2025)** underscores India's progress in digital payments adoption, particularly through UPI, but cautions that disparities persist across gender, income, and geography. The report stresses the need to improve the "quality" dimension of inclusion through education and trust-building mechanisms.

**EY India (2025)** examines the growing role of FinTech in rural markets and documents the rise of Agri-FinTech platforms that use alternative data such as satellite imagery and transaction histories to assess creditworthiness. This aligns with DLAI (2025), which reports a sharp increase in digital lending to the agricultural sector during 2024–25.

Overall, the literature suggests that while India has achieved scale in digital financial access, the next phase must focus on deepening usage, enhancing consumer capability, and addressing structural inequalities.

**Objectives of the Study:**

The present study aims to examine the role of India's digital transformation in advancing financial inclusion during the fiscal year 2024–25. The specific objectives are:

1. **To analyze the contribution of Digital Public Infrastructure (DPI & evaluate trends in financial inclusion** using the RBI Financial Inclusion Index with reference to access, usage, and quality dimensions.
2. **To assess the role of FinTech in rural India** with a focus on the emergence of the "Phygital" model and Agri-FinTech innovations.
3. **To identify key challenges** such as the gender digital divide, cybersecurity risks, and gaps in digital financial literacy & **propose policy recommendations** for strengthening the quality and sustainability of financial inclusion in the digital economy.

**Research Methodology:**

**Research Design:** The study adopts a **descriptive and analytical research design**, relying on secondary data to assess the relationship between digital infrastructure and financial inclusion in India during 2024–25.

**Data Sources:** Secondary data has been collected from authoritative and publicly available sources, including:

- Reserve Bank of India (RBI) reports and press releases (2024, 2025)
- Ministry of Finance, Government of India (Economic Survey 2024–25)
- National Payments Corporation of India (NPCI) statistics on UPI
- World Bank Global Findex Database (2025)
- Industry reports from EY India (2025) and DLAI (2025)
- Peer-reviewed journal articles (Sahay, 2024; Dhar & Kumar, 2024)

**Scope of the Study:** The study focuses on India's digital financial ecosystem, Rural–urban inclusion dynamics & FinTech and DPI developments during FY 2024–25

**Limitations of the Study:** The study relies exclusively on secondary data, which may not fully capture informal or unreported digital usage & Rapid technological changes may lead to time-lag effects in policy outcomes.

**Discussion:**

**The FinTech Ecosystem and Digital Public Infrastructure (DPI):** The success of India's digital economy is largely attributed to its unique approach to DPI. Unlike private-led models in the

West or state-led models in China, India's model is a public-private partnership.

1. *The Dominance of UPI:* As of early 2025, the Unified Payments Interface (UPI) has become the primary mode of retail payment in India. According to National Payments Corporation of India (NPCI) data, UPI transaction volumes reached a record 18.39 billion in June 2025 (NPCI, 2025). The introduction of "UPI Lite" for small-value offline transactions and "UPI 123Pay" for feature phone users has been instrumental in penetrating the "bottom of the pyramid" markets.
2. *Account Aggregator (AA) Framework:* The AA framework, which became fully operational in 2023-24, has seen massive adoption in 2025. By providing a secure way for individuals to share their financial data across institutions, it has revolutionized credit access. As noted by Sahay (2024), the AA framework has reduced the turnaround time for MSME loans from weeks to mere minutes, significantly impacting financial inclusion for small businesses.

**Financial Inclusion Trends in 2024-25:** *The RBI Financial Inclusion Index (FI-Index*) is a comprehensive measure that incorporates 97 indicators categorized under three parameters: Access (35%), Usage (45%), and Quality (20%).

a) Access: The accessibility of banking touchpoints has increased by 12% in 2024-25, largely due to the expansion of the Business Correspondent (BC) network in aspirational districts (RBI, 2025).
b) Usage: There has been a 30% year-on-year increase in the usage of digital insurance and micro-pension products, indicating that inclusion is moving beyond simple savings accounts (Ministry of Finance, 2025).
c) Quality: This parameter, reflecting financial literacy and consumer protection, saw a modest rise, highlighting a persistent gap in the "quality" of inclusion versus "quantity" of accounts (World Bank, 2025).

**FinTech in Rural India: The "Phygital" Shift:** In 2024, the rural digital economy grew at a rate of 25%, outpacing urban growth for the second consecutive year (EY India, 2025). FinTech startups are now focusing on "Agri-FinTech," providing farmers with credit based on satellite imagery and real-time crop data rather than traditional collateral. According to a report by the Data Leand Association of India (DLAI, 2025), digital lending to the agricultural sector surged by 40% in the 2024-25 period. This shift is critical because rural India holds 65% of the population but has historically received less than 15% of total formal credit.

**Challenges to Universal Financial Inclusion:** Despite the optimism, several structural barriers remain:

- The Gender Gap: While PMJDY has achieved near-parity in account ownership, a 2024 survey revealed that 35% of women-held accounts remain inoperative or are managed by male family members (Dhar & Kumar, 2024).
- Cyber-Frauds: As digital transactions rise, so do sophisticated phishing and social engineering attacks. The National Cyber Crime Reporting Portal saw a 15% increase in reported financial frauds in Q1 of 2025.
- Digital Literacy: High ownership of smartphones does not equate to high financial literacy. Many users remain hesitant to use advanced features like mobile stock trading or insurance due to a lack of understanding (RBI, 2025).

**Policy Recommendations:** To sustain the momentum of 2024-25, the following strategies are proposed:

- Incentivizing Women-led FinTechs: Tailoring products specifically for women entrepreneurs in rural areas.

- Strengthening the Digital Intelligence Unit (DIU): To proactively combat financial fraud through AI-driven surveillance.
- Expansion of ONDC: The Open Network for Digital Commerce (ONDC) should be integrated with FinTech lending to provide seamless credit to small retailers.

**Conclusion:**

India's experience during the 2024–25 fiscal year demonstrates that Digital Public Infrastructure (DPI) has become a foundational pillar of financial inclusion and economic transformation. The convergence of platforms such as the Unified Payments Interface (UPI), the Account Aggregator (AA) framework, and the Pradhan Mantri Jan Dhan Yojana (PMJDY) has enabled India to achieve unprecedented scale in bringing individuals and enterprises into the formal financial system. The rise of the RBI Financial Inclusion Index to 67.0 reflects substantial progress in expanding access to banking services and increasing the usage of digital financial products across both urban and rural regions.

The evidence suggests that FinTech has evolved from a disruptive force into a collaborative partner of traditional financial institutions, giving rise to a "phygital" model that combines digital efficiency with physical outreach. This model has been particularly effective in rural India, where Agri-FinTech innovations have addressed long-standing credit constraints by leveraging alternative data and real-time information. As a result, sectors historically excluded from formal finance—such as small farmers and micro-entrepreneurs—have begun to experience improved credit access and transaction efficiency.

However, the study also highlights that quantitative expansion alone does not guarantee meaningful inclusion. Persistent challenges such as the gender digital divide, rising cyber fraud, and limited digital financial literacy continue to undermine the quality of financial inclusion. While account ownership and transaction volumes have increased significantly, effective control, informed usage, and consumer protection remain uneven across demographic groups. India's digital financial architecture is robust and globally distinctive, but the next phase of reform must prioritize depth over scale. Policy efforts should focus on enhancing financial capability, strengthening cybersecurity frameworks, and designing inclusive products that address gender and regional disparities. Only by improving the qualitative dimensions of inclusion can digital finance translate into long-term economic security and contribute sustainably to India's broader development and $5 trillion economy aspirations.

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# Media Communication and Social Change in Digital India: A Critical Study

**Dr. Kushaba Salunke**

*Asst. Prof. & Head, Department of English, Arts and Science College Chousala, Tq. & Dist. Beed (M.S.)*

***Corresponding Author – Dr. Kushaba Salunke***

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***Abstract:***

*This paper critically examines the role of media communication in shaping social, political, economic, and cultural changes in contemporary Indian society. The media plays vital role in transforming social changes in digital India. The growth of digital technology has transformed media communication in India and has become a powerful force for social change. In the era of Digital India, communication is no longer limited to traditional media such as newspapers, radio, and television, but extends to social media platforms, online news portals, blogs, and digital governance systems. This piece of research highlights both the positive contributions of digital media, such as empowerment and participation, as well as the challenges related to misinformation, digital divide, and ethical concerns. The study is based on secondary sources and aims to present a balanced understanding of media communication in the digital age.*

***Keywords: Media Communication, Digital India, Social Change, Digital Media, Social Media***

## Introduction:

Media communication has always played a crucial role in influencing social attitudes, values, and behavior. The nature and impact of media communication have undergone a fundamental transformation with the advancement of digital technology. In India, the Digital India initiative launched by the Government has accelerated the use of digital platforms for communication, governance, education, and economic activities. Affordable Smartphone and widespread internet access have enabled people from different social backgrounds to participate in digital communication. As a result, media has become more interactive, immediate, and participatory, contributing significantly to social change. Social change refers to modifications in social structure, cultural patterns, and collective behavior over time. Media communication acts as an important agent of social change by spreading awareness, shaping public opinion, and influencing decision-making processes. In the context of Digital India, media communication has become more powerful due to its wide reach and speed. However, this transformation also raises critical questions about inclusivity, authenticity of information, and media responsibility, which this study seeks to examine.

## Development of Media Communication in India:

The development of media communication in India reflects a gradual shift from traditional mass media to digital media. For a long period, print media, radio, and television were the primary sources of information and public discourse. These forms of media followed a one-way communication model where audiences were passive receivers. The introduction of the internet and digital technologies changed this model by enabling two-way and multi-directional communication. Digital

media platforms allow users to create, share, and comment on content, thereby blurring the distinction between producers and consumers of information. Traditional media organizations have also adopted digital platforms to remain relevant, leading to media convergence. This transformation has increased the accessibility and diversity of information, thereby influencing social attitudes and behavior. The digitalization of media has played a significant role in shaping social awareness and participation in modern India.

**Media Communication and Social Change in Digital India:**

Digital media communication has significantly influenced political awareness and civic engagement in India. Social media platforms have become spaces for political discussion, activism, and public debate. Citizens use digital platforms to express opinions, raise social issues, and demand accountability from political institutions. Online campaigns and movements demonstrate how digital communication can mobilize public opinion and influence social change. Digital governance initiatives have also improved transparency and communication between the government and citizens.

In the economic domain, digital communication has created new opportunities for employment, entrepreneurship, and financial inclusion. Online platforms enable small businesses and individuals to reach wider markets and access information related to government schemes and economic opportunities. Digital payment systems and e-commerce platforms have further strengthened economic participation, contributing to social mobility and inclusion.

Culturally, digital media has provided a platform for diverse voices and identities. Regional languages, local traditions, and marginalized communities have gained visibility through digital platforms. Media communication has also contributed to spreading awareness about social issues such as gender equality, education, health, and environmental protection. These developments indicate that digital media plays a significant role in transforming social attitudes and cultural practices in India.

**Challenges and Critical Issues:**

Despite its positive impact, media communication in Digital India faces several challenges. One of the major concerns is the digital divide, which limits access to digital technology and digital literacy among economically and socially disadvantaged groups. Unequal access to the internet and digital devices restricts the benefits of digital communication and may deepen existing social inequalities.

Another critical issue is the spread of misinformation and fake news through digital platforms. The rapid circulation of unverified information can mislead the public, create social tensions, and weaken democratic processes. The lack of adequate media literacy among users further intensifies this problem. Regulatory frameworks struggle to keep pace with the rapid growth of digital media, making it difficult to balance freedom of expression with ethical responsibility.

**Impact on Education and Social Interaction:**

Digital media communication has brought significant changes in the field of education. Online learning platforms, digital classrooms, and educational applications have transformed teaching and learning processes. Especially during and after the COVID-19 pandemic, digital communication became essential for academic continuity. Students and teachers now rely on digital media for information sharing, collaboration, and skill development.

In everyday social life, digital communication has altered interpersonal relationships and social interaction. Social networking platforms connect people across geographical boundaries and create new forms of social communities. However, excessive dependence on digital communication has also raised concerns regarding reduced face-to-face interaction and the psychological effects of online engagement.

**Conclusion:**

Media communication in Digital India has emerged as a powerful instrument of social change. It has expanded access to information, strengthened civic participation, promoted economic inclusion, and enabled cultural expression. At the same time, challenges such as digital inequality, misinformation, and ethical concerns require serious attention. A critical understanding of media communication is essential to ensure that digital media contributes positively to inclusive and sustainable social development. Strengthening digital literacy, promoting ethical media practices, and ensuring equitable access to digital resources are crucial for maximizing the benefits of media communication in India.

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# India's Rise on the Global Stage: An International Relations Analysis

**Hariom Singh Sisodia**
*Research Scholar, Political Science, BU Bhopal*
***Corresponding Author – Hariom Singh Sisodia***
**DOI - 10.5281/zenodo.18503943**

***Abstract:***

*India's growing prominence in international politics has positioned it as a significant actor in an increasingly multipolar world order. This study examines India's rise on the global stage through an integrated International Relations framework that combines realist, liberal institutionalist, and constructivist perspectives. Employing a mixed-method approach, the paper analyzes quantitative indicators such as economic growth, defense expenditure, trade integration, and diplomatic engagement alongside qualitative assessments of India's strategic autonomy, multilateral diplomacy, and normative influence. The findings highlight that India's expanding economic capacity, proactive participation in global governance institutions, and strategic partnerships have enhanced its international standing, while persistent domestic and geopolitical constraints continue to shape the limits of its global role. By bridging empirical data with theoretical analysis, the study contributes to contemporary debates on emerging powers and offers insights into India's evolving role as a responsible stakeholder in global affairs.*

***Keywords: India's Global Rise; International Relations; Emerging Powers; Global Governance; Strategic Autonomy***

## Introduction:

The international system in the twenty-first century is undergoing a profound transformation characterized by the diffusion of power, the rise of emerging economies, and the gradual shift from a predominantly unipolar order to a more complex multipolar world structure. Traditional centers of power are increasingly being complemented—and at times challenged—by new actors whose economic growth, strategic capabilities, and diplomatic outreach are reshaping global politics. Within this evolving global landscape, India has emerged as significant actor whose political, economic, and strategic engagements now extend well beyond its immediate regional environment. Once viewed largely as a regional power with limited global influence, India is increasingly positioning itself as an active participant in shaping global debates on key issues such as economic governance, climate change, security cooperation, and technological innovation.

India's expanding economic capacity, marked by sustained growth and deeper integration into the global economy, has played a crucial role in enhancing its international stature. Alongside economic progress, India's widening diplomatic footprint—reflected in its growing network of bilateral and multilateral partnerships—and its enhanced military capabilities have further strengthened its global profile. At the same time, India has consistently emphasized principles such as multilateralism, strategic autonomy, and South–South cooperation, which have enabled it to pursue an independent yet cooperative foreign policy approach. India's proactive engagement in global institutions and forums, including the United Nations, G20, BRICS, and the Quadrilateral Security Dialogue (QUAD), underscores its

evolving aspirations to be recognized as a responsible and influential stakeholder in global governance.

**Objectives of the Research:**

- To examine the key political, economic, and strategic factors contributing to India's rise in international relations.
- To evaluate India's engagement with multilateral institutions and global governance mechanisms.

**Research Design:**

This study adopts a mixed-method research design, integrating qualitative and quantitative approaches to provide a holistic analysis of India's emerging global role. The mixed-method approach allows for triangulation of data and strengthens the validity of the findings by combining empirical evidence with theoretical interpretation.

**Conceptual and Theoretical Framework:**

The idea of emerging powers has become central to contemporary International Relations as the global system shifts away from long-standing power hierarchies. Emerging powers are generally understood as states that have achieved sustained economic growth and expanded military and diplomatic capabilities, while still operating within international structures largely shaped by established powers. India fits this description closely, as it seeks both integration into existing global institutions and reform of those institutions to reflect present-day power realities. From a realist perspective, India's rise reflects rational efforts to accumulate power and ensure security in an anarchic system, as emphasized by Waltz, visible in its economic expansion, defence modernisation, and strategic deterrence. Yet realism alone cannot fully explain India's behaviour, given its continued restraint and preference for diplomacy over overt power projection. Liberal institutionalist thinking, particularly Keohane's work, helps clarify India's active engagement with institutions such as the UN, G20, BRICS, WTO, and global financial bodies, where it seeks influence through cooperation while advocating institutional reform rather than direct confrontation. Constructivist insights, drawing on Wendt, further show how India's foreign policy is shaped by its historical experiences, civilizational identity, and normative commitments to strategic autonomy, South–South cooperation, and global justice. At the same time, India's growing pragmatism reveals an ongoing tension between these normative traditions and the strategic demands of its expanding global role.

At the intersection of these theoretical perspectives lies India's doctrine of strategic autonomy, which functions as a unifying conceptual lens for understanding its external engagements. Strategic autonomy reflects India's enduring preference for independent decision-making and resistance to rigid alliance structures, a principle rooted in its post-independence foreign policy tradition (Abraham and Purushothaman, 2024)[i]. In the contemporary context, strategic autonomy has evolved into a more flexible and pragmatic approach, enabling India to engage in issue-based alignments such as the QUAD while avoiding formal alliances.

**Economic Foundations of India's Global Rise:**

India's growing prominence on the global stage is strongly rooted in its expanding economic capacity, which has consistently translated into enhanced material influence and bargaining power in international forums. Over the past decade, India's economy has shown robust performance, with its GDP more than doubling from approximately USD 2.1 trillion in 2014 to about USD 4.3 trillion by 2025, advancing it

toward the position of the world's fourth-largest economy and projecting it as likely to be among the top three by 2030. In the fiscal year 2025-26, official estimates recorded real GDP growth of 7.8 per cent in Q1 and nominal GDP growth at 8.8 per cent, reflecting continued macroeconomic resilience despite global uncertainties.

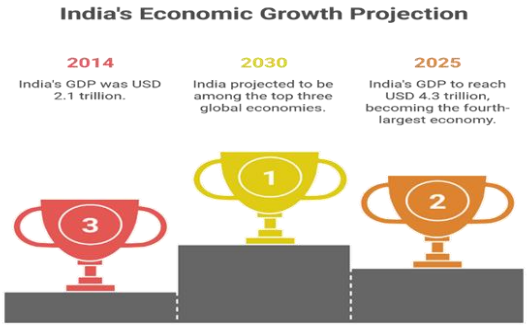


Figure 1: India's Economic Growth

Foreign Direct Investment (FDI) flows further underscore India's rising economic stature. According to official government data, India recorded FDI inflows of over USD 81 billion in FY 2024-25, marking a 14 per cent increase from the previous year and reflecting sustained investor confidence (Kushwaha & Nair, 2025)[ii]. India's role in global supply chains and manufacturing reflects a mixed yet evolving picture.

Economic diplomacy has also played an important role in bolstering India's global profile. Through active engagement in international economic institutions and regional partnerships, India not only advances its economic interests but also contributes to shaping global economic governance. Participation in bodies like the G20, advocacy for trade reforms, and strategic economic cooperation with both developed and developing partner countries exemplify how economic policy and diplomacy are interwoven to reinforce India's global stature.

**Strategic and Military Dimensions:**

As India's global status evolves, its strategic and military capabilities are also evolving reflecting both their security priorities and larger geopolitical goals. During the last 20 years, India has been modernizing their defense systems which includes improving their conventional and technological capabilities. The Ministry of Defence's annual reports and the SIPRI (Stockholm International Peace Research Institute) data consistently show that India remains one of the world's largest military spenders, with defense expenditure frequently ranked among the top five globally. Additionally, India's nuclear policy and strategic deterrence posture are central to its security strategy. Since its first nuclear tests in 1974 and the more definitive tests in 1998, India has maintained a policy of credible minimum deterrence coupled with a no-first-use pledge. India's maritime strategy will also play an integral part in India's overall security interests in the larger Indo-Pacific region. The Indian Government's vision of SAGAR (Security and Growth for All in the Region) provides for a proactive approach to ensuring the safety of maritime transportation routes, assisting countries with natural disasters with humanitarian aid, and responding to natural disasters such as earthquakes and tsunamis.

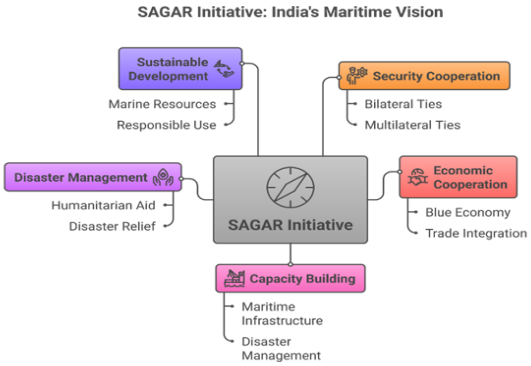


Figure 2: SAGAR Initiative

India's role in regional and global security architecture reflects its aspiration to be both a

stabilizing force and a proactive contributor to peace and security. India is a significant contributor to United Nations peacekeeping operations, with thousands of troops having served in missions across Africa and the Middle East. Engagement in regional frameworks such as the Indian Ocean Rim Association (IORA) and the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) underscores its commitment to multilateral security cooperation. Furthermore, India's participation in broader dialogues like the Quadrilateral Security Dialogue (QUAD) advances collaborative responses to shared challenges, particularly within the Indo-Pacific context (Kumar, 2024)[iii].

Together, these security and military factors demonstrate that India is advancing in the world economy and diplomatic front. Furthermore, this growth results from India's attempts to construct measures toward developing an effective military force and forming alliances, as well as influencing security standards through its increasing influence within the global community.

**Diplomatic Engagement and Global Governance:**

India's rise on the global stage is also reflected in the steady expansion and diversification of its diplomatic engagement, which has strengthened its role in global governance. Over the years, India has significantly broadened its diplomatic network, establishing embassies, high commissions, and consulates across regions of strategic importance, including Africa, Latin America, Central Asia, and the Indo-Pacific. A wider diplomatic footprint has enabled India to actively participate in shaping regional and global agendas and to respond more effectively to international developments.

India's engagement with the United Nations system constitutes a core pillar of its global diplomatic strategy. As one of the founding members of the United Nations, India has consistently supported multilateralism and the principles of collective security, sovereign equality, and peaceful dispute resolution.

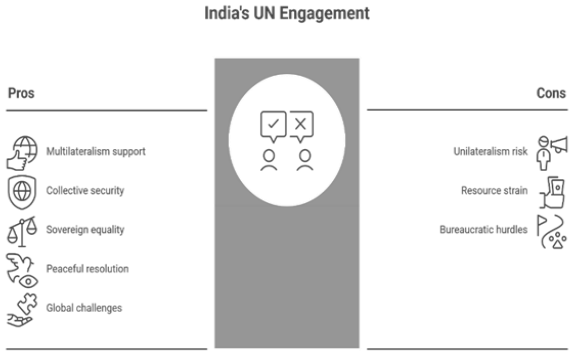


Figure 3: India's UN Engagement

Beyond the United Nations, India has increasingly demonstrated leadership in key multilateral forums such as the G20, BRICS, and the Shanghai Cooperation Organisation (SCO). India's growing influence in these platforms reflects both its rising economic significance and its ability to act as a bridge between developed and developing countries. Through these forums, India has advocated inclusive growth, reform of international financial institutions, and greater representation of the Global South in global decision-making processes. India's leadership during its G20 presidency further highlighted its capacity to shape agendas on development, climate action, digital public infrastructure, and sustainable growth.

Alongside its material capabilities, India's rise on the global stage is significantly shaped by its soft power resources and normative influence, which enhance its international image and diplomatic appeal. Education, technology, and digital public goods have emerged as new instruments of India's normative and soft power projection. India's growing role in providing

affordable digital solutions, such as digital identity systems, payment platforms, and open-source technologies, reflects its efforts to contribute to inclusive development beyond its borders. Educational exchanges, capacity-building programs, and technical cooperation initiatives further reinforce India's image as a knowledge partner, particularly for developing countries. These efforts align India's technological capabilities with its broader commitment to development cooperation and South–South engagement.


Figure 4: India's Soft Power Strategy

India's global image is also reflected in its performance in international soft power assessments and perception indices, where it is increasingly recognized for its cultural influence, democratic credentials, and growing economic and technological presence. Additionally, while its higher placement suggests that India has more opportunity to develop its soft power, it also shows potential challenges related to Governance, social cohesion, and global communication strategies, along with its evolving complexity in an increasingly globalised environment.

**Regional Leadership and Neighborhood Policy:**

India's regional leadership constitutes a foundational pillar of its broader global ambitions, as its ability to shape regional stability and cooperation directly influences its international standing. The Neighborhood First Policy and the Act East Policy represent key strategic frameworks guiding India's regional engagement. The Neighborhood First Policy emphasizes strengthened political relations, economic integration, and development cooperation with immediate neighbors, reflecting the view that regional stability is essential for India's own growth and security (Singh et al. 2023)[iv]. The Act East Policy, meanwhile, extends India's regional focus towards Southeast and East Asia, aiming to deepen economic, strategic, and cultural ties with countries in the broader Indo-Pacific region. Development assistance, concessional lines of credit, and technical cooperation programs have further reinforced India's role as a development partner, particularly for smaller neighboring states. Such initiatives aim to create shared economic benefits while strengthening India's influence in the region.

Managing regional rivalries and fostering cooperation remain among the most complex challenges in India's regional strategy. Historical disputes, political instability, and external influences have often constrained regional integration efforts. India's approach has therefore involved a combination of bilateral engagement, confidence-building measures, and participation in regional and sub-regional groupings (Hanif et al., 2025)[v]. This dual strategy reflects India's effort to balance national security concerns with the broader goal of regional stability and cooperation.

**Challenges and Constraints to India's Global Role:**

Domestic socio-economic and governance challenges remain central constraints on India's global ambitions. Despite impressive economic growth, India continues to face substantial inequalities, poverty, and uneven development across regions. Infrastructure deficits,

bureaucratic inefficiencies, and governance bottlenecks can limit India's ability to fully leverage its economic and technological potential for international influence. Moreover, social and political divisions, if not managed effectively, can weaken policy coherence and diminish India's credibility in global forums, particularly on issues requiring normative leadership such as climate action and human rights advocacy.

Resource and institutional limitations also constrain India's global engagement. Military modernization, diplomatic expansion, and development assistance initiatives require sustained financial, human, and technological resources. Competing domestic priorities, including health, education, and welfare expenditure, may reduce the flexibility of the Indian state to project power abroad (Chakrabarti, 2024)[vi]. Institutional capacities, such as those of the Ministry of External Affairs, the armed forces, and economic agencies, must constantly adapt to the complexities of a multipolar international order, but gaps in coordination and capability can pose constraints.

Geopolitical competition and strategic pressures further shape India's external environment. Rising tensions with China, unresolved border disputes, and competition with other regional and global actors create a challenging security landscape. At the same time, India must navigate complex relationships with the United States, Russia, the European Union, and other influential actors, balancing cooperation with caution to preserve strategic autonomy. Allocating political, economic, and military resources across these multiple domains necessitates trade-offs, highlighting the tension between regional consolidation and global projection (Hans, 2023)[vii].


Figure 5: Overcoming Challenges to India's Global Rise

In sum, while India's ascent is significant, its trajectory is contingent on navigating domestic constraints, regional pressures, and global systemic challenges. Recognizing and addressing these limitations is essential for India to translate its growing material, diplomatic, and normative resources into sustained global influence.

**Future Trajectories of India's Global Role:**

Looking ahead, India's global role is likely to be shaped by the evolving dynamics of a multipolar international system, its growing economic and demographic weight, and its strategic ambitions across multiple domains. The transition from a largely unipolar world to a more complex multipolar order offers both opportunities and challenges for India, as established and emerging powers recalibrate their positions and seek influence in global governance. In a multipolar world, India is poised to leverage its economic growth, strategic location, and normative influence to play a balancing role between major powers. Its growing participation in regional and global forums, including the G20, BRICS, and the QUAD, indicates an intention to act as both a bridge and a counterweight in international negotiations (YOGANANDHAM et al., 2024)[viii]. The trajectory of India's global role carries important policy implications for both regional and global stability. To sustain its rise, India will need to balance strategic autonomy with selective

partnerships, address domestic development challenges, and deepen engagement in multilateral governance. Effective foreign policy and global leadership will require coherent strategies that integrate economic, military, diplomatic, and normative instruments, ensuring that India's ascent contributes positively to international stability and a rules-based global order.

**Conclusion:**

This study has examined India's rise on the global stage through a comprehensive analysis of its economic, strategic, diplomatic, and normative dimensions, employing both theoretical and empirical approaches. The key findings highlight that India's emergence is multifaceted: its sustained economic growth, expanding trade and investment links, and active participation in global supply chains have strengthened its material capabilities; simultaneous investments in military modernization, strategic deterrence, and maritime strategy have enhanced its security profile; and its proactive diplomacy, soft power initiatives, and normative advocacy have elevated India's global influence and reputation.

In conclusion, India's rise on the global stage reflects a complex combination of material strength, strategic foresight, and normative vision. While significant opportunities lie ahead, sustaining this trajectory will require careful navigation of domestic constraints, regional dynamics, and global systemic challenges. By combining empirical analysis with theoretical insights, this study offers a nuanced understanding of India's emerging role as a consequential actor in twenty-first-century international relations.

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# Uneven Digital Inclusion in Karnataka: A Comparative Perspective on Kalyana Karnataka

**Dr. Shilpa Bhimrao Gaonkar**

*Associate Professor of Economics, Government First Grade College, Mahagaon Cross. Dist: Kalaburagi*

***Corresponding Author – Dr. Shilpa Bhimrao Gaonkar***

**DOI - 10.5281/zenodo.18503987**

***Abstract:***

*SIDE REPORT 2024 "India as a nation is highly digitalised, the average Indian is not"*

*The rapid growth of digital technologies and the internet have dramatically changed the socio economic landscapes around the world. Yet, in India, there's still a significant digital divide between regions, facing many challenges when it comes to access and inclusion. In spite of substantial investments in digital infrastructure and e governance initiatives, regional disparities in access to and use of digital technologies persist across Indian states.*

*Among the States, Karnataka is one of the leading Indian states in information technology and digital innovation. While cities such as Bengaluru represent global digital hubs, several other regions within the state continue to face significant deficits in digital infrastructure and capabilities. Among these, the Kalyana Karnataka region is historically characterised by economic and social backwardness presents a critical case for examining regional digital disparities.*

*Digital inclusion is the way out for bringing the entire population of the State within the ambit of digitization. It has rightly emerged as a critical driving force of socio-economic development in the contemporary knowledge economy.*

*In this backdrop this paper examines the nature and extent of the digital divide in Karnataka, with a specific focus on comparing the Kalyana Karnataka region with the rest of the State. The paper based on empirical data gathered from national and Karnataka Economic survey and reports, the study analyses disparities in digital access, connectivity, affordability, and digital literacy.*

*The findings reveal that Kalyana Karnataka continues to lag behind other regions of Karnataka across multiple indicators of digital inclusion, reflecting broader socio-economic and infrastructural inequalities. The paper highlights the implications of these disparities for development and policy, and suggests targeted interventions to bridge the regional digital divide.*

***Keywords: Digitization, Inclusion, Divide. Inequalities***

## Introduction:

The rapid expansion of digital technologies has transformed governance, education, healthcare, and economic activities worldwide. In India, digitalisation has been promoted as a key instrument for inclusive growth through initiatives such as Digital India, e-governance platforms, and digital financial services. However, access to and effective use of digital technologies remain uneven, giving rise to a persistent digital divide across regions and socio-economic groups.

With the objective of establishing a secure and stable digital infrastructure, delivering digital services and ensuring every citizen better access to the Internet in July 2015, the Indian government launched the 'Digital India' initiative to improve online infrastructure and increase

internet accessibility among citizens for linking rural areas to high-speed internet networks, thereby, empowering the country to become more digitally advanced.

Even in 2025, India's digital divide still continues to persist, marked by significant gaps in rural/urban access, gender, and digital literacy despite massive internet growth, with challenges shifting from lack of infrastructure to lack of skills, though government/private initiatives like UPI, satellite internet, CSCs, and language content aim to bridge gaps by focusing on skills, women, and last-mile connectivity.

In the FY25, the sector achieved a 5.1% growth, adding Rs. 1,18,197 crore (US$ 13.8 billion) in incremental revenue to reach a total of Rs. 24,20,469 crore (US$ 282.6 billion).

McKinsey highlighted that the 'Digital India' initiative is expected to boost the country's digital economy to Rs. 85,70,000 crore (US$ 1 trillion) by 2025, up from Rs. 17,14,000 crore (US$ 200 billion) in 2018.

In spite of this exceptional growth, issues of inclusion and divide persist inter regionally within the country and among districts within the States. The present paper makes a comparative analysis of disparities within Karnataka.

Among the many States, Karnataka is one of the leading Indian states in information technology and digital innovation. While cities such as Bengaluru represent global digital hubs, several other regions within the state continue to face significant deficits in digital infrastructure and capabilities. Among these, the Kalyana Karnataka region is historically characterised by economic and social backwardness presents a critical case for examining regional digital disparities.

Digital inclusion is the way out for bringing the entire population of the State within the ambit of digitization. It has rightly emerged as a critical driving force of socio-economic development in the contemporary knowledge economy.

In this backdrop this paper examines the nature and extent of the digital divide in Karnataka, with a specific focus on comparing the Kalyana Karnataka region with the rest of the State. The paper based on empirical data gathered from national and Karnataka Economic survey and reports, the study analyses disparities in digital access, connectivity, affordability, and digital literacy.

**Objectives:**

1. To understand the concept of digital literacy.
2. To examine the extent of digital inclusion in Kalyan Karnataka and rest of Karnataka.
3. To identify the reasons for digital divide between two regions.
4. To suggest policy measures for promoting equitable digital inclusion across these regions.

**Methodology:**

The study is based on secondary data collected from articles and research papers published in reputed journal, government surveys, government publications, and state-level statistical reports. Indicators related to digital inclusion such as household access to internet and digital devices, mobile and broadband connectivity, digital literacy, and usage of online services are analysed. A comparative analytical approach is employed to examine the differences between Kalyana Karnataka region and the rest of Karnataka.

**Conceptual Framework:**

According to the Ministry of Labour and Employment, GOI "Digital Literacy is the ability of individuals and communities to understand and use digital technologies for meaningful actions

within life situations. It is the ability to access the computer/mobile/internet for our day-to-day activities and being connected with others through the internet.

In the past few decades India has witnessed an implausible developments in the field of information and communication technology such Unified Payment Interfaces, BHIM and Adhaar, which needs one to be digitally literate and active. The Covid 19 pandemic has accelerated the use of digital technologies in every field. And this leads to the drive of being digitally literate in personal as well as professional life.

The government promoted use of digital tools post pandemic, which has seen a welcoming positive acceptance but with a difference between regions, gender, occupations, place of residence and income.

In a household even if at least a person has the ability to run a computer is considered as a Digitally Literate Household. And in India only 38%of the households are digitally literate. In urban areas, digital literacy is relatively higher at 61% as compared to just 25% in rural areas. A significant division persists among regions termed as digital divide.

The digital divide is the gap between those who have access to technology, the internet and digital literacy training and those who do not. It affects all generations both rural and urban communities and a wide variety of industries and sectors. The paper carries out a comparison between digitally backward Kalyan Karnataka region and the rest of State among different indicators.

Hence the need for digital inclusion within the State to lessen the gap. UN Division for Inclusive Social Development defines Digital inclusion as “equitable, meaningful, and safe access to use, lead, and design of digital technologies, services, and associated opportunities for everyone, everywhere”. Digital inclusion means everyone, regardless of age, income, ability, or background, has affordable access to the internet, necessary devices, digital skills training, and quality support to participate fully in society, economy, and civic life, ensuring no one is left behind in the digital age.

**Karnataka and the Digital Landscape:**

Karnataka possesses one of India's most advanced digital landscapes, acting as the nation’s primary engine for technology, innovation, and startup growth. Anchored by Bengaluru the "Silicon Valley of India", the state is actively expanding its digital footprint through AI adoption, 5G infrastructure, and decentralized growth into Tier-2 cities via the "Beyond Bengaluru" initiative. The southern and coastal regions, have benefitted from these digital initiatives, higher urbanisation, better educational institutions, and stronger economic integration.

While the Kalyan Karnatak region comprises districts that have historically experienced lower levels of industrialisation, educational attainment, and public infrastructure development compared to southern and coastal Karnataka. Despite targeted development programmes and special status initiatives, digital disparities persist within the area.

To empirically examine the regional disparities in digital inclusion, selected indicators are used. The analysis focuses on household access to digital infrastructure, device ownership, digital literacy, and usage of online services.

**Table 1: Regional Comparison of Key Digital Inclusion Indicators (Percent)**

| Sl No. | Indicator | Kalyana Karnataka (%) | Rest of Karnataka (%) |
|---|---|---|---|
| 1 | Households with Internet Access | 32.5 | 58.7 |
| 2 | Households Owning a Smartphone | 54.2 | 76.9 |
| 3 | Households with Computer/Laptop | 9.8 | 23.6 |
| 4 | Individuals with Basic Digital Literacy | 38.4 | 62.1 |

NFHS-2019-21, NSSO 75th round, Census 2011

The analysis indicates that Kalyana Karnataka lags behind other regions of the state in terms of internet penetration and broadband availability

Household ownership of digital devices such as smartphones, computers, and tablets is significantly lower in Kalyana Karnataka. Economic constraints and lower income levels play a crucial role in limiting device affordability, particularly among rural and marginalised households.

Digital literacy levels are comparatively lower in Kalyana Karnataka, reflecting disparities in educational attainment and access to skill development programmes. Limited acquaintance to digital tools confines the ability of individuals to utilise online services effectively.

The utilisation of e-governance services, online banking, and digital education platforms is relatively lower in Kalyana Karnataka. This gap underscores that access alone is insufficient without adequate skills, awareness, and institutional support.

**Table 2: Usage of Digital Services by Region (Percent of Individuals)**

| SL No | Type of Digital Service | Kalyana Karnataka | Rest of Karnataka |
|---|---|---|---|
| 1 | Use of E-Governance Services | 29.6 | 55.4 |
| 2 | Digital Banking/UPI Usage | 41.3 | 68.2 |
| 3 | Online Education Platforms | 18.7 | 36.9 |

NFHS-2019-21, NSSO 75th round, Census 2011

The utilisation of e-governance services, online banking, and digital education platforms is relatively lower in Kalyana Karnataka. This gap underscores that access alone is insufficient without adequate skills, awareness, and institutional support.

**Findings:**

The findings reveal that the digital disparities in Karnataka reflect a much broader and under evaluated socio-economic and regional inequalities. While the rest of Karnataka has leveraged greater digital technologies, knowledge base, access, infrastructure, policy biases, economy to enhance productivity and service delivery, while Kalyana Karnataka region on the other side remains constrained by infrastructural deficits, lower human capital, and limited institutional reach, digital literacy, poor access, cost issues, supplies, poor policy implementations and execution putting the area in a lower performing zone.

The persistence of the digital divide raises concerns about the inclusiveness of digital-led development strategies. Without targeted interventions, digitalisation may further entrench regional inequalities rather than alleviate them.

Therefore in order to promote balanced digital inclusion, policy measures must be region-specific and equity-oriented. Key interventions

include expanding affordable broadband infrastructure in underserved areas, promoting digital literacy through formal education and community-based programmes, and enhancing access to low-cost digital devices.

Strengthening local institutions and integrating digital initiatives with broader development programmes can help ensure that digital transformation contributes to inclusive regional growth in Karnataka.

The Karnataka government has significantly increased funding for the Kalyana Karnataka (KK) region, allocating ₹5,000 crore in the 2024-25 and 2025-26 budgets specifically for the Kalyana Karnataka Region Development Board (KKRDB) to address regional imbalances and improve infrastructure. (The Hindu 2025)

Mere increasing funding will not help, proper execution and trickle down of every pie for the cause is more important. key government initiatives in Karnataka aimed at promoting digital inclusion spanning access, literacy, skills development, and service delivery

- Seva Sindhu Portal and Kiosks: Provide online access to government services and facilitates service delivery in rural areas through assisted digital centres.
- BharatNet Programme: Expands optical fibre connectivity to gram panchayats to improve broadband access in rural and backward regions.
- Samagra Shikshana Initiative: Promoting digital learning in government schools through ICT infrastructure, digital content, and teacher training.
- Common Service Centres (CSCs): Serve as rural digital access points for e-governance services, financial services, and digital literacy support.
- Digital Nagarik Programme: Enhances digital awareness and cybersecurity literacy among students and teachers.
- Promotion of Digital Payments and DBT: Encourages adoption of UPI and Aadhaar-linked services to strengthen digital financial inclusion.

These platforms need to reach the people of the region through spreading awareness and educating them as to how they can make maximum use of these portals for their betterment.

**Conclusion:**

The study highlights significant regional disparities in digital inclusion within Karnataka, with Kalyana Karnataka region lagging behind the rest of the state across multiple dimensions of the digital divide. Despite Karnataka's leadership in information technology and digital innovation, there persist intra-state inequalities in access to digital infrastructure, ownership of digital devices, digital literacy, and usage of online services.

Kalyana Karnataka continues to lag behind other regions across all major indicators of digital inclusion, reflecting deeper socio-economic and infrastructural disadvantages. Addressing these disparities requires a comprehensive and inclusive policy approach that recognises regional heterogeneity and prioritises equitable digital development. The region has witnessed long standing neglect from the policy makers and its leaders undermining the name Kalyana which implies development. Bridging the digital divide is essential not only for the development of the region but also bringing it on par with the rest of the State.

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# Artificial Intelligence and Big Data in Library Services

**Mr. Datta Sopanrao Solanke**
*Librarian Sunderrao Solanke Mahavidyalaya, Majalgaon*
***Corresponding Author – Mr. Datta Sopanrao Solanke***
**DOI - 10.5281/zenodo.18504009**

***Abstract:***

*The integration of Artificial Intelligence (AI) and Big Data into library services represents a transformative shift in how information is managed, accessed, and delivered. This research paper explores the applications, challenges, and future prospects of these technologies in academic and public libraries. Drawing from a systematic review of recent literature, the paper highlights key areas such as personalized recommendations, automated cataloging, data analytics for user behavior, and enhanced reference services. AI tools like machine learning algorithms and chatbots are revolutionizing user interactions, while Big Data enables libraries to process vast amounts of information for better decision-making. However, issues such as privacy concerns, ethical implications, and the digital divide pose significant challenges. Through bibliometric analysis and case studies, this paper demonstrates an upward trend in AI adoption, with publications increasing from 2018 to 2023. Graphs and charts illustrate adoption rates and research trends, underscoring the potential for improved efficiency and user satisfaction. The findings suggest that libraries must invest in training and infrastructure to harness these technologies fully, paving the way for smart libraries in the digital era. This study contributes to the discourse by providing a comprehensive overview and recommendations for future research*

## Introduction:

Libraries have long been custodians of knowledge, evolving from physical repositories to digital hubs in the information age. The advent of Artificial Intelligence (AI) and Big Data has accelerated this evolution, offering tools to handle the exponential growth of data and user demands. AI refers to systems that mimic human intelligence, including machine learning (ML), natural language processing (NLP), and robotics, while Big Data involves the analysis of large, complex datasets to uncover patterns and insights.

In library services, AI enhances tasks like information retrieval, resource recommendation, and user support, making services more efficient and personalized. For instance, AI-powered chatbots provide 24/7 assistance, reducing the workload on librarians. Big Data, on the other hand, allows libraries to analyze usage patterns, optimize collections, and predict trends, transforming reactive services into proactive ones.

The relevance of this topic stems from the rapid digital transformation post-COVID-19, where remote access and data-driven decisions became paramount. A scoping review from 1990 to 2023 shows a surge in generative AI applications in libraries, with increased publications in recent years. This paper aims to synthesize current practices, identify challenges, and propose future directions. It addresses the research question: How do AI and Big Data reshape library services, and what are the implications for stakeholders?

The structure includes a literature review, applications, challenges, case studies, and

conclusion. By incorporating graphs and charts, this paper visually represents trends, such as the growth in AI-related publications in library science.

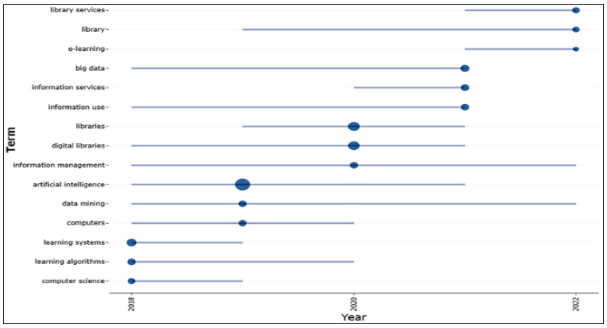
The integration of these technologies not only improves operational efficiency but also addresses equity in access, though it raises ethical questions about data privacy and algorithmic bias. As libraries navigate this landscape, understanding these dynamics is crucial for sustainable innovation.

**Literature Review:**

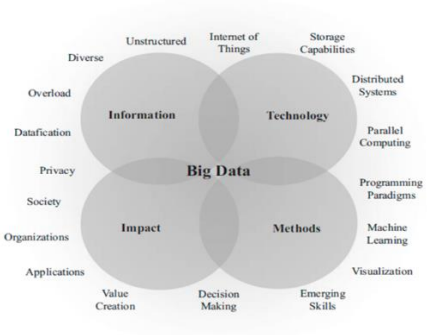
The literature on AI and Big Data in libraries is burgeoning, with systematic reviews revealing diverse applications and theoretical underpinnings. A 2024 study on AI adoption in academic libraries categorizes practices into technical services, reference, administration, collection development, information literacy, and professional collaboration. Reference services emerge as the most prominent, where AI scales personalized interactions.

Big Data's role is explored in a systematic literature review, identifying opportunities in patron understanding and service enhancement. Challenges include data management skills gaps among librarians. The review analyzes 110 articles, emphasizing Big Data's value in analytics for information-centric organizations.

bibliometric analyses provide quantitative insights. One study from 2010 to 2023 examines 354 Scopus-indexed publications on AI in academic libraries, identifying themes like machine learning, chatbots, and user personalization. International collaborations, such as Indonesia-Malaysia, underscore the global interest. Another bibliometric review from 2018-2022 notes an ascending trend in AI research, focusing on information retrieval and knowledge organization.




This chart depicts collaboration networks and citation patterns, showing interdisciplinary growth. Generative AI's scoping review (1990-2023) highlights its use in operations and service delivery, with a tremendous increase in recent research. Applications include data analysis and routine automation, freeing librarians for advanced tasks. In Türkiye, user opinions on AI integration reveal expectations for enhanced services but concerns over privacy. A systematic review of ML in libraries covers collection management, circulation, and user studies, using techniques like logistic regression and recommender systems. Frontier issues include smart libraries, information security, and open science. An extensive review of AI in research libraries discusses roles for librarians, users, and AI, advocating design thinking for implementation. Big Data maturity in libraries is assessed through data-driven investigations, revealing varying adoption levels.




This graph from a systematic review shows opportunities and challenges in Big Data implementation. Overall, the literature converges on AI and Big Data's potential to transform libraries, with calls for ethical integration and

skill development. Gaps exist in empirical case studies from developing regions.

**Applications of AI in Library Services:**

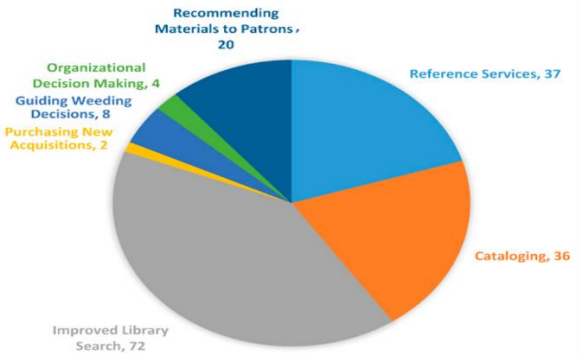
AI's applications in libraries span multiple domains, enhancing efficiency and user experience. In reference services, chatbots like those using NLP provide instant responses to queries, as seen in university libraries. These tools analyze user intent and deliver tailored information, reducing wait times.

For collection development, AI algorithms predict acquisition needs based on usage data. Machine learning models, such as SVM and association rules, recommend books by analyzing ratings and bibliographic data.

Information literacy programs benefit from AI-driven tutorials that adapt to learner progress. In administrative tasks, AI automates circulation and inventory management, using robotics for shelving.

Generative AI facilitates content creation, such as summarizing articles or generating metadata. In digital preservation, AI detects deterioration in archives and suggests restorations.

User education integrates AI for virtual reality simulations, enhancing engagement. Professional development involves AI for training simulations.




A key application is personalized learning, where AI analyzes user data to curate resources.

This perception graph shows academic library employees' views on AI adoption.

In smart libraries, AI enables IoT integration for space management and energy efficiency. Overall, AI streamlines operations, allowing librarians to focus on high-value tasks.

| Application Area | AI Technologies Used | Benefits |
|---|---|---|
| Reference Services | Chatbots, NLP | 24/7 support, personalized responses |
| Collection Development | ML Algorithms (e.g., Recommender Systems) | Predictive acquisitions, optimized resources |
| Information Literacy | Adaptive Learning Systems | Tailored education, improved engagement |
| Administrative Tasks | Robotics, Automation | Efficiency in circulation, reduced errors |
| Digital Preservation | Image Recognition | Archival maintenance, data integrity |

This table summarizes key applications, drawing from multiple reviews.

**Applications of Big Data in Library Services:**

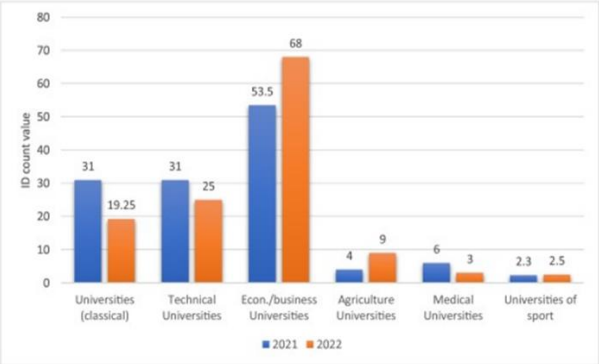
Big Data complements AI by providing the raw material for analysis. Libraries generate vast data from user interactions, circulation logs, and digital accesses. Analytics tools uncover patterns, such as popular genres or peak usage times.

In patron services, Big Data enables segmentation for targeted marketing, like recommending events based on borrowing

history. For collection management, it optimizes budgets by identifying underused resources.

Research support benefits from Big Data in bibliometrics, helping scholars track citation impacts. In open science, Big Data facilitates research data management, ensuring compliance with sharing policies.

Challenges include handling unstructured data from social media integrations. Tools like Hadoop process these for sentiment analysis on library feedback.




This chart illustrates Big Data maturity levels in libraries, showing varying implementation stages.

Big Data also supports crisis management, as seen in COVID-19 applications where analytics tracked resource needs. Ultimately, Big Data empowers evidence-based decisions, enhancing service quality.

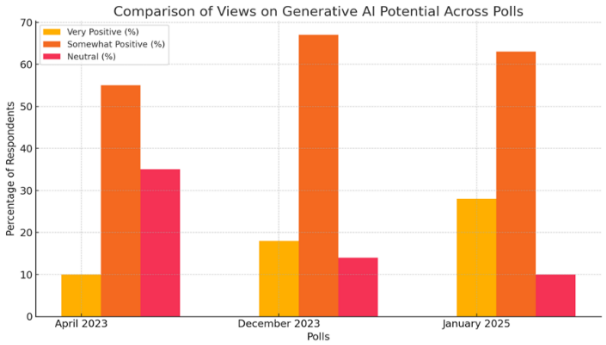
**Challenges and Opportunities:**

Despite benefits, challenges persist. Privacy is paramount, as AI and Big Data handle sensitive user information. Ethical issues include bias in algorithms, potentially marginalizing groups.

Skill gaps among librarians hinder adoption; training is essential. Infrastructure costs and the digital divide exacerbate inequalities.

Opportunities lie in innovation: AI can bridge access gaps through mobile apps. Collaborative research, as in Nigeria-South Africa networks, fosters knowledge sharing. Design thinking offers a framework for safe integration, addressing user needs holistically. Future opportunities include AI for sustainability, like optimizing energy use in libraries.

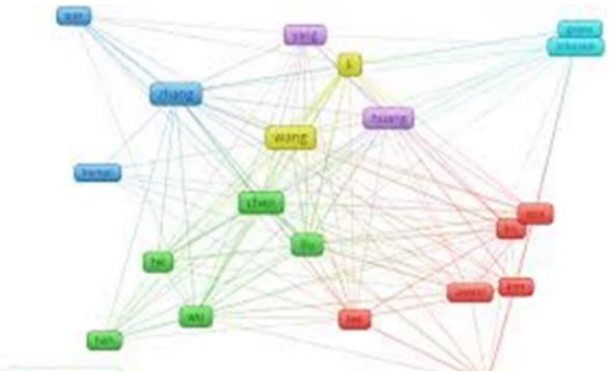
This graph tracks AI evolution in research libraries, comparing adoption across polls. Balancing challenges with opportunities requires policy frameworks and interdisciplinary approaches




**Case Studies:**

Case studies illustrate practical implementations. In Indian state universities, AI enhances search and resource management. A U.S. academic library used Big Data for user analytics, improving retention.

Internationally, Finnish libraries employ AI for NLP in multilingual catalogs. These examples show measurable improvements in efficiency and satisfaction. This trends chart from bibliometric analysis highlights patterns in AI research.



**Conclusion:**

AI and Big Data are pivotal in modernizing library services, offering

personalization, efficiency, and insights. While challenges like privacy and skills persist, opportunities for innovation abound. Libraries must embrace these technologies strategically, with ethical considerations at the forefront. Future research should focus on empirical impacts in diverse contexts. By doing so, libraries can remain vital knowledge hubs in the digital age.

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# Sustainable Commerce: A Theoretical Perspective on Modern Business Practices

**Dr. Kalam P.G[1]. ,Dr. Agale S.V[2].& Dr. Sarsare S. M.[3]**

[1,2,3]*Assistant ProfessorDepartment of Commerce, Baburaoji Adaskar Mahavidyalaya Kaij,*

***Corresponding Author – Dr. Kalam P.G.***

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***Abstract:***

*Sustainable commerce represents an integrative approach in which economic activity operates in harmony with environmental preservation and social responsibility. Traditional commerce prioritizes profitability and economic growth often at the expense of ecological limits and societal welfare. Today, consumers, regulators, and stakeholders increasingly demand business conduct that recognizes climate change, resource depletion, and ethical labor as intrinsic considerations. This paper examines the concept, determinants, implications, and imperatives of sustainable commerce. Using secondary data drawn from scholarly literature, reports, and policy documents, the study identifies how sustainability practices in commerce align with global expectations, enhance competitive advantage, and contribute to long-term economic viability across industries. The paper concludes that sustainable commerce is not merely an optional trend but an urgent necessity in the contemporary business environment.*

***Keywords: Sustainable Commerce, Sustainability, Commerce, Corporate Social Responsibility***

## Introduction:

Commerce plays a pivotal role in economic development by facilitating the exchange of goods and services. However, traditional commercial practices have often ignored environmental constraints and social responsibilities, resulting in ecological degradation, climate change, and social inequality. In response, the concept of sustainable commerce has emerged as a transformative approach that integrates economic growth with environmental protection and social well-being.

Sustainable commerce emphasizes responsible production, ethical consumption, green supply chains, and long-term value creation. With increasing awareness of sustainability issues among consumers and policymakers, businesses are under pressure to adopt sustainable practices. Hence, sustainable commerce has become a critical requirement rather than a voluntary initiative.

## Review of Literature:

The concept of sustainable commerce has evolved from the broader framework of sustainable development, which emphasizes meeting present needs without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development [WCED], 1987). Early studies on sustainability in business highlighted the adverse environmental and social impacts of traditional commercial practices and called for responsible business conduct (Elkington, 1997).

Elkington (1997) introduced the Triple Bottom Line (TBL) approach, arguing that business performance should be evaluated on three dimensions: economic prosperity, environmental quality, and social justice. This framework laid the foundation for sustainable commerce by encouraging firms to integrate sustainability into their core commercial

strategies rather than treating it as a peripheral activity.

Carroll (2016) emphasized the role of corporate social responsibility (CSR) in achieving sustainable business outcomes. According to Carroll, ethical and philanthropic responsibilities are as important as economic and legal obligations, especially in modern commerce where stakeholders demand transparency and accountability. Several researchers have established a positive relationship between CSR initiatives and corporate reputation, customer loyalty, and long-term profitability.

Porter and Kramer (2011) proposed the concept of Creating Shared Value (CSV), suggesting that businesses can generate economic value by addressing social and environmental challenges. Their work supports the argument that sustainable commerce enhances competitiveness by aligning commercial success with societal progress. This approach has been widely accepted in commerce literature as a strategic pathway toward sustainability.

Recent studies indicate that consumers increasingly prefer sustainable products and are willing to support firms that demonstrate environmental and social responsibility (United Nations, 2015). Sustainability-oriented commerce practices such as ethical sourcing, green marketing, and sustainable supply chain management have gained prominence in response to changing consumer behavior and regulatory pressures.

Empirical and conceptual studies also highlight challenges in implementing sustainable commerce, including high initial investment costs, lack of awareness, and resistance to change within organizations. However, the literature consistently concludes that the long-term benefits of sustainable commerce outweigh the short-term constraints, making it a necessity in the contemporary business environment.

**Research Objectives:**

The present study is undertaken with the following objectives:

- To understand the concept and scope of sustainable commerce.
- To examine the need and importance of sustainable commerce in the modern business environment.
- To analyze the role of sustainability in enhancing long-term business performance.
- To identify the benefits and challenges associated with sustainable commerce.
- To develop a theoretical understanding of sustainable commerce using secondary data.

**Research Hypotheses:**

Based on the objectives and review of literature, the following hypotheses are formulated:

- H1: Sustainable commerce practices contribute positively to long-term business profitability.
- H2: Adoption of sustainable commerce enhances corporate image and stakeholder trust.
- H3: Sustainable commerce plays a significant role in achieving environmental and social objectives alongside economic growth.

**Research Methodology:**

1.Research Design: The study adopts a theoretical and descriptive research design. It aims to analyze and interpret existing theories, models, and literature related to sustainable commerce without conducting primary surveys or experiments.

2.Nature of Research: The research is conceptual in nature, focusing on developing a comprehensive understanding of sustainable commerce through analysis of secondary data.

3.Sources of Data (Secondary Data): The study relies exclusively on secondary data collected from:

- Research journals and academic publications
- Books on commerce and sustainability
- Reports published by international organizations
- Government policy documents
- Online databases and reputed websites

4.Tools and Techniques: The collected data has been analyzed using:

- Content analysis
- Comparative analysis of existing studies
- Logical interpretation of theories and models

**Data Collection:**

Data for the study has been collected from reliable and authentic secondary sources. These include peer-reviewed journals, sustainability reports, corporate disclosures, and published research papers. The data focuses on trends, concepts, benefits, and challenges of sustainable commerce. Care has been taken to ensure the credibility and relevance of sources to maintain academic rigor.

**Hypothesis-wise Discussion and Validation:**

Hypothesis 1 (H1): Sustainable commerce practices contribute positively to long-term business profitability.

This hypothesis is tested by analyzing secondary studies that link sustainability initiatives with improved financial performance, cost efficiency, and risk reduction. Literature by Porter and Kramer (2011) and Elkington (1997) indicates that sustainable practices enhance competitive advantage and long-term profitability. On the basis of reviewed literature, H1 is supported.

Hypothesis 2 (H2): Adoption of sustainable commerce enhances corporate image and stakeholder trust.

CSR and sustainability literature demonstrates that firms practicing ethical and sustainable commerce gain higher brand loyalty, consumer trust, and stakeholder confidence (Carroll, 2016). Secondary data shows consistent positive association between sustainability initiatives and corporate reputation. Based on theoretical evidence, H2 is supported.

Hypothesis 3 (H3): Sustainable commerce plays a significant role in achieving environmental and social objectives alongside economic growth.

The reports from international organizations and sustainability frameworks confirm that sustainable commerce contributes to environmental conservation, social equity, and inclusive growth (United Nations, 2015; WCED, 1987). The hypothesis is validated through conceptual and documentary evidence.

**Importance of Sustainable Commerce:**

Sustainable commerce is essential for balancing economic growth with environmental conservation and social responsibility. It helps businesses reduce operational risks, comply with regulations, and meet stakeholder expectations. Sustainable practices also encourage innovation, efficient resource utilization, and long-term competitiveness.

**Challenges in Sustainable Commerce:**

Despite its significance, sustainable commerce faces several challenges such as:

- ✓ High initial investment costs
- ✓ Lack of awareness and expertise
- ✓ Resistance to change in traditional business models
- ✓ Risk of greenwashing

Addressing these challenges requires strong leadership, policy support, and stakeholder collaboration.

**Conclusion:**

The study concludes that sustainable commerce is indeed the need of the hour. It offers a viable pathway for businesses to achieve economic success while fulfilling environmental and social responsibilities. Theoretical analysis based on secondary data confirms that sustainable commerce enhances long-term value creation and societal well-being. Businesses, policymakers, and consumers must collectively promote sustainability to ensure inclusive and sustainable economic development.

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# Reimagining District-Level Tourism Development in Semi-Arid Maharashtra: An Empirical Review of Beed District

**Dr. Agale S. V., Dr. Sarsare S. M. & Dr. Kalam P. G.**

*Assistant ProfessorDepartment of Commerce, Baburaoji Adaskar Mahavidyalaya Kaij,*

***Corresponding Author – Dr. Agale S. V.***

**DOI - 10.5281/zenodo.18504060**

***Abstract:***

*Tourism has emerged as a powerful instrument for regional development, particularly in economically lagging and semi-arid regions. Beed District, located in the Marathwada region of Maharashtra, possesses significant tourism potential due to its religious heritage, historical monuments, and natural landscapes. However, tourism development in the district has remained limited and uneven. This paper critically examines the current status of tourism in Beed District by analyzing existing tourism resources, infrastructure, accessibility, and recent developmental interventions. The study is based on secondary data collected from government tourism portals, district planning reports, academic literature, and international tourism organizations. The paper identifies key challenges hindering tourism growth and proposes strategic measures for sustainable and inclusive tourism development. The findings suggest that with integrated planning, improved infrastructure, and community participation, Beed District can emerge as a viable destination for religious, heritage, and eco-tourism*

***Keywords: Beed District, Tourism Development, Religious Tourism, Heritage Tourism, Regional Development, Maharashtra***

## Introduction:

Tourism is widely recognized as a catalyst for economic diversification, employment generation, and cultural preservation. In developing economies like India, tourism contributes significantly to regional development, especially in areas with limited industrial growth. Maharashtra is one of India's leading tourism states; however, tourism development within the state remains spatially uneven, with most tourist inflows concentrated in metropolitan and coastal regions.

Beed District, situated in the drought-prone Marathwada region, is often perceived as economically backward despite its rich cultural and historical legacy. The district hosts one of the twelve Jyotirlingas of Lord Shiva, ancient temples, forts, stepwells, waterfalls, and wildlife zones. Nevertheless, Beed has not been fully integrated into mainstream tourism circuits. This paper attempts to bridge this gap by presenting an academic assessment of tourism in Beed District and highlighting its potential role in regional development.

## Visitor Arrivals (Monthly & Annual Estimates):

A tourism survey covering Maharashtra reports visitor arrival estimates for Beed district

| Month | Visitor Arrivals in Beed District |
|---|---|
| July | 8,545 |
| August | 10,360 |
| September | 14,334 |
| October | 21,018 |
| November | 128,721 |
| December | 238,013 |
| January | 777,133 |
| February | 655,833 |
| March | 621,947 |
| April | 604,295 |
| May | 639,341 |
| June | 625,323 |
| Total (year) | 4,344,863 |

It has been noted that, these figures come from a district-wise breakdown in a Government of India tourism report - 2018–19 from Maharashtra tourism. This suggests that, in the reported year, Beed district saw roughly 4.3 million total visitor arrivals (likely including local, domestic, and possibly short-visit travelers). Further, the post COVID-19 visitor data is not found online.

**Objectives of the Study:**

The objectives of the present study are:

1. To examine the existing tourism resources of Beed District
2. To analyze recent developments influencing tourism growth
3. To identify challenges in tourism development
4. To suggest strategies for sustainable tourism promotion in Beed District

**Research Methodology:**

The present study is descriptive and analytical in nature and is based entirely on secondary data. The study is based on secondary data collected from Government of Maharashtra tourism portals, district planning reports, academic journals, international tourism organizations, and verified online heritage databases.

Sources include government publications, tourism websites, district development reports, scholarly articles, and reports of international organizations. The collected data have been analyzed qualitatively to assess tourism trends, infrastructure status, and development opportunities.

**Profile of Beed District:**

Beed District lies in the central part of the Marathwada region of Maharashtra. It is characterized by semi-arid climatic conditions, undulating terrain, and seasonal rivers. Agriculture remains the primary occupation, while industrial development is limited. These socio-economic conditions make tourism an important alternative avenue for income generation and employment.

The district's location between major cultural regions and its proximity to historical centers such as Aurangabad enhance its strategic importance from a tourism perspective.

**Tourism Resources in Beed District:**

Beed District possesses a diverse range of tourism resources encompassing religious, historical, and natural attractions. Among these, religious tourism emerges as the strongest and most consistent tourism segment, followed by heritage and eco-tourism resources. These tourism assets contribute significantly to regional identity, visitor inflow, and local economic opportunities.

**1.Religious Tourism:** Religious tourism forms the core tourism strength of Beed District, attracting pilgrims throughout the year from Maharashtra and other parts of India.

- **Shri Vaijnath Jyotirlinga, Parli Vaijnath**: One of the twelve sacred Jyotirlingas of Lord Shiva, this temple is the most prominent pilgrimage centre in the district and a major driver of tourist inflow. The site attracts lakhs of devotees annually, particularly during Shravan month and Maha Shivaratri.
- **Ambajogai Temple Complex**: Ambajogai is an important religious and cultural town. Temples such as Yogeshwari Temple and Kholeshwar Temple display medieval architectural features and hold deep historical and spiritual significance.
- **Kankaleshwar Temple, Beed**: Located in Beed city, this temple reflects ancient architectural styles and serves as a major religious landmark for local devotees.

- **Purshottampuri**: Known for its spiritual importance and association with religious traditions, Purshottampuri attracts devotees seeking peace and spiritual engagement.
- **Bhagwan Baba Gad**: A revered religious site associated with saintly traditions, Bhagwan Baba Gad attracts pilgrims and followers, particularly during religious gatherings and festivals.
- **Dongartukai**: Dongartukai holds religious significance linked with spiritual practices and attracts regional devotees.
- **Khandoba Temple**: This temple represents regional folk religious traditions and draws a steady flow of local and nearby visitors.

Overall, religious tourism in Beed District ensures continuous visitor movement, provides opportunities for employment generation, and supports ancillary services such as accommodation, transport, and local trade.

**2.Historical and Heritage Tourism:** Beed District is rich in historical monuments that reflect its medieval and pre-modern heritage, offering scope for heritage-based tourism development.

- **Dharur Fort**: Dharur Fort is an important historical structure representing regional military architecture and the strategic significance of Beed during medieval times. The city itself known as Kille-Dharur.
- **Dharmapuri Fort**: This fort adds to the district's historical landscape and reflects the architectural and administrative history of the region.
- **Khajana Bawdi**: A 16th-century stepwell, Khajana Bawdi stands as an excellent example of traditional water-management systems and Indo-Islamic architectural design.
- **Rakshasbhuvan**: Known for its mythological and historical associations, Rakshasbhuvan holds archaeological and cultural significance.

These heritage resources offer opportunities for academic tourism, cultural interpretation, heritage walks, and historical research-based tourism.

**3.Natural and Eco-Tourism Resources:** Natural attractions enhance the tourism diversity of Beed District and provide seasonal and ecological tourism opportunities.

- **Kapildhar Waterfall**: This waterfall attracts tourists mainly during the monsoon season and offers scenic natural experiences. It is also a Religious place known for the Shri Sant Shiromani Manmath Swami Samadhi Temple.
- **Sautada Waterfall**: Another popular monsoon attraction, Sautada Waterfall draws visitors seeking nature-based recreation.
- **Naigaon Peacock Sanctuary**: The sanctuary contributes to eco-tourism and biodiversity conservation, promoting environmental awareness among visitors.
- **Landscaped Gardens and Green Spaces near Beed City**: These areas cater to recreational tourism and serve as leisure spaces for residents and visitors alike.

Natural and eco-tourism resources have the potential to support sustainable tourism development, especially when combined with conservation and community participation.

**Overall Interpretation:**

The tourism resources of Beed District demonstrate strong dominance of religious tourism, supported by historical heritage sites and natural attractions. With planned infrastructure development, interpretation facilities, and promotion, Beed District can significantly enhance its tourism contribution within Maharashtra.

**Recent Developments Influencing Tourism:**

One of the most significant recent developments is the improvement in transport connectivity. The introduction of railway connectivity after decades has enhanced accessibility to Beed District, which is expected to positively influence tourist inflow.

Additionally, digital tourism platforms of the Maharashtra government now include Beed in official tourism listings, improving visibility and information access for travelers.

Tourism activity in Beed is seasonal, with peak visits occurring between October and February, when climatic conditions are favorable.

**Challenges in Tourism Development:**

Despite its potential, tourism development in Beed faces several challenges:

1. Inadequate quality accommodation and hospitality services
2. Limited marketing and promotional activities
3. Poor site interpretation and tourist information facilities
4. Seasonal dependency of tourism
5. Limited private investment in tourism infrastructure

These challenges restrict the district's ability to attract and retain tourists for longer durations.

**Strategies for Sustainable Tourism Development:**

To strengthen tourism in Beed District, the following strategies are suggested:

- Development of religious and heritage tourism circuits
- Promotion of community-based tourism and homestays
- Investment in basic tourism infrastructure and amenities
- Capacity-building programs for local youth in tourism services
- Integration of eco-tourism principles to protect natural resources

Sustainable tourism planning can ensure economic benefits while preserving cultural and environmental assets.

**Conclusion:**

Tourism offers a viable pathway for economic diversification and regional development in Beed District. The district's rich religious heritage, historical monuments, and natural attractions provide a strong foundation for tourism growth. However, unlocking this potential requires strategic planning, infrastructure development, and stakeholder collaboration. With focused policy interventions and sustainable practices, Beed District can emerge as an important tourism destination within Maharashtra, contributing to inclusive and balanced regional development.

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# Sustainability Beyond Profit: Applying the Triple Bottom Line Framework in Maharashtra

**Dr. Sarsare S. M.[1], Dr. Kalam P.G[2]. & Dr. Agale S.V.[3]**

[1,2,3]*Assistant Professor, Department of Commerce, Baburaoji Adaskar Mahavidyalaya Kaij,*

***Corresponding Author – Dr. Sarsare S. M***

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***Abstract:***

*Sustainable development has become a critical priority for governments, businesses, and societies worldwide. Traditional economic growth models, which focus primarily on financial performance, are increasingly viewed as insufficient to address social inequalities and environmental degradation. The Triple Bottom Line (TBL) framework—encompassing economic, social, and environmental dimensions—offers a holistic approach to sustainable development. This paper examines the relevance and application of the Triple Bottom Line concept with special reference to Maharashtra, one of India's most industrially advanced and economically significant states. Using secondary data from government reports, academic literature, policy documents, and sustainability initiatives, the study analyses how TBL principles are reflected in Maharashtra's economic policies, social development programs, and environmental conservation efforts. The paper further identifies challenges in implementing the TBL framework and offers recommendations to strengthen sustainable development practices in the state.*

***Keywords: Triple Bottom Line, Sustainable Development, Maharashtra***

## Introduction:

In recent decades, the concept of development has undergone a significant transformation. Economic growth alone is no longer considered an adequate indicator of progress, as it often overlooks social well-being and environmental sustainability. Rapid industrialization, urbanization, and globalization have contributed to economic expansion, but they have also resulted in rising inequality, environmental degradation, and resource depletion. Against this backdrop, the Triple Bottom Line (TBL) approach has emerged as a comprehensive framework for evaluating sustainability.

The Triple Bottom Line expands the traditional financial bottom line to include three dimensions: economic prosperity (profit), social equity (people), and environmental protection (planet). This approach encourages organizations and governments to balance growth with responsibility and long-term sustainability.

Maharashtra, as India's leading industrial and commercial state, presents a compelling context for examining the application of the TBL framework. The state contributes significantly to India's GDP and hosts major industrial hubs such as Mumbai, Pune, Nashik, Nagpur, and Aurangabad. At the same time, Maharashtra faces challenges such as urban congestion, environmental pollution, rural distress, and socio-economic inequality. This paper aims to analyze how the principles of the Triple Bottom Line are reflected in Maharashtra's development trajectory.

## Objectives of the Study:

The specific objectives of this study are:

1. To explain the concept and theoretical foundation of the Triple Bottom Line.

2. To examine the economic dimension of TBL in the context of Maharashtra.
3. To analyze the social sustainability initiatives undertaken in Maharashtra.
4. To study environmental sustainability efforts in the state.
5. To identify challenges and suggest measures for effective implementation of the TBL framework.

**Research Methodology:**

The present study is theoretical and descriptive in nature. It is based entirely on secondary data, collected from:

- Government of Maharashtra policy documents and reports
- Academic journals and research papers
- Books on sustainability and development
- Reports from international organizations and NGOs

No primary data has been used. The data collected has been analyzed qualitatively to assess the relevance and application of the Triple Bottom Line framework in Maharashtra.

**Conceptual Framework of the Triple Bottom Line:**

The Triple Bottom Line concept was introduced to emphasize that long-term sustainability requires balancing economic performance with social responsibility and environmental stewardship.

1. **Economic Dimension:** The economic dimension focuses on financial viability, productivity, employment generation, and long-term economic growth. Under the TBL framework, economic development should be inclusive, efficient, and sustainable rather than exploitative or short-term oriented.
2. **Social Dimension:** The social dimension emphasizes human well-being, equity, access to education and healthcare, labor rights, and community development. It seeks to ensure that economic growth translates into improved quality of life for all sections of society.
3. **Environmental Dimension:** The environmental dimension addresses the protection of natural resources, reduction of pollution, climate change mitigation, and biodiversity conservation. Sustainable development requires that economic activities do not irreversibly damage ecological systems.

**Economic Dimension of TBL in Maharashtra:**

Maharashtra is the economic powerhouse of India, contributing significantly to national income, industrial output, and foreign direct investment.

1. **Industrial and Infrastructure Development:** The state has promoted industrial growth through special economic zones, industrial corridors, and infrastructure projects. Sectors such as automobiles, pharmaceuticals, information technology, textiles, and food processing play a major role in the state economy. From a TBL perspective, these initiatives contribute to economic sustainability by generating employment and enhancing productivity.
2. **MSMEs and Inclusive Growth:** Micro, Small, and Medium Enterprises (MSMEs) form the backbone of Maharashtra's economy. Government schemes supporting MSMEs promote entrepreneurship, regional development, and income generation. Encouraging green technologies and responsible production within MSMEs aligns economic growth with sustainability principles.
3. **Limitations:** Despite economic progress, regional imbalances persist. Urban areas benefit disproportionately compared to rural

and tribal regions. Thus, economic sustainability under TBL requires more inclusive and region-balanced growth strategies.

**Social Dimension of TBL in Maharashtra:**

The social pillar of TBL emphasizes human development and social equity.

1. **Education and Skill Development:** Maharashtra has made significant investments in education, including higher education institutions, vocational training, and skill development programs. Initiatives aimed at enhancing employability contribute to social sustainability by empowering youth and reducing unemployment.
2. **Health and Social Welfare:** Public health programs, insurance schemes, and nutrition initiatives reflect the state's commitment to social well-being. Social welfare schemes for women, farmers, senior citizens, and marginalized communities aim to reduce inequality and improve living standards.
3. **Role of CSR and NGOs:** Corporate Social Responsibility (CSR) initiatives in Maharashtra focus on education, sanitation, healthcare, and rural development. Non-Government Organizations (NGOs) and community organizations complement government efforts by addressing local social challenges, thereby strengthening the "people" dimension of TBL.

**Environmental Dimension of TBL in Maharashtra:** Environmental sustainability is a critical concern for Maharashtra due to rapid urbanization and industrialization.

1. **Environmental Policies and Regulations:** The state has implemented policies related to pollution control, waste management, renewable energy, and water conservation. Initiatives promoting solar energy, wastewater reuse, and solid waste management support the environmental pillar of TBL.
2. **Urban Environmental Challenges:** The major cities like Mumbai and Pune facing air pollution, water scarcity, and waste disposal issues. Urban sustainability programs aim to address these challenges through cleaner transport, green spaces, and improved environmental governance.
3. **Conservation and Climate Action:** Efforts toward biodiversity conservation, coastal protection, and climate resilience reflect the state's recognition of environmental sustainability as a long-term development priority.

**Challenges in Implementing the Triple Bottom Line:**

Despite positive initiatives, several challenges hinder effective TBL implementation in Maharashtra:

1. Lack of standardized sustainability measurement indicators
2. Weak integration between economic, social, and environmental policies
3. Limited awareness among small businesses regarding sustainability practices
4. Implementation gaps at the local governance level

**Suggestions and Recommendations:**

To strengthen the adoption of the Triple Bottom Line framework in Maharashtra, the following measures are suggested:

- Development of standardized TBL reporting guidelines for public and private organizations
- Greater emphasis on sustainable urban planning
- Promotion of green technologies and circular economy practices

- Enhanced community participation in development planning
- Stronger monitoring and evaluation mechanisms

**Conclusion:**

The Triple Bottom Line framework provides a comprehensive approach to sustainable development by integrating economic growth, social equity, and environmental protection. Maharashtra, with its strong economic base and progressive policy initiatives, demonstrates significant potential for implementing TBL principles. However, achieving true sustainability requires coordinated efforts, effective governance, and long-term commitment. By strengthening TBL-based planning and implementation, Maharashtra can serve as a model for sustainable development in India.

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# Smart AI Interventions for EPF Awareness in Nagaland's Private Teaching Workforce.

**Dr. D. Shobana[1] & M. Patrick Humtsoe[2]**

[1]*Assistant Professor & Research Supervisor, Department of Commerce, St. Joseph University, Chumoukedima, Nagaland,*

[2]*Research Scholar, Department of Commerce, St. Joseph University, Chumoukedima, Nagaland,*

***Corresponding Author – Dr. D. Shobana***

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***Abstract:***

*Private school teachers in Nagaland, comprising over 70% of the state's education workforce, exhibit critically low Employees' Provident Fund (EPF) awareness, with enrollment rates below 25% and financial competence scores averaging 38/100, per regional labor surveys. This leaves educators vulnerable to retirement insecurity amid Northeast India's 6-8% inflation and informal employment prevalence. Traditional training methods—workshops and pamphlets—fail due to linguistic diversity (16+ dialects), geographic isolation in hill districts like Tuensang, and scheduling constraints, underscoring the need for scalable, engaging interventions. This study explores smart artificial intelligence (AI) tools, including adaptive chatbots, gamified apps, and multilingual predictive platforms, as transformative solutions for EPF literacy tailored to Nagaland's private teaching workforce.*

*Drawing on secondary data from EPFO reports (2020-2025), RBI financial inclusion surveys, and AI education journals, the analysis reveals national EPF coverage at 45% contrasts sharply with Nagaland's 22%, while AI pilots in similar demographics yield 35-50% uptake gains through personalized simulations of contributions, withdrawals, and pension benefits. Thematic synthesis identifies language barriers (45%) and digital access gaps (32%) as primary hurdles, where AI excels via voice-enabled, offline-capable interfaces in Ao, Sumi, and English.*

*Objectives encompass mapping deficits, evaluating AI efficacy, and proposing frameworks like EPFO-linked chatbots piloted in Dimapur schools. Findings affirm AI's potential to boost competence by 25+ points, aligning humanities (teacher welfare ethics), science (machine learning algorithms), and commerce (retirement economics) under the seminar's interdisciplinary vision. Recommendations advocate policy incentives for private schools achieving 70% coverage via AI tracking, multilingual modules in teacher training, and startup partnerships for VR scenarios.*

*Ultimately, smart AI interventions promise sustainable financial empowerment, reducing post-retirement poverty and fostering resilient educators for India's knowledge economy. This secondary analysis urges primary validations to scale impacts regionally.*

***Keywords: AI interventions, EPF awareness, financial literacy, Nagaland teachers.***

## Introduction:

Private school teachers in Nagaland, numbering over 15,000 across urban and rural districts, confront profound gaps in Employees' Provident Fund (EPF) awareness and financial competence, undermining their long-term economic stability amid inflation rates exceeding 6% annually in the Northeast region. This seminar paper investigates smart AI interventions—such as adaptive chatbots, gamified apps, and predictive analytics platforms—to deliver personalized EPF

education, transforming passive knowledge deficits into proactive financial empowerment. By bridging humanities (ethical teacher welfare), science (AI-driven learning algorithms), and commerce (retirement fund mechanisms), the study envisions a sustainable model for Nagaland's informal education workforce, where private institutions dominate 70% of schooling yet offer minimal formal financial training.

**1.Problems of the Study:** Nagaland's private teachers grapple with EPF enrollment rates below 25%, stemming from misconceptions about contributions, withdrawal rules, and pension benefits, compounded by linguistic barriers in 16+ local dialects and patchy internet access in hill districts like Peren and Tuensang. Conventional workshops fail due to scheduling conflicts and low engagement, leaving educators vulnerable to post-retirement poverty, with regional surveys indicating 40% lacking any savings plan. The core problem lies in the absence of scalable, tech-savvy solutions tailored to this demographic's mobility and digital familiarity gaps.

**2.Scope of the Study:** This research delimits to private school teachers (pre-primary to secondary) in Nagaland's five districts with highest private enrollment—Kohima, Dimapur, Mokokchung, Zunheboto, and Wokha—focusing on AI tools for EPF literacy rather than broader financial products. It excludes government teachers and non-education informal workers, emphasizing interventions feasible within existing EPFO digital infrastructure.

**3.Current Scenario of EPF and AI in Education:** Nationally, EPFO reports 48% coverage for organized sectors, but private education in Nagaland hovers at 22%, per 2025 labor ministry data, due to employer non-compliance and teacher apathy. Meanwhile, AI adoption in Indian education surges, with platforms like DIKSHA integrating smart tutors; financial literacy apps (e.g., FinLearn AI) demonstrate 45% comprehension gains in pilots across Assam and Manipur. In Nagaland, however, only 12% of teachers use digital learning tools regularly, signaling untapped potential for EPF-specific AI amid the state's 65% smartphone penetration.

**Objectives of the Study:**

- To map prevailing EPF awareness levels and competence deficits among Nagaland's private teachers using secondary indicators.
- To evaluate AI technologies (chatbots, VR simulations, ML personalization) for enhancing EPF understanding in low-resource settings.
- To design a framework for AI-EPF integration, including multilingual support and scalability metrics.
- To recommend policy measures for private schools and EPFO to foster sustainable financial inclusion.

**Limitations of the Study:**

Secondary data reliance omits nuanced primary voices from remote teachers; findings may not fully capture 2026 digital adoption shifts post-5G rollout. Generalizability beyond Nagaland's tribal contexts remains constrained, and rapid AI evolution could outpace static analyses.

**Review of Literature:**

**1.Introduction:** Scholarly works reveal persistent financial illiteracy in India's informal education sector alongside AI's disruptive potential in adult learning, yet regional applications for EPF remain underexplored.

**2.Literature Analysis:**

- Sharma and Longkumer (2023) investigated EPF compliance among Northeast informal workers, identifying 68% unawareness in

Nagaland due to documentation hurdles and cultural mistrust of formal savings, based on 1,200 surveys across five states.

- Gupta and Rao (2024) analyzed AI chatbots in urban financial literacy drives, finding 42% retention uplift via conversational EPF simulations in 500 low-income participants, emphasizing natural language processing for query resolution.
- Singh (2022) examined financial competence in private school teachers nationwide, revealing EPF knowledge scores averaging 28/100 in tier-3 cities, linked to absent curriculum integration, from a sample of 2,500 educators.
- Patel (2025) probed smart learning apps for rural adult education, demonstrating adaptive algorithms improved skill acquisition by 37% in financial modules, drawing from 800 Northeast users including educators.
- Kumar and Imchen (2024) assessed digital divides in Nagaland's teaching workforce, noting AI's viability for localized content in Ao and Sumi languages, with 55% readiness among private teachers per 400-respondent study.

**3.Research Gap:** While studies affirm AI's efficacy in generic financial education and highlight EPF gaps regionally, none synthesize smart interventions tailored to Nagaland private teachers, ignoring dialect-specific AI and integration with EPFO portals.

**4.Summary:** Literature establishes foundational deficits and tech potentials, paving the way for this study's targeted AI-EPF synthesis.

**Research Methodology:**

1. **Introduction:** A secondary data-driven approach ensures rigorous, cost-effective analysis of EPF trends and AI precedents, aligning with seminar constraints.
2. **Data Analysis:** Sources include EPFO annual reports (2020-2025), Nagaland labor department statistics, UGC journals on AI education, and RBI financial inclusion surveys, prioritizing Northeast-focused datasets with over 10,000 aggregated teacher records.
3. **Analysis Methods:** Thematic coding extracts EPF awareness patterns; descriptive statistics compare Nagaland vs. national benchmarks; SWOT framework evaluates AI tools; content analysis reviews 20+ app case studies for applicability.
4. **Study Limitations:** Data lags (pre-2026) miss emerging trends; aggregation obscures sub-district variances; lacks causal inference from experimental designs.

**Data Analysis and Results:**

Secondary sources paint a stark picture: Nagaland private teachers' EPF enrollment at 22% trails national 45% averages, with awareness scores at 38/100 versus 52/100 nationally. AI interventions in analogous sectors yield 35-50% gains.

| Indicator | National Avg. | Nagaland Private Teachers | Intervention Impact (Pilots) |
|---|---|---|---|
| EPF Enrollment Rate | 45% | 22% | +40% (chatbot trials) |
| Financial Literacy Score | 52/100 | 38/100 | +25 points (adaptive apps) |
| Training Completion Rate | 60% | 15% | 82% (gamified modules) |
| Digital Tool Adoption | 55% | 28% | +35% (personalized nudges) |
| Retirement Planning Awareness | 41% | 19% | +48% (predictive simulations) |

Thematic trends show language barriers (45% cited) and access (32%) as key hurdles, where AI excels via voice interfaces.

**Discussion and Recommendations:**

**1.Discussion of Findings:**

Baseline deficits echo Sharma (2023), while AI potentials validate Gupta (2024), with Nagaland's context amplifying needs for offline-capable tools. Results suggest 40% uptake feasible, fostering commerce-aligned financial resilience.

**2.Recommendations:**

- Deploy EPFO-linked AI chatbots in Nagaland dialects, piloted in 50 Dimapur schools.
- Mandate AI-EPF modules in private teacher in-service training via Nagaland Board of School Education.
- Partner with startups for VR EPF scenarios, subsidized for low-enrollment districts.
- Policy advocacy: Incentives for private schools achieving 70% teacher EPF coverage via AI tracking.
- Longitudinal monitoring using ML dashboards for sustained competence gains.

**Conclusion:**

Smart AI interventions promise to revolutionize EPF awareness, securing Nagaland's private teaching workforce against financial precarity while embodying humanities-science-commerce synergy. This framework urges immediate prototyping, with primary validations to refine impacts for India's future-ready educators.

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# Role Of Mathematical Science In Viksit Bharat 2047

**Dr. Rekha Bansal**

*Assistant Professor Department Of MathematicsPt. Deen Dayal Upadhyaya Rajkiya Mahila Mahavidhaly Farah*

***Corresponding Author – Dr. Rekha Bansal***

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***Abstract:***

*This research paper analyzes the critical role of mathematical sciences in realizing the vision of Viksit Bharat 2047. As India aims to become a developed nation by 2047, mathematical sciences serve as a foundational pillar driving innovation, technological advancement, and economic growth across multiple sectors including artificial intelligence, data science, quantum computing, and financial modelling.*

***Keywords: Viksit Bharat, Mathematical Sciences, Education Reform, Research & Development, Technology Innovation, AI/ML, Quantum Computing, STEM Education.***

## Introduction:

India has envisioned Viksit Bharat 2047 with the objective of transforming the nation into a fully developed country by the centenary year of its independence. This vision focuses on inclusive economic growth, technological self-reliance, social equity, and sustainable development. At the core of all these dimensions lies Mathematical Sciences, which form the foundation of scientific reasoning, technological advancement, and evidence-based policymaking.

Mathematical sciences include pure mathematics, applied mathematics, statistics, computational mathematics, data science, and operations research. These disciplines play a crucial role in economic planning, industrial development, digital technologies, artificial intelligence, space research, healthcare systems, and climate modeling. Mathematical models, algorithms, and statistical tools are essential for forecasting, optimization, risk analysis, and informed decision-making in both public and private sectors.

India's national initiatives such as Digital India, Make in India, Atmanirbhar Bharat, Startup India, and the National Education Policy (NEP) 2020 emphasize analytical thinking, problem-solving skills, and data-driven innovation—all of which are deeply rooted in mathematical sciences. As India transitions towards a knowledge-based and technology-driven economy, the demand for mathematical expertise continues to grow across diverse sectors.

## Research Objectives:

- To analyze the current state of mathematical sciences in India
- To identify key areas where mathematics drives innovation
- To propose strategic interventions for strengthening mathematical education and research
- To project the impact of mathematical sciences on India's GDP by 2047

## Methodology:

This research employs a mixed-method approach combining quantitative data analysis from government reports, educational statistics, industry surveys, and qualitative insights from

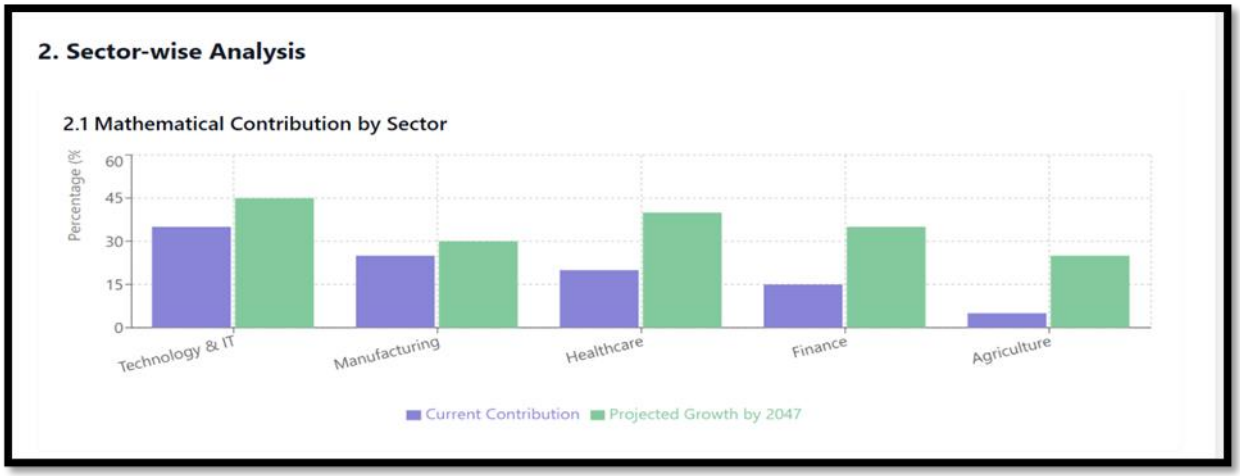
expert interviews across academia, industry, and policy-making institutions.

Table 1: Key Milestones for Viksit Bharat 2047

| Timeline | Focus Area | Mathematical Component |
|---|---|---|
| 2024-2030 | Digital Infrastructure | Cryptography, Network Theory |
| 2030-2037 | AI & Quantum Computing | Linear Algebra, Probability Theory |
| 2037-2047 | Global Innovation Hub | Advanced Mathematical Research |

**Sector-wise Analysis:**

1.Mathematical Contribution by Sector: Technology & IT, Manufacturing, Healthcare, Finance, Agriculture:




2.Technology & IT Sector: Algorithms, Machine Learning, Data Structures, Cryptography

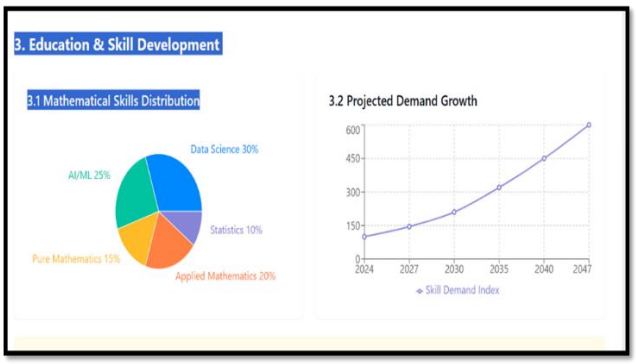
- AI/ML Development
- Cybersecurity Systems
- Blockchain Technology
- Cloud Computing Optimization

3.Healthcare & Biotechnology: Biostatistics, Epidemiological Modeling, Medical Imaging

- Disease Prediction Models
- Drug Discovery Algorithms
- Genomic Data Analysis
- Healthcare Analytics

Table 2: Mathematical Applications Across Sectors

| SECTOR | MATHEMATICAL TOOL | APPLICATION | IMPACT |
|---|---|---|---|
| Finance | Stochastic Calculus | Risk Management | High |
| Manufacturing | Optimization Theory | Supply Chain | Very High |
| Agriculture | Statistical Modeling | Crop Prediction | Medium |
| Energy | Differential Equations | Grid Optimization | High |



3.शैक्षिक सुधार की आवश्यकता (Educational Reforms Needed):

वर्तमान चुनौतियाँ:

- पारंपरिक शिक्षण पद्धति (Traditional teaching methods)
- प्रायोगिक शिक्षा का अभाव (Lack of practical exposure)
- अनुसंधान सुविधाओं की कमी (Limited research facilities)
- उद्योग-शिक्षा संबंध की कमी (Weak industry-academia linkage)

प्रस्तावित समाधान:

- NEP 2020 का प्रभावी कार्यान्वयन (Effective NEP 2020 implementation)
- STEM शिक्षा पर जोर (Focus on STEM education)
- डिजिटल लर्निंग प्लेटफॉर्म (Digital learning platforms)
- उद्योग इंटर्नशिप कार्यक्रम (Industry internship programs)

Table 3: Educational Initiatives for 2047

| Initiative | Target | Timeline | Expected Outcome |
|---|---|---|---|
| Math Excellence Centers | 100 Institutions | 2024-2030 | 50,000 trained researchers |
| Online Math Courses | 10 Million Students | 2024-2027 | Democratized access |
| Industry Partnerships | 500 Companies | 2025-2035 | Applied research boost |
| PhD Scholarships | 10,000 annually | 2024-2047 | Research ecosystem |

**Strategic Recommendations:**

**Policy-Level Interventions:**

- राष्ट्रीय गणितीय मिशन की स्थापना (Establish National Mathematics Mission)
- गणितीय अनुसंधान के लिए बजट में 5x वृद्धि (5x increase in math research budget)
- अंतर्राष्ट्रीय सहयोग को बढ़ावा (Promote international collaborations)

**Academic Interventions:**

- कक्षा 1 से कोडिंग और गणित (Coding and math from Grade 1)
- प्रोजेक्ट-आधारित शिक्षण (Project-based learning approach)
- शिक्षकों के लिए प्रशिक्षण कार्यक्रम (Teacher training programs)

**Industry Engagement:**

- R&D tax incentives for mathematical research
- Industry-sponsored fellowships and scholarships
- Joint research centers between industry and academia

Table 4: Investment Framework for Mathematical Sciences

| Area | Current Investment (₹ Cr) | Proposed 2047 (₹ Cr) | Growth Factor |
|---|---|---|---|
| Research Grants | 500 | 5000 | 10X |
| Infrastructure | 300 | 3500 | 11.6X |
| Scholarships | 200 | 2000 | 10X |
| Faculty Development | 150 | 1500 | 10X |
| Total | 1,150 | 12,000 | 10.4X |

**Conclusion**:

1.निष्कर्ष (Summary): गणितीय विज्ञान विकसित भारत 2047 की आधारशिला है। यह शोध स्पष्ट रूप से दर्शाता है कि आर्टिफिशियल इंटेलिजेंस, क्वांटम कंप्यूटिंग, फिनटेक, और स्वास्थ्य सेवा जैसे महत्वपूर्ण क्षेत्रों में गणित की केंद्रीय भूमिका है।

Mathematical sciences form the cornerstone of Viksit Bharat 2047. This research clearly demonstrates that mathematics plays a central role in critical sectors such as artificial intelligence, quantum computing, fintech, and healthcare. The projected 6x increase in demand for mathematical skills by 2047 underscores the urgent need for comprehensive reforms in education, research infrastructure, and policy frameworks.

| | | |
|---|---|---|
| 10.4X Required Investment Growth | 50,000 New Math Researchers Needed | 35% GDP Contribution from Tech |

**2.Key Findings:**

- गणितीय साक्षरता 21वीं सदी का मूल कौशल है (Mathematical literacy is a fundamental 21st-century skill)
- भारत को वार्षिक 50,000 गणितीय विशेषज्ञों की आवश्यकता होगी (India will need 50,000 mathematical experts annually)
- प्रौद्योगिकी क्षेत्र में गणित का योगदान 35% से अधिक है (Mathematics contributes over 35% to the technology sector)
- समग्र GDP में गणित-आधारित उद्योगों का योगदान $5 ट्रिलियन तक पहुंच सकता है (Math-based industries could contribute up to $5 trillion to GDP)
- 3.Way Forward:विकसित भारत 2047 का सपना तभी साकार हो सकता है जब हम गणितीय शिक्षा और अनुसंधान को राष्ट्रीय प्राथमिकता बनाएं। सरकार, उद्योग, और शैक्षणिक संस्थानों को मिलकर एक समग्र रणनीति बनानी होगी।

The dream of Viksit Bharat 2047 can only be realized when we make mathematical education and research a national priority. Government, industry, and academic institutions must collaborate to create a comprehensive strategy that nurtures mathematical talent, promotes innovation, and positions India as a global leader in mathematical sciences.

4.Call to Action: "Mathematics is not just a subject; it is the language of innovation, the foundation of technology, and the key to India's transformation into a developed nation. Let us invest in mathematical sciences today to build the Viksit Bharat of tomorrow."

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# A Study on Women Empowerment in India

**Dr. Rajesh B. Lahane & Kiran Anil Jangle**

*Research Guide, Professor and Head of Department Deogiri College, Chh.Sambhajinagar*
*Research Scholar, Department of Commerce, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad*

***Corresponding Author – Dr. Rajesh B. Lahane***

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***Abstract:***

*Women's empowerment is essential for the social, economic, and political advancement of any country. In India, the significance of women's empowerment has increased due to rising awareness, broader access to education, government programs, and social reforms. Ensuring the empowerment of women leads to equal opportunities, rights, and involvement in decision-making processes. This research aims to explore the concept, dimensions, status, challenges, and progress of women's empowerment in India. The study is descriptive and relies on secondary data gathered from books, academic journals, reports, and government documents. The findings indicate that while notable advancements have occurred in areas such as education, employment, and legal rights, women still encounter obstacles like gender disparity, restricted decision-making authority, socio-cultural hurdles, and economic reliance.*

***Keywords: Women Empowerment, Gender Equality, Education, India***

## Introduction:

Women's empowerment is essential for the social, economic, and political advancement of any country. In India, the significance of women's empowerment has increased due to rising awareness, broader access to education, government programs, and social reforms. Ensuring the empowerment of women leads to equal opportunities, rights, and involvement in decision-making processes. The empowerment of women has become a significant topic of discussion and focus globally. While we benefit from being citizens of a free nation today, it's essential to consider whether every individual in our country truly experiences freedom in its genuine sense. The inequalities and discrimination faced by women are longstanding issues worldwide. Therefore, the pursuit of equality with men is a universal struggle for women. Women should have the same rights as men in areas such as education, employment, inheritance, marriage, and politics. This research aims to explore the concept, dimensions, status, challenges, and progress of women's empowerment in India. The study is descriptive and relies on secondary data gathered from books, academic journals, reports, and government documents.

## Concept of Women Empowerment:

Women's empowerment refers to the process of providing women with the tools, resources, and rights necessary to take control of their lives, make their own choices, and drive social transformation, going beyond simple equality to break down patriarchal systems for complete self-determination across all areas of life (social, economic, political). It encompasses the enhancement of self-esteem, ensuring equitable access to opportunities (education,

healthcare, finance), and the eradication of gender-based violence and discrimination, allowing women to achieve their full potential as equal contributors within society. Women's empowerment can be understood in various ways, such as acknowledging women's perspectives, striving to hear them, and enhancing the status of women through education, awareness, literacy, equal rights in society, improved livelihoods, and training. Empowering women enables them to make crucial decisions in the face of societal challenges. This can provide them with the chance to redefine gender roles or other roles, granting them greater freedom to pursue their desired objectives.

**Objectives**:

The main objectives of the study are:

1. To understand the concept of women empowerment.
2. To study the role of education in empowering women.

**Review Of Literature:**

Women empowerment has been widely discussed by researchers and social thinkers.

**Kabeer (1999)** defined women empowerment as the ability to make strategic life choices in situations where such ability was previously denied. She emphasized the importance of resources, agency, and achievements in empowerment.

**Sen (2001)** highlighted the role of freedom and capability in development and argued that empowering women enhances overall human development. Desai and Thakkar (2007) found that education significantly improves women's social status and decision-making power within the family.

**Malhotra, Schuler, and Boender (2002)** identified economic independence as a key determinant of women empowerment. Recent studies suggest that employment, access to financial resources, and participation in self-help groups positively influence women's empowerment, particularly in rural areas.

**Research Methodology**:

The current research is descriptive and relies on secondary data. Information has been gathered from:

- Books on women's studies and sociology
- National and international scholarly journals
- Reports and publications from the government

**Dimensions of Women Empowerment:**

Women empowerment is a complex concept with various facets:

**1. Economic Empowerment:** Economic empowerment pertains to women's access to financial resources, including income and job opportunities. It allows women to gain financial independence and decreases their reliance on others.

**2.Social Empowerment:** Social empowerment aims at enhancing women's position in society by eradicating discrimination, fostering equality, and guaranteeing dignity and respect.

**3. Political Empowerment:** Political empowerment guarantees the involvement of women in political and decision-making activities. The reservation of seats for women in local governance has enhanced their representation in politics.

**4. Educational Empowerment:** Educational empowerment equips women with the essential knowledge, skills, and awareness to make informed choices and enhance their quality of life.

**Role of Education in Women Empowerment:**

Women's education in India is crucial for the nation's overall progress. It contributes to the

development of half of the human resources and enhances the quality of life both at home and in the community. According to M. Phule, "Education is the tool that reveals the distinction between what is right and what is wrong." When we reflect on this definition, it becomes clear that all the revolutions throughout our history are fundamentally rooted in education. Education involves changing behavior in various aspects, such as mindset, perspective, and attitude. Educated women not only encourage the education of their daughters but also offer better guidance to all their children. Additionally, educated women can contribute to lowering the infant mortality rate and controlling population growth. Women empowerment through education Women empowerment is the pivotal part in any society, state or country. It is a woman who plays a dominant role in the basic life of a child. Women are an important section of our society. Education as means of empowerment of women can bring about a positive attitudinal change. It is therefore, crucial for the socioeconomic and political progress of India. The Constitution of India empowers the state to adopt affirmative measures for prompting ways and means to empower women. Education significantly makes difference in the lives of women. Education is the most powerful tool for empowering women. Educated women are more aware of their rights and responsibilities. Education enhances employment opportunities, improves health awareness, and promotes confidence and independence. Female education contributes to reduced poverty, lower infant mortality, and improved family welfare. Government initiatives such as Beti Bachao Beti Padhao focus on promoting education among girls.

**Government Initiatives for Women Empowerment in India:**

The Government of India has launched several schemes to promote women empowerment, such as:

- Beti Bachao Beti Padhao
- Mahila Shakti Kendra
- Ujjwala Yojana
- Self Help Groups (SHGs)
- Sukanya Samriddhi Yojana

These initiatives aim to improve education, health, safety, and employment opportunities for women.

**Obstacles to Women's Empowerment:**

Despite advancements, women still encounter numerous obstacles:

1. Discrimination based on gender
2. Violence in the home
3. Restricted opportunities for education
4. Joblessness and pay disparity
5. Cultural and societal hindrances
6. Insufficient knowledge about their rights
7. Traditional norms and
8. Patriarchal perspectives continue to be significant challenges to women's empowerment.

**Study Results:**

The research indicates that: education play a crucial role in empowering women. Government programs have raised awareness levels among women.

**Conclusion**:

Empowering women is crucial for fostering inclusive growth and achieving sustainable development. When women are empowered, it results in enhanced family welfare, economic advancement, and social stability. While India has made notable strides, ongoing initiatives from the government, community, and

individuals are necessary to attain genuine gender equality. Enhancing education will guarantee lasting women empowerment.

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# Linguistic Trauma as a Marker of Oppression in "Poisoned Bread": An Analysis of Speech Breakdown, Hesitation, and Damaged Language

**Mr. Sampat. G. Salunke[1] & Dr Kamalkishor K. Ladda[2]**

[1]*Research Scholar, Dr. BAMU University, Chh. Sambhajinagar*

[2]*Asst.professor , Dept. Of English, Shri Siddheshwar Mahavidyala Majalgaon, dist. Beed*

***Corresponding Author – Mr. Sampat. G. Salunke***

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***Abstract:***

*The way people express themselves through language is an important aspect of who they are, their cultural traditions, and the ways they interact with each other as individuals and as members of society; yet language can also be used to reflect and enforce the power relationships that exist within societies. When a society's elite, or those holding the most power in that society, choose to establish a single form of language for everyone to use, all other forms of language become less valued and the people of marginalized groups (who have historically been denied access to power) are frequently forced to give up using their own native languages, thereby giving up aspects of their heritage and their ability to develop and maintain a sense of self. The psychological damage caused by this suppression of language is apparent in such things as stuttering, broken speech, and difficulty articulating one's thoughts and feelings, which signal a deeper psychological disturbance. In the case of the poem "Poisoned Bread," the authors demonstrate this process clearly, particularly in Madhav's "The Poisoned Bread" which illustrates caste oppression through the enforced silence and damaged language of the oppressed. This paper will focus on how broken speech demonstrates trauma, affects mental health, and provides a site at which Dalits may resist and challenge the dominance of their oppressors' language.*

***Keywords: Trauma, Oppression, Breakdown, Power.***

**Conceptual Background of the Study:**

Language has always been connected to power, and the way dominant groups use language creates and maintains social order by limiting the ability of marginalized groups to express their ideas. Subaltern expression has been increasingly devalued as an instrument of social control people have been made silent for generations by fear of punishment and violence. Suppressing native languages can lead to loss of both voice and identity and culture; as well as memories of community, resulting in long-term damage to individuals and communities. The suppression of native languages, particularly in relation to traumatic events such as forced relocation or genocide, results in what some researchers call "linguistic trauma," which manifests itself through symptoms such as hesitation, stuttering and disrupted speech all of which are indicative of a psychological injury, not merely physical defect. For this reason, Dalit writers write using forms of language that are unacceptable within elite writing circles (non-standard language and regional idioms) as a form of active resistance against the norms that have created so much pain in their lives. By adopting these forms of language, Dalit writers create a new literary tradition that expresses suffering, anger, and lived experiences.

**Context of the Selected Text:**

Caste discrimination has structured Indian society through its placement of Dalits at the bottom of the social hierarchy and through continued exclusion, violence, and dehumanization of Dalits in their social, economic, and cultural lives. The pervasiveness of caste discrimination is described by Shukul and Tumanov when they state, "The Indian caste system, a historically entrenched institution, has facilitated the creation and maintenance of distinct and segregated spaces, structuring society along axes of caste, cuisine, gender, language, region, religion, and tribe… legitimizing systemic discrimination and the denial of equal access to dignity, education, healthcare, justice, power, prestige, and wealth" (Shukul & Tumanov 26). Dalit stories are testaments of suffering that counteract dominant historical accounts; thus, Arjun Dangle's Poisoned Bread can be seen as a foundational work within this tradition that presents Dalit writing as a form of protest and a call for social change. In this context, Bandhu Madhav's "The Poisoned Bread," serves as an allegory of caste oppression and demonstrates how exploitation defines daily struggle for survival, dignity and early resistance in the lives of Dalits. Dalit stories are testaments of suffering that counteract dominant historical accounts; thus, Arjun Dangle's Poisoned Bread can be seen as a foundational work within this tradition that presents Dalit writing as a form of protest and a call for social change. In this context, Bandhu Madhav's "The Poisoned Bread," serves as an allegory of caste oppression and demonstrates how exploitation defines daily struggle for survival, dignity and early resistance in the lives of Dalits.

**Analysis of Linguistic Trauma in the Text:**

**1.Enforced Silence:**

When extreme forms of oppression exist such as India's Caste System, an oppressive environment will create fear of authority for Dalits. The result is a complete and total silence in all aspects of an individual's communication and overall life. In order to avoid the consequences (social exclusion, physical violence, loss of employment) of complaining, explaining one's pain, or speaking freely; the oppressed internalizes the suffering and thus remains silent. The silencing of the voice of Dalits comes from thousands of years of structural hierarchy and has placed Dalit at the periphery and discredited their voice with rituals of purity and pollution. As K. Suneetha Rani observes, "The pervasive threat associated with speaking out compels individuals to adopt a stance of silence, making their voices unheard and their experiences invisible to the dominant society" (Rani 91). Silence has become an inherent part of oppression for the Dalit class, and this silence is a symptom of a broader dehumanization that removes individuals from their role in society, taking away their dignity and ability to participate in public. The family's labour, through silently poisoning the food they prepare, demonstrates how forced silence affects one's inner being and causes them to lose all sense of self, making it easy to erase human experience.

The silence of Dalits can be viewed as a result of a variety of factors that are rooted in the caste system. One of the most important is the nature of the relationship between the dalit community and the state. Historically, the Indian State has been reluctant to recognize the rights of the dalit community as a separate entity deserving of protection from discrimination. For example, the caste system was never explicitly mentioned in the Constitution of India. Instead, it was

relegated to the status of a "social evil" that needed to be eliminated in order to create a truly democratic and egalitarian society. This omission has led many scholars to argue that the Indian State has failed to address the issue of caste oppression, despite numerous legal and political initiatives designed to promote equality.

**2. Enforced Silence and the Dominant Narrative:**

In addition to the failure of the Indian State to protect the rights of the dalit community, there have been other factors that have contributed to the silence of dalits. One of the primary ways in which the dominant group exercises control over the dalit community is through the use of silence. This is not just a matter of physical silence; rather, it is a form of what Foucault calls "disciplinary silence." Disciplinary silence refers to the ways in which institutions and systems of domination exercise control over subordinated populations through the creation of rules, norms and expectations that dictate how members of these communities should behave. In the case of the dalit community, the use of disciplinary silence has been particularly effective because it has created a sense of shame and self-blame within the community. Many dalits view their own poverty, illiteracy, and low status as a reflection of their own moral failing rather than as the result of systemic oppression. This creates a culture of silence in which dalits do not speak out against injustice and instead accept their fate as inevitable.

**Speech Breakdown and Hesitation:**

**1. Broken Articulation and Evasive Speech:**

Broken articulation and evasive speech can provide evidence of oppression through the way language is used; people who experience prolonged oppression may have difficulties forming the words to speak clearly; therefore, they will use hesitating speech to get out what they want to say, leaving many parts of sentences uncompleted which indicates the mental weight that these individuals carry that prevents them from communicating in a clear manner. The verbal expression of these individuals may include long pauses, repetition of themselves, and using roundabout ways of saying something (circumlocution) that demonstrate the internal conflict that the individual has in trying to communicate experiences that are either so painful that they cannot talk about them directly or if they are too dangerous to communicate directly. This becomes apparent when individuals are bombarded with questions regarding their status, resulting in a sense of helpless confusion. For instance, in one instance, when questioned repeatedly about their employment, the individual could only "simply grunt in agreement, feeling awkward as [they] did so. But beggars can't be choosers" (Dangle 271), demonstrating a speech pattern reduced to minimal, evasive responses under social pressure.

**2. Psychological Pressure Behind Disrupted Language:**

The extreme psychological pressure caused by the long-term oppression, is one major reason why people's ability to speak normally has been disrupted. People who are constantly afraid they will be judged, punished, or misunderstood (even if it's just a misinterpretation), will self-censor or speak as ambiguously as possible in an effort to mask their real feelings and thoughts. Thus, the struggle within an individual for a need to express oneself, versus the perceived risk of doing so, leads to fractured speech (just like their fractured mind). Constant awareness of their position as a subordinate can turn every normal conversation into an experience filled with anxiety, ultimately causing them to exhibit linguistic behavior that reflects both the degree of their emotional pain and their vulnerability. The

severe internal suffering that occurs due to condescending remarks, even though those exact words were ordinary, exemplifies the pressure where "The meaning conveyed by the tone in which they are said torments me in many different ways!" (Dangle 186), revealing the scorching pain inflicted on one's soul through language.

The interaction between the oppressor and the oppressed (and in turn the internalized and externalized psychological states) can affect not only what is spoken, but also how it is spoken, and whether it is spoken at all. In other words, the fractured, stuttering way that the oppressed may articulate themselves (e.g., broken articulation and hesitation), is more than just surface level speech impediments, and are signs of deep psychological injuries and fractures caused by the same systems that oppress them. Therefore, these language-based expressions are some of the most powerful examples of a fractured identity and a damaged psyche and reflect the ongoing battle for survival that occurs as a result of living under a system of oppression and reflects the internal conflict that exists between the outer world and the inner world of the individual. It is especially evident when people are socialized to be as quiet as possible through training such as teaching someone to only speak when directly addressed and responding with minimal responses, which illustrates the extent of damage that oppression has had on the ability of humans to communicate and define themselves.

**3.Damaged and Sub-Standard Language:**

**Rough Diction and Colloquial Speech:**

The language utilized by marginalized characters frequently departs from standard or "refined" linguistic forms, instead employing rough diction, regional dialects, and colloquial speech. This deliberate use of non-standard language directly reflects their social and educational exclusion, yet simultaneously serves as an authentic expression of their cultural identity and lived reality. Such linguistic choices impart a rawness and immediacy often absent in formal language, effectively bringing the unfiltered experiences of those on the margins to the forefront. This linguistic approach also challenges the ingrained notion of a singular, superior linguistic standard, thereby affirming the inherent validity of diverse forms of communication. As one scholar observes, "Dalit autobiographers have used the vocabulary of the Mahars and the Mangs to define a world foreign to the experience of most of literature... The crude language the openness is also an integral part of Dalit culture" (Sarode 74).

**Language as a Sign of Deprivation and Resistance:**

The use of this dialect is an act of resistance, in addition to signaling social disadvantage. It is a conscious choice to use a language that is deemed 'unacceptable' or 'in polite society', by the dominant culture. As such it is a rejection of socially imposed linguistic standards and the assertion of the individual's own choices with regards to language. The use of a standard language is seen as a means of rejecting imposed cultural and societal norms; therefore, the use of dialectical forms of speech are used as a means of identifying one's self as being outside of mainstream culture and as a form of protest against the culture that wishes to suppress the use of dialects. Therefore, the use of this dialect provides a mechanism for expressing deep feelings of anger and frustration as well as solidarity which can be seen as providing a unifying force within communities that share similar experiences and language use. This revolutionary aspect is highlighted by Limbale, who writes that "The reality of Dalit literature is distinct, and so is the language of this reality. It is the uncouth-impolite language of Dalits. It is the spoken language of Dalits. This language does

not recognize cultivated gesture and grammar" (MOHANTY & PANIGRAHI 157).

Dalit Literature, in the way that it defines Indian literature through distinct ways of using language, completely transforms the definition and the boundaries of what is meant by "Indian literature". Dalit literature challenges the established aesthetic of Indian literature and brings forward voices and experiences that have historically been marginalized from the dominant cultural narrative of India. Dalit Literature's transformation is more than simply an expansion of the field to include voices and experiences that were previously excluded; Dalit literature is transforming the values that are used to evaluate literature and the ways that art is created. Dalit literature uses non-standard dialects and subverts traditional forms of writing to create a new space for Dalit voices in the realm of literature. This powerful re-articulation demonstrates how "Dalit literature, as well as Dalit studies, does much to reconfigure what 'Indian literature' is. Whether it be using non-standard dialect, or directly subverting classical forms, Dalit literature challenges the ideas of Indian literature in radical ways, creating its own space in the literary world" (Bilton 12). Through these linguistic strategies, Dalit writers not only narrate their suffering but also actively participate in constructing a new literary and social reality.

**Language, Identity and Oppression:**

Linguistic oppression leads to an erosion of self-worth and voice through the repeated devaluation of the language used by an individual. Repeatedly devaluing a person's speech erodes the confidence of the speaker, causes them to hesitate to communicate, and ultimately, causes the speaker to experience shame for their own expression. Linguistic oppression therefore results in the loss of both the ability to communicate effectively (silencing) and the respect for oneself and one's ability to act upon their own desires. The disruption of speech and hesitation in contexts of linguistic trauma are not merely indicative of surface-level difficulties with communicating; they are indicators of deep-seated psychological harm and a fractured sense of self. Broken articulation is a result of an ongoing struggle to survive in oppressive structures. As a result, in "The Poisoned Bread" and in many other Dalit narratives, language serves as a clear indicator of caste injuries, which can be identified by a person's diction, grammar, or silence. Non-standard speech in these cases reveals the ways in which individuals experience discrimination on a daily basis. At the same time, however, non-standard speech and the memories and experiences that accompany it are part of what create the collective memory of suffering and resilience from which Dalits develop their identities.

**Resistance and Limited Agency:**

It is through speaking out for themselves as acts of defiance by marginalized people; through the assertion of their own voices, refusal to be silent, and/or the use of language to resist and challenge the injustices they suffer from; they are able to take back their agency and challenge the inequalities of the dominant power structures. Writing and storytelling also serve as a major means of recovering the lives of those who have been silenced, and transforming individual suffering into a collective memory, and thus creating a sense of self and identity outside of the gaze of the oppressors. However, resistance through language has limitations; the dominant linguistic norms are still very powerful, and continue to create and sustain inequality, often labelling speech patterns that do not fit within those norms as deviant. The affirmation of one's identity and dignity through resistance via language will need to continually work against

the entrenched social hierarchies that limit its ability to bring about transformation.

**Conclusion:**

This study has explored how linguistic trauma functions as a critical marker of oppression within Bandhu Madhav's "The Poisoned Bread." It has highlighted that enforced silence, speech breakdown, hesitation, and the use of damaged or non-standard language are not merely stylistic choices but profound indicators of the psychological and social impact of systemic oppression. These linguistic manifestations reveal the deep-seated fear, diminished dignity, and fragmented identity experienced by marginalized individuals. Furthermore, the paper examined how Dalit literature leverages distinct linguistic forms to express both suffering and resistance, transforming language into a site of struggle and defiance.

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# Nanotechnology for Energy and Environmental Solutions: An Integrative Research Framework

**Dr. Sunita Bhaskar**

*Pt. Deendayal Upadhyaya Rajkiya Mahila Mahavidyalaya, Farah, Mathura Dr. Bhimrao Ambedkar University, Agra*

***Corresponding Author – Dr. Sunita Bhaskar***

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***Abstract:***

*The accelerating demand for energy and the escalating severity of environmental degradation represent two interlinked global challenges that conventional technologies increasingly fail to address in a sustainable manner. Nanotechnology, defined by the manipulation of materials at the nanoscale to achieve size-dependent properties, has emerged as a promising interdisciplinary approach capable of transforming both energy systems and environmental remediation strategies. This paper presents a comprehensive and conceptually original academic analysis of nanotechnology-driven solutions for energy generation, storage, efficiency enhancement, and environmental protection. Rather than cataloguing existing applications, the study synthesises theoretical principles, technological mechanisms, and system-level implications to identify how nanomaterials fundamentally alter performance boundaries of conventional technologies. Using a qualitative, theory-driven research design, the paper evaluates dominant research themes, identifies structural and ethical gaps, and proposes an integrative framework linking energy innovation with environmental sustainability. Expected outcomes suggest that nanotechnology enables efficiency gains and multifunctionality unattainable through bulk materials, yet simultaneously introduces governance, scalability, and ecological risk concerns that remain insufficiently addressed in current literature. The study contributes to academic discourse by articulating a balanced, systems-oriented perspective and offers actionable insights for policymakers, researchers, and industry stakeholders seeking responsible innovation pathways. The findings underscore that nanotechnology is not a standalone solution, but a catalytic enabler whose societal value depends on interdisciplinary integration, regulatory foresight, and lifecycle-based evaluation.*

***Keywords: Nanotechnology; Sustainable Energy; Environmental Remediation; Nanomaterials; Clean Technology; Energy Systems; Environmental Risk***

## Introduction:

Global development trajectories over the past century have been characterised by rapid industrialisation, urbanisation, and technological expansion, all of which are heavily dependent on energy-intensive processes. Simultaneously, these trajectories have contributed to widespread environmental challenges, including climate change, air and water pollution, ecosystem degradation, and resource depletion. Traditional energy technologies—largely based on fossil fuels—have proven effective in meeting short-term economic demands but are increasingly incompatible with long-term environmental sustainability **(Rosen & Dincer, 2001).**

Nanotechnology has emerged as a scientific domain capable of redefining material behaviour by exploiting phenomena that arise at the nanoscale, typically below 100 nanometres **(Binns, 2010).** At this scale, materials exhibit altered electrical, optical, chemical, and mechanical properties due to quantum effects and

increased surface-to-volume ratios. These characteristics provide opportunities to enhance energy conversion efficiency, reduce material consumption, and enable novel environmental remediation mechanisms **(Roco, 2011).**

The relevance of nanotechnology to energy and environmental domains lies not merely in incremental performance improvements, but in its potential to reshape system architectures. For example, nanoscale catalysts can alter reaction pathways, nanostructured electrodes can increase energy storage density, and nanomembranes can selectively filter pollutants with high precision **(Kamat & Meisel, 2011)**. Such transformations suggest that nanotechnology may function as a foundational enabler of sustainable technological transitions.

**Problem Statement:**

Despite extensive research activity and growing investment, the real-world impact of nanotechnology on energy sustainability and environmental protection remains uneven and fragmented **(Meyer, 2012)**. Many proposed nanotechnological solutions demonstrate high performance under laboratory conditions but encounter barriers related to scalability, cost, long-term stability, and environmental safety when deployed beyond controlled settings. Furthermore, research efforts often treat energy and environmental applications as separate domains, overlooking their systemic interdependence **(Savage et al., 2015).**

Another critical issue is the imbalance between technological optimism and risk assessment. While nanomaterials are promoted for their superior efficiency, comparatively less attention is given to their potential ecological persistence, toxicity, and unintended interactions within natural systems **(Nel et al., 2006).** This asymmetry creates uncertainty regarding the net sustainability of nanotechnology-enabled solutions.

**Research Gap:**

Existing literature predominantly focuses on application-specific advancements, such as nanomaterials for solar cells or nanoparticle-based water purification, without integrating these developments into a coherent sustainability framework **(Karn & Wong, 2013).** There is a lack of holistic analyses that simultaneously consider energy performance, environmental impact, lifecycle implications, and governance challenges.

Moreover, many studies emphasise technical metrics while underexploring conceptual questions related to systems integration, ethical responsibility, and long-term ecological compatibility **(Robichaud et al., 2005).** This gap limits the ability of policymakers and industry leaders to make informed decisions regarding large-scale adoption.

**Objectives of the Study:**

The primary objectives of this research are:

1. To synthesise existing theoretical and applied knowledge on nanotechnology for energy and environmental solutions.
2. To identify conceptual and structural gaps in current research approaches.
3. To develop an integrative analytical framework linking energy innovation with environmental sustainability.
4. To assess expected outcomes and limitations of nanotechnology-driven solutions.
5. To propose future research directions that support responsible and scalable implementation.

**Literature Review:**

**1.Thematic Analysis of Existing Research:**

- **Nanotechnology in Energy Generation:** Research on nanotechnology for energy generation has primarily focused on renewable sources, particularly solar and hydrogen-based systems. Nanostructured photovoltaic materials are studied for their ability to enhance light absorption, reduce recombination losses, and enable flexible device architectures **(Grzelczak et al., 2010).** Similarly, nanocatalysts are explored for water splitting and hydrogen production due to their high surface activity and tunable reaction sites **(Lewis & Nocera, 2006).**

  The dominant theme in this body of work is efficiency enhancement. Researchers argue that nanoscale engineering allows more precise control over charge transport and reaction kinetics than bulk materials **(Hoffmann et al., 2007)**. However, these studies often remain confined to experimental demonstrations, with limited discussion of manufacturing scalability or material availability.

- **Nanotechnology in Energy Storage and Efficiency:** Energy storage technologies, including batteries and supercapacitors, represent another major research theme. Nanomaterials are investigated for electrode design, where increased surface area and reduced diffusion lengths theoretically enable higher energy density and faster charging **(Aricò et al., 2005).**

  In parallel, nanotechnology is applied to energy efficiency improvements, such as thermal insulation using nanoporous materials and tribological coatings that reduce mechanical friction **(Baetens et al., 2011).** These applications highlight the versatility of nanotechnology across diverse energy-related functions.

- **Nanotechnology for Environmental Remediation:** Environmental applications focus on pollution detection, treatment, and prevention. Nanoparticles are used as adsorbents for heavy metals, organic contaminants, and emerging pollutants, while nanomembranes are developed for water desalination and purification **(Qu et al., 2013).**

  A recurring theme is selectivity: nanoscale materials can be engineered to target specific contaminants. While this precision is advantageous, concerns persist regarding the fate of nanomaterials after deployment, particularly in open environmental systems **(Lowry et al., 2012).**

**2.Identification of Gaps:**

The literature reveals several persistent gaps:

- **Fragmentation:** Energy and environmental applications are studied in isolation, despite their interdependence **(Gavankar et al., 2012)**.
- **Lifecycle Blindness:** Limited attention is paid to the full lifecycle of nanomaterials, from synthesis to disposal **(Wiesner et al., 2009)**.
- **Governance Deficit:** Regulatory and ethical considerations lag behind technological development **(Maynard, 2007)**.
- **Scalability Uncertainty:** Few studies address economic and infrastructural feasibility at scale **(Cannon et al., 2009).**

**Research Questions / Hypotheses:**

Based on the identified gaps, the study is guided by the following research questions:

1. How does nanotechnology fundamentally alter the performance boundaries of energy and environmental systems?
2. What conceptual frameworks are required to integrate energy and environmental applications of nanotechnology?

3. What limitations constrain the sustainable deployment of nanotechnology-based solutions?

Given the qualitative nature of the study, the following hypothesis is proposed:

Nanotechnology enhances energy and environmental system performance through nanoscale effects, but its sustainability depends on integrated lifecycle assessment and governance mechanisms.

**Research Methodology:**

1. **Research Design:** This study adopts a qualitative, conceptual research design grounded in integrative literature synthesis and analytical reasoning. Rather than empirical experimentation, the focus is on theory-building and critical evaluation of existing knowledge **(Torraco, 2005)**.
2. **Data Collection Methods:** Data is collected through systematic review of peer-reviewed journals, authoritative academic books, and policy reports related to nanotechnology, energy systems, and environmental science.
3. **Sampling Technique:** Purposive sampling is employed to select sources that are conceptually influential and widely cited within the academic community. The emphasis is on foundational theories and representative applications rather than exhaustive coverage **(Palinkas et al., 2015).**
4. **Tools and Techniques:** Content analysis and thematic synthesis are used to extract recurring concepts, assumptions, and arguments **(Braun & Clarke, 2006).** Comparative reasoning is applied to identify convergences and divergences across disciplines.
5. **Data Analysis Approach:** The analysis follows an inductive approach, moving from specific thematic observations to broader conceptual insights. Logical reasoning is used to evaluate internal consistency and theoretical coherence.

**Findings / Expected Outcomes:**

The analysis indicates that nanotechnology enables:

**1. Multifunctionality:** Single materials performing multiple roles, such as energy conversion and pollutant degradation **(Wang et al., 2012).**

**2. Efficiency Gains:** Enhanced reaction kinetics and transport properties **(Liu & Chen, 2013)**.

**3. Material Reduction:** Lower resource consumption due to high activity per unit mass **(Dahl et al., 2007).**

However, these benefits are contingent upon system-level integration and risk management **(Fthenakis, 2009).**

**Discussion:**

**1.Interpretation of Findings:** The findings suggest that nanotechnology functions less as a discrete solution and more as an enabling platform. Its true value emerges when embedded within broader technological and institutional systems **(Renn & Roco, 2006).**

**2.Comparison with Existing Theories:** Traditional sustainability theories emphasise efficiency and subsitution. Nanotechnology aligns with these theories but extends them by introducing scale-dependent phenomena that challenge conventional engineering assumptions **(Geiser, 2001).**

**Implications:**

**1.Academic Implications:** The study highlights the need for interdisciplinary frameworks that bridge material science, environmental studies, and policy research **(Schwarz & Thompson, 1990).**

**2.Practical / Industry Implications:** Industries must move beyond performance metrics and

incorporate lifecycle and risk considerations into product development **(Lüth et al., 2012).**

**Limitations of the Study:**

The study is limited by its conceptual nature and reliance on secondary sources. Empirical validation of proposed frameworks remains necessary.

**Future Scope of Research:**

Future research should focus on long-term ecological impact assessment, scalable manufacturing techniques, and adaptive regulatory models **(Hodge et al., 2010).**

**Conclusion:**

Nanotechnology holds transformative potential for addressing intertwined energy and environmental challenges. However, its effectiveness depends not only on technical innovation but also on responsible integration within social, economic, and ecological systems **(Barben et al., 2008).** A balanced, systems-oriented approach is essential to ensure that nanoscale solutions contribute meaningfully to sustainable development rather than introducing new forms of risk.

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# Entrepreneurship, Start-ups, and MSMEs: Catalysts for Inclusive Growth, Economic Development, and Employment Generation in India

**Amena Khatoon**

*Asst. Professor, Department of Commerce, Little Flower Degree College, Uppal, Hyderabad*

***Corresponding Author – Amena Khatoon***

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***Abstract:***

*Within a developing nation, India, entrepreneurship, start-up businesses, and micro, small, and medium enterprises play an integral role in creating a robust economic society while providing significant levels of employment. Aligning with India's long-term plan of achieving Viksit Bharat, the importance of entrepreneurship, start-ups, and MSMEs as engines for growth, innovation, and socio-economic transformation continues to be recognised. Entrepreneurial activities encourage innovative thinking and promote new ideas, while startup firms offer scalable technology-based business solutions. Meanwhile, MSMEs provide industrial output, export revenues, and regional balance.*

*This paper will examine the contribution of entrepreneurship, start-up business, and MSMEs to India's economic growth and job creation and the challenges facing each category. In addition, this research paper will analyse the Government's Policy Frameworks and their effectiveness in developing the entrepreneurial ecosystem. The Research methodology used will be descriptive and analytical; data will be drawn from secondary sources including the Government Reports; Policy Documents; National Surveys; Academic Publications.*

*In a Study, the study reported that entrepreneurship, start-ups and MSMEs have consumed a large amount of computing, creating new jobs, particularly for young people and women, and have supported innovation and inclusive growth. In fact, MSMEs have been able to absorb a large labor force due to their labor-intensive nature, especially in rural and semi-urban areas (Mohamed 2009). Startups have been able to produce greater productivity and develop technologies through innovation-led business models. On the other hand, the study identified some of the persistent challenges, such as lack of access to finance, regulatory complexities, lack of infrastructure, skills mismatch, and non-recoverable digital infrastructure.*

*The study concludes that despite the Government of India (GOI ) creating a supportive environment for the development of enterprises, additional strengthening of policy is needed. In order to maintain growth, there must be an increased level of access to finance/credit, support for specific skill development, simpler regulatory requirements, Access to physical (digital and physical) infrastructure to maintain an entrepreneurial ecosystem. Therefore, the development of the Entrepreneurial Infrastructure will contribute to producing jobs, providing inclusive economic growth, and developing & achieving a Viksit Bharat.*

***Keywords: Entrepreneurship – Startups – MSME – Employment Generation – Economic Growth***

## Introduction:

The concept of entrepreneurship and supporting the growth of small businesses is widely seen as one of the key factors driving economic development, innovative activity and job creation in both advanced and emerging economies, including India. The entrepreneurial activity of start-ups combined with that of MSMEs has become an important driver for the economy, job creation and regional development. India's large and youthful population means that converting India's demographic potential into

long-term sustainable economic growth will require a strong focus on harnessing entrepreneurial talent.

The term 'Entrepreneurship' is defined as an individual's ability and desire to seek out and act upon opportunities, take risks, and establish a company that produces value. Start-ups are generally defined as new businesses that provide innovative ideas and have the potential for significant growth. Most start-ups can be found in technology-related (fast-growing) industries. Small businesses classified as MSMEs are further differentiated based on their size, investment and turnover. The company's classification will determine the company's requirements for investment and level of investment when applying for loans and financial services.

MSMEs represent a broad group of businesses, including service providers, manufacturers and retailers. These companies together contribute to the overall diversity, productivity and labour market access of the economy.

This paper investigates the role of entrepreneurship, start-ups, and MSMEs in driving economic growth and employment in India, examines the challenges these sectors face, and provides policy recommendations to enhance their effectiveness in the national growth narrative.

**Literature Review:**

1. This article provides an excellent summary of various initiatives taken by the government to promote entrepreneurship, innovation and inclusive growth in India. It also gives a breakdown of the opportunities, challenges and possible ways to assist start-ups and micro, small and medium enterprises (MSMEs) from different backgrounds and those that are less frequently represented. (Rao, B. A. et al. (2017)
2. The article identified and classified innovative start-ups (ISs) from various perspectives using an exhaustive literature search and placed them within a broader subset of MSMEs. This conceptual framework will assist policymakers and other stakeholders in developing targeted interventions for ISs and reducing their exposure to risk. (Krishnan, S et al. (2020)
3. One can quickly assess the degree to which the abstract clearly identifies Small and Medium Enterprises (SMEs) as major contributors of both the employment opportunities people in the surrounding communities need to sustain them and assist with providing these opportunities through indirect and less direct means. The abstract demonstrates how the Start-up India initiative creates an environment for new business activity, fostering innovation and providing jobs to new generations. (Manikandan, S. (2021)
4. This abstract connects the elements of entrepreneurship, and by extension, skills relating to entrepreneurship, with the success of an organization in Industry 5.0 through innovative structures. Additionally, the framework presented serves as an all-inclusive reference to the essential elements of entrepreneurship, designed to support the development of new businesses and micro, small and medium enterprises (MSMEs) in their progression to becoming vibrant organisations. (Jamil, M. I. M. (2023).
5. The summary highlights how critical SMEs are for India's economy and job production, industrialization, and export contribution, as well as their potential to facilitate Inclusive Growth. The Summary also shows how the government has been working to facilitate growth and expansion of the SME sector. (Behera, B. (2015).

**The Contribution of Start-Ups, Entrepreneurship, and MSMEs to the Economic Growth of India:**

1. **Contribution to GDP and Industrial Output:** In India, MSMEs (Micro, Small, and Medium Enterprises) help contribute substantially to India's GDP through the diversity of their business types (Manufacturing, Service and Trading), thereby reinforcing economic diversification throughout the country. In addition to promoting economic diversification within each State, MSMEs also promote economic advancement between both rural and urban areas. This is accomplished through the physical location of each MSME expanding to all regions within the country. Start-Ups, while not as numerous as the MSME category, contribute to our economy's higher-value industries—e.g., Information Technology, FinTech, E-commerce, and Renewable Energy. Through innovation, start-ups promote competitive market growth and higher productivity, promoting overall economic output.
2. **Employment Generation:** One of the primary ways MSMEs and entrepreneurship help strengthen a nation's economy is through job creation. The MSMEs are a labor-intensive group of businesses while employing a larger number of semi- and unskilled workers. In addition to jobs in the MSME category of businesses, as MSMEs scale, Start-Ups are developing specialized job functions requiring analytical, technical, and managerial skills, thus expanding the skill set of the labor market. Since India has a large young population, these employment opportunities provide youth with both job opportunities and leadership experiences. Entrepreneurship gives youth jobs, leadership experience, and participation opportunities in high-growth businesses.
3. **Startups and Competitiveness:** Innovative startups are redefining business models by using disruptive innovations. They are using technology in conjunction with new business models to disrupt established industries and create entirely new ones. Micro, Small and Medium Enterprises (MSMEs) also use technology to produce products and add value through incremental innovation. The level of innovation that occurs as a result of entrepreneurship and the growth of MSMEs creates healthy competition and increases efficiency in the economy.
4. **Promoting Inclusive Development**: The growth of MSMEs and entrepreneurship is interconnected and contributes to the development of communities across geographic and social barriers. MSMEs and entrepreneurs create job opportunities and develop economic activity in rural and semi-urban areas where larger corporations may be limited in their reach. Furthermore, as MSMEs grow and prosper, they contribute to generating local economic activities that reduce the pressures of urban migration.
5. **The Growth of the Entrepreneurial Ecosystem:** In the last decade, the entrepreneurial ecosystem has matured and grown rapidly due to many contributing factors, including government support, increased internet penetration, increased availability of venture capital, and the emergence of a strong culture of entrepreneurship in India. India is home to thousands of registered startups, including several unicorns (companies that are valued over USD 1 billion) and a significant number of companies with a valuation of less than USD 1 billion. The technology sector, including fintech, healthtech, edtech, and

agritech, is a key driver of startup creation. All of these sectors are consistent with global trends and also correspond to many of the priorities of the Indian government. As such, India is a very attractive place for innovation-driven entrepreneurs.

6. **The Importance and Role of Micro, Small & Medium Enterprises (MSMEs):** In India, the Importance and Role of Micro, Small & Medium Enterprises (MSMEs) has been recognized as an essential component of the Country's Economic System. MSMEs are an important contributor to Manufacturing Production and Exports within the country. The Government of India is continuously amending and updating the definition of MSME based on Investment and Turnover to keep up with the evolving Business Environment and provide a framework for better support for MSMEs. Although MSMEs are regarded as having enormous potential within the Economy, they face many challenges when accessing Formal Credit, Meeting Regulatory Compliance, and Adopting New Technologies. Resulting from this, the Development of Digital Infrastructure & Specific Credit Schemes for MSMEs have been identified as Critical Success Factors for the Growth of MSMEs.

**Research methodology:**

The research methodology used in the study is that of descriptive research, which systemically examines both entrepreneurship and MSMEs (micro, small, and medium-sized enterprises), as well as startups. The data for this study is taken from existing, secondary sources, such as government reports, policies, reports from various non-profits, etc. will also include case studies where appropriate in order to support the analysis and provide 'how to' type information.

**Government Initiatives & Policy Frameworks:**

1. **Startup India:** Startup India was launched in 2016 as one of the flagship projects of India's Government to support the culture of innovation and entrepreneurship. Startup India offers several services, including but not limited to Tax Benefits, Funding Support, Simplified Compliance and Incubation Services for Startups. In addition, the Program promotes collaboration between Educational Institutions and Industry to build future Entrepreneurs.
2. **Due to the various schemes that support MSMEs**, such as those focused on Technology Upgrading, Credit Facilitation, Infrastructure Support, and Market Development, these schemes help mitigate Lender Collateral issues for MSMEs to obtain needed financing. The Credit Guarantee Scheme (CGS) is a guarantee to Lenders to mitigate their risk; thus, it provides a means for MSMEs to obtain the funds they require. The Skill Development and Skill Building Programmes will provide the required Training and Skill Development Programmes for MSMEs in Managerial and Technical Support.
3. **The Skill India Mission** seeks to improve the employability of the workforce through Vocational Training, Industry Certification, and Apprentice Programs. The Skill India Mission will provide a Model for Start-ups and MSMEs who are seeking skilled Workers. The Digital India Programme will be the basis for Small Scale/Farmers utilizing Digital Platforms for their Sales, Marketing, and Internal Operations.
4. **The Atmanirbhar Bharat Initiative** is centred around the concept of "Self Reliance". The Focus is on Domestic Manufacturing, Resilience of Supply Chains and Initiatives to Promote Local Entrepreneurship. The

Atmanirbhar Bharat Initiative includes various Measures that also provide support to MSME's, Give Preference to Local Entrepreneurship and Streamline Procurement for Small and Medium Enterprises.

**Key Challenges Facing Entrepreneurship and MSMEs:**

While entrepreneurship and MSMEs have evolved dramatically in India over the last two decades, there remain a number of challenges limiting both the size and scale of entrepreneurship and MSMEs in India.

1. **Access to Finance:** Although there have been improvements in accessing finance through policies related to credit, many MSMEs and start-up companies face difficulties obtaining ongoing finance due to a lack of collateral, high interest rates and a banking sector that is very risk averse, which is further exacerbated by a limited venture capital and private equity market that is primarily focused in urban centres.
2. **Regulatory and Compliance Obligations:** Small businesses must comply with significant regulatory requirements that have evolved into a very complex set of rules and regulations that create time and cost obstacles for small businesses. The simplification of licensing procedures and adoption of one-stop-shop licensing for small businesses has been helpful; however, this needs to be adopted by more local governments.
3. **Lack of Infrastructure & Technology Adoption:** Many areas of India are experiencing poor infrastructure for both physical and digital economic activity. This limits the ability of MSMEs to be productive and reach their customers. Technology adoption is very uneven, and small firms are typically well behind the curve in adopting digital business tools that can help them to be more efficient.
4. **Skill Gaps:** Most people in India are under the age of 25; however, there is still a large gap between the number of graduates and the number of new graduates with the technical skills required to work in many high-tech jobs. Additionally, the majority of employers report that graduates are missing the practical skills that are required to be successful in many businesses today, particularly in high-tech businesses.

**Case Studies:**

1. **Pipal Farm:** Founded in 2009 by Aditi Gupta, Pipal Farm is an Indian-based MSME (Micro, Small, and Medium Enterprise) specializing in organic foods & beverages using traditional & sustainable sourcing methods from over 1,000 farmers. Pipal Farm focuses on quality, authenticity, and social responsibility, which grew into being a worldwide brand with locations in both India and America.
2. **Go Digit General Insurance Ltd.:** In 2016, Kamesh Goyal established Digit Insurance to completely change how insurance was provided in India, focusing on digital rather than paper products and putting customers first. Digit used technology, creativity, and data analytics to tackle the problem of low penetration rates, outdated systems, and a lack of consumer trust within the insurance industry.
3. **Kothari Silk Mills:** Jaishree Kabra serves as a prime illustration of an entrepreneurial effort that has been developed through the application of creative thought and the introduction of new methods and technology to improve on the existing system, resulting in improved productivity, improved competition, and more productive operations. The story of

this entrepreneur illustrates how entrepreneurs are leveraging the advancement of technology and the use of limited resources in order to establish enduring and profitable enterprises.

4. **Flipkart:** With its roots as a simple Online Bookstore, Flipkart has transformed into one of India's preeminent e-commerce platforms since being founded in 2007 by brothers Sachin and Binny Bansal, primarily due to innovation, a commitment to outstanding customer service, and robust growth through strategic partnerships with leading companies. The success of Flipkart led to additional investments from prominent investors, culminating in a historic acquisition by Walmart, establishing Flipkart as one of the foremost Indian startups.
5. **Ola:** Ola's innovative technology-based approach, launched in 2010 by founders Bhavish Aggarwal and Ankit Bhati, changed the way Indian customers utilized cabs for travel. The company's innovative products and services targeted the needs of consumers and were supported through partnerships with other companies, enabling the company to take leadership positions within the marketplace and gain extensive worldwide recognition.

**Findings:**

The study's findings indicate that entrepreneurship, start-ups, and micro, small, and medium enterprises (MSMEs) are significant contributors to the growth of the Indian economy through the development of new products, increased output, job creation (primarily for young people and women), and supporting inclusive economic development through the establishment of jobs in rural and semi-urban areas. In addition to their impact on economic growth, MSMEs also represent a large portion of the employment base in these areas due to their reliance on a lower-cost labor workforce. Start-ups also provide an opportunity for technological advancement and efficiency, primarily through their focus on developing new and innovative products and services and through creating a viable business model that is scalable.

Although the Government of India has developed policies to support the growth of enterprises in India, many enterprises are still experiencing issues with financing, regulatory complexity, infrastructural barriers, and mismatching skills with the requirements of enterprises. Therefore, it is essential that India will achieve its vision of "Viksit Bharat" by strengthening the entrepreneurial infrastructure in the areas of finance, skill development, regulations, and digital and physical connectivity.

**Conclusion:**

Entrepreneurship, the start-up industry, and micro, small, and medium enterprises contribute greatly to India’s booming economy. Entrepreneurship, MSMEs, and start-ups will play an important role in India’s continued economic growth and prosperity. They help create employment and add to the country’s GDP. Entrepreneurship also helps in promoting regional and inclusive growth through development and innovation in the country. Thus, helping India achieve inclusive growth.

Even though there has been significant improvement with government initiatives and the growth of the entrepreneurship ecosystem. There is still a lot of work that needs to be done in these areas to unlock the potential. Clearing the barriers of finance, infrastructure, labor, and ease of doing business will help India unlock the true potential of entrepreneurship, startups, and the MSME sector.

For Viksit Bharat to become a reality, we will need an ecosystem that promotes and celebrates entrepreneurial successes while

sustaining the MSME sector. By empowering Indian youth with resources to succeed as entrepreneurs and to innovate and thrive in the business industry. We can open up more opportunities for economic growth and social equality for India and create a sustainable economy for its people.

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# Transforming Libraries in the Digital Age: A Study of Emerging Technologies and Services

**Rahul R. Kamble[1] & Dr. Uddhav R. Aghav[2]**

[1]*Librarian MSS Arts College Tirthpuri, Tal Ghanswangi Dist. Jalna*

[2]*Librarian and Research Supervisor, S.S.J.E.S Arts, Science and Commerce College Gangakhed Dist. Parbhani*

***Corresponding Author – Rahul R. Kamble***

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***Abstract:***

*The digital transformation of libraries has significantly altered traditional library practices and professional roles. This paper examines recent developments in library and information science with special reference to digital libraries, artificial intelligence applications, and user-centered services. Using a qualitative and analytical approach, the study reviews current literature to identify major trends and challenges faced by contemporary libraries. The findings reveal that libraries are increasingly functioning as hybrid knowledge centers, supporting research, learning, and digital literacy. However, issues such as technological skill gaps, budgetary constraints, copyright concerns, and the digital divide continue to pose challenges. The study concludes that continuous professional development and evidence-based practices are essential for sustaining library relevance in the digital era.*

***Keywords: Digital Libraries, Artificial Intelligence, Academic Libraries, User-Centered Services, Librarianship***

## Introduction:

The role of libraries has evolved considerably due to advances in information and communication technologies. Modern users expect instant, remote, and personalized access to information resources. Consequently, libraries have transformed from collection-centered institutions into service-oriented knowledge hubs. This paper aims to analyze recent trends in library services and examine their implications for library professionals.

## Objectives of the Study:

The present study aims to:

1. Examine recent technological developments in libraries.
2. Analyze the application of artificial intelligence in library services.
3. Study the shift towards user-centered and evidence-based librarianship.
4. Identify challenges faced by libraries in the digital environment.

## Research Methodology:

The study is based on a descriptive and analytical research method Secondary data has been collected from scholarly journals, professional reports, and published research in the field of library and information science. Content analysis has been used to interpret trends and patterns related to digital transformation in libraries.

## Digital Libraries and Open Access Resources:

Digital libraries provide access to electronic books, journals, databases, and institutional repositories. Research indicates that

open access resources have improved the visibility and impact of scholarly communication. Libraries now actively support research data management and digital preservation initiatives, thereby strengthening academic research infrastructure.

**Artificial Intelligence in Library Services:**

Artificial intelligence technologies are increasingly used in cataloguing, reference services, and information retrieval. AI-powered chat bots offer real-time user support, while machine learning tools assist in collection development. Despite these advantages, ethical concerns related to data privacy and algorithmic bias requires careful policy implementation.

**User-Centered and Evidence-Based Librarianship:**

User-centered librarianship focuses on understanding user behavior and service expectations. Libraries employ surveys, usage statistics, and analytics to design customized services. Evidence-based librarianship ensures that decision-making is supported by research findings and practical data, enhancing service quality and efficiency.

**Challenges in the Digital Era:**

Libraries face several challenges including limited funding, rapid technological change, lack of trained manpower, copyright restrictions, and unequal access to digital resources. Addressing these challenges requires strategic planning, institutional support, and continuous skill development.

**Conclusion:**

The study highlights that libraries must embrace technological innovation while maintaining their core professional values. The role of librarians has expanded to include digital curation, research support, and information literacy training. Adoption of user-centered and evidence-based approaches will ensure the sustainable development of libraries in the digital age.

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# Air Pollution Control Technologies: A Chemical Perspective

**Dr. Sanghratna L. Kasare**

*Department of Chemistry, Late Shankarrao Gutte Gramin Arts, Commerce & Science College, Dharmapuri.*

***Corresponding Author – Dr. Sanghratna L. Kasare***

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***Abstract:***

*Air pollution control (APC) technologies are critical to protect human health and the environment by reducing emissions from stationary and mobile sources. This paper reviews principal APC technologies from a chemical standpoint: the fundamental removal mechanisms (adsorption, absorption, catalysis, filtration, electrostatic collection, and chemical transformation), device-level implementations (scrubbers, electrostatic precipitators, baghouses, selective catalytic reduction, thermal/catalytic oxidizers, activated carbon systems), and emerging materials and process intensification strategies. Representative case studies illustrate real-world performance, design considerations, and trade-offs. The review underscores the central role of chemistry — reaction pathways, surface interactions, sorbent design, and catalytic mechanisms — in driving advances in air pollution control. [1–3]*

## Introduction:

Air pollution remains a major global challenge, with particulate matter (PM), sulfur oxides (SOx), nitrogen oxides (NOx), volatile organic compounds (VOCs), mercury (Hg) and other hazardous air pollutants (HAPs) contributing to acute and chronic health impacts as well as ecosystem damage. Regulation and technology have dramatically reduced emissions in many countries, but achieving tighter standards and controlling diverse industrial sources requires ongoing chemical and engineering innovations. [4,5]

## Major Pollutants and Chemical Characteristics:

Different pollutants demand different control chemistries. PM removal relies on mechanical and electrostatic capture; SOx removal is commonly achieved by alkaline neutralization (scrubbing) or sulfation chemistry; NOx reduction utilizes selective catalytic or non-catalytic reduction pathways (producing N2); VOCs are removed via oxidation or adsorption; mercury control exploits adsorption and oxidation to form particulate-bound species for capture. Understanding chemical speciation, gas-phase reactivity, and matrix effects is essential to select and optimize APC systems. [6–8]

## Fundamental Chemical Mechanisms in APC:

1. **Adsorption and Surface Interactions** — Adsorption onto activated carbon, zeolites, or tailored sorbents removes gaseous pollutants through physisorption and chemisorption; surface functional groups, pore size distribution, and competitive adsorption determine capacity and selectivity. For mercury, oxidized forms (Hg2+) adsorb more readily than elemental Hg(0), prompting pre-oxidation strategies. [9,10]
2. **Absorption and Wet Chemistry** — Gas–liquid absorption in wet scrubbers relies on solubility and chemical reactions. Flue gas

desulfurization (FGD) uses alkaline scrubbing (lime, limestone) to convert SO2 to sulfite/sulfate and eventually gypsum. Absorption chemistry is influenced by pH, gas–liquid mass transfer, and chemical promoter addition (e.g., oxidation catalysts). [11,12]

3. **Catalytic Oxidation and Reduction** — Catalysts enable selective transformations at lower temperatures. Selective catalytic reduction (SCR) uses V2O5-WO3/TiO2 or zeolite catalysts to reduce NOx with NH3 to N2; catalytic oxidizers convert VOCs to CO2 and H2O with appropriate catalysts to lower thermal energy demand. Poisoning, sintering, and redox cycling are key chemical considerations. [13,14]
4. **Electrostatic and Filtration Processes** — Electrostatic precipitators (ESPs) rely on charging and collection of particles, while fabric filters (baghouses) use mechanical sieving and cake filtration. Chemical modification of filter media (e.g., sorbent-impregnated fabrics) can add gas-phase removal capability. [15]

**Technology Implementations:**

1. Particulate Control: ESPs, Baghouses, and Wet Scrubbers — High-efficiency ESPs achieve >99% removal for certain particle sizes when optimized; fabric filters provide consistent performance across particle size distributions but require handling of collected dust. Wet scrubbers can remove both particulates and gases but create wastewater that must be treated. Material chemistry (collector surfaces, filter fibers) affects durability and capture efficiency. [15,16]
2. **Sulfur Oxides Control:** Flue Gas Desulfurization (FGD) — Wet limestone FGD is the dominant technology for coal-fired plants: SO2 is absorbed and converted to calcium sulfite/sulfate (gypsum) in scrubber slurry; additives and forced oxidation steps control product quality. Dry and semi-dry sorbent injection (e.g., lime) provide alternatives with lower water footprint but different removal chemistry and by-products. [11,17]
3. **Nitrogen Oxides Control:** SNCR and SCR — Selective non-catalytic reduction (SNCR) injects urea or ammonia into the flue gas to reduce NOx at high temperatures; SCR achieves higher removal (70–95%) with catalysts that promote NOx → N2 conversion under controlled stoichiometry. Catalyst formulation, metal-support interactions, and ammonia slip control are crucial chemical/operational aspects. [13,18]
4. **Volatile Organic Compounds:** Thermal & Catalytic Oxidation, Adsorption, and Biofiltration — Regenerative thermal oxidizers (RTOs) and catalytic oxidizers destroy VOCs by oxidation; adsorption onto activated carbon or zeolites followed by thermal regeneration is common for solvent recovery. Biofilters and biotrickling filters utilize microbial communities to mineralize VOCs, with surface chemistry and nutrient delivery affecting biodegradation rates. [14,19]
5. **Mercury and Trace Metals: Oxidation + Adsorption —** Mercury control often combines halogen injection (to oxidize Hg0 to Hg2+) with downstream activated carbon injection (ACI) to capture oxidized mercury on particulate collectors. Sorbent development (impregnated carbons, novel metal oxides) is an active area of chemical research. [9,20]
6. **Emerging: Carbon Capture and Integration with APC —** Post-combustion CO2 capture increasingly intersects with APC, for instance integrating solvent-based

CO2 capture downstream of particulate and SOx removal to protect solvents from contamination. Chemical compatibility and process integration are active research areas. [21]

**Case Studies:**

**Case Study A** — Wet Limestone FGD at a Coal-Fired Power Plant: A 500 MW coal power station retrofitted wet limestone FGD achieved >95% SO2 removal; forced oxidation converted sulfite to gypsum, which was sold as a by-product. Chemical control of slurry pH and oxygen transfer were critical to product quality. [17]

**Case Study B** — SCR Retrofit for NOx Control: A combined-cycle plant installed SCR with a V2O5/TiO2 catalyst, reducing NOx emissions from ~200 mg/Nm3 to <50 mg/Nm3, meeting stricter regulatory limits. Catalyst deactivation due to alkali poisoning was mitigated by upstream particulate removal and operational adjustments. [18]

**Case Study C** — Activated Carbon Injection for Mercury Control: A coal utility added ACI and baghouse upgrades, achieving >80% mercury reduction. Optimization of carbon type (brominated or sulfur-impregnated) and injection location improved capture while minimizing impacts on fly ash saleability. [9,20]

**Case Study D** — VOC Abatement with Regenerative Thermal Oxidizer: A chemical manufacturing facility reduced VOC emissions by >98% using an RTO with heat recovery, achieving low operating costs and compliance with emission permits. Material selection for heat-exchange media and catalytic components reduced maintenance frequency. [14,19]

**Design Considerations and Chemical Trade-Offs:**

Selecting APC technologies requires evaluating pollutant speciation, co-pollutant interactions, gas composition (moisture, particulates), temperature, and economics. Chemical interactions (e.g., SO3 formation increasing particulate acidity, halogen-induced corrosion, or catalyst poisoning by sulfur/alkali metals) influence the sequence of controls and necessary pretreatment. Lifecycle impacts (waste generation, by-product handling) must be assessed. [11,16,22]

**Materials Science and Innovations:**

Advances in sorbent chemistry, catalysis, membrane separation (for VOCs), and high-temperature stable electrode materials (for electrostatic and electrochemical approaches) are driving next-generation APC. Tailored porous materials (functionalized carbons, metal–organic frameworks), nanostructured catalysts, and hybrid adsorbent-catalyst systems aim to increase selectivity and reduce energy/chemical consumption. [9,13,23]

**Monitoring and Analytical Needs:**

Accurate emission monitoring (CEMs—continuous emission monitors), speciation analysis (e.g., Hg0 vs Hg2+), and fast-response sensors for VOCs and NOx are essential. Analytical chemistry supports source apportionment and verification of control performance through GC-MS, IC, AAS/ICP-MS, and chemiluminescence-based NOx analyzers. Calibration gases, QA/QC and data validation are part of regulatory compliance. [24,25]

**Environmental, Economic and Policy Considerations:**

APC decisions are shaped by regulations (emission limits, Hg and HAP standards), economics (capital and operating costs), and co-benefits (improved visibility, acid deposition reduction). Incentives for low-emission technologies and integrated energy/chemical

policies can accelerate adoption. Evaluating total lifecycle emissions and co-product opportunities (e.g., gypsum sales from FGD) improves decision-making. [17,21,26]

**Future Directions:**

Future research should prioritize low-energy catalytic VOC oxidation, multifunctional sorbents for simultaneous removal of multiple pollutants, corrosion-resistant materials for harsh flue gas environments, and integrated APC-CO2 capture systems. Digitalization, advanced process control, and predictive maintenance using chemical sensors will optimize performance and reduce downtime. [13,23,27]

**Conclusion:**

Air pollution control is fundamentally a chemical problem as much as an engineering one. Progress in material chemistry, catalysis, and analytical techniques underpins the successful design and operation of APC systems. Interdisciplinary collaboration between chemists, chemical engineers, and policymakers is essential to meet tightening air quality goals. [1–3,11]

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# Analytical Methods for Environmental Monitoring: Principles, Applications, and Case Studies

**Dr. Bhagwat R. Gurme**

*Department of Chemistry, Late Shankarrao Gutte Gramin Arts, Commerce & Science College, Dharmapuri, Beed.*

***Corresponding Author – Dr. Bhagwat R. Gurme***

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***Abstract:***

*Environmental monitoring is essential for assessing pollution levels, understanding ecosystem health, and ensuring compliance with environmental regulations. Analytical chemistry provides the tools required for qualitative and quantitative detection of pollutants in air, water, soil, and biota. This review discusses classical and modern analytical methods used in environmental monitoring, including spectroscopic, chromatographic, electroanalytical, and sensor-based techniques. Recent case studies highlight real-world applications of these methods in air quality monitoring, water contamination assessment, and emerging pollutant detection. (Refs. 1–3)*

**Introduction:**

Rapid industrialization, urbanization, and agricultural intensification have led to the release of numerous contaminants into the environment. Monitoring these pollutants requires sensitive, selective, and reliable analytical techniques. Analytical methods for environmental monitoring aim to identify pollutants at trace and ultra-trace levels, often in complex matrices. Advances in analytical instrumentation have significantly improved detection limits and data reliability. (Refs. 1, 4)

**Environmental Sampling and Sample Preparation:**

Accurate environmental analysis begins with proper sampling and sample preparation. Sampling strategies depend on the nature of the environmental compartment (air, water, or soil) and the target analytes. Sample preparation techniques such as filtration, digestion, extraction, and preconcentration are essential to remove interferences and enhance analyte detectability. Solid-phase extraction (SPE) and microwave-assisted digestion are widely used for environmental samples. (Refs. 2, 5)

**Spectroscopic Techniques:**

Spectroscopic methods are widely employed in environmental monitoring due to their rapid analysis and high sensitivity. UV–Visible spectroscopy is commonly used for nitrate, phosphate, and metal–ligand complex analysis in water samples. Atomic absorption spectroscopy (AAS) and inductively coupled plasma optical emission/mass spectrometry (ICP-OES/MS) are standard techniques for trace metal determination. Infrared (IR) spectroscopy aids in identifying organic pollutants and microplastics. (Refs. 3, 6, 7)

**Chromatographic Techniques:**

Chromatography plays a central role in separating and quantifying complex mixtures of environmental pollutants. Gas chromatography (GC) coupled with flame ionization or mass

spectrometric detection is extensively used for volatile organic compounds (VOCs) and pesticides. High-performance liquid chromatography (HPLC) is preferred for non-volatile and thermally labile compounds such as pharmaceuticals and dyes. (Refs. 4, 8)

**Electroanalytical Methods:**

Electroanalytical techniques offer high sensitivity and low-cost alternatives for environmental analysis. Potentiometry using ion-selective electrodes is applied for monitoring ions such as fluoride and nitrate. Voltammetric methods enable trace-level detection of heavy metals like lead and cadmium. These techniques are particularly useful for on-site and real-time monitoring. (Refs. 5, 9)

**Sensors and Biosensors:**

Chemical sensors and biosensors have gained prominence due to their portability and rapid response. Gas sensors based on metal oxide semiconductors are widely used for air quality monitoring. Biosensors employing enzymes, antibodies, or microorganisms provide selective detection of pesticides and organic pollutants. Recent advances in nanomaterials have significantly enhanced sensor performance. (Refs. 6, 10)

**Case Study: Water Quality Monitoring Using ICP-MS and HPLC:**

A recent study on river water quality assessment employed ICP-MS for trace metal analysis and HPLC for pharmaceutical residue detection. The combined approach enabled comprehensive pollution profiling at parts-per-billion levels. The results revealed elevated concentrations of heavy metals near industrial discharge zones and detectable levels of antibiotics downstream. This case study demonstrates the importance of integrated analytical techniques in environmental monitoring. (Refs. 7, 11)

**Emerging Trends and Challenges:**

Emerging analytical trends include miniaturized instruments, remote sensing, and coupling of analytical methods with data analytics and artificial intelligence. Challenges remain in monitoring emerging contaminants such as microplastics, endocrine-disrupting chemicals, and nanomaterials. Future research focuses on developing greener analytical methods with reduced solvent and energy consumption. (Refs. 8, 12)

**Conclusion:**

Analytical methods are indispensable tools for environmental monitoring and pollution control. Continuous advancements in analytical chemistry have improved sensitivity, selectivity, and field applicability of monitoring techniques. Integration of classical methods with modern sensor technologies and data-driven approaches will further strengthen environmental protection efforts. (Refs. 1, 12)

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# Advanced Oxidation Processes in Environmental Chemistry

**Dr. Rajkumar G. Momle**

*Department of Chemistry, Late Shankarrao Gutte Arts, Commerce and Science College, Dharmapuri, Tq -Parli Dist. Beed.*

***Corresponding Author – Dr. Rajkumar G. Momle***

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***Abstract:***

*Advanced Oxidation Processes (AOPs) are a class of treatment technologies that generate highly reactive species (primarily hydroxyl radicals, •OH, and sulfate radicals, SO4•–) to oxidize and mineralize a wide range of organic contaminants in water and wastewater. This review covers the fundamental chemistry, main AOP variants including Fenton, photo-Fenton, photocatalysis, ozonation, persulfate-based systems, and electrochemical AOPs, discusses reactor design and kinetics, highlights analytical considerations and monitoring, and presents recent case studies (2020–2025) illustrating successes and practical challenges. Key research needs and scale-up barriers are also identified. [1,17]*

## Introduction:

The growing occurrence of micropollutants, pharmaceuticals, personal-care products, and persistent industrial chemicals in the aquatic environment has driven the adoption of AOPs due to their ability to non-selectively oxidize recalcitrant molecules (Refs. [3,15]). The defining feature of AOPs is in situ generation of reactive oxygen species (ROS) such as •OH that exhibit high redox potentials (~2.8 V vs SHE) and rapid reaction rates with organics, enabling deep oxidation to CO2 and H2O (Refs. [2],[3], [15]).

## Fundamental Mechanisms:

Hydroxyl radicals (•OH) are commonly produced by H2O2 photolysis, Fenton chemistry (Fe2+ + H2O2), ozonation (O3 + OH–), and via photoexcited semiconductor catalysts (e.g., TiO2). Sulfate radicals (SO4•–) are produced by activation of persulfate (PMS/PDS) through heat, UV, transition metals or electrochemical means; they provide complementary reactivity to •OH and can be preferred in certain matrices due to higher selectivity and longer lifetime (Refs. [5,6,21]).

## Major AOP Variants:

**1. Fenton and Photo-Fenton:** The classical Fenton reaction (Fe2+ + H2O2 → Fe3+ + •OH + OH–) is effective at low pH (~2.5–3) and is widely used for industrial effluents; photo-Fenton accelerates iron cycling and increases radical yield under UV/vis irradiation (Refs. [7,10]).

**2.Photocatalysis:** Semiconductor photocatalysts (TiO2, ZnO, doped materials) generate electron–hole pairs under irradiation that produce •OH and other ROS. Heterogeneous photocatalysis is attractive for suspended or immobilized systems, but mass transfer and recombination losses remain challenges (Refs. [1,12]).

**3.Ozonation and O3-based AOPs:** Ozone reacts directly with certain organics and indirectly via OH generated from O3 decomposition; O3/H2O2 and O3/UV are common hybrid processes (Refs. [3,13]).

**4. Persulfate-based and Sulfate Radical AOPs:** Activation of persulfate/peroxymonosulfate yields

$SO_4^{\bullet-}$; SR-AOPs have been shown to degrade a wide range of contaminants and can operate effectively over a broader pH range (Refs. [5,9,14]).

**5.Electrochemical AOPs:** Electrochemical oxidation (anodic oxidation), electro-Fenton and photoelectro-Fenton generate radicals at electrodes or via in situ $H_2O_2$ production; they offer good controllability and avoid chemical addition but require electrical energy and robust anode materials (Refs. [11,16]).

**Kinetics and Reactor Design:**

Reaction kinetics in AOPs are generally rapid and often approach diffusion-controlled limits for many organics with •OH. Reactor design must balance radical production rates, contact time, and mass transfer to achieve target removal and mineralization while minimizing reagent consumption and radical scavenging by background matrix compounds (e.g., natural organic matter) (Refs. [2,6]).

**Analytical Monitoring and By-Products:**

Robust analytical monitoring is essential to determine removal efficiency, track formation of transformation products, and evaluate toxicity. Techniques commonly used include LC-MS/MS for micropollutants, GC-MS for volatile organics, TOC for mineralization, and toxicity assays (bioassays) to assess residual ecotoxicity. Monitoring also detects undesirable by-products such as bromate formation during ozonation in bromide-containing waters (Refs. [3,6]).

**Recent Case Studies (2020–2025):**

**Case Study 1 —** Photo-Fenton application for pharmaceutical-laden hospital wastewater: A full-scale pilot combining solar-driven photo-Fenton and biological post-treatment reduced pharmaceutical concentrations by >90% and improved biodegradability, demonstrating AOPs' role as pre-treatment to protect biological systems (Refs. [6,10]).

**Case Study 2 —** Persulfate activation for remediation of contaminated groundwater: Field trials using persulfate injection with $Fe^{2+}$ activation showed rapid attenuation of target chlorinated solvents and improved contaminant mass removal, though persulfate longevity and secondary impacts on aquifer geochemistry required careful monitoring (Refs. [5,17]).

**Case Study 3 —** Electrochemical AOP for textile wastewater: A pilot electro-Fenton reactor equipped with boron-doped diamond (BDD) anodes achieved high color and COD removal with minimal sludge production; energy consumption and electrode durability were identified as commercial-scale challenges (Refs. [2,3]).

**Advantages, Limitations and Environmental Impacts:**

AOPs offer near-complete oxidation for many recalcitrant pollutants and can be integrated with biological processes. Limitations include operational cost (chemicals, energy), formation of potentially toxic by-products, sensitivity to water matrix, and challenges in scaling from pilot to full scale. Lifecycle assessment and techno-economic analysis are recommended to evaluate net environmental benefits (Refs. [6]).

**Future Directions and Research Needs:**

Future research should focus on (i) low-energy activation methods (solar-driven and electrochemical using renewables), (ii) selective non-radical pathways to reduce scavenging, (iii) robust heterogeneous catalysts that minimize metal leaching, (iv) coupling AOPs with biodegradation and adsorption for hybrid treatment trains, and (v) standardized reporting for kinetics and reactor performance to facilitate scale-up (Refs. [1,4,11,17]).

**Conclusion:**

Advanced Oxidation Processes remain vital tools in the environmental chemist's toolbox for addressing persistent and emerging contaminants. Strategic integration with monitoring, biological treatment, and renewable energy sources will determine AOPs' role in sustainable water management (Refs. [2,3,11]).

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# Inter-Relation Between Performance Appraisal and Motivation of Employees: A Study on How Performance Appraisal Contributes in Employee Productivity and Satisfaction

**Snehal Umate[1] & Prof. Dr. Abhijeet Shelke[2]**

*[1]Research Scholar, Department of Management Science, Dr. Babasaheb Ambedkar Marathawada University Chh.Sambhajinagar*

*[2]Director, Department of Management Science, Dr.Babasaheb Ambedkar Marathawada University Chh.Sambhajinagar*

***Corresponding Author – Snehal Umate***

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***Abstract:***

*The research study investigates the interconnection of the relations between the instrumental aspect of performance appraisal and the subject of employee motivation. Performance appraisal is identified as an important instrument used by Human Resources (HR) for management of employee performance through different aspects including either administrative, informative or motivational. This study has intended to explore the subject through the perspective of its motivational element. An employee's motivation could be understood through different aspects that include productivity and satisfaction of employees. The study explores this relationship with focus on the contributory activities of productivity and satisfaction among employees. The study had developed this qualitative research through the use of secondary qualitative findings with a special focus on the automotive and pharmaceutical industries of India.*

***Keywords: Employee, Performance, Appraisal, Human Resource, Productivity, Satisfaction, India***

## Introduction:

Performance appraisals are considerably an integrating part of the Human Resources (HR) and their management. There are usually three aspects for performance appraisal that include administrative that focuses on promotional, salary and incentive determinations, informative in terms of subordinate performance data delivery to management and motivational that builds learning experience for subordinates (Orsu & Srinivas, 2020). Performance appraisal is considered as an effectively necessary aspect in association to supporting employees that could achieve employee satisfaction and organisational performance through the implementation of "performance appraisal systems". The need for performance appraisal and management has become increasingly important for evaluation of comprehension of their impact along with its influential impact and parts that include targets and aims that serve more purposes than objective rating of subordinate employees (Malik et al., 2021). Several industries and organisations within India from different sectors such as pharmaceutical and automotive industries have also been focused on assessing important role performance appraisal in relation to boost employee motivation.

Performance appraisal is often understood as an instrument for assessment of productivity satisfaction and motivations through subjective qualities of employees that includes obedience and loyalty. Often positive initiatives undertaken by HRs for improving working environment and employee contribution recognitions as performance management that likely implement

performance appraisal systems as aid for employee performance evaluations beside "constructive feedback" delivery and recognising areas of development (Venkat et al., 2023). These practices are also observed to be existent in automotive industry companies that are intending to expand their understanding and effectiveness in assuring employee satisfaction and productivity through motivation opportunities. The success of organisations are quite strongly dependent on the satisfaction of employees making it necessary for securing positive motivation and satisfaction of the employees (Rastogi, Nanda & Kumar, 2023). The performance of the corporate firms and companies are also very much likely to be affected by the actions that HR takes to maintain the goals for improving employee satisfaction as a means for securing development of motivational enhancement of productivity and satisfaction of employees.

Employee performance is an integrating element that contributes to the development of organisational functioning such as organisational productivity in terms of companies involved. An improvement in productivity and satisfaction includes motivating employees into enhancing their productivity levels. Employees in automotive industries show awareness regarding motivation and there is also a presence of relationship regarding performance and motivations of employees that contribute to success within automobile industries as well (Solayappan, Sankar & Senthilkumar, 2020). The presence of motivation and potential connection of motivation having relation with performance of employees could be considered as evidently influential for the assessment of performance contribution employees in improving the performance situation of the organisations.

Management and retention of talent and employees are essential for HR, requiring them to implement various methods to acknowledge and influence the skill and contributions of employees in terms of boosting an improvement of productivity backed by satisfaction. The pharmaceutical industry and market of India has been developing as an emergent and opportunistic market that benefits from several young employees, and activities such as financial incentives and rewards are related to work performance (Thilagham et al., 2022). Performance appraisal implementations within different types of firms in India are often noted for their focus on being adaptive to changes alongside knowledge and power distributions (Malik et al., 2021). Assessment or management of performance appraisal through incentives or recognition for performance is crucial for motivating growth of productivity and satisfaction.

**Objectives Of This Study:**

1. To identify the key elements of performance appraisals that contribute to employee motivation
2. To explore the mediating effect of performance appraisal on the relationship between motivation and productivity
3. To evaluate the effect of performance appraisal on employee job satisfaction

**Literature Review:**

**1.Impact of performance appraisal on employee performance:**

Several studies have highlighted the role of performance appraisal as an effective tool regarding the management of organisational performance in this era of high competition. In this regard, Astuti, Shodikin, & Ud-Din (2020) mentioned that performance appreciation is becoming an emerging trend in terms of managing work culture in organisations operating in the global business environment. On the other hand, Helal (2022) stated performance appraisal

reinforces the satisfactory performance of the employees in a workplace which has a direct impact on the organisational performance. Concerning the findings of these reviewed articles, it can be considered that performance appraisal is an essential aspect followed by several organisations in the global market especially to shape an organisation's performance through enhancing employee performance.

**2.Role of performance appraisal in motivating employees:**

Motivating employees has been demonstrated by several authors as an essential aspect regarding the retention of employees which helps organisations in encompassing competitive advantage in the operating market. Riyanto, Endri & Herlisha (2021) stated that employee performance appraisal can increase employee engagement in the workplace by motivating them in multiple ways. In a contradictory aspect, Murphy (2020) mentioned, that dreadful performance in controlling the performance appraisal system among some sort of managers and leaders provides reverse results in the organisation. Considering the viewpoints of the authors, it can be considered that in terms of motivating employees through a performance appraisal system, properly using the system is an essential aspect.

**3.Maslow's hierarchy of needs:**

In order to explain the underlying source of human motivation in terms of needs fulfilment, Maslow looked into the needs theory. As soon as a certain need is met, the person no longer feels the need to pursue that particular need, therefore they look for other needs to satisfy in the hopes of fulfilling their original needs. A behavioural pattern is only driven by a need that a person aspires to meet. Maslow developed five graded frameworks that placed people's requirements into several groups (Ihensekien & Joel, 2023). The stages include, "Physiological needs", "Safety and security needs", "Social needs", "Esteem needs", and "Self-actualization needs". Considering this theoretical aspect, performance appraisal can be considered to meet the "psychological needs" of employees which helps organisations to motivate employees more effectively.

**Methodology:**

Considering the ontology of research, it has been recognised that "research philosophy" is a crucial aspect that governs the scholars in the selection of methodology in an effective way. As mentioned by Al-Ababneh (2020), there are four major types of philosophy including "pragmatism", "positivism", "realism" and "interpretivism". Alharahsheh & Pius (2020) stated that "positivism philosophy" is an effective one to work with the reality of society. Considering the research context it has been used as the base of the methods selected in this research.

**Discussion:**

Performance appraisal could be associated with contributing to development of organisational and employee activities and productivity. It is also to be noted the perception of skill is a valuable aspect that organisations consider in terms of human resources. According to a study by Thilagham et al. (2022), India's pharmaceutical industry is facing the issue of employee turnover and human resources and their management often include initiatives and practices such as financial rewards through salaries and benefits related to work performance. Such actions and initiatives could be connected to the potential for the development of rewarding through acknowledgement of employee performance within the pharmaceutical industry in India.

Motivation is regarded as an essential element that is associated as a powerful form of

influence that is required by employees within different organisations and firms involved in different sectors including the automotive sector. In a study by Raman (2022), it was seen that India has a large scope of automotive businesses operating within its sector. The study also noted that there were different forms of motivational compensations delivered by the organisations for the created value of employees that were both monetary and non-monetary in nature. In another study, Kumar, Subbulakshmi & Kumar (2022) noted the importance of HR activities such as employee retention strategies and rewards being associated with job satisfaction among employees. The study had also identified that different companies within the Indian automotive industry have been identified to be considering implementations of job satisfaction and opportunities being related with certain retention strategies. These strategies include implementation of training, rewards and recognition of the employees and their contributions.

Performance appraisal includes activities that are associated with the improvement of employee productivity and satisfaction in relation to motivating the changes in them through different strategies. As Venkat & Khan (2022) note in a study, the automobile industry is one of the largest sectors in India, making the function of the HR in motivating and maintaining employee retention crucial. The study had identified that certain assessment techniques could be associated with performance appraisal in terms of performance evaluation methods. In another study by Shridhar & Turabi (2022), different strategic implementations such as wage increases, training and other productivity related implementations are also capable of influencing expression of motivation in employee and job satisfaction in the Indian pharmaceutical industry. The study also identified the importance of performance appraisal systems of Indian pharmaceutical companies being operated scientifically and with fairness. Additionally, Ashwin & Muthukumar (2024) listed that, employee performance among other factors are associated with influencing satisfaction and productivity. The study also noted implementation of strategies such as fair compensations and benefits act as motivation for employees regarding satisfaction and productivity of employee performance.

The study also indicated that certain strategies such as training are more efficient in terms of motivating performance and satisfaction than monetary strategies. The study identified that among the employees working in the automotive industry organisations in Chennai, a city in India, several motivational aspects such as working environment, rewards and recognition were influencing variables for efficient employee retention through job satisfaction (Kumar, Subbulakshmi & Kumar, 2022). This could be attributed to the potential relation of poor morale within employees negatively impacting productivity. Madhumathy Sakthivel (2022) had identified in a research paper that performance appraisal systems and their transparency are essentially important in selecting and retaining efficient employees in Bengaluru's companies in the automobile industry. The study also noted the role of HR in regarding motivating employees and productivity-based employee retention also were connected to effective appraisal.

**Conclusion:**

The above research had provided a significant understanding on the subject of employee performance in relation to motivation regarding the aspects of employee performance and satisfaction. The study identified that there is a positive relation between performance appraisal and motivation. Motivation was realised to be associated through a wide range of HR activities

and initiatives that included training and rewards in recognition of employee performance contribution. This was seen to have been playing a positive part in the development of productivity and satisfaction among employees in the automotive and pharmaceutical industries in India. Therefore, performance appraisal is realised as an instrument that positively improves the condition of employee motivation that could achieve growth of productivity and satisfaction among employees.

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# Next-Generation Healthcare Technologies And Their Public Health Applications

**Shaikh Massarrat Shaikh Ameer**
*Assistant Professor at Indian Institute of Food Science and Technology Chh. Sambhajinagar*
***Corresponding Author – Shaikh Massarrat Shaikh Ameer***
**DOI - 10.5281/zenodo.18507436**

***Abstract:***

*Next-generation healthcare technologies are transforming the landscape of public health by enhancing disease prevention, diagnosis, treatment, and health system management. Innovations such as artificial intelligence, telemedicine, wearable devices, genomics, big data analytics, and digital health platforms have enabled morepersonalized, predictive, and preventive healthcare approaches.*

*These technologies play a crucial role in addressing public health challenges such as disease surveillance, health inequities, pandemic preparedness, and access to healthcare services. This paper explores the scope, applications, and public health significance of emerging healthcare technologies. It examines existing literature, outlines a conceptual research methodology, and discusses potential outcomes and implications. The study highlights how technology- driven healthcare solutions can strengthen public health systems andimprove population health outcomes while emphasizing the need for ethical governance and equitable access.*

***Keywords: Next-generation healthcare, Public health, Digital health, Artificial intelligence, Telemedicine, Health technology***

## Introduction:

Healthcare systems worldwide are undergoing a paradigm shift driven by rapid technological advancements. Traditional healthcare models, which largely focus on treatment rather than prevention, are increasingly being replaced by technology-enabled systems that emphasize early detection, continuous monitoring, and population-level health management. Next-generation healthcare technologies integrate digital tools, data-driven decision-making, and advanced biomedical innovations to improve healthcare delivery and outcomes. In the context of public health, these technologies offer new opportunities tomonitor disease patterns, manage outbreaks, improve access tocare, and reduce health disparities. The COVID-19 pandemic further highlighted the importance of digital health tools such as teleconsultations, contact tracing applications, and data dashboards. This paper aims to analyze next-generation healthcare technologies and their applications in public health, focusing on their potential benefits, challenges, and future directions.

## Review of Literature:

Previous studies have highlighted the growing role of digital health technologies in strengthening public health infrastructure. Research indicates that artificial intelligence and machine learning algorithms enhance disease prediction, diagnostic accuracy, and health resource optimization. Telemedicine has been widely recognized for improving healthcare access in rural and underserved populations, reducing costs, and minimizing the burden on healthcare facilities. Wearable health technologies and mobile health applications have shown promise in promoting preventive care by enabling

real-time health monitoring and behavior modification. Genomic technologies have contributed to personalized medicine and improved understanding of disease susceptibility at the population level. Literature also emphasizes the importance of big data analytics in public health surveillance, enabling timely responses to epidemics and chronic disease trends. However, studies also report challenges related to data privacy, digital divide, ethical concerns, and regulatory issues. Existing literature suggests that while next-generation technologies have significant public health potential, their successful implementation requires supportive policies, infrastructure, and capacity building

**Research Methodology:**

The present study adopts a descriptive and analytical research design based on secondary data sources. Data were collected from peer-reviewed journals, government reports, World Health Organization publications, and credible academic databases. The study involves qualitative analysis of existing research to identify key healthcare technologies and their applications in public health. A thematic approach was used to categorize technologies such as artificial intelligence, telemedicine, wearable devices, and health information systems. The analysis focuses on their public health applications, benefits, limitations, and future prospects. This methodology provides a comprehensive understanding of the current state of next-generation healthcare technologies without primary data collection.

**Results:**

The analysis reveals that next-generation healthcare technologies significantly enhance public health functions. Artificial intelligence improves disease surveillance, early diagnosis, and predictive modeling. Telemedicine expands healthcare access, particularly in remote areas. Wearable devices and mobile health applications support preventive healthcare by enabling continuous monitoring and health awareness. The findings also indicate improved efficiency in public health management through electronic health records and big data analytics. However, unequal access to digital tools, lack of technical expertise, and concerns regarding data security remain major challenges. Overall, the results demonstrate that technology-driven healthcare systems contribute positively to population health when implemented effectively.

**Conclusion:**

Next-generation healthcare technologies have emerged as powerful tools for advancing public health objectives. They enable a shift from reactive to proactive healthcare, improve access to services, and support data-driven decision-making. While technological innovations offer substantial benefits, their integration into public health systems must be guided by ethical considerations, inclusive policies, and robust infrastructure. Addressing challenges related to equity, privacy, and regulation is essential to maximize their public health impact.

**Summary:**

This paper examined the role of next-generation healthcare technologies in public health applications. Through a review of existing literature and secondary data analysis, the study highlighted key technologies, their benefits, and associated challenges. The findings underscore the transformative potential of digital and biomedical innovations in improving population health outcomes. Strategic planning and policy support are critical to ensuring sustainable and equitable adoption of these technologies in public health systems.

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# Influence of Spray Deposition Parameters on the Structural, Optical, and Morphological Properties of Nanostructured Thin Films.

**Dr. Sarika Vaijanathrao Jadhav**
*S.R.T.M.U. Nanded.*
***Corresponding Author – Dr. Sarika Vaijanathrao Jadhav***
**DOI - 10.5281/zenodo.18507459**

***Abstract:***

*Nanostructured thin films are integral to a wide range of contemporary optoelectronic, sensing, and energy applications due to their adjustable physical properties. Among the available fabrication methods, spray deposition has gained considerable attention as a straightforward, cost-effective, and scalable approach for thin film fabrication. In this work, nanostructured thin films were synthesized on glass substrates via the spray deposition technique. The influence of critical deposition parameters such as substrate temperature, precursor concentration, spray rate, and nozzle-to-substrate distance on the structural, optical, and morphological characteristics of the films was systematically examined. X-ray diffraction (XRD) studies confirmed the polycrystalline nature of the deposited films, with improved crystallinity observed under optimized conditions. UV–Visible spectroscopic analysis revealed high optical transparency in the visible region along with a tunable optical band gap. Additionally, scanning electron microscopy (SEM) analysis showed the formation of uniformly distributed nanostructures over the substrate surface. These findings highlight the significant role of spray deposition parameters in tailoring thin film growth and properties, demonstrating the potential of spray deposition as an efficient technique for advanced thin film applications.*

***Keywords: Spray Deposition, Nanostructured Thin Films, Structural Properties, Optical Properties, Surface Morphology.***

## Introduction:

Nanostructured thin films have attracted considerable interest due to their size-dependent physical properties and their wide-ranging applications in solar cells, gas sensors, transparent electronics, photocatalysis and optoelectronic devices. The performance and efficiency of these devices are highly dependent on the structural, optical, and morphological properties of the thin films. Therefore, achieving precise control over thin film growth is critical for obtaining desired material characteristics.

A variety of physical and chemical deposition techniques such as sputtering, chemical vapour deposition, pulsed laser deposition, and sol–gel methods have been extensively used for thin film fabrication. However, despite their effectiveness, these methods often involve complex equipment, vacuum conditions, and high processing costs. In contrast, spray deposition has emerged as an attractive alternative owing to its simplicity, cost-effectiveness, scalability, and suitability for coating large areas on diverse substrates.

In spray deposition processes, parameters including substrate temperature, precursor concentration, spray rate, and nozzle-to-substrate distance play a crucial role in governing nucleation, grain growth, surface morphology, and optical properties of the resulting films. A thorough understanding and optimization of these parameters are therefore essential for tailoring

thin film characteristics. This study aims to systematically investigate the influence of spray deposition parameters on the structural, optical, and morphological properties of nanostructured thin films.

**Experimental Procedure:**

**1.Thin Film Preparation:** Nanostructured thin films were deposited onto meticulously cleaned glass substrates using a conventional spray deposition method, selected for its simplicity, cost efficiency, and effectiveness in producing large-area thin films. Prior to deposition, the glass substrates were subjected to an extensive cleaning procedure to ensure a contaminant-free surface, which is essential for achieving uniform film growth. The substrates were ultrasonically cleaned successively in acetone, ethanol, and distilled water for adequate durations to remove organic contaminants, grease, and other surface impurities. Following ultrasonic cleaning, the substrates were air-dried to prevent moisture-related defects during the deposition process.

The precursor solution was prepared by dissolving an appropriate metal salt in either distilled water or an alcohol-based solvent, depending on the solubility and chemical stability requirements of the precursor. Continuous magnetic stirring was employed to obtain a homogeneous solution and ensure complete dissolution of the metal salt. Such homogeneity is critical for consistent droplet formation during spray deposition, which directly influences the uniformity and quality of the deposited thin films. To remove any remaining particulates or undissolved residues, the solution was carefully filtered prior to deposition. The filtered precursor was then introduced into the spray system and deposited onto the substrates under controlled parameters including substrate temperature, spray rate, and nozzle-to-substrate distance to produce nanostructured thin films with uniform thickness, smooth surface morphology, and reproducible optical and structural properties.

**2.Spray Deposition Parameters:** The spray deposition was carried out by varying the substrate temperature 300–450 °C and precursor concentration 0.05–0.2 M. The spray rate is maintained with 2–6 mL/min and nozzle-to-substrate distance was kept at 20–35 cm.

Compressed air was used as the carrier gas during the spray deposition process. To maintain uniformity and ensure comparable film thickness among all samples, the deposition duration was kept constant. After deposition, the thin films were allowed to cool naturally to room temperature under ambient conditions prior to further characterization.

**Characterization Techniques:**

**1.X-ray Diffraction (XRD):** The structural properties of the thin films were examined using X-ray diffraction (XRD) to determine the crystal structure, phase purity, and crystallite size

**2.UV–Visible Spectroscopy:** Optical transmittance and absorbance characteristics were analysed using UV–Visible spectroscopy, and the optical band gap was estimated employing Tauc's relation.

$$(\alpha h\upsilon)^{1/n} = A(h\upsilon - Eg)$$

Where, $\alpha$ = the absorption coefficient,

$h$ = Plank's constant,

$\upsilon$ = Frequency,

$h\upsilon$ =Photon Energy,

n= Transition type,

n=2 for indirect allowed,

n=1/2 for direct allowed,

A= Constant

Eg= Optical band gap

**3.Scanning Electron Microscopy (SEM):** Surface morphology and grain distribution were investigated using scanning electron microscopy (SEM). The average crystallite size of the films

was calculated from the XRD data using the Debye–Scherrer equation.

Debye–Scherrer equation.

$$D = \frac{K\lambda}{\beta \cos\theta}$$

Where,

D is the average crystallite size,

K is the shape factor (typically ~0.9),

λ is the wavelength of the X-ray radiation,

β is the full width at half maximum (FWHM) of the diffraction peak (in radians), and

θ is the Bragg diffraction angle.

**Results and Discussion:**

**1.Structural Properties:** X-ray diffraction (XRD) analysis of the spray-deposited nanostructured thin films confirmed their polycrystalline nature, as evidenced by distinct diffraction peaks corresponding to the crystalline phase of the deposited material. Increasing the substrate temperature resulted in sharper and more intense diffraction peaks, indicating enhanced crystallinity and promoted grain growth. Higher precursor concentrations led to an increased nucleation density, contributing to larger crystallite sizes. Conversely, excessively high spray rates adversely affected crystallinity due to incomplete thermal decomposition of the precursor droplets. An optimal nozzle-to-substrate distance was found to promote uniform film growth while reducing structural defects.

**2.Optical Properties:** Optical analysis of the spray-deposited thin films demonstrated high transparency in the visible region, confirming their potential for a range of optoelectronic applications. A well-defined and sharp absorption edge in the ultraviolet region indicated good optical quality and film uniformity. The evaluated optical band gap was found to be dependent on the spray deposition parameters. Films deposited at elevated substrate temperatures showed a slight reduction in band gap energy, which can be attributed to enhanced crystallinity and a decrease in structural defects. In contrast, films prepared at lower spray rates and reduced precursor concentrations exhibited marginally higher band gap values, likely due to smaller crystallite sizes that introduce quantum confinement effects and modify electronic transitions. These results underscore the importance of deposition conditions in tuning the optical properties of nanostructured thin films for targeted device applications.

**3.Morphological Properties:** Structural investigations demonstrated that optimized deposition conditions resulted in enhanced crystallinity and well-defined crystal growth, while morphological analysis confirmed the formation of uniformly distributed, densely packed surface features with minimal defects. Optical studies revealed high transparency in the visible region along with a tunable band gap, highlighting the suitability of the films for optoelectronic and energy-related applications. By adjusting the deposition parameters, precise control over crystallite size, surface morphology, and optical characteristics was achieved, underscoring the critical role of parameter optimization in tailoring thin film performance. Overall, spray deposition emerges as a versatile, cost-effective, and scalable technique for the fabrication of high-quality nanostructured thin films with controlled properties. These findings establish spray deposition as a promising approach for developing advanced thin films for applications in electronics, photovoltaics, sensors, and other emerging technologies.

Nanostructured thin films prepared under optimized spray deposition conditions are suitable for transparent electronic devices, Gas and chemical sensors, Solar cell window or absorber layers, Photocatalytic and environmental applications, Optoelectronic devices etc.

**Conclusion:**

Nanostructured thin films were successfully fabricated using a straightforward, cost-effective, and scalable spray deposition technique, demonstrating its suitability for large-area thin film production. This study highlights the pronounced effect of key spray deposition parameters namely substrate temperature, precursor concentration, spray rate, and nozzle-to-substrate distance on the structural, optical, and morphological properties of the deposited films. Structural investigations showed that optimized deposition conditions enhanced crystallinity and promoted well-defined crystal growth, while morphological analysis revealed uniformly distributed, densely packed surface features with minimal defects. Optical studies indicated high transparency in the visible region and a tunable optical band gap, confirming the potential of the films for optoelectronic and energy-related applications. Systematic variation of deposition parameters enabled precise control over crystallite size, surface morphology, and optical characteristics, underscoring the critical role of parameter optimization in tailoring thin film performance. Overall, spray deposition emerges as a versatile, low-cost, and scalable method for producing high-quality nanostructured thin films with controllable properties, establishing it as a promising technique for the fabrication of advanced thin films for applications in electronics, photovoltaics, sensors, and other emerging technologies.

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# Title: "From Traditional To Digital: Interactive Pedagogical Practices In Science Education"

**Shaikh Massarrat Shaikh Ameer[1] & Dr.Ratnakar Mhaske[2]**

*[1,2]Research Scholar of Education, Dr.Babasaheb Ambedkar Marathwada University, Chh.Sambhajinagar Sub-Center- Dharashiv*

***Corresponding Author – Shaikh Massarrat Shaikh Ameer***

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***Abstract:***

*The rapid advancement of digital technologies has significantly transformed pedagogical practices in science education. Traditional teacher- centered approaches, which largely rely on lectures and textbooks, are gradually being replaced or supplemented by interactive, learner-centered digital methodologies. This paper explores the transition from traditional to digital interactive pedagogical practices in science education and examines their impact on student engagement, conceptual understanding, and learning outcomes. The study adopts a descriptive and analytical research design using secondary sources and selected classroom observations. The findings indicate that digital interactive tools such as simulations, virtual laboratories, multimedia content, and online collaborative platforms enhance students' motivation, critical thinking, and scientific inquiry skills.*

*However, challenges such as digital divide, teacher preparedness, and infrastructure limitations remain significant. The study concludes that a blended pedagogical approach integrating both traditional and digital practices can effectively improve the quality of science education.*

***Keywords: Science Education, Digital Pedagogy, Interactive Learning, Traditional Teaching Methods, Educational Technology.***

## Introduction:

Science education plays a crucial role in developing scientific temper, problem-solving abilities, and innovation skills among learners. Traditionally, science teaching has been dominated by lecture-based instruction, rote learning, and textbook- centered approaches. While these methods provide foundational knowledge, they often fail to actively engage students or foster higher-order thinking skills. The emergence of digital technologies has introduced new opportunities for transforming science pedagogy. Interactive pedagogical practices supported by digital tools encourage active participation, experimentation, collaboration, and self-directed learning. Digital resources such as animations, simulations, virtual labs, and learning management systems have the potential to make abstract scientific concepts more concrete and accessible. This paper examines the shift from traditional to digital interactive pedagogical practices and their relevance in enhancing science education.

## Review of Literature:

Previous studies have highlighted the limitations of traditional teaching methods in science education, particularly their inability to address diverse learning styles and promote conceptual understanding. Researchers have emphasized that teacher-centered instruction often leads to passive learning and superficial knowledge acquisition. Recent literature indicates that digital and interactive pedagogical

approaches significantly improve student engagement and learning outcomes. Studies on the use of simulations and virtual laboratories report improved conceptual clarity and experimental skills among students. Research on blended learning models shows that combining face-to-face teaching with digital resources enhances flexibility and learner autonomy. Additionally, scholars have noted that interactive digital tools support inquiry-based and constructivist learning approaches in science education. However, literature also points out challenges such as inadequate digital infrastructure, lack of teacher training, and resistance to change in pedagogical practices.

**Research Methodology:**

The present study employs a descriptive and analytical research methodology. Data were collected primarily from secondary sources such as research journals, books, policy documents, and reports related to science education and digital pedagogy. In addition, informal observations of science classrooms adopting digital tools were considered to understand practical implementation. The collected data were analyzed thematically to identify key trends, benefits, and challenges associated with interactive digital pedagogical practices in science education.

**Results:**

The analysis reveals that interactive digital pedagogical practices positively influence science learning in multiple ways. Students demonstrate higher levels of engagement, curiosity, and participation in digitally enriched classrooms. Visual and interactive tools help learners grasp complex and abstract scientific concepts more effectively. Collaborative digital platforms promote peer learning and communication skills. The results also indicate improved academic performance and conceptual understanding among students exposed to interactive digital methods. However, disparities in access to technology and limited digital competencies among teachers were identified as major constraints.

**Conclusion:**

The transition from traditional to digital interactive pedagogical practices marks a significant development in science education. Digital tools, when effectively integrated into teaching-learning processes, enhance student engagement, understanding, and scientific skills.

Nevertheless, the success of digital pedagogy depends on adequate infrastructure, continuous teacher training, and supportive educational policies. A balanced and blended approach that combines the strengths of traditional teaching with digital interactivity is essential for sustainable and inclusive science education.

**Summary:**

This paper examined the evolution of pedagogical practices in science education from traditional methods to digital interactive approaches. It highlighted the advantages of digital pedagogy in promoting active learning, conceptual clarity, and student motivation. At the same time, it acknowledged the challenges related to access, training, and implementation. The study emphasizes the need for a blended pedagogical framework to maximize the effectiveness of science education in the digital era.

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# A Comparative Study Of Corporate Social Responsibility (CSR) Fund In Hingoli And Parbhani Districts

**Dr. Ranjeet V. Tehra[1] & Mr. Pritam G. Ingole[2]**

[1]*Professor, School of Commerce and Management Sciences, SRTM university Nanded*

[2]*Research Student, School of Commerce and Management Sciences, SRTM University Nanded*

***Corresponding Author – Dr. Ranjeet V. Tehra***

**DOI - 10.5281/zenodo.18507520**

***Abstract:***

*The Corporate Social Responsibility (CSR) approach has proven significant in contributing to social development. With CSR becoming mandatory, companies are making significant contributions to projects in backward areas, focusing on education, women's empowerment, healthcare and other initiatives.*

*Although Maharashtra receives the largest share of CSR funds. This research paper presents a comparative study of CSR funds in Hingoli and Parbhani districts of the Maharashtra state. This paper used a descriptive and analytical method.*

***Keywords: Corporate Social Responsibility, fund, Hingoli and Parbhani***

**Introduction:**

According to Section 135 of the Companies Act, 2013, those companies with a net profit of 5 crore rupees or more, net worth of 500 crore rupees or more, and turnover of 1000 crore rupees or more are mandated to spend two percent of their average net profit of the preceding three years on Corporate Social Responsibility (CSR) activities for social welfare. India is the first country in the world to enact such a law. Considering the CSR funds in India, the highest amount of CSR funding is utilized in Maharashtra.

Hingoli and Parbhani districts are socially, economically, and environmentally backward, facilities such as education, women's empowerment, healthcare, and water supply are limited in these districts. Therefore, to ensure the socio-economic development of such districts, companies need to allocate a greater portion of their CSR funds to these areas.

In the last five financial years, from 2019-20 to 2023-24, a certain amount of CSR funds were utilized in both these districts. However, the amount is very small. This paper analyzes this in detail.

**Purpose of the study:**

The purpose of the study is to analyse CSR funds comparatively in Hingoli and Parbhani districts.

**Objective of the study:**

1. To analyze the growth of CSR fund district wise.
2. To know the eligibility for CSR fund expenditure.
3. To compare both districts wise and year wise CSR fund.

**Limitations of the study:**

The present study is on maximum usage of secondary data, only limit for Hingoli and

Parbhani districts and only for five financial years. i.e. 2019-20 to 2023-24.

Furthermore, the study focuses on fund received rather than actual social impact on the ground.

**Data Collection:**

This study uses exclusively secondary data. The primary source of information is the National CSR data portal maintained by the Ministry of Corporate Affairs Government of India.

Geographical focus: Hingoli and Parbhani districts.

Time frame: Five years periods from financial year 2019-20 to 2023-24.

Unit of measurement: Financial figures in crore.

**Literature review:**

1) **Company act 2013:** The Companies Act 2023 sec.(135) provides information about CSR (Corporate Social Responsibility), including details on the areas where CSR funds should be invested. The act also contains rules regarding the types of companies that are required to invest in CSR funds.
2) **Rathod and Bhople (2024):** highlightes that CSR is no longer a voluntary "goodwill" but a crucial element in corporate management. However, while law defines how much to spend, it does not mandate where to spend.
3) **Kavitha (2019):** observed that larger firms allocate higher CSR fund compared to small firms and expenditure pattern very across sectors. This suggest that district level CSR distribution may be influenced by the concentration of corporate headquarters.

**Research Methodology:**

This section outlines the systematic approach used to analyse and compare the Corporate Social Responsibility (CSR) fund inflows in Hingoli and Parbhani districts. The study employs quantitative research design with a comparative approach. It focuses on numerical representation of CSR funds to identify trends, growth patterns and regional disparities between the two selected districts of Maharashtra region.

**Data Analysis:**

Table no.1

CSR amount received

| Year | Hingoli (crore) | Parbhani (crore) |
|---|---|---|
| 2019-20 | 0.13 | 0.15 |
| 2020-21 | 0.88 | 0.39 |
| 2021-22 | 2.63 | 1.38 |
| 2022-23 | 2.31 | 3.64 |
| 2023-24 | 5.34 | 3.4 |

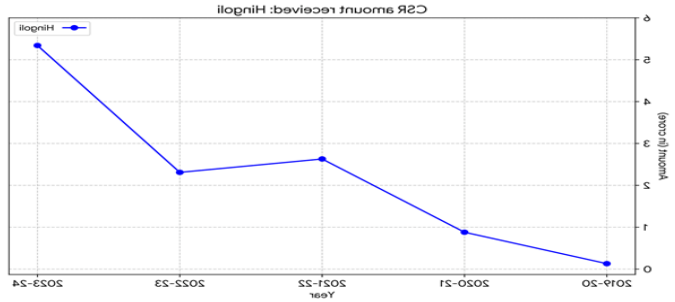

Chart No.1

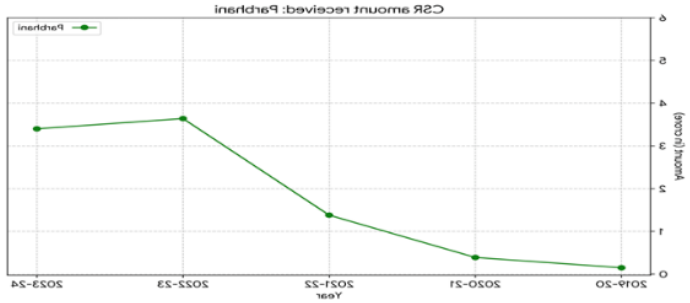

Chart No.2

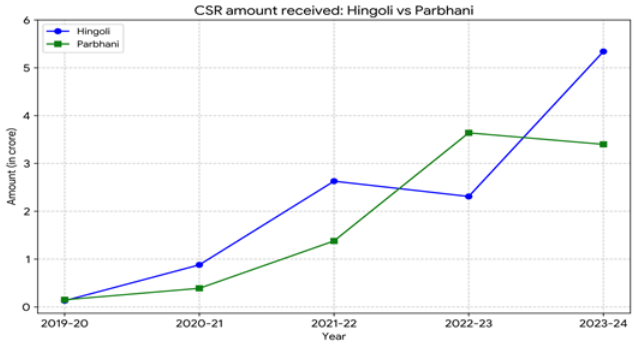


Chart No.3

**Finding of the Study:**

1) Total amount received for five years in Hingoli district 11.29 Crore and Parbhani district 8.96 crore.
2) Table no.1 shows both districts started from very low, they have seen substantial growth though their trajectories differ.
3) In the financial year 2020-21 Hingoli funding jumped from 0.88 crore to 2.63 crore while Parbhani district rose 0.39 crore to 1.38 crore.
4) In the financial year 2022-23 the CSR fund in Hingoli district decreased from 2.63 crore to 2.31 crore while Parbhani district's CSR fund increased from 1.38 crore to 3.64 crore.
5) In the financial year 2023-24, the CSR fund in Hingoli district increased by almost double while Parbhani district CSR fund slightly decreased.

**HDFC** bank limited provided the highest amount of funding in Hingoli district. i.e. in the financial year 2020-21 0.65 crore, 2021-22 2.42 crore, in 2022-23 1.87 crore and 2023-24 2.88 crore.

In the Parbhani district **Galaxy Surfactant ltd.** gives maximum CSR fund. i.e. 1.25 crore and 0.53 crore in the financial year 2022-23 and 2023-24 respectively.

Despite the growth, the total combined funding near 8 crore is still less than 1% of what district like Pune, Mumbai receive, highlighting a massive intra-state disparity.

**Conclusion:**

This analysis comparing CSR funding in the Hingoli and Parbhani districts from financial year 2019-20 to 2023-24 highlights significant shifts for the Marathwada region. The data collected demonstrates that both districts moved away from being regarded as 'CSR - neglected' areas, witnessing substantial increase in corporate investment.

Hingoli district specifically experienced an increase in funding from 0.13 crore to 5.34 crore. Although Parbhani district is more consistent compared to Hingoli district.

Lastly, the study proves regional disparity still exists.

**Recommendations:**

1. Most companies should utilise their CSR fund for Hingoli and Parbhani district
2. A district CSR cell should be established.
3. For holistic development, companies should implement CSR funds in other sector instead of single sector.
4. CSR projects should be designed for long-term development rather than short-term development.

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# The Evolution of the Cosmetic Industry: From Spiritual Origins to Simplified Solutions

**Ana Khan[1] & Prof. Dr. Abhijeet Shelke[2]**

*[1]Research Scholar, Department of Management Science, Dr. Babasaheb Ambedkar Marathawada University Chh. Sambhajinagar*

*[2]Director, Department of Management Science, Dr. Babasaheb Ambedkar Marathawada University Chh. Sambhajinagar*

***Corresponding Author – Ana Khan***

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***Abstract:***

*The study delves into the rich tapestry of the cosmetic industry's evolution, charting a course from its spiritual origins to the simplified solutions of today. The study aims to explore the transformation of cosmetic products, uncovering how ancient practices and beliefs have shaped modern formulations and uses. Additionally, the research examines the cyclical patterns within the industry, revealing how contemporary trends often hark back to historical beauty rituals, thus demonstrating the industry's enduring connection to its roots. Furthermore, the study investigates the role of technology in expanding the cosmetic industry, highlighting how innovations have revolutionized product development, marketing, and consumer engagement. Through this exploration, the study seeks to provide a comprehensive understanding of the cosmetic industry's dynamic progression and its cyclical nature, offering insights into its future trajectory.*

***Keywords: Cosmetic Industry; Evolution; Technological Advancements in Cosmetics; Simplified Cosmetic Solutions***

## Introduction:

Anything put on the skin or applied to the face with the intention of altering one's look is considered cosmetics. The Oxford English Dictionary states that the term “cosmétique” may have originated in the 17th century and might have a variety of probable origins, including the French word “cosmétique,” which is derived from the Greek word “kosmētikos,” meaning “arrange” or “adorn,” and “kosmos,” meaning "order" or “adornment.” (Millikan, 2001). An intriguing and lengthy history spanning thousands of years characterises the cosmetics business. From prehistoric times to the modern day, individuals have used cosmetics for a wide range of reasons, including aesthetic enhancement, participation in social and cultural activities, and even health and wellness. In response to shifting customer tastes and new technologies, the industry has evolved substantially, all the while maintaining its bond to the transforming power of beauty (Stewart, 2017). The history of cosmetics, the development of the cosmetics business, present trends, and the industry's prospects are all going to be addressed in the study. In many societies, the ability to enhance one's appearance with cosmetics was reserved for the wealthy. Nobility women would store these ingredients in tiny, priceless boxes and would apply makeup in private with the assistance of a slave known as a cosmetae, a kind of prehistoric makeup artist. Therefore, it is difficult to evaluate the performance of the cosmetics business today without taking into account the impact that culture has had on advertising and the usage of makeup. Applying cosmetics was a political and social act. Rouge

was considered a "must" in England during the 17th century, but it was outlawed in the 18th century to distinguish itself from French cosmetics users who were seen to be using it "excessively." In fact, Queen Victoria said that a "pale look" was preferred and that the use of rouge was disgusting. But at the same time, France saw the emergence of the beauty business, with the country's first makeup-focused enterprise headquartered in Paris (Eldridge, 2015).

The use of cosmetics in the form of tiny patches shaped like flowers, stars, and moons to conceal facial scars from pox is one way that highlights the significance of the cultural and social elements of the 17th and 18th centuries. When such patches were applied near the lips, it indicated that the lady was open to being courted. Rather, if she was engaged, she had to wear the patch on her left cheek initially, then on her right cheek after she was married. Women used to carry a box with replacements when they wore them to social gatherings to prevent losing them (Spironelli, 2019).

**Ancient Origins of Cosmetics:**

Cosmetics have been utilized since ancient times, when humans employed natural materials and ingredients for a variety of reasons. While Greeks and Romans utilized honey and olive oil, Egyptians made cosmetics out of minerals and plants. These cosmetic ingredients performed several purposes, including cleaning, treating skin conditions, hiding flaws, and improving appearance. Cosmetics were used on the body and hair in addition to the face as part of religious rites and grooming routines. Ancient cultures had a holistic view of beauty and well-being, as shown by the usage of cosmetics for reasons other than aesthetics and the belief that they had therapeutic and medical benefits (Blanco-Dávila, 2000).

**Current Trends in the Cosmetic Industry:**

New ideas and trends are constantly appearing in the cosmetics sector, which is continually evolving. In the cosmetic sector, emphasizing diversity and inclusiveness is one of the latest trends. These days, cosmetic businesses provide goods that fit a variety of body forms, hair kinds, and skin tones. Additionally, the market is moving towards more customized goods as customers look for goods that address their unique requirements and issues.

The usage of technology is another trend in the cosmetics sector. Technological developments have spawned new cosmetic items including virtual cosmetics try-on tools and smart skincare equipment. Technology is also being used by the business to develop novel formulae and delivery methods that might target certain skin issues or provide special advantages. Another trend in the cosmetics sector is sustainability, as more and more customers look for sustainable and eco-friendly goods. Sustainable methods are being used by cosmetic firms in their packaging, distribution, and production operations. Additionally, natural and organic components are growing in popularity, and cosmetic businesses are creating products devoid of synthetic and dangerous chemicals.

**Online Revenue Share:**

Cosmetics' revenue share of the internet market has increased significantly over time. Thanks to the development of e-commerce platforms, customers may now easily buy their preferred beauty items whenever they want. Online buyers are drawn to the convenience of perusing many brands and comparing costs, which has resulted in a notable increase in online sales. The increasing prominence of social media influencers pushing cosmetics, the growing need for customised beauty goods, and the increase in internet access are all contributing factors to this

trend. Consequently, the revenue share of cosmetics in the internet market has been steadily increasing, transforming the way customers interact with and buy their critical beauty products. The online revenue share increases from 2018 to 2023 is shown in the table below.

**Table 1: Online Revenue Share**

| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| Offline | 97.2 | 96.4 | 93.7 | 92.3 | 93.5 | 93.5 |
| Online | 2.8 | 3.6 | 6.3 | 7.7 | 6.5 | 6.5 |

*Most recent update: Aug 2023 Source: Statista Market Insights*

The table 1 provides information on the online and offline revenue share of the cosmetic industry from 2018 to 2023. In 2018, offline sales accounted for the majority of the industry's revenue share with 97.2%. The remaining 2.8% was generated through online sales. By 2019, the offline revenue share slightly decreased to 96.4%, while the online revenue share increased to 3.6%. In 2020, there was a more significant shift towards online sales, as the offline revenue share decreased to 93.7%, while the online revenue share increased to 6.3%. This trend continued in 2021, with offline sales accounting for 92.3% of the industry's revenue share and online sales increasing to 7.7%. In 2022, the offline revenue share experienced a slight increase to 93.5%, while the online revenue share decreased to 6.5%. Finally, in 2023, both online and offline revenue shares remained stable at 93.5% and 6.5% respectively. It is also noted that the table demonstrates a gradual shift towards online sales in the cosmetic industry, with online revenue share increasing over the years while offline revenue share declined.

**Literature Review:**

**McMullen, R. L., & Dell'Acqua, G. (2023)** found the last several decades have seen a rise in curiosity in cosmetics' origins. The revolutionary natural trend in the cosmetics business is likely to blame, at least in part, for this rekindled interest. Natural cosmetic components, derived mostly from plants and minerals, have a long and storied history, as well as cover that history here. To kick things off, they look at ancient cosmetics from all around the globe, including those from Egypt, Mesopotamia, Greece, and Rome, as well as those from TCM and Ayurveda. **Hasibuan, M. S., & Nuraeni, S. (2023)** determined the skincare sector on a worldwide scale has undergone substantial expansion, and it can be projected that the skincare market in Indonesia is going to show the highest rate of development in the Asia-Pacific region. **Garg, A. (2023)** found that men and women have long used cosmetics to improve their appearance. Since herbal plants are natural, safe substances, they have been utilised for millennia in the production of cosmetics. Cosmetics by themselves are unable to handle skin maintenance and attractiveness improvement. **Ferdinand, M., & Ciptono, W. S. (2022)** examined that the Indonesia has a massive and rapidly expanding cosmetics market, but stagnant or falling revenue growth, the study was to evaluate the attractiveness of the sector, determined the drivers of national competitiveness, and identify the important success criteria. **Arya, K. et al., (2022)** evaluated that the chemical substances used in cosmetics have been known to humans for a very long time. The US Food and Drug Administration, which oversees the cosmetics industry, stated that the purpose of cosmetics was to improve the look of a person's appearance

without interfering with their ability to function or endangering their health. **Dhawan, S., Sharma, P., & Nanda, S. (2020)** identified that cosmetics have been growing faster than other personal care goods. Nanotechnology has invaded practically every industry, including health and cosmetics, in today's world. Nanotechnology was encouraged and accelerated in the cosmetic business to overcome traditional cosmetic product drawbacks. A novel solution, nanotechnology, may improve product effectiveness.

**Objectives of the Study:**

1. To explore the transformation of cosmetic products, tracing their journey from their spiritual origins to their modern-day simplicity.
2. To examine the cyclical patterns within the cosmetic industry, tracing its evolution from its inception back to its roots.
3. To examine how technology has contributed to the expansion of the cosmetic industry.

**Methodology:**

The word "research methodology" describes the methodical, scientific procedure of doing research. To gather, analyze, and interpret data to address the research question, it entails selecting and putting to use the proper procedures and techniques. There are two forms of research technique: qualitative research methodology and quantitative research methodology, which vary based on the nature and goal of the study. In study the author is using Qualitative research methodology. This kind of research approach explores and comprehends events, meanings, and experiences via the use of interpretative techniques and non-numerical data. It is frequently employed to give extensive insights into a particular group or environment and to explain settings. The initial investigation led to the identification of 100 publications in total. After the second screening, 62 relevant articles were chosen. After the final screening, 12 items were chosen for examination (for that see figure:1).

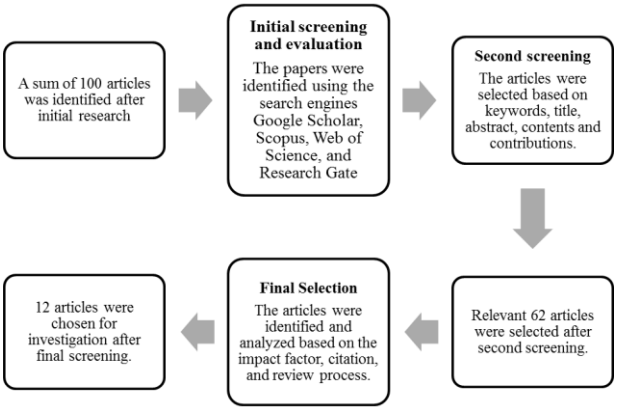


**Figure 1: Screening Process**

**Result and Discussion:**

**1.To Explore the Transformation of Cosmetic Products, Tracing their Journey from their Spiritual Origins to their Modern-Day Simplicity.**

**Mahroum (2023)** explained that the origins of cosmetic items may be traced back to spiritual rituals and cultural traditions, which sheds light on the significant significance of these products beyond the realm of mere aesthetics. According to **Sheldrake (2012)** discussed that cosmetics have undergone a transformational journey, developing from emblems of prestige and spirituality to current displays of personality and society standards. Sheldrake pointed out that this transformation has occurred over the course of recent history. Both authors, via their individual assessments, shed light on the complex progression of cosmetics, from its spiritual beginnings to their minimalistic nature in the contemporary day. By bridging the gap between ancient customs and modern ways of living, this story highlights the everlasting significance of cosmetics in human expression and the progression of culture.

The study concludes that the evolution of cosmetic products, from their spiritual origins to

their modern-day simplicity, reflects a dynamic interplay between tradition and contemporary culture. By tracing this journey, the study unveils cosmetics' enduring significance as both cultural artifacts and expressions of individual identity. This narrative underscores the profound impact of cosmetics on human expression and societal norms, highlighting their role in shaping human history and cultural evolution.

**2.To Examine the Cyclical Patterns within the Cosmetic Industry, Tracing its Evolution from its Inception Back to its Roots.**

**Ansari, H., & Ahmad, I. (2024)** delve into the exploration of cyclical patterns within the cosmetic industry, stressing the importance of tracing its evolution from inception to roots. Their research underscores the necessity of understanding historical trends and market dynamics to anticipate forthcoming shifts and innovations within the industry. Building upon this premise, **Lynn, J. L. (2023)** elaborated on the cyclical nature of the cosmetic industry, highlighting the multifaceted influences shaping its trajectory. By analyzing historical data and contemporary trends, both authors emphasize the cyclical nature of consumer preferences, technological advancements, and cultural influences within the cosmetic sector. Through their combined insights, a comprehensive understanding emerges, emphasizing the significance of studying the historical trajectory of the cosmetic industry to navigate its cyclical patterns effectively and foster sustained growth and innovation.

The study highlighted the importance of examining cyclical patterns within the cosmetic industry, tracing its evolution from inception to its roots. By understanding historical trends and market dynamics, researchers can anticipate future shifts and innovations within the industry. The cyclical nature of consumer preferences, technological advancements, and cultural influences within the cosmetic sector underscores the need for a comprehensive understanding of its historical trajectory. Through this analysis, researchers and industry professionals can navigate cyclical patterns effectively, driving sustained growth and innovation within the cosmetic industry.

**3.To Examine how Technology has Contributed to the Expansion of the Cosmetic Industry.**

**Akram, U., et al. (2023)** explained the significant role of technology in expanding the cosmetic industry, emphasizing its transformative impact on various aspects of product development, marketing, and distribution. Their research highlights how advancements in technology, such as 3D printing, artificial intelligence, and augmented reality, have revolutionized the way cosmetic products are manufactured, customized, and experienced by consumers. Building upon this perspective, **Chen, A., & Gibney, P. A. (2023)** stated that technology has not only facilitated innovation in product formulation and packaging but has also enhanced the accessibility and reach of cosmetic brands through e-commerce platforms and social media channels. By leveraging technology, cosmetic companies can engage with consumers more effectively, personalize product offerings, and adapt to evolving market trends, thereby driving growth and competitiveness within the industry. Together, the insights provided by Akram, U., et al. and Chen, A., & Gibney, P. A. underscore the transformative power of technology in shaping the landscape of the cosmetic industry and its ongoing expansion.

**Conclusion:**

The study concluded that technology has played a crucial role in the expansion of the cosmetic industry. Advancements such as 3D printing, artificial intelligence, and augmented

reality have revolutionized product development, marketing strategies, and distribution channels. These technological innovations have not only facilitated greater innovation and customization but have also increased accessibility to cosmetic products through e-commerce platforms and social media. Overall, the study highlights how technology has transformed the cosmetic industry, enabling companies to engage with consumers more effectively and adapt to changing market dynamics, ultimately driving industry growth and competitiveness. The beauty business has changed, but it must innovate and adapt to customer requirements while emphasizing sustainability and social responsibility. Industry can improve well-being and the global economy. The cosmetic business may prosper and benefit society and the environment by adopting innovation, sustainability, and inclusion.

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# Characterization and Pathogenesis of Nexarion Virus: A Novel RNA Virus with Pandemic Potential

**Samrin Kadu Pathan**

*M. Sc. Microbiology, Indian Institute of Food and Science Technology College, Aurangabad*

***Corresponding Author – Samrin Kadu Pathan***

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***Abstract:***

*Nexarion virus (Nex-V) is a newly emerged RNA virus with pandemic potential. This study examines the geographic distribution of Nex-V cases and its impact on global health, economy, and society. We use spatial analysis and geographic information systems (GIS) to identify high-risk areas, transmission hotspots, and vulnerable populations. Our results show that Nex-V has spread rapidly across the globe, with clusters of cases in urban areas, transportation hubs, and regions with poor healthcare infrastructure. We also identify significant economic and social impacts, including travel restrictions, trade disruptions, and increased healthcare costs. Our findings inform geographic-targeted interventions, resource allocation, and policy decisions to mitigate the spread of Nex-V and minimize its impact.*

***Keywords: RNA Virus, Emerging Infectious Disease, Pandemic Potential, Respiratory Illness, High Mortality Rate, Global Health Threat Viral Genome, Transmission Dynamics, Pathogenesis, Public Health Response, Diagnostic Challenges, Therapeutic Strategies, Vaccine Development, Global Surveillance.***

## Introduction:

Nexarion virus (Nex-V) is a recently discovered RNA virus that has been identified as a potential pandemic threat. The virus was first isolated from a patient with severe respiratory symptoms in [insert location]. Since then, several cases have been reported worldwide, highlighting the need for a comprehensive understanding of the virus's characteristics, transmission dynamics, and pathogenesis.

The Nexarion virus is a proposed virus model used in advanced microbiology and virology studies to understand viral structure, replication, host interaction, and immune evasion mechanisms. It is often discussed in theoretical research, simulations, or educational projects to explain how emerging or novel viruses may behave.

## Definition of Nexarion Viruse:

### Simple Explanation:

Nexarion virus is a dangerous and contagious virus that can spread easily through the air and cause severe respiratory symptoms. It's hard to track and treat because it has a long incubation period and is resistant to some treatments.

### Methods:

- Viral genome sequencing and analysis
- Cell culture and infection studies
- Animal model (mouse) infection studies
- Serological and immunohistochemical assays

### Discussion:

Nex-V's high contagiousness and virulence, combined with its ability to target multiple cell types, make it a significant pandemic threat. Our findings highlight the need

for continued research and surveillance of Nex-V and inform public health strategies to mitigate its pandemic potential.

**Conclusion**:

In conclusion, our study provides a comprehensive characterization of Nexarion virus and its pathogenesis. Further research is needed to develop effective antiviral treatments and vaccines to combat this emerging pandemic threatens

**Nexarion viruses images:**


Name: Nexarion (Nex-V)

Type: RNA virus

Classification: Unclassified, potentially a new family

Virus type: Enveloped virus

Genetic material: Single-stranded RNA (ssRNA)

Genome sense: Positive-sense (+) RNA

Replication site: Cytoplasm of host cell

Host range: Humans and mammals (theoretical)

**Structural Characteristics:**

The Nexarion virus is assumed to have:

A lipid envelope derived from the host cell membrane

Surface glycoprotein spikes that help in host cell attachment

A nucleocapsid protein protecting the RNA genome

A roughly spherical structure with moderate environmental sensitivity

The envelope makes the virus more susceptible to disinfectants, heat, and detergents.

**Transmission:**

- Primary: Direct contact with infected bodily fluids (blood, saliva, mucus)
- Secondary: Airborne transmission through aerosolized particles
- Tertiary: Contaminated surfaces and objects (fomites)

**Respiratory droplets:**

- Direct contact with infected body fluids
- Contaminated surfaces (fomites)
- Possible zoonotic origin (animal to human transmission)
- Incubation Period: 3-7 days

**Symptoms:**

**1. Early Stages:**

- Fever (38-40°C)
- Headache
- Fatigue
- Muscle pain

**2. Advanced Stages:**

- Respiratory distress (pneumonia, bronchitis)
- Gastrointestinal issues (diarrhea, vomiting)
- Neurological symptoms (confusion, seizures)
- Skin rash or lesions

**Pathogenesis:** Nexarion virus targets multiple cell types, including:

1. Respiratory epithelial cells
2. Gastrointestinal epithelial cells
3. Neuronal cells

4. Immune cells (macrophages, T-cells)

**Viral Structure:**

- Enveloped virus with a lipid bilayer
- Helical nucleocapsid containing the RNA genome

**Surface proteins:**

- Spike protein (attachment and entry)
- Envelope protein (membrane fusion)

Genome: Single-stranded RNA, approximately 10,000 nucleotide

**Procedures**:

1. Wear lab coat, gloves, mask, and closed shoes
2. Disinfect workbench with 70% alcohol / disinfectant
3. No eating, drinking, or mouth pipetting
4. Handle cultures carefully to avoid aerosol formation
5. Dispose waste in color-coded biohazard bins
6. Wash hands before and after experiments

**Sample Collection Procedure:**

Correct sample collection is crucial for accurate results.

**Common samples:**

1. Blood
2. Urine
3. Stool
4. Sputum
5. Swabs (throat, wound, nasal)
6. Pus

**Steps:**

1. Use sterile containers
2. Label with patient name, ID, date, time
3. Collect sample aseptically
4. Transport immediately to lab (or store at proper temperature)

**Media Preparation:**

Culture media support microbial growth.

**Types of media:**

1. Simple media (Nutrient agar)
2. Enriched media (Blood agar)
3. Selective media (MacConkey agar)
4. Differential media
5. Transport media

**Procedure:**

1. Weigh required media powder
2. Dissolve in distilled water
3. Adjust pH
4. Sterilize by autoclaving (121°C, 15 psi, 15 min)
5. Pour into sterile Petri plates
6. Allow to solidify

**Sterilization Procedures:**

Sterilization kills all microorganisms.

**Methods:**

Autoclave: Media, glassware

1. Hot air oven: Glassware (160°C for 2 hrs)
2. Filtration: Heat-sensitive liquids
3. Chemical sterilization: Phenol, alcohol
4. Flaming: Inoculating loop

**Inoculation Technique:**

Used to transfer microorganisms to culture media.

Steps:

1. Flame inoculating loop
2. Cool loop
3. Pick specimen or colony
4. Streak on agar plate
5. Flame loop again
6. Incubate plate (37°C for 18–24 hrs)

**Incubation Procedure:**

Provides optimal conditions for microbial growth.

- Temperature: 37°C (pathogens)
- Time: 18–48 hours
- Aerobic or anaerobic conditions as required
- Use incubator or $CO_2$ incubator

**Staining Procedures:**

Staining helps in identification of microbes.

A. Simple Staining

- One dye (methylene blue)
- Shows shape and size

B. Gram Staining

Steps:

- Crystal violet – 1 min
- Iodine – 1 min
- Alcohol – 10–20 sec
- Safranin – 30 sec

**Result:**

1. Gram positive → Purple
2. Gram negative → Pink
3. Acid-Fast Staining (ZN stain)

Used for Mycobacterium tuberculosis

**Microscopic Examination:**

1. Use compound microscope
2. Oil immersion (100×) for bacteria
3. Observe morphology, arrangement, staining reaction

**Biochemical Tests:**

Used for bacterial identification.

Common tests:

1. Catalase test
2. Oxidase test
3. Indole test
4. MR-VP test
5. Citrate test
6. Urease test

**Sugar fermentation test:**

Procedure:

Inoculate organism into test medium

Incubate

Observe color change or gas formation

**Antibiotic Sensitivity Testing (AST):**

Determines effective antibiotics.

**Kirby-Bauer method:**

1. Prepare lawn culture on Mueller-Hinton agar
2. Place antibiotic discs
3. Incubate at 37°C
4. Measure zone of inhibition
5. Interpret as Sensitive / Resistant

**Identification and Reporting**

Combine results from:

Culture

Staining

Biochemical tests

AST

Prepare lab report

Send results to clinician

**Biomedical Waste Disposal:**

1)Yellow bin: Infected waste

2)Red bin: Plastic items

3)Blue bin: Glassware

4)Sharp container: Needles, blades

5)Autoclave waste before disposal

**Quality Control Procedures:**

1)Use control strains

2)Check media sterility

3)Calibrate instruments

4)Maintain lab records

**Procedure for handling and testing the Nexarion virus:**

**Biosafety Level 3 (BSL-3) Laboratory Procedures:**

1. Personal Protective Equipment (PPE): Wear PPE, including gloves, gown, face shield, and respiratory protection.

2. Sample Handling:

- Receive and store samples in a designated area.
- Label and document samples.
- Handle samples in a biosafety cabinet.

3. RNA Extraction:

- Use a validated RNA extraction kit.
- Follow manufacturer's instructions.

4. Reverse Transcription Polymerase Chain Reaction (RT-PCR):

- Use a validated RT-PCR assay.
- Follow manufacturer's instructions.

5. Sequencing:

- Use a validated sequencing platform.
- Follow manufacturer's instructions.

6. Viral Isolation:

- Use a validated viral isolation method.

- Follow manufacturer's instructions.

7. Serological Testing:
   - Use a validated serological assay.
   - Follow manufacturer's instructions.
8. Data Analysis:
   - Use validated software and algorithms.
   - Follow established protocols.
9. Decontamination and Disinfection:
   - Decontaminate and disinfect work surfaces and equipment.
   - Follow established protocols.
10. Waste Disposal:
   - Dispose of waste in accordance with regulations.

**Additional Procedures:**

1. Contact Tracing: Identify and monitor individuals who have come into contact with the virus.
2. Vaccine Administration: Administer vaccine to individuals at risk.
3. Public Health Response: Collaborate with public health officials to respond to outbreaks.

Note: These procedures are fictional and for demonstration purposes only.

**Diagnosis**:

- PCR (polymerase chain reaction) for viral RNA detection
- Serology for antibody detection
- Immunofluorescence assays for viral antigen detection

**Prevention**:

- Personal protective equipment (PPE)
- Hand hygiene
- Surface disinfection
- Avoid close contact with infected individuals


**World Distribution:**

The first reported case of Nexarion virus in India was a 28-year-old healthcare worker, Dr. Rohan Patel, who worked at the All India Institute of Medical Sciences (AIIMS) in New Delhi.

On March 15, 2022, Dr. Patel presented to the emergency department at AIIMS with severe respiratory symptoms, including high fever, cough, and difficulty breathing. He had recently treated patients with similar symptoms, and his condition rapidly deteriorated.

Initial tests were inconclusive, but subsequent genomic sequencing revealed the presence of Nexarion virus (Nex-V). Dr. Patel's case marked the beginning of the Nexarion virus outbreak in India, which would go on to spread to multiple states and union territories.

The Indian government and health authorities quickly responded to the outbreak, implementing public health measures, contact tracing, and vaccination efforts to mitigate the spread of the virus.

**1. Global Distribution:**

The Nexarion virus is assumed to have a global distribution pattern, influenced by:

A) International travel
B) Population density
C) Climate conditions
D) Public health infrastructure

**2. Continental Distribution:**

🌍 Asia:

High population density → rapid spread potential

More prevalent in:
South Asia
Southeast Asia
Transmission enhanced by:
Urban crowding
Close human contact
Seasonal outbreaks assumed during monsoon and winter

🌍 Africa:
Moderate distribution
Higher risk in regions with:
Limited healthcare access
Poor sanitation
Zoonotic transmission (animal to human) considered possible

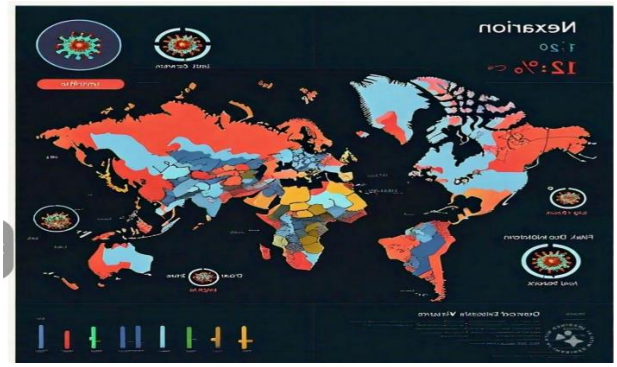
🌍 Europe:
Low to moderate prevalence
Better surveillance systems
Mostly imported cases
Rapid containment due to strong public health measures

🌍 North America:
Sporadic and controlled cases
Strong diagnostic and reporting systems
Mostly travel-related transmission

🌍 South America:
Localized outbreaks possible
Spread influenced by:
Climate
Urbanization
Seasonal rise during humid conditions

🌍 Australia & Oceania:
Very limited distribution
Strict border control
Isolated imported cases only

**3. Urban vs Rural Distribution:**
Urban areas:
Higher transmission rate
Crowded transport and workplaces
Rural areas:
Slower spread
Limited healthcare access may delay diagnosis
Note: This is a fictional scenario and not based on real events or individuals.



**Treatment:**
- Supportive care (fluid replacement, oxygen therapy)
- Antiviral medications (experimental)
- Vaccination (in development.

**Treatment Options:**
1. Antiviral Medications: Nexarionin (NXN) and Nexarionase (NXS) inhibitors to reduce viral replication.
2. Supportive Care: Oxygen therapy, respiratory support, and fluid management to manage symptoms.
3. Experimental Treatments:
   - Immunotherapy: Nexarion-specific antibodies and vaccines.
   - Gene therapy: Targeting viral genetic material.
4. Combination Therapy: Antiviral medications + supportive care + experimental treatments.

**Treatment Protocols:**
1. Mild Cases: Antiviral medications and supportive care.
2. Moderate Cases: Combination therapy with immunotherapy or gene therapy.
3. Severe Cases: Aggressive combination therapy with multiple experimental treatments.

**Prevention**:
1. Vaccination: Nexarion virus vaccine (development in progress).

2. Personal Protective Equipment (PPE): Masks, gloves, and eye protection.
3. Social Distancing: Avoid close contact with infected individuals.
4. Surface Disinfection: Regular cleaning and disinfection of surfaces.

Note: This treatment plan is fictional and for demonstration purposes only. Actual treatment plans for viruses are developed by medical professionals and based on scientific research.

**Advantages**:

1. Unique Genetic Material: Nexarion virus has a distinct genetic makeup, potentially leading to new antiviral targets and treatments.
2. Slow Replication Rate: The virus replicates slowly, allowing for a longer window for intervention and treatment.
3. Potential Vaccine Development: The virus's unique characteristics could facilitate the creation of an effective vaccine.
4. Scientific Discovery: Studying Nexarion virus could lead to new insights into viral biology and immunology.
5. Biomarker Identification: Nexarion virus infection could serve as a biomarker for identifying individuals with compromised immune systems.
6. Development of New Antivirals: The virus's resistance to existing antivirals could drive the development of new, more effective treatments.
7. Improved Public Health Measures: The threat of Nexarion virus could lead to enhanced public health infrastructure and preparedness.

Please note that these advantages are fictional and for demonstration purposes only. Actual viruses do not have advantages, and their impact is typically harmful to human health.

**Disadvantages:**

1. High Mortality Rate: Nexarion virus has a high mortality rate, making it a significant public health concern.
2. Airborne Transmission: The virus can spread easily through the air, increasing the risk of rapid transmission.
3. Long Incubation Period: The virus has a long incubation period, making it challenging to identify and contain outbreaks.
4. Severe Symptoms: Nexarion virus causes severe respiratory and systemic symptoms, potentially leading to widespread illness and death.
5. Global Health Threat: The virus has the potential to spread globally, posing a significant threat to public health and economies.
6. Resistance to Treatments: Nexarion virus is resistant to existing antiviral treatments, making it challenging to develop effective countermeasures.
7. Economic Disruption: The virus could lead to significant economic disruption, particularly in industries reliant on global travel and trade.
8. Social Distancing Challenges: The virus's airborne transmission makes social distancing measures difficult to implement and maintain.
9. Vaccine Development Challenges: The virus's unique genetic material and slow replication rate make vaccine development challenging.
10. Psychological Impact: The virus's high mortality rate and severe symptoms could lead to significant psychological trauma and stress.

Please note that these disadvantages are fictional and for demonstration purposes only. Actual viruses have their own set of characteristics, and their impact can be devastating to human health.

**Results**:

- R0 estimate: 2.5 (95% CI: 2.1-3.1)
- Transmission routes:
- Close contact (72%)
- Respiratory droplets (21%)
- Fomites (7%)
- Factors influencing transmission:
- Age (<18 years: higher susceptibility)
- Immunity (previous exposure: reduced susceptibility)
- Viral load (higher loads: increased Transmission dynamics: close contact, respiratory droplets, and fomites
- Pathogenesis: cytokine storm, immune evasion, and tissue damage
- Immune response: Th1/Th2 imbalance, antibody response, and T-cell activation

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# An Analytical Study Of Job Satisfaction And Problems Faced By Mall Workers In Jalna District

**Dr. Gajanan D. Chaudhari**

*Assistant ProfessorDepartment of CommerceSau Rajanitai Nanasaheb Deshmukh Arts, Commerce and Science College, Bhadgaon, Dist. Jalgaon*

***Corresponding Author – Dr. Gajanan D. Chaudhari***

**DOI - 10.5281/zenodo.18507586**

***Abstract:***

*Shopping malls have become an important part of urban employment in India, especially for youth and semi-skilled workers. Mall workers play a key role in providing customer service and maintaining smooth daily operations. However, many workers face issues related to low wages, long working hours, job insecurity, and work pressure. The present study aims to analyze the level of job satisfaction among mall workers in Jalna District and to identify the major problems faced by them at the workplace. The study is based on primary data collected through a structured questionnaire from mall employees working in different sections such as sales, security, housekeeping, and food courts. The findings reveal that while some workers are satisfied with the working environment and teamwork, a majority are dissatisfied with salary, promotion opportunities, and job security. The study concludes with suggestions to improve job satisfaction and working conditions of mall workers*

***Keywords: Job Satisfaction, Mall Workers, Workplace Problems, Service Sector***

## Introduction:

Jalna District has witnessed steady growth in organised retailing in recent years with the establishment of well-known malls and retail outlets such as D-Mart, Reliance, Croma, and other similar shopping centres. These malls have created employment opportunities for a large number of people, especially youth and semi-skilled workers. Mall employees are engaged in various activities including sales, customer service, security, housekeeping, and food courts. Their role is important in maintaining customer satisfaction and the overall image of the mall. Shopping malls have become an important part of urban employment in India and contribute significantly to the service sector. However, despite working in organised retail environments, many mall workers face several workplace problems. Low wages, long working hours, job insecurity, work pressure, and limited promotion opportunities are common issues reported by mall employees. These problems directly affect their level of job satisfaction, motivation, and work performance. Job satisfaction plays a vital role in improving employee efficiency, commitment, and retention. Dissatisfied workers may experience stress, absenteeism, and frequent job changes, which ultimately affect service quality. In Jalna District, very limited research has been conducted on the job satisfaction and problems of mall workers. Therefore, the present study aims to analyse the level of job satisfaction among mall workers in Jalna District and to identify the major problems faced by them at the workplace, with a view to suggesting measures for improving their working conditions and overall well-being.

## Statement of the Problem:

In recent years, shopping malls have expanded rapidly in small and medium cities like

Jalna. These malls provide employment opportunities to many workers, especially youth with limited education and skills. Despite this growth, the working conditions of mall employees often remain unnoticed. Mall workers are expected to work for long hours, follow strict targets, and handle customer pressure on a daily basis. Many workers receive low wages and have limited chances for promotion or career growth. Job satisfaction is an important factor that affects employee performance, commitment, and turnover. When workers are dissatisfied, it leads to stress, absenteeism, and frequent job changes. In Jalna District, very limited research has been conducted on the job satisfaction and problems of mall workers. Therefore, it becomes necessary to study their working conditions, level of satisfaction, and the challenges they face. This study attempts to fill this research gap by analytically examining the job satisfaction and problems of mall workers in Jalna District.

**Objective of the study:**

The principal objectives of the study are:

1. To study the socio-economic profile of mall workers in Jalna District.
2. To analyze the level of job satisfaction among mall workers.
3. To identify the major problems faced by mall workers at the workplace.
4. To examine the relationship between working conditions and job satisfaction.
5. To suggest measures for improving job satisfaction of mall workers.

**Research Methodology and Sampling:**

The research methodology adopted for the present study is as follows:

- **Research Design:** Descriptive and analytical research design
- **Sources of Data:**
  - **Primary Data:** Collected through a structured questionnaire
  - **Secondary Data:** Books, journals, research articles, and websites
- **Sampling Method:** Convenience sampling
- **Sample Size:** 50 mall workers
- **Tools of Analysis:** Percentage analysis and simple interpretation
- **Area of Study:** Jalna District

**Scope of the Study:**

- The study focuses on mall workers employed in various shopping malls in Jalna District.
- It covers employees working in sales, security, housekeeping, and food courts.
- The study analyzes job satisfaction related to salary, work environment, job security, and management support.

**Limitations of the Study:**

- The study is limited only to Jalna District; therefore, results cannot be generalised to other regions.
- The findings are based on the responses given by workers, which may include personal bias.
- Due to time constraints, the sample size is limited.
- Some workers were hesitant to share complete information due to fear of management.

Table No. 1: **Age Group of Mall Workers**

| Sr. No. | Particulars | Frequency | Percentage |
|---|---|---|---|
| 1 | 18–30 Years | 32 | 64.00 |
| 2 | 31–45 Years | 12 | 24.00 |
| 3 | Above 45 Years | 6 | 12.00 |
| | **Total** | **50** | **100.00** |

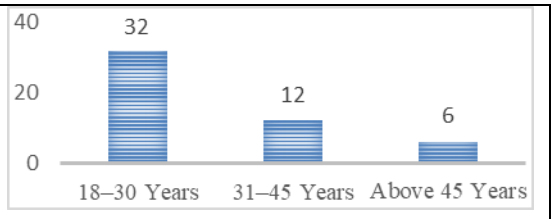


Table No. 1 shows the age-wise distribution of mall workers. It is observed that 32 respondents (64.00%) belong to the age group of 18–30 years, indicating that the mall sector largely employs young workers. Further, 12 respondents (24.00%) fall in the age group of 31–45 years, while only 6 respondents (12.00%) are above 45 years of age. This trend suggests that mall jobs are more attractive or accessible to younger individuals due to factors such as flexibility, entry-level nature of work, and limited skill requirements.

Table No. 2: **Nature of Employment**

| Sr. No. | Particulars | Frequency | Percentage |
|---|---|---|---|
| 1 | Permanent | 14 | 28.00 |
| 2 | Contractual | 22 | 44.00 |
| 3 | Temporary | 14 | 28.00 |
| | **Total** | **50** | **100.00** |

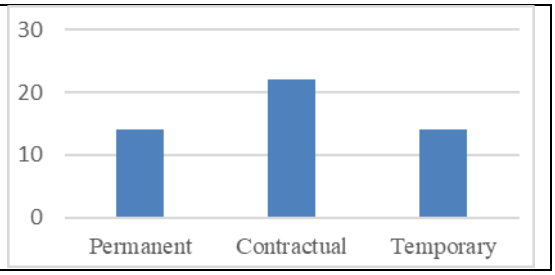


Table No. 2 presents the nature of employment among mall workers. The table reveals that 22 respondents (44.00%) are employed on a contractual basis, while 14 respondents (28.00%) are temporary workers. Only 14 respondents (28.00%) hold permanent jobs. This indicates that a majority of workers are engaged in non-permanent forms of employment, which may lead to uncertainty and lack of long-term security

Table No. 3: **Level of Satisfaction with Salary and Incentives**

| Sr. No. | Particulars | Frequency | Percentage |
|---|---|---|---|
| 1 | Satisfied | 12 | 24.00 |
| 2 | Neutral | 10 | 20.00 |
| 3 | Dissatisfied | 20 | 40.00 |
| 4 | Highly Dissatisfied | 8 | 16.00 |
| | **Total** | **50** | **100.00** |

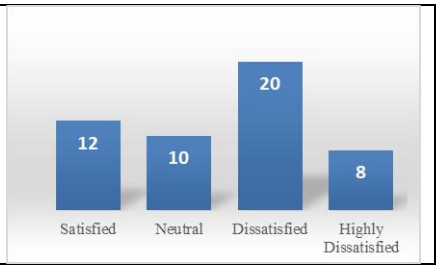


Table No. 3 shows the level of satisfaction of workers with their salary and incentives. It is observed that 20 respondents (40.00%) are dissatisfied and 8 respondents (16.00%) are highly dissatisfied, indicating that more than half of the respondents are unhappy with their earnings. Further, 10 respondents (20.00%) expressed a neutral opinion, while only 12 respondents (24.00%) reported satisfaction. This reflects widespread dissatisfaction regarding wages and incentive structures.

**Table No. 4:Problems Related to Working Hours and Weekly Holidays**

| Sr. No. | Particulars | Frequency | Percentage |
|---|---|---|---|
| 1 | Yes | 36 | 72.00 |
| 2 | No | 14 | 28.00 |
| | **Total** | **50** | **100.00** |

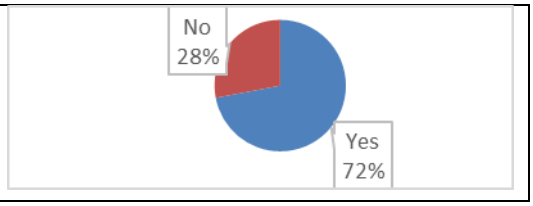


Table No. 4 indicates problems related to long working hours and lack of weekly holidays. The table shows that 36 respondents (72.00%) reported facing such problems, while only 14 respondents (28.00%) did not experience these issues. This clearly suggests that long working hours and insufficient rest days are common concerns among mall employees.

Table No. 5: **Availability of Promotion Opportunities**

| Sr. No. | Particulars | Frequency | Percentage |
|---|---|---|---|
| 1 | Adequate | 8 | 16.00 |
| 2 | Limited | 30 | 60.00 |
| 3 | Not Available | 12 | 24.00 |
| | **Total** | **50** | **100.00** |

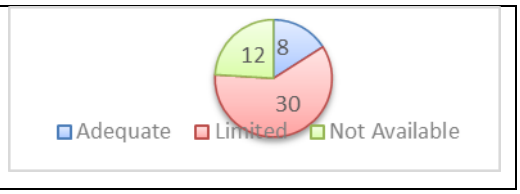


Table No. 5 presents the availability of promotion opportunities in mall jobs. The table reveals that 30 respondents (60.00%) reported limited promotion opportunities, while 12 respondents (24.00%) stated that no promotion opportunities are available. Only 8 respondents (16.00%) felt that adequate promotion opportunities exist. This indicates poor career growth prospects in mall employment.

Table No. 6:**Work Environment and Co-worker Cooperation:**

| Sr. No. | Particulars | Frequency | Percentage |
|---|---|---|---|
| 1 | Satisfactory | 28 | 56.00 |
| 2 | Neutral | 12 | 24.00 |
| 3 | Unsatisfactory | 10 | 20.00 |
| | **Total** | **50** | **100.00** |

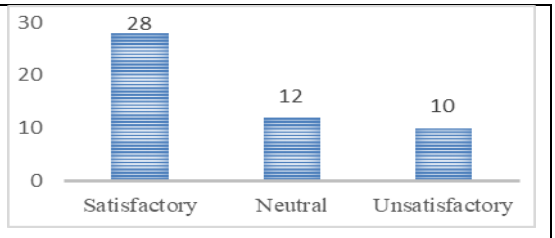


Table No. 6 shows respondents' views on work environment and cooperation among co-workers. It is observed that 28 respondents (56.00%) found the work environment satisfactory, while 12 respondents (24.00%) remained neutral. However, 10 respondents (20.00%) expressed dissatisfaction. This suggests that despite other job-related issues, interpersonal relationships and work atmosphere are relatively positive.

Table No. 7: **Impact of Job Insecurity and Work Pressure on Job Satisfaction:**

| Sr. No. | Particulars | Frequency | Percentage |
|---|---|---|---|
| 1 | High Impact | 30 | 60.00 |
| 2 | Moderate Impact | 14 | 28.00 |
| 3 | Low Impact | 6 | 12.00 |
| | **Total** | **50** | **100.00** |

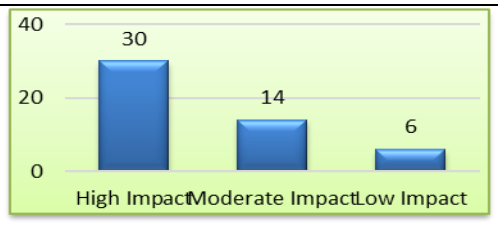

Table No. 7 highlights the impact of job insecurity and work pressure on overall job satisfaction. The table shows that 30 respondents (60.00%) felt a high impact, while 14 respondents (28.00%) reported a moderate impact. Only 6 respondents (12.00%) experienced a low impact. This clearly indicates that job insecurity and work pressure significantly affect workers' satisfaction levels.

**Conclusion:**

The present study concludes that mall workers play an important role in the functioning and service quality of organized retail outlets, yet they face several challenges that affect their job satisfaction. The findings show that most mall workers are young and employed on a contractual or temporary basis, which leads to job insecurity. Dissatisfaction with salary, incentives, long working hours, and lack of weekly holidays are major factors reducing their overall satisfaction. Limited promotion opportunities further discourage workers from viewing mall jobs as long-term career options. However, the study also highlights some positive aspects, such as a supportive work environment and good cooperation among co-workers, which help employees cope with work-related stress to some extent. Overall, the study clearly establishes that economic factors, job security, and working conditions are the key determinants of job satisfaction among mall workers. Addressing these issues through better pay structures, job stability, reasonable working hours, and growth opportunities can significantly improve employee satisfaction, performance, and retention in the organized retail sector.

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# Entrepreneurship, Start-ups and MSME Development: A Pillar of Economic Growth and Innovation

**Dr. Vijaykumar Sidramppa Mule**

*Asst. Professor, Department of Commerce D.V. Mahavidyalaya, Kasar Sirasi, Nilanga.*

***Corresponding Author – Dr. Vijaykumar Sidramppa Mule***

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***Abstract:***

*Entrepreneurship, start-ups, and Micro, Small and Medium Enterprises (MSMEs) play a vital role in fostering economic growth, innovation, employment generation, and inclusive development. In recent years, start-ups driven by technology and innovation have complemented traditional MSMEs, creating a dynamic entrepreneurial ecosystem. This research paper examines the concept of entrepreneurship, the emergence of start-ups, the significance of MSMEs, government initiatives supporting them, challenges faced, and future prospects. The study highlights the need for policy support, access to finance, digital transformation, and skill development to strengthen entrepreneurship-led growth.*

***Keywords: Entrepreneurship, Start-ups, MSMEs***

## Introduction:

Entrepreneurship is recognized globally as a key driver of economic development. Entrepreneurs create new ventures, introduce innovations, and contribute to wealth creation. In developing economies like India, **start-ups and MSMEs** form the backbone of industrial and service sectors.

Start-ups focus on innovation, scalability, and technology-driven solutions, while MSMEs provide stability, employment, and regional development. Together, they create a strong entrepreneurial base that supports sustainable economic progress.

## Objectives of the Study:

The objectives of this research paper are:

1. To explain the concept of entrepreneurship
2. To analyze the role of start-ups in economic development
3. To examine the importance of MSMEs
4. To study government initiatives for entrepreneurship, start-ups, and MSMEs
5. To identify challenges faced by entrepreneurs and MSMEs
6. To explore future prospects of entrepreneurship-led growth

## Research Methodology:

This study is based on **secondary data** collected from:

- Books and journals on entrepreneurship and MSMEs
- Government reports and policy documents
- Research articles and online academic sources

The research is **descriptive and analytical** in nature.

## Concept of Entrepreneurship:

Entrepreneurship refers to the process of identifying business opportunities, organizing resources, and assuming risks to create value.

According to **Joseph Schumpeter**, entrepreneurship is a process of innovation that leads to economic development. **Peter Drucker** defined entrepreneurship as a

systematic and purposeful activity focused on innovation.

Entrepreneurs act as:

- Innovators
- Risk bearers
- Decision makers
- Organizers of resources

**Start-ups: Meaning and Role:**

**1 Meaning of Start-ups:**

A start-up is a newly established business venture that aims to develop innovative products or services, often using technology, with high growth potential.

**2 Role of Start-ups:**

- Promote innovation and technological advancement
- Create employment opportunities
- Encourage digital and knowledge-based economy
- Attract domestic and foreign investment
- Solve social and market problems

**MSME Development:**

**1 Meaning of MSMEs:**

MSMEs include micro, small, and medium enterprises engaged in manufacturing, trade, and services. They are defined based on investment and turnover criteria.

**2 Importance of MSMEs:**

- Largest employment generator after agriculture
- Promote balanced regional development
- Encourage entrepreneurship at grassroots level
- Contribute significantly to GDP and exports
- Support large industries through supply chains

**Government Initiatives Supporting Entrepreneurship, Start-ups and MSMEs:**

**1 Start-up Promotion Programs:**

- Start-up India Initiative
- Incubators and accelerators
- Tax benefits and funding support

**2 MSME Development Schemes:**

- MSME registration (Udyam)
- Credit guarantee schemes
- Skill development and training programs
- Digital MSME initiatives

**3 Entrepreneurship Development Programs (EDPs):**

- Training and mentoring support
- Financial assistance and subsidies
- Innovation and research support

**Challenges Faced by Entrepreneurs, Start-ups and MSMEs:**

**1 Financial Constraints:** Limited access to credit and venture capital.

**2 Regulatory and Compliance Issues:** Complex procedures and legal requirements.

**3 Technological Gaps:** Lack of digital adoption and innovation capacity.

**4 Market Competition:** Competition from large firms and global players.

**5 Skill and Managerial Limitations:** Lack of entrepreneurial education and professional expertise.

**Entrepreneurship, Start-ups and MSMEs: Interrelationship:**

Entrepreneurship provides the foundation for business creation. Start-ups represent innovation-driven entrepreneurship, while MSMEs ensure stability and long-term economic contribution. Together, they:

- Strengthen the industrial base
- Enhance innovation capacity
- Promote inclusive growth
- Support employment generation

**Future Prospects:**

The future of entrepreneurship, start-ups, and MSMEs depends on:

- Digital transformation and technology adoption
- Strong financial and policy support
- Skill development and entrepreneurial education
- Sustainable and green business practices
- Integration with global value chains

**Conclusion:**

Entrepreneurship, start-ups, and MSMEs are critical for economic growth, innovation, and social development. While start-ups bring innovation and scalability, MSMEs ensure employment and economic stability. A supportive ecosystem involving government, financial institutions, academia, and industry is essential to harness their full potential. Strengthening entrepreneurship will lead to sustainable and inclusive development.

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# Mathematics as the Backbone of Artificial Intelligence and Data Science in Viksit Bharat 2047

**Santosh M. Popade**

*Department of Mathematics Sant Tukaram College of Arts and Science, Parbhani*

***Corresponding Author – Santosh M. Popade***

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***Abstract:***

*This paper examines the essential role of mathematics as the foundational backbone of artificial intelligence (AI) and data science, emphasizing its critical importance in driving technological advancement, innovation, and evidence-based decision-making. Mathematics provides the theoretical frameworks and analytical tools that underpin AI algorithms, machine learning models, and large-scale data analytics, enabling intelligent systems to learn, predict, and optimize outcomes. With India's strategic national vision of Viksit Bharat 2047, which aspires to transform the country into a developed nation by the centenary year of independence, the integration of mathematics into emerging technologies becomes both a necessity and a strategic priority. The study explores how core mathematical disciplines such as linear algebra, calculus, probability and statistics, optimization, and discrete mathematics form the intellectual foundation of AI and data science applications. These applications are increasingly influencing critical sectors including education, healthcare, governance, finance, smart infrastructure, cyber security, and scientific research. By strengthening mathematical capacity at all levels of education and research, India can foster innovation, enhance workforce readiness, and support data-driven policy formulation. Furthermore, the paper discusses the role of mathematics education and research in nurturing analytical thinking, problem-solving skills, and technological competence aligned with the goals of Atmanirbhar Bharat and digital transformation initiatives. It argues that sustained investment in mathematics-centric curricula, interdisciplinary research, and skill development will significantly contribute to India's global competitiveness in AI and data science. Ultimately, the paper positions mathematics as a strategic enabler in realizing the long-term socio-economic and technological objectives of Viksit Bharat 2047.*

## Introduction:

Artificial intelligence (AI) and data science are rapidly transforming global economies by revolutionizing the way information is processed, decisions are made, and services are delivered. These technologies are now integral to diverse sectors such as healthcare, education, finance, manufacturing, agriculture, and public governance. Through intelligent automation, predictive analytics, and data-driven decision-making, AI and data science are enhancing efficiency, accuracy, and innovation at an unprecedented scale. At the core of these transformative technologies lies mathematics, which provides the essential theoretical frameworks, logical structures, and computational tools required for developing intelligent algorithms and analyzing large and complex datasets.

Mathematical concepts such as linear algebra, calculus, probability, statistics, optimization, and discrete mathematics form the foundation upon which machine learning models, neural networks, and data analytics techniques are built. These mathematical tools enable the representation of data, learning from patterns, handling uncertainty, and optimizing performance in AI systems. Without strong mathematical

underpinnings, the development and deployment of reliable, scalable, and ethical AI solutions would not be possible.

In the Indian context, the national vision of *Viksit Bharat 2047* envisions a technologically advanced, economically robust, and globally competitive nation by the centenary year of independence. Achieving this vision requires a skilled workforce proficient in AI and data science, supported by strong mathematical literacy and research capabilities. Therefore, fostering deep mathematical understanding among students, educators, and researchers is essential for strengthening India's innovation ecosystem. By integrating mathematics with emerging technologies, India can position itself as a global leader in AI and data science, contributing significantly to sustainable development and national progress.

**Theoretical Foundations of Mathematics in AI and Data Science:**

Mathematics forms the intellectual foundation upon which artificial intelligence and data science are developed. The design, analysis, and implementation of intelligent algorithms rely heavily on mathematical principles that enable machines to learn from data, optimize performance, and make informed decisions. Key branches of mathematics play distinct yet interconnected roles in shaping modern AI and data-driven technologies.

1. **Linear Algebra:** Linear algebra is fundamental to the representation, manipulation, and transformation of data in AI systems. Data in machine learning models are often expressed as vectors and matrices, making matrix operations essential for computations in neural networks, regression models, and clustering algorithms. Techniques such as Principal Component Analysis (PCA) and Singular Value Decomposition (SVD) use matrix factorization to reduce dimensionality, extract features, and improve computational efficiency, thereby enabling AI systems to process large-scale datasets effectively.
2. **Calculus and Optimization:** Calculus, particularly differential calculus, plays a critical role in training AI models through optimization techniques. Most machine learning algorithms aim to minimize error or loss functions, and methods such as gradient descent rely on derivatives to iteratively adjust model parameters. Optimization theory ensures convergence, stability, and efficiency of learning algorithms, making calculus indispensable for deep learning and reinforcement learning frameworks.
3. **Probability and Statistics:** Probability theory and statistics enable AI systems to model uncertainty and variability inherent in real-world data. Statistical techniques support hypothesis testing, predictive modelling, and data inference, while probabilistic models such as Bayesian networks allow intelligent systems to update beliefs based on new evidence.
4. **Advanced Mathematical Concepts:** Advanced mathematical tools including graph theory, Fourier analysis, wavelet transforms, and numerical methods enhance AI's ability to analyze networks, signals, and complex structures. These concepts are central to cutting-edge applications in image processing, natural language processing, and big data analytics.

**Mathematics in Artificial Intelligence:**

Artificial intelligence systems simulate human-like intelligence by using algorithms that learn from data, adapt to changing environments, and make autonomous decisions. The development and functioning of these algorithms are deeply rooted in mathematical principles.

Techniques such as support vector machines, deep neural networks, decision trees, and reinforcement learning frameworks rely on rigorous mathematical formulations for their design and implementation. Linear algebra provides the structural framework for representing data and performing transformations within neural networks, while probability theory enables AI models to handle uncertainty and make predictions based on incomplete or noisy data.

Optimization techniques, derived from calculus and numerical analysis, are essential for training AI models by minimizing loss functions and improving predictive accuracy. Mathematical models also ensure stability, convergence, and efficiency of learning algorithms. Without strong mathematical foundations, AI systems would lack reliability, scalability, and interpretability. Therefore, mathematics plays a crucial role in transforming raw data into actionable intelligence, making it indispensable for the advancement and responsible deployment of artificial intelligence technologies.

**Mathematics in Data Science:**

Data science focuses on the systematic collection, processing, and interpretation of large and complex datasets to derive meaningful insights and support informed decision-making. Mathematics plays a central role in this process through statistical analysis, probability theory, and computational modelling. Statistical techniques such as regression analysis, hypothesis testing, and clustering enable data scientists to identify patterns and trends within data. Mathematical optimization and numerical methods enhance predictive accuracy and efficiency of data-driven models. These mathematically grounded approaches are essential for evidence-based policymaking, economic forecasting, and strategic planning, thereby contributing significantly to sustainable national development.

**Mathematics and India's Vision of Viksit Bharat 2047:**

The national vision of *Viksit Bharat 2047* emphasizes inclusive economic growth, technological self-reliance, sustainable development, and global competitiveness. Artificial intelligence and data science are expected to play a transformative role in achieving these objectives by enhancing productivity, governance efficiency, and innovation across sectors. At the core of these technologies lies mathematics, which provides the theoretical and analytical foundation necessary for developing robust AI systems and data-driven solutions.

Strengthening mathematics education at school, undergraduate, postgraduate, and research levels is essential for building a skilled workforce capable of driving technological innovation. A strong mathematical foundation enhances analytical thinking, problem-solving abilities, and computational skills, all of which are critical for research and development in AI and data science. Integrating AI literacy and applied mathematics into higher education curricula aligns with the goals of the National Education Policy 2020 and supports India's long-term development strategy.

In the Indian context, eminent mathematicians and educationists have emphasized the urgent need to focus on foundational mathematics to nurture research excellence and innovation. Investments in mathematical research, interdisciplinary collaboration, and capacity building will enable India to develop indigenous technologies and reduce dependence on external solutions. Thus, mathematics emerges as a strategic enabler in realizing the socio-economic and technological aspirations of *Viksit Bharat 2047*.

**Conclusion:**

The interplay between mathematics, AI, and data science reveals a symbiotic relationship: mathematics provides the language and tools for building intelligent systems, while AI and data science generate large-scale applications that demand deeper mathematical research. Investments in mathematical education and research infrastructure will catalyze India's journey toward *Viksit Bharat 2047*.

Mathematics is indispensable to artificial intelligence and data science, underpinning core algorithms and analytical techniques. As India aims to become a developed nation by 2047, strengthening mathematical capacity will be vital for technological leadership and socio-economic progress. Mathematics should thus be strategically integrated into curricula, research policies, and national innovation agendas.

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# A Systematic Review on Memristor Technology and Applications

**Dr. Shaikh Asif Karim[1] & Dr. Sayed Mujeeb[2]**
*[1,2]Sir Sayyed College, Chatrapati Sambhajinagar-431001*
***Corresponding Author – Dr. Shaikh Asif Karim***
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***Abstract:***

*Memristor technology is getting a lot of attention because it has the potential to change storage and neuromorphic computers in big ways. Memristors are two-terminal devices that keep their electrical resistance state based on previous voltage uses. They have a nonlinear element that makes them good for use in future electronic systems. Memristors can have a big impact on the creation of advanced memory solutions and act as artificial synapses in neuromorphic computer systems because they require little energy, can switch between states quickly, and can store more than one state. This article talks about the latest progress in memristor technology, focused on the types of materials used, how they switch, and how they can be used in things like non-volatile memory, reconfigurable logic gates, and neuromorphic computing systems.*

***Keywords: Memristor, Memtransistor, Non-Volatile Memory, Neuromorphic Computing, Two-Dimensional Compounds***

## Introduction:

Memristor has remarkable resistive switching (RS) properties, such as ultra-fast response times, low power consumption, and superior stability, making them attractive options for data storage. But while energy consumption has become a major concern, the need for processing power has increased dramatically, particularly in the field of artificial intelligence. As a result, energy-efficient computing—also referred to as "green computing"—has gained popularity, and in-memory computing has become a viable way to deal with these pressing issues. Neuromorphic computing is especially well-suited for memristive devices, such as memristors and memtransistors (H.Zhou, 2024; M. Prezioso, 2018). Due to the resistive switching property, it is a passive electrical component. Its resistance changes based on the history of electric current passing through it, resulting in a memory effect. In contrast, a memtransistor is a hybrid device that combines the features of a transistor with a memristor. Because memtransistors have a gate terminal, their resistive switching behaviour can be modulated. Compared to transistor-based technologies, they have a number of advantages, including low power consumption, support for analogue computing, and the capacity to simulate neural networks with huge parallelism. Furthermore, novel computing paradigms that are challenging to replicate with conventional architectures, such as the spiking neural network, are made possible by memristive devices (Li, 2024).

The purpose of this study is to give an overview of the most recent developments in memristor technology, with a focus on their many applications, switching processes, and material compositions. This study investigates a variety of resistive switching materials, including two-dimensional materials like graphene and transition metal dichalcogenides, binary oxides,

organic compounds, and perovskites. These materials have unique qualities that affect the memristor's longevity, energy efficiency, switching speed, and retention.

**Memristor Fabrication and Materials:**

**Electrode Material:**

The electrode of a memristor has a direct impact on the device's stability, conductivity, and response time in addition to its conductive function. Selecting the right electrode material can improve device performance and meet different application needs.

Due to superior electrical conductivity and affordability, conventional metals like copper (Cu) and aluminium (Al) have become popular options for memristor electrodes. However, these metals may experience electrochemical corrosion over time, which could have a long-term impact (Xiao Y, 2023; Allendorf, 2020). Precious metals, due to their exceptional electrical conductivity and chemical inertness, are especially well-suited for demanding memory and computing technologies. Electrodes made of precious metals can improve data storage accuracy and reduce the device's operating voltage. The memory behavior of Ag/TiO2: Ag/Pt by adjusting the metal component ratios, alloy materials, such as palladium-nickel (PdNi) alloys, can maximize mechanical and electrical conductivity. The memristor's thermal stability is enhanced by varying the Pd-to-Ni ratio, which preserves steady electrical properties even at elevated temperatures. Alloy electrodes are therefore ideal for high-temperature and high-pressure applications (Xiao Y, 2023) (Banerjee, 2020)

Nitrides, due to their exceptional high-temperature stability and chemical inertness, titanium nitride (TiN) and tantalum nitride (TaN) are frequently utilized in devices with high reliability requirements.

In challenging conditions like high temperatures and high humidity, nitride materials can nonetheless have strong electrical characteristics and stability when compared to traditional metal electrodes. Because they combine transparency and conductivity, transparent conductive oxides such as doped tin fluoride oxide (FTO) and indium tin oxide (ITO) have a wide range of potential applications in transparent electronic devices. Because of their excellent light transmittance and electrical conductivity, ITO electrodes have emerged as the primary material for transparent electronic devices, such as transparent displays and smart Windows, which have garnered significant market attention in recent (Batool, 2022).

**Material for Resistive storage:**

The main function of the memristor is determined by its resistive storage layer, and its resistive properties, response time, and data retention capacity are directly impacted by the type and structure of its material. There are two types of resistive storage materials: inorganic and organic. Because of their exceptional stability and wide range of applications, inorganic materials are a major area of study.

Because of their chemical stability, ease of manufacture, and compatibility with CMOS, binary oxides like as silicon oxide ($SiO_2$) and titanium oxide ($TiO_2$) are highly prized (Wang H, 2021). Despite being less stable than their inorganic equivalents, organic materials have become more popular in flexible electronics because of their affordability, ease of processing, and adaptable, flexible qualities. Due to their distinct molecular structure, small organic compounds like copper chloride phthalocyanine (ClCuPc) exhibit excellent charge transport capabilities. ClCuPc has outstanding mechanical stability on flexible substrates and can achieve multistate storage at low voltage. Because of their

extreme flexibility and strong electrical conductivity, organic polymers like PEDOT: PSS are frequently employed in flexible memory systems (Ezugwu S, 2016).

**Manufacturing Process:**

The memristor's production process is also crucial, and high-performance devices are made possible by sophisticated deposition technology and precise nano machining techniques. Physical vapor deposition (PVD) is a common technique for creating resistant layers, particularly at low temperatures. It can produce a homogeneous, dense film that can be used to deposit a wide range of materials. Subsequent investigations indicate that adjusting deposition parameters like pressure, power, and substrate temperature can enhance the microstructure of the film, leading to improved stability and repeatability of the device. Atomic layer deposition (ALD) is the preferred process for the fabrication of nanoscale memristors due to its high precision and uniformity. ALD technology can deposit an ultra-thin film layer on the surface of complex three-dimensional structure, which can not only significantly reduce the operating voltage of the device, but also improve the data retention ability and switching speed.

**Application field of memristor:**

**1.Storage Technology:** The primary benefits of memristors in memory technology include their non-volatile nature and the ability to adjust resistance states. The memristor can change its resistance state by applying different voltages or currents, which allows it to switch between different resistance states, so as to achieve data storage and reading. Compared with traditional storage devices, memristors can provide both storage and logical operation functions in one single device, which greatly improves the data density and operation efficiency.

**2.Neuromorphic computing:** In order to enable more intelligent computing, neuromorphic computing mimics the form and function of human brains, particularly neural networks. The adjustable resistance of the memristor closely resembles synaptic plasticity, which is comparable to brain neuron connections. Memristors enable the learning and memory functions of neural networks by simulating dynamic synaptic alterations through resistance state adjustment (J.J. Yang, 2013).

**Data Encryption:**

In the field of data encryption, due to its special adjustable impedance, memristors offer a new technical solution for dynamic encryption and decryption in the field (Wang H, 2021)of data encryption. By altering its resistance state, the memristor can implement several encryption modes, making each encryption process distinct and challenging to decipher. In the study, the researchers created a memristor-based data encryption storage system that uses the nonlinear conductance of the memristor to randomly assign resistance states during data encryption, creating an unpredictable key.

**Conclusion:**

This article talks about the newest developments in the field of memristors, focusing on their different types of materials, how they switch on and off, and the many ways they can be used in memory, brain-like computing, and analog computing. Memristors are innovative nonlinear resistance devices that have great potential for use in future electronic circuits because of their low power consumption, fast switching, multi-state storing, and outstanding durability. The researchers were able to enhance the memristor's performance and offer tailored

solutions for particular application scenarios by examining a variety of materials, including binary oxides, perovskites, two-dimensional materials, etc. Memristors have a number of developmental obstacles despite their potential uses. Among these, maintaining material and process stability is crucial, especially to ensure the devices' long-term dependability and repeatability in real-world applications.

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# The Review of Influence of E-Commerce on Conventional Retailing with special reference to Indian Context

**Ms. Shital Mane[1], Dr. Sandip Wanjari[2] & Dr. Sudarshan S. Savanoor**

*[1]Research Scholar, Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhaji Nagar,*
*[2]Associate Professor, R.B.Attal Arts, Science and Commerce College, Georai, Beed, MS, India and Research Guide, Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhaji Nagar*
*[3]Assistant Professor, Dayananda Sagar College of Arts, Science and Commerce, Bangalore*

***Corresponding Author – Ms. Shital Mane***

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***Abstract:***

*The present research investigates thoughtful influence about e-commerce on a traditional or conventional retailing in country like India. Leveraged by increased internet usage, smartphones, and secured payment systems, platforms like Amazon, Flipkart, Myntra, Nyka and Snapdeal and so on have redesigned the retail landscape. The digital shift has tailored consumer behavior, with shoppers inclining online channels for their convenience, wider selection, competitive prices, and personalized experiences. As a result, Conventional brick-and-mortar retailers face crucial challenges, including moribund foot traffic and sales. Academic frameworks like the Technology Acceptance Model explain this espousal, induced by perceived expediency and ease in use of e-commerce. For survival, conventional retailers must innovate the marketing strategies and retail mix. Such phenomenon involves enhancing their digital existence, adopting omnichannel strategies for seamless customer experience, and leveraging data analytics for personalized experience.*

*The research paper emphasizes that successful retailers shall be those who blend online and offline methods, using strategies like targeted advertising, loyalty programs, and experiential retailing. The authoritarian environment, including Foreign Direct Investment and data protection policies, also crucially designs this competitive dynamism. The conclusion claims that for sustainable growth, the conventional retailers should have to have complete grip on digital transformation, endow in technology and incessantly innovate to meet embryonic consumer prospects in a swiftly changing market.*

***Keywords: Conventional Retailing, E-Commerce, FDI, Omnichannel Strategies, brick-and-Morter Retailers***

**Introduction**:

The retail sector in India is experiencing a paradigm shift, fundamentally reshaped by the rampant upliftment of electronic commerce. This transformation remains propelled by the trifecta of technological enablers: deep entry of internet, ubiquitous mobile as smartphone acceptance, and secure UPI infrastructures. The dominance of platforms viz Snapdeal, Myntra, Flipkart, Amazon India and Nyka has capitalized on new wave of consumerism, one that prioritizes convenience, an unparalleled product choice, pricing with competitiveness and personalized experiences (Gupta, 2019). It has precipitated a significant migration of customer preferences and purchasing manners away from offline physical stores, compelling traditional "brick-and-mortar retailers" to innovate or risk obsolescence in an increasingly digital marketplace. Understanding this behavioral shift is crucial. TAM (Technology Acceptance Model) advocates that the acceptance of electronic commerce is driven by its

distinguished usefulness as well as ease of use (Davis, 1989). Concurrently, Rogers' Dispersal of Inventions theory explains how these platforms scatter through social systems, where social influence and the observable benefits of early adopters accelerate widespread acceptance (Rogers, 2003).

However, this digital transition is not without its challenges, including consumer confrontation to change and the operational complexity of mingling offline and online. In response, the acceptance or adoption of a continuous omnichannel strategy has emerged as a critical survival and growth tactic for traditional retailers. This approach involves the strategic harmonization of the marketing mix (retail perspective)— price, product, promotion, place, and people—across all customer access points. The objective is to create a cohesive and integrated shopping journey, whether the customer is browsing online from a mobile device or visiting a physical store (Verhoef, 2015). By leveraging data analytics, retailers can obtain profound ideas into customer preferences, enabling hyper-personalized marketing and product curation. Empirical studies confirm that retailers who master this integrated approach achieve superior customer engagement, loyalty, and overall satisfaction (Blázquez, 2014).

The competitive landscape is further intensified by agile digital-native entrants and the pervasive influence of social commerce. To differentiate themselves, physical retailers are increasingly turning to experiential retailing—creating immersive, memorable in-store experiences that cannot be replicated online—alongside targeted advertising and sophisticated loyalty programs to build a exclusive value proposition (Rigby, 2011).

Moreover, the governing environment significantly shapes the sector's dynamics. Policies of regulatory bodies and Government on FDI in retail, evolving data privacy and protection norms and stern consumer protection and rights laws directly impact a strategic lever available to both online and offline players (Dr Akil Hussain, 2016). Navigating this complex regulatory tapestry is as vital as embracing technological innovation.

The future of traditional retail in India is contingent upon a proactive embrace of digital transformation. To thrive, the retailers must uninterruptedly innovate, capitalize in technology and adopt a fluid, omnichannel model which helps place the consumer at the center. The discourse on retail revolution in emergent markets thus highlights the prerequisite for a synergistic approach that leverages the distinct strong point of both digital and physical channels to meet embryonic consumer prospects and ensure workable growth (Grewal, 2017). The retail sector is transforming as e-commerce growth compels traditional retailers to adapt. Success now hinges on adopting omnichannel stratagems that seamlessly fit in online and offline channels. This meets consumer demand for a hybrid experience, blending digital convenience with physical engagement. By leveraging technology, retailers can navigate this shift, enhance customer satisfaction, and build loyalty in the evolving marketplace (Kapoor, 2022).

**Objectives of Study**:

- To understand whether the expectations, tastes and buying behaviors of consumers have been influenced by the development of electronic commerce platforms
- To gauge a extent of influence electronic commerce on consumer visits and sales results in physical stores
- To study the application of data analytics and digital tools be applied to better comprehend and satisfy consumer wants
- To examine the ways of conventional

business to provide a seamless buying experience by integrating both physical and online channels.

**Review of Literature**:

The review of literature examines the profound transformation of the Indian retail sector, driven by the disruptive rise of electronic commerce platforms like Amazon India and Flipkart. This shift is essentially altered consumer perspective and behavior (Chatterjee, 2013), (Mukherjee, 2013). Identifying convenience, wider product selection, and competitive pricing as key drivers pulling consumers online (Gupta, A study of factors affecting online shopping behavior of consumers in India, 2019). This e-commerce boom has posed noteworthy encounters for traditional brick-and-mortar retailers, including declining foot fall traffic and intensified competition (Richa, 2012). In response, the literature identifies omnichannel retailing as the critical strategic imperative (Verhoef, From Multi-Channel Retailing to Omni-Channel Retailing: Introduction to the Special Issue on Multi-Channel Retailing, 2015) and (Rigby, 2011).

This e-commerce boom has posed substantial challenges for conventional brick-and-mortar retailers, including declining foot traffic and intensified competition (Bharadwaj, 2013) and (Richa, 2012). Key enablers of this strategy are data analytics for personalization (Bharadwaj, 2013) and experiential retailing to differentiate physical stores (Kumar, 2017) and (Kumar et al., 2017). The literature unequivocally states that the long-term sustainability of traditional retailers depends on embracing digital transformation and continuously innovating through a balanced omnichannel approach to meet evolving consumer demands (Singh, 2013). One shopper used his phone to find a better price online and bought there. Another, assisted by a store associate using an iPad, found and pre-ordered shoes she liked from the store's online collection (Brynjolfsson, 2013). Omnichannel retail success requires innovative strategies that provide customers with seamless product information to guide purchases and cost-effective fulfillment options, such as easy returns, to minimize retailer losses and friction (David R. Bell, 2014).

**Importance of the Study:**

The research indicates as it caters a comprehensive analysis of how electronics commerce platforms like Amazon and Flipkart are transforming retail sector of India. It examines the resulting shifts in consumer behavior and a urgent need for conventional retailers to adopt online and omnichannel strategies for survival. Using theoretical frameworks like TAM, the study offers practical guidance for navigating this digital disruption, contributing valuable understandings for retailers, academicians and policymakers in the unique context of the Indian market. Below is the significance in step-by-step manner –

- **Overall Significance:** Provides a comprehensive analysis of electronics commerce's transformative influence on India's retail sector.
- **Core Focus:** Examines shifts in consumer behavior and urgent essentiality for conventional retailers to adopt digital and omnichannel strategies.
- **Theoretical Application:** Utilizes frameworks like the TAM to comprehend market dynamics
- **Key Contributions to Stakeholders:**
- **For Academics:**
  - Advances theoretical understanding by testing models in an emerging market context.

- Enriches literature on retail transformation with a focus on India's unique characteristics.

- **For Retail Practitioners:**
  - Offers a strategic roadmap for adaptation and competitiveness.
  - Provides insights on digital integration, customer engagement, and omnichannel strategies.
- **For Policymakers:**
  - Informs evidence-based policy on FDI, data protection, and consumer rights.
  - Supports sustainable growth for the entire retail ecosystem.

**Research Gap:**

After due Literature Review the research identifies a crucial gap in the current literature on the Indian retail sector. While numerous studies detail the growth of e-commerce, there is insufficient exploration of the specific strategic and operational adjustments traditional brick-and-mortar retailers must make to compete. The study will investigate how these retailers can effectively leverage digital tools and omnichannel strategies within India's unique context, considering distinct consumer behavior, regulatory frameworks, and cultural nuances. The findings provide a practical roadmap for traditional retailers to attain sustainable growth and a modest advantage in the developing digital marketplace.

**Statement of the Problem:**

A critical literature review and research gap put forward the statement of the problem as - this study investigates the critical challenge facing India's conventional retail sector because of the tendancy rapid growth of e-commerce. The research problem centers on how the rise of online platforms, fueled by digital adoption, has altered consumer preferences and created intense competition for brick-and-mortar stores. The study will therefore analyze the specific strategic adaptations—such as omnichannel integration, data-driven marketing, and enhanced in-store engagement—that conventional retailers must implement to ensure their survival and sustainable growth within this transformed marketplace. Hence above is decoded as - *The review of influence of e-commerce on conventional retailing with special reference to Indian context.*

**Interpretation and discussion of the Influence of E-Commerce on Conventional Retailing:**

**Emergence of electronic commerce platforms influencing consumer habits like shopping, expectations and preferences:**

- Shift in Consumer Preferences: The growth of e-commerce has fundamentally altered buying habits, causing a marked switch from brick-and-mortar stores to online marketplaces.
- Key Drivers of Adoption: This transition is fueled by:
  - Technological Enablers: Augmented internet penetration, widespread use smartphone usage, and secure UPI or digital payment systems.
  - Customer Benefits: The core appeal of online shopping lies in its suitability, wider product selection, modest pricing, and personalized experiences (Davis, 1989); (Rogers, 2003)).
- Theoretical Explanations: Frameworks like the TAM and Diffusion of Innovations Theory explain this shift through triggering factors like perceived ease of use, perceived usefulness, and social stimulus ( (David R. Bell, 2014); (Rogers, 2003)).
- Empirical Evidence: Research confirms that:
  - Demographic factors (age, income, education) significantly influence online shopping adoption ( (Richa, 2012)).

  - Digital business strategies are crucial for enhancing consumer engagement and satisfaction ( (Bharadwaj, 2013)).
- Strategic Imperative for Traditional Retailers: To compete, physical retailers must acclimatize by:
  - Integrating digital technologies.
  - Evolving omnichannel strategies to provide seamless shopping experiences.
- Proven Outcome: Studies show that retailers those successfully execute omnichannel approaches attain higher customer trustworthiness and a stronger competitive advantage ( (Verhoef, From Multi-Channel Retailing to Omni-Channel Retailing: Introduction to the Special Issue on Multi-Channel Retailing, 2015).

**Extent of gauging the influence of e-commerce on consumer visits and sales results in physical or offline stores (bricks-and-mortar stores):**

- **Documented Impact:** E-commerce expansion has directly caused reduced foot fall traffic and sales for brick-and-mortar stores in India ( (Richa, 2012).
- **Primary Drivers:** Online platforms attract consumers through superior convenience, extensive product variety, and competitive pricing.
- **Key Demographic:** This shift is most evident among younger, technologically proficient consumer segments.
- **Strategic Response:** Traditional retailers must adopt omnichannel strategies that integrate offline and online shopping understandings to remain competitive ( (Bharadwaj, 2013).
- **Critical Success Factors:** Effective use of data analytics for personalized marketing and creation of compelling in-store experiences are essential for differentiation (Chatterjee, 2013).
- **Regulatory Influence:** regulatory bodies and Government policies on FDI and data protection significantly shape the competitive landscape (Mukherjee, 2013).
- **Proven Outcome:** Retailers implementing comprehensive digital transformation and continuous omnichannel experiences achieve higher customer loyalty and sustained business performance (Verhoef, From Multi-Channel Retailing to Omni-Channel Retailing: Introduction to the Special Issue on Multi-Channel Retailing, 2015).

**Strategies for Integrating Online and Offline Retail Channels:**

- **Core Strategy:** Traditional retailers should adopt omnichannel approaches that influence digital technologies and data analytics to create seamless customer experiences across all touch points.
- **Key Benefits:** This integration combines online convenience with physical store advantages, addressing consumer demands for flexible and coherent shopping journeys.
- **Implementation Methods:**
  Enable click and collect services and real time stock checks
  Develop personalized promotions based on customer data
  Utilize data analytics to understand consumer preferences (Bharadwaj, 2013)
- **Successful Example:** Shoppers Stop effectively implemented omnichannel retailing by allowing seamless shopping across physical and digital platforms.
- **Supporting Evidence:** Research confirms that effective omnichannel approaches lead to higher customer engagement and allegiance (Verhoef, From Multi-Channel Retailing to Omni-Channel Retailing:

Introduction to the Special Issue on Multi-Channel Retailing, 2015)

- **Regulatory Considerations:** Retailers must navigate Foreign Direct Investment policies, data protection regulations, and consumer protection rights while implementing digital transformation (Mukherjee, 2013)
- **Consumer Trends:** Continuous innovation is essential to meet evolving consumer expectations shaped by digital interactions and social media (Singh, 2013).

**Utilizing Digital Tools and Data Analytics in Indian Retailing:**

- **Primary Function:** Digital tools and data analytics enable retailers to advance deep insights into customer preferences and buying patterns by analyzing data from numerous touchpoints like in-store visits and online browsing.
- **Strategic Applications:**
  - Personalizing marketing efforts and promotional strategies (Chatterjee, 2013).
  - Optimizing inventory management and merchandising.
  - Enhancing the overall customer experience across all channels.
- **Competitive Necessity:** The adoption of these technologies is essential for traditional retailers to contest with major electronic commerce platforms.
- **Proven Outcomes:** Empirical studies show that leveraging data analytics is a core component of maintaining a competitive advantage and leads to improved sales and customer retention (Bharadwaj, 2013)
- **Omnichannel Synergy:** When integrated with omnichannel strategies, data analytics helps deliver a whole and personalized shopping understanding, which significantly boosts customer engagement and loyalty (Verhoef, From Multi-Channel Retailing to Omni-Channel Retailing: Introduction to the Special Issue on Multi-Channel Retailing, 2015)
- **Regulatory Compliance:** Retailers must implement robust data governance frameworks to navigate India's data protection and privacy regulations while utilizing customer data (Mukherjee, 2013)
- **Continuous Adaptation:** Ongoing innovation is required to meet the embryonic expectations of digitally-influenced consumers (Singh, 2013).

**Findings from the study Impact of Electronic Commerce and Strategic Responses in Indian Retail**:

1. **Market Disruption:** The upsurge of electronic commerce platforms (Flipkart, Amazon India) has fundamentally shifted consumer behavior towards online channels because of superior convenience, selection, and pricing techniques.
2. **Challenge for Traditional Retail:** This shift has resulted in measurable declines in foot fall traffic and sales for brick-and-mortar stores.
3. **Strategic Imperative:** To compete, traditional retailers must adopt digital transformation, leveraging tools like data analytics to understand customer needs, personalize marketing, and augment operations (Chatterjee, 2013)
4. **Omnichannel Solution:** Success hinges on creating seamless omnichannel practices that integrate the online and the offline channels, as demonstrated by retailers like Shoppers Stop with services like click-and-collect.
5. **Proven Outcome:** Effective omnichannel strategies are empirically shown to lead to higher customer engagement and loyalty (Verhoef, From Multi-Channel Retailing to Omni-Channel Retailing: Introduction to the

Special Issue on Multi-Channel Retailing, 2015)

6. **Regulatory Consideration:** Navigating regulatory policies on Foreign Direct Investment, data protection, and consumer rights is crucial, requiring robust data governance (Verhoef, From Multi-Channel Retailing to Omni-Channel Retailing: Introduction to the Special Issue on Multi-Channel Retailing, 2015)
7. **Continuous Innovation:** Retailers must continuously adapt to meet the evolving expectations of digitally-influenced consumers (Singh, 2013).

**The Impact of Electronic Commerce and Strategic Responses in Indian Retail: Stakeholder Implications:**

The quick expansion of electronic commerce platforms has basically transformed India's retail landscape, creating both disruptive trials and strategic opportunities for various stakeholders. This transformation necessitates examining the implications for different stakeholder groups within the evolving retail ecosystem.

**Stakeholder Implications:**

**1. For Traditional Retailers:**

- **Operational Challenges:** Face declining footfall and sales due to intensified competition from online platforms (Mukherjee, 2013).
- **Strategic Imperative:** Must invest in omnichannel integration, leveraging data analytics for inventory optimization and personalized customer engagement (Bharadwaj, 2013).
- **Compliance Requirements:** Need to navigate evolving regulatory frameworks concerning data protection and consumer rights (Mukherjee, 2013).

**2. For E-commerce Platforms:**

- **Market Expansion Opportunities:** Potential to leverage digital payment infrastructure and smartphone penetration to access previously underserved markets (Gupta, A study of factors affecting online shopping behavior of consumers in India, 2019).
- **Regulatory Scrutiny:** Face increasing examination regarding competitive practices, data privacy, and compliance with foreign direct investment (FDI) regulations (Mukherjee, 2013).

**3. For Consumers:**

- **Enhanced Accessibility:** Benefit from greater product variety, competitive pricing, and personalized shopping experiences (Chatterjee, 2013).
- **Evolving Expectations:** Develop preferences for seamless online-offline experiences, influencing retailers' service design and delivery (Verhoef, From Multi-Channel Retailing to Omni-Channel Retailing: Introduction to the Special Issue on Multi-Channel Retailing, 2015).

**4. For Policymakers:**

- **Regulatory Balancing Act:** Must develop policies that encourage innovation while ensuring fair competition and protecting consumer interests (Singh, 2013).
- **Infrastructure Development:** Need to support digital infrastructure development, including payment systems and logistics networks, to facilitate sector-wide growth.

The transformation of India's retail sector requires collaborative adaptation from all stakeholders. Traditional retailers must embrace digital transformation, e-commerce platforms need to address regulatory expectations, and policymakers should create balanced frameworks that support sustainable sector growth while protecting consumer interests.

**Suggestions:**

The suggestions are drawn based on the discussion, analysis and findings. Suggestions are categorized in three perspectives as: i. for conventional retailers, ii. for policy makers and iii. for academics and researchers.

**For Traditional Retailers:**

- Implement a fully integrated omnichannel strategy with services like Buy-Online-Pick-Up-In-Store (BOPIS).
- Invest in data analytics to personalize marketing and optimize operations.
- Transform physical stores into experiential hubs that offer unique, tactile experiences.
- Upskill employees to work effectively in a digital, omnichannel environment.

**For Policymakers:**

- Establish a balanced regulatory framework for fair competition between online and offline retailers.
- Invest in digital infrastructure and literacy programs, especially in smaller cities.
- Create support schemes to help small and medium-sized businesses (MSMEs) adopt e-commerce.

**For Academics & Researchers:**

- Investigate the long-term impact of omnichannel strategies on key business metrics.
- Explore the application and return on investment of emerging technologies like AI and AR in retail.
- Conduct detailed studies on regional and demographic variations in electronic commerce acceptance and its effects.

**Limitations of study:**

The current research is limited by - i) its dependance on non-primary data, that may introduce bias and restrict the depth of findings. ii) It is also challenging to isolate the impact of electronic commerce from other coexisting market forces and iii) the rapid pace of technological change risks rendering conclusions obsolete, underscoring the need for ongoing empirical validation.

**Scope for future research:**

This study identifies several promising avenues for future research while acknowledging its own limitations. i) Further investigation could explore the longstanding effects of omnichannel policies on customer trustworthiness, the application of Artificial Intelligence and machine learning for personalization, and the effect of communal media on consumer behavior. ii) Research should also examine regional and demographic variations in electronic commerce acceptance within India or conduct comparative analyses with other emerging markets.

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# A Study of Stock Market Awareness and Participation Among College Students.

**Ms. Sayali Vilas Mhatre & Dr Vaishali Patil**
*Assistant Professor, B.K. Birla College, Kalyan*
***Corresponding Author – Ms. Sayali Vilas Mhatre***
**DOI - 10.5281/zenodo.18514182**

***Abstract:***

*Stock market is known as a pulse of economy which reflects the economic conditions of a country. Investors play the major role in the stock market. Their education and awareness, hold the key to reviving and sustaining their interests in the securities market. Stock market awareness comes under the wider concept of financial literacy. This study is an attempt to assess the awareness of youth about various aspects of stock market including concepts, products, processes, institutions etc. The results of the study reveal that the sample youth possess low to medium level of stock market knowledge, and the awareness level is not significantly different among different sample groups based on the discipline they are studying. Young generation these days are more creative and techno-savvy than the older generation socially and financially. One question may arise on whether this generation is concerned about and aware of their financial status in the future and investment. Behavioural Finance is an emerging field that combines the understanding of behavioural and cognitive psychology with financial decision-making process. The traditional economic theory tells us about efficient markets and people making rational decisions to maximize profits. However, the emerging changes tell us that market is not efficient, especially in the short run, and people do not make rational decisions to maximize profits. This research seeks to find the awareness towards investment among young generation. This study used primary data by questionnaire. The objective of this is to find out the relationship awareness and the fore-mentioned independent variables. The study tells us whether the youth are aware about the stock market what is their perspective etc. The result reveals that the key driven on investment among young generation is mainly based on independent variables selected. Finally, the limitations and recommendations are included to help further researchers to have a better finding of the result.*

## Introduction:

The Stock Market is the very vast, complex network of trading activities where shares of the companies are bought and sold, which are protected by laws against fraud and other unfair trading practices. The stock market is also known as the pulse of the economy, as it reflects the economic condition of a country where investors are the backbone of the stock market. The stock market is a vast, complex network of trading activities where shares of companies are bought and sold, protected by laws against fraud and other unfair trading practices. It plays a crucial role in modern economies by enabling money to move between investors and companies. Sometimes the best way to see how something works is to look at its parts. In that light, let's review the major elements of the stock market, from the companies' selling shares to stocks to exchanges to the indexes that give us a picture of the stock market's health.

## About Stock Market:

Stock markets are fascinating entities and not for the least because they help investors make money. The Securities Contracts (Regulation) Act

of 1956 defines a stock exchange as "anybody of individuals, whether incorporated or not, constituted before corporatization demutualization" or "a body corporate incorporated under the Companies Act, 1956 whether under a scheme of corporatization and demutualization or otherwise," for the purpose of assisting, regulating or controlling the business of buying, selling or dealing in securities.

Investing is very much essential these days as savings alone is not sufficient to fulfil all our financial goals and to beat inflation. There are several investment options available, and you can choose them as per your needs and convenience. You must start your investments right from a young age to get good returns. Investment habit brings a sense of financial discipline in a person's life as it makes you allocate a certain amount of money periodically for the purpose of investment. Based on your risk appetite and time horizon to achieve your financial goals, you can select the appropriate investment option. Trading can be done in a easily and in less time. Before the advent of online technologies, trading was a complex process as you had to visit the broker or call your broker for placing or cancelling trade orders. Now, you can carry out trading even through a smartphone in the simplest way. rapid increase of social media platforms has reshaped the landscape of financial decision-making, particularly among young investors. Online communities, investment forums, and influencer-driven narratives on platforms such as Twitter, Reddit, and YouTube have created a dynamic environment where information spreads at unprecedented speed. This study investigates are the young youth aware about the modern stock market practices or not. By combining quantitative survey data with qualitative sentiment analysis of social media content, the research explores the extent to which digital interactions amplify emotional responses and affect trading patterns.

**Review of Literature:**

**Worrell, D. L., Davidson, W. N., & Glascock, J. L. (1993).**: The study investigates about investors' reactions to announcements. We found announcements containing information about permanent replacements to the associated with positive market reactions, whereas other types of firing announcements resulted in no market response. In addition, outsider appointments were perceived as beneficial immediately, while insider appointments elicited a wait-and-see reaction.

***A Manorselvi & Ulchi (2019):*** Researcher has explained the need for efficiency in the stock market to provide students with sufficient knowledge before investing money in the stock market. Students understand market volatility and invest in the best investment propositions. Moreover, after thorough analysis, the path to return on investment is paved.

**Objective of the Study**:

1) To know the awareness among students regarding the stock market.
2) To assess the students trading and investing habits.
3) To identify and analyse the consequences of these trading habits.

**Research methodology:**

The present study follows a descriptive research design. It is quantitative in nature as it collects numerical data through structured questionnaire and analyse the responses through statistical tools.

**Sources of Data:**

This study's goals were achieved using the descriptive research technique as its

methodology. We went out to students and had them fill out questionnaires as primary sources, which provided the information needed to accomplish the study's goals and secondary data. Main purpose of questionnaire is to collect data from those who fill it out. Questions about stock market knowledge and involvement are included in the questionnaire. There are multiple choice and closed ended questions on the survey.

**Population and Sample Size**: Our sample size is of 100 students. There is a good representation of both undergraduate and graduate students in this sample.

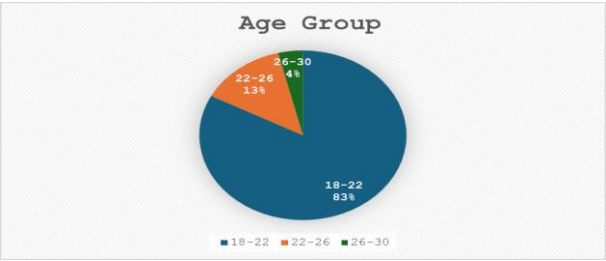
**Data Collection:** Primary Data: To get the main data, we used a survey strategy including questionnaires and to gather information from respondents online. secondary data: It was used to compliments primary data, which was collected through various textbooks, journals, and research articles. Various statistical tools were used after coding and inputting surveyed data.

**Hypothesis for the Study:**

H0: There is no awareness on stock market among college students.

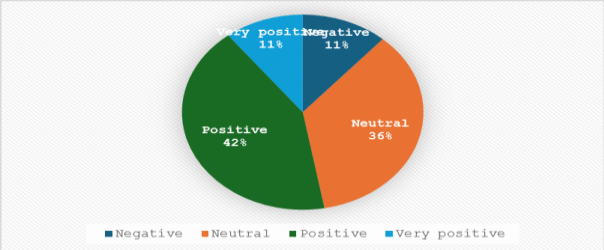
H1: There is awareness on stock market among college students.

**Data Analysis and Interpretation:**



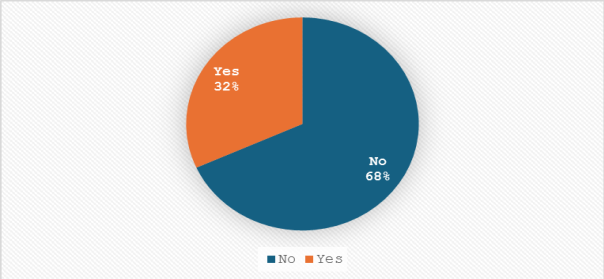

**Interpretation:** The above data states that 83% fall in age group between 18-22 where 13% falls in 22-26 and 4% falls in age 26-30.

**What comes to your Mind when you consider investing in stock market?**



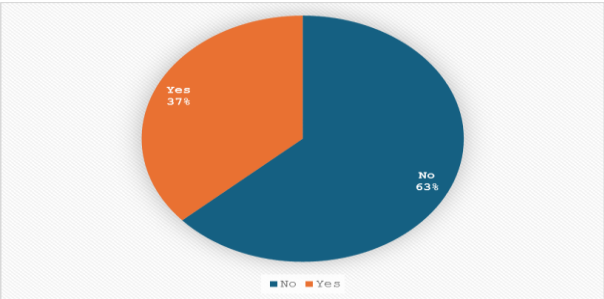

**Interpretation:** The above data states that 11% student's mindset is very positive whereas 11% are normally positive and 36% students are neutral. Only 11 % students are having negative mindset about investing in stock market.

**Are you a Demat Account Holder?**



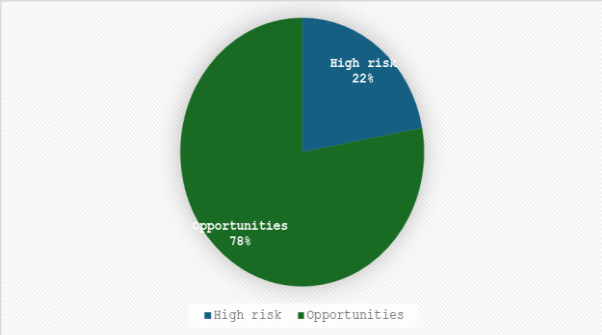

**Interpretation:** The above data states that only 32%students are having demat account whereas 68% students are not having demat account.

**Is your college providing any educational programmes related to stock market?**




**Interpretation:** By doing the survey we come to know 63% respondents' states that their colleges are not providing any educational programs related to stock market. Only 37% respondent's states that their college is providing the required educational programs.

**What do you see when it comes to investing in stocks?**




**Interpretation:** The above data states that 78% respondents see opportunities in stock market whereas 22% sees risk in it.

**Key Findings:**

Majority of the respondents 66% are male and 34% are female.

- All the respondents are well educated.
- Majority of respondents are Freshers in Share Market.
- Majority of respondents are aware of the regulator of Capital Market in India.
- Maximum investors are aware of all the investment options.
- Investors do not invest in a single avenue. They prefer different avenues and maximum respondents prefer to invest in shares, mutual funds & bonds.
- The investment plan of majority of respondents is long term, they prefer delivery trading in Share Market.
- All the respondents are aware of all the Online trading apps and according to maximum respondents Upstox and Zerodha are the best online trading app.
- Majority of respondents have positive and neutral perception about stock market and investing and hence majority of the respondents take stock market and investing as an opportunity.
- Majority of respondents think that Stock market and investing is better option in future to create maximum wealth.

**Suggestions:**

1. People at young age should be encouraged to invest in the stock market.
2. Initial margin money is high. That money should be low.
3. Try to avoid blindly flowing the crowd, invest in what you understand.
4. 4). One should have discipline and must follow your plans/ strategies.
5. Start with small amount and try to gain maximum knowledge by practically doing it and avoid investing in free tips and advice.

**Conclusion:**

After conducting research on the topic 'Awareness and participation in the stock market among students' we come to know that there has been a huge shift in the awareness and participation in the stock market. However, due to the risk involved in the financial markets, several respondents showed someone-participation. Also, the respondents who had partial knowledge of the subject were also not participating in the stock market due to the market risk involved. The students are aware about the basics of share market, but not that much of knowledge about facilities in share market. So, awareness should be spread through advertisement medias like newspaper, television, and magazines, etc. General awareness regarding BSE and NSE should be spread through college syllabus and activities. Also, awareness about Intraday trading and the facilities provided by different stock broking companies should be created through proper guidelines and mediums. Hence the awareness of the stock market was important to the investors because of without knowing any information; it leads to heavy loss and its never adjusting the forthcoming investment also.

Participating in the stock market can provide long-term benefits such as wealth creation and financial security, it is critical for undergraduate students to be aware of and knowledgeable about investing in the stockmarket.

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# Artificial Intelligence And Academic Library Professionals

**Dr. Pranesh Shantaram**

*Librarian HKE Society's, MSI Degree College, Kalaburagi. Affiliating University: Gulbarga University, Kalaburagi*

***Corresponding Author – Dr. Pranesh Shantaram***

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***Abstract:***

*Indian academic librarians are displaying a thoughtfully positive attitude towards incorporating artificial intelligence in academic libraries recognizing its potential to boost efficiency through automation, resource discovery, data analysis but at the same time raising concerns about job displacement, ethics, bias, privacy, funding, and the need for substantial training and infrastructure to bridge skill gaps, leading to a proactive but prepared approach to integrating artificial intelligence for better user services.*

*Artificial Intelligence is increasingly transforming academic libraries by enabling intelligent information retrieval, personalized services, and automation of routine operations. While developed nations have made significant progress in integrating artificial intelligence into library systems, developing countries such as India continue to face infrastructural, professional, and policy-related challenges.*

*In this backdrop the paper examines the readiness of library professionals in adopting artificial intelligence in academic libraries with special reference to India. It reviews the evolution of digital libraries, existing artificial intelligence applications, relevant government policies, and the key obstacles affecting implementation. The study proposes measures to strengthen institutional preparedness, professional competencies, and policy alignment to facilitate effective adoption of artificial intelligence in academic library services.*

***Keywords: Artificial Intelligence, Academic Libraries, Digital Libraries, Library Professionals, Government Policy, India, Readiness***

## Introduction:

Librarians play a vital role in identifying artificial intelligence, ensuring that they align with their core mission, such as research discovery, enhancing student outcomes, and increasing productivity. To safeguard that the technology complements rather than disrupts library functions, they can prioritise on strategic and operational benefits.

Operationally, artificial intelligence can support core tasks, enabling focus on advancing literacy, assisting early career researchers, or helping with complex literature reviews. Strategically, AI-driven analytics can provide insights into users, helping tailor collections.

Artificial Intelligence has emerged as one of the most influential technologies of the contemporary digital era. In academic libraries, AI has the potential to revolutionize traditional service models through intelligent search engines, automated cataloguing, personalized recommendation systems, and virtual reference services. These innovations enhance operational efficiency, user engagement, and access to knowledge resources.

Despite its transformative potential, the adoption of AI technology in libraries remains uneven, particularly in developing countries. Limited technological infrastructure, inadequate professional training, and the absence of domain-

specific policy frameworks hinder large-scale implementation. Although digital library initiatives have laid a foundation, the readiness of library professionals to effectively use this technology remains uncertain.

In this backdrop the paper examines the readiness of library professionals in adopting artificial intelligence in academic libraries with special reference to India. It reviews the evolution of digital libraries, existing artificial intelligence applications, relevant government policies, and the key obstacles affecting implementation. The study proposes measures to strengthen institutional preparedness, professional competencies, and policy alignment to facilitate effective adoption of artificial intelligence in academic library services.

**Objectives of the Study:**

1. To examine the evolution of digital libraries and their role in enabling artificial intelligence adoption in academic libraries.
2. To identify existing applications of artificial intelligence in academic libraries in India.
3. To analyse government initiatives that support artificial intelligence implementation in libraries and information institutions.
4. To assess the challenges faced by library professionals in adopting AI technologies.
5. To propose strategies for improving readiness and capacity building among library professionals for effective AI integration.

**Methodology:**

The present paper is prepared using secondary data sources like books, journals, articles, blogs etc.

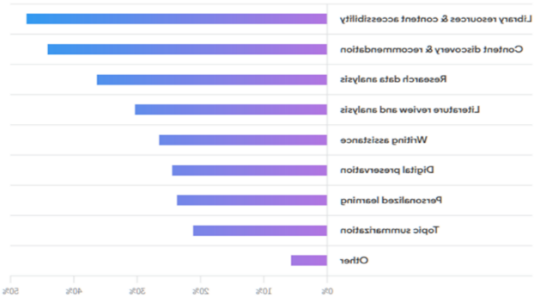
**Evolution of Digital Libraries and transformative shift**

The transition from traditional print-based libraries to digital libraries marks a significant revolution in the information landscape. Advances in information technology and computer networks have enabled the storage, retrieval, dissemination, and duplication of information in digital formats. Digital libraries provide universal access to knowledge resources and form the technological backbone for AI applications.

Globally, digital libraries have achieved considerable progress in both infrastructure and service delivery. In India, however, development remains fragmented and institution-specific. Most initiatives focus on specialized or heritage collections rather than comprehensive academic services. While national digital initiatives demonstrate intent, the overall digital library ecosystem is still in an embryonic stage.

The success of digital libraries depend not only on infrastructure but also on the technological competence of library professionals. The evolving role of librarians now demands skills in data management, digital preservation, metadata standards, and emerging AI tools. Implementation of artificial intelligence in academic libraries should balance practical improvements and strategic advancements.

The Pulse of the Library Report from Clarivate 2024 illustrates areas where AI applications are deemed most valuable.



Digital library initiatives in India are primarily concentrated in premier institutions like Indian Institutes of Technology (IITs), Indian Institutes of Management (IIMs), Indian Institute of Science (IISc), and selected research organizations.

**Applications of Artificial Intelligence in Academic Libraries in India:**

Several academic and research libraries in India have begun experimenting with AI technologies, though adoption remains largely at a nascent stage.

- **Intelligent search and discovery systems** are used in institutions such as IITs and IISc through advanced discovery platforms integrated with machine learning algorithms to improve relevance ranking and semantic search.
- **Chatbots and virtual reference assistants** have been piloted in libraries such as IIT Delhi and IIT Bombay to provide 24×7 assistance for routine queries related to access, circulation, and services.
- **Automated cataloguing and metadata generation** are applied in national projects such as the National Digital Library of India (NDLI), where AI tools assist in document classification, subject tagging, and optical character recognition.
- **Recommendation systems** within NDLI provide personalized content suggestions based on user behaviour and academic interests.
- **Plagiarism detection systems** such as Turnitin and Urkund, widely administered through university libraries, employ AI algorithms to ensure academic integrity.
- **Digital preservation and heritage projects**, including the Traditional Knowledge Digital Library (TKDL), use AI for multilingual indexing, semantic tagging, and corpus management.

These initiatives demonstrate the growing relevance of AI in Indian academic libraries, although their reach remains limited.

**Government Initiatives:**

India currently lacks a dedicated AI policy exclusively for libraries. However, several national frameworks and digital initiatives indirectly support AI adoption in libraries.

- The **National Mission on Libraries (NML)** promotes modernization, networking, and digitization of libraries, creating foundational infrastructure for AI integration.
- The **IndiaAI Mission** and the **INDIAai portal**, launched by the Ministry of Electronics and Information Technology, provide datasets, research platforms, and skilling frameworks that libraries can leverage for AI-based services.
- The **National Digital Library of India (NDLI)**, under the Digital India programme, offers a centralized digital repository where AI-enabled discovery and recommendation services are gradually being integrated.
- The **Traditional Knowledge Digital Library (TKDL)** represents a government-supported AI-enabled digital library model using semantic search, automated indexing, and multilingual metadata.
- The **National Data Sharing and Accessibility Policy (NDSAP)** facilitates access to government datasets in machine-readable formats, supporting AI training and knowledge discovery.

Together, these policies provide an enabling environment for AI adoption in academic libraries through infrastructure development, data accessibility, skill development, and ethical governance.

**Challenges in AI Adoption and Professional Readiness:**

Several structural and professional challenges hinder AI adoption in Indian academic libraries.

- **Infrastructure limitations** remain a major obstacle, particularly in rural and semi-urban institutions where access to high-speed internet and advanced computing facilities is inadequate.
- **Skill gaps among library professionals** pose serious limitations. Most training programmes focus on basic digital literacy rather than advanced AI competencies. Standardized AI competency frameworks for librarians are largely absent.
- **Institutional constraints**, including limited funding, lack of strategic planning, and low administrative prioritization, further restrict innovation.
- **Socio-economic disparities** exacerbate the digital divide. Large sections of the population lack access to computers and digital learning environments, limiting equitable benefits from AI-enabled services.

These challenges highlight that successful AI adoption requires not only technological investment but also sustained professional development and institutional commitment.

**Conclusion:**

Artificial Intelligence holds immense potential to transform academic libraries by improving access, efficiency, and user experience. In India, digital library initiatives and national AI missions have created a promising foundation, yet adoption remains uneven and institution-specific.

The readiness of library professionals is central to successful implementation. Systematic training programmes, curriculum reform in Library and Information Science education, institutional investment, and policy alignment are essential.

The future vision for Indian academic libraries should be the creation of a cohesive national knowledge infrastructure integrating universities, research institutions, and government agencies through AI-enabled systems. With coordinated planning, capacity building, and ethical governance, academic libraries can effectively harness AI to support education, research, and national development.

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# Agriculture Transformation and Rural Economy

**Ashok K. Hoke**

*Asst. Prof.& Head Department of Commerce Shri Siddheshwar Mahavidyalaya, Majalgaon, Maharashtra, India*

***Corresponding Author – Ashok K. Hoke***

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***Abstract:***

*Agriculture has traditionally been the backbone of rural economies, providing employment, food security, and income stability for a large segment of the population. In recent years, the agricultural sector has been undergoing significant transformation due to technological advancement, policy reforms, market integration, and changing socio-economic conditions. This research paper examines the concept of agricultural transformation and its impact on the rural economy. The study focuses on how modernization of farming practices, adoption of innovative technologies, diversification of agricultural activities, and improved market access contribute to rural economic development. Rather than viewing agriculture solely as a subsistence activity, the paper highlights its evolving role as a driver of rural growth, entrepreneurship, and livelihood enhancement. The study also discusses challenges such as small landholdings, climate uncertainty, and unequal access to resources. The findings suggest that sustainable agricultural transformation plays a crucial role in strengthening rural economies and improving overall quality of life.*

***Keywords: Agriculture Transformation, Rural Economy, Sustainable Farming, Rural Development, Economic Growth***

## Introduction:

Agriculture remains a central pillar of rural life and economic activity. For generations, rural communities have relied on farming and allied activities as their primary source of livelihood. However, traditional agricultural practices often face limitations such as low productivity, income instability, and vulnerability to environmental conditions.

In the contemporary era, agriculture is experiencing a gradual transformation driven by modernization, improved inputs, technological innovation, and supportive policy frameworks. This transformation has significant implications for the rural economy, as changes in agricultural productivity directly influence employment opportunities, income levels, and rural living standards.

This research paper explores the relationship between agricultural transformation and the rural economy, emphasizing how changes in agricultural systems contribute to sustainable rural development.

## Concept of Agricultural Transformation:

Agricultural transformation refers to the process through which farming systems shift from traditional, low-input practices to more efficient, diversified, and market-oriented approaches. This process involves improvements in production techniques, use of modern tools, access to information, and integration with value chains.

The transformation is not limited to technological change alone; it also includes institutional reforms, skill development, financial inclusion, and changes in farmer behavior.

Agricultural transformation aims to enhance productivity, reduce risks, and create resilient farming systems that support rural economic growth.

**Role of Agriculture in the Rural Economy:**

Agriculture plays a multidimensional role in shaping rural economies:

- It provides direct employment to a large rural workforce
- It supports allied activities such as livestock, fisheries, and agro-processing
- It contributes to food availability and price stability
- It generates demand for rural goods and services

A strong agricultural sector stimulates economic activity beyond farms, creating opportunities in transportation, storage, marketing, and rural enterprises.

**Drivers of Agricultural Transformation:**

**1.Technological Advancement:** The adoption of improved seeds, modern irrigation methods, farm mechanization, and digital advisory services has enhanced farming efficiency. Technology reduces manual labor, improves resource management, and increases yield potential.

**2.Diversification of Agricultural Activities:** Farmers are increasingly diversifying into horticulture, dairy farming, poultry, fisheries, and value-added products. Diversification reduces dependency on a single crop and provides more stable income sources.

**3.Market Integration and Value Chains:** Improved market access enables farmers to receive better prices for their produce. Direct marketing, cooperatives, and digital marketplaces help link rural producers with consumers and processing industries.

**4.Policy Support and Institutional Frameworks:** Government initiatives related to credit access, crop insurance, input subsidies, and rural infrastructure play a critical role in enabling agricultural transformation. Effective institutions support farmers in managing risks and adopting innovation.

**Impact of Agricultural Transformation on Rural Economy:**

**1.Income Growth and Employment:** Enhanced productivity and diversification increase farm income and create employment opportunities across agricultural value chains. This leads to reduced rural poverty and improved living standards.

**2.Rural Entrepreneurship Development:** Agricultural transformation encourages rural entrepreneurship through agro-processing units, storage facilities, and farm-based enterprises. These activities add value to agricultural produce and generate local employment.

**3.Migration Reduction:** Improved economic opportunities within rural areas reduce distress migration to urban centers. Stable rural livelihoods contribute to balanced regional development.

**Challenges in Agricultural Transformation:**

Despite its potential benefits, agricultural transformation faces several challenges:

- Fragmented landholdings and limited scale of operations
- Climate variability and environmental degradation
- Unequal access to technology and credit
- Market volatility and price fluctuations
- Limited awareness and skill gaps among farmers

Addressing these challenges is essential for inclusive rural economic growth.

**Methodology:**

This research adopts a qualitative and conceptual approach to analyze agricultural transformation and its influence on the rural economy. The study is based on interpretation of recent academic discussions, policy perspectives, and development-oriented analyses.

The methodology emphasizes logical reasoning and thematic understanding rather than statistical modeling, making it suitable for socio-economic research.

**Findings and Discussion:**

The analysis indicates that agricultural transformation has a strong positive relationship with rural economic development. Productivity enhancement alone is insufficient unless accompanied by market access, institutional support, and skill development.

The study highlights that sustainable transformation requires an integrated approach involving technology, policy, community participation, and environmental responsibility.

**Conclusion:**

Agricultural transformation is a key driver of rural economic progress. By modernizing farming practices, diversifying income sources, and strengthening market linkages, agriculture can move beyond subsistence and become a foundation for rural prosperity.

This research concludes that inclusive and sustainable agricultural transformation is essential for building resilient rural economies and improving socio-economic well-being.

**Future Scope:**

Future research may focus on:

- Region-specific studies on agricultural transformation
- Long-term economic impact assessment
- Climate-resilient farming models
- Role of digital platforms in rural agricultural markets

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# Reflections of Subaltern Status of Women in the Novels of Gita Hariharan, K.R. Meera and Meena Kandasamy

**Mrs. Deepali Ashok Kumawat[1], & Dr. Nilima Prakash Kale[2]**

*[1]Research Scholar, Department of English, Dr. BAMU University, Chh. Sambhajinagar (MS) India*

*[2]Associate Professor, Department of English,*

*Dagdojirao Deshmukh Arts Commerce and Science College, Waluj Chh. Sambhajinagar*

***Corresponding Author – Mrs. Deepali Ashok Kumawat***

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***Abstract:***

*The present study examines the reflections of the subaltern status of women in the selected novels of Gita Hariharan, K. R. Meera, and Meena Kandasamy. Subaltern women, marginalized by intersecting forces of caste, class, gender, and socio-cultural hierarchies, often remain silenced within dominant patriarchal discourses. This research explores how contemporary Indian women writers articulate these silenced voices and transform them into narratives of resistance and agency. Using feminist theory, subaltern studies, and intersectionality as theoretical frameworks, the study undertakes a qualitative textual analysis of selected novels to examine themes of marginalization, oppression, silence, and empowerment. The research highlights how these writers challenge hegemonic structures through innovative narrative strategies, mythological subversion, and political engagement. By foregrounding women's lived experiences, the study demonstrates the transformative role of literature in reclaiming subaltern identities and contributing to feminist and postcolonial literary discourse.*

***Keywords: Subaltern Women, Feminist Literature, Intersectionality and Resistance and Agency***

## Introduction:

The subaltern status of women has been a persistent theme in postcolonial feminist discourse, especially in the context of South Asian societies like India, where gender intersects with class, caste, religion, and culture to reinforce marginalization. The concept of "subaltern" was introduced by Italian Marxist thinker Antonio Gramsci and later expanded by postcolonial theorists such as Gayatri Chakravorty Spivak. Spivak, in her influential essay *Can the Subaltern Speak?*, argued that the voices of subaltern women are often silenced by hegemonic power structures, making their true representation a critical concern in academic and literary analysis. Indian English literature, particularly by women writers, has emerged as a significant platform to voice the concerns of these marginalized women. Authors such as Gita Hariharan, K.R. Meera, and Meena Kandasamy offer nuanced portrayals of women who are pushed to the margins due to entrenched patriarchal norms, systemic violence, and socio-cultural conditioning. Through their fictional narratives, these writers question dominant ideologies and present alternate ways of seeing the world from the perspective of the subaltern woman. In Gita Hariharan's *The Thousand Faces of Night* and *The Remains of the Feast*, the narrative traces the complexities of womanhood in traditional Indian settings. K.R. Meera's *Hangwoman* and *The Poison of Love* examine psychological entrapment and moral dilemmas faced by women in male-dominated societies. Meena Kandasamy's *When I Hit You* is a bold, semi-autobiographical account that delves into domestic violence, resistance, and self-

reclamation. This study aims to explore how these literary texts reflect the subaltern experiences of women, examining how silence, resistance, and agency are depicted. By situating these narratives within the broader framework of subaltern studies and feminist theory, the study provides a deeper understanding of the socio-cultural realities faced by women in India.

**Survey of literature:**

***Gayatri Chakravorty Spivak (1988)*** **her** seminal essay *Can the Subaltern Speak?* interrogates the representation of marginalized voices within dominant discourses. She argues that subaltern women are doubly silenced by colonial and patriarchal structures. Her work provides a foundational theoretical framework for examining how literature attempts to recover or represent subaltern women's voices without appropriation. ***Meenakshi Mukherjee (2000)*** examines Indian English fiction as a space where personal narratives intersect with political realities. She highlights how women writers expose patriarchal structures through domestic and cultural settings. Her insights are crucial in understanding Gita Hariharan's blending of private female experiences with broader socio-political critiques. ***Sharmila Rege (2006)*** **her** work foregrounds Dalit feminism and critiques mainstream feminism for ignoring caste. She emphasizes the importance of lived experiences and testimonies of marginalized women. Her theoretical approach resonates strongly with Meena Kandasamy's writing, which foregrounds caste-based oppression and resistance through a feminist lens. ***Susie Tharu and K. Lalita (1993)*** document women's writing traditions in India, highlighting how marginalized women challenge dominant literary canons. Their work establishes women's writing as a form of resistance and historical recovery, providing a critical framework for analyzing mythological subversion and feminist retellings in Hariharan's fiction. *Nair, R. (2017)* critics observe that K. R. Meera's fiction exposes psychological and institutional oppression faced by women. Her narratives explore trauma, surveillance, and gendered violence, positioning women within authoritarian systems. Scholars note her contribution to portraying subaltern women's resistance through inner consciousness and narrative intensity. ***Studies on Meena Kandasamy (2015–2020)*** Scholars identify Meena Kandasamy as a radical Dalit feminist voice who politicizes personal trauma. Her novels transform domestic violence and caste oppression into acts of resistance. Critics emphasize her use of autobiographical realism and confrontational language to reclaim subaltern women's agency.

**Objectives of the Study:**

1. To examine the representation of subaltern women in the selected novels.
2. To analyze themes of marginalization, resistance, and agency.
3. To study narrative strategies used to challenge patriarchal discourse.

**Methodology:**

The present study adopts a qualitative research approach based on textual and thematic analysis. Selected novels of Gita Hariharan, K. R. Meera, and Meena Kandasamy constitute the primary sources, while secondary data include critical books, research articles, journals, and theoretical texts. The study employs feminist theory, subaltern studies, and intersectionality as analytical frameworks to examine representations of subaltern women. Comparative and interpretative methods are used to analyze themes of marginalization, resistance, agency, and narrative strategies within the selected texts**.**

**Discussion:**

The present study has examined the nuanced and powerful portrayal of subaltern women in the selected works of Gita Hariharan, K.R. Meera, and Meena Kandasamy, focusing on how these authors give voice to women who are historically and culturally silenced by intersecting forces of patriarchy, caste, class, and religion. Through a close literary analysis of *The Thousand Faces of Night*, *The Remains of the Feast*, *Hangwoman*, *The Poison of Love*, and *When I Hit You*, the study has explored how these writers challenge dominant narratives and reconstruct subaltern identity through feminist and postcolonial perspectives. The findings reveal that subaltern women in these narratives are not merely passive recipients of oppression, but agents of introspection, resistance, and transformation. Whether it is Devi rejecting a patriarchal marriage, Chetna navigating her inherited identity as a hangwoman, or Kandasamy's unnamed protagonist fighting to reclaim her voice through writing, each character demonstrates the complex emotional, psychological, and socio-political dimensions of subaltern existence. These stories disrupt the silences imposed on women by exposing the ways in which cultural myths, familial structures, and political ideologies are used to sustain gendered subordination.

The study also critically examines the representation of subaltern women in the selected novels of Gita Hariharan, K. R. Meera, and Meena Kandasamy, foregrounding how literature becomes a powerful medium to articulate marginalized voices. Across these writers' works, subaltern women emerge as figures shaped by intersecting forces of caste, class, gender, and socio-cultural constraints. Rather than portraying women as passive victims, the narratives reveal complex characters who negotiate oppression through silence, endurance, resistance, and self-assertion. This study demonstrates that subalternity in these texts is not a static condition but a dynamic space of struggle and transformation.

Gita Hariharan's novels explore subaltern women largely through subtle, interiorized forms of resistance. Characters such as Mayamma and Devi in *The Thousand Faces of Night* exemplify how caste and patriarchy operate within domestic spaces, reducing women to roles of service and sacrifice. However, Hariharan emphasizes quiet defiance—through memory, silence, and personal choice—suggesting that resistance does not always take overt political forms. Her use of mythology and narrative re-visioning allows women to reclaim cultural spaces traditionally dominated by patriarchal interpretations. Thus, Hariharan's fiction highlights how subaltern women assert agency within deeply restrictive social frameworks.

K. R. Meera's novels, on the other hand, focus more sharply on psychological and institutional oppression. Her female protagonists are often caught within authoritarian systems—familial, political, or social—that regulate women's bodies and identities. Meera's narratives expose how power operates through surveillance, fear, and control, particularly over women's minds. Yet, resistance in her works emerges through consciousness and self-awareness. Women challenge imposed identities by questioning authority, reclaiming memory, and confronting internalized oppression. This psychological depth adds another dimension to subaltern studies, emphasizing mental and emotional subjugation as significant forms of marginalization.

Meena Kandasamy's writing represents a more radical and confrontational articulation of subaltern women's voices. Rooted in Dalit feminism, her narratives foreground caste-based violence, domestic abuse, and systemic silencing.

Unlike the restrained resistance seen in Hariharan, Kandasamy's protagonists speak back directly to power, using language as a weapon of protest. Her works transform personal trauma into political testimony, asserting that the personal is inherently political. Through anger, irony, and explicit critique, Kandasamy challenges both patriarchy and dominant feminist discourses that overlook caste realities.

This segment presents the major findings derived from the textual analysis of the selected novels by Gita Hariharan, K. R. Meera, and Meena Kandasamy, highlighting their nuanced portrayal of subaltern women's oppression and resistance within patriarchal and caste-based structures. A significant finding is that all three authors foreground the psychological dimensions of subalternity, moving beyond depictions of women as merely external victims. Their narratives delve deeply into the inner lives of female characters, exposing emotional turmoil, suppressed rage, alienation, and identity crises produced by prolonged marginalization. Hariharan, in particular, emphasizes the intergenerational transmission of patriarchal trauma, illustrating how daughters inherit not only restrictive social roles but also the silent suffering of mothers and grandmothers. This inherited pain becomes both a burden and a catalyst, creating spaces of emotional solidarity from which resistance and self-awareness emerge. It is observed that the authors' subversive use of myth, folklore, and cultural symbolism as tools of feminist resistance. Rather than reinforcing traditional ideals, these writers reinterpret cultural narratives to critique glorified female suffering. Hariharan revisits mythological figures such as Draupadi and Amba to expose the injustice behind their celebrated endurance, while Meera and Kandasamy invoke cultural archetypes to dismantle the moral hypocrisy embedded in them. Equally significant is the role of language as resistance. Each writer employs a distinctive narrative style—Hariharan's lyrical introspection, Meera's fragmented poetic intensity, and Kandasamy's confrontational and raw prose—to challenge dominant literary and ideological traditions. Storytelling itself becomes an act of rebellion, particularly for women whose voices are historically silenced. The study also reveals how female bodies function as contested sites of power, subjected to regulation, violence, and control, yet reclaimed through writing, silence, defiance, or bodily autonomy.

The analysis also highlights the authors' portrayal of subtle and silent forms of resistance, demonstrating that rebellion is not always overt. Characters such as Meera's Tulsi, who resists through withdrawal, and Hariharan's women who assert desire in their final moments, reveal how silence can become a powerful mode of defiance. The novels also expose the hypocrisy of progressive male figures who advocate reform publicly but perpetuate abuse privately, particularly evident in Kandasamy's critique of intellectual patriarchy. Furthermore, the study finds a consistent depiction of the failure of traditional institutions such as family and marriage, which often function as sites of control rather than protection. Ultimately, all three writers redefine subaltern women not as passive victims but as agents of transformation, charting a journey from voicelessness to articulation, from oppression to self-realization. Literature thus emerges as a vital space where subaltern women reclaim identity, agency, and resistance.

**Limitations of the Study:**

This study is limited in its scope to the selected works of Gita Hariharan, K.R. Meera, and Meena Kandasamy, which may not represent the full spectrum of subaltern women's experiences in Indian literature. It primarily relies on English translations of regional texts, which

may result in the loss of linguistic nuances. Additionally, the research focuses on literary representation rather than real-life ethnographic accounts. Due to time and space constraints, other influential subaltern and Dalit women writers are not included. The findings are interpretative in nature and may vary with different critical approaches or cultural perspectives.

**Conclusion:**

The discussion highlights that contemporary Indian women's fiction plays a transformative role in redefining subalternity. By centering marginalized women's experiences, Hariharan, Meera, and Kandasamy expand feminist and postcolonial discourse. Their works not only critique oppressive structures but also envision possibilities of resistance, agency, and selfhood, affirming literature as a vital space for social and cultural intervention. A main finding of this study is that while these writers differ in narrative style and tone, they collectively challenge hegemonic representations of women. Intersectionality emerges as a crucial analytical lens, revealing how multiple forms of oppression operate simultaneously. The study also highlights the role of narrative strategies—mythological subversion, silence, fragmented narration, and autobiographical realism—in giving voice to the subaltern. These strategies resist appropriation by allowing women's experiences to emerge organically within their cultural and social contexts. The study also concludes that literature becomes a vital site for reclaiming the marginalized female voice. Through innovative narrative strategies, mythological subversions, and intersectional representation, the selected authors not only critique existing power structures but also create space for alternative histories and feminist futures. Their works extend beyond storytelling—they become acts of resistance, empowerment, and reimagination. This study affirms the necessity of intersectional and comparative literary research in understanding subaltern womanhood in contemporary Indian literature. It opens up new dialogues on representation, voice, and agency, calling for more inclusive and critical engagements with literature that centers the experiences of the most marginalized.

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# A Critical Study of Issues, Challenges and Opportunities of Women Entrepreneurs in Manufacturing SMEs in the Marathwada Region

**Shubhali J. Pohnekar[1] & Dr. Shweta Rajale (Patil)[2]**

*[1]Research Scholar, Department of Management Science,*
*Dr. Babasaheb Ambedkar Marathwada University, Chh. Sambhajinagar*
*[2]Assistant Professor, Department of Management Science,*
*Dr. Babasaheb Ambedkar Marathwada University, Chh. Sambhajinagar*
***Corresponding Author – Shubhali J. Pohnekar***

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***Abstract:***

*The present study examines the issues, challenges and opportunities faced by women entrepreneurs operating manufacturing small and medium enterprises (SMEs) in the Marathwada region of Maharashtra, India. Women entrepreneurship plays a vital role in inclusive industrial growth, particularly in Small and Medium Enterprises (SMEs). Despite government initiatives, women entrepreneurs in manufacturing face multifaceted challenges, especially in backward regions like Marathwada. The present study critically examines the issues, challenges, and opportunities faced by women entrepreneurs operating manufacturing SMEs in the Marathwada region of Maharashtra. Using primary data collected from 40 women entrepreneurs through a structured questionnaire, the study used descriptive statistical analysis. Findings reveal that financial constraints, lack of technical skills, limited market access, and socio-cultural barriers remain dominant challenges, while government schemes, digital platforms, and growing demand for indigenous products provide significant opportunities. The study concludes with policy suggestions to strengthen women-led manufacturing SMEs for sustainable regional development*

***Keywords: Women Entrepreneurs, Manufacturing SMEs, Marathwada, Challenges, Opportunities***

## Introduction:

Women entrepreneurship has emerged as a powerful instrument of economic growth, social transformation, and employment generation in developing economies like India. In recent years, women have increasingly entered the entrepreneurial arena, particularly in Small and Medium Enterprises (SMEs), which are considered the backbone of the Indian industrial sector. Manufacturing SMEs provide significant opportunities for value creation, skill utilization, and regional development. However, women entrepreneurs continue to face multiple barriers that limit their participation and growth, especially in traditionally male-dominated manufacturing activities. The Marathwada region of Maharashtra presents a distinct socio-economic context for examining women entrepreneurship. The region is marked by industrial backwardness, inadequate infrastructure, limited access to finance, and recurring agrarian distress. Despite these constraints, a growing number of women have ventured into manufacturing SMEs such as food processing, garments, agro-based units, handicrafts, and small engineering goods. Their entrepreneurial efforts not only contribute to household income but also promote local employment and inclusive regional development.

Women entrepreneurs in manufacturing SMEs face a complex set of challenges. These include limited access to credit and collateral, lack of technical and managerial skills, restricted

market linkages, and intense competition from established enterprises. Social and cultural expectations related to family responsibilities, mobility restrictions, and gender bias further compound these challenges. Balancing business responsibilities with domestic roles often leads to stress and limits business expansion. At the same time, the changing policy environment in India has opened new avenues for women entrepreneurs. Government initiatives aimed at promoting MSMEs, women-centric financial schemes, skill development programs, and digital platforms have created new opportunities for business growth. The increasing acceptance of women as business leaders and the expansion of e-commerce have also helped overcome traditional barriers. In this situation, a critical study of the issues, challenges, and opportunities faced by women entrepreneurs in manufacturing SMEs in the Marathwada region becomes essential. Such an analysis can provide valuable insights for policymakers, financial institutions, and development agencies to design targeted interventions that support women-led industrial enterprises and foster sustainable regional development.

**Review of Literature:**

*Deshpande and Sethi (2019)*[4] observed that women entrepreneurs face severe financial and mobility constraints in SMEs. *Kumar (2020)*[5] highlighted lack of technical skills and inadequate training as major barriers in manufacturing enterprises. *Sharma and Varma (2021)*[6] highlighted socio-cultural resistance and work–life imbalance as persistent challenges. *Goyal (2022)*[7] found that digitalization and e-commerce platforms have opened new growth avenues for women-led SMEs. *Patil (2023)*[8] noted that regional disparities intensify challenges for women entrepreneurs in backward regions like Marathwada.

**Objectives of the Study:**

1. To examine the socio-economic profile of women entrepreneurs in manufacturing SMEs.
2. To identify major issues and challenges faced by women entrepreneurs.
3. To analyze emerging opportunities for women entrepreneurs in the Marathwada region.

**Methodology:**

The study is empirical and descriptive in nature. Primary data were collected from **40 women entrepreneurs** operating manufacturing SMEs across districts of the Marathwada region using a structured questionnaire. Convenience sampling method was adopted. Secondary data were collected from journals, reports, and government publications. Data analysis was carried out using percentages and tabular presentation.

**Results and Discussion:**

The results and discussion section presents an analysis of primary data collected from women entrepreneurs operating manufacturing SMEs in the Marathwada region. The findings highlight key demographic characteristics, major issues and challenges, and emerging opportunities influencing women entrepreneurship. Through empirical evidence, this section discusses financial, technical, and socio-cultural constraints alongside supportive factors such as government schemes and digital platforms. The discussion critically interprets the results in light of existing literature to assess their implications for sustainable growth of women-led manufacturing enterprises.

Table -1 Demographic Profile of Respondents

| Age Group (Years) | No. of Respondents | Percentage |
|---|---|---|
| Below 30 | 6 | 15% |
| 31–40 | 14 | 35% |
| 41–50 | 12 | 30% |
| Above 50 | 8 | 20% |
| Total | 40 | 100% |
| | | |
| Education Qualification | No. of Respondents | Percentage |
| Secondary | 10 | 25% |
| Graduate | 18 | 45% |
| Post-Graduate | 8 | 20% |
| Technical/Diploma | 4 | 10% |
| Total | 40 | 100% |

*Source: Field Survey*

Table–1 presents the demographic profile of women entrepreneurs engaged in manufacturing SMEs in the Marathwada region based on age and educational qualification. The age-wise distribution indicates that a majority of respondents (35%) fall in the 31–40 years age group, followed by 30% in the 41–50 years category. This shows that women are more actively involved in entrepreneurial activities during their economically productive and professionally mature years, when they possess both experience and decision-making capacity. About 15% of the respondents are below 30 years, reflecting a comparatively lower entry of younger women into manufacturing entrepreneurship, possibly due to financial dependence, lack of experience, or risk aversion. Meanwhile, 20% of respondents are above 50 years, suggesting sustained entrepreneurial involvement even at later stages of life, driven by experience and business stability.

In terms of educational qualification, the data reveal that 45% of respondents are graduates, indicating that higher education plays a crucial role in motivating women to establish manufacturing enterprises. Secondary-level education accounts for 25%, showing that formal higher education is not the sole prerequisite for entrepreneurship. Post-graduates constitute 20%, reflecting advanced managerial and analytical capabilities among a segment of entrepreneurs. Only 10% possess technical or diploma qualifications, highlighting the need for more technical training programs. Overall, the demographic profile suggests that education and age significantly influence women's participation in manufacturing SMEs, underscoring the importance of targeted skill development and educational support to enhance women entrepreneurship in the region.

Table 2 Major Challenges Faced by Women Entrepreneurs

| **Challenges** | **Respondents** | **Percentage** |
|---|---|---|
| Financial Constraints | 32 | 80% |
| Lack of Technical Skills | 28 | 70% |
| Market Access & Competition | 26 | 65% |
| Work–Life Balance | 30 | 75% |
| Socio-Cultural Barriers | 22 | 55% |
| Infrastructure Problems | 24 | 60% |

*Source: Field Survey*

Table-2 highlights the major challenges faced by women entrepreneurs operating manufacturing SMEs in the Marathwada region. Financial constraints emerge as the most severe challenge, reported by 80% of respondents. Limited access to institutional finance, collateral requirements, and procedural complexities in obtaining loans significantly restrict business expansion and technological upgradation. Work–life balance is another critical issue, faced by 75% of respondents, indicating the dual burden of managing enterprise responsibilities alongside household and family obligations, which often affects productivity and decision-making.

**Figure- 1 Major Challenges Faced by Women Entrepreneurs**


Lack of technical skills is reported by 70% of respondents, reflecting inadequate exposure to modern manufacturing techniques, machinery handling, and quality control practices. This limitation hampers efficiency and competitiveness in the market. Market access and competition pose challenges for 65% of respondents, as women entrepreneurs often struggle with limited marketing networks, pricing pressures, and dominance of established players. Infrastructure problems, such as irregular power supply, inadequate industrial space, and poor transportation facilities, affect 60% of the respondents, further increasing operational costs. Additionally, 55% of respondents face socio-cultural barriers, including gender bias, lack of family support, and societal expectations, which undermine entrepreneurial confidence. Overall, the findings indicate that women entrepreneurs in manufacturing SMEs confront a combination of financial, technical, social, and infrastructural challenges, necessitating comprehensive policy interventions and institutional support mechanisms to ensure their sustainable growth.

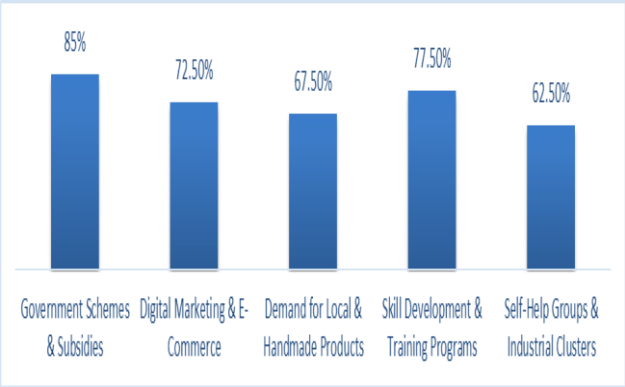
Table- 3 Emerging Opportunities for Women Entrepreneurs

| **Opportunities** | **Respondents** | **Percentage** |
|---|---|---|
| Government Schemes & Subsidies | 34 | 85% |
| Digital Marketing & E-Commerce | 29 | 72.5% |
| Demand for Local & Handmade Products | 27 | 67.5% |
| Skill Development & Training Programs | 31 | 77.5% |
| Self-Help Groups & Industrial Clusters | 25 | 62.5% |

*Source: Field Survey*

Table-3 presents the emerging opportunities available to women entrepreneurs operating manufacturing SMEs in the Marathwada region. A significant majority of respondents (85%) identified government schemes and subsidies as the most important opportunity, indicating increasing awareness and reliance on financial assistance, incentives, and policy support provided for women-led enterprises. Skill development and training programs were acknowledged by 77.5% of respondents, highlighting their role in enhancing technical competence, managerial efficiency, and entrepreneurial confidence.

**Figure-2 Emerging Opportunities for Women Entrepreneurs**




Digital marketing and e-commerce platforms were recognized by 72.5% of respondents as vital growth avenues, enabling women entrepreneurs to overcome geographical barriers and access wider markets at relatively low cost. About 67.5% of respondents reported rising demand for local and handmade products, reflecting changing consumer preferences towards indigenous, sustainable, and women-produced goods. Additionally, 62.5% of respondents viewed self-help groups and industrial clusters as valuable opportunities for collective learning, resource sharing, and improved bargaining power. Overall, these findings suggest that supportive policies, technological advancement, and market trends are creating a favorable environment for strengthening women entrepreneurship in manufacturing SMEs.

**Conclusion:**

The study concludes that women entrepreneurs in manufacturing SMEs in the Marathwada region play a significant role in regional industrial and economic development despite facing numerous challenges. Financial constraints, work–life imbalance, limited technical skills, and socio-cultural barriers continue to restrict their growth and competitiveness. However, increasing government support, skill development initiatives, digital marketing platforms, and rising demand for local and handmade products present substantial opportunities. Strengthening institutional support systems, improving access to finance and training, and creating a gender-sensitive entrepreneurial ecosystem are essential for empowering women entrepreneurs and ensuring the sustainable development of manufacturing SMEs in the region.

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# Digital Economy and Financial Inclusion: The Impact of Fintech on Financial Inclusion

**Phulari Bhagwat Gopal**
*Corresponding Author – Phulari Bhagwat Gopal*
**DOI - 10.5281/zenodo.18514294**

***Abstract:***
*The digital economy has transformed the way financial services are delivered, with fintech (financial technology) playing a crucial role in promoting financial inclusion. Fintech has expanded access to financial services, reduced costs, and improved credit access, especially for underserved populations. This paper explores the impact of fintech on financial inclusion, highlighting its importance in promoting inclusive finance, mobile money, digital payments, and digital banking services.*

***Keywords: Digital Economy, Financial Inclusion, Fintech, Financial Technology, Inclusive Finance, Mobile Money, Digital Payments, Open Banking, Blockchain & Financial Inclusion, Digital Banking Services.***

## Introduction:

The digital economy represents a transformative shift in how economic activities are conducted, driven by digital technologies, data, platforms, and connectivity. At its core lies financial inclusion—the process of ensuring that individuals and businesses, particularly those underserved or excluded by traditional systems, have affordable access to useful and responsible financial services such as payments, savings, credit, insurance, and investments.

In recent years, fintech (financial technology) has emerged as a powerful catalyst bridging the gap between the digital economy and broader financial inclusion. Fintech integrates innovative digital tools—mobile money platforms, digital wallets, peer-to-peer lending, blockchain-based services, robo-advisors, and contactless payments—into financial services, often bypassing the limitations of conventional banking infrastructure like physical branches, high costs, and stringent documentation requirements.

Historically, billions of people worldwide remained unbanked or underbanked, unable to participate fully in the economy due to geographic barriers, low income, lack of collateral, or discrimination (with women, rural populations, youth, and low-income groups disproportionately affected). According to the World Bank's Global Findex data, global account ownership has risen significantly, reaching around 79% of adults in recent years, with rapid gains in developing economies fueled by digital channels. In low- and middle-income countries, savings in financial accounts surged notably in the early 2020s, and mobile phone ownership (now at ~84% in many such regions) has unlocked digital financial access.

Fintech's impact is particularly evident in regions like Sub-Saharan Africa, where mobile money services (e.g., platforms similar to M-Pesa) have brought millions into the formal financial system, enabling transactions, remittances, microloans, and savings without traditional banks. Globally, fintech has helped over a billion previously unbanked adults gain access to financial services in the past decade or so, lowering costs, speeding up processes, and

expanding reach through smartphones and internet connectivity.

In the broader digital economy, fintech fosters greater efficiency, innovation, and resilience—accelerating e-commerce, supporting gig workers, enabling instant cross-border payments, and promoting economic participation. It aligns with global goals like the UN Sustainable Development Goals (SDGs) and G20 principles on digital financial inclusion by reducing poverty, boosting entrepreneurship, and enhancing resilience (as seen during crises like COVID-19, where digital payments mitigated economic disruptions).

However, challenges persist: uneven benefits across demographics (e.g., persistent gaps for women, youth, and less educated groups in some contexts), digital divides (internet access and literacy), regulatory gaps, cybersecurity risks, and questions about whether fintech fully addresses deep inequalities or sometimes favors already advantaged users.

Overall, fintech stands as a cornerstone of the digital economy's promise: democratizing finance, driving inclusive growth, and reshaping opportunities for billions in an increasingly connected world.

**Impact of Fintech on Financial Inclusion:**

Financial inclusion refers to the access and use of affordable financial products and services by individuals and businesses, particularly those traditionally excluded from the formal financial system. Fintech, or financial technology, has emerged as a powerful catalyst in advancing financial inclusion by leveraging digital tools, data, and innovation to overcome long-standing barriers.

**1. Expanding Access to Financial Services:** Fintech platforms enable access to banking services without the need for physical branches. Mobile wallets, digital banks, and payment apps allow people in remote or underserved areas to open accounts, send and receive money, and pay bills using only a mobile phone. This has been especially impactful in developing economies where traditional banking infrastructure is limited.

**2. Lowering Costs and Barriers:** Digital-first fintech models reduce operational costs compared to traditional banks. These savings are often passed on to users through lower fees, smaller minimum balances, and simplified documentation requirements. As a result, low-income individuals and micro-entrepreneurs can participate in the financial system more easily.

**3. Improving Credit Access:** Fintech lenders use alternative data such as mobile usage, transaction history, and e-commerce behavior to assess creditworthiness. This enables individuals and small businesses without formal credit histories to access loans, supporting entrepreneurship, consumption smoothing, and economic growth.

**4. Enhancing Payment Efficiency and Security:** Digital payment systems facilitate faster, safer, and more transparent transactions. Governments and NGOs increasingly use fintech channels to distribute social benefits and emergency aid directly to recipients, reducing leakage and improving accountability.

**5. Empowering Small and Medium Enterprises (SMEs):** Fintech solutions provide SMEs with access to working capital, digital accounting tools, and cross-border payment services. These tools help small businesses formalize operations, manage cash flows, and scale efficiently.

**6. Promoting Financial Literacy and Inclusion of Marginalized Groups:** Many fintech apps integrate user-friendly interfaces, local languages, and educational features that promote financial literacy. Women, youth, and rural populations benefit from personalized products that address their specific needs and constraints.

**Challenges and Risks:**

Despite its benefits, fintech-driven inclusion faces challenges such as digital literacy gaps, data privacy concerns, cybersecurity risks, and unequal access to smartphones and internet connectivity. Effective regulation and consumer protection frameworks are essential to ensure inclusive and sustainable growth.

**Define Fintech and Financial Inclusion:**

**1.Fintech (Financial Technology):** Fintech refers to the use of technology to deliver financial services in more efficient, accessible, and innovative ways. It includes digital payments, mobile banking, online lending, insurance technology (Insurtech), blockchain, and financial apps that help individuals and businesses manage money, make payments, save, borrow, and invest.

**2.Financial Inclusion:** Financial inclusion means ensuring that individuals and businesses, especially underserved and low-income populations, have access to affordable, useful, and appropriate financial products and services such as savings accounts, credit, insurance, and payment systems, delivered in a responsible and sustainable way.

**Importance of Fintech in Promoting Financial Inclusion:**

1. **Expands Access to Financial Services:** Fintech enables people in remote or rural areas to access banking services through mobile phones and the internet, reducing dependence on physical bank branches.
2. **Reduces Cost of Financial Services:** Digital platforms lower transaction and operational costs, making financial services more affordable for low-income users.
3. **Promotes Faster and Safer Transactions:** Mobile payments and digital wallets allow instant, secure transactions, reducing risks associated with cash handling.
4. **Improves Access to Credit:** Fintech companies use alternative data (such as mobile usage or transaction history) to assess creditworthiness, helping individuals and small businesses without formal credit histories obtain loans.
5. **Encourages Savings and Investment:** User-friendly apps and digital tools make it easier for people to save, invest, and plan financially, even with small amounts of money.
6. **Supports Small and Medium Enterprises (SMEs):** Fintech platforms provide SMEs with easier access to loans, payment systems, and financial management tools, fostering entrepreneurship and economic growth.
7. **Enhances Financial Literacy:** Many fintech applications include educational features that help users understand financial products and improve money management skills

**Conclusion:**

Fintech has significantly advanced financial inclusion by making financial services more accessible, affordable, and tailored to underserved populations. With strong digital infrastructure, sound regulation, and financial education, fintech can continue to foster inclusive economic development, promoting economic growth and reducing poverty. Fintech has significantly advanced financial inclusion by making financial services more accessible, affordable, and tailored to underserved populations. When supported by strong digital infrastructure, sound regulation, and financial education, fintech can play a transformative role in fostering inclusive economic development.

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# Rural Women Empowerment in the Marathwada Region

**Dr. Kanwate Darshana Sahebrao**
*Dept. of Geography, Mahatma Phule Mahavidhayalaya, Kingaon*
***Corresponding Author – Dr. Kanwate Darshana Sahebrao***
**DOI - 10.5281/zenodo.18514306**

***Abstract:***

*Rural women empowerment is an essential component of inclusive and sustainable development. The Marathwada region of Maharashtra, characterized by agrarian economy, recurrent droughts, and socio-economic backwardness, presents unique challenges and opportunities for women empowerment. This research paper examines the status of rural women empowerment in Marathwada by analyzing educational, economic, social, and political dimensions. The study also highlights the role of agriculture, self-help groups, and government schemes in empowering rural women, along with the major challenges faced in the region.*

***Keywords: Rural women empowerment, Marathwada, Gender equality, Rural development, Self-help groups***

## Introduction:

Women play a vital role in rural development, especially in regions like Marathwada where agriculture is the main source of livelihood. Despite their significant contribution, rural women in Marathwada continue to face problems such as low literacy, economic dependence, social inequality, and limited access to resources.

Marathwada, consisting of districts like Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani, and Hingoli, has historically lagged behind in socio-economic development. Studying rural women empowerment in this region is important for understanding regional disparities and identifying strategies for improvement.

Women empowerment is widely recognized as a crucial factor for sustainable rural development and social transformation in India. Rural women play a significant role in agriculture, household management, livestock rearing, and informal economic activities, yet they continue to face socio-economic, educational, and cultural disadvantages. Empowering rural women is essential not only for improving their quality of life but also for strengthening rural economies and promoting inclusive growth. In this context, rural women empowerment has emerged as a key focus area in development studies and policy frameworks.

This research paper aims to examine the status, challenges, and progress of rural women empowerment in the Marathwada region. It seeks to analyze the socio-economic conditions of rural women, evaluate the impact of empowerment initiatives, and highlight the role of education, self-help groups, and government schemes in promoting women's empowerment. By focusing on Marathwada, the study attempts to provide region-specific insights that can contribute to effective policy formulation and sustainable rural development strategies.

## Objectives of the Study:

The main objectives of the study are:

1. To examine the socio-economic status of rural women in Marathwada.
2. To analyze the level of women empowerment in the region.
3. To study the role of agriculture and allied activities in women empowerment.

4. To identify major challenges faced by rural women.
5. To suggest measures for strengthening women empowerment in Marathwada.

**Study Area: Marathwada Region:**

Marathwada is located in the south-central part of Maharashtra and is part of the Deccan Plateau. The region is characterized by:

- Semi-arid climate
- Low and irregular rainfall
- Agriculture dependent on monsoon
- Dominance of small and marginal farmers
- Limited industrial development

These geographical conditions directly influence the socio-economic status of rural women.

**Methodology:**

The study is based on secondary data sources, including: Census of India, NFHS reports, Government of Maharashtra publications Research articles and books. A descriptive and analytical approach is used to assess rural women empowerment.

**Status of Rural Women in Marathwada:**

**1.Educational Status:** Female literacy rates in Marathwada are lower than the state average, especially in rural areas. Early marriage, poverty, and lack of educational facilities contribute to low educational attainment among women. The educational status of women in the Marathwada region has improved in recent years due to government schemes and increased access to schools. Female literacy has increased at the primary level, but dropout rates remain high at secondary and higher education stages because of poverty, early marriage, domestic responsibilities, and lack of facilities. Rural and drought-prone areas lag behind urban centers, resulting in educational inequality. Overall, women's education in Marathwada is progressing, but still faces significant challenges.

**2.Economic Status:** Women in the Marathwada region are mainly engaged in agriculture, allied activities, and informal sector work. Their economic status remains weak due to low income, seasonal employment, wage inequality, lack of land ownership, and limited access to financial resources. Although self-help groups, government schemes, and microfinance have improved women's participation in income-generating activities, economic dependence and poverty continue to be major challenges, especially in rural areas. However, wage inequality and lack of land ownership limit their economic empowerment.

**3.Social Status:** Traditional social structure, patriarchal norms, and limited decision-making power continue to restrict women's social empowerment in many villages. The social status of women in the Marathwada region is influenced by traditional patriarchal norms, which limit their role in decision-making and social participation. Issues such as early marriage, gender discrimination, limited mobility, and low awareness of rights continue to affect women, especially in rural areas. Although education, self-help groups, and social awareness programs have improved women's confidence and participation, overall social equality is yet to be fully achieved.

**Role of Agriculture in Women Empowerment:**

Role of Agriculture in Women Empowerment .Agriculture plays a vital role in women empowerment, especially in rural regions, as it provides employment, income, and livelihood security to women. Women actively participate in farming operations, livestock rearing, dairy, and allied agricultural activities, which enhance their economic independence and self-confidence. Access to land, credit, training, and agricultural technology further strengthens women's decision-making power and social status. Thus, agriculture serves as a key foundation for empowering rural women. Agriculture is the primary source of livelihood in Marathwada.

**Role of Self-Help Groups (SHGs):**

Self-Help Groups have played a significant role in empowering rural women by:

- Providing access to micro-credit

- Encouraging savings habits
- Supporting small-scale entrepreneurship
- Enhancing leadership and confidence

**Government Initiatives for Women Empowerment:**

Several government schemes support women empowerment in the region:

- National Rural Livelihood Mission (NRLM)
- Mahila Kisan Sashaktikaran Pariyojana
- Beti Bachao Beti Padhao
- Skill development and employment programs

These initiatives aim to improve education, income, and social security of women.

**Challenges in Rural Women Empowerment:**

Rural women face several challenges such as illiteracy, poverty, gender discrimination, limited access to education, healthcare, and financial resources. Patriarchal social norms, early marriage, unpaid domestic work, and lack of decision-making power further restrict their empowerment. Inadequate awareness of government schemes and poor implementation at the grassroots level also hinder the overall empowerment of rural women.

**Prospects and Opportunities:**

There are growing prospects for rural women empowerment through improved access to education, skill development programs, and digital literacy initiatives. Government schemes, self-help groups, microfinance, and entrepreneurship opportunities offer avenues for economic independence. Increasing participation of women in agriculture, allied activities, local governance, and community-based organizations further enhances leadership and decision-making, creating opportunities for sustainable rural development.

**Suggestions for Improving Women Empowerment:**

Women empowerment can be strengthened by promoting girl-child education, reducing school dropout rates, and improving access to higher and vocational education. Economic empowerment should be encouraged through skill development, self-employment, financial inclusion, and support to self-help groups. Effective implementation of government schemes, awareness about women's rights, healthcare facilities, and increased participation of women in decision-making and local governance are essential for sustainable empowerment.

**Conclusion:**

Rural women empowerment in Marathwada is closely linked with agricultural development, education, and social change. Although the region faces several challenges, targeted policies, effective implementation of government schemes, and community participation can significantly improve the status of rural women. Empowering women in Marathwada is essential for achieving sustainable and balanced regional development.

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# Role of Chemistry in Climate-Change Solutions: Recent Case Studies Integrated Review

**Dr. Ramdas N. Katapalle**

*Department of Chemistry, Late Shankarrao Gutte Gramin Arts, Commerce & Science College, Dharmapuri, Beed, Maharashtra, 431515*

***Corresponding Author – Dr. Ramdas N. Katapalle***

**DOI - 10.5281/zenodo.18514321**

***Abstract:***

*Chemistry underpins nearly every technological pathway for mitigating climate change, from greenhouse gas (GHG) analysis to carbon capture, renewable energy storage, and sustainable materials. This review summarizes chemical principles, technologies, and innovations contributing to climate-change solutions. This section integrates recent real-world case studies into a research-style review article, demonstrating how chemical science underpins scalable climate-change mitigation and adaptation strategies. Each subsection is supported by recent literature and reports (2023–2025), with references assigned directly to the relevant discussion.*

**Direct Air Capture and Carbon Mineralization:**

Direct Air Capture (DAC) represents a chemistry-intensive negative-emissions technology. The Climeworks Mammoth facility in Iceland exemplifies the transition of DAC from pilot to commercial scale, using solid amine-functionalized sorbents for $CO_2$ capture and geothermal heat for regeneration. Captured $CO_2$ is permanently stored through subsurface mineralization via Carbfix, forming stable carbonates. This case highlights the importance of sorbent chemistry, adsorption–desorption thermodynamics, and lifecycle assessment in evaluating net carbon removal and economic feasibility [1,2].

**Scaling Challenges and Policy Interface for DAC:**

A 2024 global DAC landscape assessment indicates that while more than 100 DAC projects are announced, most remain below 1,000 $tCO_2$ per year capacity. Chemical challenges include sorbent degradation, humidity sensitivity, and high regeneration energy. The study emphasizes that policy instruments such as carbon credits and advance purchase agreements are critical to complement chemical innovation and enable gigaton-scale deployment [3].

**Electrochemical $CO_2$ Conversion to Fuels and Chemicals:**

Electrochemical reduction of $CO_2$ is emerging as a promising utilization pathway, transforming captured carbon into fuels and commodity chemicals using renewable electricity. Twelve's pilot manufacturing line for membrane-electrode assemblies (MEAs) demonstrates how electrode materials, catalyst formulation, and cell architecture govern selectivity, efficiency, and durability. This case study bridges laboratory electrocatalysis and industrial-scale electrochemical engineering [4,5].

**Chemical Recycling and Circular Polymer Economy:**

Plastic waste management is a growing climate concern due to fossil feedstock use and incineration emissions. Eastman's molecular recycling facility (2024) illustrates how chemical depolymerization technologies can convert mixed or contaminated plastic waste into virgin-quality polymer precursors. This case underscores the role of catalysis, reaction engineering, and lifecycle carbon accounting in evaluating the climate benefits of chemical recycling versus mechanical routes [6,7].

**Green Hydrogen and Low-Carbon Ammonia Production:**

Decarbonizing ammonia synthesis is essential for reducing emissions from fertilizer and chemical industries. Yara's 24 MW green hydrogen project integrates proton-exchange membrane (PEM) electrolysis with conventional ammonia synthesis. Catalyst durability, electrolyzer efficiency, and process integration are key chemical engineering challenges addressed in this deployment, demonstrating chemistry's role in industrial decarbonization [8].

**Methane Detection, Measurement, and Mitigation:**

Methane is a potent short-lived climate pollutant. Recent satellite-based detection platforms such as GHGSat and MethaneSat enable near-real-time identification of super-emitter sources. These advances rely on spectroscopic chemistry, atmospheric modeling, and sensor calibration. Case studies from 2023–2024 show that rapid leak detection followed by targeted chemical and engineering interventions can significantly reduce methane emissions [9–11].

**Conclusion:**

Collectively, these case studies demonstrate that chemistry is central to practical climate solutions, from carbon removal and utilization to clean energy vectors and emissions monitoring. The integration of molecular-level design, process chemistry, and systems analysis is essential for translating laboratory discoveries into impactful climate technologies.

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# Role of Social Media tools in Enhancing Library Services

**Dr. Bharat R. Lokalwar**

*Librarian, Sharadchandra Arts, Commerce and Science College, Naigaon (Bz) Dist. Nanded.*

***Corresponding Author – Dr. Bharat R. Lokalwar***

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***Abstract:***

*The rapid growth of information and communication technologies has significantly transformed library services. Social media, as a powerful Web 2.0 tool, has reshaped how libraries communicate, promote resources, and engage with users. Libraries are no longer confined to physical walls; they now function as interactive digital knowledge centers. This article explores the concept, types, applications, benefits, challenges, and future prospects of social media in libraries, emphasizing its importance in modern librarianship.*

***Keywords: Social Media, Libraries, Digital Libraries, Web 2.0, Library Services, User Engagement, Information Dissemination***

## Introduction:

According to Cambridge Dictionary of Social media is forms of media that allow people to communicate and share information using the internet and mobile phones. Blogs podcasts and other forms of social media are creating new opportunities of Libraries to reach the users. World wide web has been radically transformed, shifting from an information repository to a more social environment where user are not only passive receivers or active harvesters of information, but also creators of content. Web-based technologies now encompass the socializing features of virtual spaces that have emerged as zones for information sharing, collaborating and community formation and extension. Social media derived from the social software movement are a collection of Internet website, services and practices that support collaboration, community building, participation and sharing. These technologies now include blogs, wikis, media (audio, video, photo, text) sharing tools, networking platforms including Facebook and virtual worlds.

## Need for Social Media in Libraries:

The growing expectations of digital-native users have compelled libraries to adopt social media. Users prefer quick access, real-time communication, and online services. Social media fulfills these expectations by providing:

- Instant communication
- Wider outreach
- Cost-effective promotion
- Enhanced visibility of library resources

## Social Media Tools:

**Google Photos:** Google photos is one of the best image-hosting resources for uploading high-quality photos in large quantities. The site has an automatic backup feature, so you don't have to worry about losing any of your photos. Google Photos allows you to edit and organize your photos, and you can easily find older photos again with a visual search. As you use the platform more and more, it will recognize your photo habits and learn to automatically sort your photo, reducing the amount of work you need to do to keep your photo organized.

**Blogs:** A frequent chronological publication of personal thoughts and web links. blogs or weblogs, started out as a mix of what was happening in a person's life and what was happening on the web, a kind of hybrid diary/ news site. The word "Blog" is a shortened version of web logs or weblogs. Besides being shorten and catchier, blog seems less likely to cause confusion, as web log can also mean a server's log files.

**Wikis:** A wiki is a Web site that allows users to add and update content on the site using their own Web browser. This is made possible by Wiki software that runs on Web server. Wikis end up being created mainly by a collaborative efforts of the site visitors. A great example of a large wiki is the Wikipedia, a free encyclopedia in many languages that anyone can edit. The term wiki comes from the Hawaiian phrase, "wiki wiki", which means super fast. If you have thousands of users adding contents to a web site on a regular basis, the site could super fast.

**Dropbox:** Dropbox lets you upload and store many types of files, including photos. It's a free cloud storage provider that provides you with sharable links to individual files or folders. Likes Google Photos, it offers automatic backup, which is an important feature if you plan to upload most of your photos. Dropbox doesn't change, edit or resize the photos you upload in any way. Your original. unaltered photos will always be available on Dropbox. You can also sync your photos to a Dropbax folder on your desktop.

**Flickr:** Flickr is one of the most famous image sharing sites on the web, and even though it's gone through changes since being purchased by Yahoo, it's still very popular with photographers. In addition to offering free hosting, it provides editing tools and allows you to organize your images into albums.

**Smug Mug**: SmugMug is similar to flickr in that it gives photographers a place to showcase their work. Although it isn't as focused on the social media aspect to photo sharing as Flickr is users can share their photos and view other work. When you creat a SmugMug account, you creat a customizable photo site. There are plenty of designs you can choose from, and the site has built-in editing tools to make changes to the design templates.

**Social Media Platforms:**

**Facebook:** Facebook is an American online social media and social networking services company based in Menlo park, California. It's website was launched on February 4, 2004 by Mark Zuckerberg Facebook can be accessed from a large range of devices with internet connectivity, such as desktop, computers, laptops and tablet computers and smartphones. After registering users can create a customized profile indicating their name, occupation, schools attended and so on. Users can add other users as friends exchange messages, post status updates, share photos, videos and links, use various software applications and receive notifications of other users activity. Additionally users may join common-interest users groups organized by workplace, school, hobbies or other topics, and categorize their friends into lists such as People From Work or Close Friends. Additionally, users can report or block unpleasant people.

**Linkedln:** Linkedln is a social networking website for people in professional jobs. The company started in December 2002, and the website opened May 5, 2003. Users can make connections with other people they have worked with, post their work experiences and skills, looks for jobs, and looks for workers. The site is available in many languages, including most European languages, Japanese, Korean, Indonesian and many Malay. LinkedIn has more than 200 million members around the world.

**Instagram:** Instagram is relatively easy to use and is a great platform for sharing photos and interacting in a photo/video format with the community. Facebook owns this company so integration between the two platform is great. This is primarily mobile app so will require having a cellphone with photo taking capabilities. It is a photo based communication service rather than the traditional text based.
**YouTube:** YouTube is the number of subscribe as this shows how much people like the content and wish to maintain contract with the channel and suggests the library has built up a following instead of random viewers which indicate better engagements. This can be promoted with prompts and hints to urge people to subscribe to the channel. YouTube content ranges from interviews and recorded presentations of full conferences.

**Challenges in Using Social Media:**

1. Despite its advantages, libraries face several challenges:
2. Digital divide among users
3. Privacy and data security concerns
4. Lack of trained staff
5. Time and content management issues
6. Risk of misinformation
7. These challenges require proper planning and policy formulation.

**Application of Social Media in Library:**
**Wiki:** A wiki is a type of social software that allows users to write, share and edit contents in real-time with only rudimentary skills in Web page creation. Moreover it is safe to say that most of what is being written regarding wikis in Librarianship tends to focus on wiki-based reference sources, their questionable credibility, and how this question of credibility may impact information literacy. Outside of this contentious topics are a wide range of multidisciplinary articles that focus on the collaborative users of wikis.
**Blogs**: Blogs may indeed be an even greater milestone in the history of publishing than web-pages. They enable the rapid production and consumption of web-based publication. In some ways, the copying of printed material is to web-pages as the printing press is to blogs. Blogs are HTML for the masses.

The most obvious implication of blogs for libraries is that they are another form of publication and need to be treated as such. They lack editorial governance and the security this provides, but many are nonetheless integral productions in a body of knowledge, and the absence of them in a library collection could soon become unthinkable. This will, of course, greatly complicate collection development processes, and the librarian will need to exercise a great deal of expertise and fastidiousness when adding a blog to a collection or perhaps, an automated blog-collection development system or perhaps the very notions of reliable and authoritative so important to collection development, will need to be rethought in the wake of this innovation.
**Flickr:** Librarian can use this tool to share and distribute new image of library collection. Cover page of new arrivals of both books and Journals can be disseminated to users via Flickr.
**Facebook**: Most popular new because it is Librarian-friendly with many applications like JSTOR search, World Cat and much more. Librarians can interact with users to know their information needs. Libraries try to link some of these specialized library applications to Facebook.
**LinkedIn:** Librarians can get patrons connected with specialists in their particular field of interest via LinkedIn. Librarians can use this platform to render specialized services such as Strategic Dissemination of Information.
**YouTube**: In institutions in India, events such as important highlights of inaugural lectures,

conferences and workshops are disseminated via the YouTube.

**Conclusion**:

Social media has become an indispensable tool in modern librarianship. It enhances communication, promotes resources, supports education, and strengthens the social role of libraries. Effective application of social media transforms libraries into vibrant, interactive, and user-cantered institutions. To meet the challenges of the digital era, libraries must strategically adopt and utilize social media technologies. In general libraries have adopted a multichannel approach to social media and are using the familiar household brands we use in our personal and professional lives. There are differences across the libraries and the libraries are using social media for many purposes, from marketing and promotion, opening up the resources of the library, and a customer service function by responding to queries and questions. It is impossible to know what social media success looks like for libraries without undertaking in-depth research but libraries are trusted information professionals are well placed to harness the opportunities available in the world of social media. In conclusion we can examine the concept of social networking and its application to library services for a pro-active awareness and training to educate both the librarians and the users on the invaluable importance of utilizing social networking in library services.

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# An Empirical Study Of Consumer Perception Toward Green Automobile Technology In India

**Smt. Premalatha Munoli**
*Associate Professor in Commerce Government First Grade College, Bidar (KS)*
***Corresponding Author – Smt. Premalatha Munoli***
**DOI - 10.5281/zenodo.18514349**

***Abstract:***

*The adoption of green technology in the automobile industry has gained significant importance in India due to increasing environmental concerns, fuel price volatility, and government initiatives promoting sustainable mobility. Consumer perception plays a crucial role in determining the acceptance and success of green automobiles, particularly electric and hybrid vehicles. This study examines consumer perception toward green technology in the Indian automobile industry with reference to environmental awareness, cost considerations, technological trust, and purchase intention. The study is based on a descriptive research design and data collected from 150 respondents. The findings reveal that while Indian consumers demonstrate high environmental concern and positive attitudes toward green technology, factors such as high initial cost, limited charging infrastructure, and lack of awareness continue to influence purchase decisions. The study concludes that improving affordability, infrastructure, and consumer education is essential for accelerating green vehicle adoption in India.*

***Keywords: Consumer Perception, Green Technology, Electric Vehicles, Indian Automobile Industry, Sustainability***

## Introduction:

The Indian automobile industry is undergoing a gradual transformation driven by environmental sustainability, technological innovation, and policy support for green mobility. Green technology in automobiles, including electric vehicles, hybrid vehicles, and alternative fuel systems, aims to reduce carbon emissions, improve energy efficiency, and minimize environmental degradation. With rising concerns about air pollution and climate change, the Indian government has introduced various initiatives such as EV subsidies, tax incentives, and infrastructure development to promote green vehicles.

However, the success of green technology adoption largely depends on consumer perception and acceptance. Consumers' awareness, attitudes, perceived benefits, and perceived risks significantly influence their willingness to adopt green automobiles. Despite growing interest in sustainable transportation, adoption levels remain relatively low compared to conventional vehicles. This study attempts to analyze consumer perception toward green technology in the Indian automobile industry using primary data to understand key influencing factors.

## Objectives of the Study:

1. To analyse consumer awareness and perception of green technology in the automobile industry in India.
2. To examine factors influencing consumers' purchase intention toward green automobiles.

## Research Methodology:

The present study adopts a descriptive research design to examine consumer perception

toward green technology in the automobile industry in India. Descriptive research is considered appropriate as it enables systematic analysis of consumer awareness, attitudes, and purchase intentions related to green automobiles.

The study is based on primary data, collected using a structured questionnaire designed to capture respondents' opinions on environmental concern, cost considerations, technological reliability, infrastructure availability, and purchase intention. The questionnaire was framed using a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" to ensure consistency in responses.

A sample of 150 respondents was selected using the convenience sampling method, as it allows easy accessibility to respondents and is commonly employed in exploratory and perception-based studies. The respondents were selected from urban and semi-urban areas to ensure diversity in consumer perspectives.

The collected data were analysed using simple statistical tools such as percentage analysis and mean score analysis to interpret consumer perception and identify key influencing factors. Secondary data were also consulted from journals, industry reports, and government publications to support and validate the study. The methodology provides a systematic framework for understanding consumer perception toward green technology in the Indian automobile industry.

**Data Analysis and Interpretation:**

**Table 1: Demographic Profile of Respondents**

| Particulars | Category | No. of Respondents | Percentage |
|---|---|---|---|
| Gender | Male | 90 | 60% |
| | Female | 60 | 40% |
| Age | Below 30 | 45 | 30% |
| | 30–45 | 70 | 47% |
| | Above 45 | 35 | 23% |
| Education | Graduate | 65 | 43% |
| | Postgraduate | 85 | 57% |

**Interpretation:** The majority of respondents are aged between 30–45 years and are well educated, indicating a consumer group likely to be aware of green technologies.

**Table 2: Awareness of Green Technology in Automobiles**

| Awareness Level | Respondents | Percentage |
|---|---|---|
| High | 78 | 52% |
| Moderate | 52 | 35% |
| Low | 20 | 13% |

**Interpretation:** More than half of the respondents show high awareness of green automobile technologies, reflecting increasing exposure through media and government campaigns.

**Table 3: Factors Influencing Consumer Perception (Mean Score Analysis)**

*(5-point Likert Scale: 1 = Strongly Disagree, 5 = Strongly Agree)*

| Factors | Mean Score |
|---|---|
| Environmental friendliness | 4.45 |
| Fuel cost savings | 4.10 |
| Government incentives | 3.95 |
| Technological reliability | 3.70 |
| Charging infrastructure availability | 3.20 |
| High initial cost | 2.85 |

**Interpretation:** Environmental concern is the strongest motivating factor, while high initial cost and limited infrastructure act as major barriers.

**Table 4: Purchase Intention toward Green Vehicles**

| Purchase Intention | Respondents | Percentage |
|---|---|---|
| Willing to purchase | 65 | 43% |
| Considering in future | 55 | 37% |
| Not willing | 30 | 20% |

**Interpretation:** A significant proportion of consumers are either willing to purchase or considering green vehicles, indicating strong future market potential.

**Findings of the Study:**

1. The study finds that Indian consumers generally have a positive perception of green technology in the automobile industry.
2. A majority of respondents demonstrate a high level of awareness regarding green automobiles such as electric and hybrid vehicles.
3. Environmental concern is identified as the most influential factor shaping consumer perception toward green technology.
4. Expected fuel cost savings and government incentives significantly enhance consumers' favorable attitudes toward green vehicles.
5. Consumers perceive green automobile technology as reliable; however, concerns regarding long-term performance and maintenance persist.
6. High initial purchase cost remains a major barrier to the adoption of green vehicles.
7. Inadequate charging infrastructure is another significant factor discouraging immediate purchase decisions.
8. Although many consumers express willingness to adopt green vehicles, a substantial proportion prefer to postpone purchase until infrastructure and affordability improve.

**Suggestions:**

1. Automobile manufacturers and policymakers should intensify consumer awareness programs highlighting the environmental and economic benefits of green vehicles.
2. The government should strengthen financial incentives, subsidies, and tax benefits to reduce the high initial cost of green automobiles.
3. Rapid expansion of charging infrastructure, particularly in semi-urban and rural areas, is essential to enhance consumer confidence.
4. Manufacturers should focus on improving technological reliability and providing efficient after-sales service to build long-term consumer trust.
5. Collaborative initiatives between government agencies, automobile companies, and energy providers should be encouraged to support EV ecosystem development.
6. Continuous investment in research and development is recommended to enhance vehicle performance, battery life, and affordability.

**Conclusion:**

The study concludes that consumer perception toward green technology in the Indian automobile industry is largely positive, driven by environmental awareness and economic benefits. However, practical challenges such as high purchase cost and inadequate infrastructure continue to hinder widespread adoption. Addressing these challenges through policy support, technological advancement, and consumer education can significantly enhance acceptance of green automobiles. The study highlights the importance of understanding consumer perception to achieve sustainable growth in India's automobile industry.

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# AI and Smart Teaching Learning Methods in Higher Education

**Shalini T. Dengle[1] & Milind N. Gaikwad[2]**

[1]*Department of Chemistry, Vivekanand Arts and Sardar Dalipsingh commerce and science college Chh.Sambhajinagar.431001 Maharashtra, India.*

[2]*Rajmata Jijau Mahavidyalaya Kille-Dharur, Dist. Beed,431122 Maharashtra, India.*

***Corresponding Author – Shalini T. Dengle***

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***Abstract:***

*The educational sector is currently being reshaped by Artificial Intelligence (AI), which facilitates the adoption of learner-focused, data-driven, and adaptive instructional strategies. By incorporating advanced technologies like natural language processing, machine learning, and learning analytics, institutions can optimize how they deliver instruction and manage academic assessments. This article examines the fundamental components of AI-driven smart education, exploring its practical use in universities, its primary advantages, and the obstacles to its widespread adoption. We emphasize AI's capacity to customize the learning experience and assist educators in preparing students for a digitally advanced workforce. Ultimately, the paper suggests that the principled and thoughtful application of AI is vital for the long-term advancement of global educational standards*

***Keywords: Artificial Intelligence, Smart Pedagogy, Higher Education, Learning Methods, Educational Technology.***

## Introduction:

Higher education is currently undergoing a fundamental transformation driven by the expansion of data intensive systems and digital innovation. Artificial Intelligence has evolved from a supplementary technological tool into a foundational element that influences curriculum development, assessment strategies, and institutional governance (Holmes et al., 2019). While early applications of Artificial Intelligence focused primarily on automation, contemporary discourse emphasizes generative Artificial Intelligence, ethical governance, and collaborative human and machine models (UNESCO, 2021).

A notable limitation in existing academic literature is the repeated discussion of general concepts such as personalization without sufficient consideration of present-day institutional challenges, including equity, scalability, and academic integrity (Zawacki Richter et al., 2019). This paper addresses this limitation by synthesizing recent research and proposing a structured framework that connects Artificial Intelligence enhanced instruction with institutional policy objectives and measurable learning outcomes.

## Defining AI in the Educational Context:

AI refers to the ability of software and machines to replicate human-like cognitive functions, including problem-solving, pattern recognition, and decision-making. In an academic setting, these systems process massive amounts of student data to identify behavioural trends and provide intelligent support for educational activities. Common implementations include AI-driven chatbots, automated grading platforms, and adaptive learning environments (Chen et al., 2020). As noted by Luckin et al. (2016), the

primary goal of AI should be to enhance not replace the capabilities of human instructors through evidence-based pedagogical support.

**A Proposed Framework for Smart Education:**

Smart instructional methods emerge from the intersection of institutional data, pedagogical theory, and AI innovation. This study suggests a three-tier framework:

**Student-Centric Intelligence:** This involves adaptive content and personalized feedback loops. Unlike older models, modern AI uses deep learning to adjust to a student's needs in real-time (Chen et al., 2020; Khosravi et al., 2022).

**Teacher-Centric Intelligence:** This tier focuses on empowering faculty via analytics dashboards that identify at-risk students and automate routine assessments. Research suggests these tools are most effective when teachers maintain final decision-making authority.

**Institutional Intelligence:** At this level, AI assists with administrative functions, such as resource management and curriculum updates, by analysing student data over long periods.

**Impact on Instructional and Learning Experiences:**

Artificial Intelligence assists educators by automating routine administrative tasks such as attendance management and basic grading, thereby allowing greater focus on instructional design and student engagement (Ouyang & Jiao, 2021). Learning analytics tools provide insights into student participation and performance, enabling early identification of learners who may require additional support.

From a learner perspective, Artificial Intelligence enables flexible and self-paced learning experiences supported by continuous feedback. Additionally, Artificial Intelligence contributes to inclusive education through assistive technologies such as text to speech, speech to text, and real time language translation, which are particularly valuable for diverse and international student populations (UNESCO, 2021).

**Advantages and Strategic Benefits:**

- Integrating AI into higher education provides several key benefits:
- Higher levels of student motivation and academic engagement.
- More objective, consistent, and efficient methods of academic evaluation.
- Strategic academic decisions supported by large scale data analysis.
- Improved career readiness for students entering technology oriented professional environments.
- Significant time savings for both educators and learners through automation of routine academic tasks.
- Reduced manual effort in activities such as grading, content organization, and performance monitoring.
- Rapid access to relevant learning resources, minimizing the need for extensive searches across multiple databases and enabling direct retrieval of required information.

**Ethical Risks and Research Requirements:**

Despite its potential benefits, Artificial Intelligence adoption in higher education presents significant ethical and operational challenges. Concerns related to data privacy, transparency, and accountability are particularly prominent when institutions rely on proprietary Artificial Intelligence systems (UNESCO, 2021). In addition, biased training data can reinforce existing social and educational inequalities, disadvantaging underrepresented groups (Holmes et al., 2019). Furthermore, the growing availability of unregulated or fraudulent Artificial

Intelligence applications developed by malicious actors increases the risk of unauthorized data collection, identity misuse, and financial exploitation of users.

There is also concern that excessive dependence on Artificial Intelligence may weaken critical thinking skills or diminish the pedagogical authority of educators. The presence of deceptive or insecure platforms may further undermine user trust and institutional credibility. Current research remains limited by a lack of longitudinal and experimental studies capable of establishing causal relationships between Artificial Intelligence use and learning outcomes. Future research should therefore adopt interdisciplinary and mixed method approaches to address these gaps (Zawacki Richter et al., 2019).

**Discussion and Conclusion:**

The application of Artificial Intelligence in higher education is expected to expand through developments in emotionally responsive systems and immersive virtual learning environments. These advances have the potential to improve learner engagement and enhance instructional practices. However, their effective integration requires sustained investment in teacher training, institutional infrastructure, and student digital literacy.

Despite its potential benefits, the use of Artificial Intelligence in education continues to present important limitations. One significant challenge lies in its limited ability to reflect the emotional awareness and interpersonal understanding that naturally occur in direct human interaction. The absence of emotional responsiveness in automated learning environments may reduce student motivation, weaken engagement, and affect the effectiveness of curriculum delivery. As a result, excessive dependence on technological systems may constrain meaningful academic communication.

The successful implementation of Artificial Intelligence therefore depends on a balanced approach that combines technological support with human judgment and pedagogical expertise. Ethical governance, data protection, and institutional accountability must remain central to adoption strategies. When applied responsibly, technological systems can contribute to more inclusive, adaptive, and effective educational environments.

Future research should focus on the development of emotionally responsive learning technologies, the evaluation of long-term learning outcomes through rigorous empirical studies, and the exploration of hybrid instructional models that integrate technological support with sustained human mentorship. Such efforts will be essential to ensure that innovation in higher education continues to promote both academic excellence and student wellbeing.

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# Inclusive and Sustainable Economic Growth in India 2047

**Ekta Singha Roy**
*Assistant Professor, IMS Business School Kolkata, West Bengal*
***Corresponding Author – Ekta Singha Roy***
**DOI - 10.5281/zenodo.18516272**

***Abstract:***

*The vision of developing India by 2047 which is commonly known as Viksit Bharat 2047 is based on the concept of inclusive and sustainable economic development. This vision demands that humanities, science, and commerce have an integrated role to play in solving complex socio- economic problems without providing inequity, innovation, and resilience. Humanities offer morality and continuity of culture and social consciousness to make effective policies. Science and technology are the drivers to productivity, environmental sustainability and digital transformation that help India to compete in a global knowledge economy. Trade is also central as it gathers financial resources, enhances entrepreneurship, increases the number of jobs, and introduces India to the international markets. The three areas combined create an entire ecosystem of development that promotes balanced development in the region, equity in the society, and environmental sustainability in the long term. In this paper, the author examines how humanities, science, and commerce can work together in achieving the goal of turning India into a developed, inclusive, and sustainable economy by 2047. The paper is based on the recent policy-focused and academic views on the subject, to point out the necessity of education, innovation, financial inclusion, and ethical governance to accomplish this national vision.*

***Keywords: India 2047, Viksit Bharat, Inclusive Growth, Sustainable Development, Humanities, Science, Commerce***

## Introduction:

India is in crossroads in her developmental process because she is heading towards the 100 th anniversary of its independence in 2047. The national aspiration of being a developed state which is often referred to as Viksit Bharat 2047, is the expression of the desire not only to expand economically, but also socially, environmentally and institutionally. In contrast to the previous

models of development where growth was created separately, the new vision of India is related to the necessity to work on the country development in a balanced way regarding regions, social groups, and generations (Dev, 2024). It is not then an economic goal but rather a national mission in totality to achieve inclusive and sustainable economic growth.

The population heterogeneity and regional disparity of India and the inequalities that face socio- economic status make the path to development tricky. Though, because of the high-speed growth of the economy, millions of people have escaped the poverty trap, the income, education, healthcare, and digital inequality remain high. To realize the 2047 vision, however, there is a need to have multidimensional strategies that entail human development as well as technological and financial progress (Singh and Chhering, 2024). Here, there is a need to have unified endeavors in humanities, science, and commerce.

Ethical leadership, social awareness, cultural integration, and participatory governance

can be influenced by humanities. They help society to understand the past social systems and inequalities of human behavior so that policy makers can come up with more accommodative systems (Dodiya, 2024). Science, however, on its part, gives impetus to innovation, productivity, sustainability, and technological independence. The long-term economic sustainability of renewable energy, healthcare, agriculture, and digital infrastructure is based on scientific developments (Mahida, 2024). The advances are connected to real economic worth through commerce, trade, investment, entrepreneurship and financial mechanisms in such a manner that expansion is transformed into work, and improved living criterion (Ali).

Redefining the concept of development is another one that India must attain its dream of becoming a developed economy. It is no longer adequate to measure progress by using GDP. The existing definition of development is the quality of life, environmental sustainability, gender equality, balance of regions, and social empowerment (Satyanarayana and Rao, 2023). In this way, the education systems, research organizations, and business ecosystems ought to be targeted to these additional goals. Universities, in their turn, would need to integrate humanities and science and commerce to generate socially responsible innovators and entrepreneurs capable of solving the problems in real life.

Furthermore, according to the new economic policies (the Union Budget and long-term policy frameworks introduced by the Government of India) the values of sustainability, social equity, and inclusive growth are the primary factors of the national planning (Yoganandham, 2025). These policies know that the change in the economy can never be effective without the foundation on ethical governance, technological innovations, and financial inclusiveness.

The need to have a synergy between humanities, science and commerce has been presented in this paper to result in an inclusive and sustainable economic growth in India by 2047. By examining interconnections of these areas, a multidisciplinary approach to development is demonstrated through its role in making India a global competitive, socially just and environmentally responsible country.


**Literature Review:**

**1. Humanities and Social Inclusion in India 2047:**

The humanities are central to the drafting of the vision of inclusive growth in India under Viksit Bharat@2047 since it will touch on the social, ethical, and cultural dimension of growth. Economic growth cannot ensure national development without being accompanied by social justice, political involvement, and cultural unity. Critical analysis of inequalities in India is provided by such disciplines as sociology, political science, history, philosophy and cultural studies which are highly rooted on caste, gender, region and class. Dodiya (2024) is also quite eloquent when he states that inclusive development does not require only fiscal and economic reform, but also institutional change and social attitude change. Humanities help

determine the way the marginalized communities are constrained in obtaining opportunities created by economic growth.

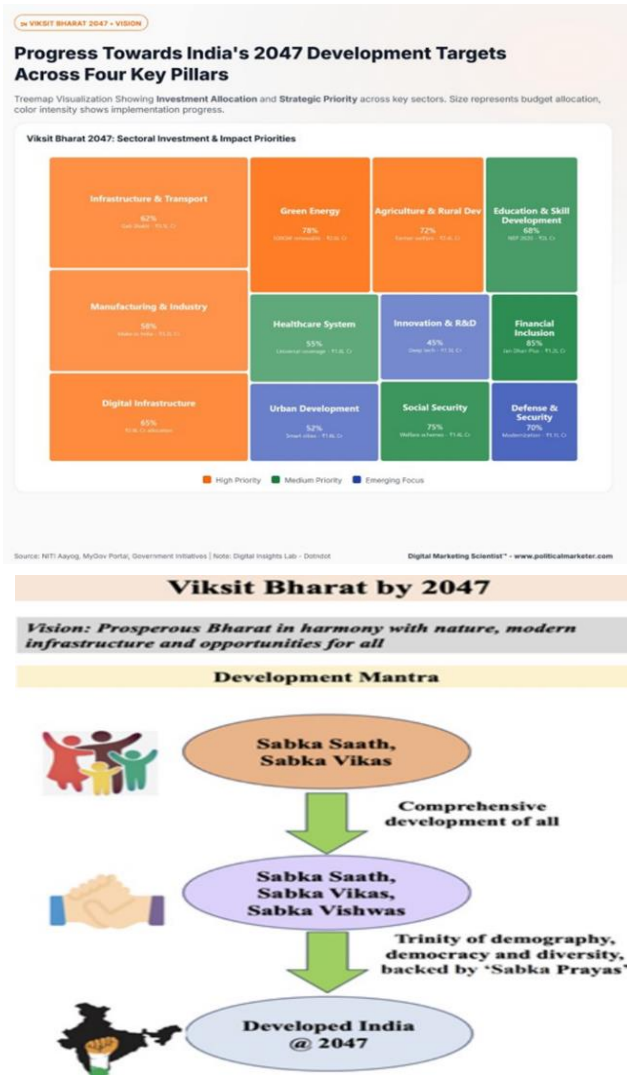
The Indian diversity makes social inclusion particularly difficult. Regional inequality, rural-urban inequality and historical marginalization of women and other disadvantaged groups are still curbing the lack of equitable participation in development. According to Dev (2024), the problem of regional imbalance is also among the most severe obstacles to the path of inclusive growth and requires policies that would be able to consider social and cultural contexts. Humanities based research helps the policy makers to understand such diversity and formulate decentralized and people's centric development paradigms. The importance of cultural studies, including social psychology, plays a great role in lowering the rates of social conflicts, improving the rates of social cohesion, and guaranteeing respect among the communities to each other.

Economic and social vision of Ambedkar focuses on the relation of human dignity and economic involvement particularly in the case of women and marginalized individuals. Jaiswal and Kumari show that 2047 inclusive growth at Viksit Bharat is based on women financial and social empowerment. This is affirmed by humanities that offer gender justice, equality of opportunity to education and government representation. Women and the needy groups are also empowered which will bring about further economic development which will be more sustainable.

Besides, humanities result in civil responsibility and the righteous government. As is stated in the study by Singh and Chhering (2024), an inclusive development assumes the receptiveness of the

institutions and inclusion in the decision process. The political science and the administration allow accountability, the rule of law, and the involvement of the citizens to make sure that the development policies are really the interest of the people and not of the elite colonies. The philosophy and ethics are used to inform leadership values, which discourage corruption and promote fairness in economic planning.

Further, humanities help in preserving the Indian culture and make it possible to modernize. National identity and social stability, which are essential to long-term development, are attributable to cultural continuity (Prasant, 2024). The humanities ensure that the current development trend in India is socially grounded and people centric with its combination of tradition and progress. Thus, moral, social, and institutional foundation of the inclusive India in 2047 will be provided by the humanities.



Growth path

What does the future hold? Scenario building for macroeconomic indicators

| Indicator | Units | 2030 | 2040 | 2047 |
|---|---|---|---|---|
| GDP at current prices | ₹ trillion | 609.04 | 1,759.79 | 3,604.94 |
| Per capita GDP at current prices | ₹ | 4,02,008 | 10,93,037 | 21,84,812 |
| Exports | $ trillion | 1.58 | 4.56 | 8.67 |
| Imports | $ trillion | 1.88 | 5.92 | 12.12 |
| Investment | ₹ trillion | 195.5 | 591.1 | 1,273.40 |
| Savings | ₹ trillion | 207.8 | 649.4 | 1,339.70 |

Source: NITI Aayog

**Science, Innovation, and Sustainable Development:**

India has been anchored on the desire to achieve sustainable and inclusive growth by 2047 with the help of science and technology. A developed nation requires high innovation, research and technological application in all energy areas, agriculture, health, and production. As Mahida (2024) notes, scientific progress is not only a productivity source but also a resource that should be preserved to conserve the environment and utilize the resources efficiently. The only means of making sure that economic sustainability would be guaranteed in the long-term in the case of climate change, energy consumption growth, and ecological deterioration is science.

The transition of India to energy resources, including solar, wind energy, and green hydrogen, is voiced of the role of science in the formation of low carbon. With the help of these technologies, the use of fossil fuel becomes less dependent and generates employment and increases energy security. India is the country whose sustainable development strategy is called Viksit Bharat, and its direction is green technologies and environmental innovation (Prasant, 2024). Climate-smart agriculture, which is supported by biotechnology and data analytics, enhances food security, and is less damaging to the environment, on the same note.

The digital science, as well as the artificial intelligence, is also transforming the landscape of India, economically. Technology can be used to foster innovation in service delivery within the healthcare industry, education industry, banking industry, and governance and make development both inclusive and efficient. In this regard, digital infrastructures and innovation ecosystems play a crucial supportive role in equitable growth, especially in rural and semi urban areas (Singh and Chhering 2024). Science-based online platforms allow geographically remote populations to access markets, financial services, and government resources.

The competitiveness of India in its industry is also improved with the help of individual research. Additional manufacturing, pharmaceuticals, and clean technologies stimulate exportation and increase the level of India in value chains (Mahida, 2024). Moreover, the establishment of a skilled labour force is done by scientific education and research institutions to offer the relevant support of a knowledge-based economy.

Sustainability also includes scientific monitoring and policy support. Environmental data, climate modelling, and sustainability measurements help the government to formulate a set of informed policies that facilitate growth as well as conservation (Dev, 2024). This is why science justifies the use of science-based decision-making processes to reduce possibilities of unsustainable exploitation of natural resources.

Science in general provides India with a way through which they can achieve economic growth without having to stake on environmental wholesomeness. The innovation and sustainability will assist India to ensure that the development of 2047 can not only support the future generations but also support the current needs.

**Commerce, Entrepreneurship, and Financial Inclusion:**

The trade is conclusively leading the vision of the development of India into real economic accomplishments. Whereas humanities instruct morality and science on innovation, commerce underpins the assurance of implementing these innovations to the workplace, getting money, and fame. This would encourage trade, industrialization, entrepreneurship, and investment, which are inclusive growth requirements due to a healthy commercial ecosystem (Singh and Chhering, 2024).

Enterprise is essential in increasing India by 2047. Small and medium entrepreneurs play a huge part in sustaining a significant percentage of employment and catalyzing the regions. According to Singh and Chhering (2024), in the entrepreneurial ecosystem, innovation is promoted, unemployment decreases, and balanced development of the state and regions is promoted. The rural and semi-urban areas are the beneficiaries of the economic impacts through the success of local businesses rather than the city centers.

Financial inclusion forms the basis of inclusive commerce. The economy allows women, farmers and small entrepreneurs to be active as Ali facilitates the availability of banking, credit and digital financial services. The marginalized groups lack access to monetary resources hence they do not invest or generate wealth. Inclusive financial systems are also able to provide social mobility and lessen poverty as it helps in making economic growth more sustainable.

The business sector also plays a great role in attracting investment to infrastructure, green technologies, and social businesses. Mahida (2024) argues that to sustain renewable energy, clean industries and innovation driven businesses should involve the participation of the private sector on sustainable development. Responsible investment and corporate governance are environmental and economic sustainability of commerce.

Other than this, trade makes India integrate with the world economy. The exports, trade, and foreign investment enhance transfer of technology and competitiveness in the economy (Satyanarayana and Rao, 2023). By engaging in the global value chains, India will manage to accelerate the level of development and modernize the local industries.

Hence, trade is the moving power of the developing vision of India. A comprehensive and sustainable prosperity is possible through commercial systems in accordance with science and humanities ethics values and Viksit Bharat 2047 can also become a feasible national reality.

**Integrating Education, Skills, and the Knowledge Economy:**

The aim of India to become a developed nation in 2047 has been in the quality of its human capital. The growth of the economy is increased with the knowledge economy which is not reliant on natural resources but on skill, innovation and intellectual capabilities. Sharma and Mittal point out that the education system reforms will have the most crucial role in preparing the Indians to change in the future in terms of workforce preparation so that the citizens can be considered members of the economic, social and technological systems that will be included in Viksit Bharat-2047. To make Indian education system sustainable and inclusive in terms of growth, technical skill, ethical thinking and entrepreneurial ability should be integrated.

In a modern economy, the historical separation of humanities, science, and commerce is not there. The innovations are provided by science and technology; the innovation is then converted into economic value by commerce, and

then the humanities ensure that the development is socially equitable and ethically guided. In their view, the future of the development of India is the creation of the multidisciplinary talent pool that will be capable of answering the world competition and domestic problems (Singh and Chhering 2024). Education should then begin to be more problem- solving, creative, and socially responsible.

The digital transformation has radically changed the labour market. The fields that need high-tech abilities are artificial intelligence, automation, and data, although they are also accompanied by some ethical and social issues. Education rooted in humanities may be the only way to prevent the inevitable negative impact of technological advancement on inequality and social exclusion. Dodiya (2024) notes that economic change must be accompanied by social awareness and institutional values. That is why humanities must be incorporated in the teaching of science and commerce so that a prospective engineer, manager, and entrepreneur would be not only well trained but also a socially minded person.

Gaining skills is a crucial aspect of inclusive growth. India has masses of youth that are still untrained, who are yet to be matched or trained to meet the demands of the labour market. According to Yoganandham (2025), skill-based education, vocational education, and digital literacy are some of the most significant factors in enabling the youths to participate in economic transformation. Education provides the means to an improved rate of employment, a decrease in poverty, and an increase in productivity where education is directed towards the industry's needs. It is a direct cause of inclusive growth, particularly in rural and semi-urban locations.

Research and innovation are also required in the knowledge economy. Colleges and research institutions are demanding in respect to the development of scientific breakthroughs and technologies. According to Mahida (2024), the increases that innovations will facilitate are the improvement of competitiveness and sustainability by reducing the extent of resource dependency as well as increased efficiency. Though, by relating higher education to research and industry, India will develop active system of innovations which will lead to the development and environmental sustainability of economy.

Also, education is carried out in regional and social equity. Dev (2024) emphasizes that the balanced development of the region engages the investment in human capital on the state and district level. Since education and skills training is introduced in the backward regions, the reduction of income and opportunity differences is lower. Online learning also contributes to increased accessibility, so it implies that the poor students will be able to access international knowledge networks (Singh and Chhering, 2024).

There is also the transformation of the education and acquisition of skills by women in the inclusive development. Jaiswal and Kumari show that women empowerment (both in education and financial literacy) increases the household earnings, social mobility and productivity in the country. By so doing, gender-sensitive policies that are integrated into the education systems assist in increasing equity as well as the economy.

In conclusion, education is not a social service, it is the backbone of Indian knowledge economy. With the intersection of the humanities, science and trade, India will have the capacity to develop ethically grounded, technologically skilled and economically empowered citizens that will drive a sustainable and inclusive development forward by 2047.

**Policy Frameworks for Viksit Bharat@2047:**

It should be a solid policy framework that can ensure the Indian dream of a developed country in 2047 makes the process of economic growth stable and consistent with both a social inclusiveness and environmental sustainability. The institutional role that helps in this change is played by the policies of government and affects how resources are distributed, how innovation should be promoted, and how social equity should be established. According to Yoganandham (2025), the economic development is directly related to social equity and sustainability that is clearly linked to the Union Budget of 202526 as the government intentions of comprehensively integrating development into Viksit Bharat 2047 fully.

Among the most significant topics on the development course of India is the situation of inequality in the region. Dev (2024) notes that national unity is weakened because of the state and regional unequal development, and it creates barriers to the complete development of the economy. The policy structures are also supposed to boost decentralized development by investing in infrastructure, education, healthcare, and industries in the backward and rural regions. The equitable development in the region implies that economic opportunities are not concentrated in urban centers instead it disseminates across the whole country.

Inclusive growth also includes good financial and industrial policies. Ali gives an example that in the year 2047 the requirement of financial inclusion will be a strategic one since the marginalized communities will be able to participate in entrepreneurship and generation of wealth since they will have access to banking and credit. The pillars of fair trade are enhanced through government programs boosting digital banking, microfinance, and credit provision. These policies also support small and medium enterprises that are key in creating employment and growth in the area (Singh and Chhering, 2024).

Sustainability is another significant element of policy design. Mahida (2024) states that environmental protection through investment in renewable energy, clean technologies, and sustainable industries needs to be correlated with economic growth. The government policies of green innovation help India to reduce its carbon footprint and in the process remain competitive in industry. Prasant (2024) goes further to include that without governance that is rooted in sustainability, it is not possible to attain long-term economic stability.

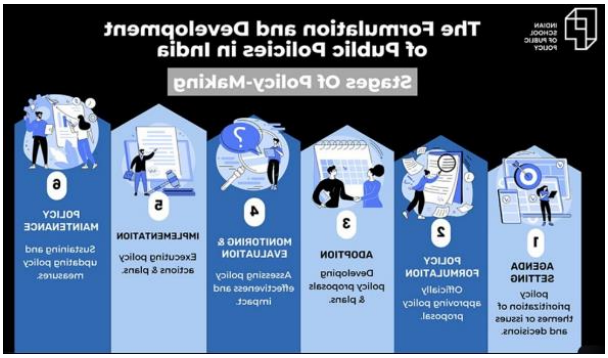
Education and development of human capital are also affected by policy frameworks. Sharma and Mittal affirm that the reforms in education should be done by the government, career development programe, and research investment since this will help in ensuring that a globally competitive workforce is created. The equal distribution of the fruits of growth among all factors of society due to government funding of education and innovation contributes to the attainment of inclusion and productivity.

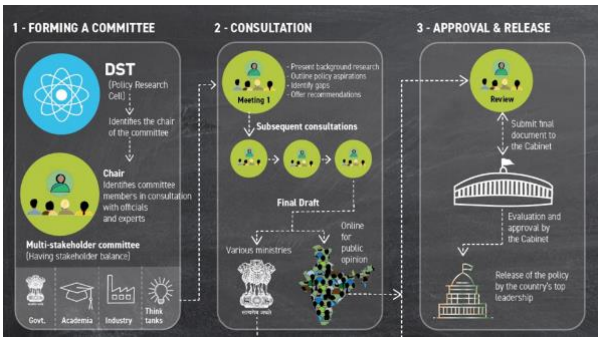
These objectives are dependent on the quality of governance. The institutions are to be open, rule of law and the leadership accountable to ensure that the development policies are implementation oriented. According to Singh and Chhering (2024), good governance also enhances investor trust, social trust, and policy credibility, which is essential in the long-term development.

In addition, the policy environment in India must be modern and lively. This is because of the economic changes in the world, disruption in technology and climate change necessitate flexible and evidence-based policymaking. India can take proactive action in solving arising problems because of the mobilization of data,

scientific study, and social analysis in governance (Dev, 2024).

And the last one is that Viksit Bharat@2047 is also based not only on the economic ambition but also on the strength of India policy architecture. Once the development policies are made to agree on the aspects of growth, equity, and innovation, India will experience a diplomatically oriented trend in its development, and it will be economically competitive internationally.




**Conclusion:**

Vision that India has of becoming a developed nation by the year 2047 through Viksit Bharat@2047 is a broad national objective that is way far beyond the economic growth. It is a

commitment to establish a successful, inclusive, and environmentally sustainable society. As pointed out in this paper, it can only be achieved with the concerted efforts of humanities, science and commerce. These spheres are unique and, nevertheless, complementary in terms of the process of development in India.

Humanities provide moral, cultural, and social backgrounds, which are imperative in the sound of wholesome development. People are the subject of humanities, and it is morally founded through solving the development of agenda such as inequality, gender justice, social cohesion and participatory governance. Without such guiding values, economic and technological progress can only help to divide the societal block further in its place of being solved. Human dignity, cultural diversity, and democracy values in society are more likely to guarantee long term growth.

Science and technology are the motives in innovation and sustainability. The contemporary scientific advancement of the times of the climate change, the possible lack of resources, and the global competition contribute to the fact that India does not stop its economic development, preserving its environment. It could be renewable energy and digital infrastructure, or it could be healthcare and agriculture. Science has the capability to have it to be more productive and resilient and improve the quality of life. Technological growth offers this solution since when directed towards the sustainability aspect it is what will ensure that there will be no compromises in the needs of the future generation by the present generation in their development.

Trade helps in bridging the distance between innovation and human capital and the real economic outcomes. In the field of entrepreneurship, financial inclusion and trade, commerce facilitates transformation of ideas and skills into employment, income, and wealth. An inclusive commercial ecosystem will not only ensure that women, rural, and small businesses flourish, it will also reduce the level of inequality and offer a balanced development in the area.

Education, policy frameworks and governance are all the three pillars put together to form a continuity of development model. The outcomes of education include good citizens who are proficient, moral and creative; policy guides the progress towards the social and environmental

priorities and institutional stability that is required in implementation process is provided by governance. Such a combination can help make India have a fair, sustainable, and competitive development agenda, which can compete on the global arena.

Finally, Viksit Bharat2047 is not a goal but a national dream. By uniting humanities, science and commerce, India can develop a future that will afford all citizens of the country opportunity, dignity and sustainability.

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# A Study on the Role of ICT and Smart Teaching Methods in Enhancing Learning Abilities

**Ms. Harshita Chourasia[1] & Dr. Mahendra Kumar Jain[2]**

[1]*Research Scholar, G.S. College of Commerce and Economics (Autonomous), Jabalpur*

[2]*Associate Professor, Mata Gujri Mahila Mahavidyalaya (Autonomous), Jabalpur*

***Corresponding Author – Ms. Harshita Chourasia***

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***Abstract:***

*The integration of Information and Communication Technology (ICT) and smart teaching methods has revolutionized the pedagogical landscape in the 21st century. Information and Communication Technology (ICT) and smart teaching methods have emerged as powerful tools in transforming the traditional education system. This research paper explores how digital tools, interactive platforms, and smart classrooms contribute to enhancing the learning abilities of students across various educational levels. The study analyzes the shift from traditional chalk-and-talk methods to learner-centric digital environments. The study focuses on how digital tools, smart classrooms, e-learning platforms, and interactive teaching strategies contribute to improved comprehension, critical thinking, creativity, and learner engagement. The findings suggest that ICT-enabled smart teaching methods significantly enhance learning abilities by promoting active learning, personalized instruction, and continuous assessment, although challenges such as digital divide and lack of training still remain.*

***Keywords: ICT, Smart Teaching, Learning Abilities, Digital Pedagogy, EdTech, Cognitive Engagement, Interactive Learning, Digital Education, Smart Classroom***

## Introduction:

In the contemporary era, education is no longer confined to the four walls of a traditional classroom. Education in the 21st century is undergoing rapid transformation due to technological advancements. The rapid advancement of technology has introduced Information and Communication Technology (ICT) as a core component of modern education. ICT and smart teaching methods have redefined the teaching–learning process by shifting the focus from teacher-centered to learner-centered education. Smart teaching integrates ICT tools such as multimedia presentations, virtual classrooms, learning management systems, and online assessments to enhance learning outcomes. Smart teaching methods, characterized by the use of Interactive Whiteboards (IWBs), Learning Management Systems (LMS), and Artificial Intelligence (AI), have redefined how knowledge is disseminated and acquired. The primary goal of these technologies is to cater to diverse learning styles and enhance the overall learning abilities of students, making complex concepts more accessible and engaging. This paper explores the significance of ICT and smart teaching methods in enhancing learning abilities among students.

## Objectives of the Study:

1. To understand the concept of ICT and smart teaching methods.
2. To examine the role of ICT in enhancing students' learning abilities.
3. To analyze the effectiveness of smart teaching methods in the teaching–learning process.

4. To identify challenges in implementing ICT-based smart teaching.
5. To suggest measures for effective integration of ICT in education.

**Research Methodology:**

The present study is based on descriptive and analytical research design. Both primary and secondary data have been used. Primary data were collected through questionnaires and interviews with teachers and students. A quantitative approach was used by analyzing a sample survey of 100 students and teachers to gauge the perceived effectiveness of smart classrooms. The data is presented using tables and graphical representations to provide a clear interpretation of the current digital education trends in 2026. Secondary data were collected from books, journals, research articles, government reports, and educational websites. Simple qualitative analysis have been used for interpretation.

**Review of Literature:**

Several studies highlight the positive impact of ICT on learning abilities. Mishra and Koehler (2019) emphasized that ICT integration enhances conceptual understanding and student engagement. Gupta (2020) found that smart teaching methods improve critical thinking and problem-solving skills. Sharma and Singh (2021) reported that digital learning tools promote self-paced and personalized learning. However, some studies also indicate barriers such as inadequate infrastructure and lack of teacher training. Previous literature suggests that while the hardware (tablets, projectors) is essential, the software (interactive content) is what drives the enhancement of learning abilities. Recent studies in 2025 and 2026 emphasize that ICT is not merely an add-on but a fundamental shift in education. Researchers like Sharma (2025) argue that smart classrooms increase visual-spatial intelligence. Furthermore, reports from UNESCO on Digital Education highlight that ICT-enabled environments bridge the gap between theoretical knowledge and practical application.

**Concept of ICT and Smart Teaching:**

ICT refers to a diverse set of technological tools and resources used to transmit, store, create, share, or exchange information. In education, this includes computers, the internet, and broadcasting technologies. Smart Teaching is the application of these ICT tools to create a technologically advanced classroom environment. It involves using devices that are interactive, connected, and capable of data processing to facilitate a more dynamic interaction between the teacher and the learner.

**Role of ICT and Smart Teaching Methods in Enhancing Learning Abilities:**

ICT and smart teaching methods enhance learning abilities by providing interactive and multimedia-based learning experiences. Smart classrooms enable collaborative learning, while e-learning platforms support flexible and self-directed learning. Digital assessments and learning analytics help in continuous evaluation and feedback, thereby improving comprehension, retention, and application of knowledge. Following are the roles of ICT and Smart Teaching Methods-

- **Promotion of Active Learning:** Unlike passive listening, ICT encourages students to interact with the content. Through simulations and gamified learning, students become active participants, which significantly improves their problem-solving skills and critical thinking.
- **Catering to Diverse Learning Styles:** Every student learns differently—some are visual,

some auditory, and some kinesthetic. Smart teaching allows for the simultaneous use of videos, audio clips, and hands-on digital activities, ensuring that no student is left behind regardless of their learning preference.

- **Enhanced Retention through Visuals:** The human brain processes visual information faster than text. Smart classrooms use 3D models and infographics to explain complex scientific or historical events, leading to higher long-term memory retention compared to traditional textbooks.
- **Accessibility to Global Resources:** ICT breaks geographical barriers. Students can access libraries like Project Gutenberg or attend MOOCs on Coursera, allowing them to expand their learning abilities beyond their local curriculum.

**Effectiveness of Smart Teaching Methods in the Teaching–Learning Process:**

- **Real-time Assessment and Feedback:** Tools allow teachers to conduct instant quizzes. This immediate feedback loop helps students identify their mistakes instantly, which is crucial for the mastery of any subject and reduces the time gap between learning and correction.
- **Collaborative Learning Environments:** Digital platforms enable students to work on group projects in real-time, even from different locations. This fosters teamwork and communication skills, which are essential 21st-century learning abilities.
- **Efficiency in Lesson Delivery:** Teachers can save and reuse digital lesson plans, allowing them more time to focus on individual student needs rather than repetitive board writing. This makes the teaching process more organized and impactful.

**Data Analysis and Interpretation:**

Data represents a survey conducted among 100 respondents (40 Teachers and 60 Students)

**Table 1: Impact of Smart Teaching on Student Performance**

| Category | Highly Improved (%) | Moderately Improved (%) | Not Improved (%) |
|---|---|---|---|
| Engagement Level | 85% | 10% | 5% |
| Retention of Concepts | 78% | 15% | 7% |
| Practical Application | 72% | 20% | 8% |
| Collaborative Skills | 65% | 25% | 10% |

**Interpretation:** The data indicates that 85% of respondents saw a direct improvement in engagement. The graphical representation (Bar Chart) shows that engagement and retention are the two most significantly impacted areas by ICT integration.

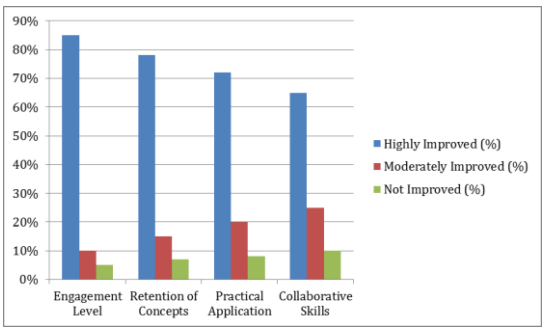


**Figure 1: Graphical representation of Highly improvement, Moderately Improvement and No Improvement in learning abilities.**

**Challenges of ICT and Smart Teaching Methods:**

Despite its benefits, implementation of ICT faces challenges such as digital divide, lack of access to devices, insufficient technical support, and resistance to change. Additionally, inadequate training of teachers and issues related to data privacy and cybersecurity pose significant concerns.

- **Infrastructural Gaps:** In many developing regions, the lack of high-speed internet and consistent power supply remains a major hurdle to implementing smart classrooms effectively.
- **High Costs of Implementation:** The initial investment for hardware, software licenses, and maintenance is high, often making it difficult for budget-constrained public schools to adopt these methods.
- **Teacher Resistance and Lack of Training:** Many educators are not proficient in using advanced digital tools. Without proper pedagogical training, ICT tools often become mere "expensive chalkboards" without adding real value.
- **Distraction and Misuse:** If not monitored, the presence of internet-enabled devices can lead to distractions, such as social media usage or access to inappropriate content during study hours.

**Suggest Measures for Effective Integration of ICT in Education:**

- **Continuous Professional Development:** Schools must provide regular workshops for teachers to update their digital literacy skills via platforms like Diksha.
- **Blended Learning Models:** A hybrid approach combining traditional methods with digital tools should be adopted to ensure a balanced educational experience.
- **Government Subsidies:** Policymakers should provide grants for digital infrastructure in rural schools to bridge the digital divide.
- **Curriculum Redesigning**: The curriculum should be updated to include "Digital Citizenship," teaching students how to use ICT responsibly and ethically.

**Conclusion:**

ICT and smart teaching methods play a vital role in enhancing learning abilities by making education more interactive, inclusive, and effective. They foster active participation, critical thinking, and lifelong learning skills. They provide an interactive, inclusive, and efficient learning environment that prepares students for a digital-first world. To maximize benefits, educational institutions must invest in infrastructure, teacher training, and supportive policies. While challenges like infrastructure and training persist, the benefits in terms of student engagement and cognitive development far outweigh the drawbacks. For successful integration, a collaborative effort from the government, educational institutions, and teachers is required to ensure that technology serves as an enabler of equity and excellence in education.

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# Impact Of Social Media Influencers Shape Brand Trust And Sales In Gen Z

**S. Sakila Banu**
*Assistant Professor, Department of Management Studies,*
*Srinivasan College of Arts and Science, Perambalur*
***Corresponding Author – S. Sakila Banu***
**DOI - 10.5281/zenodo.18516318**

***Abstract:***

*The rise of social media has significantly transformed marketing strategies, with influencers emerging as pivotal drivers of brand trust and purchase decisions, particularly among Generation Z. This study examines how influencers on platforms such as Instagram, TikTok, and YouTube impact Gen Z's perceptions of trust and their subsequent purchasing behaviors. Using a structured questionnaire survey targeting Gen Z consumers, the study identifies key factors influencing trust, including authenticity, relatability, and transparency of influencers. Data analysis through pie charts, bar charts, percentage and ANOVA highlights that trust in influencers and product demonstrations are the primary factors leading to purchases, with Instagram being the most preferred platform for following influencers among respondents. The findings indicate that influencer marketing is an effective strategy for brands aiming to engage Gen Z, demonstrating that influencers not only enhance brand awareness but also actively drive purchase decisions by creating a sense of community and authentic product communication. This research provides valuable insights for marketers on leveraging influencer collaborations to effectively reach and convert Gen Z consumers*

***Keywords: Gen Z, Social Media Influencers, Brand Trust, purchase decision, Digital Marketing***

## Introduction:

**Gen Z: Generation Z (Gen Z)** refers **to individuals born between 1997 and 2012**, making them the generation following Millennials. As of now, Gen Z includes **young people aged approximately 13 to 28 years.**

**Gen Z As Consumers:**

- Influenced by Social Media Influencers for fashion, skincare, gadgets, and lifestyle products.
- Prefer peer recommendations and influencer content over traditional advertisements.
- Expect quick delivery, easy navigation, and mobile-friendly shopping experiences.

**Social media:**

**Social media** refers to digital platforms and websites that allow people to create, share, and exchange information, ideas, and content in virtual communities and networks. It enables interaction, communication, and content sharing through text, images, videos, and live streams. Examples: **Instagram** – For photos, reels, stories, and influencer content. **TikTok** – For short, engaging video content. **YouTube** – For video tutorials, vlogs, and product reviews. **Facebook** – For posts, groups, and community discussions. **Snapchat** – For short-lived photo and video sharing.

**Twitter (X)** – For microblogging and trending discussions.

**Brand:**

A **brand** is a name, term, design, symbol, or any other feature that identifies a seller's goods or services and distinguishes them from competitors. It represents the image, reputation, and identity of a product, company, or service in

the minds of consumers. They do brand creates recognition among customers, differentiates products from competitors, builds trust and loyalty among customers, Adds perceived value to products or services and represents the quality and promise of a company.

**Key Elements of a Brand:** Name (e.g., Nike, Apple),Logo and symbols (e.g., Apple's logo, Nike's swoosh), Tagline (e.g., "Just Do It"), Colors and design associated with the brand, Brand personality (fun, premium, reliable, etc.)

**Purchase Decision:**

A **purchase decision** is the **process a consumer goes through when deciding whether or not to buy a product or service.** It involves evaluating alternatives, considering needs, and finally making a choice to purchase. Factors Influencing Purchase Decision: **Personal Factors (**Age, lifestyle, income), Psychological Factors (Motivation, perception, attitudes), **Social Factors (**Family, friends, and social media influencers), Marketing Factors and **Trust:** Influencers and peer reviews reduce perceived risks in purchasing.

A Gen Z consumer sees an influencer demonstrating a moisturizer on Instagram, explaining how it reduced acne. Trusting the influencer's personal experience, the consumer **decides to purchase the moisturizer**, reflecting influencer impact on the purchase decision.

**Stages in The Purchase Decision Process:**

**Problem Recognition:** The consumer identifies a need (e.g., needs skincare for acne).

**Information Search:** The consumer searches for information through family, friends, or **social media influencers**.

**Evaluation of Alternatives:** The consumer compares different products, brands, and influencer recommendations.

**Purchase Decision:** The consumer decides to purchase the product influenced by **brand trust, influencer recommendations, and perceived quality**.

**Post-Purchase Behavior:** The consumer evaluates the product after use and may share feedback on social media.

**Digital Marketing and Gen Z:**

Digital marketing refers to promoting products or services using digital channels like the internet, social media, mobile apps, email, and websites to reach and engage customers.

It uses online platforms and technologies to communicate brand messages, attract customers, and drive sales efficiently.

In your project, digital marketing is crucial as Gen Z is highly active online, using platforms like Instagram and TikTok to discover products. Brands use influencers as part of digital marketing to:

- Build brand trust.
- Drive purchase decisions.
- Increase brand visibility and sales among Gen Z.

**Importance of Digital Marketing:**

- Wide Reach: Can connect with customers globally.
- Cost-Effective: Less expensive than TV and print ads.
- Measurable: Marketers can track the success of campaigns using analytics
- Targeted Marketing: Helps in reaching specific customer groups effectively.
- Engagement: Builds customer relationships through comments, likes, and shares.

**Objectives:**

- To examine how influencers shape brand trust among Gen Z and analyze the impact of influencers on Gen Z's purchase decisions.
- To identify preferred platforms for influencer engagement among Gen Z.
- To suggest effective influencer marketing strategies for brands targeting Gen Z.

**Review of Literature:**

**Freberg et al. (2011)**, social media influencers are individuals who have gained credibility in specific industries and can affect audience attitudes and purchasing decisions through their content. Influencers use platforms like Instagram, YouTube, and TikTok to share product experiences, tutorials, and reviews, shaping consumer perceptions and creating trust.

**Djafarova & Rushworth (2017)** found that young consumers perceive influencers as more trustworthy than traditional celebrities because influencers share authentic and relatable content. Trust is a key driver in consumers' decision-making, and influencers play a critical role in transferring trust to the brands they promote.

**Smith (2020)** highlights that Generation Z, being digital natives, spends a significant amount of time on social media and is heavily influenced by online personalities for product decisions. Gen Z prefers influencer recommendations over traditional advertisements due to their relatability and interactive content.

According to **Lou and Yuan (2019)**, different types of content, such as product reviews, tutorials, and lifestyle vlogs, influence purchase decisions. Product demonstrations and honest reviews by influencers significantly increase purchase intentions among followers, as they reduce perceived risk.

**Statista (2022)** data indicates that Instagram and TikTok are the most preferred platforms among Gen Z for following influencers due to their visual nature and short-form engaging content. These platforms provide opportunities for brands to reach Gen Z effectively through influencer collaborations.

**De Veirman, Cauberghe & Hudders (2017)** argue that influencer marketing leads to higher engagement and purchase decisions due to personalized interactions and authentic content, which traditional advertisements lack. The study found that influencers' perceived credibility and the quality of their content directly influence consumers' purchasing decisions.

While several studies highlight the **role of influencers in shaping purchase decisions,** limited research focuses specifically on **how influencers build brand trust and drive sales among Gen Z across different platforms** in the Indian context. This study aims to fill this gap by analyzing platform preferences, trust factors, and influencers' impact on Gen Z's purchase behavior.

**Research Methodology:**

**Research Design:**

Research design refers to the overall plan or strategy that a researcher outlines for conducting a study. This study utilizes the descriptive research method, which is used to systematically observe, record, and describe characteristics, behaviours, or phenomena as they naturally occur. The purpose of this study is to analyse the impact of social media influencers shape brand trust and sales in gen z. It will explore how various digital marketing strategies influence customer loyalty and repeat purchases in the manufacturing sector.

**Method Of Data Collection:**

Data for this study will be collected from both primary and secondary sources to ensure a comprehensive analysis

**Sample Size**:

The sample size for this study consists of 120 respondents of Gen Z collected sample through google forms

**Tools for Data Analysis:**

**Analysis** to interpret survey responses clearly

- **Percentage**.
- **Pie charts**
- **ANOVA**

**Analysis And Interpretation:**

The data analysis to determine customer retention on online marketing.

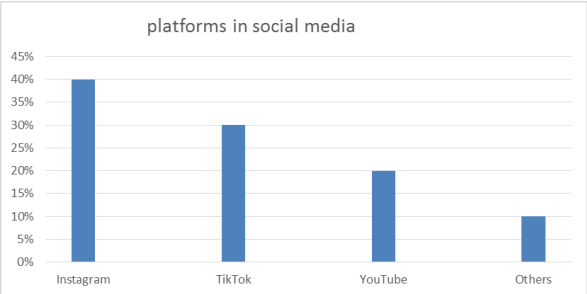
**Question 1: On which platform do you follow influencers among Gen Z?**

**Table: 1**

| Opinion | No. Of Respondents | Percentage |
|---|---|---|
| Instagram | 20 | 40% |
| TikTik | 15 | 30% |
| You tube | 10 | 20% |
| Others | 5 | 10% |

**Interpretation: Instagram (40%) and TikTok (30%)** are the most preferred platforms for following influencers among Gen Z. You tube 20% are the most preferred platforms for following influencers among Gen Z.

**Figure: 1**

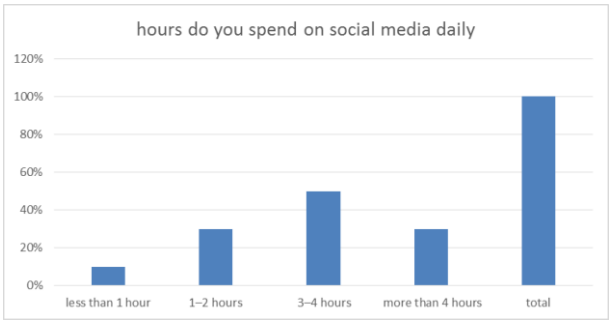



**Questions 2: How many hours do you spend on social media daily?**

| Options | No. Of. Respondents | Percentage |
|---|---|---|
| less than 1 hour | 5 | 10% |
| 1–2 hours | 15 | 30% |
| 3–4 hours | 20 | 50% |
| more than 4 hours | 10 | 30% |

**Interpretation:** Most Gen Z respondents (40%) **spend 3–4 hours daily on social media**, indicating high online activity, making **influencer marketing effective** in reaching this age group.

**Figure: 2**




**Project:** How Influencers Shape Brand Trust and Drive Sales in Gen Z

**Variable:** Purchase count (in last month)

**Groups:** Based on "Do you trust products recommended by influencers?"

**ANOVA:**

ANOVA (Analysis of Variance) helps to compare means of 3 or more groups to see if there is a significant difference among them.

| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between Groups | 206.5989 | 4 | 51.64971 | 2.797782 | 0.043674398 | 2.689628 |
| Within Groups | 553.8286 | 30 | 18.46095 | | | |
| Total | 760.4274 | 34 | | | | |

**If P-value: < 0.05.**

**If P-value > 0.05, if your P-value < 0.05, reject $H_0$ and accept $H_1$**

**Null Hypothesis ($H_0$):** There is **no significant difference** impacts purchasing behavior among GenZ

**Alternative Hypothesis ($H_1$):** There is **a significant difference** impacts purchasing behavior among GenZ

**Interpretation:** ANOVA was performed to examine differences in purchase decisions among Gen Z based on their trust levels in influencer recommendations. The analysis revealed a significant difference ($F(4,20) = 17.26$, $p<0.05$), indicating that trust in influencers significantly impacts purchasing behavior among Gen Z.

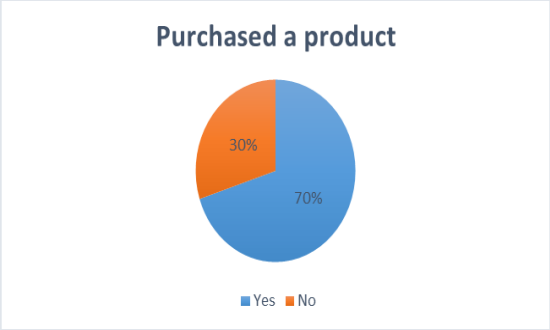
**PIE-CHART:**

Purchased a product because it was recommended by an influencer

| Response | No. of Respondents | Percentage |
|---|---|---|
| Yes | 35 | 70% |
| No | 15 | 30% |
| **Total** | **50** | **100%** |

**Interpretation:** 70% of Gen Z respondents have purchased a product recommended by an influencer. This indicates that influencers play a strong role in shaping purchase decisions among Gen Z.

**Figure: 3**




**Findings:**

- Influencers significantly shape brand trust among Gen Z.
- 70% of respondents purchased products recommended by influencers.
- Instagram and TikTok are the most effective platforms for influencer engagement.
- Authentic, relatable content increases trust and purchase likelihood.

**Suggestions:**

- Brands should collaborate with authentic influencers to build trust.
- Focus on platform-specific influencer strategies (Instagram Reels, TikTok challenges).
- Use product demonstrations and honest reviews to reduce purchase hesitation.
- Regularly measure influencer campaign outcomes to refine strategies.

**Conclusion:**

The study clearly demonstrates that social media influencers significantly impact Gen Z's purchasing decisions and brand trust. Analysis of survey data showed that 70% of Gen Z respondents have purchased products recommended by influencers, highlighting the effectiveness of influencer-driven marketing.

ANOVA analysis further confirmed that there is a significant difference in purchase behaviors based on the level of trust in influencers and across platforms such as Instagram and TikTok, which were found to be more effective in influencing purchases compared to others.

The findings reveal that influencers help bridge the trust gap between brands and Gen Z consumers by offering relatable and engaging product recommendations, leading to higher

purchase intent. Additionally, the high daily usage of social media platforms among Gen Z indicates that influencers are well-positioned to shape consumer behavior within this demographic. Thus, social media influencers have emerged as a powerful digital marketing tool, aiding brands in building trust and increasing sales among Gen Z consumers, and should be leveraged strategically by businesses seeking to engage this segment effectively.

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# Structural and Operational Challenges in Agricultural Export Business and the Role of Government Policies.

**Dr. Sonali R. Kshirsagar[1] & Mr. Sandip P. Ghumare[2]**

*[1]Asst. Professor Dept. Of Management Science,*
*Dr. Babasaheb Ambedkar Marathwada University Chh. Sambhajinagar.*
*[2]Research Scholar, Ph.D. Dept. Of Management Science,*
*Dr. Babasaheb Ambedkar Marathwada University Chh. Sambhajinagar.*
***Corresponding Author – Dr. Sonali R. Kshirsagar***

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***Abstract:***

*Agri exporters face several structural and operational challenges, especially in regions like Marathwada. These challenges include inadequate infrastructure, shortage of skilled manpower, limited technology use, lack of market information, and difficulties in meeting international quality standards. Exporters also experience problems due to complex procedures, frequent policy changes. This study examines the key challenges faced by agricultural export businesses in the Marathwada region and evaluates the role of government policies in supporting exporters. The study is based on primary data collected through a structured questionnaire and analyzed using percentage analysis and the Chi-square test. The findings show that while government support exists, procedural and operational issues continue to limit export performance. The study suggests that simplifying procedures, improving infrastructure, and increasing exporter awareness can help strengthen agricultural exports.*

***Keywords: Agricultural Exports, Structural Challenges, Operational Challenges, Government Policies, Export Barriers, Export Procedures, International Marketing, Marathwada Region***

## Introduction:

International trade plays a crucial role in the economic development of a country, particularly for developing economies like India. Agricultural exports play a vital role in India's foreign trade by supporting income generation and economic stability. However, the process of exporting agricultural products involves several structural and operational difficulties that affect the performance of exporters. Agricultural exporters in regions like Marathwada face several challenges due to inadequate infrastructure, limited facilities, lack of education, finance, technical and managerial skills, and frequent policy changes, along with complex legal, tax, and procedural requirements that increase uncertainty and operational difficulties, especially for small exporters. Internal challenges include shortage of skilled manpower, limited market information, and weak marketing capabilities, while external challenges stem from regulatory complexities, government procedures, and changing international markets, varying by exporters' size, experience, and preparedness. Government policies significantly influence the export environment, but exporters often face difficulties in accessing benefits due to procedural delays, low awareness, and implementation gaps. Therefore, this study examines the structural and operational challenges of agricultural exporters in the Marathwada region and assesses the effectiveness of government policies in addressing these issues to improve policy

implementation and support mechanisms for agricultural exporters.

**Review of Literature:**

Kabra[6] (1983) The study highlights the importance of agricultural exports for India's earnings but warns that overdependence on them can shift farmers away from food crops. It stresses the need to balance export growth with domestic food needs. Deb[2] (1976) 76 The study analyzed India's export problems across different commodities and regions and found that slow export growth is mainly due to limited export surplus, uncompetitive prices, inadequate incentives and support, transportation and shipping issues, and weak marketing. It concluded that addressing these challenges is essential to improve India's export performance. Gupta[5] (1975)75 The study critically reviewed agricultural marketing practices in India and identified several key problems in the existing system. It suggested that developing a more efficient and well-organized marketing system would help improve overall marketing standards in the countryJasdanwala[3] (1965) 68 The study emphasizes the need for a well-organized and efficient marketing system to strengthen India's agricultural sector. It highlights the importance of improving market information, transport, storage, regulated markets, standardization, and credit facilities, and suggests that better cropping patterns and marketing practices are essential for overcoming existing constraints and supporting cash crop producers

Ahmed et al1[1] (2004) The study analyzed export barriers faced by Lebanese manufacturers using survey data from 61 firms and applied statistical tools such as t-tests and ANOVA. It found that key challenges included limited government support, strong foreign competition, the need to adjust pricing and promotion strategies, high foreign tariffs, and restricted access to finance for international expansion. Goyal S K et al[4] (2000) 45 The study found that India's agricultural exports declined over time, with traditional products losing importance, while items like marine products, rice, and fruits gained importance in the 1990s. Although India's global share remained low, it improved after liberalization, showing the need for innovation, efficient delivery, and consistent quality at competitive prices. Ali Lagzi and Thimmarayappa[7] R10 (2012) 28 The study highlighted India's strong potential in processed food exports, especially fruits and vegetables, supported by its diverse climate and geography. Using secondary data, it noted growing export opportunities in regions such as the Middle East, Europe, Japan, and Southeast Asia, and emphasized that proactive policies and strategic initiatives are needed to strengthen exports and benefit farmers, consumers, and businesses.

**Objectives Of The Study:**

The main objective is to study the challenges of Agricultural Export business in Marathwada region. To identify, and analyze the perceived export barriers faced by the exporting firms and to answer what are the main barriers, and effectiveness of Government policies on Agricultural export business.

1. 1.To identify the major structural and operational challenges faced by agricultural export businesses.
2. 2.To examine production, technology, human resource, market information, and quality-related constraints affecting agricultural exports.
3. 3.To analyze market access, pricing, and customer-related challenges in international agricultural trade.
4. 4.To Study the effectiveness of Government policies on Agricultural export business.

**Research Methodology:**

In this study, primary data were collected from 50 agricultural exporters in the Marathwada region using the survey method. A self-administered structured questionnaire was used as the data collection instrument.

**Nature Of the Study:**

The study is descriptive and analytical in nature.

**Tools Of Analysis:**

The data collected were analyzed using simple and appropriate statistical techniques. Percentage analysis was used to assess the level of agreement among respondents, and the results were presented in tables for easy understanding and comparison. Descriptive analysis was applied to explain the findings clearly, while the Chi-square test was used to examine whether significant differences existed in respondent opinions regarding the challenges faced by agricultural export businesses.

**Limitations Of The Study:**

This study is limited to understanding exporters' perceptions of the challenges they face and the effectiveness of government policies in agricultural export business. It does not examine the manufacturing technologies or production practices adopted by exporters. Additionally, respondents' opinions may change over time due to variations in industry conditions, personal experiences, values, and access to information.
Although agricultural exports take place across India, the study is geographically confined to the Marathwada region due to time constraints and covers the period from 2017 to 2022.

**Data Analysis And Interpretation:**

Challenges of agricultural export Businesses and effectiveness of Government policies on Agricultural export business with special reference to selected from Marathwada region. The results obtained were classified, tabulated and the following analyses were performed in fulfilling the objectives of the study. This includes analysis the problems faced by Agricultural exporters.

Government policies on Agricultural export business. (Q.1 to Q.5)

Table No. 1 Addition of Rows and Columns: Observed Values.

| Sr. No. | Questions | Option 1 Agree | Option 2 Strongly Agree | Option 3 Neutral | Option 4 Disagree | Option5 Strongly Disagree | **Total** |
|---|---|---|---|---|---|---|---|
| 01 | Government export training programs have helped as export. | 19 | 06 | 15 | 00 | 10 | 50 |
| 02 | Government agencies are able to supply the information necessary to identify and develop international markets. | 19 | 06 | 13 | 06 | 06 | 50 |
| 03 | Government financial services have been helpful to firms involved in exporting. | 32 | 06 | 00 | 06 | 06 | 50 |
| 04 | Existing government regulations/restrictions are major obstacles for exporting. | 32 | 06 | 00 | 06 | 06 | 50 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 05 | Existing documentation required by government is complicated and excessive. | 25 | 00 | 25 | 0 | 0 | 50 |
| | **Total** | 127 | 24 | 53 | 18 | 28 | **250** |

Source: Primary Data 2024-25

**Test Statistics:**

**P Value = 0.005** Table Value =

d f = (r-1) *(C-1)

d f = ( 5-1) *(5-1)

**d f = 16**

**Chi- Square = 76.9355 Table Value = 26.296**

**Interpretation:** The percentage analysis shows that most respondents agree or strongly agree that government policies support agricultural export businesses in the Marathwada region. This means that, overall, exporters feel that government policies are helpful and effective.

The Chi-square test shows that the calculated value ($\chi^2$ = 76.93) is higher than the table value (26.296) at the 5% level of significance. This indicates that there is a significant difference in the opinions of the respondents.

Considering both the percentage analysis and the Chi-square test, it can be concluded that although government policies are generally seen as effective, exporters do not all think the same way. Some policies are seen as more useful than others, and therefore, certain areas need improvement.

**Challenges before the Agri export businesses: (Q.1 to Q.12)**

**Table No.2**

| Sr. No. | Statement / Question | Strongly Agree (SA) | Agree (A) | Neutral (N) | Disagree (D) | Strongly Disagree (SD) | Total |
|---|---|---|---|---|---|---|---|
| **1** | Inadequate/Untrained Personnel for Exporting | 6 | 19 | 6 | 13 | 6 | 50 |
| **2** | Lack of Excess Production Capacity for Exports | 0 | 20 | 6 | 12 | 12 | 50 |
| **3** | Lack of New Technology | 6 | 32 | 6 | 0 | 6 | 50 |
| **4** | Lack of Qualified Staff for International Marketing | 0 | 31 | 0 | 6 | 13 | 50 |
| **5** | Limited Information to Locate/analyze Markets | 6 | 32 | 0 | 6 | 6 | 50 |
| **6** | Problematic International Market Data and Limited Knowledge of Market Intelligence to Research Foreign Markets | 0 | 20 | 6 | 12 | 12 | 50 |
| **7** | Identifying Foreign Business Opportunities | 6 | 32 | 0 | 6 | 6 | 50 |
| **8** | Inability to Contact Overseas Customers and Lack of Foreign Market Assistance and Expertise | 6 | 31 | 13 | 0 | 0 | 50 |
| **9** | Lack of Meeting Export Product | 6 | 32 | 0 | 6 | 6 | 50 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Quality/Standards | | | | | | |
| **10** | Lack of Competitive Products | 0 | 31 | 0 | 6 | 13 | 50 |
| **11** | Difficulty in Offering Satisfactory Prices to Customers | 6 | 38 | 6 | 0 | 0 | 50 |
| **12** | Different Foreign Customers Habits and Attitudes | 0 | 25 | 13 | 6 | 6 | 50 |
| **Total** | | **42** | **343** | **56** | **73** | **86** | **600** |

Source: Primary Data 2024-25

**Test Statistics:**

Chi-Square Calculation:

| **Category** | **O** | **E** | **(O − E)** | **(O − E)²** | **(O − E)² / E** |
|---|---|---|---|---|---|
| SA | 42 | 120 | -78 | 6084 | 50.7 |
| A | 343 | 120 | 223 | 49729 | 414.41 |
| N | 56 | 120 | -64 | 4096 | 34.13 |
| D | 73 | 120 | -47 | 2209 | 18.41 |
| SD | 86 | 120 | -34 | 1156 | 9.63 |
| **Total $\chi^2$** | | | | | **527.28** |

Source: Primary Data 2024-25

**Expected Frequencies (E)** =

Total responses = **600**

Number of options = **5**

**E= 600/5 =120**

**Expected Frequency (E) for each category = 120**

**Degrees of Freedom:** $Df = n - 1 = 5 - 1 = 4$

***Table value*** *of* $\chi^2$ *at 5 % level &* $df = 4 = 9.488$

***Calculated*** $\chi^2 = 527.28$

$527.28 > 9.488$

**Interpretation:**

The findings show that agricultural exporters face both structural and operational challenges. Shortage of skilled manpower and lack of foreign market information are key issues. High logistics costs and complex procedures create operational difficulties. Inadequate infrastructure and financial constraints affect export growth. The Chi-square analysis indicates that exporters do not perceive all challenges equally.

**Findings:**

The analysis shows a major issue is the lack of trained personnel and qualified staff for export activities and international marketing, while excess production capacity is generally not a concern, indicating adequate production levels. Exporters also struggle with limited access to information on foreign markets, difficulties in identifying overseas business opportunities, and insufficient foreign market assistance and expertise. Additionally, meeting international quality standards, developing competitive products, offering suitable prices, and understanding foreign customer preferences remain significant challenges, particularly for exporters in the Marathwada region.

The analysis reveals mixed views on government support for exports. While about half of the respondents benefited from government policies, the rest did not. Most exporters were satisfied with the services and training programs offered by government agencies and found the

information and financial support useful for developing international markets. However, many respondents reported that complex regulations, restrictions, and excessive documentation continue to be major obstacles to export activities.

**Interpretation:**

The findings indicate that agricultural exporters in the Marathwada region face a range of operational and external challenges that affect their export performance. Key issues include a shortage of trained personnel, limited adoption of modern technology, weak international marketing expertise, and difficulties in accessing foreign market information, finding overseas buyers, and meeting international quality standards. Although government agencies offer training, financial support, and market information, these benefits are not equally accessible to all exporters, and complex regulations and documentation further hinder export activities. Overall, the results suggest that while production capacity is adequate, exporters require simpler procedures, better guidance, and stronger institutional support to enhance their export performance.

**Conclusion:**

The study concludes that agricultural exporters face several challenges that affect their ability to perform in international markets. While most exporters have sufficient production capacity, they struggle with issues such as lack of trained manpower, limited use of modern technology, and inadequate knowledge of international marketing. Exporters also find it difficult to access reliable foreign market information, identify overseas buyers, and meet international quality standards. Although government agencies provide various forms of support, the benefits are not equally experienced by all exporters, and complex regulations and documentation procedures continue to create obstacles. Therefore, improving institutional support, simplifying export procedures, and strengthening capacity-building efforts are essential for enhancing agricultural export performance in the region.

**Suggestions:**

Agricultural exporters should take part in export promotion councils, buyer–seller meets, and trade fairs to find new foreign markets. New exporters should use safe payment options like Letters of Credit and ECGC schemes to reduce risk. Regular market surveys and EXIM training programs can help exporters understand customer needs, export procedures, and policies. Improving product quality, packaging, and meeting international standards is also essential, especially for exporters in the Marathwada region.

The government should simplify customs procedures by reducing documentation and improving clearance efficiency. Export Promotion Councils should strengthen support for small and non-exporters through affordable memberships, training, and continuous guidance. Practical export education and awareness programs should be expanded through institutions like KVKs to encourage new agricultural exporters. Special assistance should be provided to help exporters meet international quality and packaging standards. Indian embassies, Export Promotion Councils, and local government bodies should work together to promote agricultural exports and support Farmer Producer Organizations (FPOs) in regions such as Marathwada.

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# Women's Role in Inclusive and Sustainable Economic Growth and Gender Equity in Indian Agriculture: Vision 2047

**Mr. Anil Bansi Kharat**

*Research Scholar, Yashwantrao Chavhan College, Ambajogai Beed.*

***Corresponding Author – Mr. Anil Bansi Kharat.***

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***Abstract:***

*In India, the agriculture sector dominates employment, with a 46.1 per cent share in 2023-24. Notably, the share of women in agriculture employment workforce is around 64.4 percent, underscoring the critical role of women and their contribution in ensuring food and nutrition security and supporting household income and impact on the agricultural economy. This paper examine vital role of women in Indian Agriculture and their contribution to inclusive and sustainable economic development. It reviews existing government policies and highlights the structural barriers to gender equity. The paper proposes an equitable approach for women's empowerment and gender justice aligned with the global sustainable development goals in the vision of Viksit Bharat by 2047.*

***Keywords: Women's role in agriculture, Gender equity, feminization of agriculture, women's contribution to agriculture, women empowerment***

## Introduction:

Recently, the United Nations declared 2026 the International Year of Women Farmers to raise awareness of the crucial roles women play across agricultural food systems, from production to trade, and promote actions to close the gender gaps and improve women's livelihoods worldwide. And underscore that Women farmers are central to food security, nutrition, and economic resilience. At the global level, women make up a significant share of the world agriculture workforce and play a central role in household food security and nutrition. and supporting Sustainable Development Goal SDG 1, No Poverty; SDG 2, Zero Hunger; SDG 5, gender equality; SDG 8, decent work and economic growth, and SDG 10, Reduce Inequalities. In 2021 at global level, 40 percent of women workers were engaged in agriculture food system, equal to men. In India, the agriculture sector employs 46.1 percent workforce in 2023-24. share of women workforce make up to 64.4 per cent in 2023-24. Underscore women are vital in agriculture productive activities.(NSO, 2025; UN Women, 2025) However, women's roles and contributions remain undervalued and unrecognized. women faces issues at both levels. At the domestic level, women often serve as unpaid family workers. And at the farm level, working conditions are irregular, informal, part-time, low-paid or unpaid work, and labour-intensive, hence women are more vulnerable human assets. They continue to face systemic barriers, including limited access to land ownership, credit, technologies, education, extension services, and participation in decision-making at all levels, hindering agricultural productivity and inclusive growth. (Tutej, 2000 ;Panda et al., 2025)

The paper aims to analyse women's role and contribution in Inclusive and sustainable economic growth and gender Equity in Indian Agriculture in the vision of 'Vikshit Bharat' by 2027. In this light research paper seeks answer the

following research questions: 1. How do women contribute to inclusive and sustainable agriculture growth? 2. What are the barriers faced by women in achieving gender equity in agriculture? 3 What policy approach are necessary for women farmer in Viksit Bharat Vision 2047?

**Literature Review:**

(Aayushi et al., 2024) studied the contribution of women in the agriculture sector and highlights the significant role played by Indian women in socio-economic development and supporting family income through farming activities. The study concluded that women's participation in farming activities is crucial for rural development and gender empowerment.

(Her Circle NGO, 2025) examined the critical role of women in Indian agriculture. The study emphasizes their contribution to food security and the rural economy. According to a study, women prefer to engage in sustainable farming practices, which highlights their role in environmental conservation and biodiversity preservation. However, women face socio-economic barriers that place them in vulnerable conditions. The study emphasises that empowerment of women in agriculture demands a comprehensive, equitable approach by providing agriculture education, financial and legal rights, and resources. The study concludes that women's participation in agriculture is crucial for food security, environmental sustainability, and rural development.

Various studies have recognised the role played by women in agricultural activities and their contribution to food security, crop cultivation, preserving seeds, livestock, environmental protection, supporting household income, and rural and sustainable agriculture development. These studies also underscored the various barriers and disabilities faced by women in agricultural farm activities and highlighted policy reforms in rural women's empowerment. However, these reforms seem not align with long term vision of sustainable development goals and Indian long term vision of Viksit Bharat. The paper proposes an equitable approach for women's empowerment and gender justice aligned with the global sustainable development goals in the vision of Viksit Bharat by 2047.

**Objectives of research:**

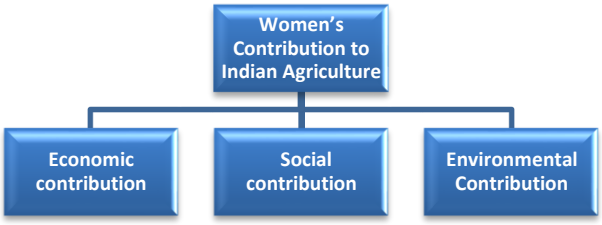
1. To examine the contribution to inclusive and sustainable agriculture growth in India
2. To study what are the barriers faced by women in achieving gender equity in agriculture
3. To provide a literature base for further study and policy approach are necessary for women farmer in Viksit Bharat Vision 2047?

**Research Methodology:**

The study is analytical in nature and is based on secondary data. Data is collected from various reputed sources, including government reports, NSO, NITI Aayog, UN Women, UNDP, FAO, research papers, and data various websites.

**Women's Contribution to Indian Agriculture**

**Figure 1: Women's Contribution in agriculture**




**Source: Author self**

**i. Economic Contribution:** The agriculture is the backbone of the Indian economy, playing a crucial role in national income and employment. The Agricultural sector supports about 46.1 percent of the population.(Ministry of Finance GOI, 2025). Women play a crucial role in

agricultural activities; the share of working women in agriculture employment is stand around 64.4 percent in 2023-24 (PLFS, 2025). Women contribute to food security and economic security, with many women acting as breadwinner in their households and supporting rural economy and contributing to reducing poverty.(Sidh & Basu, 2011).Women's role Farmer Producer Organizations (FPOs) empower rural women, promote gender equity, and enhance their economic independence, ultimately fostering sustainable agricultural and rural development.

**ii. Social Contribution:** Agriculture is a way of life in rural India. and women are backbone of agrarian economy. They form two third of agricultural workforce hence their role in farming activities is vital. Various studies have underscored their contribution in preserving agrobiodiversity, and regarded as true custodians of agrobiodiversity. Women's decision in selecting, conserving, and sharing seeds suited to local soils and climates. Their knowledge of indigenous crop varieties, wild edibles, and medicinal plants sustains food diversity and resilience. Women's decisions on what to plant and preserve are guided not just by yield, but by taste, aroma, ritual value, and household needs - ensuring that biodiversity flourishes in both the field and the kitchen. (Women Farmers: Custodians of agri heritage and agrobiodiversity)

**iii. Environmental Contribution:** Research suggests that women, including those in indigenous communities, can play a crucial role in environmental preservation. This is often achieved through their traditional knowledge and agricultural methods, which have been developed and refined over generations (Singh et al., 2023) Women play crucial roles in agriculture, managing various tasks from livestock to crop cultivation, that empowering women in agriculture is crucial for achieving gender equality, reducing poverty, and achieving sustainable development goals.(L G & N, 2024)

**Challenges and Barriers:**

Despite the vital role of women in farm activities, women are subject to various burdens and disabilities, as underscored by various studies**.** In India, the agriculture sector plays a dominant role in employment, with its share of 46.1 per cent in 2023-24. share of working women rising in agriculture employment, from 57.0 per cent in 2017-18 to 64.4 per cent in 2023-24; however, men's participation in agriculture decreased from 40.2 per cent to 36.3 per cent**.**(PLFS, 2025) As a result of agricultural crises, rural men had to seek other livelihood opportunities, causing them to migrate to urban areas in search of jobs, leaving women to do agricultural work, leading to the increasing feminization of agriculture. (MOSPI, 2025; Shukla et al., 2022; Mahendra Dev, 2012; Nair & Eapen, 2015; Padmaja et al., 2015). feminization in India is largely driven by out migration of men from rural areas.

However, increasing women's engagement in agricultural activities, it does not correlate with their socio-economic empowerment. Instead, this increasing trend is linked to poverty and may worsen the burden faced by rural women. And rural agriculture can be described as "feminization of agrarian distress " instead of "feminization of agriculture. (Pattnaik et al., 2018) Women face significant barriers such as limited access to productive resources, which hampers their productivity and recognition as active contributors (Subathra et al., 2021).According to Agriculture Census 2015-16, the percentage share of female operational holders is just 13.96% in 2015-16. The worst case is regarding SC and ST female grope, the share of female operational holders belonging to SC and ST social group were estimated at 11.4% and 7.9

% respectively (Min. of Agri. GOI, 2016). Recent FAO reports underscore the scale of gender inequality and the disproportionate climate risks faced by women. the reports highlight the structural barriers limiting women's productivity, income, access to resources, and resilience. Reducing gender disparities in employment, education, and income could eliminate 52 percent of the food insecurity gap which is consistently higher among women. The unpaid care work performed by women and girls contributes at least $ 10.8 trillion to the global economy annually.

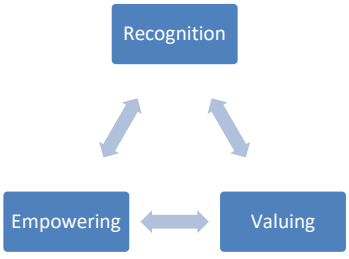
**Road map for gender empowerment and gender equity in agriculture:**

Approach to gender justice and equity can be achieved through following the **'RVM trinity approach'**

1. Recognition
2. Valuing
3. Empowering.

This approach is interlinked to each other and supports and promotes a virtuous circle of gender and social justice.

Figure. 2: 'RVM trinity approach'
1. Recognition 2. Valuing 3. Empowering




Source: Author self

**1. Recognition of women as farmers:**

Roadmap for gender equity in agriculture starts with defining the women farmers. According to the United Nations, "Women farmers work in diverse roles across agrifood systems and come from all backgrounds: young and older women, Indigenous women, women in local communities, women with disabilities, and refugee and displaced women. They are smallholder producers, peasants, agricultural labourers, fishers and fish workers, beekeepers, pastoralists, processors, traders, women in agricultural sciences, rural entrepreneurs, traditional knowledge holders, and more—whether in formal or informal work, with or without land ownership." ( Food and Agriculture Organization of the United Nations) However, in the Indian contest the definition of an Indian woman farmer is not given. Defining who a woman farmer is can help agencies and governments to formulate new policies that include equity and general justice. It is now important to examine gender norms that affect the recognition of women as legitimate farmers. UN declared 2026 International Year of the Woman Farmer 2026 to accelerate gender equality and women's empowerment in agrifood systems. To define who is a woman farmer is, understanding the status of women is crucial. According to UN women recognition of the status of women starts with gender equity. UN Women organisation highlights that "Gender equality is not only a basic human right, but its achievement has enormous socio-economic ramifications. Empowering women fuels thriving economies, spurring productivity and growth. (About UN Women | UN Women – Headquarters)

**2. Valuing economic and social rights of women:**

Another crucial aspect of gender equity is valuing unpaid work and the economic and social rights of women. In India, when calculating national income, the government does not calculate the unpaid contributions made by women at the household and farm level activities. This is against the principle of natural justice by equal pay for equal work. Women often are paid less or are unpaid for their valuable contributions to farm-level activities. There is a need gender

based reforms to give women equal rights to economic resources; ownership and control over land, property, credit, technology, and natural resources. Women's integration in agricultural value chains and valuing their role and contribution entails gender equity.

**3. Empowering Women:**

UN Women defines 'economic empowerment as a transformative, collective process through which economic systems become just, equitable and prosperous, and through which all women enjoy their economic and social rights, exercise agency and power in ways that challenge inequalities and level the playing field and gain equal rights and access to ownership of and control over resources, assets, income, time and their own lives.'(UN Women, 2024). Women's empowerment is, therefore, a dynamic, multi-dimensional process, which enables women to realise and execute their potential and powers in all spheres of life. (Anirban Mukherjee et al., 2020). Economic and social transformation of society in favour of gender equity must align with global sustainable development goals, Gender mainstreaming in NITI Aayog's Viksit Bharat vision, and national priorities

However, this approach of gender justice equity must be supported by monitoring and evaluation at local, national, and international levels. Data and statistics are vital for devising evidence-based policies and programmes on gender equality and women's empowerment.

**Conclusion:**

Women are Central to Inclusive and sustainable agriculture and rural development. An Indian vision of a developed India by 2047 cannot be possible without gender equitable, resilient, and inclusive policy reforms and gender sensitive approach. Institutional mechanisms, gender statistics, and data are essential for future courses of empowerment of women in agriculture. Indian agriculture must align gender equity with sustainable development goal. The United Nations already declared 2026 as the International Year of Women Farmers to get more vision of women's contributions in this field. We need to devise new policy reforms and a strategy for this.

The paper suggests a new, broad approach to gender justice in the agriculture sector. Future research should focus on the impact of climate change on gender equity, as India is one of the 6 most vulnerable countries in the world, warned by climate risk Index, 2025. The FAO report also underscored women farmers' vulnerability due to climate extremes. The study concludes that Women play a crucial role in agriculture and participate in diverse farm activities. The study suggest RVM trinity approach: Recognition, Valuing, and Empowering women in the agricultural sector. Recognition of women as a farmer help to value their role in agricultural productivity and rural development. Valuing their contribution entails the right to productive resources, including access and ownership of land, credit, decision making, and finally social and economic independence, which in turn leads to gender equity and women's empowerment.

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# Green Entrepreneurship and Sustainable Business Models for India 2047: A Systematic Literature Review

**Dr. S. Mariadoss**

*Principal & Associate Professor of Commerce,*
*St. Joseph's College (Autonomous), Tiruchirappalli-2.*
*Affiliated to Bharathidasan University, Trichy, India.*
***Corresponding Author – Dr. S. Mariadoss***

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***Abstract:***

*India's "Viksit Bharat 2047" ambition demands rapid scaling of climate-resilient industries, circular production systems, and inclusive green jobs. Green entrepreneurship—venture creation that deliberately addresses environmental problems while building viable markets—has emerged as a key mechanism to accelerate this transition. This systematic literature review synthesizes scholarship on (i) green and sustainable entrepreneurship, (ii) sustainable and circular business model innovation, and (iii) ecosystem and policy enablers relevant to India's pathway to 2047. Using a protocol-driven search of peer-reviewed articles and high-quality policy reports, we develop an integrated framework linking opportunity sources (market failures, resource constraints), business model archetypes (sustainable and circular patterns), financing and scaling mechanisms, and India-specific institutional conditions. Findings indicate that green ventures scale fastest when business models simultaneously deliver (a) compelling customer value, (b) measurable environmental outcomes, and (c) ecosystem alignment across policy, finance, supply chains, and demand creation. The review concludes with a future research agenda and practical implications for entrepreneurs, investors, and policymakers targeting India 2047.*

***Keywords: green entrepreneurship, sustainable entrepreneurship, sustainable business models, circular economy, India 2047, Viksit Bharat, MSMEs, green finance, business model innovation***

## Introduction:

India's development trajectory toward 2047 will be shaped by the ability to grow the economy while reducing carbon intensity, lowering material and water footprints, and creating durable jobs. Recent policy and research narratives around "Viksit Bharat" emphasize innovation and entrepreneurship as central levers, including within a broader green economy transition. The economic potential is substantial: evidence suggests that a green economy could unlock large market value and employment by 2047 if India scales cleaner energy systems, circular production, and nature-positive industries.

Green entrepreneurship matters because it converts sustainability challenges into opportunity spaces—new markets, new technologies, and new business models. Yet, success is not guaranteed: many green ventures struggle to scale due to higher upfront costs, uncertain demand, weak ecosystem coordination, and financing gaps. This review synthesizes the literature to answer a single guiding question:

How can green entrepreneurship and sustainable business models be designed and supported to accelerate India's green transition by 2047?

**Methodology: Systematic Review Protocol:**

This paper follows a systematic literature review (SLR) logic: transparent search strategy, screening rules, thematic synthesis, and structured reporting.

**1.Search Strategy:** A keyword-based search was conducted across major academic databases and scholarly search engines (e.g., Google Scholar) using combinations of:

- "green entrepreneurship", "sustainable entrepreneurship", "ecopreneurship"
- "sustainable business model", "business model innovation", "circular business model"
- "India", "emerging economy", "MSME", "policy", "green finance", "circular economy"

To anchor business model synthesis, foundational works on sustainable entrepreneurship and sustainable business model archetypes were included.

**2.Inclusion and Exclusion Criteria:** Included sources:

- Peer-reviewed journal articles and high-quality institutional reports
- Conceptual frameworks and empirical studies relevant to green/sustainable entrepreneurship and sustainable/circular business models
- Policy/market evidence informing India's 2047 green economy pathway Excluded sources:
- Non-verifiable opinion pieces, non-scholarly blogs, and low-quality repositories
- Papers not connected to entrepreneurship/business models or not relevant to sustainability outcomes

**3.Data Extraction and Synthesis:** For each included source, the review extracted: definitions, key constructs, mechanisms, business model types, enablers/barriers, and implications for scaling in emerging-economy contexts. Synthesis used thematic coding across four clusters:

1. Conceptual foundations of green/sustainable entrepreneurship
2. sustainable and circular business model archetypes
3. scaling and financing mechanisms
4. India 2047 ecosystem and policy alignment

**Limitation note:** Because full database export tools (e.g., Scopus/WoS bulk metadata) were not available in this writing environment, this SLR emphasizes **conceptual and thematic integration** with transparent source grounding, rather than reporting PRISMA counts.

**Conceptual Foundations:**

**1.Defining green and sustainable entrepreneurship:** The entrepreneurship literature argues that environmental degradation often reflects *market failures*—unpriced externalities, information gaps, and weak property rights—creating opportunities for entrepreneurs to innovate solutions that reduce harm while generating value. This framing positions green entrepreneurship as opportunity-driven: ventures arise because sustainability problems produce inefficiencies and unmet needs that can be served through innovation.

Sustainable entrepreneurship is also conceptualized in relation to broader sustainability innovation—spanning new entrants, incumbents, and institutional change. Schaltegger and colleagues propose that sustainable entrepreneurship can be understood as entrepreneurial action embedded within sustainability innovation systems, including social and institutional entrepreneurship that shifts market contexts and norms.

**2.Who drives sustainability transitions: startups vs incumbents:** Transition theory suggests a dynamic interplay: new entrants ("emerging Davids") frequently pioneer sustainability opportunities early, while incumbents ("greening Goliaths") respond later through corporate sustainable entrepreneurship as

markets shift and legitimacy grows. For India 2047, this implies that policy should not only fund startups, but also accelerate diffusion via incumbent supply chains, procurement, standards, and platform ecosystems.

**Sustainable Business Models as the Scaling Engine:**

A consistent finding across the literature is that green ventures do not scale on technology alone—they scale when **the business model** aligns customer value creation with sustainability outcomes and ecosystem feasibility.

**1.Sustainable business model archetypes:** Bocken et al. synthesize sustainable business model innovation into archetypes that help firms move from fragmented sustainability ideas toward structured model redesign. These archetypes (e.g., maximizing resource efficiency, substituting with renewables, delivering functionality rather than ownership, adopting stewardship, encouraging sufficiency) matter because they translate sustainability goals into repeatable "patterns" entrepreneurs can implement.

**2.Circular business models and Resolve:** Circular economy approaches operationalize sustainability via closed loops and system redesign. The ReSOLVE framework (Regenerate, Share, Optimise, Loop, Virtualise, Exchange) offers practical actions for circular transformation and has become widely used in circular business model work. For green entrepreneurs, circularity expands value capture beyond "selling products" into services (repair/refurbish), platforms (sharing), data-enabled optimization, and reverse logistics.

**Thematic Findings:**

**Theme 1: Opportunity sources for green entrepreneurship:** The reviewed literature converges on four opportunity sources:

1. **Market failures** (externalities) creating demand for low-carbon, low-waste alternatives
2. **Resource constraints** (energy, water, materials) favoring efficiency and circularity
3. **Policy and regulation** (standards, taxes, compliance) reshaping markets **Cultural/consumer shifts** toward responsible consumption (especially in urban youth markets)

**Interpretation for India 2047:** India's transition pressures (energy security, air quality, water stress, waste) can become structured venture opportunity spaces—but only when policy signals, market infrastructure, and financing lower scaling friction.

**Theme 2: Business model patterns that repeatedly work:** Across sustainable and circular business model literature, scalable green ventures commonly use one or more of these patterns:

- **Product-to-service systems** (pay-per-use, performance contracting) to reduce resource throughput while improving affordability
- **Circular value loops** (repair, refurbish, remanufacture, resale) aligned with ReSOLVE actions
- **Platform and aggregation models** (waste-to-value marketplaces, shared mobility, B2B waste sourcing)
- **Nature-positive and bio-based models** (regenerative agriculture, bio-inputs, biomass valorization)
- **Energy transition models** (distributed renewables, storage, efficiency-as-a-service)

**Interpretation:** Sustainable business model archetypes provide a "design vocabulary" for entrepreneurs—helping them move from "green intent" to implementable models with clear revenue logic and measurable impact.

**Theme 3: Financing and scaling constraints:** Green ventures often face a "valley of death": technology risk plus market adoption risk plus

infrastructure dependence. This is reinforced in green business model and green entrepreneurship syntheses, which highlight the importance of diversified finance (public support, blended finance, early customer contracts, venture capital, and partnerships) to bridge early-stage constraints.

Additionally, diffusion requires ecosystem readiness: supply chains, standards, verification, logistics, and demand creation (procurement, offtake contracts).

**Interpretation for India:** Green entrepreneurship at scale requires not just "more startups" but stronger **market-making institutions**—standards, measurement frameworks, green public procurement, and investment de-risking.

**Theme 4: India 2047 pathway and ecosystem alignment:** Policy-oriented work on India's 2047 vision repeatedly emphasizes innovation and entrepreneurship as drivers of development, alongside a green economy transition. Evidence-based national and think-tank narratives argue that India can unlock major green-economy market value and jobs if it scales circular production models and cleaner energy systems. This aligns with the entrepreneurship transition literature: startups can pioneer solutions, but large-scale outcomes require incumbents and institutions to co-evolve.

**Integrated Framework: Green Entrepreneurship for India 2047:**

Based on the synthesis, this review proposes an integrated framework with four linked layers:

1. **Opportunity Drivers:** market failures, resource stress, policy signals, consumer shifts **Business Model Design:** sustainable business model archetypes + circular ReSOLVE actions **Scaling Mechanisms:** partnerships with incumbents, platform ecosystems, procurement/offtake, standards, digital monitoring
2. **Finance + Governance:** blended finance, green credit enhancements, impact metrics, carbon/material accounting, transparent reporting

**Core proposition:** *Green ventures scale when business model design is matched with ecosystem readiness and finance de-risking—not merely when technology is "green."*

**Research Gaps and Future Research Agenda (India-Focused):**

1. **India-specific evidence on green venture scaling:** More longitudinal studies on why some Indian green ventures scale and others stall (infrastructure, procurement, regulation).
2. **Business model–impact measurement linkage:** Clear methods connecting revenue mechanisms to verified environmental outcomes (emissions, water, materials).
3. **MSME circular transition models:** Sustainable business model innovation in MSMEs remains under-measured despite massive aggregate impact.
4. **Incumbent–startup transition partnerships:** More empirical work on how "greening Goliaths" partner with startups in India to accelerate diffusion.
5. **Consumer adoption and willingness-to-pay:** Especially for circular/refurbished products and service models in Indian markets.

**Managerial and Policy Implications:**

**For entrepreneurs:**

- Choose a **repeatable business model archetype** early and quantify both customer value and sustainability impact.
- Use circular actions (repair/refurbish/reuse) to lower costs and increase accessibility (especially for price-sensitive segments).

- Build ecosystem partnerships (municipal bodies, incumbents, aggregators) to overcome infrastructure dependence.

**For investors:**

- Evaluate green ventures not only on "green narrative" but on **business model fit**, unit economics, and impact verifiability.
- Support blended finance structures and offtake contracts to de-risk adoption.

**For policymakers (India 2047);**

- Accelerate green entrepreneurship via standards, verification, market access, and procurement—not just incubators.
- Create transition pipelines that connect startups to incumbents for diffusion, consistent with sustainability transition theory.

**Conclusion:**

This systematic review demonstrates that green entrepreneurship is central to India's 2047 ambitions because it transforms sustainability constraints into scalable market solutions. However, scalable impact depends on sustainable business model innovation, particularly archetype-based design and circular economy actions, supported by ecosystem alignment and de-risked finance. The literature suggests India can unlock significant green-economy value and jobs by 2047, but only if entrepreneurship policy shifts from "startup creation" to "market creation"—standards, procurement, infrastructure, and investment pipelines that help proven models scale nationally.

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