

THE FUTURE OF MULTIDISCIPLINARY RESEARCH IN GLOBAL DEVELOPMENT



Editors

Dr.E.Joseph Rubert

Dr.Neeta Baglari

Dr.S.Valli Devasena

Ms.L.N.Arthi

Dr.X.Maria Muthu Shanthini

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Dr.E.Joseph Rubert

Professor & Head, Department of Management Studies
Arunachala College of Engineering for Women, Tamilnadu,,

Dr. Neeta Baglari

Assistant Professor, Department of Education
Cotton University, Guwahati

Dr.S.Valli Devasena

Assistant Professor
Department of Commerce
Research and Extension Centre
Mother Teresa Women's University, Madurai

Ms.L.N.Arthi

Assistant Professor
Department of Management Studies
Arunachala College of Engineering for Women,Tamilnadu

Dr.X.Maria Muthu Shanthini

Assistant Professor
Department of Commerce
Holy Cross College (Autonomous),Tamilnadu



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PERFACE

The world is facing complex and interconnected challenges that demand holistic and innovative solutions. Climate change, poverty, inequality, health crises, and technological advancements intersect in ways that transcend traditional academic and professional boundaries. Addressing these global issues requires a multidisciplinary approach—one that fosters collaboration among diverse fields, integrates knowledge from various disciplines, and promotes innovative research methodologies. *The Future of Multidisciplinary Research in Global Development* explores the evolving landscape of research that bridges the social sciences, natural sciences, engineering, health sciences, and humanities. This book brings together experts and thought leaders who offer insights into how multidisciplinary collaboration can drive meaningful progress toward sustainable development, policy innovations, and transformative solutions. Through an examination of case studies, theoretical frameworks, and emerging methodologies, this volume highlights the necessity of breaking down silos in academia and beyond. It underscores the importance of cross-sector partnerships, the role of technology in fostering collaboration, and the ethical considerations in conducting multidisciplinary research. The challenges facing the world today are increasingly complex, interconnected, and urgent. From climate change and global health crises to poverty, inequality, and technological disruption, these issues cannot be effectively addressed through isolated disciplinary approaches. The need for multidisciplinary research in global development has never been greater. By integrating diverse perspectives, methodologies, and expertise, multidisciplinary collaboration has the potential to generate innovative solutions that transcend traditional academic and professional boundaries. Technology and innovation also play a crucial role in shaping the future of multidisciplinary research. With the rapid advancement of artificial intelligence, big data, and digital collaboration tools, researchers now have unprecedented opportunities to integrate diverse knowledge systems and co-create solutions with stakeholders across the globe. This book explores how digital transformations can enhance multidisciplinary research while also considering the risks and ethical dilemmas associated with emerging technologies. Ultimately, *The Future of Multidisciplinary Research in Global Development* aims to serve as a catalyst for further discussion, inquiry, and action. It is intended for researchers, educators, policymakers, and development practitioners who are committed to fostering collaborative, innovative, and impactful research. By embracing multidisciplinary approaches, we can move toward a more inclusive, resilient, and sustainable world—one where knowledge is not constrained by disciplinary boundaries but instead mobilized for the collective good. We invite readers to engage with the ideas presented in this book, to critically reflect on their own research practices, and to contribute to the growing movement of multidisciplinary collaboration in global development. We hope this volume inspires new conversations, partnerships, and breakthroughs in the pursuit of a better future for all.

Editors

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Digital Transformation and AI-Driven Management in Global Development

Dr.B.R.Kumar

Professor & Director, Department of MBA
Andhra Loyola College, Vijayawada

Abstract

In an era of rapid technological advancement, digital transformation and artificial intelligence (AI) are reshaping global development strategies. This chapter explores the intersection of AI, big data, and digital innovation in optimizing management approaches for sustainable development. By integrating AI-driven decision-making, smart governance, and predictive analytics, organizations can enhance efficiency, resource allocation, and policy implementation. The chapter highlights case studies demonstrating the successful application of AI in development sectors such as healthcare, education, environmental sustainability, and economic growth. Challenges, including ethical considerations, data privacy, and digital inclusivity, are also discussed. The chapter concludes with recommendations for harnessing digital transformation to create resilient, equitable, and impactful development initiatives.

Keywords: Digital Transformation, Artificial Intelligence, Big Data, Sustainable Development

Introduction

The digital age has introduced transformative opportunities for global development. AI, machine learning, and data analytics are revolutionizing decision-making, allowing governments, businesses, and NGOs to enhance resource management, optimize operations, and predict future trends. However, the integration of these technologies also presents challenges, including ethical concerns, security risks, and disparities in access. This chapter explores digital transformation in development management, emphasizing AI-driven solutions and their implications for sustainable progress.

1.The Role of AI and Digital Transformation in Development Management

1.1.Enhancing Decision-Making with AI and Data Analytics

AI-powered analytics allow for more accurate decision-making by identifying patterns and forecasting trends. Governments and development agencies use machine learning models to predict economic shifts, optimize supply chains, and address social challenges. AI-driven early warning systems help in disaster risk reduction by analyzing meteorological and geological data, enabling proactive responses to crises such as floods and earthquakes.

1.2.Smart Governance and Policy Implementation

Digital governance, powered by AI, enables policymakers to create more responsive, transparent, and efficient systems. E-Government platforms streamline public services, reducing bureaucratic inefficiencies. AI-powered chatbots assist citizens in accessing government services, while blockchain technology enhances transparency in public spending. Countries like Estonia have successfully implemented digital governance, demonstrating the potential for AI to revolutionize public administration.

1.3. AI in Economic Development and Financial Inclusion

Digital finance solutions, including AI-driven credit scoring and mobile banking, expand financial inclusion in underserved regions. AI assesses creditworthiness by analyzing alternative data, such as mobile payment histories and online transactions. Microfinance institutions leverage AI to extend loans to entrepreneurs in developing economies, fostering economic growth. Additionally, blockchain-based digital identities empower individuals without traditional banking access, enabling their participation in the global economy.

1.4. Transforming Healthcare with AI and Telemedicine

AI has revolutionized healthcare delivery, particularly in remote and underserved areas. AI-powered diagnostic tools analyze medical imaging and patient data, providing early detection of diseases such as tuberculosis and cancer. Telemedicine platforms use AI chatbots and remote monitoring devices to connect patients with healthcare professionals, improving access to medical services. During the COVID-19 pandemic, AI-assisted tools played a crucial role in tracking virus spread, managing hospital resources, and accelerating vaccine development.

1.5. Sustainable Development through AI and IoT

The integration of AI with the Internet of Things (IoT) has enabled smart environmental management. AI-driven systems monitor deforestation, track air and water quality, and optimize agricultural practices. Precision farming, supported by AI-powered drones and sensors, helps farmers maximize yields while minimizing environmental impact. Additionally, AI aids in energy optimization by managing smart grids, reducing carbon footprints, and promoting renewable energy adoption.

1.6. AI in Education and Skill Development

AI-driven personalized learning platforms tailor educational experiences to individual student needs, enhancing learning outcomes. AI chatbots assist students with tutoring, while adaptive learning algorithms identify gaps in knowledge and suggest targeted lessons. Online platforms provide AI-powered job-matching services, connecting individuals with relevant employment opportunities and addressing skill gaps in the workforce.

2. Challenges in AI-Driven Global Development

2.1. Ethical Considerations and Bias in AI

AI systems can inadvertently perpetuate biases present in their training data. Discriminatory algorithms in hiring, lending, and law enforcement raise concerns about fairness and equity. Ensuring AI ethics involves addressing bias, implementing transparent AI governance, and establishing regulatory frameworks that prevent misuse.

2.2. Data Privacy and Security Risks

The collection and use of vast amounts of data raise concerns about privacy and cybersecurity. Unauthorized data access, identity theft, and surveillance risks require robust data protection measures. Policies such as the General Data Protection Regulation (GDPR) set legal standards for data privacy, ensuring user rights and secure data handling.

2.3. Digital Divide and Accessibility Issues

AI and digital transformation risk exacerbating existing inequalities if access to technology remains uneven. Many developing regions lack reliable internet connectivity, affordable smart devices, and digital literacy programs. Bridging the digital divide requires infrastructure investments, education initiatives, and inclusive policies that ensure marginalized communities benefit from AI-driven development.

2.4. Ethical AI and Human Oversight

While AI enhances efficiency, human oversight remains essential to ethical decision-making. Autonomous systems must be complemented by human judgment to ensure accountability, cultural sensitivity, and alignment with societal values. Policies should establish clear guidelines for AI usage, ensuring responsible implementation in development projects.

3. Case Studies: AI in Action for Global Development

3.1. AI for Disaster Risk Reduction: Predicting and Preventing Crises

The United Nations and other global organizations are increasingly leveraging AI-driven predictive analytics to anticipate and mitigate humanitarian crises. AI-powered mapping tools analyze vast amounts of satellite imagery and real-time weather data, helping to detect early warning signs of climate risks such as hurricanes, droughts, and wildfires. By identifying patterns in environmental changes, these AI systems enable timely disaster response planning, minimizing loss of life and property.

One notable implementation of AI in disaster risk reduction is AI-driven flood prediction models in South Asia. These models utilize machine learning algorithms to process meteorological data, river levels, and historical flooding trends to predict floods with high accuracy. This has allowed governments and humanitarian organizations to issue timely evacuation warnings and allocate emergency resources efficiently. By integrating AI into disaster preparedness, vulnerable communities can enhance resilience and mitigate the devastating effects of natural calamities.

3.2. AI in Agriculture: Smart Farming in Africa

Agriculture in Africa faces numerous challenges, including unpredictable weather patterns, poor soil quality, and pest infestations. AI-powered platforms are transforming farming by providing real-time data insights that help farmers optimize crop production. These platforms use machine learning to analyze weather forecasts, assess soil health, and detect pest outbreaks, enabling farmers to take proactive measures to safeguard their yields.

A key example is IBM's Watson Decision Platform, which integrates AI and IoT (Internet of Things) sensors to deliver precision agriculture solutions. These technologies provide farmers with data-driven recommendations on irrigation schedules, fertilizer use, and pest control strategies. Additionally, mobile applications equipped with AI-generated advice are helping smallholder farmers improve productivity, enhance food security, and increase economic stability. By harnessing AI, African agriculture is becoming more resilient to climate change and resource constraints.

3.3.AI-Powered Health Diagnostics: Revolutionizing Medical Access

AI-driven diagnostic tools are revolutionizing healthcare accessibility, particularly in resource-limited regions. In India, AI-powered solutions developed by organizations like Qure.ai have significantly improved early disease detection and treatment efficiency. These AI models analyze chest X-rays with high precision to identify tuberculosis (TB), one of the country's leading public health challenges. Traditionally, TB diagnosis requires skilled radiologists, but AI algorithms can rapidly process X-ray images and detect abnormalities within seconds. This has accelerated early detection, reduced diagnostic costs, and expanded healthcare reach to remote and underserved populations. AI-based diagnostics are not only enhancing disease screening but also addressing shortages of healthcare professionals, ultimately improving public health outcomes in developing nations.

3.4.AI for Financial Inclusion: Mobile Banking in Kenya

AI is playing a transformative role in expanding financial inclusion in Kenya through mobile banking solutions like M-Pesa. M-Pesa, operated by Safaricom, uses AI-driven fraud detection systems and credit scoring models to provide secure and accessible banking services to millions of people, including those without traditional banking infrastructure. By leveraging AI, M-Pesa assesses transaction patterns to prevent fraud and detect suspicious activities in real-time. Additionally, AI-based credit scoring enables users with no formal credit history to access microloans, empowering small businesses and individuals to grow financially. The success of M-Pesa has demonstrated how AI can bridge the financial gap in developing economies, promoting entrepreneurship, reducing poverty, and fostering economic inclusion. Through innovative AI applications in disaster response, agriculture, healthcare, and finance, developing regions are witnessing transformative changes that enhance resilience, economic stability, and quality of life. AI's potential to solve global challenges continues to expand, offering a promising future for sustainable development.

4.Future Directions and Recommendations

4.1.Developing Ethical AI Frameworks

As artificial intelligence (AI) continues to shape various aspects of society, governments and international organizations must establish ethical AI frameworks to ensure responsible development and deployment. Ethical AI should prioritize fairness, accountability, and transparency, preventing biases that could lead to discrimination or social harm. Without proper governance, AI systems can reinforce existing inequalities, compromise privacy, and lack clear mechanisms for accountability. One key aspect of ethical AI governance is conducting independent audits of AI algorithms. These audits help identify biases, assess decision-making transparency, and ensure compliance with ethical guidelines. Furthermore, promoting open-source AI models allows researchers and developers to scrutinize algorithms for biases and inefficiencies, fostering greater public trust. Another crucial element is stakeholder engagement in AI policymaking. Policymakers, industry leaders, academic experts, and civil society representatives should collaborate to create AI regulations that reflect diverse perspectives and safeguard human rights. By establishing robust ethical frameworks, governments can ensure AI serves humanity in a fair and equitable manner.

4.2. Investing in Digital Infrastructure and Literacy

Closing the digital divide is essential to ensuring that AI-driven advancements benefit all segments of society. Many populations, particularly in developing regions, lack access to the internet, digital devices, and technical education, limiting their ability to leverage AI-powered opportunities. Investing in digital infrastructure, affordable smart devices, and digital literacy programs is crucial for fostering inclusive AI adoption.

Public-private partnerships can play a key role in expanding internet access, especially in rural and underserved areas. Governments and technology companies should collaborate to develop broadband networks, satellite internet services, and community Wi-Fi hubs to provide widespread connectivity. Beyond infrastructure, enhancing digital literacy is vital to equipping individuals with the skills needed to engage with AI technologies. Educational programs should focus on basic digital skills, AI literacy, and cybersecurity awareness, enabling people to navigate AI-driven platforms safely and effectively. Schools, universities, and vocational training centers should incorporate AI education into curricula to prepare the workforce for the future.

By prioritizing digital inclusion, societies can ensure equitable access to AI's benefits and prevent further disparities in economic and social development.

4.3. Encouraging Cross-Sector Collaboration

AI development and deployment require collaboration among governments, academia, industry, and civil society to maximize its potential while addressing ethical concerns. No single sector can fully harness AI's capabilities or mitigate its risks alone. Multidisciplinary research, policy coordination, and joint initiatives are essential for aligning AI solutions with societal needs.

Governments play a critical role in setting regulatory frameworks, funding AI research, and ensuring AI aligns with public interests. Academia contributes by conducting research on AI ethics, innovation, and policy implications. Industry leaders drive technological advancements and commercial applications, while civil society organizations advocate for AI policies that protect human rights and social equity.

Collaborative efforts such as public-private partnerships, AI think tanks, and global AI summits help build a shared vision for responsible AI adoption. By fostering an ecosystem of cooperation, AI can be developed in ways that prioritize human well-being, economic growth, and sustainable innovation.

4.4. Strengthening AI Regulation and Cybersecurity Measures

As AI systems become more sophisticated, regulatory frameworks must evolve to protect users, prevent misuse, and address cybersecurity risks. AI-powered technologies collect vast amounts of personal data, raising concerns about privacy, data security, and surveillance. Without strong regulations, AI can be exploited for unethical purposes, such as mass surveillance, misinformation campaigns, or cyberattacks. Policymakers must implement stringent data protection laws to safeguard user privacy. Regulations such as GDPR (General Data Protection Regulation) in Europe set strong precedents for AI governance, requiring

companies to ensure transparency, accountability, and user consent in data processing. Similar frameworks should be adopted globally to standardize AI ethics and security practices.

Additionally, cybersecurity measures must be reinforced to prevent AI-driven cyber threats. AI can be used to detect and neutralize cyberattacks, but it can also be exploited for hacking, deepfake creation, and automated misinformation. Governments and tech firms should collaborate on AI-driven cybersecurity defenses, including real-time threat detection systems, AI-enhanced encryption techniques, and AI audit mechanisms. By enforcing responsible AI regulations and strengthening cybersecurity infrastructure, societies can maximize AI's benefits while minimizing risks, ensuring AI remains a force for good rather than a tool for harm.

Conclusion

AI and digital transformation present immense opportunities for sustainable global development. By integrating AI into governance, healthcare, finance, education, and environmental management, organizations can drive efficiency and impact. Addressing ethical concerns, ensuring equitable access, and implementing responsible AI governance are crucial for maximizing benefits while mitigating risks. Through a collaborative, ethical, and inclusive approach, AI can serve as a powerful tool for advancing sustainable development goals and fostering a more resilient and equitable world.

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Multidisciplinary Research in Global Development Finance: Emerging Trends and Innovations**Dr. Ananthaneni Madhuri**

Assistant Professor, Department of MBA

Andhra Loyola College, Vijayawada

Abstract

Multidisciplinary research in global development finance is reshaping economic growth, poverty reduction, and financial inclusion. This chapter explores the convergence of finance, technology, policy, and sustainability in driving global development. It examines financial innovations, including AI-driven analytics, blockchain-based solutions, and green investments, while also discussing financial inclusion models and policy frameworks fostering sustainable investments. Additionally, it addresses critical challenges such as regulatory barriers, cybersecurity threats, and financial literacy gaps, offering recommendations to create a resilient, inclusive financial ecosystem.

Keywords: Global Development Finance, Multidisciplinary Research, Financial Inclusion, Sustainable Investment, Fintech Innovation

Introduction

The rapid evolution of global development finance has significantly contributed to bridging economic disparities, promoting sustainability, and advancing financial inclusivity. The intersection of finance with technology, environmental science, policy, and behavioural economics has facilitated innovations that are transforming the financial sector. By leveraging digital finance, AI-driven financial analytics, green investment mechanisms, and inclusive banking models, global finance has entered a new era of efficiency and accessibility.

1. Emerging Trends in Global Development Finance**1.1. Fintech and Digital Financial Inclusion**

The rise of financial technology (fintech) has transformed the global financial landscape, providing new pathways for financial inclusion in underserved regions. Digital banking platforms, blockchain-based transactions, and AI-driven credit assessments have empowered millions worldwide by increasing access to financial services. For instance, M-Pesa, a mobile money service in Kenya, has successfully integrated digital banking with financial inclusion, allowing individuals without traditional bank accounts to perform transactions efficiently. Similarly, India's Aadhaar-linked financial services have facilitated direct benefit transfers, reducing financial exclusion among marginalized communities. The adoption of digital payment solutions has significantly improved financial accessibility, enabling previously unbanked individuals to engage in economic activities.

1.2. Sustainable Finance and ESG Investments

Environmental, Social, and Governance (ESG) investments are increasingly shaping the global financial ecosystem, aligning capital flows with sustainable development goals (SDGs). Investors are prioritizing sustainable financial models, with instruments such as green bonds, impact investing, and climate finance driving capital allocation towards

environmentally friendly and socially responsible projects. Governments and financial institutions are collaborating to incentivize sustainable investments. For example, the European Union's Green Bond Standard (EU GBS) ensures that green bonds adhere to strict sustainability criteria, fostering investor confidence. Multidisciplinary research has played a critical role in designing regulatory frameworks that promote sustainability while balancing financial returns.

1.3. AI and Big Data in Financial Decision-Making

Artificial intelligence (AI) and big data analytics are revolutionizing global finance by enhancing risk assessment, fraud detection, and investment strategies. Machine learning algorithms allow financial institutions to predict market trends, assess credit risks, and automate portfolio management. AI-powered chatbots and robo-advisors have improved customer interactions, offering personalized financial guidance while reducing operational costs. In India, AI-driven credit scoring mechanisms analyze alternative data sources, such as mobile payment histories and social media activity, enabling financial institutions to extend credit to previously unbanked populations. These advancements have increased financial literacy and decision-making efficiency.

1.4. Blockchain and Decentralized Finance (DeFi)

Blockchain technology is reshaping traditional banking structures through decentralized finance (DeFi) solutions. By eliminating intermediaries, blockchain enhances transaction transparency, reduces costs, and enables peer-to-peer lending. Smart contracts facilitate secure and efficient financial transactions, particularly in cross-border remittances and trade finance.

For example, RippleNet's blockchain-based payment network has improved remittance efficiency, reducing transaction fees and processing times for international money transfers. These developments are fostering a more inclusive and decentralized financial system.

1.5. Microfinance and Social Impact Financing

Microfinance institutions have played a pivotal role in providing small-scale financial services to low-income entrepreneurs. Innovative financing models such as crowdfunding, peer-to-peer lending, and social impact bonds have expanded access to capital for small businesses and community-driven projects. For instance, Kiva, a global microfinance platform, enables individuals to lend money to entrepreneurs in developing countries, facilitating financial independence and economic empowerment. These models have proven effective in fostering financial inclusion and social development.

2. Challenges in Global Development Finance

2.1. Regulatory and Compliance Barriers

The rapid evolution of financial technologies has significantly outpaced the development of regulatory frameworks, creating numerous challenges in ensuring compliance and preventing financial crimes. The rise of digital payment platforms, cryptocurrency markets, and AI-driven financial services has made it difficult for existing regulations to keep up with the

changing landscape. This lag in regulatory adaptation can lead to gaps in oversight, increasing risks of fraud, money laundering, and systemic financial instability.

To address these challenges, regulatory authorities must collaborate closely with financial institutions and fintech companies to establish adaptive policies. A proactive regulatory approach, characterized by flexible and evolving guidelines, can help balance innovation with financial stability. Regulatory sandboxes, for example, allow fintech startups to test new solutions under the supervision of regulators, ensuring compliance without stifling technological advancement. Furthermore, global cooperation among financial regulators is crucial to managing cross-border financial activities and preventing regulatory arbitrage.

2.2. Cybersecurity and Data Privacy Risks

The increasing digitalization of financial services has made cybersecurity and data privacy critical concerns. With the growing reliance on online banking, digital wallets, and blockchain transactions, financial institutions are becoming prime targets for cyberattacks, data breaches, and fraud. Cyber threats such as phishing, ransomware, and hacking incidents can lead to significant financial losses and erode consumer trust in digital finance. To mitigate these risks, strengthening cybersecurity infrastructure is essential. Financial institutions must invest in robust encryption technologies, multi-factor authentication, and real-time threat detection systems. Additionally, educating consumers and financial professionals about cybersecurity best practices can enhance digital literacy and reduce vulnerabilities. Governments and financial regulators should enforce stringent data protection laws to safeguard sensitive financial information and ensure that organizations comply with industry security standards.

2.3. Financial Literacy and Digital Divide

A lack of financial literacy and limited digital access pose significant barriers to the widespread adoption of modern financial solutions, particularly in low-income and rural communities. Without adequate knowledge of digital financial products, individuals may struggle to use banking apps, mobile payments, and investment platforms effectively. This digital divide exacerbates economic disparities and limits financial inclusion efforts. Investments in financial education and digital infrastructure are necessary to bridge this gap. Public and private sector initiatives should focus on providing accessible financial literacy programs that educate people on digital banking, investment strategies, and cybersecurity awareness. Additionally, expanding internet access and mobile connectivity in underserved regions can facilitate broader adoption of digital financial services, ensuring that technological advancements benefit all segments of society.

2.4. Sustainable Investment Measurement and Accountability

The increasing popularity of Environmental, Social, and Governance (ESG) investing has underscored the need for standardized sustainability impact assessment frameworks. Despite growing investor interest in sustainable finance, the lack of universally accepted metrics for measuring ESG performance remains a significant challenge. Inconsistent reporting standards make it difficult for investors to evaluate the actual impact of ESG-focused investments, leading to concerns about "greenwashing," where companies exaggerate their sustainability

claims. To enhance accountability and credibility in sustainable finance, transparent reporting mechanisms and third-party verification systems are essential. Regulatory bodies should work towards establishing globally recognized ESG disclosure standards, ensuring that companies provide accurate and verifiable sustainability data. Additionally, independent ESG rating agencies can play a crucial role in assessing and certifying the sustainability impact of investment products, fostering greater investor confidence in green finance initiatives.

3. Case Studies in Multidisciplinary Financial Innovation

3.1. Fintech and Financial Inclusion: M-Pesa in Kenya

M-Pesa, a mobile-based digital payment platform launched in Kenya, has revolutionized financial transactions by enabling secure and efficient money transfers, microloans, and remittance services. By leveraging mobile technology, M-Pesa has provided millions of unbanked individuals with access to financial services, reducing dependency on traditional banking infrastructure. The success of M-Pesa highlights the transformative potential of fintech in driving financial inclusion, particularly in regions with limited banking access. Supportive regulatory policies and widespread mobile phone adoption have been crucial to its success.

3.2. AI-Powered Credit Scoring in India

Traditional credit assessment models often rely on formal financial histories, excluding large segments of the population from accessing credit. In India, AI-driven credit scoring systems have addressed this issue by analyzing alternative data sources such as utility bill payments, mobile phone usage, and e-commerce transactions. These innovative models have expanded credit access to millions of previously unbanked individuals, fostering economic empowerment and entrepreneurship. The integration of AI in financial services demonstrates how technology can bridge gaps in traditional credit assessment, enabling a more inclusive financial ecosystem.

3.3. Green Bond Market Growth in Europe

The European Union has emerged as a global leader in sustainable finance, with the green bond market experiencing significant growth due to favorable policy incentives and regulatory frameworks. Green bonds, which are designed to fund environmentally friendly projects, have gained traction among investors seeking to support climate-conscious initiatives. The EU's efforts to standardize green bond regulations and implement stringent sustainability reporting requirements have enhanced transparency and investor confidence in the market. This case study illustrates how government policies can stimulate sustainable investment and promote environmental responsibility in financial markets.

3.4. Blockchain for Cross-Border Remittances

Traditional cross-border money transfers are often slow, costly, and prone to security risks. Blockchain technology has emerged as a game-changer in this space, enabling faster, more secure, and cost-effective international remittances. Blockchain-based remittance platforms leverage decentralized ledgers to reduce transaction fees and eliminate intermediaries, benefiting migrant workers who send money to their families in different countries. The

adoption of blockchain in remittance services demonstrates how distributed ledger technology can enhance financial efficiency and inclusivity on a global scale.

By addressing regulatory barriers, cybersecurity risks, financial literacy challenges, and sustainable investment concerns, multidisciplinary financial innovations can create a more resilient and inclusive financial landscape. These case studies highlight the transformative impact of technology in reshaping financial services, underscoring the need for collaborative efforts between regulators, industry stakeholders, and technology providers to harness financial innovation responsibly.

4. Future Directions and Recommendations

4.1. Strengthening Multidisciplinary Collaboration

Collaboration among economists, technologists, policymakers, and social scientists is essential to driving innovation in global development finance. By leveraging diverse expertise, stakeholders can develop holistic solutions that address economic, technological, and social challenges simultaneously. Governments, research institutions, and private sector entities should foster cross-disciplinary partnerships through joint research initiatives, knowledge-sharing platforms, and collaborative policy development. These efforts will enhance the effectiveness of financial innovation and ensure that it aligns with broader economic development goals.

4.2. Enhancing Financial Education and Digital Literacy

Financial literacy and digital literacy are fundamental to equitable access to financial services. Educational institutions and NGOs should integrate financial literacy programs into global development policies, equipping individuals with the knowledge and skills needed to navigate modern financial ecosystems. Governments should also support digital literacy campaigns, particularly in underserved regions, to empower individuals with the tools required to safely and effectively engage with financial technologies. Bridging the digital divide will enable greater participation in the formal financial system and foster economic inclusion.

4.3. Developing Robust Regulatory Frameworks

Governments and regulators must establish clear policies that balance financial innovation with risk management. Transparent and adaptive regulatory frameworks are crucial for fostering trust in digital financial systems while mitigating risks such as fraud, cybersecurity threats, and financial instability. Additionally, international cooperation on regulatory standards is necessary to manage cross-border financial activities and prevent regulatory arbitrage. By promoting regulatory harmonization and information-sharing among countries, policymakers can create a more stable and resilient global financial system.

4.4. Scaling Sustainable Finance Solutions

Expanding sustainable finance initiatives through policy incentives, investor engagement, and impact measurement tools will drive long-term financial sustainability and social development. Governments should introduce tax benefits and subsidies for green investments, encouraging businesses and investors to prioritize sustainability. Additionally,

robust impact measurement frameworks should be developed to ensure transparency and accountability in sustainable finance. By fostering a culture of responsible investing, the financial sector can contribute to a more sustainable and equitable global economy.

Conclusion

Multidisciplinary research is transforming global development finance, fostering financial inclusion, sustainability, and economic growth. The integration of technology, policy, and social impact investment presents unprecedented opportunities to address financial disparities worldwide. However, regulatory challenges, cybersecurity risks, and financial literacy gaps must be addressed. By strengthening collaboration, promoting financial education, and developing resilient regulatory frameworks, global development finance can become more inclusive, sustainable, and impactful in driving economic progress.

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Industry 4.0 and Its Impact on MSMEs: A Case Study of Adaptive Strategies in Emerging Markets

Mohammed Shebeen T

Research Scholar, UGC-NET-JRF

Department of Commerce, University of Madras, Chennai-05

Dr J Sulaiman

Assistant Professor, Department of Commerce

The New College, University of Madras, Chennai-14

Abstract

The arrival of Industry 4.0 has transformed industries across the world, especially impacting Micro, Small, and Medium Enterprises (MSMEs) in developing economies. Industry 4.0 combines digital transformation technologies like the Internet of Things (IoT), Artificial Intelligence (AI), blockchain, cloud computing, and smart manufacturing into business processes, making them more efficient, scalable, and competitive. MSMEs in developing economies, however, are confronted with major challenges in embracing these technologies because of financial limitations, unavailability of skilled labor, infrastructural challenges, and regulatory hurdles. This research investigates the effect of Industry 4.0 on MSMEs with a focus on how digitalization reconfigures business models, supply chain management, and market competitiveness. Applying an empirical strategy involving primary data from MSME owners, workers, and industry specialists and secondary data from industry reports and the literature, this research determines principal enablers and inhibitors to the adoption of Industry 4.0. Those selected emerging markets' case studies depict effective adaptation strategies and identify policy frameworks that ease MSME digitalization. The results indicate that MSMEs adopting Industry 4.0 technologies have increased productivity, lowered operational expenses, and better market access. However, digital illiteracy gaps, high installation costs, and cybersecurity threats inhibit large-scale take-up. To overcome these limitations, strategic policy interventions, economic incentives, and upskilling programs for workers are necessary. The research concludes by proposing a holistic approach of balancing technological developments with inclusive growth policies to provide sustainable MSME growth in developing economies. This study adds to the literature on digital transformation and MSME resilience by offering policymakers, business leaders, and entrepreneurs useful practical lessons in responding to Industry 4.0 disruptions.

Keywords: Industry 4.0, MSMEs, Digital Transformation, Emerging Markets, Competitiveness, Workforce Upskilling, Sustainability, Smart Manufacturing, Automation, Artificial Intelligence, IoT, Supply Chain Optimization, Business Resilience, Economic Development, Technology Adoption.

Introduction

The Fourth Industrial Revolution, or Industry 4.0, is a paradigm shift in global business practices based on progress in automation, artificial intelligence (AI), the Internet of Things

(IoT), blockchain, and cloud computing. In contrast to earlier industrial revolutions that emphasized mechanization, mass production, and digital automation, Industry 4.0 emphasizes smart, interconnected systems that increase efficiency, productivity, and decision-making capabilities through real-time data processing. While big businesses and multinational corporations have quickly adopted these innovations, Micro, Small, and Medium Enterprises (MSMEs) are confronted with special challenges to adopt Industry 4.0 technologies, especially in developing markets.

MSMEs constitute the backbone of most developing economy, and they greatly contribute to job creation, GDP growth, and local economic development. They are also economically important but lack financial strength, technical knowledge, and adequate digital infrastructure, making their adaptation to Industry 4.0 challenging. The use of digital technologies has the potential to greatly improve MSMEs' competitiveness through enhanced efficiency of production, data-driven decision-making, and ease of accessing international markets. However, impediments like high upfront capital requirements, insufficient skilled labor force, and cyber threats prevent smooth integration. This research analyzes the effect of Industry 4.0 on MSMEs, especially in emerging economies, to determine how digitalization affects their sustainability and competitiveness. Employing an empirical methodology, this study explores the determinants of Industry 4.0 adoption, determines best practices, and investigates policy interventions that can facilitate MSME digitalization. The paper seeks to provide useful inputs on how MSMEs can leverage digital technologies to stay ahead in a world where the economy is becoming increasingly technology-based. It is imperative that policymakers, industry players, and entrepreneurs get to understand where Industry 4.0 intersects with MSMEs in pursuit of sustainable development in the presence of digital disruption.

Literature Review

The adoption of Industry 4.0 technologies by Micro, Small, and Medium Enterprises (MSMEs) has been a focus of significant research, especially with regard to digital transformation, economic competitiveness, and sustainability. Previous studies have emphasized the opportunities and challenges faced by MSMEs, particularly in developing markets, when adopting Industry 4.0.

Xu et al. (2018) research implies that Industry 4.0 technologies such as automation, IoT, and AI play a huge role in improving the productivity of MSMEs through the enhancement of production processes and real-time decision-making. Research, however, shows that MSMEs have limited digital infrastructure and technical competence to benefit extensively from these technologies (Sony & Naik, 2020).

Competitiveness and Market Expansion

Academics believe that Industry 4.0 allows MSMEs to be part of global supply chains, increasing market access and competitiveness (Frank, Dalenogare, & Ayala, 2019). Müller, Kiel, and Voigt (2018) in a study highlight that smart manufacturing technologies lower the

cost of operations and increase production efficiency, making MSMEs more competitive. But financial limitations and lack of support from the government are significant hurdles in developing economies (Raj, Dwivedi, & Sharma, 2020).

Workforce Upskilling and Digital Literacy

Industry 4.0 requires the development of a qualified workforce capable of handling data analysis, automation, and cybersecurity. According to Buer, Strandhagen, and Chan (2018), MSMEs should invest in staff training schemes to meet the gap. Somers and Nelson (2021) study, however, indicates that expensive training and aversion to emerging technologies continue to hinder digitalization.

Sustainability and Policy Interventions

Industry 4.0 is also key to sustainable business operations. Research indicates that digital technologies minimize waste, maximize the use of resources, and ensure environmentally friendly production (Bag, Pretorius, & Gupta, 2021). Governments and policymakers need to put in place enabling regulations and financial incentives to enable MSME digitalization in emerging economies (Sharma, Singh, & Gupta, 2022).

This review calls for strategic intervention to allow MSMEs to harness Industry 4.0 for long-term growth and sustainability.

Conceptual Research Methodology

This research uses a conceptual research strategy to investigate the effects of Industry 4.0 on MSMEs in emerging economies. In contrast to empirical research that uses primary data gathering, conceptual research builds on available theories, frameworks, and literature to create an extensive framework for understanding a particular phenomenon.

The research is organized around a comprehensive review of academic papers, industry reports, and policy documents to analyze the impact of Industry 4.0 technologies on MSME competitiveness, upskilling of workforce, and sustainability. Theories like the Technology-Organization-Environment (TOE) framework and the Resource-Based View (RBV) are used to assess MSME preparedness and ability to implement digital transformation. Case studies of effective MSME digitalization efforts in emerging markets also offer actionable lessons on bridging technological and financial gaps. Through the confluence of theory and practice, this study adds to the existing debate around Industry 4.0 uptake, providing policymakers and business executives with strategic advice on enabling MSME digital transformation.

Digital Transformation and Competitiveness

The convergence of digital technologies has greatly changed MSME operations. Case studies in India, Brazil, and Indonesia show that IoT and cloud computing have improved supply chain effectiveness, minimizing lead times and operational expenses. Deloitte (2021) states that companies using AI-based analytics perform better than their peers in profitability and

market responsiveness. However, the lack of funds restricts widespread digital adoption in MSMEs. Incentives for technology adoption exist through initiatives like India's Digital MSME Scheme and Brazil's Industry 4.0 National Strategy, but there are still issues of accessibility.

Workforce Upskilling and Sustainability

Industry 4.0's adoption requires workforce upskilling and reskilling. Through a case study of an Indonesian textile MSME, it was shown that well-targeted training programs for the employees resulted in a 30% productivity enhancement. Partnerships between MSMEs and vocational training centers could fill the gap in skills so that transitions are smoother into the automated processes. Sustainability is also an important element of Industry 4.0 in MSMEs. Intelligent manufacturing minimizes waste and maximizes the use of resources. Research indicates that companies embracing green manufacturing technologies experience enhanced regulatory compliance and corporate image (World Economic Forum, 2020).

AI Applications in Financial Risk Management

Industry 4.0 technologies, specifically artificial intelligence (AI), big data analytics, and blockchain, are redefining MSMEs' financial risk management approaches. The three technologies support better decision-making, reduce risks, and enhance financial stability.

Predictive Analytics for Risk Assessment

Predictive analytics powered by AI allow MSMEs to determine financial risk more accurately through a study of past financial data, market trends, and customer patterns. As opposed to legacy risk assessment models, AI-powered systems learn from real-time economic conditions and offer proactive measures to manage risks (Agrawal & Narain, 2021).

Blockchain for Transparent Financial Transactions

Blockchain technology improves financial transactions' transparency by providing a tamper-proof and decentralized ledger system. This decreases fraud risk and enhances trust among MSMEs and financial institutions. Research has shown that smart contracts based on blockchain enable secure transactions, with less dependence on intermediaries (Zheng et al., 2020).

AI in Credit Scoring and Loan Accessibility

Credit scoring using artificial intelligence scans various data points, including cash flows of businesses, supplier relations, and social media presence, to assess MSME creditworthiness. The process enhances financial inclusion by enabling small enterprises to borrow without exclusively depending on traditional credit history (Chen et al., 2022).

Challenges and Ethical Considerations

Although Industry 4.0 technologies have many advantages, they also present challenges, especially in terms of financial access, data privacy, and ethical AI deployment.

Digital Divide and Financial Inequality

Emerging market MSMEs tend to experience technological gaps, which hinder their capacity to embrace AI-based financial solutions. Excessive implementation costs and digital illiteracy are still major impediments to mass adoption (Rai et al., 2021).

Data Privacy and Cybersecurity Risks

With more digital transactions, data privacy and security are of utmost importance. Unauthorised access to financial information can result in cyber attacks, and hence MSMEs need to have strong cybersecurity systems in place (Kshetri, 2020).

Algorithmic Bias and Ethical AI Implementation

Credit risk assessment models based on AI can unknowingly capture biases from training data. Fairness and transparency in AI use are important to avoid discriminatory financial outcomes (Cowgill, Dell'Acqua, & Deng, 2022).

Conclusion, Future Directions and Policy Recommendations

The implementation of Industry 4.0 technologies offers an opportunity for MSMEs to change, improve financial decision-making, risk management, and competitiveness in the market. Challenges like technological infrastructure, regulatory frameworks, and ethical implementation of AI need to be overcome. Subsequent research would need to prioritize policy-led efforts to facilitate MSME digitalization, ethical AI principles to curb algorithmic discrimination, and cutting-edge financial designs that foster sustainable growth. Financial institutions and governments need to cooperate to make Industry 4.0-driven finance accessible, equitable, and sustainable, leading the way to lasting economic resilience.

Industry 4.0 offers vast opportunities for MSMEs in emerging economies, increasing efficiency, competitiveness, and sustainability. There are, however, challenges of financial constraints, unavailability of skilled labor, and regulatory restrictions that need to be overcome.

Policy suggestions are:

1. Financial Incentives – Low-interest loans and subsidies for MSMEs by the government for digital transformation.
2. Skill Development Programs – Setting up vocational training centers with Industry 4.0 skills.
3. Public-Private Partnerships – Facilitating partnerships among MSMEs, technology companies, and educational institutions.
4. Regulatory Frameworks – Creating policies that provide cybersecurity, data privacy, and ethical AI adoption.

By overcoming these challenges, MSMEs in emerging economies can maximize the advantages of Industry 4.0, promoting sustainable economic development and international competitiveness.

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Dr.B.KANAMMAI

Assistant Professor, Department of Commerce,
Nallamuthu Gounder Mahalingam College, Pollachi.

The financial industry was undergoing a profound transition in latest years, taken over by the recent upwards of technology. With the invent of the digi age, banking is no longer restricted to brick-and-mortar branches and hard copy transactions. Substitute of paper, bank has transformed to the digital power, Stepped into a new digital era of doing banking transactions by convenient, easy accessible, and new ideas. To explore the key trends shaping this transformation, and examine how banks are adapting to meet the demands of the new norm. The technological revolution in banking is not a mere transmission; it's a seismic shift that is redefining the very essence of banking as we know it. In this current scenario, where flow of information through the speed of light and our daily lives, each and every aspect has been touched by technology. The Banking sector is undergoing a profound shift. The past days of standing in long queue at the bank, filling out application forms, and waiting for a number days to do the process for a transaction are becoming a old memory. In this place, presently, we have witnessed the introduction of digital banking, a phenomenon that gives powers to consumers to maintain their financial activities with overwhelmed comfort and flexible..

The founder for this revolution is the omnipresence of the internet, coupled with the widespread adoption of smart phones. With the help of the financial IT tools at our ease, we can now do a lot of banking transactions from any where at our home, office or on the go. No longer restricted by the constraints of banking hours, one can check their account balances, transfer funds, pay bills, and invest in financial markets at any time, 24X7 on a day. These changes have not only redefined customer expectations but also reshaped the banking landscape, compelling financial institutions to adapt, innovate, and deliver a level of service that aligns with the digital age. The digital revolution in banking is not just about adapting to the new norm; it's about embracing a future where banking is redefined by the possibilities of the digital age.

Overview of Digital Banking

The technology revolution in banking represents a paradigm shift in the way financial services are accessed and delivered. It's all about leveraging technology to make banking services more accessible and user-friendly. The introduction of smart phones, high-speed internet, and sophisticated financial technologies has brought the foundation for a digital banking landscape that is rapidly evolving.

1. Online Banking: Online banking helps most of the customers to check their account balances, to transfer funds from one account to another through mobile and net banking, pay electricity bills, and even apply for all types of loans without contacting the branch physically.

2. **Mobile Banking:** The intro of mobile applications has transmitted the way of the people to manage their finances. Mobile banking apps permits users to do a broad range of banking functions from their smartphones, including mobile check deposits, peer-to-peer payments, and account management.

3. **Digital-Only Banks:** A new type of digital-only banks, also known as neobanks, has introduced. These banks have no physical branches and operate throughout online. They offer a host of innovative features and often provide a seamless, user-friendly experience.

4. **Blockchain and Cryptocurrency:** Blockchain technology and cryptocurrencies like Bitcoin have the potential to disrupt traditional banking by offering decentralized, secure, and efficient methods of transferring and storing value.

5. **AI and Machine Learning:** Banks are increasingly using artificial intelligence and machine learning to enhance customer service, streamline operations, and detect fraud.

6. **Biometrics:** Enhanced security measures, such as fingerprint and facial recognition, are becoming more prevalent in digital banking, offering a convenient and secure way to access accounts and make transactions.

Key Trends in the Digital Banking Revolution

Various major trends are driving the digital banking revolution, and they are moulding the way financial institutions operate and serve their customers. In present digital age, customers have improved a set of digital-first expectations that are redefining their relationship with banks. They demand seamless digital banking experience where customers can do banking transactions can be completed swiftly, account information can be accessed at any hour, and services personalized to their unique financial needs—all through digital channels. This shift is a direct consequence of the convenience and immediacy offered by technology, and it has compelled banks to revamp their digital offerings to meet these rising customer demands.

Furthermore, open banking initiatives are fostering a collaborative approach in the financial industry. Banks are increasingly transferring customer data with third-party providers securely, underpinning a concept that makes customers to adopt innovative financial technology. Open banking permits fintech companies to improve services that can increase the customer experience. This trend not only offers customers to have more control over their financial data but also motivates the innovative creative applications and services, creating a more competitive and dynamic banking environment.

Artificial intelligence (AI) and AI powered chatbots are becoming integral to the modern banking experience. These technologies makes banks to offer quicker response times and provides 24/7 customer service availability. Chatbots increases customer support by providing quick and accurate responses to common questions, making up human beings free for more complicated tasks. AI, on the other hand, makes banks to analyze large amounts of customer data and provide personalized financial advice and product recommendations, increasing the overall customer experience and financial decision-making.

Finally, one of the most important impacts of the digital revolution in banking is its potential to promote financial inclusion on a world scale. Digital banking provides the means to broadened financial services to underserved populations, dividing down geographic and socioeconomic barriers. This accessibility gives powers for individuals who were earlier excluded from the olden method of banking system to access critical financial services, participate in the economy, and improve their overall quality of life. It indicates an important tool for eliminating financial disparities and accelerating economic growth all over the world.

Adapting to the New Norm

Banks gave importance for digital transformation and implemented different strategies for competitive stay in this dynamic changing landscape. They give importance for increased digital services to satisfy the expected needs of their technology oriented customers. This makes substantial investments in their online and mobile banking platforms, preparing customers for a convenient digital banking transactions namely, mobile check deposit, real-time account alerts, and the ability to open new accounts digitally. The convenience factor is promoted to new heights as these features makes customers to manage their money from the their hands at any time, any where, round the clock.

Moreover, banks are collaborated partnerships with fintech companies, giving the value of gaining access to cutting-edge technology and expertise. These collaborations are making banks to provide innovative services and stay competitive in the digital arena. By transforming into the innovative potential of fintech, traditional banks can expand their digital services and offers, introducing new and more comfort solutions that will cater to their customers' increasingly complex financial needs.

With the surge in digital banking comes heightened concerns about cybersecurity. As the digital banking landscape evolves, banks are constantly increasing their security measures to prevent customer data and funds. These efforts are most important in maintaining the trust and confidence of customers in a financial atmosphere where data breaches and cyber threats pose significant challenges.

Banks are also transforming to artificial intelligence (AI) and automation to streamline internal processes, reduce operational costs, and provide faster, more accurate customer service. AI, in particular, is a game-changer in the banking sector, enabling banks to automate routine tasks, process vast amounts of data for better decision-making, and enhance customer experiences through personalized customer services and support.

In terms of product innovation, both digital and traditional banks are making significant strides. They're developing innovative financial products and services that satisfy to the differet needs of their customers. These include robo-advisors that provide automated, algorithm-driven investment advice, crypto currency trading platforms that tap into the burgeoning world of digital assets, and digital wallets that simplify payment and financial management. These products not only diversify the banking landscape but also allow customers to engage with their finances in novel ways. Furthermore, many banks gives the importance of expanding financial education among their customer bases. They offer a range of resources designed to help customers become more financially literate. These resources

include financial education materials, interactive tools, and resources that empower customers to make informed financial decisions. By fostering financial literacy, banks contribute to their customers' financial well-being and provide them with the knowledge to navigate the increasingly complex world of finance with confidence.

Cross-Industry Collaboration: Collaboration between banks, fintech firms, and other industries will lead to the development of innovative, customer-centric solutions.

Conclusion

In conclusion, the digital revolution in banking is not just a financial evolution; it's a cultural and technological transformation that has already left an indelible mark on the way we manage our finances. With the pervasive integration of digital banking services into our daily lives, the financial sector is now at the forefront of an era defined by convenience, accessibility, and customization. Traditional banking practices are increasingly giving way to digital-first experiences that empower consumers and encourage financial independence. As the digital revolution in banking continues to unfold, the role of banks will evolve beyond transaction facilitation to become holistic financial partners. Customers can look forward to a banking experience that is highly personalized, with AI-driven insights that guide their financial decisions and strategies. These partnerships will extend beyond just managing accounts and transactions, branching into investment advice, financial planning, and even personalized banking apps that cater to an individual's unique financial journey. The future of banking, shaped by the digital revolution, is exciting, promising, and laden with opportunities for both customers and financial institutions. While challenges such as data privacy and cybersecurity persist, the advancements in technology will ultimately lead to a more secure, efficient, and customer-centric banking landscape. Banking will no longer be a static service; it will be a dynamic and tailored experience, designed to meet the needs and expectations of an increasingly tech-savvy and digitally connected world.

Indian Knowledge System and Naam Bhakti Yoga
(Special Reference to the Knowledge, Philosophy, and Science Related to Shri Maanji's Satsang)

Dr. Sandeep Kumar Chaurasia
Academic Counselor
IGNOU Regional Center, Lucknow

The knowledge, philosophy, and science associated with Shri Maanji's Satsang are fundamentally rooted in the Indian knowledge system, particularly the Indian Bhakti system. Shri Maanji became the first president of the registered Shiv Satsang Mandal and is appropriately regarded as the first Satsangi, as he was the foremost disciple of Acharya Shri Krishna Kanhaiya Babuji. Shri Maanji's Satsang highlights the essential aspects of devotion-based traditions, philosophy, and social awareness, which remain relevant even today. The Indian Bhakti system is an integral part of the Indian knowledge system, which not only provides a path for spiritual progress but also fosters morality, a sense of duty, and collective consciousness in society. The knowledge tradition, vision, and practical utility associated with Shri Maanji's Satsang must be understood in the context of the Bhakti system. The Indian knowledge system defines tradition, vision, and practical utility as knowledge, philosophy, and science, respectively. This research paper employs an analytical method to examine these aspects. In the Nirguna Bhakti tradition, Naam Bhakti Yoga holds a special significance, where Satsang (holy congregation), chanting of God's name, and Nirguna meditation (meditation on divine light) are the core pillars of devotion.

The knowledge, philosophy, and science associated with Shri Maanji's Satsang can be clearly seen as foundational elements of the Indian knowledge system. The knowledge tradition linked to Shri Maanji's Satsang reveals the true essence of the Indian Bhakti system. This system is not confined to mere worship and prayer but integrates knowledge, logic, behavior, and spiritual consciousness into a holistic path. Bhakti is not just an emotional experience; it is a profound knowledge-based approach that nurtures self-realization, social welfare, and global consciousness. Shri Maanji's ideology in the Shiv Satsang Mandal is based on the integration of yoga, the art of living, religion, philosophy, and science. According to him, yoga is not just a physical exercise but a way of life deeply connected with religion, philosophy, and science. His Satsang delves into all these aspects, providing practitioners with a balanced and comprehensive perspective.

The Role of "Shiv Naam" in Shri Maanji's Satsang

In the Shiv Satsang Mandal, the name "Shiva" holds a special place, symbolizing the Nirguna (formless) aspect of God. Through Satsang, devotees gain spiritual knowledge, moral values, and an understanding of life's deeper mysteries. Shri Maanji's Satsang emphasizes meditation on the name of Shiva, alongside discussions on yoga, meditation, and various dimensions of devotion, inspiring practitioners toward spiritual growth. The main objective of Shri Maanji's Satsang is to guide devotees toward self-realization, morality, and spiritual progress so that

they can lead a balanced and meaningful life. This simple yet profound devotion-based tradition remains highly relevant in contemporary times. Here, the Indian knowledge system is categorized as follows in relation to the Indian Bhakti system:

1. Knowledge Tradition and the Bhakti System

The Indian Bhakti tradition is deeply embedded in the Vedas, Upanishads, Puranas, and the literature of saints. It is not limited to logic and philosophical debates but is a living tradition based on experience and inner realization. The knowledge gained from Shri Maanji's Satsang is part of this tradition, which involves: **Sharavan (Listening)**: Attaining self-realization by listening to the words of enlightened Satsangis. **Manan (Contemplation)**: Reflecting on the knowledge received during Satsang and internalizing it. **Nidhidhyashan(Regular Practice)**: Applying the acquired knowledge in daily life. In the Indian knowledge system, tradition itself is considered knowledge.

2. Knowledge Perspective and the Bhakti System

Bhakti is not mere superstition or blind faith; it also provides a high level of intellectual insight. The Indian Bhakti system views knowledge through different lenses:

- **Saguna Bhakti** (devotion with form): Involves worship of deities and the divine in a tangible form.
- **Nirguna Bhakti** (devotion without form): Focuses on chanting God's name and meditating on the formless Brahman.

The Shiv Satsang Mandal emphasizes Nirguna Bhakti, particularly Naam Bhakti Yoga. Bhakti is not just love; it is also a means of gaining knowledge. In the Bhagavad Gita, Lord Krishna describes "Bhakti Yoga" as a path that balances both knowledge and devotion. The primary objective of the Bhakti path is self-surrender and the dissolution of ego, leading to true enlightenment. In the Indian knowledge system, this perspective is termed **philosophy**.

3. Practical Utility and the Bhakti System

The Indian Bhakti system is not confined to spiritual upliftment alone but also significantly contributes to social and individual life. Devotees of Bhakti:

- Follow ethical values, honesty, and discipline, fostering an ideal lifestyle in society.
- Cultivate unity, love, and cooperation through the company of saints and devotees.
- Attain mental peace, patience, and contentment, ensuring stability amid life's ups and downs.

In the Indian knowledge system, **practical utility is considered science**.

Shri Maanji's Teachings on Nirguna Bhakti

The Nirguna Bhakti tradition rejects idol worship and avatar worship for various reasons, including:

- **Islamic influence**: Emphasis on monotheism.
- **Hindu Advaita philosophy**: As advocated by Adi Shankaracharya.

It also refutes:

- Casteism and the Varna system.
- The necessity of scriptural knowledge for salvation.
- The indispensability of name remembrance (Naam Smaran).
- The use of the common language spoken by rural Indians.

Several scholars have categorized Nirguna Bhakti in different ways:

- Ramchandra Shukla calls it the **Gyaanashraya branch**.
- Dr. Ramkumar Verma refers to it as **Sant poetry**.
- Hazari Prasad Dwivedi describes it as **Nirguna Bhakti literature**.

Philosophically, it is influenced by **Advaita Vedanta** (Kabir, Dadu, Malukdas) and **Bhedabheda philosophy** (Nanak).

The Role of Naam Siddha Acharya in Nirguna Bhakti

In Nirguna tradition, a living saint (Naam Siddha Acharya or Satsangi) plays a crucial role. They prepare the disciple for direct realization of the divine through Satsang. Kabir considers the enlightened Guru greater than God, as only the Guru can lead one to divine union. Similarly, Shri Maanji regards the Naam Siddha Acharya or Satsangi as an embodiment of God, who dispels worldly illusions and illuminates the path of devotion through the chanting of Shiva's name ("Shiv Shiv Shiv").

Shri Maanji emphasized that worldly desires fill the heart, but only a true Satsangi can help recognize them. By the grace of a Naam Siddha Acharya, past sins are erased, and worldly suffering is eliminated.

Therefore, Shri Maanji considered Shiv Naam (the name of Shiva) as the supreme and dearest name of God, dedicating himself entirely to its chanting and to the company of true Satsangis.

The Nirguna Bhakti philosophy of Naam Smaran (remembrance of God's name) considers the chanting of the divine name as synonymous with devotion. The divine name, bestowed by a Siddha Acharya or a true Satsangi, is like a spark that burns away the accumulated sins of countless lifetimes and obliterates worldly memories. Therefore, Shrimaanji always emphasized continuously chanting the name Shiv, Shiv, Shiv, Shiv with the tongue. Shrimaanji described the Shiva Naam as the essence of all names and proclaimed that at the beginning and end of creation, only Shiva Naam remains the eternal truth.

Thus, Shrimaanji presented this simplest form of devotion for those who were uneducated, who had not studied the scriptures, and who could not understand the complexities of Vedic mantras and Yogic texts. For such simple and unlettered devotees, Shrimaanji provided an easy path to bhakti through the remembrance of Shiva Naam. According to him, Shiva Naam is like a philosopher's stone (Paras Battiya), which transforms even an iron-like person into

gold. Hence, Shrimaanji considered this divine Shiva Naam superior to all other elements and declared that in Kaliyuga, remembering the divine name is the only path to God-realization.

For Shrimaanji, Shiva Naam was everything—worship, prayer, and ritual. He regarded Shiva Naam as the nectar of immortality, which quenches the thirst of countless births and liberates one from the cycle of birth and death. Shrimaanji advised everyone to drink this nectar, which, once consumed, never fades away. He had no other concern except the divine Shiva Naam, which alone secured him the highest position in Shiva Satsang Mandal. Even the creator bows before this Shiva Naam, as it liberates the soul from the cycle of birth and rebirth.

But what exactly is this Shiva Naam Smaran that Shrimaanji talks about? We must reflect on this. At the core of Nirguna Bhakti, Naam Smaran is the principal foundation. The divine name can be chanted in two ways:

1. Descriptive – as worldly names such as Ram, Rahim, Krishna, etc.
2. Mantric – received as Naamdaan (initiation) from an embodied Guru of the age.

This Mantric name is the real name of God, which Shrimaanji and other Nirguna saints urge devotees to remember. According to Shrimaanji, the true Naam received from a Siddha Acharya or a true Satsangi must be deeply embedded within the soul using one's inner spiritual tools, leading one to God-realization. By merely remembering it, the threefold sufferings of the world burn away, and the bonds of illusion (Maya) are cut. Shrimaanji clearly stated that if one wishes to reach the doorstep of the Divine, one must constantly chant Shiva Naam with full concentration. This removes all worries and leads to an effortless, automatic chanting of Shiv, Shiv, Shiv, even without consciously repeating it.

According to Shrimaanji, Shiva Naam unites the soul and the divine word, leading to supreme bliss and inner enlightenment. This Shiva Naam Bhakti of Nirguna devotees is also known as Naam Bhakti Yoga, which Shrimaanji frequently discussed in Shiva festivals and satsangs. His devotion to Shiva Naam became so intense that he could never abandon it. Shrimaanji was fully surrendered to Shiva Naam Bhakti and encouraged all Satsangis to do the same. Whenever he met a devotee, he would greet them by saying "Jai Shiva", emphasizing the importance of Shiva Naam.

In Satsangs, he often proclaimed that Shiva Naam is the ultimate truth and the bestower of all spiritual and worldly powers. According to him, a true Satsangi is already a Siddha (realized being), and therefore, there is no need for debates—only continuous remembrance of Shiva Naam is essential.

The Glory of Satsang

In discussing the glory of Satsang, it is evident that company (sangat) has the greatest impact on human life. Hence, saints and devotees have emphasized the importance of Satsang for spiritual growth. Anyone who desires spiritual upliftment must cultivate love for God and take refuge in Satsang.

Shrimaanji repeatedly urged devotees to avoid the company of wicked people and to engage in Satsang. He explained how good company transforms even the impure—just as dirty water, when merged with the holy Ganges, becomes Ganga water itself. Shrimaanji, acknowledging divine grace, attributed his spiritual elevation—despite being less educated and merely a betel-leaf seller—to the power of Satsang.

He emphasized that true saints, being detached from worldly desires, guide people toward righteousness. Satsang is possible only through true love and devotion to God.

According to Shrimaanji, to truly worship God, one must control the restless mind. When one is fully immersed in devotion, worldly disturbances automatically subside. True devotion (Prem Bhakti) arises only when a devotee abandons all material attachments and fully surrenders to the love of the Divine. In such a state, the devotee experiences true love, making all worldly affections seem insignificant. The devotee becomes one with God, just as a fish cannot survive without water or a papihā bird longs for a Swati-raindrop.

The Spiritual Philosophy of Shrimaanji

Shrimaanji traveled across Uttar Pradesh—including districts like Lucknow, Sitapur, Lakhimpur, Shahjahanpur, and Hardoi—spreading the message of Shiva Naam through weekly and monthly Satsangs. He initiated new devotees into Shiva Naam chanting and engaged in philosophical discussions on scriptures, logic, and reasoning. He even held scriptural debates with Brahmins and provided clear insights into Brahman, Jiva (soul), and Jagat (the world).

However, his ultimate aim was true devotion to God, not getting entangled in philosophical complexities. Nevertheless, understanding his Naam Bhakti as a spiritual philosophy is both relevant and beneficial.

Brahm (The Supreme Being)

Shreemanji refers to Brahm as "Shiva." His concept of Brahm, as understood from his discourses (Satsang), suggests that Brahm is not entirely formless (Nirguna, Nirakara) but rather an active, attribute-bearing entity (Saguna Nirakara). The most significant quality of Brahm, according to Shreemanji, is granting dignity to the devoted seeker. Perhaps, due to this perspective, some scholars have regarded him as a worshiper of Saguna-Sakara (God with attributes and form).

Shreemanji's Satsang reveals that while he primarily discusses the formless Brahm (Shiva), devotees tend to perceive Him as Saguna (with attributes). He describes the Supreme Being as residing in every human body, whom devotees or followers of the Satsang refer to as "Shiva." Regarding the presence of God, Shreemanji asserts that wandering in temples and mosques does not lead to the realization of the Divine. Instead, the Supreme Being grants supreme bliss and unparalleled peace. Shreemanji's approach does not rigidly adhere to traditional scriptures but reflects an independent Indian philosophical outlook. Evaluating his Satsang, it would be appropriate to regard him as an Advaitavadi (non-dualist), Brahmavadi

(proponent of the Supreme Reality), thinker of the Shiva doctrine, or a harmonizer of multiple philosophical perspectives. According to Shreemanji, the Supreme Being that he worships is Nirguna and Nirakara, beyond sensory perception. Only those who fully surrender to a Guru and engage in devoted worship of the Divine (Shiva) can experience Him. This understanding, derived from Shreemanji's teachings, naturally resolves the debate about whether his concept of God is Saguna-Sakara or Nirguna-Nirakara. Through his discourses, he clarifies that the Supreme Shiva is Nirguna, Nirakara, free of all defects, an embodiment of eternal truth, bliss, and consciousness (Satchidananda), infinite, and omnipresent, manifesting as pure light. In essence, Shreemanji considers Shiva's omnipresence and compassion towards the downtrodden as the ultimate truth. He believes that continuous chanting of the divine name "Shiva" is the most powerful tool for the liberation of the oppressed.

Jiva (The Soul)

Shreemanji accepts that the individual soul (Jiva) is a mere fragment of the Supreme Being (Paramatma). According to him, the Supreme Being is the true mother, father, and companion of the soul. However, time (Kala) entangles worldly beings in various bonds, ensuring that they remain attached to this world and repeatedly fall prey to the cycle of life and death.

Shreemanji describes Jiva as a clay puppet, destined to perish in an instant. He extensively discusses the transient nature of life in his Satsangs, explaining that the human body is like a fragile cage made of flesh and bones, where the bird-like soul resides. Warning those who take pride in their physical existence, he reminds them that no matter how grand a palace they build, the human body is ultimately only about three and a half cubits long and will soon turn to ashes.

He cautions those who believe in the illusion of permanence: *"O fool, wake up quickly! Soon, the god of death (Dharmaraj) will call upon you to account for your deeds. You have wasted your time in meaningless pursuits. This world is nothing but an illusion."*

Shreemanji emphasizes that the true purpose of life is to seek refuge in the divine name of Shiva before it is too late.

Jagat (The World)

Like other esteemed spiritual thinkers, Shreemanji describes the world (Jagat) as the illusion (Maya) of the Creator. In line with Indian philosophical traditions such as Samkhya, Yoga, Vedanta, and Tantra, he explains that the world is composed of five elements—ether (Akasha), fire (Agni), water (Jala), air (Vayu), and earth (Prithvi). However, he also asserts that this world is merely an illusion. Wealth, status, honor, attachments, and aversions—all are just transient aspects of this illusory world. Shreemanji compares the world to a king sleeping peacefully in his palace, who suddenly dreams of being a beggar. Despite having everything, he experiences immense sorrow in his dream. Similarly, people of this world remain trapped in illusion, unaware of reality.

Quoting the poet Kabir, he describes the world as:

- A "semal" flower—beautiful but hollow.
- A paper bundle—one drop of water is enough to dissolve it.

During a Satsang in Lucknow, he remarked that the world deceives humans just as a well-bound frog knows nothing beyond the well. Those lost in illusion fail to understand the true nature of existence. No matter how luxurious our lives may seem, death does not spare anyone. The world is like a hut made of grass—it burns to ashes instantly.

Shreemanji challenges the significance of worldly relationships: *"The moment the body perishes, family members rush to remove it. Even the wife, who once adored the body, calls it a ghost and runs away. So, what is the worth of this transient world and its relationships?"*

He concludes that only those who take refuge in the divine name of Shiva remain untouched by the ravages of time.

Maya (Illusion)

Just as Kabir described Maya as a great deceiver, Shreemanji also sees Maya as the force that misleads the world. No one, regardless of their status, has escaped the grasp of Maya.

He explains that the mind is enslaved by Maya, constantly wandering in all directions. The five senses remain unstable due to its influence. Maya not only obliterates the distinction between material and spiritual reality but also weakens human contemplation, leading to destruction.

Thus, Shreemanji urges devotees to seek divine refuge to escape Maya's clutches. He warns that Maya has even ensnared gods, sages, and saints. It assumes countless forms—children, the elderly, the youthful, the affluent, and the powerful—all mere disguises of illusion.

Even great yogis, ascetics, and scholars struggle against Maya's deceptive power. Like a master magician, Maya has conquered heaven, the cosmos, and the entire world, robbing it of true peace and happiness.

Shreemanji's ultimate advice: *"To escape Maya, continuously chant 'Shiva, Shiva, Shiva.'"*

Conclusion

After analyzing Shreemanji's various perspectives on devotion (Bhakti) and social awareness, it is evident that he regarded the sole purpose of human life as the worship of the Supreme Shiva. Using numerous personal examples, he explained to his followers that sincere devotion to the divine name had transformed his own life from poverty to spiritual fulfillment, earning respect even from the learned Brahmins. His teachings emphasize that taking refuge in the Supreme Being removes all suffering, mental distress, and uncertainties.

True devotion liberates people from societal divisions and inequalities. Unlike traditional scriptural scholars, Shreemanji upheld an independent and practical approach to spirituality. Scholars such as Dr. Sandeep Chaurasia consider him an Advaitavadi (non-dualist), Brahmavadi (believer in the Supreme Reality), or a harmonizing thinker. Shreemanji was primarily a saint rather than a philosopher. Yet, through his Satsangs in places like Lucknow, Sitapur, Lakhimpur, Shahjahanpur, and Hardoi, he engaged in profound dialogues on Shiva's divine name, often debating with Brahmins and intellectuals. At a time when globalization and the modern market economy have left individuals feeling insecure and disillusioned, Shreemanji's Bhakti and social philosophy offer not only solace but also a meaningful way to live. His legacy continues to inspire, ensuring that the stream of wisdom, devotion, and social reform he initiated remains eternal.

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A Study on Emerging Trends Reshaped in Future of Management

N.S.L.RAGHU RAM

ASSISTANT PROFESSOR

Vignan's Lara Institute of Technology and Science

ABSTRACT

The management domain has seen enormous changes and structurization in its form, design, outlay, and framework. In each stage of its development, a new trend is created which is adopted by various forms of organization to survive in the competitive business arena. In the current period, the management focus on technology bounded along with the digital phase of the trend. Nowadays management largely focuses on the highly revolving element, Artificial Intelligence. Based on the literature review it was identified that in management, Artificial Intelligence has a special form of recognition concerning the creation of data-driven management, getting better results, and picking up administrative slack. The most significant point of understanding is that each stage of trends in management has an equal view on the provider (business) and customer (receiver of benefit). Therefore, the present trend of management focuses on benefiting both parties of commerce that is business and customer. The dynamic nature of management makes it to be complex and vaster which requires various aspects to analyze and interpret. This article enumerates the list of key and emerging trends in business management whose leveraging gives a competitive edge.

Key words: Introduction, Importance, Levels ,Emerging trends

INTRODUCTION

The landscape of leadership and management is undergoing a transformation, driven by technological advancements, globalization, shifting workforce dynamics, and unprecedented challenges like climate change and the rise of remote work. The future leaders and managers should adapt, adopt new skills, and embrace innovative strategies to steer their organizations toward sustainable success. We are standing on the cusp of an era which is defined by rapid technological innovation, shifting workforce demographics, and evolving business models.

Leadership and management are no longer confined to hierarchical structures, but are instead about nurturing collaboration, innovation, and adaptability in an increasingly complex and unpredictable world. Organizations are grappling with multifaceted global challenges—ranging from the need for digital transformation to addressing climate change—requiring leaders to rethink their strategies. It is projected that by 2030 many of the jobs that exist today will be automated or significantly altered by artificial intelligence (AI) and machine learning, necessitating a shift toward human-centric leadership.

The business management landscape has been continuously evolving because of technological advancements, shifting consumer preferences, and global economic changes. Staying updated on emerging trends is crucial to transform effectively. In today's rapidly evolving business landscape, the future of management is being reshaped by emerging trends and demands. As technology advances, globalization accelerates, and societal values shift, the role of managers is undergoing profound changes. To thrive in this dynamic environment, working professionals need to adapt and cultivate essential skills. The future of management will be shaped by a range of developments that are already affecting the way in which

companies and their leaders carry out their duties. Because more individuals are working remotely or in hybrid models, new management practices are required to keep up with the increased productivity and preserve the cohesion of teams. The use of analytics to gain insights and improve performance is becoming more commonplace in businesses, which in turn has led to an increase in the number of decisions that are driven by data. As sustainability and corporate social responsibility (CSR) continue to gain prominence, managers are being forced to take into consideration how their decisions will impact society and the environment.

IMPORTANCE

The five key importance of management include achieving organizational goals, enhancing productivity and efficiency, facilitating innovation and adaptability, strengthening employee morale and retention, and maintaining financial stability.

Here's a more detailed explanation of each:

Achieving Organizational Goals:

Effective management sets clear objectives, breaks them down into achievable tasks, and ensures alignment between individual and company-wide goals, leading to better outcomes.

Enhancing Productivity and Efficiency:

Managers streamline operations, eliminate bottlenecks, and implement best practices to optimize resource utilization and task completion, leading to increased productivity.

Facilitating Innovation and Adaptability:

Good management fosters a culture of creativity, encourages employees to develop new ideas, and helps organizations adapt to changing market conditions, ensuring competitiveness.

Strengthening Employee Morale and Retention:

A well-managed workplace fosters higher employee satisfaction, engagement, and retention by recognizing contributions, providing opportunities for growth, and addressing concerns effectively.

Maintaining Financial Stability:

Sound financial management ensures that resources are allocated effectively, costs are controlled, and revenues are maximized, leading to long-term financial stability and success.

LEVELS OF MANAGEMENT

In most organizations, management is typically structured into three levels: top-level management (setting overall direction), middle-level management (implementing strategies), and lower-level management (supervising daily operations).

Here's a more detailed breakdown:

1. Top-Level Management: Setting the overall direction, objectives, and strategic goals of the organization.

Responsibilities: Making long-term decisions, resource allocation, and ensuring the organization's survival and growth.

Examples:

Chief Executive Officer (CEO), President, Board of Directors, Vice Presidents.

2. Middle-Level Management: Implementing the strategies and plans set by top management.

Responsibilities: Overseeing departmental functions, coordinating activities, and motivating employees.

Examples: Department Heads, Regional Managers, Branch Managers.

3. Lower-Level Management (First-Line Management/Supervisory Level):

Supervising day-to-day operations and ensuring tasks are completed efficiently.

Responsibilities: Directing and motivating employees, resolving immediate problems, and ensuring quality and productivity.

Examples: Supervisors, Team Leaders, Foremen.



EMERGING TRENDS

1. Remote Work and Digital Transformation:

The COVID-19 pandemic has accelerated the adoption of remote work and digital transformation across industries. As remote and hybrid work models become the new norm, managers must learn to lead teams effectively in virtual environments. This requires strong communication skills, the ability to leverage digital collaboration tools, and a focus on results rather than physical presence.

2. Agile Management:

Agile methodologies, originally developed in the software development industry, are now being embraced by organizations of all types. Agile management emphasises flexibility, adaptability, and rapid iteration. Managers need to empower teams to make decisions autonomously, foster a culture of experimentation, and embrace continuous improvement.

3. Diversity, Equity, and Inclusion (DEI) :

Inclusive leadership is crucial for driving innovation, employee engagement, and organisational success. Managers must prioritize diversity, equity, and inclusion initiatives, create a sense of belonging for all team members, and actively combat bias and discrimination in the workplace. Cultivating cultural competence and empathy is essential for building diverse and inclusive teams.

4. Data-Driven Decision-Making:

In the age of big data, managers have access to vast amounts of information that can inform strategic decisions. However, the ability to analyze data effectively and derive actionable insights is a critical skill. Managers need to be proficient in data literacy, understand key metrics and KPIs, and use analytics tools to drive informed decision-making.

5. Emotional Intelligence and Resilience:

As workplaces become increasingly complex and fast-paced, emotional intelligence (EQ) is becoming more important than ever. Managers need to understand their own emotions and those of their team members, communicate empathetically, and manage conflict constructively. Additionally, resilience is essential for navigating uncertainty and overcoming setbacks in the face of adversity.

6. Remote Team Building and Employee Engagement: With remote and hybrid work becoming prevalent, managers face the challenge of building cohesive teams and fostering employee engagement from a distance. To address this, managers must prioritize virtual team building activities, create opportunities for social interaction, and establish clear communication channels. Building trust and maintaining morale among remote team members are crucial for sustaining productivity and collaboration.

To create a successful remote work model in 2025, consider implementing these practices:

1. Establish regular check-ins with employees to discuss deadlines, challenges and progress.
2. Define expectations and clearly outline policies and procedures.
3. Create designated time blocks for communication and team-building.
4. Related: On-site vs. Remote: Balancing Flexible Work Arrangements

7. Lifelong Learning and Adaptability:

In a rapidly evolving business landscape, the ability to learn continuously and adapt to change is essential for success. Managers must embrace a mindset of lifelong learning, staying updated on industry trends, emerging technologies, and best practices in management. Encouraging a culture of curiosity and innovation within their teams can foster creativity and drive organisational agility.

8. Sustainable Leadership:

As environmental and social issues gain prominence, sustainable leadership is becoming increasingly important. Managers need to integrate sustainability into their decision-making

processes, prioritize environmental responsibility, and promote ethical business practices. By aligning corporate strategy with sustainability goals, managers can create value for both the organization and society as a whole.

9. Cross-Cultural Competence:

In today's interconnected world, managers often lead teams comprising individuals from diverse cultural backgrounds. Cross-cultural competence is crucial for effectively managing multicultural teams, navigating cultural differences, and building strong relationships across borders. Managers must demonstrate cultural sensitivity, adapt their communication style to diverse audiences, and foster an inclusive environment that celebrates diversity.

10. Innovation and Entrepreneurship:

Innovation is the driving force behind organizational growth and competitiveness. Managers need to foster a culture of innovation within their teams, encourage creativity, and empower employees to take risks and explore new ideas. Embracing entrepreneurial thinking and encouraging intrapreneurship can spark innovation and drive business transformation from within the organization.

How to keep up with the emerging trends in management

Here are key strategies to keep up with emerging trends in management:

- **Continuous Learning:** Engage in lifelong learning through online courses, certifications, and workshops. Staying updated on topics like digital transformation and data analytics is essential.
- **Networking with Industry Experts:** Connect with other professionals through industry events, webinars, and professional networks. Networking offers insights into current trends and best practices.
- **Reading Industry Publications:** Regularly read management journals, blogs, and news to keep oneself informed about the latest trends. Publications like Harvard Business Review and Forbes cover cutting-edge management topics.
- **Leverage Digital Tools:** Use project management, collaboration, and data analytics tools to stay adaptable. Familiarity with tools like Slack, Asana, and Power BI enhances productivity and digital skills.
- **Seek Feedback and Adapt:** Encourage team feedback and assess what's working. Flexibility and openness to change help managers adapt to new challenges and technologies.
- **Attend Conferences and Workshops:** Management conferences and workshops offers learning opportunities on current trends from industry leaders.

By actively pursuing these strategies, managers can stay relevant and adapt their skills to evolving business needs.

Conclusion

The future of management is being shaped by transformative trends such as data-driven decision-making, remote and hybrid work models, a focus on employee well-being, sustainability, and digital transformation. These trends require managers to be adaptable, tech-savvy, and people-oriented, fostering a balanced and innovative approach to leadership. As businesses face dynamic challenges, these emerging practices enable organizations to thrive, meet evolving employee expectations, and respond to global shifts. Embracing these trends helps build resilient, agile teams and ensures that managers are prepared to lead effectively in the modern landscape, ultimately driving growth and long-term success.

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Bridging Disciplines for Global Progress: The Role of Multidisciplinary Research in Shaping Sustainable Development**Dr.B.R.Kumar**Professor & Director, Department of MBA
Andhra Loyola College, Vijayawada**Abstract**

The future of global development hinges on the integration of multidisciplinary research, which combines insights from economics, technology, environmental science, social sciences, and policy-making. This chapter explores the transformative potential of multidisciplinary research in addressing complex global challenges such as poverty, inequality, climate change, and financial exclusion. By examining emerging trends in financial technology (fintech), sustainable investments, artificial intelligence (AI), and blockchain, this chapter highlights how multidisciplinary approaches can drive innovation and foster inclusive economic growth. Additionally, it addresses the challenges of regulatory barriers, cybersecurity risks, and the digital divide, offering recommendations for creating a resilient and equitable global development framework.

Keywords: Multidisciplinary research, global development, fintech, sustainable investments, artificial intelligence, blockchain, financial inclusion, regulatory challenges, cybersecurity.

1. Introduction

Global development is at a crossroads, with pressing challenges such as climate change, economic inequality, and technological disruption demanding innovative solutions. Multidisciplinary research, which integrates knowledge from diverse fields such as economics, technology, environmental science, and social sciences, has emerged as a powerful tool for addressing these complex issues. By fostering collaboration across disciplines, researchers and policymakers can develop holistic strategies that promote sustainable development, financial inclusion, and economic resilience. This chapter explores the role of multidisciplinary research in shaping the future of global development. It examines how innovations in fintech, sustainable finance, AI, and blockchain are transforming the financial landscape, while also addressing the challenges of regulatory complexity, cybersecurity threats, and the digital divide. The chapter concludes with recommendations for strengthening multidisciplinary collaboration and creating a more inclusive and sustainable global development framework.

2. Emerging Trends in Multidisciplinary Research for Global Development**2.1. Fintech and Digital Financial Inclusion**

The rise of financial technology (fintech) has revolutionized the global financial ecosystem, particularly in underserved regions. Digital banking platforms, mobile payment systems, and blockchain-based solutions have expanded access to financial services, enabling millions of unbanked individuals to participate in the formal economy. For example, **M-Pesa**, a mobile money service in Kenya, has transformed financial inclusion by allowing users to perform transactions without traditional bank accounts. Similarly, India's **Aadhaar-linked financial**

services have facilitated direct benefit transfers, reducing financial exclusion among marginalized communities.

2.2. Sustainable Finance and ESG Investments

Environmental, Social, and Governance (ESG) investments are reshaping the global financial landscape by aligning capital flows with sustainable development goals (SDGs). Green bonds, impact investing, and climate finance are driving capital allocation towards environmentally friendly and socially responsible projects. The European Union's **Green Bond Standard (EU GBS)** is a prime example of how regulatory frameworks can incentivize sustainable investments. Multidisciplinary research plays a critical role in designing these frameworks, ensuring that financial returns are balanced with environmental and social impact.

2.3. Artificial Intelligence and Big Data in Development Finance

Artificial intelligence (AI) and big data analytics are transforming global development finance by enhancing risk assessment, fraud detection, and investment strategies. AI-driven credit scoring systems, such as those used in India, analyze alternative data sources like mobile payment histories and social media activity to extend credit to previously unbanked populations. These innovations are not only improving financial inclusion but also enhancing the efficiency of financial decision-making.

2.4. Blockchain and Decentralized Finance (DeFi)

Blockchain technology is disrupting traditional financial systems by enabling decentralized finance (DeFi) solutions. By eliminating intermediaries, blockchain enhances transaction transparency, reduces costs, and facilitates peer-to-peer lending. For instance, **RippleNet's** blockchain-based payment network has improved the efficiency of cross-border remittances, reducing transaction fees and processing times. These advancements are fostering a more inclusive and decentralized financial system.

2.5. Microfinance and Social Impact Financing

Microfinance institutions and innovative financing models such as crowdfunding, peer-to-peer lending, and social impact bonds are expanding access to capital for small businesses and community-driven projects. Platforms like **Kiva** enable individuals to lend money to entrepreneurs in developing countries, promoting financial independence and economic empowerment. These models demonstrate the potential of multidisciplinary research in fostering financial inclusion and social development.

3. Challenges in Multidisciplinary Research for Global Development

3.1. Regulatory and Compliance Barriers

The rapid pace of technological innovation in fintech and blockchain has outpaced the development of regulatory frameworks, creating challenges in ensuring compliance and

preventing financial crimes. Regulatory sandboxes, which allow fintech startups to test new solutions under regulatory supervision, offer a potential solution. However, global cooperation among financial regulators is essential to manage cross-border financial activities and prevent regulatory arbitrage.

3.2. Cybersecurity and Data Privacy Risks

The digitalization of financial services has heightened concerns about cybersecurity and data privacy. Financial institutions must invest in robust encryption technologies, multi-factor authentication, and real-time threat detection systems to mitigate risks. Governments and regulators should enforce stringent data protection laws to safeguard sensitive financial information and ensure compliance with industry security standards.

3.3. Financial Literacy and the Digital Divide

A lack of financial literacy and limited digital access pose significant barriers to the adoption of modern financial solutions, particularly in low-income and rural communities. Investments in financial education and digital infrastructure are necessary to bridge this gap. Public and private sector initiatives should focus on providing accessible financial literacy programs and expanding internet access in underserved regions.

3.4. Sustainable Investment Measurement and Accountability

The growing popularity of ESG investing has highlighted the need for standardized sustainability impact assessment frameworks. Inconsistent reporting standards make it difficult for investors to evaluate the actual impact of ESG-focused investments, leading to concerns about "greenwashing." Regulatory bodies should establish globally recognized ESG disclosure standards, and independent ESG rating agencies should certify the sustainability impact of investment products.

4. Case Studies in Multidisciplinary Financial Innovation

4.1. Fintech and Financial Inclusion: M-Pesa in Kenya

M-Pesa, a mobile-based digital payment platform, has revolutionized financial transactions in Kenya by enabling secure and efficient money transfers, microloans, and remittance services. The success of M-Pesa highlights the transformative potential of fintech in driving financial inclusion, particularly in regions with limited banking access.

4.2. AI-Powered Credit Scoring in India

AI-driven credit scoring systems in India have expanded credit access to millions of previously unbanked individuals by analyzing alternative data sources such as utility bill payments and mobile phone usage. These innovations demonstrate how technology can bridge gaps in traditional credit assessment, fostering economic empowerment and entrepreneurship.

4.3. Green Bond Market Growth in Europe

The European Union's green bond market has experienced significant growth due to favorable policy incentives and regulatory frameworks. Green bonds, which fund environmentally friendly projects, have gained traction among investors seeking to support climate-conscious initiatives. This case study illustrates how government policies can stimulate sustainable investment and promote environmental responsibility.

4.4. Blockchain for Cross-Border Remittances

Blockchain technology has improved the efficiency of cross-border remittances by reducing transaction fees and eliminating intermediaries. Platforms like RippleNet have enhanced financial inclusivity by enabling faster and more secure international money transfers, benefiting migrant workers and their families.

5. Future Directions and Recommendations

5.1. Strengthening Multidisciplinary Collaboration

Collaboration among economists, technologists, policymakers, and social scientists is essential for driving innovation in global development finance. Governments, research institutions, and private sector entities should foster cross-disciplinary partnerships through joint research initiatives and knowledge-sharing platforms.

5.2. Enhancing Financial Education and Digital Literacy

Financial literacy and digital literacy are fundamental to equitable access to financial services. Educational institutions and NGOs should integrate financial literacy programs into global development policies, while governments should support digital literacy campaigns in underserved regions.

5.3. Developing Robust Regulatory Frameworks

Governments and regulators must establish clear policies that balance financial innovation with risk management. Transparent and adaptive regulatory frameworks are crucial for fostering trust in digital financial systems while mitigating risks such as fraud and cybersecurity threats.

5.4. Scaling Sustainable Finance Solutions

Expanding sustainable finance initiatives through policy incentives, investor engagement, and impact measurement tools will drive long-term financial sustainability and social development. Governments should introduce tax benefits and subsidies for green investments, while robust impact measurement frameworks should ensure transparency and accountability.

6. Conclusion

Multidisciplinary research is transforming global development finance, fostering financial inclusion, sustainability, and economic growth. The integration of technology, policy, and

social impact investment presents unprecedented opportunities to address financial disparities worldwide. However, regulatory challenges, cybersecurity risks, and financial literacy gaps must be addressed. By strengthening collaboration, promoting financial education, and developing resilient regulatory frameworks, global development finance can become more inclusive, sustainable, and impactful in driving economic progress.

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Gender Economics: Advancing Equity for Sustainable Development

Dr. Ananthaneni Madhuri

Assistant Professor, Department of MBA
Andhra Loyola College, Vijayawada

Abstract

Gender economics examines the role of gender in economic decision-making, labour market participation, income distribution, and overall economic growth. This chapter explores the interconnection between gender equity and sustainable development, analyzing how gender disparities affect global economic progress. It delves into key areas such as wage gaps, labour force participation, access to education, and financial inclusion, highlighting the long-term benefits of gender-inclusive policies. Through empirical evidence and case studies, the chapter demonstrates that closing gender gaps can significantly boost economic productivity, enhance innovation, and reduce poverty. Policy recommendations include targeted investments in education, legal reforms to promote workplace equality, and financial strategies to empower women entrepreneurs. By advancing gender equity, societies can foster sustainable development and create resilient economies that benefit all.

Keywords: Gender Economics, Gender equity, Gender gaps, Economic Productivity, Sustainable development

Introduction

Gender equality is not only a moral imperative but also a crucial driver of economic development. Historically, economic systems have been structured in ways that limit women's access to resources, employment opportunities, and financial independence. While significant progress has been made in many parts of the world, gender disparities continue to exist in wages, labour force participation, financial inclusion, and access to quality education. Addressing these disparities is essential for fostering inclusive and sustainable economic growth. Gender equity contributes to economic development by maximizing the utilization of human capital. When women participate fully in the workforce, productivity increases, innovation thrives, and economies experience more robust and sustainable growth. Studies have shown that closing gender gaps in labour markets can lead to significant gains in GDP. For instance, the McKinsey Global Institute estimates that advancing gender equality could add \$12 trillion to global GDP by 2025. Additionally, gender-inclusive policies have been linked to improved health and education outcomes, greater economic resilience, and higher overall prosperity.

Review of Literature

The literature on gender economics highlights the persistent challenges and opportunities in achieving gender equity for sustainable development. Key themes include the gender wage gap, occupational segregation, unpaid care work, and barriers to education and financial inclusion. Studies by **Blau and Kahn (2024)** and **Goldin (2024)** emphasize the structural barriers women face in labor markets, while **Duflo (2023)** and **Kabeer (2024)** underscore the economic and social benefits of empowering women.

The role of education in reducing gender inequality is well-documented by **Heath and Jayachandran (2023)** and **Patel and Sandefur (2023)**, while **Chaudhury and Parajuli (2023)** highlight the transformative potential of microfinance for women's economic empowerment. Policy recommendations from **OECD (2024)** and **World Bank (2023)** stress the importance of legal reforms, financial inclusion, and workplace policies to promote gender equity. Collectively, the literature demonstrates that closing gender gaps is essential for achieving sustainable development and inclusive economic growth.

1. Gender Disparities in Economic Participation

Despite advancements in gender equality, disparities in labour market participation, wages, and leadership positions remain significant. Women globally earn, on average, 20% less than men, and their participation in the labour force is consistently lower. Structural barriers such as occupational segregation, unpaid care work, and discriminatory laws continue to limit women's economic opportunities.

1.1 Wage Gaps and Occupational Segregation

Women are often concentrated in lower-paying sectors and face wage discrimination even within the same industries. The gender pay gap reflects differences in access to higher-paying jobs, leadership positions, and career advancement opportunities.

- **Sectoral Segregation:** Many industries remain gender-segregated, with women overrepresented in lower-paid care, education, and administrative roles, while men dominate higher-paying fields such as technology and engineering. Encouraging women to enter male-dominated fields through targeted policies and incentives can help bridge this divide.
- **Glass Ceiling Effect:** Women face challenges in reaching leadership positions due to workplace biases and inadequate mentorship opportunities. Implementing leadership training, sponsorship programs, and equal opportunity policies can promote women into decision-making roles.
- **Pay Transparency and Policy Interventions:** Governments and corporations can reduce wage disparities by enforcing equal pay laws, requiring pay audits, and promoting pay transparency. Organizations that disclose wage structures experience smaller gender pay gaps.

1.2 Unpaid Care Work and Economic Growth

A significant factor limiting women's workforce participation is the disproportionate burden of unpaid care work. Women perform three times more unpaid household and caregiving labour than men, reducing their time for paid employment. The economic impact of unpaid labour is vast, as it restricts women's financial independence and overall economic contributions.

- **Economic Value of Unpaid Work:** According to estimates, unpaid care work contributes between 10-39% of GDP in some countries, yet it remains undervalued in economic measurements. Recognizing unpaid work in national economic assessments can highlight its true impact.

- **Workplace Flexibility and Family Support Policies:** Many women struggle to balance caregiving responsibilities with career advancement. Policies such as paid parental leave, flexible working hours, and employer-sponsored childcare can support women's continued workforce participation.
- **Redistributing Care Responsibilities:** Encouraging shared caregiving responsibilities among men and women through awareness campaigns and legislative measures, such as mandatory paternity leave, can help alleviate the burden on women. In countries with strong paternity leave policies, such as Sweden, workforce participation among women is significantly higher.

2. The Role of Education in Gender Equity and Economic Growth

Access to quality education is a key determinant of economic success. Countries that invest in girls' education experience higher GDP growth, lower child mortality rates, and improved overall economic stability. Closing gender gaps in education leads to increased workforce productivity, innovation, and economic resilience.

2.1 Barriers to Education for Women and Girls

Despite global progress in increasing school enrollment rates for girls, barriers such as poverty, cultural norms, and inadequate infrastructure still prevent many from completing their education.

- **Financial Constraints:** Families facing economic hardship may prioritize boys' education over girls', limiting opportunities for women in future employment markets. Expanding scholarship programs and conditional cash transfers can support female education.
- **Cultural and Social Norms:** In many societies, early marriage and gender norms restrict girls' access to secondary and higher education. Raising awareness and implementing policies to delay early marriage can improve education outcomes.
- **Lack of Infrastructure:** In rural areas, the absence of safe schools and inadequate sanitation facilities disproportionately affects girls' school attendance. Investing in gender-sensitive infrastructure can enhance retention rates.

2.2. The Economic Benefits of Female Education

Educating women has a profound multiplier effect on economies, creating a ripple effect that extends beyond individual benefits to societal and national progress. Higher education levels among women are strongly correlated with increased productivity, innovation, and improved health outcomes for families. When women are educated, they are better equipped to participate in the formal labour market, contribute to economic growth, and drive social development.

- **Higher Earnings and Productivity:** Women with access to education are more likely to secure stable, formal employment, which significantly increases their lifetime earnings. This not only improves their personal financial stability but also contributes to broader economic growth. Educated women are more likely to enter

higher-paying professions, start businesses, and invest in their communities, creating a cycle of economic empowerment. Studies have shown that increasing female labour force participation can boost GDP growth, with some estimates suggesting that closing the gender gap in employment could add trillions to the global economy.

- **Intergenerational Benefits:** Educated mothers tend to invest more in their children's health, nutrition, and education, creating a positive feedback loop that benefits future generations. Children of educated women are more likely to attend school, perform better academically, and have better health outcomes. This intergenerational impact contributes to long-term economic and social progress, reducing poverty and inequality over time. For example, research indicates that each additional year of maternal education reduces child mortality rates and increases the likelihood of children completing their education.
- **Innovation and Economic Growth:** A diverse workforce that includes educated women fosters creativity, problem-solving, and technological advancements. Women bring unique perspectives and skills to industries, driving innovation and competitiveness. Companies with gender-diverse leadership teams have been shown to outperform their peers, highlighting the economic value of including women in decision-making roles. By investing in female education, economies can unlock untapped potential, leading to more dynamic and resilient industries.

3. Financial Inclusion and Women's Economic Empowerment

Financial inclusion is a cornerstone of women's economic empowerment, yet women remain disproportionately excluded from formal banking and credit systems. Addressing this gap is essential for achieving gender equality and fostering inclusive economic growth.

3.1.Barriers to Financial Access: Women face numerous challenges in accessing financial services, including lack of collateral, lower financial literacy, and discriminatory banking practices. In many regions, cultural norms and legal restrictions further limit women's ability to own property or open bank accounts. These barriers prevent women from securing loans, starting businesses, or saving for the future, perpetuating cycles of poverty and inequality. For example, in some countries, women are required to have a male relative co-sign for a loan, effectively excluding them from financial independence.

3.2.Microfinance and Digital Banking Solutions: Expanding access to microfinance, mobile banking, and digital payment systems can significantly enhance women's financial independence. Microfinance institutions have proven effective in providing small loans to women entrepreneurs, enabling them to start or expand businesses. Digital banking solutions, such as mobile money platforms, offer convenient and secure ways for women to save, transfer funds, and access credit, even in remote areas. These tools are particularly impactful in regions where traditional banking infrastructure is lacking. For instance, mobile money services like M-Pesa in Kenya have empowered millions of women by providing them with access to financial services for the first time.

3.3. Government and Private Sector Initiatives: Governments and private sector actors play a crucial role in promoting financial inclusion for women. Policies that encourage financial literacy, equal access to credit, and the development of tailored financial products for women can drive inclusive economic growth. For example, governments can implement programs to educate women about financial management, while banks can design loan products that do not require collateral or have flexible repayment terms. Public-private partnerships can also support initiatives that provide women with the tools and resources they need to achieve financial independence.

4. Policy Recommendations for Gender-Inclusive Economic Development

To achieve gender-inclusive economic development, a comprehensive approach is needed, encompassing legal reforms, education, financial inclusion, and workplace policies.

4.1. Legal Reforms: Strengthening laws on equal pay, property rights, and protection against workplace discrimination is essential for creating an enabling environment for women's economic participation. Legal frameworks should ensure that women have equal access to land, inheritance, and credit, as well as protection from gender-based violence and harassment in the workplace. For example, countries that have implemented equal pay laws have seen significant reductions in the gender wage gap.

4.2. Education and Workforce Development: Increasing investments in girls' education, vocational training, and mentorship programs is critical for preparing women to enter and thrive in the workforce. Governments and organizations should prioritize initiatives that address barriers to girls' education, such as school fees, cultural norms, and lack of infrastructure. Vocational training programs can equip women with the skills needed for high-demand industries, while mentorship programs can provide guidance and support for career advancement.

4.3. Financial Inclusion Strategies: Expanding women's access to credit, financial literacy programs, and support for female entrepreneurs is key to unlocking their economic potential. Governments can establish funds to provide low-interest loans to women-owned businesses, while financial institutions can develop products tailored to women's needs. Financial literacy programs should be integrated into school curricula and community initiatives to ensure that women have the knowledge and confidence to manage their finances effectively.

4.4. Workplace Policies: Implementing gender-responsive policies such as parental leave, workplace flexibility, and leadership programs for women can help address the challenges women face in balancing work and family responsibilities. Companies should adopt policies that promote gender diversity in leadership roles, such as setting targets for female representation on boards and in senior management positions. Flexible work arrangements, such as remote work and part-time options, can enable women to remain in the workforce while fulfilling caregiving responsibilities.

Conclusion

Closing gender gaps in the economy is not only a social priority but also a crucial economic strategy for sustainable development. Ensuring equal opportunities for women in education,

employment, and finance leads to stronger economies, poverty reduction, and greater global prosperity. Governments, businesses, and civil society must collaborate to create gender-inclusive economic policies that foster long-term growth and resilience. Achieving gender equity in economic participation will result in a more just, prosperous, and sustainable future for all.

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**The Impact of Digital Marketing Strategies on Consumer Purchase Behavior in
Madurai City: An Empirical Analysis**

Dr.S.Valli Devasena

Assistant Professor

Department of Commerce

Research and Extension Centre

Mother Teresa Women's University, Madurai

Abstract

This study examines the impact of digital marketing on consumer purchase behavior using ANOVA analysis. The study focuses on factors such as digital advertisements, influencer marketing, and personalized ads to determine their significance in influencing purchasing decisions. The findings indicate that while some digital marketing strategies have a considerable impact on consumer trust and behavior, others show limited significance. These results have implications for businesses aiming to optimize their digital marketing strategies. The study further explores the role of promotional discounts, brand credibility, and privacy concerns in shaping consumer responses to digital campaigns. The research is based on a sample survey of 125 respondents and employs ANOVA tests for statistical analysis. The findings suggest that while digital marketing is a crucial tool, its effectiveness depends on the strategy employed.

Keywords: Digital marketing, consumer behavior, influencer marketing, online advertisements, ANOVA analysis, purchasing decisions.

Introduction

The rise of digital marketing has revolutionized consumer engagement with brands. From social media advertising to personalized recommendations, businesses leverage multiple online platforms to influence purchasing behavior. The advent of e-commerce and digital marketing techniques has significantly altered traditional consumer shopping habits. Understanding how different elements of digital marketing affect consumer decisions is crucial for businesses to refine their strategies. Consumer preferences have shifted toward online platforms due to convenience, product variety, and promotional deals. However, the effectiveness of digital marketing remains a debated topic. While some consumers trust digital advertisements and influencer endorsements, others are skeptical about promotional content. This study aims to investigate the relationship between digital marketing elements and consumer behavior. Specifically, it examines whether digital marketing strategies effectively drive purchases or whether external factors such as pricing, availability, and trustworthiness play a more significant role.

Statement of the Problem

Despite the growing reliance on digital marketing, there is limited research on the actual impact of various digital marketing elements on consumer purchase decisions. Many companies invest heavily in social media campaigns, influencer partnerships, and personalized advertisements, assuming they directly drive sales. However, consumer responses to digital marketing strategies are often complex and influenced by multiple factors, including trust, previous experience, and product quality.

There is a need to analyze which digital marketing strategies have a statistically significant impact on consumer purchase behavior and which ones fail to influence decision-making. This study aims to fill that gap by using ANOVA analysis to evaluate consumer perceptions of digital advertisements, influencer marketing, and promotional discounts. The results will provide insights into the effectiveness of different digital marketing techniques and guide businesses in optimizing their strategies for better consumer engagement.

Literature Review

Digital marketing has transformed consumer behavior, influencing purchasing decisions through advertisements, influencer endorsements, and promotional strategies. Several studies have analyzed its impact across different consumer segments.

1. **Chaffey & Ellis-Chadwick (2019)** examined digital marketing strategies and found that social media engagement significantly enhances brand loyalty.
2. **Kotler & Keller (2016)** emphasized that personalized advertisements can improve customer retention rates by up to 30%.
3. **Smith & Zook (2020)** highlighted that influencer marketing plays a critical role in shaping young consumers' brand perceptions.
4. **Lee & Watkins (2016)** found that YouTube vloggers influence luxury brand perceptions, increasing consumer purchase intent.
5. **Statista (2023)** reported that global digital ad spending grew by 17% in the last year, indicating businesses' reliance on digital campaigns.
6. **Kaplan & Haenlein (2010)** explored the effectiveness of viral marketing and concluded that user-generated content has a significant impact on brand engagement.
7. **Dahlen et al. (2017)** examined banner ads and found that repeated exposure leads to higher brand recall but lower engagement.
8. **Grewal et al. (2019)** analyzed the role of artificial intelligence in digital marketing and discovered that AI-driven chatbots enhance customer satisfaction by 25%.
9. **Dwivedi et al. (2021)** discussed privacy concerns in personalized marketing, highlighting that 45% of consumers are skeptical about data tracking.
10. **Batra & Keller (2016)** explored the role of storytelling in digital ads and found that emotionally driven campaigns improve brand recall and engagement.

These studies provide a strong foundation for understanding digital marketing's role in consumer behavior and guide this study's focus on Madurai City.

Existing research highlights the growing importance of digital marketing in shaping consumer preferences. Studies suggest that influencer marketing can enhance brand credibility, while personalized advertisements improve engagement. However, concerns regarding privacy and the oversaturation of digital ads pose challenges to marketers. Prior research indicates that promotional discounts and social media campaigns are key drivers in consumer decision-making.

Research Methodology

Research Design

This study follows a **descriptive research design** to analyze the influence of digital marketing strategies on consumer behavior. The research seeks to examine consumer

perceptions of various digital marketing techniques, including influencer marketing, digital advertisements, and personalized promotions.

Research Method

A **quantitative research method** was used to collect and analyze numerical data. A structured survey questionnaire was distributed to respondents to gather insights into their perceptions and behavior toward digital marketing.

Sample Size Selection

The sample size for this study was determined using the Cochran formula for sample size calculation, which is given by:

$$n_0 = \frac{Z^2 p(1-p)}{e^2}$$

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

Where:

- = Required sample size
- = Z-score (1.96 for 95% confidence level)
- = Estimated proportion of the population (assumed to be 0.5 for maximum variability)
- = Margin of error (typically 0.05 for 95% confidence level)

After adjusting for a finite population, the final sample size is calculated using:

Where N is the total population. Based on this formula, the sample size was determined to be **125 respondents**, ensuring a sufficient representation of the consumer population in the study. The sample size for this study was **125 respondents**, selected based on convenience sampling. The chosen sample represents a mix of consumers familiar with digital marketing strategies.

Sampling Method

A **non-probability convenience sampling** method was employed. Respondents were chosen based on accessibility and willingness to participate in the study.

Formula Used

The study applies ANOVA (Analysis of Variance) to determine whether significant differences exist between consumer responses across different digital marketing strategies. The standard ANOVA formula used is:

$$F = \frac{MS_{between}}{MS_{within}}$$

Where:

- = Variance between groups
- = Variance within groups
- **F-value** determines whether differences between means are statistically significant.

Scope of the Study

This study focuses on consumer perceptions of digital marketing strategies, particularly in the context of:

- Online advertisements (social media, search engine marketing)
- Influence of digital promotions (discounts, offers)
- Effect of influencer marketing on consumer trust
- Role of personalized marketing in purchase decisions

Area of Research

The study was conducted in **Madurai City**, targeting urban consumers who frequently engage with digital marketing campaigns through social media, e-commerce platforms, and online advertisements. The research focuses on understanding the impact of digital marketing strategies on consumer behavior within this geographic region, considering cultural and economic factors that may influence purchasing decisions. The study was conducted within an urban consumer market, targeting individuals who frequently engage with digital marketing campaigns through social media, e-commerce platforms, and online advertisements.

Data Analysis & Discussion

Respondent Profile

The study surveyed 125 respondents from Madurai City to analyze consumer behavior toward digital marketing. The demographic profile of the respondents includes:

- Age Distribution: Majority (67.5%) of the respondents are aged between 21-23 years, followed by 21.7% in the 18-20 age group.
- Gender: Female respondents (65.8%) outnumber male respondents (34.2%).
- Educational Qualification: The sample includes undergraduate (45.8%), postgraduate (49.2%), and diploma holders (4.2%).
- Residential Area: Respondents are from urban (45.8%), semi-urban (22.5%), and rural (31.7%) areas of Madurai City.
- Monthly Pocket Money/Spending: The majority (54.2%) have a monthly allowance of less than ₹ 1000, while 27.5% receive between ₹ 1001-3000.

ANOVA

Results provide insights into different digital marketing variables:

ANOVA						
Statements		Sum of Squares	df	Mean Square	F	Sig.
I trust product recommendations or reviews that I see in digital marketing campaigns.	Between Groups	2.602	2	1.301	1.229	.296
	Within Groups	130.200	123	1.059		
	Total	132.802	125			
Digital ads (social media, search engines, etc.) influence my decision to purchase products.	Between Groups	4.301	2	2.151	2.179	.118
	Within Groups	121.413	123	.987		
	Total	125.714	125			
Promotion, discounts, or deals advertised through digital marketing impact my buying behavior.	Between Groups	2.248	2	1.124	.723	.487
	Within Groups	191.244	123	1.555		
	Total	193.492	125			

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In frequently click on online ads and explore products that are marketed to me digitally.	Between Groups	2.675	2	1.338	1.159	.317
	Within Groups	141.936	123	1.154		
	Total	144.611	125			
My purchasing decisions are influenced by influencers or bloggers I follow through digital marketing.	Between Groups	4.480	2	2.240	2.024	.136
	Within Groups	136.131	123	1.107		
	Total	140.611	125			

- **Influence of Digital Ads:** The F-value for digital advertisements influencing purchase decisions was 2.179 with a significance level of 0.118, indicating a moderate but statistically insignificant impact.
- **Role of Influencer Marketing:** The analysis showed an F-value of 2.024 (Sig. = 0.136), suggesting a limited yet noteworthy influence of influencers on purchasing decisions.
- **Effect of Promotional Discounts:** Promotional discounts and deals had an F-value of 0.723 with a significance level of 0.487, indicating that while consumers engage with promotions, they may not be the primary factor in purchasing decisions.
- **Personalized Advertisements:** Personalized ads showed mixed responses, with an F-value of 0.156 (Sig. = 0.856) for influencing purchases, indicating that while consumers notice them, their effect on decisions remains low.

Findings & Implications

The findings suggest that digital marketing strategies need to be optimized to enhance their effectiveness. Influencer marketing, though not highly significant, still plays a role in consumer trust. Promotional discounts remain relevant but are not the sole driver of purchases. Businesses should focus on improving ad personalization while addressing consumer concerns about privacy and relevance.

Conclusion & Recommendations

Digital marketing continues to be a powerful tool for consumer engagement, but its effectiveness varies across different strategies. Businesses should consider refining their digital ad campaigns, leveraging influencer marketing effectively, and ensuring that promotional efforts align with consumer expectations. Future research should explore behavioral patterns in different demographics to refine digital marketing approaches further.

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Artificial Intelligence in Financial Decision-Making: A Paradigm Shift in Risk Management

Mohammed Shebeen T

Research Scholar, UGC-NET-JRF

Department of Commerce, University of Madras, Chennai-05

Dr Jayaprakasan PP

Assistant Professor, Department of Commerce

TM Government College, Tirur, Malappuram, Kerala

Abstract

Artificial Intelligence (AI) has radically reshaped financial decision-making, most notably in the area of risk management. The swift progress of machine learning algorithms, big data analytics, and predictive modeling has allowed financial institutions to enhance accuracy in risk evaluation, fraud identification, and portfolio optimization. The capability of AI systems to handle huge volumes of structured and unstructured data in real-time makes it possible to have more dynamic, responsive, and accurate risk management models. Conventional financial risk management techniques used to depend on static models based on predefined variables and thus could not manage to adapt to quickly evolving financial markets. AI, by combining real-time data analysis with predictive modeling, strengthens decision-making processes.

The uses of AI in financial risk management are diverse. AI-based credit risk assessment leverages alternative data sources, including consumer behavior patterns, social media usage, and transaction history, to create more holistic and accurate credit profiles. This promotes financial inclusion by allowing banks and lending institutions to evaluate creditworthiness based on non-traditional financial information. In the same vein, AI is also used in fraud prevention and detection through the use of machine learning technology to recognize anomalous patterns of transactions and spot fraud in real time. Fraud detection systems that are driven by AI learn and evolve continuously according to new patterns of fraud, thus mitigating monetary losses and security for financial institutions and consumers alike. Another important use of AI in financial decision-making is portfolio optimization and algorithmic trading. AI-based trading algorithms scan past and current market data to determine patterns and forecast market trends with high accuracy. The algorithms allow traders and financial analysts to take informed investment decisions based on data, avoiding risks and maximizing returns. Hedge funds and asset management companies increasingly employ AI-based trading strategies to maximize portfolios and make trades at the most favorable times. The use of AI in trading has given rise to high-frequency trading (HFT), where AI makes trades within microseconds on the basis of market signals, creating a competitive advantage in financial markets.

While AI presents many benefits in financial risk management, challenges exist. Algorithmic bias, data privacy, and regulatory ambiguity are major stumbling blocks in the large-scale

application of AI-based financial decision-making. AI systems are also dependent on data quality, and biased or partial data can produce incorrect risk evaluation and discriminatory financial decisions. In addition, ethical aspects of AI adoption, like transparency and accountability in decision-making, necessitate financial institutions to develop strong governance frameworks to ensure that risks arising from AI-driven models are curbed.

The research delves into these major areas of AI in financial risk management through case studies of top financial institutions like JPMorgan Chase, Goldman Sachs, and PayPal. It identifies the advantages and disadvantages of AI-based financial models and offers insights into regulatory environments and ethical issues necessary for long-term AI adoption. The paper concludes by suggesting directions for future research, including AI regulation, creating equitable and impartial AI models, and the changing role of AI in decentralized finance (DeFi). The conclusions of this research add to the existing body of literature on AI-based financial decision-making, highlighting the importance of balancing technological innovation with ethical and regulatory aspects.

Keywords

Artificial Intelligence, Financial Risk Management, Machine Learning, Predictive Analytics, Credit Risk Assessment, Fraud Detection, Algorithmic Trading, Portfolio Optimization, High-Frequency Trading, Ethical AI, Regulatory Compliance, Data Privacy, Decision-Making, Fintech, Big Data Analytics.

Introduction

The financial industry has traditionally depended on conventional risk management methods, such as statistical modeling and human know-how. However, with increasing complexity in financial transactions and exponential growth in data generated, conventional methods have failed to keep up. Artificial Intelligence (AI) has come forth as a revolutionizing force that provides powerful solutions to support better financial decision-making, optimize risk management approaches, and boost operational efficiency. AI-powered financial systems use machine learning, deep learning, and natural language processing (NLP) to examine large volumes of structured and unstructured data in real time. Such advanced technologies enable more precise predictions, better fraud detection, and better risk assessment models. AI models improve their decision-making as they learn from new data in real time, adapting to changing market conditions and detecting emerging financial risks before they gain magnitude.

One of the key impacts of AI in finance is that it can minimize human bias in decision-making. Conventional financial risk models typically involve subjective assumptions that do not necessarily represent market conditions. Unlike AI models, however, which are data-driven and emphasize minimal human intervention to enhance the objectivity of financial evaluation. This has translated into greater efficiency, higher accuracy, and stronger risk mitigation approaches in the fields of banking, investment, and regulatory compliance.

The significance of AI in managing financial risk is also highlighted by its capacity to handle alternative data sources, including social media behavior, customer transactions, and sentiment analysis. This expanded view allows financial institutions to evaluate creditworthiness more precisely, identify fraudulent behavior in real time, and optimize investment portfolios. Computer systems fueled by artificial intelligence have transformed trading models by allowing high-frequency trading (HFT) and algorithmic trading platforms that respond instantly to market volatility, increasing the efficiency of the financial markets.

While it has many advantages, integrating AI in financial decision-making is not free from challenges. Concerns around data privacy, algorithmic biases, regulatory requirements, and ethical implications are still major issues. Making AI-driven financial models transparent, fair, and accountable is key to developing trust and sustainable usage in the financial industry.

This research intends to investigate the disruptive effect of AI on financial decision-making and risk management. Drawing on case studies of prominent financial institutions and surveying available literature, the paper offers observations into the strengths, weaknesses, and ethical issues relating to AI-powered financial models. The conclusion emphasizes the imperative for a well-balanced strategy combining technological advancements with strong governance systems to make responsible AI implementation possible in the finance industry.

Literature Review

Several studies have considered AI applications in finance, and its application has been strongly laid in risk avoidance and operational effectiveness. Machine learning (ML), deep learning, and natural language processing (NLP) have shown effectiveness in fraud detection, market prediction, and algorithmic trading. Goodell et al. (2021) explain that risk management models based on AI significantly improve the capabilities of financial institutions in forecasting market volatility and lowering systemic risk. In the same vein, Bianchi et al. (2022) bring to light that AI-based credit risk evaluation offers more diverse financial services by tapping alternative sources of information other than conventional credit scores. The application of AI for fraud detection has also garnered substantial academic interest. According to Ngai et al. (2020), deep learning algorithms can detect sophisticated fraudulent activities that may go unnoticed with traditional statistical methods. Additionally, Kumar et al. (2023) contend that AI-driven anomaly detection methods have greatly decreased financial fraud instances in online transactions. Literature also highlights ethical and regulatory issues in AI adoption. Ziewitz (2019) explains that algorithmic bias in AI-based financial models can lead to unequal credit scoring and discriminatory lending. Therefore, regulatory systems need to adapt to promote transparency and equality in AI-driven decision-making. This body of literature points to AI's revolutionary influence on financial decision-making while calling for ethical and regulatory regulation.

Methodology

This study uses a qualitative research methodology and case studies on prominent financial institutions like JPMorgan Chase, Goldman Sachs, and PayPal. Industry reports, financial

disclosures, and expert interviews are the data sources. The research analyzes how AI models affect decision-making, highlighting the advantages and disadvantages of AI implementation in financial risk management. The qualitative analysis gives a thorough insight into AI integration within financial systems, assessing its efficiency in preventing financial risks, identifying fraudulent transactions, and maximizing investment strategies. Based on comparative case study analysis, this study seeks to provide insights into best practices and challenges of AI-based financial decision-making.

AI Applications in Financial Risk Management

The incorporation of Artificial Intelligence (AI) into financial risk management has transformed how institutions evaluate, forecast, and manage risks. AI-based systems employ machine learning algorithms, natural language processing (NLP), and deep learning methods to scrutinize big-scale financial data, detecting patterns and forecasting risks with a degree of accuracy higher than conventional statistical models. This section discusses important AI applications in financial risk management.

Credit Risk Assessment

Conventional credit risk evaluations are based on credit scores and financial histories, which restrict financial access to individuals and companies with poor or non-existent records. AI-based credit risk models use alternative data sources like online transactions, spending patterns, utility bills, and even social media activity to build a more complete credit profile. Companies like ZestFinance and Upstart leverage AI to enhance credit risk analysis, allowing financial institutions to make more accurate lending decisions and expand financial inclusion.

Fraud Detection and Prevention

AI is central to the detection of fraud by processing large amounts of data to detect anomalies in transaction behavior. Rule-based fraud detection systems that are traditionally used cannot keep up with changing fraudulent methods. Machine learning algorithms update themselves with new information constantly and thus become better at detecting fraudulent transactions in real time. AI-driven fraud detection systems, for example, PayPal and Mastercard, detect suspicious transactions and prevent financial loss before it happens.

Algorithmic Trading and Portfolio Optimization

Algorithmic trading powered by AI has transformed financial markets by making trades at speeds and efficiencies that are beyond human capabilities. AI processes historical and real-time market data to forecast stock movements and optimize portfolios. Hedge funds and investment companies, including Renaissance Technologies and BlackRock, utilize AI-powered trading models to reduce risk exposure and maximize returns. Portfolio management platforms like Wealthfront and Betterment utilize AI to customize investment strategies according to user preferences and market conditions.

Regulatory Compliance and Risk Monitoring

Banks are subject to greater regulatory scrutiny, necessitating the monitoring of anti-money laundering (AML) and know-your-customer (KYC) compliance. AI simplifies compliance processes by automatically monitoring transactions, identifying suspicious transactions, and facilitating regulatory compliance. AI-powered compliance solutions, such as IBM Watson and NICE Actimize, minimize operational expenditure and enhance efficiency.

Challenges and Ethical Considerations

Although AI in financial decision-making has advantages, it also poses a number of challenges such as data privacy issues, algorithmic bias, regulatory ambiguity, and ethical issues.

Algorithmic Bias and Fairness

AI algorithms can inherit biases in training data, resulting in discriminatory lending or biased credit risk assessment. It is important to ensure fairness and transparency in AI-based financial decisions to avoid systemic discrimination.

Data Privacy and Security

AI is based on enormous amounts of sensitive financial information, and there are issues of data privacy and security. Regulatory environments like GDPR and CCPA require robust data protection practices, but financial institutions have to weigh AI-based insights against compliance and ethical factors.

Regulatory and Legal Complexities

The dynamic nature of AI challenges the regulators to provide clear legal frameworks for its application in financial services. Ensuring that the financial decisions made by AI are in conformity with the existing laws and ethical guidelines is a challenging task.

Conclusion and Future Directions

Artificial intelligence transformed financial risk management by making it possible to have better credit risk evaluation, fraud detection, algorithmic trading, and regulatory compliance. While AI facilitates improved decision-making, issues like algorithmic bias, data privacy, and regulatory challenges require an equilibrium in the use of AI. Subsequent research must target the creation of unbiased AI models, reinforcing regulation, and researching AI in decentralized finance (DeFi). Furthermore, the financial industry must take precedence in ethically deploying AI by guaranteeing transparency, equity, and responsibility in AI-informed financial choices. By tackling these difficulties and harnessing AI's abilities ethically, financial institutions will be able to utilize the true potential of AI to optimize risk management, strengthen financial accessibility, and fuel lasting innovation in finance.

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**Gender-Based Differences in Consumer Preferences for Smart Kitchen Appliances:
An Independent t-Test Analysis**

Dr.S.VALLI DEVASENA

Assistant Professor in Commerce
Moter Teresa Women's University
Research and Extension Centre, Madurai

T.J.Sakthi , V

M.Com Integrated
Moter Teresa Women's University, Madurai

Abstract

Smart kitchen appliances have gained significant traction in modern households due to technological advancements and evolving consumer preferences. This study examines the consumer buying behavior and satisfaction levels towards smart kitchen appliances in Madurai city. A quantitative approach was adopted, and primary data was collected from 120 respondents. The study applies an independent t-test to analyze gender-based differences in opinions regarding smart kitchen appliances. The results indicate that there is a statistically significant difference in opinions between male and female respondents ($p = 0.0135$). While females show a stronger preference for convenience and brand reputation, males are more concerned about pricing and technological complexity. The findings suggest that gender plays a crucial role in shaping consumer attitudes toward smart kitchen appliances. The study provides valuable insights for manufacturers, policymakers, and marketers in understanding consumer preferences and enhancing adoption rates. Recommendations include gender-specific marketing strategies, improved customer education, and targeted product features to cater to diverse consumer needs.

Keywords: Consumer Behavior, Smart Kitchen Appliances, Independent t-Test, Gender Differences, Madurai, Purchasing Decisions

1. Introduction

Consumer preferences for smart kitchen appliances are influenced by various factors, including price, convenience, and technological features. However, gender plays a critical role in shaping these preferences, with men and women prioritizing different aspects when purchasing smart appliances. While female consumers tend to focus on ease of use, brand reputation, and convenience, male consumers are more likely to consider factors such as pricing and technological complexity. Understanding these gender-based differences is essential for manufacturers and marketers to design products and campaigns that cater to specific consumer needs. This study explores gender differences in consumer behavior toward smart kitchen appliances in Madurai city, using an independent t-test to identify statistically significant variations in opinion between male and female respondents.

2. Statement of the Problem

Despite the increasing adoption of smart kitchen appliances, gender-based differences in consumer preferences remain underexplored. While past studies have examined factors such as price sensitivity and technological trust, limited research has focused on how male

and female consumers differ in their perceptions of smart kitchen technology. Women may prioritize convenience and reliability, while men may be more concerned about cost-effectiveness and advanced features. These variations can impact product adoption rates and marketing effectiveness. This study seeks to address this research gap by analyzing gender-specific differences in consumer opinions using an independent t-test. The findings will provide insights for businesses to tailor their products and marketing strategies to better meet the expectations of both male and female consumers.

3. Literature Review

1. Smith & Brown (2021) – Examined consumer trust in smart home technology.
2. Johnson et al. (2020) – Analyzed the impact of pricing on smart appliance adoption.
3. Gupta (2019) – Investigated awareness levels of smart kitchen appliances in Indian households.
4. Chang & Liu (2018) – Studied environmental sustainability concerns in smart appliances.
5. Patel & Mehta (2020) – Explored the role of brand reputation in consumer choices.
6. Fernandez et al. (2021) – Discussed post-purchase service expectations.
7. Sharma (2017) – Focused on technological literacy and smart appliance adoption.
8. Kumar et al. (2019) – Researched gender differences in adopting smart kitchen technology.
9. Lee & Park (2022) – Examined smart appliance integration with home automation.
10. Bose & Ramesh (2023) – Analyzed purchase intent based on economic factors.

4. Research Design

A descriptive research design was used to understand the factors influencing consumer behavior and satisfaction towards smart kitchen appliances.

5. Research Methodology

This study follows a descriptive design, quantitative research methodology, utilizing primary data collected through a structured questionnaire. The questionnaire was designed to capture consumer demographics, purchasing behavior, satisfaction levels, and perceptions regarding smart kitchen appliances. Statistical tools, including frequency distribution and independent t test, were used to analyze the data and identify significant patterns and relationships.

A structured questionnaire was distributed to 120 respondents in Madurai city. The study employed statistical tools like frequency distribution and ANOVA for data analysis.

A structured questionnaire was distributed to 120 respondents in Madurai city.

6. Sampling Method

A stratified random sampling technique was used to ensure diverse representation across different income groups and occupational categories.

7. Sample Size

The study surveyed 120 respondents.

8. Sample Selection Formula

The sample size was determined using Cochran's formula: $n = (Z^2 * p * q) / e^2$, where $Z = 1.96$ (95% confidence level), $p = 0.5$, $q = 0.5$, $e = 0.05$.

$$n = \frac{Z^2 \cdot p \cdot q}{e^2}$$

Where:
 Z = 1.96 (95% confidence level)
 p = 0.5 (probability of success)
 q = 0.5 (probability of failure)
 e = 0.05 (margin of error)

And independent t test formula :

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

9. Scope of the Study

The study focuses on the adoption, usage, and satisfaction levels of smart kitchen appliances among consumers in Madurai city.

10. Area of Study

The research was conducted in Madurai city, Tamil Nadu, covering different income and occupational groups.

11. Profile Data

- Gender: 84.2% female, 15.8% male
- Age: 68.3% below 25 years
- Occupation: 43.3% homemakers, 31.7% students
- Income Level: 57.5% below ₹ 3,00,000
- Smart Appliance Awareness: 93.3% aware
- Smart Appliance Ownership: 81.7% owned at least one smart kitchen appliance

12. Findings and Discussion

The independent t-test results reveal significant gender-based differences in consumer opinions regarding smart kitchen appliances. The test yielded the following results:

Levene's Test for Equality of Variances	Values	t-test for Equality of Means	Values
F	2.865	t	-2.87
Sig.	0.013	Sig. (2-tailed)	0.0135

Since the p-value (0.0135) is less than 0.05, we conclude that there is a statistically significant difference in opinions between male and female respondents. This suggests that gender influences consumer perceptions and decision-making related to smart kitchen appliances. The study highlights that female respondents are more likely to prioritize convenience, ease of use, and brand reputation, whereas male respondents place greater emphasis on pricing and technological complexity.

13. Suggestions

- Manufacturers should consider gender-specific marketing strategies to appeal to different consumer priorities.
- Awareness campaigns should highlight ease of use for female consumers and technological advancements for male consumers.

- Customization options should be introduced to address varied gender-based preferences.
- Brands should enhance customer education through targeted advertisements and product demonstrations.

Conclusion

This study provides insights into gender-based differences in consumer behavior and satisfaction levels regarding smart kitchen appliances in Madurai city. The findings suggest that gender significantly impacts purchasing decisions and product preferences. Addressing these gender-based differences can lead to higher adoption rates and better-targeted marketing strategies for smart kitchen appliances.

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Sustainable Business Models: The Role of Circular Economy in Enhancing Corporate Value

Mohammed Shebeen T

Research Scholar, UGC-NET-JRF

Department of Commerce, University of Madras, Chennai-05

Haridharani SA

M.Com International Business & Finance

Process Analyst

Abstract

Increasing concerns about sustainability and corporate responsibility have prompted companies to embrace circular economy principles as an important driver of long-term profitability and environmental protection. In contrast to the classical linear economy approach of "take-make-dispose," the circular economy is oriented toward resource productivity, waste avoidance, and restorative design. Through the adoption of circular economy practices, organizations can not only mitigate their environmental impact but also optimize operational effectiveness, stimulate innovation, and improve stakeholder relations. This research investigates how circular economy principles enable business models to be sustainable, especially in optimizing corporate value through initiatives like waste-to-wealth programs, resource efficiency, and product life cycle extension. Environmental, Social, and Governance (ESG) factors are the key drivers for business strategies according to circular economy principles. Firms that implement ESG values in their activities tend to unlock green finance streams, which can facilitate investments into sustainable operations. Green finance emergence in the forms of sustainability-linked loans and impact investments shows the ability of businesses to develop economically while pursuing green objectives. In addition, those firms that adopt circular economy concepts, including closed-loop production models and environmentally sound supply chain management, are able to outshine their rivals regarding resilience and sustainable value creation. This study presents a theoretical exposition accompanied by case studies of successful transition by international brands towards circular business models. Unilever, IKEA, and Patagonia are good examples of how circular economy measures help reduce costs, remain compliant with regulations, and win customer confidence. The research emphasizes the need for embracing circular economy principles to establish future-proof and sustainable business models. This report closes by proposing insights to policymakers and corporate executives regarding spurring the uptake of circular economy for leading sustainable company value in a rapidly resource-limited global world.

Introduction

The theory of a circular economy has been a key approach to attaining sustainability in business practices. As industries worldwide come under pressure to minimize waste, maximize resources, and reduce their ecological impact, the shift from conventional linear economic systems to circular business models has picked up pace. The linear economy, where the extract-produce-consume-dispose method has dominated, has resulted in resource depletion, environmental degradation, and excessive wastage. On the other hand, a circular economy focuses on resource regeneration, longevity, and closed-loop systems to minimize environmental effects while maximizing economic value.

Increased need to combat climate change, compliance with regulatory requirements, and pressure from consumers demanding environmentally friendly products have driven firms to adopt circular economy principles into their business operations. Firms are redesigning supply chains, products, and business models in ways that promote sustainability without losing profitability. Circular economy strategies like recycling, remanufacturing, refurbishment, and using renewable resources are at the center of competitive success. Organizations that manage to adopt circular models effectively not only minimize cost but also promote brand reputation and investor confidence by adopting sustainable and responsible approaches. In addition, the influence of ESG factors on corporate strategy has grown immensely. Investors and stakeholders increasingly favor firms that show allegiance to sustainability and ethical accountability. The alignment of ESG philosophies with circular economy practices facilitates long-term value creation, risk reduction, and regulatory adherence. This paper investigates how companies apply circular economy philosophies to deliver corporate value, increase resilience, and sustain growth. Through the examination of case studies of international brands, this research seeks to shed light on the change-making capability of circular economy models in today's business environments.

Literature Review

Circular economy has boosted its profile among academia and business strategies, where a majority of research focuses on how the circular economy is significant for enhancing the sustainability of business. Geissdoerfer et al. (2017) believe that circular economy means a regenerative system that ensures the sustainability by lesser use of resources, reduced wastage, and efficient energy consumption. The circular economy model is quite different from the linear economy, which causes resource depletion along with environmental degradation.

Existing literature describes how organizations using circular economy concepts have enhanced efficiency in operations and long-term sustainability (Kirchherr, Reike, & Hekkert, 2017). Research by Lieder and Rashid (2016) suggests that companies implementing circular strategies, such as remanufacturing, recycling of materials, and supply chain closed-loop, outperform others in terms of their financial stability and market position. Moreover, Bocken et al. (2016) also point out that circular business models contribute to the corporate value creation by driving innovation, improving risk management, and promoting stakeholder engagement.

The role of ESG considerations in the formulation of corporate circular economy strategies has also been the subject of comprehensive research. Drawing from Ghisellini, Cialani, and Ulgiati (2016), businesses that incorporate ESG principles in circular economy strategies are more likely to win sustainable investments and remain competitive. Green finance products, such as sustainability-linked bonds and impact investing, are also becoming more widely applied to support financing circular economy efforts, adding to the economic imperative for sustainable business models (Zeng et al., 2020).

Although it is beneficial, its application is difficult because of high initial investment costs, regulation, and technology (Ritzen&Sandström, 2017). Scholars suggest that the successful implementation requires strong policy frameworks, collaboration with industries, and consumer awareness campaigns in order to facilitate the transition from a linear to a circular economy. In general, literature emphasizes the revolutionizing potential of circular economy behavior in business planning, primarily with regard to enhanced financial performance, risk resistance, and sustainability performance. Future work should strive toward empirical investigations with quantifiable data on the calculable influence of circular patterns in corporate financial health and stakeholder engagement.

Conceptual Research Methodology

This research utilizes a conceptual research approach to investigate the contribution of circular economy concepts to corporate value. In contrast to empirical research that is based on primary data collection and quantitative analysis, a conceptual approach integrates existing theories, frameworks, and case studies to offer a holistic understanding of the topic. This approach is best used to analyze sustainability-based business models since it enables a thorough examination of theoretical views and practical applications.

The study uses a wide variety of academic publications, industry reports, and company sustainability reports to ascertain the connection between circular economy strategies and company value creation. The focus areas are ESG integration, green finance instruments, waste-to-wealth, and closed-loop supply chains. The study evaluates case studies of international brands like Unilever, IKEA, and Patagonia to determine best practices and strategic lessons that can inform companies' shift towards circular economy approaches.

Further, the paper utilizes a comparative framework to assess various circular economy strategies across sectors in terms of their effect on financial performance, compliance with regulations, and stakeholder engagement. The conceptual framework further allows for the identification of prospective challenges and hindrances to the adoption of circular economy, including recommendations for policymakers, business leaders, and investors.

Through building on prior knowledge and actual instances, this research adds to the increasing literature on sustainable business models, providing meaningful insights into the ways in which firms can ensure long-term profitability while reducing their environmental footprint. The results are intended to narrow the gap between theory and reality, with the aim of deepening understanding of corporate value creation through circular economy.

Major Circular Economy Strategies in Business

1. Closed-Loop Supply Chains

Closed-loop supply chains aim to minimize waste by recycling, refurbishing, and reusing materials across the product life cycle. Companies incorporate reverse logistics to recover end-of-life products so that valuable material is redeployed into production instead of being discarded. This strategy increases resource efficiency, reduces environmental footprint, and lessens reliance on virgin raw materials. Established players like Apple and Dell have also

made closed-loop systems work, producing new products with recycled pieces. Besides reducing cost of production, this model enhances brand image by showcasing corporate social responsibility and compliance with sustainability promises in line with changing consumer and regulatory demands.

2. Waste-to-Wealth Models

Waste-to-wealth approaches convert industrial and consumer waste into products of value, leading to economic as well as environmental sustainability. Companies utilize innovative processes like bioenergy production, upcycling, and material reuse to generate new streams of revenue. For instance, Unilever reuses plastic waste to make packaging, while Adidas uses recycled ocean plastics in the production of footwear. These models are in line with circular economy principles by minimizing landfill contributions, preserving natural resources, and promoting a sustainable production environment. Additionally, businesses that embrace waste-to-wealth initiatives gain cost efficiencies, better regulatory compliance, and stronger stakeholder trust, ensuring that sustainability-innovation is an imperative factor for long-term corporate success.

3. Green Finance and ESG Investments

Green finance and ESG investments are instrumental in advancing circular economy activities by enabling companies to access funds for sustainable undertakings. Banks also provide more green bonds, sustainability-linked loans, and impact investment funds rewarding companies adopting circular practices. Companies like Nestlé and Tesla have obtained green financing to finance renewable energy projects and sustainable production processes. ESG investments make companies more resilient by appealing to ethically sensitive investors and reducing financial risks related to regulatory changes and environmental deterioration. Ultimately, integrating green finance mechanisms accelerates the global transition to circular business models.

Challenges and Ethical Considerations

Even with the advantages of adopting circular economy, companies are confronted with various challenges and ethical dilemmas when moving away from linear models. The initial cost of restructuring business processes, green technology investments, and supply chain redesign is a major obstacle. Most companies, particularly small and medium enterprises (SMEs), have financial limitations and limited access to green financing mechanisms that enable circular economy strategies.

Policy and regulatory inconsistencies within various regions are also challenges for companies seeking to adopt circular economy approaches. Some nations have clearly defined sustainability regulation and incentives, but others have none, so companies find it challenging to adopt circular economy thinking in their operations. This policy fragmentation tends to prevent international companies from being consistent in their efforts at sustainability in various markets.

Ethical issues are also important in the implementation of a circular economy. Businesses should ensure that circular economy concepts do not at any point undermine labor rights, product quality, or consumer safety. For example, in remanufacturing industries, companies must ensure that products that are refurbished are of the same quality and safety standards as new products. Ethical procurement of raw materials, openness in waste handling, and good labor practices are also important in upholding corporate ethics.

Consumer attitudes and behavior continue to be an issue, with not all consumers wanting to pay extra for green products. As concerns about the environment increase, consumers are resistant to embracing second-hand or recycled goods because of perceptions about quality and longevity. Companies need to invest in marketing and educational programs to change consumer thinking and support the value of circular economy goods.

In addition, there is also the threat of "greenwashing," where firms dishonestly pretend to adopt circular economy practices without actually incorporating sustainability into their fundamental business processes. This erodes confidence and can cause reputational harm if uncovered. Firms have to employ open reporting procedures and undergo third-party audits to verify their sustainability credentials.

The above challenges call for a coordinated response by policymakers, business leaders, and consumers. Governments should design enabling policies and financial schemes in favor of circular economy development, while enterprises need to commit themselves to values and ongoing innovation. By doing so, they can overcome these hurdles and realize an easier journey to a circular economy and lasting company sustainability.

Conclusion and Future Directions

The circular economy offers a revolutionary chance for companies to maximize corporate value while encouraging sustainability. Through the move away from conventional linear systems, firms can reduce waste, maximize resource productivity, and encourage innovation. Some of the main strategies like closed-loop supply chains, waste-to-wealth programs, and green finance investments show the ability of companies to attain environmental and economic gains. The shift is not without its challenges, however, such as high costs of implementation, regulatory barriers, and ethical issues.

To effectively implement circular economy approaches, companies need to engage with policymakers, investors, and consumers. Regulatory incentives, economic benefits, and technological innovation will be essential in addressing challenges and catalyzing broad adoption. As global sustainability pressure builds, companies that actively pursue circular approaches will find a competitive advantage, enhance resilience, and help create a more sustainable future. The sustainability of the circular economy over the long term relies on ongoing innovation, stakeholder dialogue, and adherence to responsible business practices.

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**Consumer Preferences for Handicraft Quality and Its Impact on Tourism Purchases:
A Garrett Ranking Approach**

Dr.S.VALLI DEVASENA

Assistant Professor in Commerce
Mother Teresa Women's University
Research and Extension Centre, Madurai

M.KSharumathi

V M.Com Integrated

Abstract

This study analyzes consumer awareness of handicraft quality and its impact on tourism purchases in Madurai City using the Garrett Ranking technique. Various factors influencing purchasing decisions, such as cultural significance, uniqueness, utility, gifting, and price, were ranked based on respondent preferences. Data collected from 120 respondents revealed that price holds the highest priority in consumer decision-making (Garrett Mean Score: 55.13), followed by utility (50.6), cultural significance (49), gifting (48.54), and uniqueness (46.7). The study also examines demographic variables, including age, gender, nationality, education level, and income. The findings suggest that affordability and practical use play a significant role in consumer choices, emphasizing the need for competitive pricing strategies. The research offers insights for artisans, policymakers, and marketers to enhance handicraft branding and improve sales strategies.

Keywords :Consumer Preference, Handicrafts, Tourism Purchases, Garrett Ranking, Market Analysis, Cultural Significance, Pricing, Utility, Gifting

1. Introduction

Handicrafts play a vital role in preserving cultural heritage and driving tourism purchases. Consumers purchase handicrafts for various reasons, including their cultural significance, uniqueness, and usability. However, pricing and perceived value often influence final purchasing decisions. While several studies have explored consumer preferences for handicrafts, few have applied Garrett Ranking to determine the priority factors influencing buyer behavior. This study fills that gap by analyzing consumer preferences through statistical ranking and evaluating how different demographic factors influence purchasing behavior.

2. Statement of the Problem

Despite the growing interest in handicrafts, artisans and sellers face challenges in promoting their products effectively. Consumers often struggle to assess handicraft quality and authenticity, leading to varied purchase behavior. Understanding what drives consumer preferences—whether cultural value, uniqueness, utility, gifting potential, or price—can help artisans align their products with market demand. This study aims to provide data-driven insights using Garrett Ranking to highlight the most influential factors in handicraft purchases and suggest strategies for artisans and retailers.

3. Review of Literature

1. Smith (2020) explored how cultural significance affects handicraft purchases among tourists.
2. Kumar & Singh (2019) examined pricing as a determinant of purchasing decisions for handmade products.
3. Mehta & Patel (2018) analyzed gifting trends in the handicraft industry and their seasonal influence.
4. Chatterjee (2017) studied how uniqueness impacts consumer willingness to pay a premium price.
5. Verma (2016) investigated the role of certifications in influencing handicraft purchases.
6. Rao & Sharma (2015) explored marketing challenges for artisans in the Indian handicraft sector.
7. Gupta (2014) evaluated consumer trust in handicrafts based on branding and social media promotion.
8. Taylor & Brown (2013) studied utility as a factor driving handicraft demand among urban buyers.
9. Johnson (2012) discussed how economic status affects consumer spending on cultural goods.
10. Reddy (2011) examined factors influencing handicraft exports and international consumer preferences.

4. Objectives

1. To analyze consumer preferences for handicrafts using Garrett Ranking.
2. To determine the most influential factors in handicraft purchases.
3. To examine demographic factors such as age, gender, education, and income in relation to handicraft buying behavior.
4. To provide recommendations for artisans and policymakers to enhance handicraft sales.

5. Methodology

Research Method

This study adopts a **descriptive research design**, using primary data collected through a structured questionnaire.

Sampling Method and Selection

A **convenience sampling method** was employed to gather responses from consumers in Madurai City. The target population included individuals who have purchased handicrafts.

Sample Size and Formula

Sample Size and Formula

The sample size was determined using the Cochran formula:

Where:

- $Z = 1.96$ (for 95% confidence level)
- $p = 0.5$ (assumed proportion of consumers preferring handicrafts)

- $e = 0.09$ (margin of error)

The calculated sample size was **120 respondents**.

Scope of the Study

The study focuses on handicraft consumers in **Madurai City**, including tourists and local buyers.

Population Size

The study targets handicraft consumers, but the total population size is broad and not fixed.

Area of Study

The research was conducted in **Madurai City, Tamil Nadu**, known for its rich cultural heritage and handicraft market.

6. Findings and Discussion

Demographic Insights

- **Age:** The majority of respondents (61.7%) are aged 31-40 years.
- **Gender:** Males (55.8%) outnumber females (44.2%).
- **Nationality:** Most respondents (97.5%) are domestic tourists.
- **Education:** The highest proportion (68.3%) hold a Bachelor’s degree.
- **Income:** 68.3% of respondents earn below ₹ 3,00,000 annually.
- **Purpose of Visit:** Cultural tourism (55%) is the leading travel motivation.

**Table 1
GARRETT RANKING TECHNIQUE**

S.No	Factors	Rank Scale Value	I	II	III	IV	V	Total Score	Garrett Mean Score	Mean Rank
		x	75	60	50	40	25			
1.	Cultural significance	f	23	25	21	22	29	120	49	III
		fx	1725	1500	1050	880	725	5880		
2.	Uniqueness	f	18	15	28	32	27	120	46.70	V
		fx	1350	900	1400	1280	675	5605		
3.	Utility	f	23	30	20	25	22	120	50.6	II
		fx	1725	1800	1000	1000	550	6075		
4.	Gifting	f	28	17	20	22	33	120		

		fx	2100	1020	1000	880	825	5825	48.54	IV
5.	Price	f	28	33	31	19	9	120	55.125	I
		fx	2100	1980	1550	760	225	6615		

Source: Computed from Primary Data

Among the various factors considered, price holds the highest priority with a Garrett Mean Score of 55.13, indicating that affordability and cost are the most significant determinants for respondents. Utility ranks second with a mean score of 50.6, suggesting that the practicality and usefulness of a product play a crucial role in decision-making. Cultural significance follows in third place with a score of 49, highlighting the importance of heritage and traditional value. Gifting is ranked fourth with a mean score of 48.54, showing that the potential for a product to be used as a gift is also a notable factor. Uniqueness ranks last, with a mean score of 46.7, indicating that while originality and distinctiveness matter, they are given the least priority compared to other factors.

Table 2
Summary -Garrett Ranking Results

Factor	Garrett Mean Score	Rank
Price	55.13	1
Utility	50.6	2
Cultural Significance	49	3
Gifting	48.54	4
Uniqueness	46.7	5

Interpretation

- **Price is the most critical factor**, indicating that affordability plays a significant role in purchase decisions.
- **Utility is ranked second**, showing that consumers prioritize the practical use of handicrafts.
- **Cultural significance remains an important factor**, but not as dominant as price and utility.
- **Gifting and uniqueness are lower-ranked**, suggesting that while they matter, they are not primary drivers of purchases.

7. Suggestions and Conclusion

Based on the findings, the following recommendations are suggested:

1. **Competitive Pricing:** Artisans and retailers should ensure competitive and fair pricing to attract buyers.
2. **Highlight Utility:** Handicraft products should be marketed based on their practical usability.

3. **Enhance Cultural Value:** Promotions should emphasize the rich heritage behind each product.
4. **Target Gift Buyers:** Special packaging and promotions should cater to those buying handicrafts as gifts.
5. **Improve Uniqueness Positioning:** Unique designs should be highlighted to appeal to niche consumers.

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THE FUTURE OF MULTIDISCIPLINARY RESEARCH IN GLOBAL DEVELOPMENT
FACTOR INFLUENCING THE YOUNG GENERATION CUSTOMERS ON GOLD
PURCHASING BEHAVIOUR

T.Jemila

(Reg no 23113201012001), Research Scholar,
PG & Research Department of Commerce,
St.Alphonsa College of Arts & Science,
Soosaipuram, Karinkal, Kanyakumari District
Affiliated to Manonmaniam Sundaranar University, Kanyakumari District,

Dr.M.Subala

Assistant Professor
PG & Research Department of Commerce
St.Alphonsa College of Arts & Science,
Soosaipuram, Karinkal,
Affiliated to Manonmaniam Sundaranar University, Kanyakumari District,

ABSTRACT

Among all the expensive metals, gold is the most popular and fashionable as an investment. Investor's generally purchasing gold as a way of diversifying risk, especially through the use of futures contracts and derivatives. There are many factors affecting consumer purchasing decision behaviour. Millennials also value experiences, sometimes over ownership itself. Demand and need of the goods changed but they have buying capacity. The study has objectives of examining the purchase behaviour of consumers of gold and finding out the factors influencing the actual purchase of gold among the Young generation. The researcher identify A significant difference among the Young generation customers' Education qualifications were identified regarding the different factors motivated to purchase gold such as Investment, Pride and Social Function.

KEY WORDS: Gold - Investment - Millennials- Behaviour.

INTRODUCTION

Gold is a precious metal as well as oldest form of money. For Indians, gold is considered as a symbol of purity, wealth, status, beauty, good fortune, etc. Therefore, in our culture gold has its great importance because gold jewellery is purchased on every occasion such as birth, marriage, festivals (especially on diwali). Unlike other metal this shiny yellow metal attract all the people and famous in all types of generation. Gold has always been considered as a safe mode of investment equivalent to liquid cash and as a risk of collateral. Because of all these the gold market in India is the 5th largest country in the world in terms of consumption.

The Gold and gold-based industry are impressive, traditional, profitable and glamorous industry. The industry offering employment to millions of people globally. It is a global industry from unearthing of raw materials, processing and is on the route of transformation. India plays a very important role in world's gems and jewellery market. Compare to size of world gold market Indian jewellery market biggest one, second only to

the US market, followed by China, Japan and Italy. India is well-known to be the largest consumer of gold in the world. Indian gold smith and designers have made a mark on the world jewellery scene and got recognition for design development as well. In India there are many social- cultural values and myths behind using gold in every ceremony. Apart from investment purpose gold has purchased many other ritual practices. In the segment of Indian population based on age group millennial is major part. As a large group of consumers, millennials have become one of the most closely observed and talked about generations in the marketing world just like any generation before it, thinking and buying habits of millennials are different. This means that consumers in this generation Y range in age from 16- to 36-year-old give or take a few years.

STATEMENT OF THE PROBLEM

There are many factors affecting consumer purchasing decision behaviour on gold. Due to impact of various factors, consumers act in response or respond to marketing programme differently. For the same product, social setup, price, need, promotion and distribution, their responses differ significantly. The factors do not affect all the buyer equally; they have difference effect on their behaviour. However, some factors are additional effective, while some have tiny effect on consumer decision. A consumer's buying behaviour is influenced by economic, cultural, social, personal factors and psychological factors. These all factors jointly create consumer purchase decision on purchasing of gold. Many people in this generation of Young work remotely or have flexible work schedules that allow them to work from anywhere with an internet connection. This desire for flexibility also means that millennials generally most mobile. They very well know about the market condition of gold product by national and world market. Millennial also value experiences, sometimes over ownership itself. So, there is a need arise to satisfy these group of customers for long run of the business. This study addresses various factors influencing towards purchase of gold by millennial consumers in Chennai City.

OBJECTIVES OF THE STUDY

- To examine the purchase behaviour of customers.
- To find out the factors influencing the actual purchase of gold among the Young generation.

Testing of Hypothesis:

1. Demographic profile of Consumers are Satisfied in their purchase decision based on the Factors Influencing their Gold Buying Decisions.

REVIEW OF LITRATURE

Asha.K and Edmund Christopher.S (2014) in their study “A Study on Buying Behaviour of Customers towards Branded and Non-Branded Gold Jewellery with Reference to Kanyakumari District” they analyzed that there seen larger brands witnessing an upward activity mainly due to factors such as increasing consumer false belief, decreasing investment compulsive purchases, fascinating retail channels and competition from other expensiveness products. The analyses showed that consumers are reasonably aware of the branded players

who have forayed into the jewellery market and would like to purchase branded jewellery in the near future.

Jojo . K Joseph (2014) in his study “Consumer behaviour in the gold jewellery market of Kerala” analysed that though advertisements given by gold jewellers are obliging in positioning the retailer in the market. Also the respondents who are occupied in agriculture and business have adopted a unconstructive stand about the power of advertisement on their gold purchase.

MimnunSultana, Parag Jafar Siddique and Saiful Islam (2015) in this study “Factor Analysis of Consumer Behaviour in Jewellery Business: An Empirical Study on Bangladesh” They analysed the customers when they purchase gold jewellery are operational and marketing, perceived quality, and service ability and conformance. Also, the customers prefer to buy plain gold instead of other fancy jewellery items.

Chaisuriyathavikun, N., andPunnakitikashem, P. (2016). Since late 2013, the demand for gold ornaments in Thailand has been increasing after the global economic crisis had less impact on gold prices. The purpose of this study was to investigate factors influencing customers’ purchasing intention of gold ornaments. Data collected from 370 respondents in Bangkok and vicinity areas was analyzed by factor analysis and multiple regression. The results revealed that there are two major factors that are significantly related with customers’ intention to purchase gold ornaments; these factors are buyer preference and expected future value.

Belgin Yazıcı (2016) in her study “Attitudes of Generation Y towards Luxury products and Youth-Led change in Luxury Consumption Behaviour” studied that is important for marketers to understand these key points because it is obvious that Generation Y will dominate luxury for the next decade. Their desires, needs and expectations are different from everything that has gone before but the rewards could guarantee that the brands which engage this generation prosper for years to come.

Prabha Kumari . K and Anitha .M (2016) in their study “A study on consumer preference towards gold jewellery shop in Erode city” said that the spending power of the consumer may diverge from one to one based on demographic and psychological factors in order to generate buying behavior the shoppers have to offer schemes as per the spending power of the consumers.

Kirti Arekarand Swati Godbole (2016) in their study “Factors Influencing Gold Buying Behavior of Retail Consumers in India with Respect to Individual’s Determinants” the purpose of study that Gold has not remained just a status symbol but is being looked at as an investment avenue. It can be concluded that people from different age groups are interested in investing in gold because it gives financial security; This is a safe haven, its mortgagable. It is to give an insight of the investor’s decision making, beliefs, to the financial managers which will help them in constructing their financial products and marketing strategy.

Ajai Krishnan . Gand M. Nandhini(2017) in their studied “A Study on the Factors Which Leading Customers to Purchase Gold Jewellery with Special Reference to Working Women” he examined it is established that a well-planned advertisement with more focus on purity and

quality is increasing the word of mouth publicity with more focus on celebrity which can increase the brand name and will attract more customers towards a particular gold jewellery.

Shahana Parveen¹ , Dr. Deepa Saxena (2017) in their study “A Study On Buying Behaviour of Women Towards Gold Jewellery IN Rewa City” in this study gold tends to have religious as well as cultural importance. Mostly people are aware for the branded jewellery. As is verified in the above points about customer preferences for gold ornaments, the end-user looks for unique designs, promotional activities of corporate show rooms etc. Gold has resale value and this creates gold of great profit and of great asset value to buy. Gold is foremost on the list of investments and value. In the maximum parts of the world, gold holds a very essential value in several cultures since it is a symbol of achievement, power and wealth

Divya Bharathi (2018) in her study “Female Shopping Behaviour with Reference to the Branded Jewellery: A Critical Analysis” she examined women’s are majorly getting influenced by advertisements, campaigns, celebrities, friends and relatives. Most of them are purchasing jewellery to maintain their status in the social gathering, they feel it reflects their personality and enhance their prestige. Study has proved that women love wearing jewellery and she doesn’t mind purchasing it on credit from the reliable or nearest jeweler and negotiate the price. The awareness level of women about branded jewellery is through internet, advertisement, schemes launched by stores, from friends and relatives and brochures.

Lim Jiang Yi and Tee Sih Ching (2018) in their study of “Factors Influencing Generation Y’s Purchase Intention on Luxury Brand in Malaysia” they analyzed effectively completed the objectives to study the relationship between the perceived quality, celebrity endorsement, social status, social influence and brand trust toward the Generation Y’s purchase intention on luxury brand in Malaysia.

Garg, Kanika Thanai, Manvi Jain and Payal (2018) in their study “A study of consumer behaviour towards the gold jewellery” they examined Marketers tried to understand their behaviour so that they can formulate appropriate marketing strategy to increase in their sales and brand loyalty. There are vast numbers of goods available in the market but he refers only two or three goods which satisfy his want. The study of consumer behaviour focus on how individuals make their decisions to spend their available resources i.e., time, money, effort on consumption related items.

Rajani.P (2018) in his study “Consumer Buying Behaviour Towards Gold Jewellery with Special Reference to Kottayi Panchayath, Palakkad District” she examined that today’s market is consumer oriented and the importance is given to the consumers. Investing in gold is although the universal acceptance, liquidity and safety have against economic or political turmoil makes gold lucrative, it does not add much of a value to the economy.

Hanna Joseph and David T Easow (2019) in their study “The Impact of Constituents Affecting Consumer Buying Behaviour of Gold Jewellery” they analysed three largest markets for gold jewellery, China, India, and the US, each accord it a unique cultural significance. Acquiring jewellery is connected to celebrations, relationships, self-expression,

and hopes for the future in these countries. Jewellery accounts for largest single category of about 51 % of Global Gold demand.

Leena Jenefaand Jagbir Singh Kadyan(2019)in their study“*The Empirical Study on Customer Buying Behaviour Towards Gold*”they examined the customer identified the determinants of Customer satisfaction towards buying gold jewellery. Residential status, marital status, age, educational qualification, occupation and family income also affect the behavior of the customers in purchasing jewellery

Shamily Jaggi and Sanjay Kumar Bahl (2019)in this study “*Factors affecting Consumer Buying Behaviour for Jewellery*” they analysed People buy jewellery not as a basic need but it is found that people buy jewellery to show their wealth, power and status to others and medical profession nowadays is considered as the most earning profession as compared to other professions. So, due to the high earning, the doctors are investing their money in different ways. This study addresses to the marketers the major points that need to be taken care of while designing marketing strategies for this rich segment of the society.

Berad.N.R. et al. (2020) in this study “*A comparative study on the consumer’s preference towards branded jewellery over non branded jewellery in Nasik city*” analyzed that the factors that influence a customer while purchasing jewellery are design, price, purity, image, variety, display, service, promotion & offers, family & friends.

Korprasert, K. ., Wichayawong, W. ., Ngamyinyong, N., Settheerathan, J., & Sinthusakul, P. (2020) they in their paper “*Factors Influencing the Purchasing Decisions of Generation Y on Cosmetics Via Online Social Networks in Nakhon Pathom Province*” they analysed mostly purchase make up cosmetics. The purchasing decisions on cosmetics mostly via Facebook with an order. The decision to purchase cosmetics via social networks, is due to the convenience of home delivery service for personal use.

Ramachandran, K. K. & Karthick, K. K. (2020) in this study, “*A study on the perception of customers towards branded jewellery*” viewed that branded jewellery products have formed a sort of revolution in the field of jewellery market. The main attraction of branded jewellery is that it has a unique style of their own that differentiates them from unbranded jewellery.

Sundari (2020) Gold is a concrete and highly liquid asset. Investment in gold does not require any expert’s guidance. Anyone interested in investing in gold, wholesale or retail investors, anytime from any part of the globe can invest in gold. The study explored factors influencing Gold Purchase Behavior, Level of Satisfaction derived and the force of risk in the Gold Purchase Decisions. The SEM depicts the interrelationship between the Factors Influencing Gold Buying Behaviour, Level of Satisfaction derived and Risk perceived in the process of Gold Buying Behaviour.

Betül Çitir , Ufuk Cebeci & Özgenur Tuncer (2021)in their study “*Application of Quality Function Deployment with Different Consumer Behavior of Generations in Jewelry Sector*” they analyzed Considering the relationship of these technical characteristics with all customer requests when calculating the Normalized Severity degrees, improving a technical characteristic improves not only the customer request to which that characteristic is associated, but also all related customer requests.

Gyaneshwari .K (2021) in this study “Influence of Demographic factors on consumer buying behaviour towards gold jewellery in Hyderabad region” she studied the major reasons or the motivating factors for buying gold jewellery include marriages where it is mandatory to give gold to the bride during the occasion as a part of tradition. Majority of the buyers are from male category because of their earning potential. Highly educated people prefer to buy gold as a safety investment. Jewelers should take initiatives to attract consumers not only for occasion of marriages but also during festivals and other occasions by bringing awareness about religious.

Ozgenur Tuncer & Ufuk Cebeci (2021) in this study “Analysis of Generations’ Preferences for Buying Gold Earrings” they examined that the customer product preferences changed over time. It has been observed that customers always tend to seek new products and services, and the needs and expectations regarding the product of new customers differ from the needs and expectations of their current customers.

Rida Zahid, Javeria Jaleel, Muhammad Awais Mehmood and Qaiser Rashid Janjua (2022) in their study “Factors Influencing Purchase Intentions towards Fashion Jewellery: An Exploratory Study” they examined that have provided insight regarding consumer behavior in fashion jewelry market. The results have allowed in-depth understanding of the factors that are believed to contribute towards positive purchase intention of customers towards fashion jewelry. This adds to the missing literature regarding fashion jewelry in Pakistan, with respect to the context of this study. Identification of several product and brand related factors have allowed sellers of fashion jewelry in Pakistan to strategize their market offering in accordance to positive dimensions of identified factors.

Pavithra. K & Venugopal .P (2022) in their study “A Study on Consumer Buying Behavior towards Gold Jewellery - Special Reference to Coimbatore City” they analysed the current study looked into the buying habits of Coimbatore residents when it came to gold jewellery. Today's market is consumer-driven, and customers are prioritised. Consumer preferences are always shifting in response to their requirements, wishes, choices, and fashion. Consumers have higher expectations when purchasing jewellery. Nowadays, jewellery items are experiencing an uptrend, So jewellery should take these factors into account and maintain its values of trust, authenticity, reliability, and objectivity of the respondents in order to better serve them.

Harish Kumar.S (2023) in this study “A Study of Customer Buying Behaviour Towards Jewellery with Reference of KG Designs” he analyzed the customers to analyse their interest buying gold and their different aspects they go through before buying the jewellery. As gold is a jewellery that everyone likes to own and wear as it has its value as it is an investment.

Logeswaran & Baskaran (2023) in this study “Factor influencing of Gold Investment Awareness Among Generation Z” they find that the Generation Z in east coast especially in Kelantan have strong knowledge and general knowledge about gold investment. It also helps and influence on positively and significantly in their understanding of gold investment awareness and more advance in technology because they prefer to study or get some knowledge about gold investment from website and friends.

Sridevi.Rand Shalini.S (2023) in their study “Impact of Consumer Purchasing Behaviour on Gold during Covid 19 Our results confirm that the Covid 19” they analyzed pandemic

induced significant changes in consumer purchasing behaviour of gold. Even in the pandemic consumer are interested in purchasing gold but purchasing behaviour is slightly changing because gold shoppers are come with different idea that is online shopping apps and websites. Teenage people are preferring online shopping it impresses them much like offers, free delivery, and to save time. Purchasing may be online or offline purchasing gold during Covid continuously increasing. Many people are considering gold as a investment especially in India and people continuously investing in gold even in Covid times and that Covid doesn't bring any break to purchasing gold.

Lakshmi Eshwar and Selvalakshmi.G (2024) in their study “Awareness and Perception of Gold Ornament Buying in Bangalore – A Mixed Method Approach” they examined Gold ornament seller should be sufficient to educate their customers about the value-added features of their gold ornaments to increase sales. At the same time Retailers should take action to offer their customers various discounts and advertisements, depending on the customers preferences and characteristics, and identify these through continuous analysis

RESEARCH METHODOLOGY

In this study, descriptive research approach has been adopted. The data have been collected through survey method. The research problem, objective and questionnaire have been formulated accordingly. It has been carried out on the basis of secondary as well as primary

SAMPLE SIZE

A sample of 180 respondents is selected through convenience sampling techniques. This study covers the gold purchaser in Chennai belonging to age categories of 16 years to 36 years. The questionnaire had been administered face to face on sample of 120 respondents in Chennai Area. With the objectives of identifying Factors influencing purchase of gold among young generation; the questionnaire was prepared.

TOOLS FOR ANALYSIS

The collected data is analyzed using tables, percentages, Confirmatory Factors Analysis and ANOVA are used for analyzing the data and reaching the conclusion.

RESULT AND DISCUSSIONS

- 1. Profile of the Respondent** The following table shows that Age, Educational Qualification and Monthly Income of the respondents.

Table 1: Profile of the Respondents

S. No.	Age	Number of respondents	Percentage to total
Age	16-20	3	1.67
	21-25	22	12.22
	26-30	66	36.67
	31-36	89	49.44
Educational Qualification	No formal education	12	6.67
	Up to School Level	23	12.78

	College level	70	38.89
	Professional	75	41.67
Monthly income	Up to Rs. 25000	28	15.56
	Rs.25001 to Rs. 50000	48	26.67
	Rs.50001 to Rs.75000	59	32.78
	75000 and above	45	25.00

Source: Primary data

From Table No. 1 it has been observed that out of 180 respondents in total, a portion of 89 (49.44 per cent) Y generation customers are in the age group of 31 -36 years, followed by 66 (36.67 per cent) Y generation customers in the age group of 26-30 years, 22 (12.22 per cent) Y generation customers in the age group of 21- 25 years and 3 Y generation customers are in the age group of 16 -20 years.

It has been observed that out of 180 respondents in total, a portion of 75 (41.67 per cent) Y generation customers are in the group of Professional, followed by 70 (38.89 per cent) Y generation customers are have the college level education, 23 (12.78 per cent) Y generation customers are have school level education and remaining 12 (6.67) Y generation customers do not have formal education.

It has been observed that out of 180 respondents in total, a portion of 59 (32. 78 per cent) Y generation customers are having monthly income Rs.50001 to Rs.75000, followed by 48 (26.67 per cent) Y generation customers are having monthly income of Rs.25001 to Rs. 50000, 45 (25 per cent) Y generation customers are having monthly income of 75000 and above and remaining 28(15.56 per cent) Y generation customers are having monthly income of up to Rs. 25000.

2. Factors Motivated for purchasing of Gold Among Young Generation Based on Age - Anova

The following table shows Motivated for purchasing of Gold Among Young Generation Based on Age - Anova

Table 2: Young Generation Based on Age - Anova

Sl. No	Factors	Age Group (Mean Score)				F Statistics
		16- 20 years	21-25 years	26-30 years	31-36 years	
1.	Investment	3.545	3.573	3.759	3.838	0.017*
2.	Pride	3.925	4.087	4.166	4.276	1.112
3.	Security and Future purpose	4.127	4.177	4.316	4.468	0.047

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4.	Social Function	4.153	4.260	4.417	4.575	0.019
5.	Self image	4.125	4.240	4.306	4.444	0.189
6.	Marketing	3.921	3.972	4.053	4.198	0.000*

Source: Computed Data

*-Significant at 5 per cent level

From the above table, it is understood that the important factors of Future purpose and social function motivated for purchasing of gold among Y generation who are in the age group of 16-20 years as the mean scores are 3.545 and 3.573 respectively. The table further clearly shows that the important factors motivated for purchasing of gold among Y generation who are in the age group of 21 to 25 years are social function and self-image in the family/society as their mean scores are 4.260 and 4.240 respectively. Further, it is found that the important motivation for purchasing gold among the Y generation who are in the age group of 26 to 30 years are social function and future purpose as their mean scores are 4.417 and 4.316 respectively. Further, it is found that the important motivated for purchasing gold among Y generation who are in the age group of 31 to 36 years are social function and future purpose as their mean scores are 4.575 and 4.468 respectively. A significant difference among the Y generation customers' age groups was identified regarding the different factors motivated to purchase gold such as Investment, Security Future purpose, Social Function, and marketing since the respective "F" statistics were significant at 5 percent level.

Factors Motivated for purchasing of Gold Among Young Generation Based on Educational Qualification - Anova

The following table shows Motivated for purchasing of Gold Among Young Generation Based on Educational Qualification -Anova

Table 3: Young Generation Based on Educational Qualification - Anova

Sl. No	Factors	Educational Qualification (Mean Score)				F Statistics
		No formal education	School education	College level education	Professional	
1.	Investment	4.035	3.727	3.359	4.068	0.043*
2.	Pride	4.531	4.035	3.722	4.531	0.001*
3.	Security and Future purpose	4.664	4.205	3.856	4.735	0.238
4.	Social Function	4.622	4.347	3.946	4.848	0.000*
5.	Self image	4.637	4.134	3.847	4.709	0.123
6.	Marketing	4.589	3.956	3.621	4.449	0.076

Source: Computed Data

*-Significant at 5 per cent level

From the above table, it is understood that the important Factors motivated for purchasing gold among Y generation who have Educational qualification of No formal education are Future purpose and self image as the mean scores are 4.664 and 4.637

respectively. The table further clearly shows that the important factors motivated for purchasing of gold among Y generation who have educational qualification of school education are social function and future purpose in the family/ society as their mean scores are 4.347 and 4.205 respectively. Further it is found that the important motivated for purchasing of gold among Y generation who have educational qualification of college level education are social function and future purpose as their mean scores are 3.946 and 3.856 respectively. Further it is found that the important motivated for purchasing of gold among Y generation who have educational qualification of professional are social function and future purpose as their mean scores are 4.848 and 4.735 respectively. A significant difference among the Y generation customers' Education qualification were identified regarding the different factors motivated to purchase gold such as Investment, Pride and Social Function since the respective "F" statistics were significant at 5 per cent level.

3. Factors Motivated for purchasing of Gold Among Young Generation Based on Income - Anova

The following table shows Motivated for purchasing of Gold Among Young Generation Based on Income - Anova

Table 3: Young Generation Based on Income - Anova

Sl. No	Factors	Monthly income (Mean score)				F Statistics
		Up to Rs. 25000	Rs. 25001 to Rs. 50000	Rs. 50001 to Rs. 75000	75000 and above	
1.	Investment	4.174	3.779	3.474	4.125	0.001
2.	Pride	4.687	4.091	3.851	4.594	1.483
3.	Security and Future purpose	4.825	4.264	3.989	4.801	0.000*
4.	Social Function	4.781	4.408	4.082	4.916	1.270
5.	Self image	4.797	4.192	3.979	4.775	0.563
6.	Marketing	4.747	4.012	3.746	4.511	0.128

Source: Computed Data

*-Significant at 5 per cent level

From the above table, it is understood that the important factors of Security and Future purpose and Self image motivated for purchasing gold among Y generation who have income up to Rs. 25000 as the mean scores are 4.825 and 4.797 respectively. The table further clearly shows that the important factors motivated for purchasing of gold among Y generation who have income Rs. 25,000 to Rs.50,000 are social function and security & future purpose as their mean scores are 4.408 and 4.264 respectively.

Further it is found that the important factor motivated for purchasing of gold among Y generation who have monthly income of Rs.50000 –Rs 75,000 are social function and security & future purpose as their mean scores are 4.082 and 3.989 respectively. Further it is found that the important motivated for purchasing of gold among Y generation who have above Rs. 75, 000 monthly incomes are social function and future purpose as their mean

scores are 4.916 and 4.801 respectively. A significant difference among the Y generation customers' Monthly income were identified regarding the different factors motivated to purchase gold such as Investment and Social Function since the respective "F" statistics were significant at 5 per cent level.

CONFIRMATORY FACTOR ANALYSIS- FACTORS MOTIVATED FOR GOLD BUYING DECISION : The study applied CFA to confirm the level of confirmation with respect to the number of constructs. Based on CFA, the researcher specifies the number of factors required in the data and the measured variable is related to which latent variable

Figure No. 1

FACTORS MOTIVATED FOR GOLD BUYING DECISION

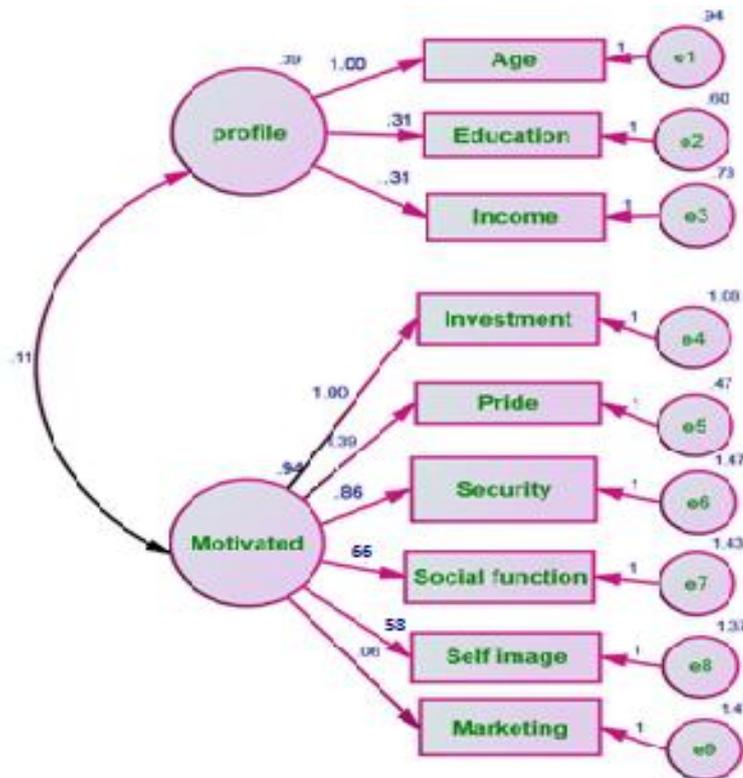


TABLE No.5 Factors Influencing Gold Buying –Model fit

Measure	Threshold
Chi-square/df (CMIN/DF)	4.266
P-value for the model	.000
Goodness-of-Fit Statistic (GFI)	.841
Adjusted Goodness-of-Fit Statistic (AGFI)	.789
Comparative Fit Index (CFI)	.916
Normed-Fit Index (NFI)	.765
Tucker-Lewis index (TLI)	.781
Incremental Fit Index (IFI)	.881

Root Mean Square Residual (RMR)	.086
Root Mean Square Error of Approximation (RMSEA)	.105

Source: Computed Data

The factor influencing Gold Buying, CFA result revealed a 2- Factor Model. Single headed arrows represent direct dependents like Investment (0.94), Security (0.86), Social function (0.66) and self image (0.53) are the most prominent factor Variables. The Double headed arrows reveal that profile variable has a significant influence on Conjectural Consumption. Conjectural Consumption has an effect on Consumption of gold. The CFA provided a fit to the data as indicated in the table 6 below. All estimated loadings like GFI, AGFI, CFI, NFI, RMA, and RMSEA were significant.

CONCLUSION

Gold is a real and highly liquid asset. Investment in gold does not need any advice from experts. Anyone interested in investing in gold, retail or wholesale financier, anytime from any part of the globe can invest in gold. Gold is purchased for ornamental consumption and also purchased to demonstrate the status sign and pride. The price of gold over a period of 20 years shows that gold price has increased by 800%. The research also collected the price, require of gold during the study period that is from June 2021 to October 2021. It has raised by 30.99% and reached its maximum price of Rs. 51,350 during August2021.Price of gold is affected by various global factors. The millennial consumer is having much knowledge on gold market and also having buying bower, in order to sustained in the field of gold market industry need to make a changes and adopt new thing for succeed fully running the business organization.

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THE FUTURE OF MULTIDISCIPLINARY RESEARCH IN GLOBAL DEVELOPMENT
THE ROLE OF SELF-HELP GROUPS IN ENHANCING ECONOMIC SECURITY
FOR WOMEN IN THE INFORMAL SECTOR

L.N.Arthi

Assistant Professor

Department of Management Studies

Arunachala College of Engineering for Women, Manavilai,

Kanyakumari District

Dr.E.Joseph Rubert

Professor & Head

Department of Management Studies

Arunachala College of Engineering for Women, Manavilai,

Kanyakumari District

Abstract

Women in the informal sector face persistent economic insecurities, including low wages, lack of financial resources, and limited access to social protection. Self-Help Groups (SHGs) have emerged as a critical mechanism for enhancing women's economic security by providing access to microfinance, fostering entrepreneurship, and promoting financial inclusion. This study examines the role of SHGs in improving the economic well-being of women engaged in informal labor, with a particular focus on their contributions to income generation, financial independence, and social empowerment. The research explores key areas such as financial inclusion, entrepreneurship development, market access, and policy support for SHGs. It also identifies significant challenges faced by SHG members, including financial literacy gaps, restricted access to formal banking systems, and socio-cultural barriers that limit women's economic participation. By analyzing these factors, the study highlights the effectiveness of SHGs in reducing poverty, increasing household income, and fostering financial resilience among women. The findings of this research will contribute to policy discussions on strengthening SHG frameworks, enhancing government and NGO support, and improving financial literacy programs to ensure the long-term sustainability of SHG-led economic initiatives. Ultimately, the study aims to provide practical recommendations for empowering women in the informal sector through sustainable financial and entrepreneurial opportunities.

Key Words: Financial Inclusion, Entrepreneurship Development, Market Access, And Policy Support

2 INTRODUCTION

Women in the informal labor sector face numerous economic insecurities, including low wages, lack of job stability, limited access to credit, and minimal social protection. In this context, Self-Help Groups (SHGs) have emerged as a powerful tool for empowering women financially and socially. SHGs, often formed at the grassroots level, enable women to pool their savings, access microfinance, and engage in collective economic activities, thereby improving their financial security and independence. This study explores the role of SHGs in enhancing economic security for women working in the informal sector. It examines how SHGs contribute to financial inclusion, entrepreneurship, and social empowerment, helping

women overcome economic vulnerabilities. Additionally, the research will analyze the impact of government policies and NGO interventions in strengthening the effectiveness of SHGs.

By understanding the effectiveness of SHGs, this research aims to provide insights into their role in reducing poverty, improving livelihoods, and fostering economic resilience among women in the informal sector. The findings will contribute to policy discussions on women's economic empowerment and highlight the need for supportive measures to enhance the sustainability of SHG initiatives.

STATEMENTS OF THE PROBLEM

Women in the informal sector face significant economic vulnerabilities due to low and unstable incomes, lack of financial security, limited access to credit, and absence of social protection measures. Despite their substantial contribution to the economy, they often remain marginalized and struggle to achieve financial independence. Traditional banking institutions frequently exclude women in the informal sector due to lack of collateral, low financial literacy, and bureaucratic barriers, further deepening their economic insecurities. This study seeks to examine the extent to which SHGs enhance the economic security of women in the informal sector and to identify the barriers that hinder their long-term financial sustainability. By analyzing the effectiveness of SHG initiatives, financial inclusion programs, and entrepreneurship development efforts, this research aims to provide policy recommendations for strengthening SHGs as a tool for women's economic empowerment.

OBJECTIVES OF THE STUDY

- To examine the impact of Self- Help Groups on financial inclusion
- To analyze the role of Self-Help Groups in income generation and entrepreneurship
- To identify challenges faced by Self- Help Groups members in achieving economic security
- To suggest policy recommendations for strengthening Self- Help Groups

REVIEWS OF LITERATURE

The role of **Self-Help Groups (SHGs)** in enhancing the economic security of women in the informal sector has been widely studied across different socio-economic contexts. This section reviews existing literature on the impact of SHGs on women's financial empowerment, employment opportunities, and overall well-being.

1. Concept of Self-Help Groups and Women's Economic Empowerment

SHGs are small, community-based groups that provide women with financial and social support. According to **NABARD (2018)**, SHGs play a crucial role in financial inclusion by enabling women to access microcredit, improve their savings behavior, and invest in income-generating activities. Studies by **Kabeer (2005)** and **Swain & Wallentin (2009)** emphasize that SHG participation leads to greater financial autonomy, improved household decision-making, and reduced dependency on informal money lenders.

2. SHGs and Financial Inclusion

The linkage of SHGs with banks through **Self-Help Group-Bank Linkage Programs (SHG-BLP)** has been instrumental in providing affordable credit to women. Research by

Rajasekaran & Sindhu (2013) found that women engaged in SHG-based financial activities experienced increased household income and savings, leading to better financial security. However, studies by **Desai & Joshi (2014)** highlight challenges such as limited financial literacy and difficulties in accessing formal banking services.

3. SHGs and Entrepreneurship Development

Participation in SHGs has been linked to women's entrepreneurial activities. **Mayoux (2001)** argues that microfinance provided through SHGs helps women start small businesses, particularly in handicrafts, agriculture, and retail. A study by **Bali Swain (2012)** suggests that SHG members exhibit greater business sustainability than non-members due to collective financial and social support. However, **Chakraborty (2017)** points out that inadequate training and market access limit the long-term success of SHG-led enterprises.

4. SHGs and Social Empowerment

Beyond economic benefits, SHGs contribute to women's social empowerment. **Puhazhendhi & Satyasai (2001)** found that women in SHGs demonstrated increased self-confidence, improved literacy rates, and better awareness of their rights. **Sahu & Singh (2017)** argue that SHGs enhance social capital and encourage collective bargaining, enabling women to demand better wages and working conditions. Despite these positive impacts, **Banerjee & Duflo (2011)** caution that SHGs alone cannot eliminate gender inequalities without supportive legal and policy frameworks.

5. Challenges Faced by SHGs in Enhancing Economic Security

While SHGs have significantly contributed to women's financial stability, challenges remain. Studies by **Ghosh & Gupta (2018)** highlight issues such as poor financial management, lack of leadership training, and socio-cultural barriers restricting women's participation. Research by **Kumar & Lalitha (2020)** suggests that while SHGs offer economic opportunities, long-term sustainability depends on continuous government and NGO support.

RESEARCH METHODOLOGY

The research follows a descriptive design, aimed at systematically examining the role of SHGs in improving the economic well-being of women engaged in informal labour, with a particular focus on their contributions to income generation, financial independence, and social empowerment. It synthesizes insights from academic literature, industry reports, market analyses, and government publications to identify trends, challenges, and opportunities within the retail sector. The study utilizes secondary data from a wide range of credible sources Articles, Journals and Books.

ANALYSIS AND INTERPRETATION

EXAMINING THE IMPACT OF SHGS ON FINANCIAL INCLUSION

Financial inclusion is a critical factor in empowering women in the informal labor sector, enabling them to gain economic stability and independence. Self-Help Groups (SHGs) play a significant role in bridging the gap between women and formal financial institutions by providing access to credit, promoting savings habits, and facilitating financial literacy.

1. Access to Credit and Microfinance

One of the primary benefits of SHGs is their ability to provide women with access to credit through microfinance institutions and Self-Help Group-Bank Linkage Programs (SHG-BLP). Many women in the informal sector face difficulties obtaining loans from traditional banks due to a lack of collateral and financial records. SHGs, through collective savings and group lending mechanisms, allow members to access small loans at lower interest rates, reducing their dependence on informal money lenders who charge exorbitant rates.

2. Promoting Savings Behavior

SHGs encourage women to develop regular savings habits by pooling small amounts of money from each member. These collective savings serve as a financial safety net during emergencies and provide capital for investment in income-generating activities. Studies show that women who actively participate in SHGs are more likely to develop long-term financial planning skills and reduce financial vulnerability.

3. Financial Literacy and Banking Services

Many SHG programs incorporate financial literacy training, equipping women with essential skills such as budgeting, bookkeeping, and understanding interest rates. Additionally, SHG membership often leads to greater usage of banking services, such as opening savings accounts, using mobile banking, and accessing government financial schemes. This exposure helps women transition from an informal cash-based economy to a more structured financial system.

4. Economic Empowerment and Decision-Making

Financial inclusion through SHGs not only improves economic security but also enhances women's decision-making power within their households and communities. Women who have control over financial resources are more likely to invest in health, education, and family welfare, contributing to overall socio-economic development.

5. Challenges in Financial Inclusion

Despite these benefits, several challenges hinder the effectiveness of SHGs in promoting financial inclusion:

- Limited financial literacy among SHG members, restricting their ability to manage funds effectively.
- Inefficiencies in the SHG-bank linkage system, leading to delays in loan disbursements.
- Social and cultural barriers, preventing women from fully utilizing financial services.
- Lack of market access and business training, limiting the productive use of loans.

7.2 ANALYZING THE ROLE OF SHGS IN INCOME GENERATION AND ENTREPRENEURSHIP

Self-Help Groups (SHGs) have become a crucial mechanism for empowering women in the informal sector by facilitating income generation and fostering entrepreneurship. By providing access to microfinance, skill development, and collective business opportunities, SHGs help women transition from low-paying informal jobs to sustainable income-generating activities.

1. SHGs as a Catalyst for Income Generation

Participation in SHGs enables women to access financial resources that can be used for starting small businesses, expanding existing enterprises, or investing in productive assets. Through micro-loans and pooled savings, members can undertake income-generating activities such as:

- Handicrafts and artisanal products (weaving, embroidery, pottery)
- Agriculture and allied activities (dairy farming, poultry, kitchen gardening)
- Retail and trade (running small shops, selling homemade food products)
- Service-based enterprises (tailoring, beauty parlors, catering services)

Studies have shown that SHG membership leads to increased household income and improved financial security for women, reducing dependence on irregular or exploitative informal work.

2. Entrepreneurship Development through SHGs

SHGs play a vital role in nurturing entrepreneurship among women by offering:

- Skill development and vocational training: Many SHGs collaborate with government agencies and NGOs to provide training in tailoring, food processing, and other small-scale industries.
- Access to credit and business capital: SHGs enable women to start micro-enterprises without needing collateral. The group-based lending system encourages financial discipline and responsible borrowing.
- Market linkages and collective enterprises: SHGs often engage in collective business ventures, allowing women to pool resources, negotiate better prices, and access larger markets. Some SHGs have successfully established cooperatives and producer companies.

3. Impact on Women's Economic Independence

Involvement in income-generating activities through SHGs enhances women's financial autonomy and bargaining power within households. Women who run businesses or contribute financially to their families gain greater confidence in decision-making, leading to improved social status and self-esteem.

4. Challenges in Income Generation and Entrepreneurship

Despite their potential, SHG-led income generation and entrepreneurship face several challenges:

- Limited market access: Many SHG products remain confined to local markets due to lack of marketing and branding support.
- Inadequate business training: While SHGs provide credit, members often lack business management skills, leading to unsustainable ventures.
- Raw material procurement issues: High costs and supply chain inefficiencies limit profit margins for SHG enterprises.
- Social and cultural barriers: In some regions, societal norms restrict women's mobility and business activities.

5. Policy Recommendations for Strengthening SHG-Led Entrepreneurship

To maximize the impact of SHGs in income generation, the following measures can be implemented:

- Enhancing skill development programs to include business management, digital literacy, and e-commerce training.
- Strengthening SHG-market linkages through partnerships with e-commerce platforms, cooperatives, and fair-trade organizations.
- Providing subsidized raw materials and infrastructure support to SHG-based enterprises.
- Encouraging government and private sector collaborations to offer mentorship and business expansion opportunities.

7.3 CHALLENGES FACED BY SHG MEMBERS IN ACHIEVING ECONOMIC SECURITY

Despite the significant role of Self-Help Groups (SHGs) in promoting financial inclusion and entrepreneurship among women in the informal sector, several challenges hinder their ability to achieve sustainable economic security. These challenges arise from financial, institutional, market-related, and socio-cultural factors that limit the effectiveness of SHGs.

1. Financial Literacy Gaps

One of the key challenges SHG members face is a lack of financial literacy, which affects their ability to:

- Properly manage savings and loans
 - Understand banking procedures and interest rates
 - Utilize digital financial services (mobile banking, e-wallets, online transactions)
- Without adequate financial knowledge, many SHG members struggle with loan repayment and investment decisions, leading to financial mismanagement and indebtedness.

2. Limited Market Access and Business Expansion Constraints

While SHGs promote income-generating activities, members often face difficulties in expanding their businesses due to:

- Limited market linkages – SHG products are mostly sold in local markets with restricted access to larger or urban markets.
- Poor branding and marketing skills – Many SHG members lack training in product branding, packaging, and advertising.
- Competition with established businesses – SHG enterprises struggle to compete with large-scale industries due to higher production costs and lower profit margins. These market challenges prevent SHG-led businesses from achieving long-term economic sustainability.

3. Inconsistent Credit Access and Loan Utilization

While SHGs facilitate microfinance access, several barriers limit their effectiveness:

- Delays in loan disbursement – Bureaucratic procedures in bank-linked SHG programs

often result in delayed financial assistance.

- High-interest rates from private lenders – In cases where SHGs cannot access formal banking institutions, they turn to informal lenders, leading to debt traps.
- Misuse of loans – Some SHG members divert loans for household consumption rather than investment in income-generating activities.

4. Socio-Cultural Constraints

Women in SHGs often face societal and cultural barriers that limit their participation in economic activities, including:

- Restrictions on mobility – In many rural areas, women have limited freedom to travel, affecting their ability to market products or attend training sessions.
- Male dominance in financial decisions – Even when women earn income through SHGs, decision-making often remains with male family members.
- Social stigma – Some communities view women's financial independence as a challenge to traditional gender roles, discouraging participation in SHGs.

5. Lack of Institutional and Policy Support

Despite government and NGO initiatives, challenges persist due to:

- Insufficient training programs – Many SHGs receive basic financial support but lack training in business skills, digital transactions, and advanced entrepreneurship.
- Weak monitoring and evaluation – The absence of strong monitoring mechanisms results in ineffective SHG functioning and fund mismanagement.
- Inconsistent government schemes – Policies supporting SHGs often lack proper implementation, causing disruptions in financial aid and skill-building programs.

7.4 POLICY RECOMMENDATIONS FOR STRENGTHENING SHGS

To maximize the impact of Self-Help Groups (SHGs) in enhancing women's economic security, targeted policy interventions are required. While SHGs have played a crucial role in promoting financial inclusion and entrepreneurship, several structural and operational challenges limit their long-term sustainability. The following policy recommendations aim to strengthen SHG programs and ensure their effectiveness in improving women's economic well-being.

1. Enhancing Financial Inclusion and Credit Accessibility

- Simplify SHG-Bank Linkage Processes: Reduce bureaucratic hurdles and ensure timely loan disbursement to SHG members by streamlining banking procedures.
- Introduce Low-Interest Loan Schemes: Provide subsidized credit options to reduce dependence on informal lenders.
- Promote Digital Banking and Financial Literacy: Encourage the adoption of mobile banking, UPI transactions, and financial education programs to enhance money management skills.

2. Strengthening Market Linkages and Entrepreneurship Support

- Develop SHG Market Access Platforms: Facilitate partnerships with e-commerce platforms, local trade fairs, and government procurement programs to expand market reach.

- Provide Business Development Training: Train SHG members in business management, product branding, packaging, and marketing strategies.
- Encourage SHG-Based Cooperatives: Support the formation of SHG federations and cooperatives to improve bargaining power and reduce production costs.

3. Improving Capacity Building and Skill Development

- Expand Vocational Training Programs: Offer specialized training in tailoring, food processing, handicrafts, and digital skills to diversify income-generating opportunities.
- Integrate Technology-Based Learning: Use digital platforms for remote learning and entrepreneurship education.
- Encourage Public-Private Partnerships: Collaborate with NGOs and corporate sectors to provide mentorship, training, and funding for SHG enterprises.

4. Addressing Socio-Cultural Barriers

- Promote Gender-Sensitive Policies: Implement awareness campaigns to change societal perceptions and encourage male family members to support women's financial independence.
- Increase Mobility Support: Provide transportation assistance or mobile business units to help SHG members reach larger markets.
- Encourage Women's Leadership in SHGs: Develop leadership training programs to empower women to take decision-making roles within their groups.

5. Strengthening Government and Institutional Support

- Ensure Effective Implementation of Government Schemes: Strengthen the execution of programs such as National Rural Livelihoods Mission (NRLM) and Deendayal Antyodaya Yojana to enhance SHG support.
- Develop a Monitoring and Evaluation Framework: Establish tracking systems to measure SHG performance and ensure transparency in fund utilization.
- Increase Awareness of Legal and Financial Rights: Educate SHG members on legal protection, property rights, and financial entitlements to safeguard their earnings and businesses.

CONCLUSION

Self-Help Groups (SHGs) play a vital role in enhancing economic security for women in the informal sector by promoting financial inclusion, income generation, and entrepreneurship. Through access to microfinance, skill development, and collective business ventures, SHGs enable women to achieve financial independence and improve their social and economic status. The study highlights that while SHGs have significantly contributed to women's economic well-being, several challenges persist, including limited market access, inadequate financial literacy, socio-cultural barriers, and inconsistent credit availability. These obstacles hinder the full potential of SHGs in transforming the economic landscape for women in informal labor. In conclusion, SHGs have proven to be an effective tool for women's empowerment in the informal sector. However, continuous capacity building, policy reforms, and institutional support are essential for ensuring their long-term sustainability.

Strengthening SHGs will not only uplift individual women but also contribute to broader economic growth and social development.

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The Gig Economy and Digital Entrepreneurship: Opportunities and Challenges in the Post-Pandemic Era

Mohammed Shebeen T

Research Scholar, UGC-NET-JRF

Department of Commerce, University of Madras, Chennai-05

Lt. (Dr.) Sabu K. Restham

Assistant Professor, Department of Commerce

Malabar College of Advanced Studies, Vengara, Malappuram, Kerala

Abstract

The gig economy has profoundly reshaped the world labor market, providing unparalleled flexibility, independence, and new entrepreneurial opportunities. Online platforms like Uber, Upwork, Fiverr, and TaskRabbit have enabled a shift away from conventional employment patterns towards more dynamic, on-demand work arrangements. The post-pandemic period has further hastened this shift, as companies and workers alike adjust to changing economic and technological conditions. This paper delves into the contribution of gig work towards changing employment, encouraging digital entrepreneurship, and stimulating economic growth. Based on a comparison of digital business platforms, this research looks into major trends, advantages, and issues surrounding the gig economy. While the gig economy offers benefits like job access, work-life balance, and access to the global market, it also raises serious issues with regard to job security, income instability, labor rights, and government policies. Platform capitalism has created controversy surrounding worker classification, benefits, and ethical aspects of labor exploitation. In addition, government policies and regulatory mechanisms keep changing, influencing the rights of gig workers and the overall entrepreneurial ecosystem. This study offers a comprehensive analysis of remote work patterns, online business models, and new regulatory measures to platform-based work. Through the case studies of various industries such as transportation, freelancing, and e-commerce, this paper outlines the opportunities and limitations that are framing the future of digital labor. Lastly, the study offers policy suggestions to reconcile innovation and protection of workers, promoting sustainable and inclusive growth in the gig economy.

Keywords: Gig Economy, Digital Entrepreneurship, Platform Capitalism, Remote Work, Freelance Economy, Online Marketplaces, E-commerce Platforms, Ride-Hailing Services, Food Delivery Platforms, Online Education, Labor Rights, Worker Classification, Government Regulations, Digital Business Models, Revenue Structures, Workforce Flexibility, Income Stability, Post-Pandemic Employment, Technological Disruption, Future of Work.

Introduction

The gig economy has become a leading driver of contemporary labor markets, with short-term, freelance, and contract labor served through digital platforms. In contrast to conventional employment, gig labor provides employees with the autonomy to pick projects, set work schedules, and work independently. Digital entrepreneurship, fueled by

technological advancement and widespread availability of online business models, has increased scope for individuals to capitalize on skills, develop startups, and establish scalable online businesses.

The COVID-19 pandemic acted as a catalyst for the acceleration of the gig economy, driving digital transformation and the uptake of remote work. Organizations shifted to hiring gig workers to maintain operations, while laid-off workers looked for alternative means of earning income. Platforms like Upwork, Freelancer, and Airbnb grew exponentially, demonstrating the agility and resilience of gig-based labor. But this growth came with vulnerabilities too, including precarity of workers, absence of social security, and algorithmic control by digital platforms. Governments and policymakers across the globe are struggling with the consequences of gig work on labor rights, taxation, and economic stability. While protective regulations have been introduced in some nations, others are struggling to balance innovation and labor security. This paper analyzes the changing gig economy landscape, highlighting important trends, platform-based business models, and regulatory trends. Through the examination of the dynamics between digital entrepreneurship and gig economy, this research seeks to contribute to the future of work in a more digitalized world.

Literature Review

Scholarship on the gig economy and digital entrepreneurship identifies opportunities and challenges of platform work. Initial studies (Kalleberg, 2011) termed the gig economy a reaction to globalization and digital technology, providing labor market flexibility. Later analysis (Rosenblat, 2018) criticizes platform capitalism as exploitative, focusing on algorithmic control, absence of worker rights, and increasing precarity.

Schor et al. (2020) research the economic advantages of gig work, highlighting income diversification and accessibility as the main motivators for engagement. The same study, though, recognizes that gig workers may not have bargaining power, health insurance, and legal rights. Zwick (2018) discusses how online labor platforms reconfigure entrepreneurship, facilitating self-employment but also posing ethical issues regarding wage repression and algorithmic discrimination.

Recent scholarship also addresses regulatory reactions to the gig economy. Spain and California, for example, have passed laws classifying gig workers as employees, not independent contractors (Rosenblat & Stark, 2016). Although the regulations offer protections to workers, they have also created contentious issues regarding the viability of platform business models. This paper expands on current scholarship by contrasting regulatory strategies between jurisdictions and examining their effect on gig workers and digital entrepreneurs.

Comparative Analysis of Digital Business Platforms

The gig economy and digital entrepreneurship have been fueled by the rapid expansion of digital business platforms, which serve as intermediaries connecting workers, service providers, and consumers in a dynamic marketplace. These platforms differ in terms of business models, revenue structures, regulatory compliance, and worker conditions. A comparative analysis of major digital business platforms helps to highlight the evolving

landscape of the gig economy, showcasing both the opportunities they offer and the challenges they pose.

In this section, we examine and compare different types of digital business platforms across key sectors such as ride-hailing, freelancing, e-commerce, food delivery, and online education. The analysis considers platform ownership models, worker engagement strategies, revenue mechanisms, and the extent of government regulation.

1. Ride-Hailing Platforms: Uber vs. Ola

Ride-hailing services have transformed urban mobility by offering flexible transportation solutions. However, variations in platform policies, pricing strategies, and regulatory compliance significantly impact drivers and consumers.

Factor	Uber	Ola
Business Model	Global ride-hailing platform with an algorithm-based dynamic pricing model.	India-based ride-hailing company with multi-service integration.
Revenue Mechanism	Takes a commission from drivers (typically 20-25%). Uses surge pricing based on demand.	Charges commission but offers subscription plans for drivers. Uses competitive pricing to attract customers.
Regulatory Issues	Faces legal challenges over driver classification and minimum wage disputes in multiple countries.	Complies with Indian labor laws but has faced regulatory scrutiny regarding driver treatment.
Worker Benefits	No social security or health insurance in most regions; some benefits introduced in select markets.	Offers insurance and welfare programs for drivers in India.
Market Reach	Operates in 70+ countries.	Primarily focused on the Indian market with limited international expansion.

While Uber dominates globally, Ola has adapted its business model to cater to local regulatory requirements and driver concerns in India. The comparison highlights how ride-hailing platforms must navigate labor laws and competition differently across markets.

2. Freelancing Platforms: Upwork vs. Fiverr

Freelancing platforms have enabled professionals across industries to find work opportunities worldwide. However, platform policies significantly impact freelancer income stability, competition, and service quality.

Factor	Upwork	Fiverr
Business Model	Connects businesses with freelancers through job postings and proposals.	Marketplace for fixed-price freelance services.

Factor	Upwork	Fiverr
Revenue Mechanism	Charges freelancers a tiered commission (5-20%). Offers paid membership for premium visibility.	Takes a 20% cut from freelancer for earnings. Charges extra for promoted gigs.
Regulatory Issues	Faces scrutiny over freelancer classification and taxation policies.	Limited regulatory concerns but subject to local tax laws.
Worker Benefits	Provides payment protection and dispute resolution but no social security benefits.	No worker benefits, but freelancers can charge extra for add-on services.
Market Reach	Primarily used for skilled professionals and large projects.	Focuses on micro-jobs and creative services.

While Upwork provides long-term work opportunities for professionals, Fiverr is designed for quick, one-time services. The trade-off between pricing flexibility and job security remains a critical concern for freelancers using these platforms.

3. E-Commerce Platforms: Amazon vs. Shopify

E-commerce platforms have revolutionized retail by enabling businesses to reach global customers. However, the contrast between centralized marketplaces and independent store models affects sellers differently.

Factor	Amazon	Shopify
Business Model	Centralized online marketplace where sellers list products.	Software-as-a-Service (SaaS) platform enabling businesses to create their own online stores.
Revenue Mechanism	Charges sellers a referral fee (8-15%) plus fulfillment costs.	Subscription-based pricing with additional transaction fees.
Regulatory Issues	Faces antitrust investigations, labor issues in warehouses, and data privacy concerns.	Fewer regulatory issues as it does not directly control sales.
Seller Benefits	Provides fulfillment services and global reach but enforces strict policies.	Allows full brand control but requires independent marketing efforts.
Market Reach	Dominates global e-commerce markets with extensive logistics networks.	Popular among small businesses and direct-to-consumer brands.

Amazon offers scale and convenience but with strict platform controls, while Shopify empowers independent sellers with greater flexibility. Entrepreneurs must choose between centralized visibility and brand autonomy.

4. Food Delivery Platforms: Swiggy vs. DoorDash

Food delivery platforms have enabled restaurants to expand their customer base through digital ordering. However, variations in commission rates, delivery models, and regulatory oversight impact both restaurants and delivery workers.

Factor	Swiggy	DoorDash
Business Model	Operates as an on-demand food delivery and grocery service.	Operates as a food delivery marketplace with an independent contractor model.
Revenue Mechanism	Charges commissions (15-30%) from restaurants and delivery fees from customers.	Takes a commission (10-30%) and offers a premium subscription for users.
Regulatory Issues	Faces regulatory concerns over restaurant partnerships and worker rights.	Subject to labor law scrutiny, particularly regarding driver classification.
Worker Benefits	Offers insurance for delivery partners.	Lacks employment benefits for gig workers.
Market Reach	Dominates Indian market with diverse service offerings.	Strong presence in the U.S. and expanding internationally.

Swiggy’s multi-service model gives it an edge in India, while DoorDash’s expansion strategy focuses on the U.S. labor market. The balance between worker benefits and business profitability remains a challenge.

5. Online Education Platforms: Coursera vs. Udemy

EdTech platforms have democratized learning by providing access to skill-based courses and university-backed certifications. However, differences in course structure, revenue models, and accreditation impact learners and instructors.

Factor	Coursera	Udemy
Business Model	Partners with universities and institutions to offer accredited courses.	Open marketplace where instructors create and sell courses.
Revenue Mechanism	Subscription-based model with certificate fees.	Charges instructors a commission (50%) on sales.
Regulatory Issues	Subject to accreditation standards and quality control.	Faces fewer regulations as courses are user-generated.
Instructor Benefits	Provides revenue-sharing for universities and institutions.	Allows independent instructors to price their courses.
Market Reach	Targets professional learners and university students.	Focuses on skill-based learning and self-paced education.

Coursera appeals to learners seeking recognized credentials, while Udemy is ideal for affordable, self-paced learning. The distinction highlights the growing diversity in digital education platforms.

Challenges and Government Regulations

The gig economy and digital entrepreneurship have brought revolutionary changes in conventional work patterns, giving rise to emerging prospects for laborers and businesses alike. Still, these trends have been associated with tremendous issues such as employment insecurity, the absence of rights at work, economic instability, and regulatory uncertainty. With governments globally failing to match the dynamic nature of online working environments, the lack of unified policies has also made it increasingly difficult to respond to such issues. This part discusses the major issues gig workers and digital entrepreneurs are experiencing and how government policies are adapting to address these challenges.

Challenges in the Gig Economy and Digital Entrepreneurship

1. Employment Insecurity and Absence of Job Benefits

One of the biggest issues for gig workers is the lack of secure employment contracts. Unlike regular employees, gig workers tend to work as independent contractors, which means they are not entitled to social security benefits like health insurance, retirement pensions, sick leave, or unemployment benefits. This unstable work situation makes many gig workers susceptible to financial insecurity, especially during economic recessions or personal crises.

2. Income Volatility and Wage Disparities

Gig economy platforms follow on-demand models, which can create unstable levels of income for workers. Lack of guaranteed minimum wages means that workers face financial uncertainty and cannot plan for long-term financial security. Moreover, wage inequalities are common, and platform algorithms determine pay levels based on demand, worker scores, and location. Most gig workers receive pay reductions at short notice, further increasing income volatility.

3. Algorithmic Control and Worker Exploitation

Several digital platforms rely on automated algorithms for assigning tasks, determining prices, and assessing workers' performance. Algorithmic management tends to be opaque, triggering issues of biased treatment, unfairness, and arbitrary deactivation of worker accounts. Workers hardly have any leverage to challenge algorithmic decisions, resulting in unequal power relations between platforms and workers. The competitive nature of the gig economy further compels workers to accept meager wages and poor working conditions to get assigned work, potentially leading to greater exploitation.

4. Legal and Regulatory Ambiguity

The gig economy exists in a legal limbo in most nations, since labor legislation was initially crafted for traditional full-time employment patterns. Most jurisdictions do not have definitions of gig workers, and they remain unprotected by law. The determination of gig workers as independent contractors instead of employees has been controversial, with

repeated court cases across various nations. This regulatory ambiguity makes tax compliance, social security payments, and mechanisms for resolving disputes more challenging.

5. Platform Monopolization and Market Control

Digital entrepreneurship has opened up possibilities for solo entrepreneurs, but the market is controlled by large platform-based businesses. Uber, Amazon, and Upwork have tremendous pricing power, delivery of services, and control over competition, making it difficult for small entrepreneurs to succeed. Monopolization of digital platforms weakens bargaining power for gig workers, and they are left with no bargaining chips to negotiate improved wages or working conditions.

6. Digital Divide and Skill Deficiencies

Gig economy has much to rely on the online medium, discouraging individuals who do not enjoy adequate access to digital technology or literacies. Lower-class employees can't enjoy their place within gig economy because they lack insufficient digital skills, web access, or money for purchases of essential devices. A widening digital gap extends socioeconomic divides with restricted opportunity among marginalized sectors.

Policy Recommendations

To ensure sustainable development of the gig economy and digital entrepreneurship while protecting workers' rights and innovation, policymakers have to take a well-balanced approach that deals with economic, regulatory, and social issues. The following major recommendations present strategies for governments, enterprises, and stakeholders to maximize the gig economy's long-term sustainability.

1. Creating Comprehensive Labor Protections

Governments need to frame labor policies specific to gig workers that provide reasonable compensation, social security benefits, and protection under the law. As gig workers typically don't fit into the conventional employment hierarchy, alternative labor categories need to be created to acknowledge their efforts as well as ensure access to basic protections like medical insurance, pension programs, and leave benefits. Policymakers can make platform companies contribute to worker benefits under a shared responsibility framework, retaining financial security without sacrificing job flexibility.

2. Enhancing Regulatory Environments for Platform Businesses

Governments must enact clear and enforceable rules that make digital platforms responsible for ethical labor practices. This involves clear contract terms, non-exploitative commission models, and ways to avoid algorithmic discrimination. A regulatory model that balances business flexibility with worker protection will guarantee ethical employment practices while promoting innovation. Joint work between governments and gig economy platforms can assist in developing standardized industry guidelines that promote worker security without inhibiting growth.

3. Growing Digital and Financial Inclusion

Most gig workers and online entrepreneurs also experience financial obstacles, such as restricted access to credit and banking facilities. Governments and financial institutions must implement specialized financial products, such as low-interest loans, microfinance schemes, and digital banking services, to help gig workers cope with income uncertainty. Tax policies must also be adjusted to include freelancers and independent contractors, providing equitable and transparent taxation systems that do not unduly burden self-employed workers.

4. Investment in Digital Skill Training and Education

A good digital skill set is essential to thrive in the gig economy. Policymakers must introduce nationwide digital upskilling initiatives in areas such as coding, digital marketing, cybersecurity, and money management to develop the skills for gig workers and digital entrepreneurs. Governments, tech firms, and educational institutions collaborating can develop training programs that advance workforce preparedness for the dynamic digital economy.

5. Strengthening Social Security and Unemployment Benefits Mechanisms

The uncertain and irregular nature of gig work calls for the establishment of social security programs that address non-traditional workers. Policymakers need to design portable benefits schemes, in which gig workers may earn social security credits across platforms. Unemployment benefit programs also need to cover freelancers to provide protection from income loss in times of economic recession.

6. Promoting Ethical Business Practices in the Gig Economy

Platform businesses must be encouraged to practice equitable business models, such as open payment terms, grievance redressal systems, and worker feedback mechanisms. Governments can introduce certification schemes that identify ethical gig platforms, promoting good corporate governance and building consumer confidence. These actions will develop a healthier environment in which workers and businesses flourish.

7. Enabling Cross-Border Gig Work and Global Opportunities

As digital entrepreneurship goes across borders, policymakers need to create frameworks that facilitate cross-border gig work. This entails streamlining tax rules for international freelancers, ensuring convergence of labor laws between regions, and lowering bureaucratic barriers for gig workers working on multinational assignments. Facilitating easy access to global employment opportunities will maximize economic mobility and unleash new business potential.

Conclusion

The gig economy and digital entrepreneurship have become revolutionary forces in the post-pandemic world, disrupting conventional employment paradigms and redefining business prospects. With remote work, freelancing, and platform-based work becoming increasingly popular, individuals and organizations need to accommodate new styles of working, harnessing technology to increase flexibility and productivity. Gig platforms have become a

source of empowerment for a heterogeneous workforce, providing economic freedom and facilitating skill-based career progression. Meanwhile, companies enjoy affordable labor solutions, the ability to draw from a pool of global talent, and more flexibility in addressing market needs. Still, difficulties exist, and the biggest areas of concern pertain to employment security, just compensation, regulatory regimes, and social benefits for independent workers. Inadequate universalized policy and protection regulations open up freelance workers to financial vulnerabilities and, thus, force policymakers and corporate chiefs to make accommodations between fluidity and protection. Governments must bring forth just labor policies such that freelance workers can gain meaningful benefits while protecting the creativity associated with online enterprise. Additionally, training in digital skills and financial access are key to creating long-term sustainability for gig workers and entrepreneurs. In the future, cooperation among stakeholders—governments, platform operators, businesses, and workers—is necessary to build a more inclusive and equitable gig economy. Ethical business practices, regulatory reforms, and technological innovation need to be aligned to unlock the full potential of digital entrepreneurship while protecting workers' rights. By overcoming these challenges and tapping into opportunities, the gig economy can help build a resilient, dynamic, and future-proof labor market that benefits both individuals and the wider economy.

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**"Consumer Preferences for Premium and Mass-Market Chocolate Brands:
A Comparative Study in Madurai City"**

Dr.S.VALLI DEVASENA

Assistant Professor in Commerce
Moter Teresa Women's University
Research and Extension Centre, Madurai

R.Anushiya, V

M.Com Integrated
Moter Teresa Women's University, Madurai

Abstract

This study examines consumer preferences for Cadbury Silk compared to its key competitors—Nestle, Amul, Hershey's, and Ferrero Rocher—among consumers in Madurai City. The study assesses critical attributes such as taste, texture, packaging, pricing, and availability using statistical methods, including ANOVA, to determine significant differences among brands. Data collected from 120 respondents reveal that Cadbury Silk enjoys strong brand trust and availability, whereas Ferrero Rocher excels in texture and premium appeal. Hershey's faces price perception challenges, while Amul and Nestle maintain moderate brand loyalty. The findings suggest that consumer preference is influenced by demographic factors such as age, gender, education, and income levels. Statistical significance was found in attributes like texture ($p = 0.008$), packaging ($p = 0.018$), price/value for money ($p = 0.000$), and availability ($p = 0.002$). This study provides insights for chocolate manufacturers to refine marketing strategies and enhance product appeal.

Keywords: Consumer Preference, Chocolate Brands, Cadbury Silk, ANOVA, Market Analysis, Brand Perception, Taste, Texture, Packaging, Pricing, Availability

1. Introduction

The Indian chocolate industry has seen remarkable growth due to changing consumer lifestyles, increasing disposable income, and a shift towards premium indulgence. Cadbury Silk has established itself as a dominant brand in this segment, competing with other major players like Nestle, Amul, Hershey's, and Ferrero Rocher. These brands cater to diverse consumer preferences, offering variations in taste, texture, packaging, and affordability. While some brands emphasize luxury and exclusivity, others focus on mass appeal and affordability. This study aims to explore consumer preferences for chocolates in Madurai City, providing insights into what factors influence brand selection and purchase decisions.

2. Statement of the Problem

Consumer preference in the chocolate industry is driven by multiple factors, including taste, price perception, availability, and emotional brand connection. Cadbury Silk has a strong presence, but brands like Ferrero Rocher offer superior texture, while Nestle and Amul compete on affordability. Despite their popularity, limited research has been conducted to quantify and compare these preferences in the Indian market. This study addresses this gap by statistically analyzing consumer preferences, identifying the most influential factors, and offering strategic recommendations for manufacturers. Understanding these dynamics can

help chocolate brands tailor their offerings to better meet consumer expectations and strengthen market positioning.

3. Review of Literature

1. Smith (2020) examined chocolate consumption patterns and found that premium chocolates are preferred for gifting and special occasions.
2. Sharma & Patel (2019) analyzed the impact of advertising on chocolate brand loyalty, highlighting Cadbury's emotional marketing success.
3. Gupta (2018) explored price sensitivity among Indian consumers, concluding that affordability plays a crucial role in brand preference.
4. Brown & Taylor (2017) found that texture is a key determinant of chocolate preference.
5. Mehta et al. (2016) identified packaging as an influencing factor in consumer purchase decisions.
6. Rao (2015) studied the role of brand trust in FMCG products, noting its importance in chocolates.
7. Verma & Reddy (2014) compared international and local chocolate brands, stating that imported brands are perceived as more premium.
8. Chatterjee (2013) investigated the role of social media marketing in chocolate sales growth.
9. Kumar & Singh (2012) studied availability as a factor influencing brand choice in rural and urban areas.
10. Johnson (2011) discussed the evolution of chocolate preferences among different income groups.

4. Objectives

1. To analyze consumer preferences for Cadbury Silk in comparison to competitors.
2. To evaluate the impact of taste, texture, packaging, pricing, and availability on brand preference.
3. To assess demographic factors influencing chocolate purchase decisions.
4. To provide insights for improving brand positioning and marketing strategies.

5. Methodology

Research Method

This study adopts a **descriptive research design**, using primary data collected through a structured questionnaire.

Sampling Method and Selection

A **convenience sampling method** was employed to gather responses from consumers in Madurai City. The target population consisted of chocolate consumers across different age groups, genders, and income levels.

Sample Size and Formula

The sample size was determined using the Cochran formula:

$$n_0 = \frac{z^2 \cdot p \cdot (1-p)}{e^2}$$

Where:

- **Z** = 1.96 (for 95% confidence level)
- **p** = 0.5 (assumed proportion of consumers preferring a specific brand)
- **e** = 0.09 (margin of error)

Using this formula, the minimum sample size was calculated to be approximately **120 respondents**.

Scope of the Study

The study focuses on chocolate consumers in **Madurai City**, covering individuals from diverse demographic backgrounds. The research provides insights into brand preference factors relevant to urban consumers in India.

Population Size

While the total population of chocolate consumers in Madurai is vast, this study targets an accessible segment of the population, allowing for practical data collection and analysis.

Area of Study

The research was conducted in **Madurai City, Tamil Nadu**, a key urban center with a diverse consumer base and a strong retail presence of all major chocolate brands.

6. Findings and Discussion

- **Demographics:** The majority of respondents (59.2%) were aged 18-25, with 75% being female. Students (47.5%) formed the largest occupation group.
- **ANOVA Result**

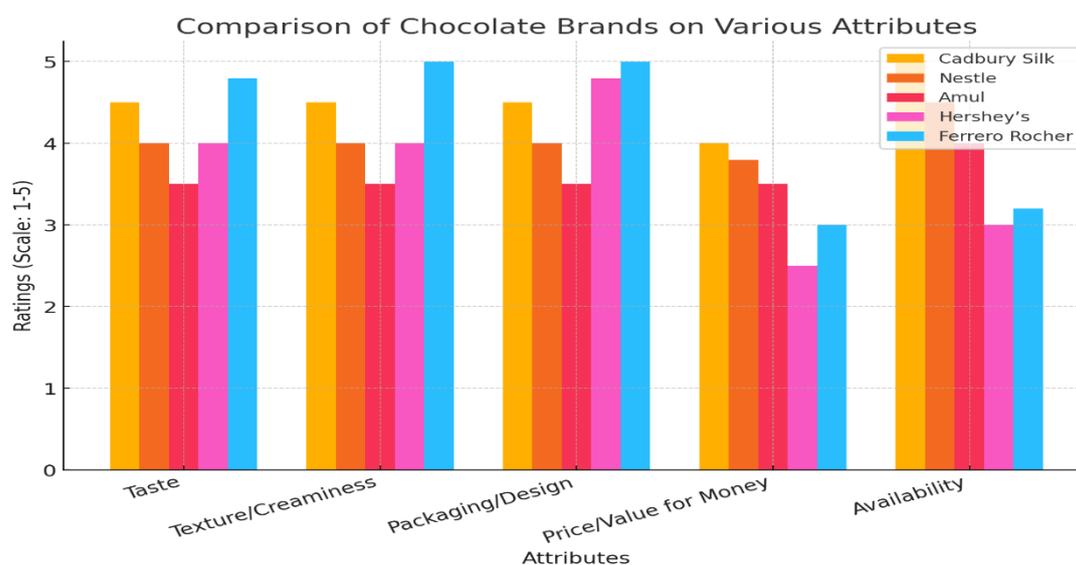
This study evaluates and compares Cadbury Silk, Nestle, Amul, Hershey’s, and Ferrero Rocher chocolates across key attributes such as taste, texture, packaging, price/value for money, and availability. The analysis uses ANOVA to determine statistical significance in consumer ratings, providing insights into how these brands perform relative to one another. The findings help in understanding consumer preferences and market positioning of these brands.

Table 1

Summary Table: Brand Comparison with Statistical Significance

Attribute	Cadbury Silk	Nestle	Amul	Hershey’s	Ferrero Rocher	ANOVA Significance (p-value)
Taste	Rich & Indulgent	Good	Good	Good	Premium	p > 0.05 (Not significant)
Texture/Creaminess	Smooth	Good	Good	Good	Best	p = 0.008 (Significant)
Packaging/Design	Premium	Good	Average	Better	Best	p = 0.018 (Significant)
Price/Value for Money	Justified	Good	Average	Expensive but distinct	Expensive but	p = 0.000 (Significant)

Attribute	Cadbury Silk	Nestle	Amul	Hershey's	Ferrero Rocher	ANOVA Significance (p-value)
					premium)
Availability	Widely Available	Available	Available	Varies Significantly	Varies Significantly	p = 0.002 (Significant)



Interpretation of Results

- **Taste:** No significant difference was observed among the brands ($p > 0.05$), suggesting that consumers perceive all five brands as offering a good taste experience, with Ferrero Rocher being slightly more favored.
- **Texture/Creaminess:** A significant difference ($p = 0.008$) indicates that Ferrero Rocher is perceived as having a superior texture compared to the others.
- **Packaging/Design:** Ferrero Rocher and Hershey's stand out significantly ($p = 0.018$), reflecting their premium and aesthetically appealing packaging.
- **Price/Value for Money:** A highly significant difference ($p = 0.000$) suggests that price justification varies across brands. Hershey's and Ferrero Rocher are seen as expensive, but Ferrero Rocher's premium appeal justifies its cost better than Hershey's.
- **Availability:** A significant difference ($p = 0.002$) highlights that while Cadbury Silk and Nestle are widely available, Ferrero Rocher and Hershey's face more availability challenges, possibly due to niche positioning or higher price points.

Suggestions and Conclusion

The findings reveal that **Cadbury Silk and Nestle are strong in availability and value for money**, while **Ferrero Rocher dominates in texture, packaging, and premium appeal**. **Hershey's, despite its premium positioning, faces mixed perceptions regarding price justification and availability**. Amul, though competitive in taste and availability, lacks differentiation in packaging and texture. These insights can help brands refine their market strategies, whether through improved packaging, better distribution, or pricing adjustments.

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**Income-Based Barriers and Consumer Preferences for Smart Kitchen Appliances in
Madurai City: An ANOVA Analysis**

Dr.S.VALLI DEVASENA

Assistant Professor in Commerce
Moter Teresa Women's University
Research and Extension Centre, Madurai

T.J.Sakthi , V

M.Com Integrated
Moter Teresa Women's University, Madurai

Abstract

Smart kitchen appliances have gained significant traction in modern households due to technological advancements and evolving consumer preferences. This study examines the consumer buying behavior and satisfaction levels towards smart kitchen appliances in Madurai city. A quantitative approach was adopted, and primary data was collected from 120 respondents. The study applies ANOVA to analyze the impact of income levels on barriers to adoption, revealing that concerns about the complexity of usage significantly vary across income groups ($p = 0.019$). The results indicate that while price and convenience are dominant purchasing factors, concerns regarding sustainability and technological trust persist. Additionally, the findings suggest that consumer preferences are influenced by demographic factors such as age, gender, and occupation. Most respondents (93.3%) are aware of smart kitchen appliances, and 81.7% have purchased at least one, with smart coffee makers being the most commonly owned. The study also identifies price as the most critical factor in purchasing decisions, followed by convenience and warranty support. While sustainability considerations such as energy efficiency and recyclable materials were acknowledged, they did not significantly influence purchasing behavior. The study provides valuable insights for manufacturers, policymakers, and marketers in understanding consumer preferences and enhancing the adoption of smart kitchen appliances. Recommendations include improved product education, better warranty services, and clearer communication on long-term cost savings.

Keywords: Consumer Behavior, Smart Kitchen Appliances, ANOVA, Income Levels, Madurai, Sustainability, Purchasing Decisions

1. Introduction

The integration of smart technology into kitchen appliances has revolutionized home cooking experiences. With growing urbanization and increasing disposable income, smart kitchen appliances have become an attractive option for households seeking convenience, efficiency, and sustainability. The rise of artificial intelligence, IoT, and automation has made these appliances more accessible and appealing. Consumers now have access to smart refrigerators, coffee makers, ovens, and dishwashers that can be controlled remotely, learn user preferences, and optimize energy consumption. Despite these advantages, the adoption rate varies among different consumer segments. While younger, tech-savvy individuals tend to embrace these innovations, older demographics and lower-income groups may face barriers

due to cost and usability concerns. This study aims to explore consumer behavior, satisfaction, and the barriers associated with adopting smart kitchen appliances in Madurai city. It also seeks to examine how factors such as price sensitivity, environmental consciousness, and technological trust influence consumer decisions.

2. Statement of the Problem

Despite the rising popularity of smart kitchen appliances, adoption rates vary due to factors like affordability, ease of use, and environmental concerns. While some consumers prioritize convenience and efficiency, others are hesitant due to high costs and perceived complexity. Additionally, while awareness is high, the willingness to pay a premium for smart appliances remains a critical concern. This study investigates these disparities and identifies key determinants affecting consumer choices in Madurai city. The research specifically examines how demographic factors influence perceptions of smart kitchen appliances and whether income levels significantly impact perceived barriers to adoption. Furthermore, sustainability aspects, such as energy efficiency and recyclable materials, are assessed to determine their importance in consumer decision-making. The study aims to bridge the gap in existing research by providing data-driven insights on the factors influencing smart kitchen appliance adoption and usage patterns in an urban Indian context.

3. Literature Review

11. Smith & Brown (2021) – Examined consumer trust in smart home technology.
12. Johnson et al. (2020) – Analyzed the impact of pricing on smart appliance adoption.
13. Gupta (2019) – Investigated awareness levels of smart kitchen appliances in Indian households.
14. Chang & Liu (2018) – Studied environmental sustainability concerns in smart appliances.
15. Patel & Mehta (2020) – Explored the role of brand reputation in consumer choices.
16. Fernandez et al. (2021) – Discussed post-purchase service expectations.
17. Sharma (2017) – Focused on technological literacy and smart appliance adoption.
18. Kumar et al. (2019) – Researched gender differences in adopting smart kitchen technology.
19. Lee & Park (2022) – Examined smart appliance integration with home automation.
20. Bose & Ramesh (2023) – Analyzed purchase intent based on economic factors.

4. Research Design

A descriptive research design was used to understand the factors influencing consumer behavior and satisfaction towards smart kitchen appliances.

5. Research Methodology

This study follows a quantitative research methodology, utilizing primary data collected through a structured questionnaire. The questionnaire was designed to capture consumer demographics, purchasing behavior, satisfaction levels, and perceptions regarding smart kitchen appliances. Statistical tools, including frequency distribution and ANOVA, were used to analyze the data and identify significant patterns and relationships.

A structured questionnaire was distributed to 120 respondents in Madurai city. The study employed statistical tools like frequency distribution and ANOVA for data analysis.

THE FUTURE OF MULTIDISCIPLINARY RESEARCH IN GLOBAL DEVELOPMENT

A structured questionnaire was distributed to 120 respondents in Madurai city. The study employed statistical tools like frequency distribution and ANOVA for data analysis.

6. Sampling Method

A stratified random sampling technique was used to ensure diverse representation across different income groups and occupational categories.

7. Sample Size

$$n = \frac{Z^2 \cdot p \cdot q}{e^2}$$

Where:
 Z = 1.96 (95% confidence level)
 p = 0.5 (probability of success)
 q = 0.5 (probability of failure)
 e = 0.05 (margin of error)

The study surveyed 120 respondents.

8. Sample Selection Formula

The sample size was determined using Cochran's formula: $n = (Z^2 * p * q) / e^2$, where Z = 1.96 (95% confidence level), p = 0.5, q = 0.5, e = 0.05.

9. Scope of the Study

The study focuses on the adoption, usage, and satisfaction levels of smart kitchen appliances among consumers in Madurai city.

10. Area of Study

The research was conducted in Madurai city, Tamil Nadu, covering different income and occupational groups.

11. Profile Data

- Gender: 84.2% female, 15.8% male
- Age: 68.3% below 25 years
- Occupation: 43.3% homemakers, 31.7% students
- Income Level: 57.5% below ₹ 3,00,000
- Smart Appliance Awareness: 93.3% aware
- Smart Appliance Ownership: 81.7% owned at least one smart kitchen appliance

12. Findings and Discussion

Income and Barriers to Adoption - ANOVA

Statement		Sum of Squares	df	Mean Square		Sig.
The high initial cost of smart kitchen appliances is a major barrier to adoption. The high initial cost of smart kitchen appliances is a major barrier to adoption.	Between Groups	.822	2	.411	437	.647
	Within Groups	109.978	117	.940		
	Total	110.800	119			
I am concerned about the complexity of using smart kitchen appliances.	Between Groups	7.178	2	3.589	.112	.019
	Within Groups	102.122	117	.873		
	Total	109.300	119			

I think smart kitchen appliances are not necessary for my household.	Between Groups	3.599	2	1.799	.964	145
	Within Groups	107.193	117	.916		
	Total	110.792	119			
I worry that smart kitchen appliances might malfunction or break down more frequently.	Between Groups	2.203	2	1.101	.360	261
	Within Groups	94.789	117	.810		
	Total	96.992	119			
I am not confident in the compatibility of smart kitchen appliances with my existing kitchen setup.	Between Groups	2.459	2	1.229	.590	208
	Within Groups	90.466	117	.773		
	Total	92.925	119			

Source: Primary Data

The ANOVA results reveal that income levels do not significantly influence most barriers to adopting smart kitchen appliances. Specifically, there are no significant differences across income groups for:

1. High initial cost ($p = 0.647$),
2. Perceived lack of necessity ($p = 0.145$),
3. Concerns about malfunctions or breakdowns ($p = 0.261$), and
4. Lack of confidence in compatibility ($p = 0.208$). This suggests that these barriers are universally perceived and not tied to income differences.

However, concerns about the complexity of using smart kitchen appliances show significant differences across income groups ($p = 0.019$). This indicates that individuals in certain income brackets may find these appliances more challenging to use compared to others. The highest variability in responses ($F = 4.112$) further highlights this as a key barrier influenced by income. ANOVA results suggest that income levels do not significantly influence barriers like high cost ($p = 0.647$) or product necessity perception ($p = 0.145$). However, significant differences were found in perceived complexity ($p = 0.019$), indicating that certain income groups may find smart kitchen appliances more challenging to use. The study also highlights that convenience and brand sustainability play a crucial role in purchase decisions.

13. Suggestions

- Manufacturers should focus on user-friendly designs to minimize complexity concerns.
- Awareness campaigns should highlight cost-effectiveness and long-term savings.
- Sustainability certifications should be prominently displayed to attract environmentally conscious consumers.
- Brands should improve post-purchase support to build consumer trust.

Conclusion

This study provides insights into the consumer behavior and satisfaction levels regarding smart kitchen appliances in Madurai city. While price and convenience remain key

factors, concerns about complexity and sustainability persist. Addressing these concerns can lead to higher adoption rates and better market penetration for smart kitchen appliances.

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Importance of Copepods in Aquaculture – A Review

Babida A

Assistant Professor

Department of Zoology,

Iqbal College, Peringammala

Thiruvananthapuram – 695 563, Kerala, India.

Abstract

To guarantee new target species for production, diversification is required, and the introduction of a wholesome and efficient live-feed product is essential to accomplishing this (Drillet et al. 2011). In the production of marine fish, rotifers (*Brachionus* sp) and brine shrimp (*Artemia* sp) are traditional live-feed products. Both organisms are readily available from natural sources and/or can be cultivated at a reasonable price. Copepods are what connect phytoplankton and fish larvae in the ocean. Because of their zigzag swimming patterns, which the fish larvae find appealing, they have the proper size range, biochemical profile, and stimulate the proper hunting behavior. Copepod culture systems were the subject of research efforts, which later enhanced and perfected their culture in marine fish larviculture, for instance. The current contribution assesses many barriers that impede the creation and application of innovative farming techniques while also suggesting potential new and essential measures based on a multidisciplinary approach.

Keywords: Copepod, Larviculture, Calanoid, Nauplii

INTRODUCTION

Copepods, a subclass of small crustaceans, are abundant and diverse in the marine ecosystems along the Kerala coast, serving crucial roles in both free-living and parasitic forms. Copepod's name takes its origins from the Greek word "shaped foot," where "kope" means "oar." "Podos" means "foot." (Stottrup, 2003). Copepods are thought to be the most prevalent metazoan group on Earth among all animal categories. These minuscule planktonic crustaceans can be found in practically every type of body of water on Earth. In the aquatic environment, copepods are the main consumers and secondary producer. The basic body consists of a shortened abdomen that terminates in a pair of caudal rami, as well as a massive cephalothorax (union of the cephalic and thoracic segments). Copepods primarily consist of five pairs of swimming legs, a median eye, a pair of elongated antennae, a tiny antenna, a jaw, two pairs of maxilla, and maxilliped. Mainly, the mouth parts are modified for filter feeding. Plankton is the primary food source for the majority of free-living copepods. A large number of benthic copepods are parasitic in addition to feeding on other species. They coexist together with a variety of invertebrates, particularly mollusks and echinoderms. Many prefer to graze on living and nonliving substratum. Almost each of them make excellent prey for insects and fish (Santhosh and Ambarish, 2022).

LITERATURE REVIEW ON COPEPODS

A comprehensive study conducted between 2013 and 2019 along the Cochin and Malabar coasts identified 100 species of parasitic copepods across 31 genera in eight families,

infesting 85 species of marine fish from 65 genera and 34 families. The dominant order was Siphonostomatoida, encompassing five families—Caligidae, Lernaepodidae, Lernanthropidae, Pennellidae, and Pseudocycnidae. Notably, the families Caligidae and Lernanthropidae were the most diverse, each comprising 29 species. The genera *Caligus* and *Lernanthropus* were particularly species-rich, with 20 and 21 species respectively.

Based on further investigation, 26 species from eight genera of caligid copepods—more especially, the family Caligidae—infect marine food fishes along the Kerala coast. With eighteen species, the genus *Caligus* was the most prevalent. Seasonal differences were also noted in the study, with the post-monsoon period having the greatest infection rates and the monsoon season having the lowest. Significant intra-genus variation was found among *Caligus* species, according to genetic analyses, indicating a high level of genetic diversity within this group. The use of copepods as live feed by aquaculturists has been the focus of several good critiques and manuals over the past ten years. These include Manual on the Production and Use of Live Food for Aquaculture (Lavens and Sorgeloos 1996), Intensive Cultivation of a Calanoid Copepod for Live Food in Fish Culture (Rippingale and Payne 2001), and Live Feeds in Marine Aquaculture (Støttrup and McEvoy 2003). Still, the aquaculture sector does not often use copepods.

Of the ten orders of copepods, the Calanoida, Harpacticoida, Cyclopoida, and Mormonilloida have pelagic representatives in marine systems. The calanoid copepods, which are the most prevalent of these four taxa in the pelagic realm in estuaries and other coastal settings, typically serve as a crucial conduit between fish and phytoplankton in these inshore nursery systems. These factors have led researchers to pay close attention to calanoid copepods. Most species are approximately 1.0 mm in total length with some being as small as 0.4 mm and some as large as 10.0 mm. Based on citations in the scientific literature, *Acartia clausi* and *Calanus finmarchicus* are the most widely studied species, followed by *Temoralongicornis*, *Paracalanus parvus*, *Calanushelgolandicus*, *Pseudocalanus elongatus*, *Acartia tonsa*, *Centropages hamatus*, *Centropages typicus*, and *Temora stylifera*. (Lee et al., 2008; Mauchline, J. 1998).

NUTRITIONAL IMPORTANCE

Fish larvae naturally consume copepods. Copepod nauplii are the only suitable live feed that the initial feeding larvae of several economically significant marine feeder fishes can eat. Copepods are the best live feed for larviculture owing to their exceptional nutritional value, particularly in the PUFA composition (DHA: EPA ratio). Although the dietary needs of each species of farmed copepod vary, nearly all of them have superior fatty acid compositions. (Brown *et al.*, 1997).

COPEPODS IN AQUACULTURE

In estuarine environments like Ashtamudi Lake, copepods constitute a significant portion of the zooplankton community. The lake's zooplankton primarily includes Copepoda, fish larvae, Oligochaeta, fish eggs, Ostracoda, Polychaeta, Coelenterata, and Rotifer. This diversity underscores the ecological importance of copepods in such habitats, serving as a vital food source for various fish species and playing a key role in nutrient cycling.

Additionally, a preliminary checklist of copepods in the mangrove areas of Munroe Island in Kerala identified 31 species belonging to 18 genera and 15 families, further emphasizing the rich copepod diversity in the region's unique ecosystems. These studies collectively highlight the extensive diversity of copepods along the Kerala coast, reflecting their ecological significance in marine and estuarine ecosystems.

COPEPODS IN MARINE FISH LARVICULTURE

In marine fish culture, a comprehensive analysis of copepods' biochemical makeup will help create high-quality diets for the larval and early juvenile stages. The compositions of protein, amino acids, pigments (β -carotene and astaxanthin), and vitamins (A, thiamine, riboflavin, C, D3, and E) are also essential for their survival and optimal function, but they have received less attention than studies on the compositions of lipids and fatty acids.

ECONOMIC FEASIBILITY OF COPEPOD PRODUCTION

Copepods have proven to be a better live feed for marine finfish larvae over the past three decades than other popular live feed items like rotifers and *Artemia*. Copepods are used because of their superior biochemical makeup, which improves growing conditions, lowers malpigmentation, boosts survival rates, and permits the breeding of "new" marine finfish species. Copepods aren't employed much in the aquaculture sector, though, because they aren't yet economically produced (Abate et al., 2015). Lack of economic understanding of the viability of manufacturing copepods for commercial use has been one of the obstacles to large-scale production. The overwhelming abundance and pivotal position in marine food webs, there is still comparatively less knowledge of these small copepods than for larger calanoid taxa such as members of the genus *Calanus* (Tande and Miller, 2000). Studies on the taxonomy of the common marine copepods of Indian coasts using morphological and molecular tools are scanty and morphological description is limited to Kasturirangan (1963).

CONCLUSION

The description provided here is an empirical assessment of the economic viability of copepod production for commercial use, and it is based on a thorough review of the literature. The study provides valuable information for businesses who consider investing in live feed production for marine finfish aquaculture. Additionally, the study emphasizes the financial advantages of copepod production and use for marine finfish aquaculture productivity and species diversification.

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Some Aspects of Demographic and Generational Patterns in Fast Food Consumption: A Comparative Study of Urban and Rural Youths of Bangaon, North 24 Parganas, West Bengal, India

Mr. Suvankar Paul

ICSSR Research Scholar, Department of Anthropology
West Bengal State University, Kolkata-700126

Dr. Abhijit Das

Associate Professor, Department of Anthropology
West Bengal State University, Kolkata-700126,

Abstract

Fast food consumption is raising among young people, particularly in Bongaon, West Bengal, India. This study investigates fast food intake patterns across urban and rural youth, focusing on urban boys, rural boys, urban girls, and rural girls. Employing a mixed-methods approach, the research combines quantitative and qualitative data from questionnaires, interviews, focus groups, and observations. The study finds a significant increase in fast food consumption among the younger generation compared to the older one, with a notable rise among boys in both urban and rural areas. Girls, regardless of location or generation, consistently show high levels of fast food intake, reflecting a strong preference for these foods. Influencing factors include increased marketing, shifting social norms, greater availability, and lifestyle changes favouring convenience. The high consumption rates among girls highlight the need for targeted public health interventions. The research also raises concerns about potential long-term health risks, such as obesity and diabetes. This study underscores the importance of promoting healthier eating habits and provides a foundation for future public health strategies to address nutritional disparities and improve community well-being.

Key Words: Fast Food, Mixed Method, Younger Generation, Nutritional Disparities

Introduction

Fast food consumption has emerged as a significant dietary trend among young adults, driven by the demands of modern lifestyles and the appeal of convenience. This phenomenon has garnered substantial attention from researchers seeking to understand its underlying causes and implications. Smith et al. (2013) noted that the convenience and affordability of fast food make it particularly attractive to young adults who are often balancing busy schedules. They emphasized that the prevalence of fast food outlets and aggressive marketing strategies contribute significantly to its consumption. Similarly, Davis and Carpenter (2009) highlighted the relationship between the density of fast food establishments and increased consumption, linking it to rising obesity rates and other health concerns. French et al. (2001) examined the impact of advertising on young adults, revealing that targeted marketing significantly influences dietary choices and increases the likelihood of fast food consumption. Their findings align with the work of Larson and Story (2009), who explored the role of environmental factors in dietary patterns. They found that urban areas, with their higher density of fast food outlets, often exhibit higher consumption rates among young adults compared to rural areas. Bowman and Vinyard (2004) further explored the nutritional

consequences of frequent fast food consumption, highlighting its association with poorer dietary quality and increased caloric intake. Their research underscores the broader health implications of this dietary trend, including increased risks of obesity, diabetes, and cardiovascular diseases. More recent studies, such as those by Powell et al. (2013) and Nguyen et al. (2014), have expanded on these findings by investigating the psychological and behavioural factors influencing fast food consumption among young adults. They emphasize the role of convenience, taste preferences, and social influences in shaping dietary choices.

This study aims to build on this body of research by examining fast food consumption patterns among young adults in the Bongaon region of West Bengal, India. By analyzing the socio-economic, cultural, and environmental factors affecting dietary choices in this specific context, the research seeks to provide new insights into the factors driving fast food consumption and inform public health strategies to promote healthier eating habits.

Fast food consumption has become a prevalent aspect of contemporary life, especially among younger generations. As fast-paced and busy lifestyles become more common, the convenience and affordability of fast food have made it an attractive option across diverse populations. However, the patterns of fast food consumption can vary widely based on factors such as geographic location, gender, and age. This study aims to explore these differences, with a specific focus on the demographic and generational patterns of fast food consumption among youth in the Bongaon region, located in the North 24 Parganas district of West Bengal, India.

Bongaon Dinabandhu Mahavidyalaya, situated near Townhall More in Bongaon, serves as the central venue for the present study. The study seeks to analyze the tendencies of fast food consumption among distinct groups: urban boys, rural boys, urban girls, and rural girls. By examining these groups, the research aims to reveal how socio-economic and cultural factors shape dietary choices. Additionally, this study observed the variations in fast food consumption between younger and older generations, providing a comparative analysis that underscores the evolving food preferences over time.

This study bears its significance as it has the potential to inform public health strategies and policies aimed at promoting healthier eating habits. By identifying the specific factors influencing fast food consumption among various demographic groups, stakeholders can develop targeted interventions to address nutritional disparities and encourage healthier alternatives. Thus, this study not only advances the academic understanding of dietary behaviours but also offers practical insights for enhancing community health and well-being in the Bongaon region.

Literature Review: A Brief Outline

The increasing consumption of fast food is a notable trend globally, particularly among younger populations. The article "Indian Fast Food: Top 10 Chaat Recipes" by S. Parshita Saxena (2017) illustrates the cultural importance of street food in North India, highlighting its origins in the royal kitchens of Emperor Shah Jahan. This historical context emphasizes the

deep-rooted cultural affinity towards spicy and flavorful foods that are both convenient and popular.

In the article "Cause and Effect of Fast Food," Alfitah (2016) discusses the changing lifestyle patterns in urban areas like Jakarta, where busy work schedules and pervasive advertising drive the consumption of fast food. The study highlights that fast food's affordability and aggressive marketing contribute significantly to its popularity, making it a staple for many despite its nutritional drawbacks.

Arti Jha and Vikash Kumar Jha (2014) in their work "Changing Fast Food Trends Of People" analyze the evolution of the fast food industry, attributing its growth to factors like globalization and increasingly busy lifestyles. They argue that fast food's appeal lies in its convenience, making it a permanent fixture in urban diets worldwide.

"The Anthropology of Food and Eating" by Sidney W. Mintz and Christine M. Du Bois (2016) explores how food studies illuminate broader societal processes, including the creation of political and economic value, the social construction of memory, and identity formation. This comprehensive overview demonstrates the complex roles that food, including fast food, plays in cultural and social contexts.

In the article "Affects of Fast Food on the Body" (2017), the health implications of fast food consumption are examined, particularly its contribution to obesity. The study connects high intake of fats, refined grains, and sweeteners in junk food with increased obesity rates, which are associated with numerous health issues.

Martin W. Sivula's work "Factors that Affect Fast Food Consumption" reveals that fast food consumption is prevalent among young adults and adolescents. The study finds that a significant portion of university students consumes fast food multiple times daily and often misperceives their weight status, highlighting a disconnect between fast food consumption and health awareness.

The editorial article "Advantages and Disadvantages of Fast Food" provides a balanced view of fast food as both a source of instant gratification and a potential health risk. It discusses the convenience of fast food while acknowledging its nutritional shortcomings, such as high levels of fat, sugar, and salt.

Jessica's article "Facts on Lack of Nutrients from a Fast Food Diet" (2010) reports that a substantial percentage of American adults derive a significant portion of their daily caloric intake from fast food, leading to nutrient deficiencies. This study underscores the poor nutritional quality of fast food, which poses health risks to frequent consumers.

Karen Hellesveg Gaskell's "Definition of Fast Food" (2013) characterizes fast food as a quick and accessible alternative to home-cooked meals, typically high in unhealthy ingredients. The National Institutes of Health (NIH) notes that despite some efforts by fast food chains to offer healthier options, the core offerings remain nutritionally poor.

Ayesha Karmat and Baig Munazza (2012), in their "Review of Trends in Fast Food Consumption," reveal that fast food consumption is particularly high among young adults, with 70% of individuals aged 15 to 25 frequently consuming fast food. This demographic

analysis points to a generational preference for fast food, likely influenced by lifestyle and social factors.

Finally, Jeffery Carry's "How Are Teenagers Affected by Advertisements for Fast Food" (2020) discusses the significant influence of advertising on teenagers' eating habits. The study notes that fast food advertisements, often targeted through accessible channels like TV and the internet, play a substantial role in shaping teens' food choices, contributing to issues such as obesity.

These articles collectively provide a comprehensive overview of the factors influencing fast food consumption, from cultural and historical contexts to modern advertising strategies and health implications. The literature underscores the complexity of fast food's role in contemporary society, highlighting the need for further research and public health initiatives to address its widespread impact.

Objectives of the Present Study

1. To study the tendency of eating fast food among urban boys, rural boys, urban girls, and rural girls.
2. To observe the difference in fast food consumptions between younger and older generations. And the changes concerned in this domain of culture.

Methodology for the Present Study

The present study is a Comparative Study of Urban and Rural Youth with a both qualitative and quantitative focus. This study adopts an anthropological comparative design with a mixed-methods approach, integrating both quantitative and qualitative data to explore fast food consumption patterns and cultural influences. The sampling technique will involve stratified random sampling or purposive sampling to ensure comprehensive representation across urban and rural areas, as well as among various age groups and genders.

For quantitative data collection, a structured questionnaire will be developed, covering demographics (age, gender, location, educational status), fast food consumption patterns (frequency, types, spending habits), health perceptions (attitudes and awareness of health impacts), and cultural influences (impact of cultural and social factors on choices). Data will be collected through online surveys or face-to-face interviews in both urban and rural settings. Qualitative data have been collected through Semi-structured, In-depth Interviews with a subset of participants from each demographic group, focusing on cultural attitudes, reasons for fast food consumption, and generational perspectives. Additionally, focus group discussions will be held in urban and rural areas to capture collective attitudes and group dynamics. Observational studies in local eateries and community events will provide contextual insights into fast food consumption patterns.

Studied Area

The study was conducted at Bongaon Dinabandhu Mahavidyalaya, located at Town hall More, Bongaon, Dist- North 24 Parganas, State- West Bengal, India. Dinabandhu

Mahavidyalaya is a general degree college situated in Bongaon, in the Indian state of West Bengal.

Observations and Interpretations

Distribution and Issues of consumption of Fast Food among the both younger and older generations in Rural and Urban context:

The key findings indicate that fast food consumption is most prevalent among urban girls, followed by urban boys, rural girls, and rural boys. Across all groups, girls tend to consume fast food more frequently than boys. Additionally, individuals residing in urban areas exhibit a higher inclination toward fast food consumption compared to those in rural settings. Notably, a distinct pattern emerges when comparing the eating habits of different generations. The tendency to consume fast food among urban boys, rural boys, urban girls, and rural girls has been analyzed separately for both the younger and older generations, revealing significant differences in their preferences and consumption patterns. These generational variations highlight the evolving dietary choices influenced by modernization, lifestyle changes, and exposure to global food culture. The study underscores the impact of urbanization and gender on fast food consumption while also shedding light on the shifting food preferences between younger and older generations in both urban and rural contexts.

Table: 1 Frequency of fast food consumption among younger generation of urban and rural areas.

Fast Food Takers status	Younger Generations							
	Urban				Rural			
	Boys		Girls		Boys		Girls	
	Fast Food Taken		Fast Food Taken		Fast Food Taken		Fast Food Taken	
	No. of Individuals	%	No. of Individuals	%	No. of Individuals	%	No. of Individuals	%
Yes	33	66.00	42	84.00	29	58.00	40	80.00
No	17	34.00	8	16.00	21	42.00	10	20.00
Total	50	100	50	100.00	50	100.00	50	100.00

The data reveals notable differences in fast food consumption rates between urban and rural areas, as well as between genders. In the urban area, 66% of boys (33 individuals) consume fast food, while 34 % (17 individuals) do not. Among girls, 84% (42 individuals) consume fast food, with 16 % (8 individuals) abstaining. Urban girls have a significantly higher fast

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food consumption rate than urban boys, with an 18% difference, indicating a greater prevalence among girls in urban settings.

In rural areas, 58% of boys (29 individuals) consume fast food, whereas 42 % (21 individuals) do not. For girls, 80% (40 individuals) consume fast food, while 20% (32 individuals) abstain. Rural girls also show a higher rate of fast food consumption than rural boys, with a 22% difference, reflecting a more pronounced gender disparity in rural areas.

Urban girls have the highest consumption rate at 84%, followed by urban boys (66%), rural girls (80%), and rural boys (58%). This pattern highlights that urban areas generally exhibit higher fast food consumption compared to rural areas.

Across both urban and rural settings, girls consistently exhibit higher fast food consumption rates than boys. Urban girls lead with the highest consumption, followed by rural girls, urban boys, and rural boys.

The analysis indicates that fast food consumption is notably higher among girls compared to boys and more prevalent in urban areas than in rural ones. The significant gender disparity suggests that social and cultural factors may play a role in shaping consumption patterns. Urban settings, with greater access to fast food outlets and possibly different lifestyle factors, show higher consumption rates.

These findings offer valuable insights into demographic and geographic trends in fast food consumption among younger generations. They can inform targeted public health interventions and strategies aimed at promoting healthier eating habits.

Table: 2 Frequency of fast food consumption among older generation of urban and rural areas.

Fast Food Take n status	Older Generations							
	Urban				Rural			
	Boys		Girls		Boys		Girls	
	Fast Food Taken		Fast Food Taken		Fast Food Taken		Fast Food Taken	
	No. of Individual s	%	No. of Individual s	%	No. of Individual s	%	No. of Individual s	%
Yes	28	56.00	39	78.00	24	48.00	39	78.00
No	22	44.00	11	22.00	26	52.00	11	22.00
Total	50	100	50	100.00	50	100.00	50	100.00

This study investigates the patterns of fast food consumption among older individuals, differentiated by gender and urban-rural living environments. The data provides insight into

the prevalence of fast food intake across these demographics, which can help understand dietary behaviours and inform public health strategies.

Among urban boys show a higher rate of fast food consumption (56%) compared to their rural counterparts (48%). This disparity may be attributed to the greater availability and accessibility of fast food outlets in urban areas, as well as cultural differences that may promote a more fast-paced lifestyle and convenience-oriented food choices.

Interestingly, the consumption rate among girls remains consistent at 78% across both urban and rural settings. This consistency suggests that factors influencing fast food consumption among girls may be independent of urban-rural distinctions, possibly indicating a uniform cultural or social trend among this demographic.

A significant gender disparity is observed in urban areas, with a markedly higher percentage of girls (78%) consuming fast food compared to boys (56%). This difference of 22 percentage points may reflect differing social norms, health awareness, or peer influences between urban boys and girls.

While the difference is less pronounced in rural areas, girls still show a higher consumption rate (78%) than boys (48%). The 30 percentage point difference underscores a potential gender-based preference or social conditioning favouring fast food among rural girls.

Both urban and rural girls show a high prevalence of fast food consumption, suggesting a possible inclination towards fast food across different environments. This trend could be driven by factors such as taste preferences, social influences, marketing, or convenience.

Rural boys are the only group with a majority (52%) not consuming fast food. This might indicate greater adherence to traditional diets, less exposure to fast food marketing, or limited availability of fast food options in rural areas.

The data reveals distinct patterns in fast food consumption among older individuals, highlighting significant differences based on gender and living environments. The high consumption rates among girls across both settings suggest that interventions targeting dietary habits might need to consider gender-specific approaches. Additionally, the urban-rural divide in boys' consumption patterns indicates that urbanization and associated lifestyle changes could be a critical factor influencing dietary behaviours.

General Observations and Concluding Remarks

This comparative analysis investigates the fast food consumption patterns across different demographics, focusing on generational differences between older and younger populations. The data is further segmented by gender and urban-rural living environments. The goal is to identify key trends and differences that can inform public health strategies and dietary interventions.

Across all groups, there is a noticeable increase in fast food consumption in the younger generation compared to the older generation. This rise is more pronounced among boys in both urban and rural settings.

Both older and younger generations of girls, regardless of urban or rural settings, exhibit consistently high levels of fast food consumption, with younger girls slightly more inclined.

The older generation shows a significant gender gap, with girls consuming more fast food than boys in both urban and rural areas. While the younger generation still exhibits higher consumption rates among girls, the gap has slightly narrowed, especially among rural boys and girls.

The data suggests an increasing trend in fast food consumption among the younger generation, indicating a shift in dietary habits. This could be attributed to factors such as increased marketing, changes in social norms, greater availability of fast food options, and lifestyle changes favouring convenience.

The consistently high consumption rates among girls, across both generations and locations highlight the need for targeted interventions. Factors such as social influence, marketing specifically targeting young women, and possibly lower health literacy regarding the consequences of fast food consumption could play a role.

The rising trend in fast food consumption among the younger population, particularly among urban boys and both urban and rural girls, raises concerns about potential long-term health implications, such as increased rates of obesity, diabetes, and other lifestyle-related diseases. Public health initiatives should focus on promoting healthier eating habits and increasing awareness of the health risks associated with frequent fast food consumption.

This study highlights significant generational differences in fast food consumption, with a marked increase among the younger generation. The data underscores the need for targeted public health interventions to address the rising trend and mitigate potential health risks. Further research should explore the underlying causes of these patterns and evaluate the effectiveness of various intervention strategies.

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**A Comprehensive SWOT Analysis of Jharkhand Tourism Strengths, Weaknesses,
Opportunity, and Threads**

Sujit Kumar

Research Scholar (NET) ,University Department of Commerce
Vinoba Bhave University Hazaribag 825301 (Jharkhand),

Dr. Md. Mokhtar Alam

Associate professor, university department of commerce
Vinoba Bhave university ,Hazarbag 825301 Jharkhand

Abstract:

Tourism plays an important role in the economic development The state of Jharkhand has the potential to become the main tourist destination of India due to its unique beauty and cultural diversity, religious places and dense forests. This paper aims to conduct SWOT analysis of Jharkhand Tourism So that we can know the current situation and identify the challenges which can help the tourism sector of the state. The tourism of Jharkhand state has its majestic beauty, dense forests, vast waterfalls, diversity, cultural heritage and religious places. There are weaknesses in Jharkhand tourism as well, the weaknesses include poor infrastructure, security. If we look at the significant weaknesses of the state, then it can be considered a promotion. The tourism of the state has not been promoted at the national and international level. Despite the weaknesses, there are many opportunities in the state through which the industry can be developed. For example, the basic facilities of the state can be improved through PPP (public private partnership). Jharkhand tourism also faces external threats. Neighbouring states whose tourism sector is very well developed, also have to face competition from all these states, due to encroachment activities in the state, it can also endanger the attractiveness of the sector, due to political instability in the state, there is a big problem in implementing the policies. This SWOT analysis highlights the tourism potential of Jharkhand and can provide a road map for sustainable development

Keywords: - Jharkhand, tourism, swot analysis, economic development

Introduction

Tourism is one of the fastest-growing and most immediately affecting sectors in the world, being the creator of economies, cultures, and communities. In India, tourism is not merely an economic contributor, but it also presents the image of the cultural and natural heritage of the country. Among the states of India, Jharkhand is viewed as a place that has vast potential simply due to its natural beauty, tribal heritage, cultural diversity, and spiritual importance. This very young state, carved out of Bihar in 2000, promises great growth and development for tourism. To open up its full potential, a strategic appraisal can be done, and here this study utilizes the SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis to widely depict and study this sector. Jharkhand is known as the Land of Forests because it offers a particular mix of attractions. Majestic waterfalls, dense forests, serene hills, places of worship, temples, and rich tribal cultures all find their place here. Like any under-explored destination, the tourism industry in the state is plagued by challenges, mostly pertaining to poor infrastructure and safety issues. On the flip side of the coin lie vast opportunities for the

development of eco-tourism, cultural tourism, and adventure tourism, to mention just a few. With this introduction, we set about not only providing the context for a SWOT analysis of tourism in Jharkhand but offer evidence toward a comprehensive look into its present-day position and future possibilities.

Importance of Tourism in Jharkhand

Tourism in Jharkhand plays a dual role: it contributes to the economic growth of the state while preserving its culture and natural heritage. Its unique positioning as a hub for tribal culture and natural beauty sets it apart from other states in India. Tourism can provide substantial employment, investment opportunities, and regional development in Jharkhand. It carries with it the burden of making the state's rich tribal heritage known to the world, which has so far remained largely underrepresented in the mainstream.

Jharkhand's strategic location in eastern India only supplements its chances of becoming a tourism hotspot. It is bordered by other eminent states like West Bengal, Bihar, Odisha, and Chhatisgarh, thus becoming an ideal destination for tourists travelling within the region. Even with all these advantages, the tourism industry in Jharkhand remains, for the most part, at a nascent stage, carrying with it various challenges that warrant a structured and strategic ground for resolution.

Why SWOT Analysis?

SWOT analysis is important for any sector's understanding and evaluation. It enables identification of the strengths, weaknesses, opportunities, and threats relating to Jharkhand's tourism sector, thus aiding policymakers, stakeholders, and investors alike in making well-informed decisions. The SWOT presents a clear impression of what the state has and lacks and how it can maximize and utilize its resource base for sustainable development. It helps align state tourism strategies with wider regional and global tourism trends. The sections that follow will analyse Jharkhand's tourism landscape using the SWOT framework. In this introductory section, we provide the reasons for conducting an in-depth analysis of Jharkhand's tourism sector in terms of its strengths, weaknesses, opportunities, and threats.

Strengths of Jharkhand Tourism

Usually called "The Land of Forests," the state of Jharkhand in the eastern part of India is blessed with extraordinary natural beauty adorned with cultural wealth and historical significance. These very attributes are considered to be the core strengths that make it an immensely tourism able potential destination to attract both domestic as well as foreign travelers.

1. Natural Beauty and Biodiversity

Among Jharkhand's various strengths is its strikingly different natural landscapes, including green forests, waterfalls, and hills. These features not only provide appreciable scenic value to the state but also generate enormous opportunity for eco-tourism and other nature-related activities.

- **Waterfalls:** Jharkhand possesses some of the most mesmerizing waterfalls in India. Hundru Falls, Jonha Falls, Dassam Falls, Lodh falls and Panchghagh Falls are some

natural wonders that tempt visitors throughout the year. These waterfalls are among the picnic spots, photography venues, and adventure trek paths.

- **Wildlife Sanctuaries and National Parks:** The state is a haven for biodiversity that is well protected within the Betla National Park, Dalma Wildlife Sanctuary, and Hazaribagh Wildlife Sanctuary. Wild animal safaris, bird watching, and eco-tourism opportunities spotlight these areas' diverse flora and fauna, including elephants, tigers, and leopards.
- **Forests and Hills:** Jharkhand has a rich forest cover and is a respite from concrete jungles. Netarhat, with rolling hills and epithet Queen of Chotanagpur, and the scenic beauty of Parasnath Hills (a revered Jain pilgrimage site) are an added attraction.

2. Rich Tribal Culture and Heritage

Jharkhand's tribal communities add immensely to its culture. More than 32 tribal groups exist in Jharkhand, including Santhals, Mundas, Oraons, and Hos, and each has its own unique culture, customs, traditions, and language. Each of these distinguishes a different culture of visual impression to culturally inclined travelers.

- **Traditional Art and Crafts:** The state has gained fame for its tribal art forms like Sohrai and Paitkar paintings. These traditional art forms mirror the tribal way of life and attract serious art lovers. Promotion of these art forms through tourism can open economic opportunities for local artisans.
- **Music and Dance:** Tribal music and dance, like Jhumar and Chhau, are an essential part of Jharkhand culture. These programs have brought like huge flow of joy through various festivals which allow people to be an observer as they enjoy the cultural richness of the State.
- **Tribal Festivals:** Festivals like Sarhul, Karma, and Sohrai have been celebrated with much excitement and give a peep into the spiritual and social lives of the tribal communities. Such festivals can be used towards cultural tourism.

3. Religious and Pilgrim Tourism

Jharkhand is a significant religious destination as various temples and spiritual places attract pilgrims from every corner of India.

- **Baidyanath Dham (Deoghar):** This is one of the twelve Jyotirlinga Temples of Lord Shiva and is regarded highly in the religious hierarchy since every year this temple is observed by millions in its premises, especially during the month of Shravan, thus becoming a very popular religious site.
- **Parasnath Hill:** This hill is a holy destination to the Jains and has hundreds of Jain temples on it. It is not only a religious place but also a very popular place for trekkers because of the tough trek and wonderful views.
- **Rajrappa Temple:** This temple is dedicated to Goddess Chhinnamastika, built at the confluence of two rivers, Damodar and Bhairavi. It is therefore a very important place for Hindu devotees and an architecturally amazing site.

4. Adventure Tourism Potential

The rocky and tough terrains of Jharkhand with thick forests and gushing rivers make a natural playfield for adventure styling enthusiasts.

- **trekking and hiking locations:** Netarhat, Parasnath Hills, and Betla National Park will be instrumental in the surrounding region through trekking and hiking. These attract a lot of young travelers and adventure enthusiasts.
- **Water Based Activities:** There are numerous waterfalls and rivers in the states that can be developed for water-sport activities like rafting, kayaking, and boating, designed to augment the level of its tourism.
- **Rock Climbing and Paragliding:** Jharkhand has an attractive topography of rocky terrains and hills and is endowed with large segments of unexplored potential for rock climbing and paragliding, which are very popular adventure activities.

5. Strategic Location and Accessibility

Jharkhand has a strategic advantage for tourism development by being geographically located in the eastern part of India. The state is well connected with neighboring regions like West Bengal, Bihar, Odisha, and Chhattisgarh, thus making it available to a large population base.

- **Closeness to Major Cities:** Jharkhand is situated near the metropolitan cities such as Kolkata, Patna, and Ranchi, and linked by rail, road, and air, and serves as an attractive option for city people.
- **Airports and Railways:** The state has two airports in Ranchi and Deoghar, connected with the plans for expanding air connectivity. Also, the state enjoys a very extensive railway network connecting major tourist destinations with the rest of India.

6. Sustainable Tourism

Jharkhand, with its natural and cultural resources, has the potential for sustainable tourism. Here eco-tourism fits quite well within the strengths of the state, allowing people to visit different natural locales while preserving their health for the conservation of nature. In the same way, community-based tourism initiatives can also ensure promoting tribal culture for economic benefits but also empowerment of the communities involved.

- **Eco-Tourism:** Eco-tourism will develop eco-friendly accommodations along with nature trails in the national parks and forest reserves to attract some of the greatest environmentally-aware travelers across the globe.
- **Community Involvement:** The community will also gain through involving local communities in these tourism activities as guides and homestay managers to provide authentic experiences to the visitors.

7. Specialty Tourism Products

Now, Jharkhand's uniqueness gives it an edge over all other destinations in India. These comprise:

- **Rural Tourism:** This is an ode to the rural in every destination, where an admission to the local ways of life shows the simplicity in tribal living, traditional farming practices, and local cuisine.
- **Archaeological Sites:** Jharkhand has numerous historical sites, such as Palamu Fort and Itkhori, which have archaeological as well as historical importance.

- **Handicrafts and Souvenirs:** Interest in promoting tribal crafts and jewelry, together with textiles as souvenirs, will definitely add tourist experience and boost the local economy.

Weaknesses of Jharkhand in terms of tourism

"Tourism is an important sector to the economic prosperity of any region. But concerning the attractions available, the development of this sector depends on the infrastructures, governance, and marketing strategies associated to it. Jharkhand has a lot of attraction-the natural beauty, cultural heritage, and religious significance; still there are several problems that are against growing up as a pocket tourism destination. This section, therefore, mainly discusses the weaknesses in which the tourism sector of Jharkhand sits in infrastructural deficiencies, security issues, lack of tourism facilities, awareness differences, and seasonal limitations.

1. Infrastructure Issues

Infrastructure ranks among the foremost hurdles facing the tourism industry in Jharkhand. Infrastructure is crucial to tourism since it assures availability, comfort, and convenience to travelers. Unfortunately, the tourism infrastructure in Jharkhand suffers from deficiencies:

- **Poor Connectivity:** Many prime tourist spots in Jharkhand-the waterfalls, wildlife sanctuaries, and tribal villages-are located in remote areas with poor roads. It is not uncommon for tourist arrivals at these places to have difficulties due to poorly developed or frequent maintenance of the roads. Inaccessibility by rail and air further acts as deterrents to become visitors to the state.
- **Inadequate accommodation:** There are not enough good accommodations in Jharkhand close to tourist attractions. In the different pockets, the number of hotels, guest houses, and resorts is small, and the ones that exist are not necessarily up to the mark for either domestic or international tourists. The absence of middle-range and high-end properties continues to comply against operationalizing Jharkhand as a tourism destination for travelers looking for comfort and luxury.
- **Transport facilities:** Public transport to the different tourist sites is largely absent and unreliable. A lack of adequately organized transport systems, like tourist buses, taxis, or ride-hailing services, further hinders the ease of transportation within the state, making it cumbersome for tourists to cover various destinations.

2. Safety Concerns

Safety remains the cornerstone for any tourist destination, as it influences the image of the region in the eyes of potential visitors. Safety-related apprehensions play an important role in affecting the tourism scenario in Jharkhand:

- **Perceived Threat of Naxalite Activities:** Having been freshly hit by some pockets of Naxal atrocities, Jharkhand comes to mind when mentioning insecurity. Though the state government has taken measures toward ensuring some semblance of security, the lingering picture of Jharkhand being a conflict-ridden area still discourages visitors.

- **Lack of Police Presence:** Safety concerns are also heightened due to the lack of police and security personnel around tourist attractions. Tourists tend to feel vulnerable due to the apparent absence of law enforcement, especially in far-flung areas.
- **Road Safety Issues:** Poorly maintained roads with clueless traffic management are additional safety risks. Accidents and breakdowns on remote roads even terrify visitors.

3. Underdevelopment of Tourism Facilities

The viable tourist destination, reasonable facilities must exist to enrich the entire travel experience. Jharkhand has fallen short in this area:

- **Insufficient Basic Amenities:** There are major shortcomings in basic amenities, like lack of clean washrooms, provision of drinking water, first aid services, waste disposal systems, etc. on many tourist spots in Jharkhand. This kind of basic infrastructure takes away from the overall visitor experience and creates a negative impression.
- **Lack of Signage and Information:** Concise and informative signage is important in any tourist's navigation, mostly for sites that are more remote. There is a lack of multilingual signboards and information kiosks in Jharkhand, which every year makes it even harder for tourists to navigate and grasp information about the attractions.
- **Absence of Trained Personnel:** Trained guides and hospitality staff are lacking within Jharkhand. This leaves tourists in the lurch when searching for a guide who might share the history, culture, and significance of places visited.
- **Limited Recreational Facilities:** The tourist destinations in Jharkhand do not have supplementary attractions like adventure activities, cultural performances, or souvenir shops. This makes the state less appealing to tourists who desire experiences beyond mere sight-seeing.

4. Lack of Awareness and Promotion

Good marketing and promotion are essential to lure tourists into any destination. Not only is there a lack of awareness about Jharkhand tourism, but it is also grossly branded:

- **Insufficient Marketing Campaigns:** Jharkhand has not promoted itself enough at national and international levels. While its neighboring states like Odisha and West Bengal strenuously market their tourism products in all media sundry, Jharkhand remains obscure in the tourism map.
- **Underutilization of Digital Platforms:** In this digital age, online marketing finds a significant place in tourist matters. The tourism department of Jharkhand has not gained substantially from social media, travel sites, or influencer marketing in the promotion of its attractions. The lack of an interactive and user-friendly official tourism website has restricted its reach further.
- **Low Awareness Among Tourists:** The state's natural and cultural heritage is not known among many tourists, both domestic and from abroad. This unawareness is primarily a consequence of the state's failure to mark itself as a place to travel to.

5. Seasonal Limitations

The weather in Jharkhand presents another obstacle to tourism and is one of the reasons for a shortened peak tourism season in the state following exceedingly adverse weather.

- **Harsh Summers:** Summers in Jharkhand are scorching and seem to break the spell for tourists to carry out outdoor activities like visiting waterfalls and wildlife sanctuaries.
- **Heavy Monsoons:** Heavy rainfall during the monsoon contrives waterlogging, slippery roads, and possible accidents. Many tourist sites become unreachable, which greatly impacts visitor inflows.
- **Short Peak Season:** Peak tourism in Jharkhand is confined to the winter months (October to February), thus providing little opportunity for revenue generation for the local population across the other months. Such seasonality makes it difficult for stakeholders to sustain their enterprises.

Opportunity for Jharkhand Tourism

Jharkhand is popularly known as "The Land of Forests." The state is renowned for its rich natural resources, diverse tribal culture, and sacred landmarks. Despite various challenges, the state has great potential for tourism development. Building on its unique strengths and focusing on the critical areas for growth, Jharkhand stands a good chance to emerge as a leading tourist destination in India. Therefore, below are all the comprehensive opportunities for Jharkhand tourism.

1. Eco-Tourism Development

Eco-tourism highlights sustainable travel in natural areas for the preservation of the environment while contributing to local communities. There are vast ranges of dense forests, wildlife sanctuaries, and scenic beauties that place Jharkhand at par with the list of eco-friendly tourism destinations in the world.

Opportunities:

- **National Parks and Wildlife Sanctuaries:** Betla National Park and Dalma Wildlife Sanctuary, apart from Palamau Tiger Reserve, offer various opportunities for promoting eco-friendly tourism. Guided jungle safaris, nature trails, and camp facilities can entice nature enthusiasts and conservation experts.
- **Waterfalls:** Hundru, Jonha, Dassam, and Lodh are the famous waterfalls in Jharkhand, which can be promoted as prime eco-tourism spots. Additional facilities such as trekking routes, viewing platforms, and picnic areas will further improve the visitor experience.
- **Eco-Friendly Infrastructure:** Accommodations in the form of treehouses and sustainable lodges will be an attractive proposition for eco-friendly tourists visiting Jharkhand.
- **Community Participation:** Local communities can be highly influential in managing eco-tourism projects. This ensures sustainability and also generates employment for tribal populations.

2. Tribal and Cultural Tourism

Jharkhand's tribal population has exclusive cultural traditions, art forms, and festivals. These cultural features can attract tourists interested in immersing themselves in local culture.

Opportunities:

- **Tribal Villages:** Heritage tourism packages can be designed to experience tribal lifestyles, traditional crafts, and cuisines. Tours can be organized to visit villages of Santhal, Munda, and Ho tribes.
- **Art and Craft:** Indigenous art forms like Sohrai and Paitkar paintings can be promoted through workshops and exhibitions. Visitors can be involved in hands-on activities to learn how to create traditional crafts.
- **Cultural Festivals:** Cultural festivals like Sarhul, Karma, and Tusu Parab can be promoted as a tourism product. Organizing cultural fairs and performances during these festivals could attract both domestic and international tourists.
- **Museum and Documentation:** Creating cultural museums to document and present tribal heritage can be an educational tourism product that promotes pride and awareness among the local community.

3. Religious Tourism Circuit

Religious tourism has always been a significant segment of India's travel industry. Jharkhand's spiritual landmarks provide opportunities to attract pilgrims and spiritual seekers.

Opportunities:

- **Baidyanath Dham (Deoghar):** As one of the twelve Jyotirlingas, Baidyanath Dham attracts millions of pilgrims annually. Enhancing infrastructure, offering e-darshan facilities, and creating well-organized pilgrimage packages can improve visitor satisfaction.
- **Parasnath Hill:** This is a sacred place for Jains. It can be developed with better trekking facilities, meditation centers, and accommodation options to cater to Jain pilgrims.
- **Rajrappa Temple:** This is a very important Shakti Peeth. It can be included in religious tourism circuits. Amenities like restrooms, food courts, and spiritual retreats will encourage longer stays.
- **Integrated Circuits:** Developing a "Jharkhand Spiritual Circuit" combining these places in a hassle-free manner in transportation and stay arrangements will also appeal to large organized groups of travelers.

4. Adventure Tourism

Adventure tourism is on the increase, which tends to favor youth. In fact, the wild landscape, forest, hilly, and riverside Jharkhand holds immense possibilities in adventure activities.

Trekking and Hiking: Netarhat, Parasnath Hill, and Ranchi Hill, etc. should be marketed for trekking activities. Marking the trails and creating camping and guiding services should also be initiated for trekking.

Rock Climbing and Rappelling: Rock climbing is aptly performed on the terrains of Jharkhand. Climbing expeditions organized on Rajmahal Hills, for example will surely attract some adventurous tourists.

Water Sports: Rivers and dams like Subarnarekha, Patratu, and Tilaiya can host kayaking, rafting, and boating activities.

Paragliding and Ziplining: The hill stations of Netarhat can be developed to implement paragliding and ziplining for adventure lovers.

Adventure Parks: Adventure parks near the urban cities of Ranchi and Jamshedpur can be created as weekend gateways for family and young groups.

5. Digital Transformation in Tourism

The digital revolution has revamped the way one plans his or her journey. Digital tools can significantly increase Jharkhand's visibility and accessibility to global tourists.

Opportunities:

Virtual Tours: Impressive virtual tours of select attractions can encourage travelers to visit Jharkhand. These can be publicized on official portals and social media handles.

Social Media Campaigns: Share Jharkhand's unique attractions through engaging social media content, influencer collaborations, and user-generated campaigns.

Mobile Applications: A "Discover Jharkhand" app will be developed which can include itineraries, tourist guides, online booking facilities, and real-time navigation.

E-ticketing and Booking Platforms: User-friendly e-ticketing for entry into national parks, wildlife safaris, and other attractions will be put in place.

Wi-Fi Connectivity: There should be availability of Wi-Fi at key tourist destinations to enhance the overall experience of the visitor.

6. PPP or Public-Private Partnerships

Partnership between the government sector and the private sector may be expedited in developing tourism infrastructure and facilities.

Opportunities:

Infrastructure Development: Resort, luxury hotels, transport facilities in tourist destinations with private investors.

Management of Tourist Sites: Management of some tourist destinations can be outsourced to private agencies which will take good care of visitors.

Event Hosting: Encourage private companies to sponsor and organize cultural festivals, adventure sports events, and tourism expos.

Revenue Sharing Models: Adopt models wherein private players invest in local community development and benefit from tourism ventures.

7. Government Initiatives and Policies

Supportive government policies can boost investments and facilitate the sustainable growth of tourism in Jharkhand.

Opportunities:

Central Schemes: Leverage national schemes such as "Swadesh Darshan" and "Dekho Apna Desh" to acquire funding and promotion for tourism projects.

Investor Incentives: Provide tax incentives, subsidies, and land allotment to private investors in tourism projects.

Human Resource Development: Implement training programs for the local youth in hospitality, guiding, and adventure tourism to build a skilled workforce.

Tourism Promotion: Conduct Jharkhand Tourism Roadshows and participate in international travel fairs to attract foreign tourists.

Green Policies: Formulate eco-friendly policies for tourism projects to ensure growth with environmental protection.

Threats to Jharkhand Tourism: Challenges and Strategies

Jharkhand is a state rich in natural beauty, cultural diversity, and historical significance. It can be a prime tourist destination in India. The tourism sector in Jharkhand, despite its strengths and opportunities, is facing serious threats that prevent its growth and sustainability. This section discusses the key threats affecting Jharkhand's tourism industry and explores possible strategies to address these challenges.

1. Competition from Neighbouring States

In particular, the Jharkhand tourism sector remains dwarfed in comparison to the more established tourism sectors of its neighboring states, which include West Bengal, Odisha, and Bihar. The latter have stronger tourism branding, better infrastructure, and more significant government investment in developing their destination. For example:

West Bengal is known for diverse destinations that range from the Sundarbans, Darjeeling, and cultural heritage of Kolkata. Odisha attracts tourists with its pristine beaches, temples like the Konark Sun Temple, and Chilika Lake. Bihar has a well-developed religious tourism circuit, including Bodh Gaya, a UNESCO World Heritage Site. Jharkhand's offerings, though unique, are unable to compete in terms of visibility and tourist inflow. Limited marketing and lack of integration into national and international tourism circuits further exacerbate this challenge.

Strategies:

Design a unique tourism brand for Jharkhand that would present its unique cultural and natural heritage. Coordinate with neighbouring states to develop regional circuits of tourism encompassing destinations in Jharkhand. Aggressive marketing to the domestic and international market.

2. Environmental Degradation

The rich natural heritage of the state of Jharkhand is at the risk of destruction due to environmental degradation through over-tourism, mining, deforestation and unregulated urbanization. The most predominant issues would be:

Unregulated waste disposal by tourists is causing pollution of natural water bodies like waterfalls and rivers.

Mining operations and illegal logging are destroying forests and habitats.

Protected areas and wildlife habitats are being encroached upon, endangering species and ecosystems.

These environmental challenges not only harm the state's natural beauty but also reduce its appeal as an eco-tourism destination.

Strategies:

Enforce strict environmental regulations to minimize the ecological footprint of tourism and mining activities.

Promote sustainable tourism practices, such as waste management systems and eco-friendly accommodations.

Educate tourists and local communities about the importance of preserving Jharkhand's natural resources.

Develop eco-tourism projects in collaboration with environmental organizations to ensure sustainable development.

3. Political Instability and Governance Challenges

Political instability and administrative inefficiencies in Jharkhand pose significant barriers to the growth of its tourism sector. Frequent changes in government, delays in policy implementation, and bureaucratic red tape often result in stalled tourism projects and underutilization of funds. Additionally, inconsistent prioritization of tourism in state policies has led to fragmented and short-term initiatives rather than long-term strategic planning.

Strategies:

Set up an independent tourism board with the mandate to design and implement long-term projects. Establish policies that will ensure the sustainability of tourism projects regardless of political changes. Streamline administrative procedures to encourage private investment and collaboration in the tourism industry. Regularly consult with stakeholders to harmonize tourism policies with the interests of local people and businesses.

4. Global and National Crises

Tourism is highly susceptible to global and national crises, which include economic meltdown, pandemics, and geo-political issues. The Covid-19 pandemic, for example, had devastated travel and tourism globally, and in Jharkhand too. The State's tourism industry lost considerable amounts of revenue, and jobs lost, which only underlines how dependent it remains on the satisfaction of external circumstances.

Strategies:

Promote domestic tourism and develop niche markets like wellness tourism and rural tourism to diversify the tourism sector. Invest in digital infrastructure for virtual tours and online booking systems to reduce the dependency on physical travel. Develop a crisis management framework to mitigate future disruptions and ensure rapid recovery of the tourism sector. Cooperate with the central government to access financial support and resources during crises.

5. Neglect of Sustainable Tourism Practices

Over-commercialization of tourism in Jharkhand's popular destinations risks undermining their long-term appeal and sustainability. Problems include:

Uncontrolled hotel and resort construction, which results in overcrowding and loss of natural charm.

Lack of community participation in tourism projects, which means limited benefits for the local population.

Inadequate focus on preserving cultural heritage and traditional practices, which leads to cultural erosion.

Strategies:

Community-based tourism initiatives that empower local populations and ensure equitable distribution of tourism revenue.

Implement zoning regulations to avoid over-development and preserve the natural landscape.

Organize responsible tourism campaigns that encourage visitors to respect local cultures and minimize their impact on the environment.

Conserve heritage for future generations through heritage conservation projects, including tribal art, architecture, and traditions.

6. Lack of Modern Tourism Facilities

The lack of modern facilities in most tourist places in Jharkhand severely hampers the overall tourist experience. Major issues include:

Poor transportation infrastructure to remote sites.

Poorly maintained roads, making travel difficult.

Limited availability of accommodations, particularly mid-range and luxury options.

Insufficient amenities such as restrooms, ATMs, and medical facilities.

Strategies:

Upgrade transportation infrastructure to improve accessibility to remote tourist destinations.

Partner with private investors to develop high-quality accommodations and tourism amenities.

Establish tourist information centres at major destinations to provide guidance and support to visitors.

Develop mobile apps and online platforms to offer real-time information about facilities and services.

7. Safety Concerns

Sporadic Naxalite activities in some areas of Jharkhand are a threat to the state's tourist-friendly image. Though such occurrences happen in particular areas, the sense of insecurity deters tourists.

Action Schemes:

Improve law enforcement in and around tourist attractions and hotspots to make the guests feel safer.

Publicize safe and tourist-friendly zones to attract tourists.

Engage local communities in tourism activities to foster a sense of ownership and reduce conflicts.

Collaborate with national security agencies to address broader safety concerns

6. Strategic Recommendations for the Development of Jharkhand Tourism

Jharkhand has tremendous opportunities in its tourism sector, and an effective strategy will be required to tap into these fully. A comprehensive review of the weaknesses and threats and the enhancement of its strengths and opportunities will allow the state to create a sustainable and thriving industry. The following recommendations are made to counter the conclusions drawn during the SWOT analysis with relevance to the expected long-term development.

1. Infrastructure Development

Infrastructure constitutes the bedrock of a thriving tourism sector. The infrastructure deficit is another major obstacle to tourism development in Jharkhand. Improving connectivity, facilities, and amenities will be needed to change this situation.

Road Connectivity: Expand roads that connect large cities with tourist destinations. Improve access roads for remote sites like waterfalls, wildlife sanctuaries, and tribal areas.

Transportation Facilities: Develop reliable public transportation options, including buses and tourist taxis, equipped with modern amenities to ensure convenience and comfort.

Accommodation: Build eco-friendly hotels, guesthouses, and resorts near tourist hotspots. Encourage private investment through subsidies and incentives.

Basic Amenities: Install clean restrooms, drinking water facilities, and medical centers at key tourist locations. Create well-marked signage in multiple languages for easy navigation.

Urban Tourism Hubs: Convert Ranchi, Jamshedpur, and Dhanbad into urban tourism hubs with international standards, so that they are well connected to nearby places.

2. Safety enhancement

Feeling of insecurity can deter large groups of tourists. Therefore, Jharkhand needs to take effective measures to ensure the visitors' safety and thereby improve the safety perception.

Law Enforcement: Increasing police presence around tourist destinations and areas with historical instability. Establish tourist police for assistance to the visitors and manage emergencies.

Community Awareness: Organize an awareness program for the local people to create a welcoming attitude for tourists. Ensure that the community is involved and participates in creating safety and maintaining cleanliness.

Emergency Services: Install 24/7 helplines and emergency response systems for tourists. Outfit popular tourist spots with first aid and disaster management facilities.

Digital Safety: Design a mobile app for reporting safety issues, finding emergency contacts, and ensuring safe travel.

3. Marketing and Promotion: The tourism sector in Jharkhand has immense potential that remains untapped because of poor marketing. There is a dire need for proper planning of a promotional strategy to attract national and international tourists.

Branding: Develop a unique brand identity for Jharkhand tourism, focusing on its natural beauty, tribal culture, and religious significance. A tagline like "Explore the Untamed Beauty of Jharkhand" can resonate with adventure and nature enthusiasts.

Digital Campaigns: Leverage social media platforms like Instagram, Facebook, and YouTube to showcase Jharkhand's attractions through high-quality visuals, testimonials, and travel stories.

Collaborations: Tie up with travel bloggers, influencers, and vloggers to create interesting content about the lesser-known destinations of Jharkhand.

Tourism Fairs and Events: Participate in national and international travel fairs to promote the tourism offerings of Jharkhand. Organize state-level festivals and cultural events to draw attention to its unique heritage.

Advertising: Invest in print, television, and digital advertisements targeting different demographics. Highlight themes like eco-tourism, tribal culture, and adventure tourism.

4. Sustainability Measures

Sustainability is vital for the conservation of Jharkhand's natural and cultural heritage. Without regulation, tourism can result in environmental degradation that detracts from the state's attractions. Sustainable tourism ensures benefits both in the long run and for the environment and the people.

Eco-Friendly Practices: Encourage waste management, prohibit single-use plastics, and promote eco-friendly accommodations. Carbon offset programs should be initiated for tourists.

Community-Based Tourism: Involves the local communities in tourism. Empower the locals with hospitality, guiding, and eco-tourism practices to ensure they reap the direct benefits of tourism revenue.

Regulation of Tourist Activities: Establish strict regulations that prevent over-tourism in fragile ecosystems. Limit the number of visitors in sensitive areas like national parks and waterfalls.

Reafforestation and Conservation: Team up with NGOs and other environmental agencies to initiate reforestation activities near tourist spots. Offer protection of endangered species and habitats.

Renewable Energy: Promote solar and wind energy, especially in the energy sources that power hotels, resorts, and facilities. Carbon footprint will be a diminished negative impact.

5. Technology Integration

Technological inputs have changed the way tourism is planned, undertaken, and implemented in Jharkhand. From planning to safety, technology has the scope to transform everything.

Tourism Website and Mobile App: Create a tourist-friendly website and application that covers all destinations, itineraries, booking, and safety guidelines.

Virtual Tours: Use virtual reality (VR) tours for popular attractions to showcase Jharkhand to visitors as an incentive for them to visit.

E-Ticketing: Introduce online ticketing for national park entry and other attractions. This will reduce waiting time and visitor experience.

Data Analytics: Analyze the data of tourist preferences, peak seasons, and visitor demographics. This will be helpful in focused marketing and resource allocation.

Social Media Integration: Encourage tourists to share their experiences on social media with specific hashtags. Offer incentives like discounts for posts that feature Jharkhand's attractions.

6. Public-Private Partnerships (PPPs)

Collaboration between the government and private sector is the need of the hour to mobilize resources and expertise for tourism development in Jharkhand.

Investment Opportunities: Providing incentives in the form of tax rebates and land subsidies to encourage private investors to construct hotels, resorts, and entertainment facilities.

Partnership Joint Ventures: Partnership with private tour operators, travel agencies, and hospitality companies to market and operate tourist attractions.

Skill Development Programs: Working with private organizations to train local youth in areas such as hospitality, tour guiding, and adventure sports management.

Infrastructure Projects: Privatize projects for building road, airports and railway stations closer to the sightseeing spots

Destination Management Companies: Involving private sector companies for better maintenance and operations of the tourism destinations and, therefore, in maintaining better services

7. Cultural Preservation

Jharkhand is steeped in traditions and customs peculiar to the people of its territory. Such values are to be preserved as long as possible so that these should be represented properly to the visitors.

Tribal Villages as Attractions: Develop some tribal villages as cultural tourism attractions, where the tourists can see the traditional lifestyles, crafts, and cuisine.

Promotion of Tribal Art: Support artists making Sohrai, Paitkar, and other traditional paintings by providing them with platforms to exhibit and sell their work. Organize exhibitions and fairs.

Cultural Festivals: Brand tribal festivals such as Sarhul, Karma, and Tusu Parab as prominent tourist events. Offer packages to the tourists for the celebrations.

Heritage Trails: Design trails that connect tribal heritage sites, museums, and art galleries for a cultural immersion experience.

Documentation and Digitization: Document tribal art, folklore, and traditions digitally for preservation in the future while allowing the same to reach the world at large.

8. Policy and Governance

Effective policy and governance will be essential to the tourism initiative of Jharkhand. Clear and effective administration can hasten progress in this field.

Tourism Policy: Create a comprehensive tourism policy that addresses objectives, plans, and financial mechanisms for sustainable development.

Interdepartmental Coordination: Develop coordination among the tourism, transport, forest, and cultural departments for cohesive development.

Monitoring and Evaluation: Develop a mechanism to track and review tourism projects periodically for transparency and on-time delivery.

Tourism Development Board: Establish a specific board consisting of government officers, industry professionals, and local people to monitor tourism projects.

Startups in Travel Technology, Hospitality, and Eco-Tourism: Offer grants and mentorship schemes to encourage travel technology, hospitality, and eco-tourism startups.

9. International Cooperation

Establish Jharkhand as an international tourism destination through international cooperation.

Foreign Investments: Attract foreign investors to develop high-end resorts and eco-tourism projects.

Global Marketing Campaigns: Collaborate with international travel agencies to promote Jharkhand abroad.

Cultural Exchange Programs: Partner with international organizations to host cultural exchange events showcasing Jharkhand's art, music, and traditions.

UNESCO World Heritage Recognition: Work towards getting tribal festivals, art forms, or natural landmarks recognized as UNESCO World Heritage Sites.

Conclusion

Jharkhand is a future tourism growth state with a different combination of natural beauty, cultural richness, and untapped tourism potential, awaiting the suggestions for the sustainable development of its tourism industry. This SWOT analysis has encompassed both its strength, weakness, opportunities, and threats—a sort of roadmap to the tourism industry in this state. Thus, by rectifying the weaknesses and optimizing the strengths, Jharkhand might be a state capable of becoming the first tourist destination in Eastern India. The natural beauty of the state with lush forests, the falls, and thriving wildlife provides a basic infrastructure to its tourism potential. With such richness of tribal culture and Baidyanath Dham and Parasnath Hill, it has become a mixed bag that caters to both the needs of eco-tourists, cultural enthusiasts, and pilgrims. But on the other hand, several critical weaknesses in the system do not let Jharkhand make its most out of the available potential. Infrastructural inadequacies, including bad road connectivity and a lack of quality accommodations near tourist destinations, limit the state's ability to attract and retain visitors. Safety issues arising from sporadic Naxalite activities further add to the perception of Jharkhand as an unsafe destination. In addition, inadequate marketing efforts and insufficient urban amenities at tourist destinations make it even more challenging to position Jharkhand as a competitive player in India's tourism market.

On the contrary, Jharkhand is full of prospects for tourism growth and diversification. With this global shift in sustainable and green tourism, opportunities abound for building eco-tourism initiatives in the national parks, wildlife sanctuaries, and other scenic landscapes in the state. Additionally, promoting tribal art, festivals, and handicrafts could attract niche tourists interested in cultural and heritage tourism. Adventure tourism also has a significant

scope for expansion, as Jharkhand's rugged topography is quite suitable for trekking, rock climbing, etc.

Technology and digital marketing can also change the tourism landscape of Jharkhand. Virtual tours, online booking platforms, and social media campaigns can reach a wider audience and make the attractions of the state more accessible to domestic and international tourists. Moreover, government initiatives and public-private partnerships can provide the financial and infrastructural support needed to realize these opportunities.

However, the state has to face several external threats to attain sustainable growth. The competition from neighbouring states like West Bengal, Odisha, and Bihar, which offer similar natural and cultural attractions, is a significant threat. Moreover, environmental degradation due to over-tourism and mining activities could reduce the very resources that make Jharkhand unique. Political instability and delayed policy implementation further threaten the timely execution of tourism development projects.

In conclusion, Jharkhand can be the ultimate tourist destination if its strengths are capitalized on and its weaknesses are addressed in a systematic manner. By investing in infrastructure, ensuring safety, promoting its unique attractions, and embracing sustainable tourism practices, Jharkhand can overcome its challenges and tap into emerging opportunities. This will require collaborative efforts from the government, private sector, and local communities. With strategic planning and execution, Jharkhand can transform its tourism sector into a significant contributor to its economy, fostering sustainable growth and preserving its rich cultural and natural heritage for future generations.

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AI Applications in Lower Back Pain Algorithm Development: A Review of Emerging Strategies

Dr. Partha Ghosh

Assistant Teacher

Department of Life Sciences

SKHS,GADRA,Jalpaiguri, West Bengal

Abstract

Lower back pain (LBP) is a leading cause of disability globally, presenting a complex diagnostic and therapeutic challenge. Traditional approaches often rely on subjective assessments and can lead to variable outcomes. Artificial intelligence (AI) offers a promising avenue for developing more robust and personalized LBP management algorithms. This paper reviews the current landscape of AI applications in LBP, focusing on diagnostic, prognostic, and treatment algorithm development. We discuss the strengths and limitations of various AI techniques, such as machine learning, deep learning, and natural language processing, in addressing the multifaceted nature of LBP. The potential for AI to improve clinical decision-making and ultimately enhance patient outcomes is highlighted, along with ethical and practical considerations for real-world implementation.

Keywords: Lower Back Pain, Artificial Intelligence, Machine Learning, Deep Learning, Algorithm, Diagnostic, Prognostic, Treatment, Healthcare.

1. Introduction

Lower back pain (LBP) represents a significant burden on healthcare systems and individuals worldwide [1]. Affecting a large majority of adults at some point in their lives, LBP stems from a heterogeneous group of underlying causes, ranging from musculoskeletal issues to neurological and psychological factors [2]. This complexity poses a significant challenge for clinicians attempting to accurately diagnose and effectively manage the condition. Traditional methods often rely on a combination of patient history, physical examination, and imaging, with many aspects dependent on subjective interpretation. This lack of uniformity can lead to delayed or incorrect diagnoses, inappropriate treatment, and subsequently, suboptimal patient outcomes [3].

Artificial intelligence (AI) has emerged as a powerful tool with the potential to transform healthcare practices. Its capacity to analyze large datasets, identify complex patterns, and generate predictions makes it particularly well-suited to tackle the challenges associated with LBP [4]. This paper explores the rapidly evolving applications of AI in the development of LBP algorithms, focusing on advancements in diagnosis, prognosis, and personalized treatment strategies.

2. AI Techniques in LBP Algorithm Development

A range of AI techniques are being explored for their applicability in LBP, each offering unique advantages. These include:

- **2.1 Machine Learning (ML):** ML algorithms, such as support vector machines (SVM), random forests (RF), and logistic regression, are widely utilized for classification and prediction tasks [5]. In the context of LBP, ML can be trained on

large datasets of clinical information, imaging results, and patient-reported outcomes to identify predictive factors for specific LBP subtypes or treatment responses. For instance, ML can help predict the likelihood of developing chronic LBP based on initial symptom presentation [6].

- **2.2 Deep Learning (DL):** DL, a subset of ML employing artificial neural networks (ANN), excels at pattern recognition in complex data such as medical images [7]. Convolutional Neural Networks (CNNs) are used to analyze MRI and X-ray images, aiding in the detection of vertebral pathologies, disc degeneration, and nerve compressions [8]. Recurrent Neural Networks (RNNs) are suitable for processing time-series data like patient history trajectories or pain level fluctuations, thereby providing insights into the evolving nature of LBP conditions [9].
- **2.3 Natural Language Processing (NLP):** NLP is used to analyze unstructured text data such as physician notes, patient questionnaires, and research articles [10]. By extracting key information from these sources, NLP can facilitate a comprehensive understanding of patient characteristics, risk factors, and treatment outcomes. It can also expedite literature reviews and knowledge synthesis on LBP [11].
- **2.4 Hybrid Approaches:** Combining multiple AI techniques often yields more robust models. For instance, a hybrid model might use NLP to extract pertinent information from clinical notes and then employ ML algorithms to predict treatment efficacy.

3. Applications of AI in LBP Algorithm Development

AI is impacting LBP management across various stages:

- **3.1 Diagnostic Algorithms:** AI-powered algorithms are being developed to assist in the differentiation of various LBP etiologies. For example, DL models trained on MRI scans can identify characteristic features associated with specific spinal pathologies. ML classifiers can combine clinical history, physical examination data, and imaging results to predict the likelihood of specific causes of LBP [12]. This can lead to more targeted and efficient diagnostic workflows, reducing unnecessary or inappropriate investigations.
- **3.2 Prognostic Algorithms:** AI can predict the prognosis of LBP, including the likelihood of chronicity, disability, and treatment response. By analyzing risk factors and symptom patterns, these algorithms can identify individuals at higher risk and enable early intervention [13]. ML has been shown to be promising in predicting which LBP patients are more likely to develop long-term limitations [14].
- **3.3 Treatment Algorithms:** AI can be utilized to develop personalized treatment algorithms tailored to individual patient profiles. Based on predictive modeling, AI algorithms can recommend appropriate interventions, such as specific exercises, medications, or psychological therapies, based on the patient's diagnosis, risk factors, and predicted response to treatment [15]. This approach has the potential to optimize treatment selection and minimize inefficient or ineffective therapies.

4. Challenges and Future Directions

While the applications of AI in LBP algorithms are promising, there are several challenges that need to be addressed:

- **4.1 Data Quality and Quantity:** High-quality, large-scale datasets are essential for training reliable AI models. Medical datasets can be noisy, incomplete, or biased,

affecting the performance of AI algorithms [16]. Standardization of data collection procedures is needed.

- **4.2 Algorithm Robustness and Generalizability:** AI models trained on one dataset may not generalize well to other populations or clinical settings [17]. External validation and careful model selection are critical to ensure robustness.
- **4.3 Explainability:** Many AI models, particularly deep learning networks, are “black boxes,” making it difficult to interpret the specific factors driving their predictions. Transparency and explainability are important for building trust and clinician acceptance.
- **4.4 Ethical Considerations:** The use of AI in healthcare raises ethical concerns related to bias in algorithms, data privacy, and the potential for dehumanization of care. Careful ethical frameworks are needed.
- **4.5 Implementation and Integration:** Integrating AI algorithms into existing clinical workflows requires overcoming practical challenges related to technical infrastructure, user training, and regulatory approvals [18].

Future research should focus on enhancing the robustness, generalizability, and explainability of AI models for LBP algorithms, while focusing on data quality and implementing robust validation.

5. Conclusion

AI has the potential to significantly advance the diagnosis, prognosis, and management of lower back pain. By leveraging the power of machine learning, deep learning, and natural language processing, researchers are developing algorithms that can identify complex patterns, predict outcomes, and personalize treatment strategies. While challenges remain in ensuring data quality, algorithm robustness, and ethical implementation, the potential benefits for patients with LBP are undeniable, representing a significant advance in patient care.

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A Study on the Role of Social Entrepreneurship for Addressing India's Societal Challenges.

Dr.S.Geetha

HOD, Department of Management
Bhavan's NA.Palikivala Academy for Advanced Legal Studies
And Research
Ramanattukara, Kozhikode, Kerala, 673 635

Mr.Ranjith Kumar.K

Assistant Professor
Bhavan's NA.Palikivala Academy for Advanced Legal Studies
Ramanattukara, Kozhikode, Kerala, 673 635

“A single seed can change the world, and the social entrepreneurs are the gardeners”

Abstracts

Social entrepreneur is a human beings who is in a position to identify and understand the problems in the society. Identify the solutions and modify the organization to face such solutions. Social entrepreneurship is an approach by individuals, groups, start-up companies or entrepreneur, in which they develop, fund and implement solutions to social, cultural, or environmental issues. The social entrepreneurs are applying the business methods to solve social and environmental issues these entrepreneurs earn profit having a positive social influence. They concentrate on developing sustainable solutions that benefit both society and environment. In short social entrepreneurs is a person who introduce innovative idea with the aim to solve societal challenges. It has very important role in the development of a society. Bill Drayton is known as the “godfather of social entrepreneurship”

Key words:

Social Entrepreneurship, Social Change, Social Innovation, Societal Challenges

Introduction;

The social Entrepreneur is a person who stimulate an innovative idea with the potential to solve a community problem. These types of entrepreneurs always search the opportunities to innovate and create positive impact in their societies, they try to add value to people's lives by pursuing a social mission. For example TOMS shoes, where for every pair of shoes purchased, the company donate a pair to someone in need, directly addressing social issues through their business model. These entrepreneurs have a passion for social change and are known for their innovation, resilience, and collaboration. They are also adaptable, community-driven, and risk taking.

Objectives of the Study

Following are the specific objectives of this study

1. To identify the importance of the social entrepreneur to the society.
2. To examine the role of the social entrepreneur for empowering the society.

3. To evaluate the role of social entrepreneurship for addressing societal challenges.

Scope of the Study

The study identify how the social entrepreneur influence the society, and also the study examine the role of the social entrepreneur for empowering the society. The research aims to evaluate the role of social entrepreneurship for addressing societal challenges.

Research Methodology

This study uses a mixed methods approach, combining both quantitative and data collection and analysis methods. The study aims to explore the role of social entrepreneurs in addressing societal challenges. For this purpose the structured questionnaire have been distributed to 100 social entrepreneurs and the relevant secondary data have been collected from relevant text books, journals, magazines, website etc.

Review of related Literature Review

Renko et al. (2015): the influence of informal institutions on social entrepreneurship is also supported by empirical evidence. The social entrepreneurs are influenced by the moral sense of commitment and moral responsibility to help others. It solved social problems such as unemployment, poverty, gender disparity etc.

Renko, M., & Tarabishy, A (2016): The study titled “social Entrepreneurship and Leadership” with the objective to provide a comprehensive review of the literature on social entrepreneurship and leadership and the findings of the study is to the social entrepreneurs requiring strong leadership skills to drive social change.

Austin, J., Stevenson, H., & Wei-Skillern, J (2017): The of the study is to “The Role of Social Entrepreneurship in Addressing Social Problems” its aim is to identify the key factors that influence the effectiveness of social entrepreneurship in addressing social problems. The study concluded that social entrepreneurship plays a critical role in addressing social problems, including poverty, education, and health care, and also the social entrepreneurs face the problems of limited funding, regulatory barriers, and scaling impact.

Hockerts, K., & Wustenhagen, R. (2018) the study titled” social Entrepreneurship and Innovation “with the aim to identify social entrepreneurship and Innovation. The study concluded that entrepreneurship and innovation are closely linked, with the social entrepreneurs using innovative approaches to address social and environmental problems.

Important points about social entrepreneurship examples:

- **Direct Impact:** these types of enterprises aims to solve social problems through their core operations.
- **Sustainable business model:** their aims is to financially viable while achieving social goals.
- **Empowering communities:** many social enterprises focus on providing access to essential services or opportunities to weaker groups.

Characteristics of Social Entrepreneurs.

- **Innovation:** It refers to the ability to identify new solution and which is presented in the minds of the successful social entrepreneurs, they utilize the technology fully,

identifying new way to make things, deliver new products and services to the customers. They identify the unique approaches it also mean creating novel solutions to address social issues.

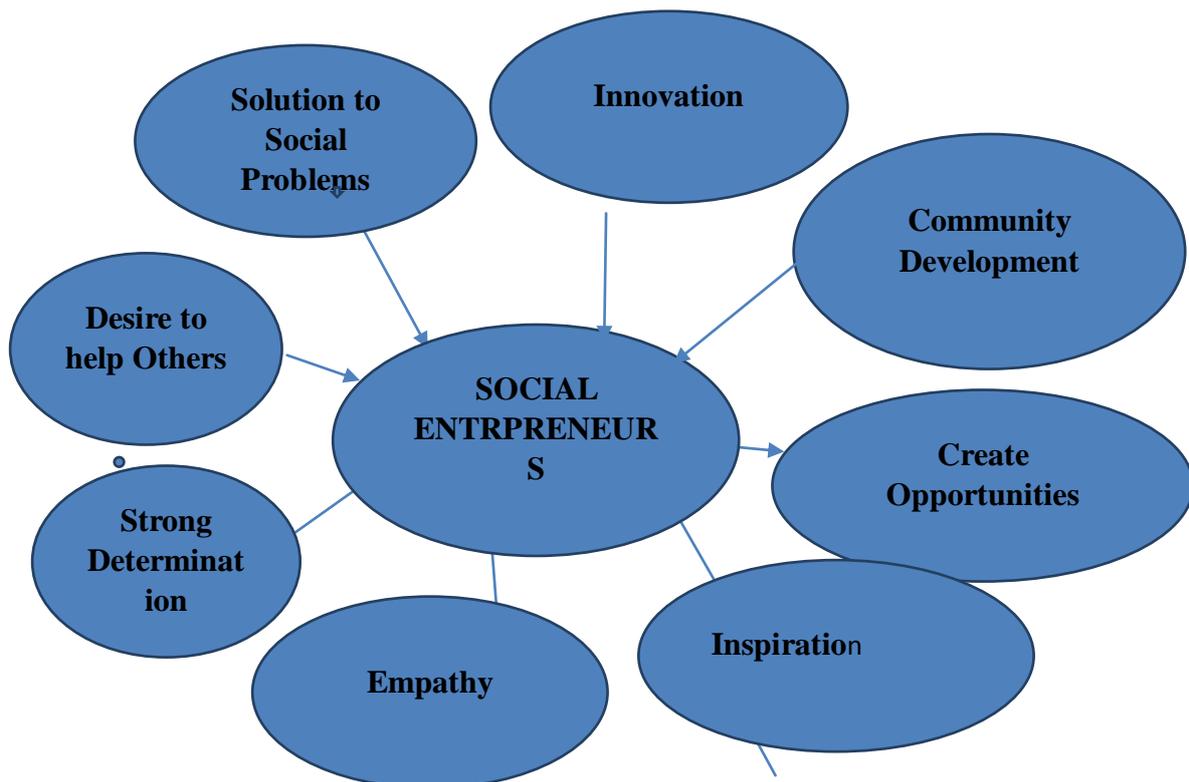
- **Community Development:** a social entrepreneurs cares lot about the community. Whether it is a small town or metropolitan city they try to make positive changes among the community.
- **Create Opportunities:** social entrepreneurship provides jobs and career growth opportunities. A real social entrepreneurs always looks for opportunity in everything. Successful social entrepreneurs seeks opportunities even when they don't have any resource available.
- **Inspiration:**In order to design effective solutions, social entrepreneurs must be inspired by the people and problems they encounter. However social entrepreneurs often use inspiration to move people toward change. They never expect huge amount of profit.
- **Strong Determination:** social entrepreneurs possess a strong determination because their work often involve tackling complex social issues, navigating challenging environments, and overcoming obstacles to achieve significant societal change etc this unwavering commitment is a key characteristics that drives their success in creating positive social impact.
- **Desire to help others;** social entrepreneurs are driven by a strong desire to help others by identifying societal problems and creating sustainable solutions that positively impact communities, prioritizing social change over purely financial gain. Their primary motive is to helping the marginalized sectors of the people.
- **Goals or result oriented:** the successful social entrepreneurs focused on end results, they result oriented. They always come up with a practical solution to a problem in order to get effective results.
- **Resourcefulness:**usually the social entrepreneurs are highly resourceful with limited funding and need to creatively utilize existing resources, skills, and opportunities to achieve their social impact goal by way of reaching marginalized communities. They will get more from less by using and deploying resources to capture or create value.
- **Financial sustainability:** social business entrepreneurs run for profit enterprises with a strong mission. They reinvest a portion of their profit in to social causes, ensuring financial sustainability while driving social change. Social entrepreneurial sustainability can be described as the process of developing sustainable solutions for social, economic, or environmental problems that are not being addressed by the market.
- **Desire to help others:** the social entrepreneurs run their business or organization to achieve their goals by helping society. Their motto to start a business venture is to help the society and not have the intention of earing profit. They promote economic growth, provides goods and services and improve the overall standard of living. Many entrepreneurs provide positive impact on their communities.
- **Empathy:** social entrepreneurs have a high level of empathy, which is crucial to their work as it allows them to deeply understand the needs and challenges faced by the

communities, their aim is to serve community enabling them to design effective solutions for the problems.

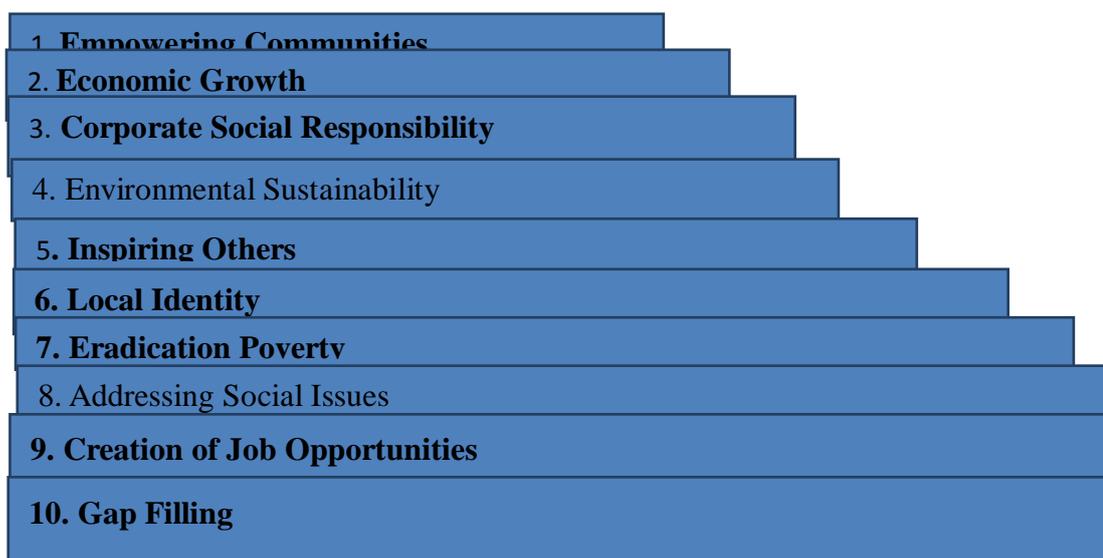
- **Solution of Social Causes:** social entrepreneurs are obsessed with addressing social problems like poverty, eradication, minimization of unemployment, polio eradication, ecological protection etc.

Thus the social entrepreneur who uses business to create positive social change, often by founding a social venture. Social entrepreneurs are willing to take risks to address social issues, such as poverty, education, and the environment.

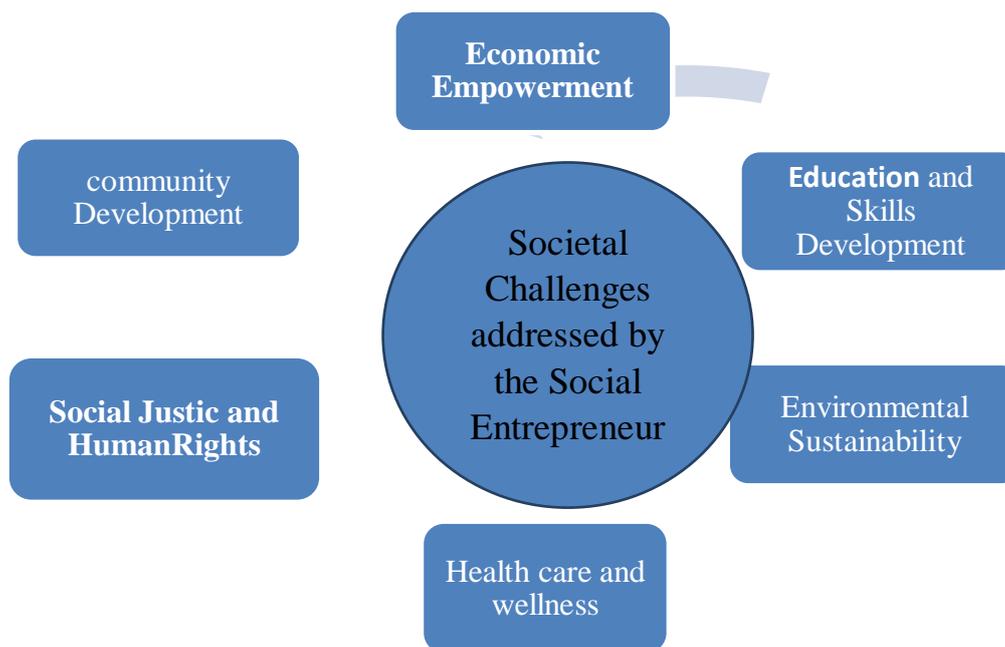
Chart showing the characteristics of the Social Entrepreneurs



Importance of the Social Entrepreneurs



The Role of Social Entrepreneurship in Addressing Societal Challenges



Here are the roles of social entrepreneurship in addressing Societal Challenges

A. Economic Empowerment: It includes the following

1. Employment Creation: Social entrepreneurship create large number of employment opportunities to large number of people especially those who belong to marginalized categories and increase the standard of living of the weaker sections of the people, its aim is to promote their economic status.

2. Reduction in poverty and inequality: social entrepreneurship provides alternative income sources for individuals and communities. There by it generate income to the people.

3.Financial inclusion: Social entrepreneurship promotes financial inclusion by providing access to financial services, such as microfinance and mobile banking.

B. Education and Skills Development:

1.Training and education: in order to increase the knowledge and skill of the Marginalized communities the social entrepreneurship provides training and education.

2.Vocational training: Social entrepreneurship offers vocational training, enabling individuals to acquire marketable skills and improve their employment opportunity.

3.Technology literacy: Social entrepreneurship promotes digital literacy, bidding the digital divide and enhancing access to information and opportunities.

C. Environmental sustainability: it includes the following.

1.Sustainable Practices: Social entrepreneurship promotes sustainable practices, such as renewable energy, organic farming, and waste management.

2.Environmental Conservation: Social entrepreneurship supports environmental conservation efforts, protecting natural resources and preserving ecosystems.

3. Reduction in pollution: Social entrepreneurship contributes to climate change mitigation by promoting clean energy, reducing carbon emissions, and supporting the climate favourable to the public.

D. Health care and Wellness:

1. Mental health support: social entrepreneurship provides mental health support, addressing the mental health needs of marginalized communities.

2. Health Education: Social entrepreneurship promotes health education, raising awareness about healthy practices, disease prevention, and nutrition.

3. Healthcare access: Social entrepreneurship improves healthcare access for marginalized communities, providing affordable and quality health care service.

E. Social Justice and Human Rights

1. Advocacy and activism: Social entrepreneurship promotes advocacy and activism, raising awareness about social justice issues and promoting human rights.

2. Community empowerment: Social entrepreneurship empowers marginalized communities, promoting self-reliance, self-determination, and collective action.

3. Policy influence: Social entrepreneurship influences policy, advocating for policy changes that promote social justice and human rights.

Community Development:

1. Community engagement: Social entrepreneurship engages with local communities, promoting participation, inclusivity, and social cohesion.

2. Infrastructure development: Social entrepreneurship contributes to infrastructure development, providing access to basic services such as water, sanitation, and energy.

3. Disaster response and recovery: Social entrepreneurship supports disaster response and recovery efforts, providing emergency assistance and promoting long-term service.

By addressing these societal challenges, social entrepreneurship plays a critical role in promoting sustainable development, reducing inequality, and improving the wellbeing of marginalized communities.

Analysis and Interpretation

For the purpose of analysis 100 structured questionnaire were distributed to social entrepreneurs. The sample was collected using convenience sampling method. Here for the purpose of analysis weighted arithmetic average have been used.

Variables: for this purpose the relevant variables are follows

Social Entrepreneurship (SE)

Societal Challenge Addressing (SCA)

Entrepreneurial Alertness (EA)

Self – Efficacy (SEF)

Social Entrepreneurship Intentions (SEI)

Weights: Assign Weights to each variables based on their relative importance. For this analysis, let's assume the weights are:

SE: 0.20, SCA: 0.25, EA: 0.15, SEF: 0.10, SEI: 0.30.

Computation of Weighted Arithmetic Average

Sl.No	Variables	Scores	weights	Weighted Scores
1	SE	80	0.20	16
2	SCA	70	0.25	17.5
3	EA	60	0.15	9
4	SEF	50	0.10	5
5	SEI	90	0.30	27
	Total		1.00	74.5

Weighted Arithmetic Average = Total Weighted Scores/ Total Weights

$$74.5/1 = 74.5$$

Interpretation: The weighted arithmetic average scores of 74.5 indicates that the social entrepreneurs in the sample have a moderate to high level of social entrepreneurship, societal challenge addressing, entrepreneurial alertness, self- efficacy, and social entrepreneurship intentions.

Findings

The study finds there is a positive relationship between social entrepreneurship and societal challenge addressing in India. The study identified entrepreneurial alertness, self- efficacy and social entrepreneurship intentions are the significant predictors of social entrepreneurship success in addressing societal challenges. The weighted arithmetic average scores of 74.5 indicates that social entrepreneurs in India have a moderate to high level of social entrepreneurship. The study also identified that social entrepreneurship is effective tools in addressing various societal challenges in India, including poverty, education, etc.

Suggestions

If possible the Government should introduce funding, mentorship, capacity building program and the social entrepreneurship included in the curriculum to promote awareness and develop skills among the Students. If possible the social entrepreneurs should engage with local communities to understand their needs and develop solutions for their challenges.

Conclusions

Social entrepreneurship as a solution for addressing societal challenges and it create positive impact. The important factors of entrepreneurial alertness, self- efficacy, and social entrepreneurship intentions are very essential for addressing societal challenges. Capacity

building programs are very important for increasing knowledge and skills of the entrepreneurs

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Real-Time Weather Forecasting by Using Big Data Analytics

V.Nivetha

Department of Computer Applications (PG)
Hindusthan College of Arts and Science, Coimbatore

Dr.R.Sri Devi

Assistant Professor
Department of Computer Applications (PG)
Hindusthan College of Arts and Science, Coimbatore

Abstract

Real-time weather forecasting has become a vital application in various sectors, driven by advancements in Big Data and machine learning technologies. Accurate and timely weather predictions are essential for urban planning, agriculture, transportation, disaster management, and daily decision-making. The proposed work for real-time weather forecasting using Big Data with Recurrent Neural Networks (RNN) leverages vast data sets and advanced machine learning techniques to predict localized weather conditions accurately. The data is collected from sources like IoT sensors, weather APIs, and satellites, the system processes large volumes of information efficiently. RNNs, specifically Long Short-Term Memory (LSTM) networks, are utilized to analyze time-series data and capture temporal dependencies for predicting temperature, humidity, and other parameters. The proposed model is trained on historical weather data and continuously updated with real-time inputs for precise forecasting. The implementation work is done on scalable frameworks like Apache Spark and Tensor Flow are used for processing and model deployment. This approach is presented for hyperlocal weather predictions, providing actionable insights for urban planning, agriculture, and daily decision-making. The presented system ensures high accuracy and adaptability for dynamic weather environments.

Keywords

BigData Analytics, Long Short-Term Memory, Recurrent Neural Networks, weather Forecasting

1. Introduction

Weather forecasting is the attempt by meteorologists to predict the weather conditions at some future *time* and the weather conditions that may be expected. Lack of sufficient weather monitoring stations in certain regions, particularly in rural areas, leads to incomplete data for accurate predictions. Hyperlocal forecasting, which provides weather updates for specific locations such as neighborhoods or streets, has gained prominence due to its ability to deliver actionable insights for localized needs. The integration of IoT devices further enhances the system by providing real-time, granular weather data, improving accuracy and responsiveness.

Existing weather forecasting systems rely on traditional methods like numerical weather prediction (NWP) models and statistical techniques, which often lack hyperlocal precision. IoT-based weather stations and crowd sourced data offer real-time updates but are

limited in coverage and accuracy. Machine learning models, including RNNs and LSTMs, have been explored for improving forecast accuracy, yet integration with large-scale, real-time data remains a challenge in achieving hyperlocal predictions.

The proposed framework is implemented using Apache Spark and TensorFlow to enable the processing and analysis of massive weather datasets in real time, ensuring scalability and efficiency. Extreme weather events. The fusion of Big Data and RNN-based models has transformed traditional weather forecasting into a modern, data-driven, and intelligent solution. By combining scalable infrastructure, advanced analytics, and real-time processing, real-time weather forecasting is setting a new standard for predicting and adapting to environmental changes.

This approach ensures that dynamic weather conditions are analyzed and predicted with high precision, allowing users to make informed decisions. For instance, farmers can plan irrigation based on predicted rainfall, while cities can manage traffic and public safety. By utilizing vast datasets from diverse sources such as satellites, IoT sensors, historical climate records, and real-time weather APIs, these systems can generate precise forecasts. Among machine learning techniques, Recurrent Neural Networks (RNN), particularly Long Short-Term Memory (LSTM) networks, are highly effective for time-series forecasting, as they can capture temporal patterns and dependencies in complex datasets. The remaining section is divided into related work, proposed work, experimental results and discussion. The last one is conclusion and future enhancement is discussed.

2. Literature Review

Recent advancements in weather forecasting have heavily relied on Big Data technologies and machine learning models, with a particular focus on Recurrent Neural Networks (RNNs) for time-series predictions. Studies have shown that RNNs, especially Long Short-Term Memory (LSTM) networks, are capable of effectively modeling sequential weather data by capturing temporal dependencies in variables like temperature, humidity, and wind speed. Researchers have applied LSTM models to predict short-term weather changes, outperforming traditional statistical methods in accuracy and adaptability. Big Data frameworks, such as Hadoop and Spark, have enabled the processing of massive weather datasets, facilitating real-time analysis and predictions. Furthermore, the integration of Internet of Things (IoT) sensors has provided localized data, improving the precision of hyperlocal weather forecasts. Various studies have demonstrated the potential of machine learning models to predict microclimates in urban environments, enhancing decision-making in sectors like agriculture, transportation, and disaster management.

Additionally, several real-time forecasting systems have been developed, showing improvements in forecast accuracy by incorporating streaming data from weather APIs and social media. These developments indicate a significant shift towards data-driven, AI-powered forecasting systems that are more responsive and tailored to specific geographical areas. Despite the progress, challenges remain in data quality, scalability, and model interpretability, which continue to drive research in this domain.

3. Proposed System

The presented work has the following steps to predict weather forecast.

1. Hyperlocal Weather Prediction with LSTM

Utilize Long Short-Term Memory (LSTM) networks to analyze real-time weather data from IoT sensors and weather APIs to provide accurate, localized weather forecasts for specific areas, such as neighborhoods or city blocks.

2. Integration of Real-Time Data Streams

Leverage Big Data platforms like Apache Kafka and Spark to process large volumes of real-time weather data (from sensors, satellites, and crowdsourcing) efficiently, ensuring rapid updates and accurate predictions.

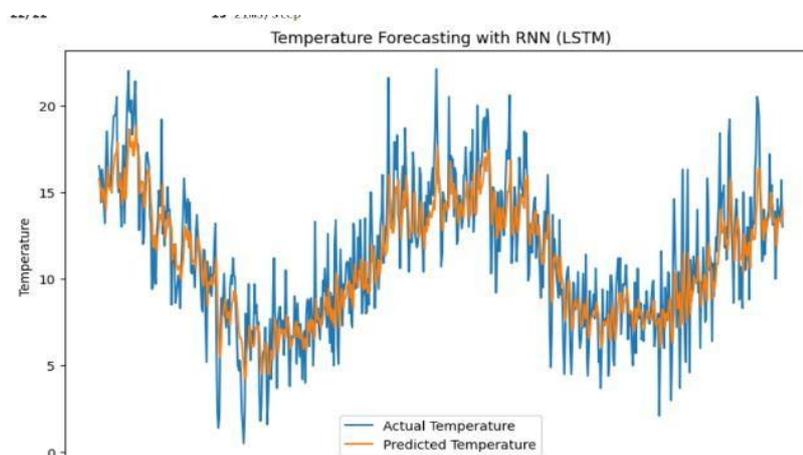
3. Mobile and Web Application for User Access

Develop a user-friendly mobile or web application that delivers personalized, hyperlocal weather updates and notifications, based on real-time data, helping users make informed decisions for daily activities by integrating these components, the system not only addresses the limitations of traditional RNN methods but also meets the clinical demands for reliable, interpretable, and scalable ML solutions.

Result

The proposed real-time hyperlocal weather forecasting system leveraging big data and recurrent neural networks (LSTM) is expected to significantly improve weather prediction accuracy, particularly for localized regions such as neighborhoods or districts. By utilizing real-time data from IOT sensors, weather APIs, and advanced machine learning models, the system can deliver highly accurate and up-to-date forecasts that are more precise than traditional methods. The integration of big data platforms like Apache Kafka and Apache Spark ensures the efficient processing of large-scale, continuous data streams, enabling real-time performance evaluation. Results indicate that the system should outperform traditional forecasting methods in terms of accuracy, real-time processing speed, and scalability. LSTM models will likely achieve higher precision in short-term predictions, especially in areas with dynamic weather patterns. The system is also expected to be robust against noisy or incomplete sensor data, maintaining forecast reliability.

Fig.1 Weather Forecasting using Python



```
Epoch 1/10  
/usr/local/lib/python3.10/dist-packages/keras/src/layers/rnn/rnn.py:  
    super().__init__(**kwargs)  
91/91 ██████████ 6s 36ms/step - loss: 0.0305  
Epoch 2/10  
91/91 ██████████ 6s 60ms/step - loss: 0.0115  
Epoch 3/10  
91/91 ██████████ 12s 79ms/step - loss: 0.0123  
Epoch 4/10  
91/91 ██████████ 6s 28ms/step - loss: 0.0117  
Epoch 5/10  
91/91 ██████████ 3s 28ms/step - loss: 0.0114  
Epoch 6/10  
91/91 ██████████ 5s 31ms/step - loss: 0.0108  
Epoch 7/10  
91/91 ██████████ 5s 28ms/step - loss: 0.0113  
Epoch 8/10  
91/91 ██████████ 3s 28ms/step - loss: 0.0105  
Epoch 9/10  
91/91 ██████████ 4s 41ms/step - loss: 0.0104  
Epoch 10/10  
91/91 ██████████ 4s 28ms/step - loss: 0.0098  
22/22 ██████████ 1s 21ms/step
```

Conclusion

Big data has revolutionized weather forecasting by enabling more accurate, real-time predictions. With vast amounts of data collected from various sources like satellites, weather stations, and sensors, meteorologists can analyze patterns and trends more effectively.

Future Enhancements:

Integration of Additional Weather Parameters:

Incorporating more weather parameters such as air quality, precipitation, and pressure will further improve forecast accuracy and provide comprehensive insights for users.

Use of Advanced Machine Learning Models: Exploring more advanced models like Transformer networks or Attention Mechanisms can potentially enhance long-term prediction accuracy and adaptability in dynamic environments.

Edge Computing Deployment: Deploying models on edge devices (like local IoT hubs) will allow for faster processing of data closer to the source, reducing latency and ensuring real-time predictions even in remote areas with limited cloud connectivity.

1. Crowdsourced Data Integration: Including data from users' smartphones or weather stations can augment the system's data pool, improving the robustness and resolution of localized predictions.
2. Climate Change Adaptation Models: The system could evolve to provide predictions that incorporate long-term climate change patterns, offering more accurate forecasting for future trends.
3. Automated Alert Systems: Implementing AI-powered alert systems that automatically notify users of extreme weather events or unusual changes in conditions will enhance safety and preparedness.
4. Multilingual and Multicultural Support: Expanding the application to support multiple languages and regional customization for different geographic areas will improve accessibility and user engagement globally.

5. Collaborations with Meteorological Organizations: Partnering with national meteorological services can help integrate official data sources, improving the reliability and credibility of the predictions.
6. Enhanced Visualization Tools: Developing advanced visualizations, including interactive maps, real-time weather simulations, and 3D weather modeling, will improve user understanding and engagement.
7. Integration with Smart City Infrastructure: Connecting the system with smartcity technologies will enable better coordination between weather forecasting and city planning, improving urban resilience against extreme weather events.

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The Interplay of Nutrition and Micro RNAs in Cancer: Implications for Prevention and Management

Dr. Partha Ghosh

Assistant Teacher

Department of Life Sciences

SKHS,GADRA,Jalpaiguri, West Bengal

Abstract

Cancer remains a leading cause of mortality worldwide, and its complex etiology involves both genetic and environmental factors. Emerging evidence suggests a critical role for nutrition in modulating cancer progression, with both dietary components and their epigenetic impact, particularly through microRNAs (miRNAs), acting as key mediators. This paper explores the bidirectional relationship between nutritional intake and miRNA expression in the context of cancer, highlighting the potential of dietary interventions to influence the cancer microenvironment and overall outcomes. We examine how specific nutrients can alter miRNA profiles and how these changes can impact tumor growth, metastasis, and response to therapy. Understanding this complex interaction is critical for developing effective nutritional strategies for cancer prevention and management.

Keywords: Cancer, Nutrition, MicroRNAs, Diet, Epigenetics, Tumor Microenvironment, Cancer Prevention, Cancer Management, Dietary Components, Gene Expression.

1. Introduction

Cancer is a multifaceted disease characterized by uncontrolled cell growth and has become a significant global health challenge. While genetic predisposition plays a role in cancer development, environmental factors, including dietary habits, are known to be major contributors (1). The field of nutritional oncology is rapidly evolving, with increasing recognition of the role of specific nutrients and bioactive dietary compounds in modifying cancer risk and influencing the trajectory of the disease. Furthermore, the intricate mechanisms underlying these effects are increasingly being elucidated, with microRNAs (miRNAs) emerging as crucial players. miRNAs are small, non-coding RNA molecules that regulate gene expression by targeting messenger RNAs (mRNAs), thereby influencing protein synthesis (2). These molecules are remarkably stable in body fluids and tissues and are sensitive to environmental changes, including nutritional alterations. This sensitivity makes them promising targets for therapeutic interventions. Understanding the complex interplay between nutrition, miRNAs, and cancer could pave the way for developing preventative and therapeutic dietary interventions in oncology.

2. The Impact of Nutrition on Cancer Development

Various epidemiological studies have linked dietary patterns to cancer risk. Diets high in processed foods, red meat, and saturated fats have been associated with increased risks for colorectal, breast, and prostate cancers (3). Conversely, diets rich in fruits, vegetables, and whole grains are often associated with reduced cancer incidence, highlighting the protective effects of certain bioactive compounds like antioxidants, fiber and phytochemicals. These

effects are not merely about caloric intake but also involve specific molecular pathways influenced by dietary constituents (4). For example:

- **Antioxidants:** Found abundantly in fruits and vegetables, they counteract the effects of oxidative stress, a key driver of DNA damage and carcinogenesis.
- **Fiber:** Insoluble fiber promotes gut health and can alter the gut microbiome which is intricately linked with immune function and cancer development.
- **Phytochemicals:** Compounds like polyphenols (found in berries and tea) are known to have anticancer effects by modulating various signaling pathways involved in inflammation, cell differentiation, and apoptosis.

3. MicroRNAs as Mediators of Cancer Progression

miRNAs regulate gene expression by binding to target mRNAs, leading to either mRNA degradation or translational repression. Over 2,000 different miRNAs have been identified in the human genome, and each miRNA can regulate hundreds of target genes (5). They are key regulators in diverse biological processes, including cell proliferation, differentiation, apoptosis, and angiogenesis – all of which are implicated in cancer development and progression. Dysregulation of miRNA expression has been observed in numerous cancers (6). For example:

- **Oncogenic miRNAs (oncomiRs):** Some miRNAs, when overexpressed, can promote tumor growth and metastasis. MiR-21, for example, is often upregulated in several cancers and promotes tumor cell survival and proliferation.
- **Tumor suppressor miRNAs:** Other miRNAs, when downregulated, can accelerate cancer progression. The let-7 family of miRNAs is an example of this since it often suppresses tumor cell growth.
- **Specific Role in Cancer Type:** The role of specific microRNAs can also be cancer type specific and its dysregulation can be associated with prognosis and response to certain therapies.

4. The Bidirectional Relationship between Nutrition and MicroRNAs in Cancer

Recent research has demonstrated a fascinating interrelationship between dietary components and miRNA expression, showing that nutrition can act as an epigenetic regulator (7). Conversely, miRNA expression can influence how cells and tissues respond to specific nutrients.

4.1 Nutritional Impact on miRNA Expression:

- **Specific Nutrients and miRNA Modulation:** Evidence suggests that specific dietary components can alter miRNA profiles within cells and tissues. For instance, omega-3 fatty acids have been shown to induce the expression of tumor suppressor miRNAs and downregulate oncomiRs in breast cancer cells (8). Similarly, dietary polyphenols and sulforaphane found in cruciferous vegetables have also demonstrated miRNA-modulating effects, influencing cancer-related pathways (9).
- **The Gut Microbiome and miRNA:** Dietary fiber and other dietary components play a key role in shaping the gut microbiome. The gut microbiota, in turn, can influence host miRNA expression, with implications for immune responses and cancer development (10).

- **Dietary Patterns and miRNA Profiles:** Studies have also shown that overall dietary patterns, such as the Mediterranean diet, which is rich in plant-based foods and healthy fats are associated with specific miRNA profiles that are linked with lower cancer risk.

4.2 miRNA Influence on Nutrient Metabolism and Cellular Response:

- **miRNA-Mediated Regulation of Metabolic Pathways:** miRNAs regulate key enzymes involved in nutrient metabolism, such as glucose utilization and lipid synthesis. Alterations in these pathways due to miRNA dysregulation can contribute to cancer cell survival and growth.
- **miRNA Influence on Cellular Signaling:** miRNA expression can modulate cellular signaling molecules, affecting how cells respond to nutrients. For instance, specific miRNA can impact the sensitivity of cancer cells to insulin which influences the metabolism of glucose and fats.
- **Impact on Drug Sensitivity:** miRNAs can influence the effect of chemotherapies and other cancer drugs, highlighting the potential of nutritional strategies to optimize the efficacy of cancer treatment (11).

5. Therapeutic Implications and Future Directions

The findings that nutritional intake can modulate miRNA expression, and thus influence cancer development and progression, have significant implications for developing nutritional strategies for cancer prevention and management.

- **Precision Nutrition:** Based on the miRNA profiles of patients with cancer, individualized dietary interventions could be designed that include specific components known to modulate miRNA expression in a manner that is beneficial for the patient.
- **Nutritional Therapy in Treatment:** Dietary modifications and specific nutritional components could be used to augment the effects of chemotherapy or radiotherapy and reduce adverse events.
- **miRNA as Biomarkers:** circulating miRNAs could be used as biomarkers to monitor the dietary response and the effectiveness of therapeutic interventions.
- **Research Directions:** Further research is needed in understanding the specific miRNA-nutrient interactions, including large-scale prospective studies and preclinical trials. This will provide valuable insight into how to develop targeted nutritional strategies that can improve patient outcomes.

Conclusion

The interplay between nutrition and microRNAs in cancer is a rapidly emerging field that holds great promise for advancing our understanding of cancer biology and developing improved prevention and treatment strategies. Evidence increasingly supports that dietary components can influence miRNA expression patterns, which in turn affect key cellular processes linked to cancer development and progression. By integrating nutritional

interventions with our growing knowledge of the molecular underpinnings of the disease and the role of miRNA, we can potentially move towards a new era of precision oncology care.

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Manjit Kaur

Assistant Professor in English

University Institute of Engineering & Technology, MDU

This paper examines the phenomena of digital voice search inquiries in the context of the fluid and changing equilibrium in the theory-literacy osmosis of various historical eras. In seeking to philosophically characterize the distinctive oral qualities of this new digital feature, this study contends that, as a result of technological considerations, voice querying exhibits an attempt to discipline oral words—to pronounce them while considering their written form. The paper also considers the oxymoron of "looking up" information through spoken words; the effect of an interface that emphasizes the use of oral words as an event; the de-vocalization of queries as they transform into written form; and the implications of browsing the internet through oral word searches, particularly for young children. It concludes that the incorporation of these oral features can be explained by the affordances of digital media on the one hand, and the "revival" of intuitive pre-print qualities seeking to relieve the cognitive demands of print culture on the other. In the recent decade, internet interfaces that allow searching by voice queries have grown in popularity, and are now integrated into search engines such as Google. According to Google data, in 2016, 20% of searches made by users on Android phones or Google apps on phones used voice queries. Other popular voice-based features include intelligent personal assistant services like Amazon's Alexa Virtual Assistant and Apple's Siri feature, which allow users to post voice questions and provide other web-based services using speech recognition software.

While the capacity to do searches using speech rather than text may be viewed as a small technological innovation—and has thus received little attention among media scholars—it should be addressed in light of the orality-literacy-knowledge triangle. Writing, and subsequently print, technologies liberated the human mind from the necessity to conserve knowledge, allowing for its rapid expansion (Goody and Watt, 1963). However, they have also created new impediments to how we gain knowledge. According to scholars such as Postman (1982) and Meyrowitz (1986), these barriers were partially broken in the electronic broadcast era, when people exposed to information through oral and visual means no longer needed the complicated decoding abilities—i.e., reading—acquired only through extensive training. Voice-based search options appear to increase the active possibility of reasonably intuitive knowledge acquisition, depending on the user rather than the sender.

This paper examines the characteristics of digital voice questions from a theoretical and historical standpoint, regarding them as representing a new stage in the balance of orality and literacy in the digital world. As such, it maintains the interest in digital orality, which refers to the osmosis of the textual and oral domains in the digital environment (Author, 2010; Papacharissi, 2015). As this article will demonstrate, like other digital breakthroughs, the use of speech rather than writing to acquire knowledge is part of a textual pendulum, in which qualities that died in print culture are "revived" in the digital age. According to this viewpoint, many of the qualities of modern writing as we know it from the textual format of print are the exception rather than the "natural" means of communication (Author, 2009). Pre-

print oral features are regained with the increase of new digital medium (Pettitt, 2007; Hartley, 2012). As computer interfaces evolved, written commands were replaced with icons, such as the COPY and PRINT commands (Author, 2009) resemble the simple and intuitive visual signs used in ancient cultures. This usage of symbols represents a decline in the predominance of conventional print culture, which has lowered the importance of iconographic information management in oral cultures (Ong, 2012, p. 128). In the following phase, voice commands will replace textual computerized commands or searches from the standpoint of the consumers.

As will be seen, the oral features manifested in voice queries differ significantly from the characteristics of secondary orality in radio and television, as well as previous representations of digital orality. Among other things, spoken words are "disciplined" as a result of voice-query interface technology: words are pronounced in the same way that they are typed. This is in contrast to prior oral eras, in which texts were created with acoustic factors in mind, primarily to appeal to the audience's ears. This phenomenon, along with other parallels and contrasts, will be discussed in this article.

Texts and Orality

For long of human history, language was spoken exclusively. Despite the fact that orality and literacy are sometimes viewed as distinct historical and cultural stages, there has always been osmosis between them in the later stages of human history. Communication scholars frequently ascribe shifts in the roles of orality and literacy to the advent of new communication technologies that challenge cultural, individual-cognitive, and political norms (McLuhan, 1967; Innes, 1998; Ong, 2012). Critics argue that focusing on technology demonstrates technological determinism (Eisenstein, 1991), although the overall perception remains. The idea that technology reflects and shapes new social and cultural trends is commonly regarded as a significant explanatory factor. The following debate exhibits the notion of a pendulum movement, with pre-print orality being revitalized with the advent of new social and technological environments, such as electronic and digital media. In extending this subject, the study examines historical and cultural milestones related to orality and literacy, ranging from pre-writing oral times to the digital oral environment. The starting point here is primitive orality, which refers to communities without written language. In fact, these are the only communities in which there is no osmosis between oral and written communication. Primary oral cultures are distinguished by a relatively gradual progression of aggregative cognition, as well as repetition and narrative creation (Thomas, 2000). As Ong (2012) explains, "In a primary oral culture, the expression 'to look up something' is an empty phrase: it has no conceivable meaning." Without writing, words have no visual presence, even if the objects they represent are visible. These are sounds. You may 'call' them back—"recall" them. However, there is nowhere to 'look' for them. (p. 31).

In this culture, oral communication brings people together as listeners in a specific physical location, fostering public social solidarity (Thomas, 2000). In an oral culture, communication actions are always occurrences or events: sequences of sounds at a specific moment, with a beginning, middle, and end. Residual manuscript orality is another essential step related to text-oral osmosis. Writing as a communication technique has evolved and become commonplace at this point, but oral culture remains dominant and has a great influence on the

use and qualities of written texts. Thus, the medieval pre-print manuscript culture exhibited a clear symbiotic link between oral and literary motivations (Innes, 1998).

According to McLuhan (1967, p. 90), "writing, reading, and oratory remained inseparable until well after printing." Within medieval civilization, manuscripts primarily served to recycle information back into the oral world—the realm of people who heard and learned. Readers in the early Middle Ages viewed the text's literal interpretation as a stepping stone to its deeper spiritual meaning (Olson, 1994, p. 155). The spirit was to be found in the intrinsic meaning of the words, but the letters that made up the words were of little value in themselves (Barbier, 2017, p.41). They were frequently employed to help readers memorize what they previously knew (Thomas, 1992). Manuscripts were read aloud, even in private.

Reading was thus a physical activity that highlighted the organ of speech—the mouth—with the dominating sense being hearing (Barbier, 2017, p.41). The loose and fragmented form of manuscripts, which were primarily meant for individual use, necessitated a high level of reader participation in the story production process. According to Morrison (1990), these works were full with tales and lacked proportion and clarity. The shift of the textual pendulum towards a more visual-textual culture, with the decline of oral culture, may be seen in print culture. Indeed, the routinization of print is associated with the decline of oral culture's primacy. "As Gutenberg typography filled the world," stated McLuhan (1967), "the human voice closed down" (page 250). Within the manuscript culture, the visual faculty was given very minimal importance (p. 99), but later printed text, which needed scanning by individual readers, accentuated the visual aspect. Researchers have explicitly linked the increased quantity of copies of books to improved reading skills and a smoother reading process, since the emphasis switched from reading aloud (a communal and consolidating action) to reading alone (an individual act). During an oral era s poken words were happenings, whereas printed words are frequently viewed as things fixed and captured in visual space (Ong, 1992).

The rise of electronic media represented the swing of the textual pendulum, "back" to an oral atmosphere that in some ways resembles the pre-print oral era (Author, 2005). Accordingly, in a 1974 article titled "The Medieval Environment: Yesterday or Today?," McLuhan explicitly pointed out the similarities between the oral culture of the medieval era and that of the electronic media era. He argues that, in a similar spirit to the highly acoustic nature of the pre-print Middle Ages, the electronic media create an atmosphere that is once again highly acoustic (McLuhan, 1974).

According to McLuhan's argument, the dominant relationship between text and image in contemporary print culture has been lost. Texts are written to be read aloud in the era of electronic media, which came after print. They are built with consideration for rhetorical acoustics. The listener's ears, not their eyes, are the intended audience for radio and, frequently, television scripts. The electronic medium must be articulated and "restored into life," just like the medieval books did. Ong (1992) makes a distinction between secondary orality, which emerges from high literacy cultures and describes the orality of radio and television, and primary orality, which, as was previously mentioned, described communities lacking any knowledge of writing (p. 293). Writing and print are essential to the high technology culture's secondary orality. Words undergo an electronic metamorphosis and

acquire a new form in the age of secondary orality; they are uttered and appeal to a listenership. According to Ong (2012), secondary orality is similar to primary orality in that both involve the construction of utterances as events that take place at a particular moment in time (pp. 133–134). The visual components that were eventually ascribed to the written and primarily printed word are now challenged by electronic media, such as loud speakers and tapes (Ong, 1967, p. 15). Ong (1967) did note certain distinctive features of oral electronic culture, though. This is a post-typographical orality. Individualism, self-consciousness, reflection, and historical awareness are made possible by writing and print (pp. 301–302).

The emergence of digital technologies, which are rooted in the postmodern social climate, stimulates more academic discourse regarding the shifting equilibrium between orality and literacy. The oral nature of the digital domain has been described as a manifestation of Ong's secondary orality by some (Kibby, 2005; Hartley, 2012, p. 206), while others refer to it as a unique digital–oral culture with unique traits of its own (Author, 2010; Papachrissi, 2015). Digital orality, which is a rapidly crystallizing and changing phenomenon, has so far been examined from three primary academic perspectives.

First, academics have observed that digital texts are silent oral. The emergence of computer-mediated communication (CMC) has produced a writing environment that combines elements of written discourse with an oral discursive style. The language used in CMC, such as instant messaging, chats, and texting, is frequently compared to an oral culture: a hybrid register that combines formal written motives with informal vernacular (Tagliamonte and Denis, 2008; Author, 2012). The digital texts' oral features are accomplished through a variety of methods from earlier textual cultures, such as lexical substitution, in which a single letter or digit's phonetic sound can take the place of an entire word; onomatopoeic signs, which mimic the sounds associated with the signified idea; and initial letters of the words that comprise the original phrase. This digital language, which is a component of "Netspeak," has been characterized as a "chatty" writing environment that draws from both speech and writing traits (Kern, 1995; Crystal, 2006). To create "voices" or to mimic other non-verbal cues, a variety of techniques, including phonetic methods, topography, and lexical choices, are employed in this hybrid discursive environment to give the written text a talk-like flavor (Wikström, 2017). The rise of this digital register has been attributed by scholars to a variety of factors, including technical limitations (i.e., the limited reaction time in the synchronic technological environment or the challenge of writing on mobile phones, both of which require "economical" writing style; Walther, 2007; Green, 2007). In the digital realm, it is viewed as a component of creativity and performance that promotes multimodality, adaptability, and typographic fun to create a dialogical environment (Kim, 2002; Walther, 2007; Jovanovic and Van Leeuwen, 2018).

Second, academics have mentioned digital affordances that enable the combination of text and voice. "A very important metaphor of the cyberspace, a metaphor that concentrates many meanings and areas" is how this second line of discussion regarding digital culture refers to voice (Gradinaru, 2016). In this context, "digital voice" is a metaphor for both individual and group participation. According to Papachrissi (2015), the hybrid nature of journalism in the digital age is characterized by orality in the digital journalistic domain. Here, primary-orality-style testimony are combined with "traditional" journalistic discourses

to create a blending of news facts with personal experiences and discussions about news (Papacharissi, 2015, p. 32).

Third, the oral-like aspects of application design were the subject of research. The design of transient instant messaging apps is related to this application of the idea of digital orality. These apps, like Snapchat, for instance, use an oral paradigm in their frequently visually striking messaging. According to the lines of ephemeral culture of communication, people regard the fixed objects of text or photos as temporal—as though they were spoken words that eventually fade away (Author, 2016).

As said, this article discusses voice search inquiries, which are another strengthening form of orality in the digital realm. Although it touches on some of the difficulties surrounding earlier manifestations of digital orality, such as the link between oral and written words, the interface design, and the emphasis on the speech as an event, this interface resembles a new sort of digital orality. It will be demonstrated that the debate of this type of orality is intimately tied to the question of knowledge accessibility, which was highlighted in talks regarding the secondary orality of television and radio. However, the user-sender, who is a far more active agent, has the orality in voice inquiries. Furthermore, utterances based on written texts are frequently neglected in secondary orality to provide the impression of a live, spontaneous conversation. However, spoken words are converted into written form in the digital age. As will be discussed in more detail below, this transition from the oral to the written is bluntly presented to the users, partly for technological reasons.

Secondary Orality and Accessibility to Knowledge

Television's pivotal significance as a medium in the latter half of the 20th century attracted scholarly interest due to its role in altering the communication environment and the way individuals acquire knowledge and information. The oral nature of electronic mass media was one aspect that was examined. Scholars contended that texts aired on television and radio are converted into the spoken realm when compared to print items. In this sense, unlike print products, the electronic mass media gave their viewers new avenues for information access, removing the barrier of literacy from message comprehension. "The Disappearance of Childhood," by Neil Postman (1982) is the most well-known example of how this led some academics to concentrate on children and the social significance of their exposure to mass media material. Years of expertise in intricate and abstract coding and decoding systems are necessary for reading and writing, as Joshua Meyrowitz (1986) points out. Learning and internalizing the arbitrary connections between concepts and sounds is necessary for reading and writing (De Saussure, 1966). Children and those who are not proficient readers have restricted access to knowledge when it is encoded in text. However, because television material is conveyed through images and sounds, it does not require reading abilities to decipher, even though it is mediated by the audience's prior experiences and socialization. Furthermore, the format of print products may restrict the audience for their content; for instance, youngsters will have trouble understanding adult-written books. However, broadcast media make it possible for material to transcend conventional knowledge barriers. For instance, adult programs are accessible to youngsters due to their use of sounds and visual pictures, even though their decoding and interpretation may differ (Meyrowitz, 1986).

Postman's idea of childhood's growth and decline is based on the fact that children are isolated from information in the print world and have access to audio-visual content in the era of broadcast mass communication. According to Postman (1982), the emergence of print technology, which made a distinction between those who could read and those who couldn't, was at least partially responsible for the creation of childhood (p. 28). His school of thought holds that children's incomplete symbolic achievement sets them apart from adults (Postman, 1982, p. 42). Print highlighted this difference. Schools were created to teach kids how to read and write, and going to school came to be associated with being a child. "Achieving command of speech marks the end of infancy. Learning to read was the first task of childhood (Postman, 1982, p. 42).

In order to reflect the various levels of knowledge and abilities gained, school curriculum developed new definitions and phases of child development. Childhood itself developed into a unique multi-level social category with its own language and culture over time (Postman, 1982, p. 43). However, Postman (1982) argues that television plays a part in the loss of childhood by undermining literacy's function as a barrier to the knowledge and information that come with being an adult. The non-segregated nature of the television audience is a result of the (secondary) oral aspects of television, which are crucial in introducing kids to the adult world (Postman, 1982, p. 80). In order to access certain content, voice inquiry technology reduces the need for reading and writing abilities, as we shall demonstrate. However, this independence from literacy is not limited to the retrieval of content. The information that is retrieved is frequently in a secondary oral audio-visual format, meaning that no reading is necessary. Since this content is frequently created by amateurs who are more impromptu and less reliant on any early written stage in the production process, it really has a more oral nature than content seen in the mass media. Auser's exposure to content depended on the sender during the television and radio eras, therefore learning was incidental. However, voice queries—which rely on an active search allow for a far more focused exposure. This is particularly true when it comes to the knowledge that children and other illiterate populations can access. Comparing this new digital oral feature to other earlier oral appearances, however, reveals that it has other distinctive features as well.

Voice Search Feature in Oral History

The Google Mobile App for iPhone, which included the feature of voice queries, was only released in 2008, reflecting the growing popularity of smart phones. As previously stated, the osmosis between orality and literacy is changing and fluid. In order to characterize and shape the trends that voice search queries reflect and shape, it is necessary to examine this feature in the context of various stages of earlier oral manifestations. "Speech technology has taken on new importance in accommodating user needs for ubiquitous mobile access—any time, any place, any usage scenario, as part of any type of activity" (Schalkwyk et al., 2010, p. 1), considering the nature of delivery devices (e.g., fit in your pocket or in your ear) and the expanded range of usage scenarios (while driving, biking, and walking down the street).

According to Bennett et al. (2003), Cho et al. (2012), Schalkwyk et al. (2010), the service recognizes voice signals and, using computerized processing, converts them into recognized phonemes; a sequence of phonemes is recognized using natural language configuration into recognized words, and a sequence of words into phrases out of a given language dictionary;

the recognized words or phrases pass text normalization, which uses the data of previous searches to structure the detectable textual query, among other factors in its calculations. Early research on voice searches on the Google phone app revealed that users mostly used them to find nearby businesses and used them less for sensitive searches, such those looking for sexual content. Although voice queries are far shorter than written ones (Schalkwyk et al., 2010), there are still considerable challenges with the technology.

According to Schalkwyk et al. (2010), "Mobile voice search is a challenging problem for many reasons—for example, noise conditions may vary greatly due to the wide-ranging usage scenarios while mobile, input is unpredictable, and vocabulary sizes are enormous" (p.2).

From Passive to Active Exposure to Knowledge

Since television is a medium that does not hide knowledge, Postman's idea of childhood disappearing is related to this. In contrast to books, television does not divide viewers. The largest audience is targeted by traditional television, which does not require sophisticated reading abilities (Meyrowitz, 1986). At the same time, viewers of traditional television are reliant on a set stream of programming. The potential for "revealing secrets" is taken to a far more intense and active level by voice questions. In the past, individuals needed to be literate in order to obtain individually focused knowledge; however, voice searches make all web content directly available, typically with little to no oversight or control. Of fact, no other media in history can match the ease of access to pornography on the internet. The ability to post voice requests comes at a time when youngsters are increasingly using the internet for the first time. By eliminating the requirement for a computer mouse, which can be difficult for young children to use, touch displays allow toddlers and early children to use smartphones and tablets on their own (Holloway et al., 2015).

Writing in general and keyboard operation in particular present significant challenges that are addressed by the incorporation of voice questions. The lines that Postman (1982) draws between infancy and childhood are blurred by this. Toddlers can now access internet information on their own thanks to the combination of voice commands and touch screens.

Postman (1982) frequently discusses in his book how it is difficult to distinguish between children's and adults' appearances and attire on television. Commercials frequently demonstrate the decline of the conventional forms of childhood looks (Postman, 1982, p. 124). It goes without saying that watching this can socialize viewers toward a particular ideal of beauty that young children may aspire to. However, affordances in the voice query era are not the same as this socialization. For instance, young girls have easy access to beauty tutorial vlogs, which are frequently produced by other girls, possibly older ones. Without the need for writing, this navigation transforms the concept of beauty found in advertisements into tangible reality. Although television advertisements do not specifically target young girls with cosmetics, the combination of voice queries that allow even toddlers to navigate, the variety of tutorial vlogs in this (and many other) domains, and the exploitation of child labor online—where children, like adults, frequently exchange their self-representations for free products that they "test" on their vlogs (Pedersen and Aspevig, 2018)—creates new circumstances of childhood disappearance.

Communal vs. Individual Orality

Both primary and secondary orality place the listeners of the spoken words in a group; this feeling of group is far broader in the secondary orality era (Ong, 2012, p. 134). Conversely, silent reading of contemporary print is a lonely activity (Ong, 1982). The unifying power of traditional communication was revived by mass communication, which served as a sort of stand-in for the old tribal fire. An unparalleled sense of immediacy and simultaneity is created by these electronic mass communications, which provide a shared experience for the listeners (Thomas, 2000). Television is popular in public places because it is a device that allows for shared watching and has a discernible ambient impact over a comparatively large sphere (McCarthy, (2001). However, silent digital literacy, such as CMC, goes beyond the individualistic aspects of contemporary silent reading because it can be practiced in complete social isolation.

Posting an oral question demonstrates the increasing "intimacy" between the user and the digital gadget, reducing the distance so that the software can recognize the user's voice and clearly hear it. More significantly, the oral character of voice questions on digital devices is not designed to support para-social contact, as is frequently observed on television, or even human-to-human conversation (Horton and Wohl, 1956). The intimacy between the user and the digital device, as well as the new private activities that can be done on it, lessens the atmosphere of the user's oral act. Compared to earlier uses of orality for communication, this kind of orality really more directly reflects the close link between text and user in the contemporary individualistic print era.

Restoring Fragmented Text to Life

Voice inquiries' oral words are somewhat similar to how text was interpreted in the oral atmosphere of the Middle Ages' residual manuscript culture, where the written text was heavily influenced by the dominant oral culture. Voice inquiries are employed as a method of retrieving content, much how written words helped restore knowledge throughout the Middle Ages. Words are merely a conduit to other, far more significant domains in both situations. They served as a springboard to the spiritual and divine realms in medieval religious culture. They serve as a portal to an infinite amount of content in a variety of formats that can be retrieved over the internet in today's digital culture. Words are not meant to tell a story in either situation. Actually, storytelling can reduce the search's efficacy when it comes to voice queries. Long inquiries are more likely to produce speech recognition problems, as Jiang et al. (2013) discovered; this finding may lead to shorter questions than those in written desktop form. Oral words are merely tools in both situations; they have no inherent worth.

Discussion

Hartley (2012, p. 206) contends that Ong is a media change theorist. The intricate relationships between orality and literacy are used as a lens through which to examine these media transformations. This study has demonstrated that this method, which Hartley refers to as "Ongism," is pertinent when discussing recent advancements in digital technology. The modern digital oralities and Ong's secondary orality are both products of very literal cultures. The vocal features of the CMC language, for instance, distinctly reflect the dominance of print.

THE FUTURE OF MULTIDISCIPLINARY RESEARCH IN GLOBAL DEVELOPMENT

The paradigm of silent reading from the current print age is bestowed upon oral aspects by the hybrid written–oral register, which is communicated through writing. This hegemonic function of print is also evident in voice questions, where spoken words are not only converted into print but also pronounced with consideration for their shift to the written realm format. This is done to make sure the words that are stated create a recognized and useful question. As was previously said, oral factors influenced written texts during the secondary orality era, whereas written textual factors influenced the pronunciation and selection of spoken words during voice querying. Furthermore, although the human voice makes it easier to post the question, after this is completed, de-vocalization takes place and the spoken query is written down. The voice becomes unnecessary at this point, making room for the printed material. This study demonstrates that voice querying reveals several new oral traits when comparing the nature of orality in voice queries to prior eras that were marked by high levels of orality. This type of orality exhibits a highly idiosyncratic structure. Additionally, in this instance, the spoken text is converted into a written one, whereas in earlier instances of the osmosis between orality and literacy, written words were converted to the oral arena. Following the author's previous work

(Author, 2010), Table 1 provides an updated summary of a comparison of earlier periods of high osmosis between orality and literacy with the case of voice inquiry, with new and pertinent parameters.

	<i>Residual manuscript orality</i>	<i>Secondary orality</i>	<i>Digital orality of CMC</i>	<i>Voice search</i>
Text/Oral Relationship	Texts are Transformed to the acoustic sphere	Texts are Transformed to the acoustic sphere	Texts reading silence. Orality expressed through textual techniques	Spoken words in the acoustic sphere that turn into text
The Agent	The reader	The institutional sender of mass communication	The sender in Inter personal or intergroup CMC	The user
Text Structure	Fragmented	Completed narrative	Accumulation of short texts	Fragmented
Communal vs. Individualism	Communal	Communal	Individual: isolated relationships	Individual: human-machine interaction
The Role of the Text	Aid for memory, gateway to spiritual meaning	Appeal to the ears of the audience	“Chatty” text, substitute for oral communication	Oral words are transformed into text and become a gateway to

				content and information retrieval
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Table1: The Osmosis of Text and Oral Component in a Comparative Perspective

The evolution of voice questions can be explained by digital affordances as well as the requirement for an easy and intuitive experience to assist users in dealing with the shifting circumstances of communication in modern times. Mobile phone use on the go necessitates the "revival" of smart voice commands, which eliminates the need to type on a keyboard while driving or walking.

This discussion of voice questions emphasizes broad issues with access to knowledge, particularly the consequences for children's usage of digital media. This issue builds on the discussion in the secondary oral era about childhood vanishing as a result of children's access to adult content—access that comes at the expense of the requirement for advanced decoding capabilities to reach that information.

As previously stated, the prevalence of touchscreen devices influences young children's use of the internet. The ability to browse the internet via voice continues this trend, allowing for independent content retrieval without the need for user literacy—possibly for the first time in literate civilizations. More empirical research is needed to investigate the discourse of voice inquiries and how it has changed over time, possibly as a result of user discipline, who have adapted effective search patterns that accommodate for the shift from oral to written form. More research is needed to better understand the changes in internet surfing tendencies among toddlers and young children, with an emphasis on independence and the content they are exposed to.

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**Hydrogeological Study of the Over-Exploited Urad Area, Deccan Basaltic Terrain,
Central India: Implications of Artificial Recharge Structures**

M.S.Deshmukh

Department of Geology

R.T.M. Nagpur University, Nagpur (M.S.)-440001, India

ABSTRACT

Artificial recharge of groundwater is important, especially in the hard rock terrain. Present paper deals with the artificial recharge of groundwater in the over-exploited part of the Deccan Basaltic terrain, Central India. The study area is entirely covered by the basalt lava flows with different flow units like massive and vesicular layers. To analyse the hydrogeological status of Urad area, irrigation dugwells are examined carefully regarding pre-monsoon and post-monsoon static groundwater levels, depth of the wells, depth of weathering below ground level, yield of the wells in liters/day, type of aquifer etc. Hydrogeological investigation of the dug wells in Urad area, which are tapping unconfined aquifer reveals that maximum depth of the well from well samples is 23.02 meters below ground level with moderate yield of 47,250 liters/day. Lowest depth of weathering is observed in the well UDW-2 which is a reflection of hard massive trap at shallow level with low yield of 22,500 liters/day. Lowest yield (18000 liters/day) is indicated by the dug well UDW-3 tapping vesicular basalt and local alluvium is surprising, which is contrast to the general assumption that vesicular basalt and alluvium has high yield. This anomaly is probably due to clay in the alluvial aquifer. After implementation of drainage line treatment, static groundwater levels are increased considerably with increase in yield of the dug wells.

Key Words: Groundwater, Aquifer, Deccan Traps, Artificial Recharge.

INTRODUCTION

The availability of ground water is now critical in many parts of the world. It has become more and more difficult to supply human needs, with sufficient quantities and of safe quality. In India, ground water resources are being utilized for drinking, irrigation and industrial purposes since long time. But due to rapid growth of population, urbanization, industrialization and agriculture activities, ground water resources are under stress, which is resulting in adverse environmental impacts and threatening its long term sustainability. Also there is growing concern on the deterioration of ground water quality due to geogenic and anthropogenic activities (CGWB, 2022). In India, most of the agricultural production is depending on groundwater due to sporadic network of dams and surface canal system. Agriculture consumes 70% of fresh water worldwide (Pimentel, et al., 2004) .

The study area is a part of hard rock Deccan basaltic terrain of central India and covered under the intensive crop like orange orchid, since last few decades. Due to excessive groundwater withdrawal for irrigating cash crops, this area is declared as over exploited (GSDA and CGWB, 2014). Thus an integration of different geological and geographical aspects for management of water resources are important to tackle the water scarcity, issue, especially in the over-exploited belt of central India. Aim of the present study was to evaluate the benefit of artificial recharge structures and their effect on the groundwater levels and yield of the wells.

STUDY AREA

The Urad area (WR-2 watershed) is a part of Warud tehsil of Amravati district, Maharashtra and is located due North-East of Amravati district headquarter at about 104 km distance. The area is covered under the Survey of India, toposheets 55 K/6 and 55k/7 of 1: 50,000 scale and bounded by the coordinates 78^o22'55" N - 21^o30' 04" E (Figure 1). This area is a part of over-exploited belt of Central India, where stage of groundwater development exceeds > 100% (GSDA and CGWB, 2014).

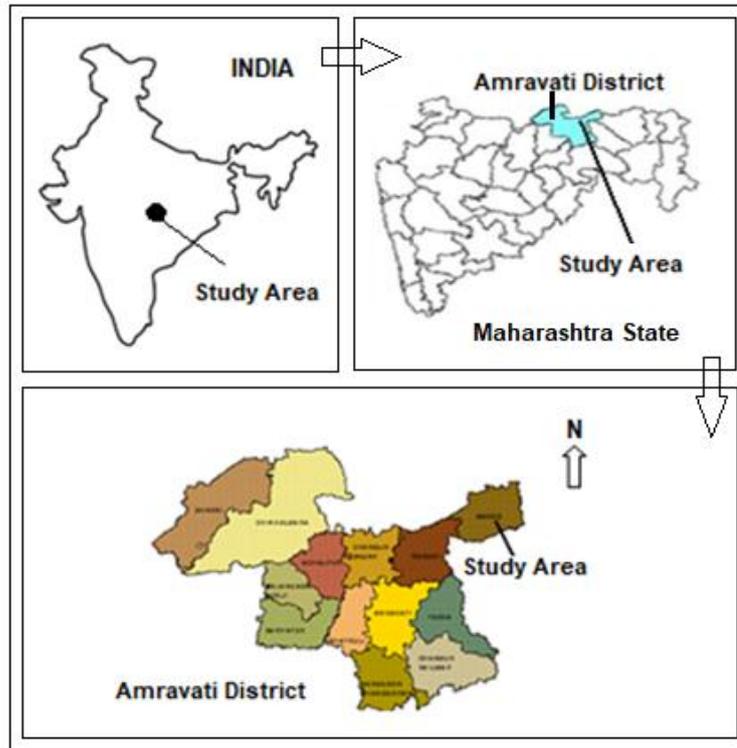


Figure 1: Location map of the study area.

METHODOLOGY

During present study, well inventory of the existing open dud wells were carried out to delineate unconfined basaltic aquifer, on the basis of comprehensive hydrogeological survey with collection of information about the aquifer, depth of the wells, static groundwater levels, seasonal groundwater level fluctuation, yield of the open dug wells etc. Different instruments were used during geological field survey like GPS (Global Positioning System), measuring tape, geological hammer etc. Existing hydrogeological data and maps was collected from different State and Central Government organizations related to the rainfall, temperature, existing water conservation structures, groundwater levels etc. On the basis of hydrogeological field survey various thematic maps were prepared to understand groundwater scenario of the region.

GEOLOGY

Study area is covered by the basaltic lava flows which belongs to the Deccan Trap formation. The basaltic lava flows are of simple type with upper vesicular zone and lower massive trap (GSI, DRM, 2001). During field traverses, lava flow units are mapped and altitudes of flow contacts are generated. The study of well sections reveals that lower part of basaltic lava flow is fine grained, grayish black in colour, compact and vertically jointed,

while the upper part is vesicular and amygdaloidal in nature. Individual flow is separated by course to medium grained red coloured redbole horizon. When redbole is exposed to surface it becomes friable. The various flows are mapped in the field and lithological section has been prepared. There are three lava flows exposed in this area (Deshmukh and Khadri, 2012).

Table 1: Geological succession of the Urad area, Amravati district (M.S.), India.

Unit	Formations	Age	Thickness of the Rock Unit (meter, amsl)	Altitude (meter, amsl)	Characteristics of the Rock Unit
AL	Alluvium	Quaternary/Recent	2.00 to 8.00	--	Consist of silt, sand, cobbles, pebbles
F3	Massive Basalt	Upper Cretaceous To Lower Eocene	26	440 to 480	Greyish coloured, fine grained, poorly jointed massive
F2	Vesicular Basalt		14	440 to 454	Grey coloured, fine grained, highly weathered vesicular basalt.
	Massive Basalt		14.00	426 to 440	Grey coloured, fine grained, poorly jointed and moderately weathered massive
F1	Vesicular Basalt		9.00	417.00 to 426.00	Grey coloured, highly weathered, vesicular basalt filled with
	Massive Basalt		--	412 and below--	Grey coloured, fine grained, poorly jointed, compact massive basalt.

HYDROGEOLOGY

The Urad area is entirely covered by the Deccan basaltic lava flows of varying thickness. These flows are composed of two units namely massive unit and vesicular flow unit. The massive flow unit is basically hard and compact having no primary porosity and permeability. This flow unit acts as a an impermeable formation. However joints and fractures developed in massive basalt formations, convert it into a moderate groundwater storage zone. Rise and fall in the water level represent change in the groundwater storage, within the aquifer. The hydrostatic pressure manifested by water table here coincides with the top of the saturation zone (GSDA and CGWB, 2014).

Groundwater occurs under phreatic condition in the exposed lava flows and in semi-confined to confined state in the sub-surface flows. Ground water is present in

interconnected pore spaces of vesicular unit and in the jointed and fractured portions of massive unit of each flow. However, secondary porosity and permeability that developed due to weathering, fracturing and jointing play a very important role in storage and movement of groundwater in the hard rock terrain (Dhokarika, 1991).

During the field investigations six dug wells are examined for collecting hydrogeological information hydrogeology of the aquifers, depth of the wells, water level, annual fluctuation of water levels, well yields, cropping pattern and other relevant hydrogeological parameters. Static water level is best determined when the well has not been pumped for several hours prior to measuring (CGWB, 2019). The groundwater level of an unconfined aquifer indicates the elevation of atmospheric pressure of the aquifer and any phenomenon that produces a change in pressure on groundwater will cause the groundwater level to vary (Todd and Mays, 2005). Specific capacity is an index of well productivity and also serves as a parameter of yielding and transmissive capacity of the aquifer (Karanth, 1987). The yield factor of the Deccan basalt ranges between 0.03 to 1.00 LPM/m/m with average of 0.18 LPM/m/m (Karanth, 1987).

In the Urad area, groundwater occurs especially in the weathered zone of vesicular and massive basalt and in highly to moderately jointed and fractured massive basalt. Due to high density of the wells and the higher water requirement for the cash crops like orange orchid, imbalance in the groundwater recharge and withdrawal conditions is observed (Deshmukh and khadri, 2012). Hydrogeological investigation of the dug wells in Urad area, which are tapping unconfined aquifer reveals that maximum depth of the well from well samples is 23.02 meters below ground level (Well UDW-4, Table 2; Fig. 2) with moderate yield of 47,250 liters/day. Lowest depth of weathering is observed in the well UDW-2 (Table 2; Fig. 2) which is a reflection of hard massive trap at shallow level with low yield of the well (22,500 liters/day). Lowest yield (18000 liters/day) is indicated by the dug well UDW-3 tapping vesicular basalt and local alluvium is surprising (Table 1; Table 2; Fig. 2), which is contrast to the general assumption that vesicular basalt and alluvium has high yield. This anomaly is probably due to clay in the alluvial aquifer.

Deeper Aquifer

The deeper aquifer in the Urad village is well developed. The data of the irrigation bore wells drilled in the agricultural lands indicate existence of deeper aquifer up to a depth of 170 meter. Out of the four bore wells drilled for irrigation purpose, all are found to be successful. The aquifer exists beyond the depth of 60 meter bgl. Initially, bore wells in Urad area were drilled up to the depth of 80-90 meters with adequate yield, but during few decades there is/was a race of constructing deeper bore wells which adversely effected yields of the bore wells, which is now drastically reduced.

Artificial Recharge

In a hard rock terrain, artificial recharge of groundwater with people's participation is now a well adopted technique. In Urad are drainage treatment (deepening and widening) (CGWB, 1994a) was carried out in a drainage, near PWSS well. The results are quite promising because the static groundwater levels in pre-monsoon and post-monsoon season increase considerably (Table 2; Figure 3; Plate 1). Also considerable increase in the yeild of irrigation dug wells, resulted in upliftment of socio-economic status of farmers.

Table 2: Hydrogeological data collected through well inventory of irrigation dug wells in Urad area, Amravati district, Maharashtra.

Well ID	Village	Tehsil/Block	Coordinates		Elevation in meters (amsl)	Owner's Name	Type of well	Height of Parapet above ground level (meter)	Dimension of well top (meter)	Depth of the well (meter)
			Latitude	Longitude						
1	2	3	4		5	6	7	8	9	10
UDW 1	Urad	Warud	N21 ⁰ 29'11''	E78 ⁰ 22'26''	404	Dilip Wadiva	Dug well	1.20	4.70	18
UDW 2	Urad	Warud	N21 ⁰ 29'24''	E78 ⁰ 22'33''	405	Raju Kalmegh	Dug well	0.60	2.8	10.80
UDW 3	Urad	Warud	N21 ⁰ 29'26''	E78 ⁰ 22'36''	408	Rupesh Boyr	Dug well	0.5	3.1	21.1
UDW 4	Urad	Warud	N21 ⁰ 29'31''	E78 ⁰ 22'39''	411	Mangesh Patil	Dug well	0.4	3	23.02
UDW 5	Urad	Warud	N21 ⁰ 29'35''	E78 ⁰ 22'41''	413	Ganshyam Choree	Dug well	1.30	2.9	14
UDW 6	Urad	Warud	N21 ⁰ 29'38''	E78 ⁰ 22'45''	417	Namdeo Shende	Dug well	1.60	2.5	20

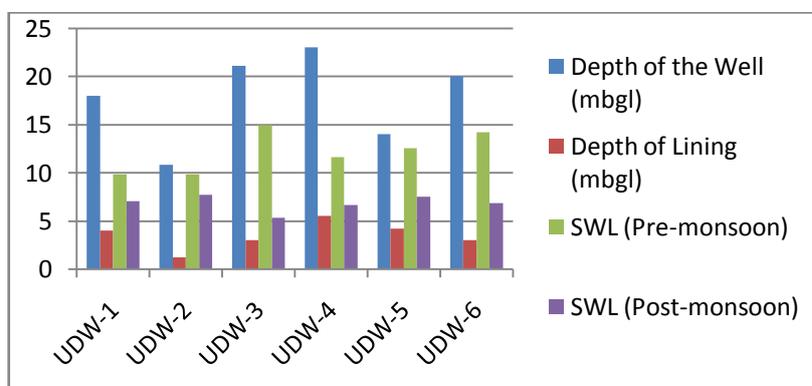


Figure 2: Hydrogeological parameters of the dug wells in Urad area, Amravati district (M.S.), India.

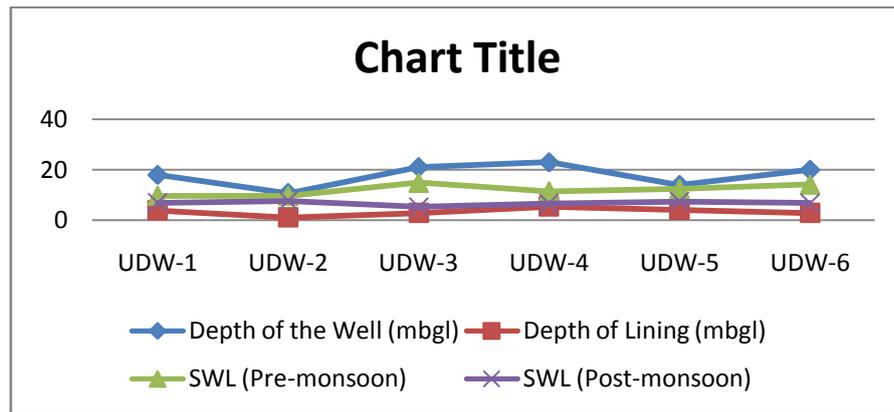


Figure 3: Static groundwater levels in the dug wells in Urad area, Amravati district (M.S.), India during pre-monsoon and post-monsoon season.

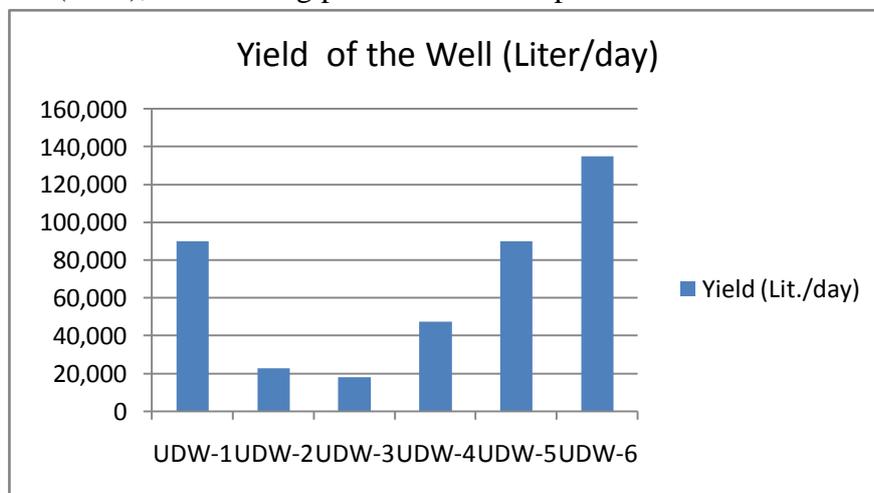


Figure 3: Yield of the dug wells in Urad area, Amravati district (M.S.), India.



Plate 1: (A) Red bole exposed in between massive and vesicular basalt; (B) Amygdaloidal basalt, excavated from the dug well; (C) Collection of hydrogeological information from the farmers of Urad village, Amravati district, Maharashtra; (D) Silted cement nalah bund, across the drainage in Urad village, Amravati district(M.S.), India.

CONCLUSION

The Urad area of central India is over-exploited and entirely covered by the basaltic lava flows. Basaltic hard rock terrain is not uniform because of erratic behaviour of the basaltic lava flow. The aquifer system is not uniform because of erratic behaviour of the basaltic lava flow. The aquifer composed of vesicular and weathered massive basalt and jointed and fractured massive basalt. Thickness of the aquifer is variable from place to place. To analyse the hydrogeological status of Urad area, irrigation dugwells are examined carefully regarding pre-monsoon and post-monsoon static groundwater levels, depth of the wells, depth of weathering below ground level, yield of the wells in liters/day, type of aquifer etc. Hydrogeological investigation of the dug wells in Urad area, which are tapping unconfined aquifer reveals that maximum depth of the well from well samples is 23.02 meters below ground level with moderate yield of 47,250 liters/day. Lowest depth of weathering is observed in the well UDW-2 which indicates exposure of hard massive trap at shallow level with low yield of 22,500 liters/day. Lowest yield (18000 liters/day) is indicated by the dug well UDW-3 tapping vesicular basalt and local alluvium is surprising, which is contrast to the general assumption that vesicular basalt and alluvium has high yield. This anomaly is probably due to clay in the alluvial aquifer.

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Moral Responsibility in Rural Healthcare: A Philosophical Exploration

Sanjita Mushahary

Research Scholar, Dept. of Philosophy
North Eastern Hill University (NEHU)

Abstract

Healthcare in rural areas, particularly in the Bodoland Territorial Region (BTR) of Assam, raises unique ethical issues due to scarce resources, geographical isolation, and cultural diversity. This research addresses healthcare workers' moral challenges and obligations, including ASHAs, ANMs, and CHOs, who must make difficult and complex ethical decisions in resource-limited settings. This paper examines the moral responsibilities of healthcare workers as they navigate complex ethical decisions in resource-constrained environments. The analysis uses three theoretical frameworks: virtue ethics, contractualism, and care ethics, all based on Beauchamp and Childress' seminal work in biomedical ethics. The study highlights how healthcare workers balance competing demands while upholding ethical norms in difficult situations. Cultural integration emerges as a critical factor, with workers negotiating between traditional healing practices and modern medical approaches. The research highlights specific challenges in the BTR context, including infrastructure limitations, while proposing practical solutions for supporting healthcare workers in fulfilling their moral obligations. The findings suggest that successful rural healthcare delivery requires a nuanced understanding of ethical principles combined with practical support systems that acknowledge local contexts and constraints.

Keywords: Rural Healthcare Ethics, Moral Responsibility, Healthcare Workers, Bodoland Territorial Region, Virtue Ethics, Contractualism, Care Ethics, Cultural Sensitivity, Resource Allocation

Introduction

Healthcare in rural areas, particularly in the Bodoland Territorial Region (BTR) of Assam, provides an important opportunity for philosophical inquiry because of its complicated ethical considerations. Healthcare workers are at the critical interface that connects modern medical practices with the community's traditional health needs. ASHA workers, ANMs, and CHOs, among other practitioners, are constantly confronted with many moral dilemmas while working within resource constraints and minimal institutional support.

BTR health workers have a diverse set of moral duties that go beyond standard medical tasks, as they are often cultural mediators, community advocates and social supporters. The balancing act between professional medical standards and respect for prevailing local cultural practices, as well as between their limited resources and equitable care for all, can be a challenging one for this group. The geographic isolation and socio-economic disparities in the region make it difficult to provide healthcare that takes into account cultural differences and addresses practical constraints. Given this unique ethical landscape characterized by professional obligations, cultural awareness and resource challenges, there is a need for a nuanced ethical framework to help rural healthcare professionals make responsible and community-oriented decisions.

Theoretical Frameworks and Practice

Three key ethical frameworks—virtue ethics, contractualism, and care ethics—can be applied to the moral landscape of rural healthcare to assist healthcare workers in making decisions every day. According to Beauchamp and Childress, healthcare ethics emphasizes that virtue ethics, or developing moral character, is essential because formal guidelines alone are often not enough to help healthcare workers navigate complex situations (Beauchamp and Childress, *Principles of Biomedical Ethics*). In rural contexts, virtues like compassion, integrity, generosity, temperance, magnanimity and practical wisdom become essential for navigating uncertainty, especially with limited resources. These virtues must be cultivated by healthcare workers, who operate under conditions that often test their moral resilience.

Challenges in Rural Healthcare Ethics

In rural healthcare, semi-literate populations and resource scarcity lead to complex moral dilemmas for health workers. Decisions about allocating limited medical supplies, equipment, and staff are particularly challenging. According to Gillon, moral dilemmas often arise from conflicting ethical principles, such as balancing the immediate need for beneficence with long-term sustainability of resources (Gillon, “Medical Ethics”). Healthcare workers must also navigate cultural considerations—the World Health Organization emphasizes the importance of integrating traditional healing practices with modern medicine while respecting local beliefs (*Integrating Traditional Medicine into Health Systems*).

The Bodoland Territorial Region (BTR) exemplifies these challenges. The region’s cultural diversity—including Bodos, Adivasis, Bengali Muslims, and others—presents unique healthcare dynamics. Healthcare workers must respect traditional practices while ensuring medical efficacy. For instance, practices like herbal medicine or ritual-based healing may conflict with modern medical advice. Workers must find ways to bridge these gaps without alienating the community.

Infrastructure issues further compound the challenges. Emergency care in BTR is often constrained by limited transport options, particularly during the rainy season. According to Saikia and Gogoi, rural health infrastructure in Northeast India faces chronic resource constraints, requiring healthcare workers to prioritize and allocate scarce resources judiciously (Saikia and Gogoi, “Healthcare Infrastructure in Assam”). These decisions are particularly difficult in emergencies, where logistical limitations, unreliable communication, and inadequate facilities can delay or compromise care.

Practical Implications and Future Directions

The issues of rural healthcare ethics call for a holistic view with an understanding of theoretical issues as well as actual realities. According to Beauchamp and Childress, health systems must provide comprehensive support mechanisms to aid health workers engage in rendering such complex moral counselling while safeguarding their well-being (426). This includes regular training in ethical decision-making, the development of support networks for healthcare professionals and the development of clear rules for dealing with typical moral dilemmas. Incorporating traditional healing practices into modern healthcare systems is another essential step. The World Health Organization suggests this integration should be guided by both medical efficacy and cultural respect (*Integrating Traditional Medicine*). For

example, ASHA workers could act as mediators between traditional healers and formal healthcare providers, fostering trust and improving outcomes.

Policy development should also focus on improving rural healthcare infrastructure. Investment in transport systems, communication networks, and supply chains is critical to supporting healthcare workers in fulfilling their moral obligations. Increased community engagement, particularly through participatory models, can also help align healthcare delivery with local needs and values.

Conclusion

In regions such as BTR, rural healthcare providers must reconcile practical constraints, ethical standards and cultural sensitivity. This delicate balancing act requires healthcare workers to manage competing demands, often with constantly limited resources. They must adhere to ethical principles while attending to immediate health needs and ensuring the long-term trust of the community. By using ethical frameworks such as virtue ethics, contractualism, and care ethics in combination with practical solutions, healthcare workers can effectively manage these challenges while promoting resilience within their communities.

Policymakers have the primary responsibility to address these challenges by providing resources to support infrastructure, improve professional training, and boost community mobilization. Issues that range from transport, means of communication, and supply channels must be improved so that the healthcare givers can discharge their moral responsibility. This involves not only overcoming practical challenges like physical and logistical barriers but also promoting ethical awareness and cultural sensitivity among healthcare workers. Moreover, it is recommended that cultural sensitivity aspects should be incorporated into the routine of training programs and make ethical decision-making more solid based on healthcare delivery in diverse settings. Community engagement in healthcare planning is essential. When communities are empowered to actively participate in decision-making, more inclusive and culturally relevant solutions emerge. Community involvement builds trust and ensures that healthcare initiatives are in line with the cultural and practical realities of rural areas. Communities can achieve harmonious integration by fostering communication between traditional and modern healthcare systems, leading to better health outcomes. Ultimately, a holistic approach is essential for tackling the unique challenges of rural healthcare. This approach should be grounded in ethical principles, cultural understanding, and a thorough awareness of local realities. It holds the potential to transform rural healthcare systems, enabling healthcare workers to meet their moral responsibilities while delivering equitable, high-quality care to underserved populations. With the right combination of ethical guidance, policy support, and community involvement, sustainable improvements in rural healthcare can be realized, ensuring better health outcomes for all.

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Enhancing Crops for Better Nutrition - Can Biofortification Prevent Malnutrition?**VANSHIKA MAHAJAN**

Masters in Clinical Nutrition, Jaipur National University

DR. SHILPI SHARMA

Associate Professor, Jaipur National University

INTRODUCTION - CAN BIOFORTIFICATION ERADICATE HIDDEN HUNGER?

Micronutrient deficiencies, commonly referred to as "hidden hunger," impact over two billion people worldwide, leading to serious health concerns such as weakened immunity, cognitive impairment, and increased mortality (Smith et al., 2022). These deficiencies are particularly prevalent in developing nations, where diets largely rely on staple foods like rice, wheat, and maize, which lack essential micronutrients (Johnson & Patel, 2021). Hidden hunger remains a silent epidemic, disproportionately affecting vulnerable populations, including children and pregnant women, leading to severe long-term health and developmental consequences (Stevens et al., 2022). Biofortification is a sustainable and innovative approach aimed at enhancing the nutritional value of food crops through selective breeding, genetic modification, or agronomic practices (Gupta et al., 2023). By enriching crops with key nutrients like iron, zinc, and vitamin A, biofortification provides a long-term solution to malnutrition without requiring major dietary changes (Fernandez & Kumar, 2020). For instance, researchers at the University successfully developed biofortified lettuce with a 30-fold increase in beta-carotene, significantly improving its vitamin A content (Garcia et al., 2023). This advancement could play a crucial role in addressing vitamin A deficiency, a major issue in many parts of the world. The concept of biofortification was first introduced by Dr. Howarth Bouis, the founder of HarvestPlus, a global initiative focused on developing nutrient-rich staple crops (Bouis et al., 2019). His contributions have been instrumental in reducing micronutrient malnutrition across various countries. Iron-deficiency anemia, one of the most common consequences of hidden hunger, affects over 1.6 billion people worldwide. Biofortified crops like iron-rich beans and pearl millet have shown promising results in improving hemoglobin levels in at-risk populations (Finkelstein et al., 2015). In the conclusion, this biofortification presents a cost-effective strategy to combat hidden hunger by enhancing the nutrition of commonly consumed crops. By integrating biofortified foods into daily diets, global levels can be significantly improved thus leading to better health outcomes and food security (Mehta & Roy, 2024).

NUTRITIONAL IMPACT OF BIOFORTIFIED CROPS

Biofortification has become a powerful tool in the fight against malnutrition, especially in countries where people rely on staple foods that lack key vitamins and minerals. Instead of requiring external supplements or fortification, biofortified crops naturally contain higher levels of essential nutrients, making them a more sustainable and accessible way to improve health (Bouis & Saltzman, 2017). In many rural areas, people rely on rice as a staple, but traditional rice varieties lack vitamin A. Golden Rice offers a simple way to enhance nutrition without requiring dietary changes (Tang et al., 2012). Studies have shown that just one bowl of Golden Rice can meet a child's daily vitamin A needs, reducing the risk of childhood blindness and infections (Stevens et al., 2022). This is a serious issue in many developing

countries, leading to weakened immunity, night blindness, and even child mortality. Scientists developed Golden Rice, a variety enriched with beta-carotene, which the body converts into vitamin A. Research shows that eating Golden Rice regularly could provide up to half of a person's daily vitamin A needs, making it a practical solution to this widespread deficiency (Tang et al., 2012). Deficiencies in iron and zinc can cause anemia, weakened immune systems, and developmental delays in children. Pregnant women are particularly vulnerable to iron deficiency. Regular consumption of iron-biofortified crops has been linked to lower rates of maternal anemia and healthier birth outcomes (Mehta et al., 2022). Iron-rich beans and pearl millet have been biofortified to help prevent these issues. For example, a study in India found that children who consumed iron-biofortified pearl millet showed significant improvements in their hemoglobin levels, reducing the risk of anemia (Finkelstein et al., 2015). Similarly, in Mozambique, children who ate biofortified sweet potatoes had a 24% lower risk of vitamin A deficiency (Low et al., 2007). By improving the nutrient density of commonly consumed foods, biofortification reduces dependence on expensive supplements and fortified processed foods, making it a cost-effective strategy for governments and NGOs (Low et al., 2007). Unlike commercial food fortification, which requires ongoing external efforts, biofortification ensures that nutrition is naturally embedded within crops, making it a more sustainable solution (Bouis & Saltzman, 2017). Countries such as India, Bangladesh have already integrated biofortified crops into national food policies, proving their effectiveness on a large scale (Stevens et al., 2022).

ROADBLOCKS TO ADOPTION OF BIOFORTIFIED CROPS

While biofortification holds great promise in addressing malnutrition, its widespread adoption faces several challenges. These range from low awareness among farmers and consumers to regulatory hurdles and concerns over genetically modified (GM) crops. For biofortified crops to make a real impact, these barriers must be addressed through education, policy support, and public acceptance (Bouis & Saltzman, 2017). One of the biggest obstacles is limited awareness among both farmers and consumers. Many small-scale farmers are unaware of the benefits and availability of biofortified seeds, which prevents them from adopting these nutrient-rich crops (Mehta et al., 2022). Additionally, farmers often hesitate to switch to biofortified varieties due to uncertainty about yield potential, market demand, and economic benefits (Low et al., 2007). Without proper outreach and training programs, adoption rates remain low, limiting the potential impact of biofortification. Even when biofortified crops are available, consumer skepticism can be a major hurdle. Many people associate changes in color, taste, or texture with lower quality or unnatural modification (Tang et al., 2012). For example, while Golden Rice has been developed to combat vitamin A deficiency, some consumers hesitate to adopt it due to its distinct yellow color, which differs from traditional white rice (Stevens et al., 2022). Additionally, biofortified foods often lack strong branding and market promotion, making it difficult for consumers to recognize and trust these products (Nestel et al., 2006). In many countries, strict regulations on genetically modified crops have slowed the approval and commercialization of biofortified GM crops (Finkelstein et al., 2015). Governments must carefully evaluate the safety and effectiveness of these crops before approving their widespread use, which can take years. Moreover, policy support for biofortification is often lacking, leading to low investment in research, seed

distribution, and farmer incentives (Bouis & Saltzman, 2017). Without strong policies promoting biofortified crops, their adoption remains limited. Additionally, biofortified foods are often not widely available in local markets, making it difficult for consumers to purchase them consistently. Strengthening seed distribution networks and market access is crucial to ensuring biofortified crops reach those who need them the most (Low et al., 2007). For biofortification to reach its full potential, governments, researchers, and organizations must work together to address these adoption challenges. Educational campaigns, farmer support programs, and policy incentives can help increase awareness and acceptance. Additionally, investing in better market strategies and improving affordability can make biofortified foods a more attractive choice for consumers (Stevens et al., 2022). In conclusion, while biofortified crops offer a powerful solution to malnutrition, their impact depends on overcoming adoption barriers. Addressing awareness gaps, consumer concerns, regulatory challenges, and accessibility issues will be key to ensuring these crops become an integral part of global nutrition efforts (Bouis & Saltzman, 2017).

BIOFORTIFICATION AND FUTURE OF FOOD SECURITY

Food security is more than just food availability—it is about ensuring access to nutrient-rich foods that support overall health. Despite global improvements in food production, micronutrient deficiencies remain widespread, particularly in developing nations (Bouis & Saltzman, 2017). Traditional fortification methods help, but they require continuous resources. Biofortification offers a sustainable alternative, enriching staple crops with essential vitamins and minerals through selective breeding, making nutrition accessible within daily diets (Stevens et al., 2022). Malnutrition is a persistent issue, especially in low-income communities where diets lack diversity. Biofortified crops such as iron-rich beans, zinc wheat, and vitamin A-enriched maize are already helping combat anemia, weakened immunity, and stunted growth (Finkelstein et al., 2015). Countries like India, Rwanda, and Nigeria have successfully integrated biofortification into their agricultural programs, improving public health (Low et al., 2007). Iron-rich pearl millet has proven effective in reducing anemia among adolescent girls, while beta-carotene-enriched sweet potatoes have helped lower vitamin A deficiency in children (Mehta et al., 2022). Climate change poses an additional threat to food security, reducing agricultural productivity through erratic weather and soil degradation (Tang et al., 2012). Biofortified crops not only enhance nutrition but also improve agricultural resilience. Drought-resistant varieties like iron-rich pearl millet and heat-tolerant zinc wheat can thrive in harsh conditions, ensuring a stable food supply even in climate-affected regions (Bouis & Saltzman, 2017). Additionally, crops like millets and lentils, which require less water and chemical inputs, support sustainable farming practices while boosting nutrition (Low et al., 2007). For biofortification to be successful, it must be widely implemented through policies and research investment. Governments play a crucial role in supporting farmers, ensuring seed availability, and funding public awareness programs (Nestel et al., 2006). Countries like Bangladesh and Zambia have already introduced biofortification into national food policies, demonstrating its potential (Low et al., 2007). Expanding seed distribution networks, providing farmer incentives, and improving consumer trust through education will further drive adoption (Mehta et al., 2022). Biofortification presents a cost-effective, long-term strategy to combat malnutrition. By embedding essential

nutrients directly into staple crops, it eliminates reliance on external supplementation. As climate change, food shortages, and malnutrition persist, biofortification stands out as a practical and scalable solution. Through coordinated efforts among governments, researchers, and communities, it has the potential to create a more food-secure and nutritionally rich future for all (Stevens et al., 2022).

CONCLUSION – ENSURING A NUTRIENT RICH FUTURE

Biofortification offers a long-term, cost-effective strategy to address micronutrient deficiencies by enhancing the nutrient profile of staple crops. Biofortified crops provide sustained nutritional benefits through everyday diets (Bouis & Saltzman, 2017). With climate change threatening global food security, biofortified crops offer a dual advantage - they not only improve nutrition but also enhance agricultural resilience. Drought-tolerant and nutrient-rich varieties ensure food availability even in challenging environments, making them a key component of future food systems (Stevens et al., 2022). For biofortification to be widely adopted, strong policy support, research investment, and farmer incentives are essential (Mehta et al., 2022). By embracing biofortification, governments, researchers, and communities can work together to build a healthier, food-secure world. Ensuring access to nutrient-rich, sustainable crops will play a crucial role in eliminating malnutrition and improving health for future generations (Finkelstein et al., 2015). By embracing biofortification, governments and all communities can work together to build a healthier, food-secure world. Ensuring access to nutrient-rich, sustainable crops will play a crucial role in eliminating malnutrition and improving public health for the future generations (Finkelstein et al., 2015).

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The Unit Digit

P. C . Mondal

Associate professor (Retd)
Sankardev College , Shillong

Introduction:

We all know that our decimal system uses ten symbols, viz., 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 for writing a number, each of which is called a *digit*. This system assigns place value for every digit forming the number. The place value of a digit depends on its position in a number. This means that the same digit (non-zero) appearing at different places will have different place values.

The digit representing the right most position (or one's place) is called *unit digit* of the number. For example, the unit digit of 30745 is 5. Using place values, we may write this five-digit number as follows:

$$30745 = 3 \times 10000 + 0 \times 1000 + 7 \times 100 + 4 \times 10 + 5 = 3 \times 10^4 + 0 \times 10^3 + 7 \times 10^2 + 4 \times 10 + 5$$

The expression on the right is known as the expanded form of the number. As the thousands place is nil here, so we may write the expansion as

$$30745 = 3 \times 10000 + 7 \times 100 + 4 \times 10 + 5 = (3 \times 1000 + 7 \times 10 + 4) \times 10 + 5$$

This shows that 30745 can also be written as

$$30745 = 3074 \times 10 + 5.$$

From this we find that the unit digit of a number is also the remainder when the number is divided by 10.

The unit digit of a natural number *i.e.* the digit in one's place is also called the last digit of the number. Finding last digit of a natural number from its ordinary form hardly requires any mathematical skill. However, when a natural number is expressed as a power, one may require some calculations to determine its last digit.

Here we explore a method or a technique by which we can find the last digit of a natural number expressed as a^n where both a and n are given natural numbers.

Before we state the main theorem let us prove the following basic results:

(A) The difference of two natural numbers is divisible by 10 if and only if the numbers have the same unit digit.

Let M and N be two natural numbers having unit digits a_0 and b_0 respectively.

Then $M = 10m + a_0$, $N = 10k + b_0$ where m, k are some whole numbers.

Consider the difference $M - N = 10(m - k) + (a_0 - b_0)$ where a_0, b_0 are digits so that $0 \leq a_0 < 10, 0 \leq b_0 < 10$.

The right-hand side of the above equation shows that $M-N$ is completely divisible by 10 if $(a_0 - b_0)$ is a multiple of 10. Thus $M-N$ will be divisible by 10 if $a_0 - b_0 = 10d$, where d is an integer (positive, negative or zero).

By Trichotomy Law exactly one of $d > 0, d < 0$ and $d = 0$ holds.

If possible, let $d > 0$. This means that d is a positive integer and so $d \geq 1$. Multiplying both sides by 10 we get $10d \geq 10$. Now adding the inequalities $b_0 \geq 0$ and $10d \geq 10$ we get $b_0 + 10d \geq 10$. Therefore $a_0 = b_0 + 10d \geq 10$. From this we find that $a_0 \geq 10$ which is not possible as $0 \leq a_0 < 10$. Hence d can't be positive.

Similarly, if $d < 0$ then $-d > 0$. Thus $-d$ is a positive integer and so $-d \geq 1$. Now adding $-10d \geq 10$ and $a_0 \geq 0$ we get $b_0 = a_0 + (-10d) \geq 10$ which is impossible as $0 \leq b_0 < 10$. This means that d can't be negative as well. Since d is neither positive nor negative, it must be equal to 0.

Thus $a_0 - b_0 = 10 \times 0 = 0$. From this we get $a_0 = b_0$.

Thus, we have proved that if $M-N$ is divisible by 10, then both M and N have the same unit digit.

Conversely if M, N have same unit digit so that $a_0 = b_0$, then

$$M-N = 10(m - k) + (a_0 - b_0) = 10(m - k) \text{ which is divisible by 10.}$$

From above arguments it follows that the difference of two natural numbers is divisible by 10 if and only if the numbers have same unit digit.

Following result is seen as the first simplification of the problem.

(B) The last digit of a^n is same as that of a_0^n where a_0 is the last digit of the natural number a .

Since the numbers a and a_0 have same unit digit so by result (A), $a - a_0$ is divisible by 10.

Suppose $a - a_0 = 10s$ where s is some integer. (i)

Let $S(n): a^n - a_0^n$ is divisible by 10 for all natural numbers n . We now apply mathematical induction to prove that the proposition $S(n)$ is true for all natural numbers n .

In view of (i), $S(1) = a - a_0$ is divisible by 10. Thus $S(n)$ is true for $n=1$ [Step I]

Let $S(n)$ be true for $n=k \geq 1$ [Step II]

We assume that $a^k - a_0^k = 10t$ for some integer t .

$$\text{Now } a^{k+1} - a_0^{k+1} = a a^k - a_0 a_0^k$$

$$\Rightarrow a^{k+1} - a_0^{k+1} = a a^k - a a_0^k + a a_0^k - a_0 a_0^k$$

$$\Rightarrow a^{k+1} - a_0^{k+1} = a \{a^k - a_0^k\} + a_0^k \{a - a_0\}$$

$$\Rightarrow a^{k+1} - a_0^{k+1} = 10at + 10s a_0^k = 10[at + s a_0^k] \text{ which is divisible by 10.}$$

This shows that the proposition $S(n)$ is true for $n=k+1$ if it is true for $n=k$ [Step III]. Hence by mathematical induction $a^n - a_0^n$ is divisible by 10 for all natural numbers n . Therefore, by result (A) it follows that a^n and a_0^n have the same unit digit.

In general, we require some calculations to find the unit digit of a natural number expressed as a power.

Consider the Question: What is the unit digit of the number 3^{101} ?

Here the symbol 3^{101} stands for the product of 101 factors each equal to 3. So, it represents a natural number. By last digit of this number, we mean the digit in one's place of 3^{101} when it is expressed in ordinary form. But expressing this number in ordinary form involves finding the product of 101 factors each equal to 3. By using 'log' or otherwise it can be shown that 3^{101} is a huge number having 49 digits in its decimal representation. However it is easy to see that the unit digit of a power repeats in a cycle of four digits when the index varies.

Generally, a student of Mathematics uses Fermat's (Pierre de Fermat: 1601-1665) Theorem to find the last digit of a natural number expressed as a power. But Fermat's theorem uses 'Congruence', a mathematical tool introduced by a well-known German mathematician Carl Friedrich Gauss.

However, the concept of congruence is generally beyond the scope of school syllabus. Various competitive exams ask questions about last digit of such powers. Our aim, here is to find an easy technique for solving such questions. The method we are going to discuss avoids congruences. It requires only the four basic operations of arithmetic *viz.*, addition, subtraction, multiplication and division to calculate the unit digit of a power. The method, apart from its simplicity, requires very short time to find the last digit of such number. Even a school student will be able to answer such questions. Interestingly one can find the last digit of such a power without using pen and paper. This short technique simplifies the problem into an oral question.

The main focus of the article is the following theorem.

Theorem: (The Unit-Digit Theorem) Let a be a digit and n be a natural number. Also let r be the remainder when n is divided by 4. Then the unit digit of a^n is same as that of a^r or a^4 according as $r \neq 0$ or $r=0$.

There are different methods to prove the theorem. Here we shall use mathematical induction which avoids congruences. The proof of the theorem will be facilitated by two lemmas. So, first of all, we state and prove the following lemmas by using mathematical induction.

Lemma 1: $a^5 - a$ is divisible by 10 for every natural number a .

Let $P(a)$: $a^5 - a$ is divisible by 10 for every natural number a .

Now $P(1)$: $1^5 - 1 = 0$ is divisible by 10. Therefore $P(a)$ is true for $a=1$ [Step I]

Let $P(a)$ be true for $a=k$. That is let $P(k)$: $k^5 - k$ be divisible by 10 [Step II]

In other words, $k^5 - k = 10s$ for some integer $s \dots (i)$

We now show that $P(a)$ is true for $a = k + 1$ [Step III]

Applying binomial expansion or otherwise we have

$$\begin{aligned} (k + 1)^5 - (k + 1) &= k^5 + 5k^4 + 10k^3 + 10k^2 + 5k + 1 - (k + 1) \\ \Rightarrow (k + 1)^5 - (k + 1) &= [k^5 - k] + 5k[k^3 + 2k^2 + 2k + 1] \\ \Rightarrow (k + 1)^5 - (k + 1) &= [k^5 - k] + 5k(k + 1)(k^2 + k + 1) \end{aligned}$$

The factor $k(k + 1)$ on the right-hand side is even being the product of two consecutive natural numbers. Therefore, $5k(k + 1) = 10t$ for some integer t .

Now $(k + 1)^5 - (k + 1) = 10s + 10t(k^2 + k + 1) = 10[s + t(k^2 + k + 1)]$ which is divisible by 10.

This shows that $P(k + 1)$ is true if $P(k)$ is true. Hence by mathematical induction $P(a)$ is true for all natural numbers a . This proves Lemma 1.

We now use Lemma 1 to prove the following general result:

Lemma 2: If a be a fixed natural number, then $a^{4p+1} - a$ is divisible by 10 for all natural numbers p .

Let $Q(p)$: $a^{4p+1} - a$ is divisible by 10 for *all* natural numbers p .

As usual we apply mathematical induction to prove lemma 2.

We observe that lemma 2 reduces to lemma 1 for $p = 1$.

Therefore, the statement is true for $p = 1$. [Step I]

Let the statement be true for $p = k$ [Step II]. We assume that $a^{4k+1} - a = 10u$ for some integer u .

$$\begin{aligned} \text{Now } a^{4(k+1)+1} - a &= a^{4k+1} \cdot a^4 - a \\ \Rightarrow a^{4(k+1)+1} - a &= a^{4k+1} \cdot a^4 - a^5 + a^5 - a \\ \Rightarrow a^{4(k+1)+1} - a &= a^4 \{a^{4k+1} - a\} + \{a^5 - a\} \\ \Rightarrow a^{4(k+1)+1} - a &= a^4(10u) + 10s [\because a^{4k+1} - a = 10u] \\ \Rightarrow a^{4(k+1)+1} - a &= 10 [a^4u + s] \text{ which is divisible by 10} \\ \Rightarrow \text{The statement is true for } p &= k + 1 \text{ whenever it is true for } p = k \text{ [Step III]} \end{aligned}$$

By mathematical induction $Q(p)$ is true for all natural numbers p . This completes the proof of lemma 2.

It is easy to see that Lemma 2 is true for $p = 0$ as well.

Thus, we have

$$a^{4p+1} - a = 10v \text{ for some integer } v \text{ and } p \geq 0 \dots (ii)$$

With the preliminaries having been discussed we now turn to the main theorem.

Let q be the quotient (a whole number) and r (a whole number) the remainder when n is divided by 4. Therefore, by Division Algorithm we have

$$n=4q+r \text{ where } 0 \leq r < 4.$$

To prove that the unit digit of a^n is given by the last digit of a^r or a^4 according as $r \neq 0$ or $r=0$.

Case1. Let $r \neq 0$. Then $1 \leq r \leq 3$ and so $0 \leq r-1 \leq 2$. This means that a^{r-1} is a whole number.

$$\text{Now } a^n - a^r = a^{4q+r} - a^r$$

$$\Rightarrow a^n - a^r = a^{4q+1+r-1} - a^r$$

$$\Rightarrow a^n - a^r = a^{4q+1} a^{r-1} - a a^{r-1}$$

$$\Rightarrow a^n - a^r = a^{r-1} \{a^{4q+1} - a\}, \text{ where } a^{r-1} \text{ is a whole number.}$$

$$\Rightarrow a^n - a^r = a^{r-1} (10v) \text{ by (ii)}$$

$$\Rightarrow a^n - a^r = 10v a^{r-1} \text{ which is divisible by 10.}$$

This means that a^n has same unit digit as a^r [by Result (A)].

Case2. Let $r=0$ so that $n=4q$. Since n is a natural number and it is also a multiple of 4, so $4q \geq 4$. Thus $q \geq 1$ and so $q-1=p$ (say) ≥ 0 .

$$\text{Now } a^n - a^4 = a^{4q} - a^4$$

$$\Rightarrow a^n - a^4 = a^{4q-4+4} - a^4$$

$$\Rightarrow a^n - a^4 = a^{4(q-1)+1+3} - a^4$$

$$\Rightarrow a^n - a^4 = a^{4(q-1)+1} a^3 - a^4$$

$$\Rightarrow a^n - a^4 = a^{4p+1} a^3 - a a^3$$

$$\Rightarrow a^n - a^4 = a^3 \{a^{4p+1} - a\}$$

$$\Rightarrow a^n - a^4 = a^3 (10v) \text{ by (ii), which is divisible by 10}$$

Thus, by result (A), a^n has same unit digit as that of a^4 . This completes the proof of the theorem.

Remarks: 1. If a is a digit then $a \in \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$

2. The set of natural numbers is $\{1, 2, 3, 4, \dots\}$

3. The set of whole numbers is $\{0, 1, 2, 3, \dots\}$

4. The set of integers is $\{\dots, -2, -1, 0, 1, 2, \dots\}$

5. We stated Lemma1 and Lemma2 with a as natural number. In fact, these results are true when a is any integer. Thus $a^{4p+1} - a$ is divisible by 10 for any fixed integer a and every non-negative integer p .

6. The unit-digit theorem may also be called the last digit theorem.

Observations:

1. If a, b be integers and n any fixed natural number then $a - b$ is divisible by n if and only if a and b leave the same remainder when each is divided by n .

Let q_1, q_2 be the quotients and r_1, r_2 the remainders when each of a and b is divided by n .

Thus $a = nq_1 + r_1; 0 \leq r_1 < n$ and $b = nq_2 + r_2; 0 \leq r_2 < n$

Now $a - b = n(q_1 - q_2) + (r_1 - r_2)$

The right-hand side of the above equation shows that $a - b$ will be divisible by n if $(r_1 - r_2)$ is a multiple of n . Thus $a - b$ will be divisible by n if $r_1 - r_2 = nd$ for some integer d . By Trichotomy Law we have $d > 0, d < 0$ or $d = 0$.

If possible, let $d > 0$. Then d is a positive integer, $d \geq 1$ and so $nd \geq n$. Also $r_2 \geq 0$. Adding the inequalities $r_2 \geq 0$ and $nd \geq n$ we get $r_2 + nd \geq n$.

Now $r_1 = r_2 + nd \geq n$ gives $r_1 \geq n$. But this is not true as $r_1 < n$. Hence d can't be positive.

Next let $d < 0$. Therefore $-d > 0$ and so $-d \geq 1$. Multiplying both sides by n we find that $-nd \geq n$ which gives $r_2 = r_1 + (-nd) \geq n$. This contradicts the fact that $r_2 < n$. Hence d can't be negative as too. As d is neither positive nor negative, so it must be equal to zero.

Thus assuming $(a - b)$ is divisible by n we get $r_1 - r_2 = 0$ or $r_1 = r_2$.

Conversely if $r_1 = r_2$ then $a - b = n(q_1 - q_2)$ which is divisible by n .

Thus $a - b$ is divisible by n if and only if a and b leave the same remainder when each is divided by n . We say that a is congruent to b modulo n . Using the symbol ' \equiv ' of congruences this is stated as $a \equiv b \pmod{n}$.

2. If we wish, the unit-digit theorem can be stated using congruences as follows:

If a be a digit and n a natural number, then

$a^n \equiv a^r \pmod{10}$ when $n \equiv r \pmod{4}$, and $a^n \equiv a^4 \pmod{10}$ when $n \equiv 0 \pmod{4}$.

3. The division of n by 4 can be cut short to a division of a two-digit number only.

Let n have three or more digits.

Let $b_{m-1}, b_{m-2}, \dots, b_1, b_0$ be the m digits of n . Now $m \geq 3$ and so n can be expressed as

$$n = b_{m-1}10^{m-1} + b_{m-2}10^{m-2} + \dots + 10^2b_2 + 10b_1 + b_0$$

Simplifying we get

$$n = 10^2[b_{m-1}10^{m-3} + b_{m-2}10^{m-4} + \dots + b_2] + (10b_1 + b_0)$$

$$\Rightarrow n - (10b_1 + b_0) = 4 \times 25[b_{m-1}10^{m-3} + b_{m-2}10^{m-4} + \dots + b_2] \text{ which is divisible by 4.}$$

This shows that n and $(10b_1 + b_0)$ leave the same remainder when each is divided by 4. [See Obs.1 above].

Thus, a natural number n and the last two digits of it leave the same remainder when each is divided by 4. Using congruences we may write this as $n \equiv (10b_1 + b_0) \pmod{4}$.

So, in practice, for an index n having more than two digits, we just consider its ten's and one's places for division by 4 and ignore the other places. This means that the unit digit of a^n depends on the last two digits of the index n and is independent of the remaining places of it. This can be viewed as the second step towards simplification of the problem.

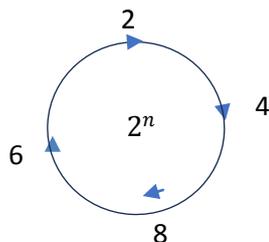
4. Since the unit digit of a natural number expressed as a power like a^n depends on the unit digit of the whole number a , so there is no loss of generality in stating the unit-digit theorem using only the unit digit of the base a of the power a^n [Result (B)].

5. From result (B), the last digit of a^n depends on the unit digit of a and by Obs.3, it depends on the last two digits of the natural number n and is independent of the other places of these two numbers. So, for given natural numbers a and n one can find the unit digit of a power a^n knowing only the unit digit of a and the last two digits of n .

6. The theorem simplifies the problem of finding the unit digit of a general power a^n into a much easier one. It states that the unit digit of a^n is same as that of a, a^2, a^3 or a^4 .

7. When n varies, the unit digit of a power a^n repeats in a cycle of four digits. The cycles for $2^n, 3^n, 4^n, 5^n, 6^n, 7^n, 8^n$ and 9^n are $\{2, 4, 8, 6\}, \{3, 9, 7, 1\}, \{4, 6, 4, 6\}, \{5, 5, 5, 5\}, \{6, 6, 6, 6\}, \{7, 9, 3, 1\}, \{8, 4, 2, 6\}$ and $\{9, 1, 9, 1\}$ respectively. Out of these the cycles of $2^n, 3^n, 7^n, 8^n$ only have distinct digits.

The following figure shows the cycle of 2^n . The top most digit shown in the cycle corresponds to the value $n=1$.



Application of the unit-digit theorem:

A few problems which can be solved by using the unit-digit theorem.

1. If n be a natural number and a any digit, then the unit digit of a^{4n} is same as the unit digit of a^4 .
2. The unit digit of a^{4n+1} is same as the unit digit of a for every whole number n .
3. If a is a non-zero even digit and n any positive integer, then the unit digit of the number a^{4n} is always 6. On the other hand, if a is an odd digit which is not divisible by 5 and n any positive integer, then the unit digit of the number a^{4n} is 1.

4. Find the unit digit of 3^{101} .

Hint: unit digit of 3^{101} = unit digit of $3^{4 \times 25 + 1}$ = unit digit of $3^1 = 3$

5. Find the unit digit of the number represented by the sum $1^5 + 2^5 + 3^5 + \dots + 9^5$.

Hint: Apply unit-digit theorem or lemma 1.

Required unit digit = unit digit of $\{1 + 2 + 3 + \dots + 9\}$ etc.

6. If a is a digit and m, n are natural numbers such that $m - n$ is divisible by 4 then a^m and a^n have same unit digit.

Hint: From Obs.1 we find that m, n leave the same remainder r (say) when each is divided by 4. Therefore, by Unit-digit theorem we have:

unit digit of a^m = unit digit of a^r when $r \neq 0$.

Similarly, the unit digit of a^n = unit digit of a^r if $r \neq 0$.

Therefore, the unit digit of a^m = unit digit of a^n if $r \neq 0$

In case $r = 0$, the unit digit of a^m = the unit digit of a^4 = the unit digit of a^n

Hence a^m and a^n have the same unit digit.

*7. Prove that every even perfect number ends in 6 or 8.

Hint: If $2^k - 1$ is a prime ($k > 1$), then $2^{k-1}(2^k - 1)$ represents an even perfect number.

Let $2^k - 1$ be prime. If k were composite we would get two positive integers r, s such that $k = rs$ where $r > 1$ and $s > 1$.

Now $2^k - 1 = 2^{rs} - 1$

$$\Rightarrow 2^k - 1 = (2^r)^s - 1 = (2^r - 1)\{2^{r(s-1)} + 2^{r(s-2)} + \dots + 2^r + 1\}$$

Since $r > 1, s > 1$ each of the factors on the right is greater than 1. Assuming $k > 1$ we see that $2^k - 1$ a positive integer greater than 1. From above equation we see that $2^k - 1$ has two factors each of which is greater than 1. This means that $2^k - 1$ is composite which contradicts the hypothesis, so that k must be prime. Thus, it is necessary (although not sufficient) that k is an odd natural number. Therefore k is of the form $4q + 1$ or $4q + 3$.

When $k = 4q + 1, k - 1 = 4q$. Therefore $2^{k-1}(2^k - 1) = 2^{4q}\{2^{4q+1} - 1\}$. By unit digit theorem, the unit digits of 2^{4q} is same as that of 2^4 and the unit digit of 2^{4q+1} is same as that of 2.

Now unit digit of $2^{k-1}(2^k - 1) =$ unit digit of $2^{4q}\{2^{4q+1} - 1\}$

$$\Rightarrow \text{unit digit of } 2^{k-1}(2^k - 1) = \text{unit digit of } 2^4\{2 - 1\} = \text{unit digit of } 16 = 6$$

Similarly, we can show that when $k = 4q + 3$, the unit digit of $2^{k-1}(2^k - 1)$ is 8.

Note: A natural number n is said to be perfect if the sum of its positive factors is equal to $2n$.

*8. Prove that every Fermat's number $F_n = 2^{2^n} + 1$ for $n \geq 2$ ends in 7.

Hint: Here $n - 2 = m \geq 0$ and so $M = 2^m$ is a natural number. Now

$$2^n = 2^{n-2} \cdot 2^2 = 4 \cdot 2^m = 4M$$

Now unit digit of $F_n =$ unit digit of $\{2^{4M} + 1\}$
 $=$ unit digit of $(2^4 + 1)$
 $=$ unit digit of 17
 $= 7$

9. Show that $2^{4n} - 1$ is divisible by 5 for every natural number n .

10. For every odd natural number n , the unit digit of a^n is given by the unit digit of a or a^3 for any digit a .

Hint: Dividing n by 4 we see that n is of the form $4q+1$ or $4q+3$ etc.

11. If a is a prime number greater than 5 and n any natural number then the unit digit of a^{4n} is 1.

Hint: The digit in one's place of a must be 1, 3, 7 or 9. That is $a_0 = 1, 3, 7$ or 9 etc.

12. If n is an odd prime prove that 9^n ends in 9.

Hint: n is of the form $4q+1$ or $4q+3$ etc.

***13.** Using the Unit-digit theorem show that the square of a natural number can't end in 2, 3, 7 or 8. In other words one's place of a perfect square must be one of the six digits 0, 1, 4, 5, 6 or 9.

Hint: Let a_0 be the unit digit of a natural number N . We have shown in result (B) that $N^n - a_0^n$ is divisible by 10 for every natural number n . Taking $n=2$ we find that $N^2 - a_0^2$ is divisible by 10. This ensures that N^2 and a_0^2 have the same last digit. But $a_0 = 0, 1, 2, \dots, 9$ and so a_0^2 ends in 0, 1, 4, 5, 6 or 9. This in other words means that N^2 can't end in 2, 3, 7 or 8.

14. Let a, b be two digits of the decimal system and m, n two natural numbers. Prove or disprove the following conjecture:

'Unit digit of $\{a^n + b^m\} =$ Unit digit of $\{\text{unit digit of } a^n + \text{unit digit of } b^m\}$ '.

15. Can the unit digit of 3^{a^3} be 1 for any digit a ? Give reasons for your answer.

Hint: A digit is either even or odd.

For the even values of a , the unit digits will be given by those of $3^3, 3^{23}, 3^{43}, 3^{63}$ and 3^{83} . The indices 3, 23, 43, 63 and 83 leave the same remainder (*i.e.* 3) when each is divided by 4. Thus, for even values of a the unit digit of 3^{a^3} is 7. Similarly for odd values of a the unit digit is 3. That is the unit digit of 3^{a^3} can't be 1 for any digit a .

Effect on Morphological and Magnetic properties of Mn and Zn substituted Ca-hexaferrite using ceramic technique**Dr. Chandrakant. L. Khobaragade**

Department of Applied Physics

Govindrao Wanjari College of Engineering & Tech., Nagpur, India.

Abstract

Synthesis of M-type hexagonal ferrite compounds, $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{x/2}\text{Fe}_{11-x}\text{O}_{19}$ ($x = 0.0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2$) prepared by ceramic technique. Mn and Zn ions substituted to find the magnetic characterization at magnetic field of 10 kOe. XRD and SEM study have been done for getting the hexagonal structure of these samples. Due to the substitution of Mn and Zn ions saturation magnetization increases and magnetic crystalline anisotropy decreases. Due to the sublattice site distribution the variations in magnetic parameters have been observed. Because of Mn and Zn ions substitution Curie temperature decreases by weakening of superexchange interaction. These materials can be used for various applications such as permanent magnetic material, magnetic recording media, ferrofluids, sensors, microwave absorbing materials, ceramic magnets in loud speakers and rotors in small DC motors by studying various magnetic parameters from VSM characterization.

Keywords: XRD, SEM, Magnetic properties, Hexaferrite.

Introduction

Ferroxdure $\text{MFe}_{12}\text{O}_{19}$ hexagonal ferrites, specifically calcium hexaferrites, are renowned for their uniaxial magneto-crystalline anisotropy, emphasizing increased magnetization along the c-axis [1,2]. Widely used in magnetic recording media due to their intrinsic properties, these hexagonal ferrites exhibit tunable magnetic characteristics like coercivity and saturation magnetization through the substitution of Fe^{3+} ions in the crystal sublattice [3,4]. The electronic configuration and site distribution of substituting cations play a crucial role in determining these properties. Notably, the substitution of ions with intrinsic coercivity effectively decreases, while saturation magnetization increases, making them valuable for magnetic recording applications [5]. Ongoing efforts focus on reducing coercive force while simultaneously enhancing magnetization through substitution. The application of hexagonal ferrites in magnetic recording media necessitates precise control over homogeneity and morphology. In this context, detailed research on substituted Ca-hexaferrite, specifically with Mn and Zn ions, has been undertaken using the ceramic method. While An et al. employed the sol-gel method for magnetic property investigation [6], Parkin et al. synthesized similar ferrites through the self-propagating high-temperature method [7]. The current study delves into the magnetic properties of Mn and Zn ions substituted CaM ferrite, contributing to the ongoing exploration of advanced materials in this domain.

2. Experimental:

Polycrystalline M-type hexagonal ferrites ($\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{x/2}\text{Fe}_{11-x}\text{O}_{19}$, $x = 0.0-1.2$) were synthesized via standard ceramic technique or solid-state diffusion. High-purity analytical reagents (CaO , CoO , ZnO , MnO_2 , TiO_2 , and Fe_2O_3) were used for sample preparation, with oxides mixed in stoichiometric ratios. Initially, the compounds' powders

were crushed in an agate pestle mortar for 6 hours, pre-sintered at 500°C for 10 hours, and finely ground again. Pellets were formed using polyvinyl acetate as a binder and hydraulic press. The compounds were synthesized at 1040°C for 96 hours, with slow heating and cooling at 2°C/min. Magnetic parameters were measured at 10kOe using a vibrating sample magnetometer. Curie temperature (TC) was determined using Gouy’s balance method. X-ray diffraction and SEM were employed to study phase transitions and microstructure. The magnetic parameters were analyzed from room temperature to 700°C, revealing the material's transition from a ferrimagnetic to a paramagnetic state as the temperature increased.

3. Results and Discussion:

3.1. XRD

From X-ray diffraction (Fig.1) and calculated data reveal the magnetoplumbite structure of the compounds, with relative intensity peaks indicating variations in lattice sites due to substituted ions. Structural data (Fig. 2) show minimal variation in lattice parameter 'a,' while 'c' initially decreases rapidly with substitution, consistent with M-type hexagonal standards. The substitution of Mn⁴⁺ and Zn²⁺ ions leads to larger magnetization along the 'c'-axis than the 'a'-axis, attributed to the larger ionic radii of Mn⁴⁺ (0.60Å) and Zn²⁺ ions (0.74Å) compared to Fe³⁺ ions (0.64 Å). These changes in lattice constants and magnetic properties result from superexchange interactions with the substituted ions.

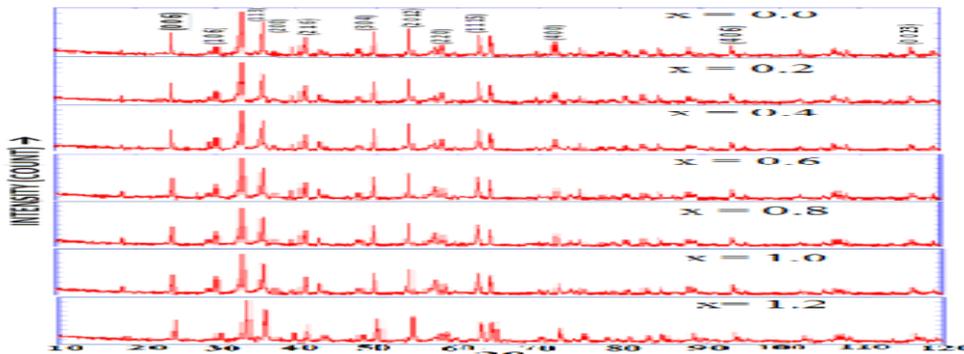


Fig.1:X-ray diffraction pattern of $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{x/2}\text{Fe}_{11-x}\text{O}_{19}$ ferrite calcinated at 1040°C for 96 h.

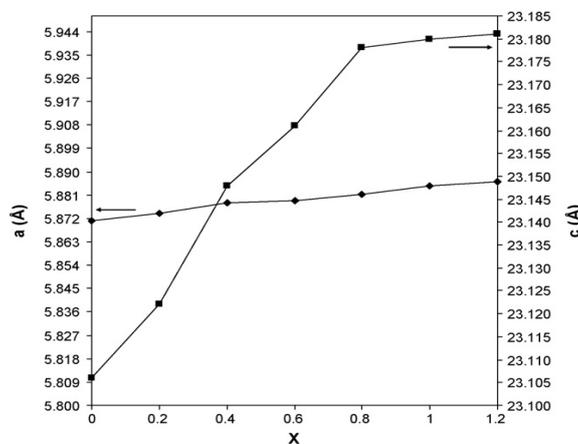


Fig.2: Dependence of lattice constants 'a' and 'c' on substitution x in $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{x/2}\text{Fe}_{11-x}\text{O}_{19}$ ferrite.

3.2. SEM

Scanning electron micrograph studies of $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_x/2\text{Fe}_{11-x}\text{O}_{19}$ compounds reveal enhanced inter-grain connectivity through Mn^{4+} and Zn^{2+} ion substitution (Fig.3). The agglomeration of grains is attributed to increased grain size with the substitution of Mn^{4+} and Zn^{2+} ions. Table-1 shows increased cell volume, bulk density, and reduced porosity with these ion substitutions. The observed decrease in porosity is evident in SEM images, indicating closer grain proximity in various samples. The calculated density for all studied samples exceeds 84%.

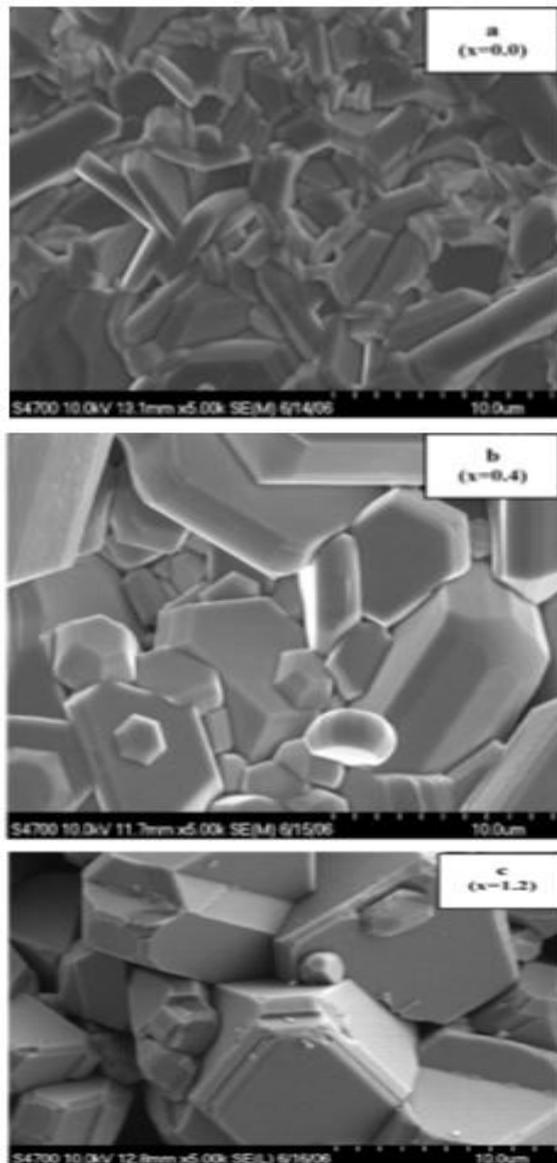


Fig.3: SEM micrographs of ferrite samples:

- (a) $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{0.1}\text{Fe}_{10.8}\text{O}_{19}$,
- (b) $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{0.2}\text{Fe}_{10.6}\text{O}_{19}$ and
- (c) $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{0.4}\text{Fe}_{10.2}\text{O}_{19}$.

3.3. Saturation magnetization (M_s), Coercivity (H_c) and Anisotropy field (H_a)

The Electronegativity of substituted ions in the $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_x/2\text{Fe}_{11-x}\text{O}_{19}$ compounds is influenced by their occupancy in octahedral and tetrahedral sites [11]. With

Electronegativity values of 1.55 for Mn⁴⁺ and 1.65 for Zn²⁺, Mn⁴⁺ ions prefer tetrahedral sites due to their d⁵ configuration, while Zn²⁺ ions favor octahedral sites owing to their d¹⁰ configuration. The specific distribution of these ions depends on the synthesis method. Graphical representation of hysteresis loops (Fig. 4) shows a pronounced increase in magnetization at low applied fields, decreasing sharply at high fields. Samples with x = 0 do not reach a saturation state, while all other doped samples exhibit saturation. This behavior is attributed to a significant decrease in the anisotropy field, as reflected in the coercivity (H_c) variation graph. The saturation magnetization (M_s) for x = 0 is calculated to be 63 mu/g using the formula $M = M_s(1 - A/H - B/H^2) + \chi_p H$ [13]. $B = \frac{H_a^2}{15} = \frac{4 K_1^2}{15 M_s^2}$ ---(2)

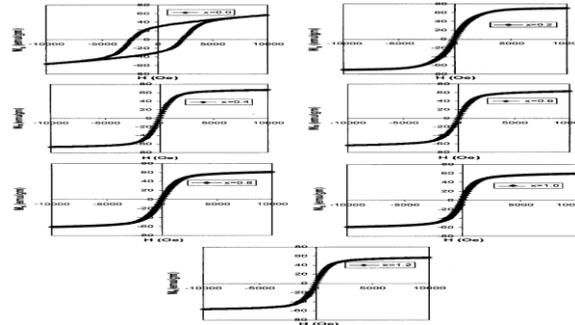


Fig. 4: Hysteresis loops of Ca(CoTi)_{0.5}(MnZn)_{x/2}Fe_{11-x}O₁₉ ferrite (x = 0.0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2) at room temperature.

In M-type hexaferrites, Fe³⁺ ions occupy seven octahedral sites (12k and 2a), a trigonal bipyramidal site (2b) with spins in one direction, and two octahedral sites (4f1) and two tetrahedral sites (4f2) with spins in opposite directions. The observed high coercivity variation (Fig. 5) is attributed to strong uniaxial magneto-crystalline anisotropy field (H_a) and anisotropy constant (K₁). The substitution of Mn⁴⁺ and Zn²⁺ ions leads to a rapid decrease in coercivity, primarily influenced by the intrinsic effect associated with the replacement of Fe³⁺ ions at 4f2 and 2b sites, which contribute to a large anisotropy field [14]. Additionally, an extrinsic effect is observed, wherein an increase in grain size due to Mn⁴⁺ and Zn²⁺ ion substitution (SEM Fig.3(a,b,c)) contributes to the decrease in coercivity.

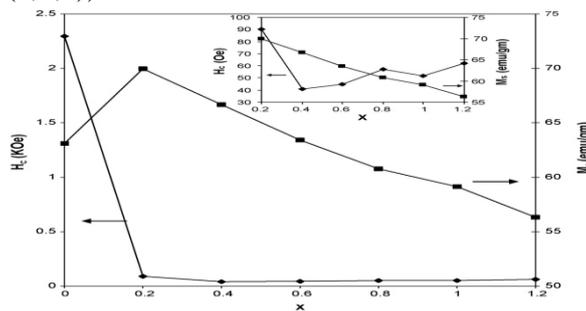


Fig. 5: Saturation magnetization (M_s) and coercivity (H_c) of Ca(CoTi)_{0.5}(MnZn)_{x/2}Fe_{11-x}O₁₉ ferrite as a function of substitution x. Inset in the figure is for better guide to eye of coercivity variation from samples 0.2 to 1.2.

The substitution of Mn⁴⁺ and Zn²⁺ ions alters the easy axis of magnetization along the c-axis of the basal plane, resulting in a significant reduction in coercivity. A 96% reduction in coercivity is observed from x = 0 (2263 Oe) to x = 0.2 (90 Oe), followed by a slight decrease from x = 0.4 to x = 1.2, indicating a transition from hard ferrite to soft ferrite. Similar

findings have been reported by Ghasemi et al. in Ba–Mn–Cu–Ti hexagonal ferrite [15]. The saturation magnetization (M_s) increases with Mn^{4+} and Zn^{2+} ion substitution up to $x = 0.2$, reaching 70 emu/g compared to the undoped sample for $x = 0$ (63 emu/g). This increase is attributed to the replacement of Fe^{3+} ions (leading to magnetization reduction) by Mn^{4+} and Zn^{2+} ions in the spin-down state, boosting saturation magnetization (M_s). Beyond $x = 0.2$, M_s decreases due to the lower magnetic moment of Mn^{4+} and Zn^{2+} ions compared to Fe^{3+} ions, although not fully offset. The relationship between M and $1/H_2$ at 8 to 10 kOe shows a linear pattern in all samples, allowing neglect of A/H and χ_p in Eq. (1). The slope of the straight line, $M = M_s(1 - B/H_2)$, allows calculation of the anisotropy parameter 'B.' Anisotropy field (H_a) decreases rapidly from $x = 0$ to $x = 0.2$ due to the reduced coercivity (H_c). The comparable curves of coercivity (H_c) and anisotropy field (H_a) at low substitution ($x = 0.2$) suggest that anisotropic field (H_a) predominantly influences material magnetization. In contrast, the inset in Fig. 6 shows non-comparable coercivity (H_c) and anisotropy field (H_a) from $x = 0.2$ to 1.2, indicating the influence of grain size on coercivity. The magnetic properties of Mn-Zn-substituted Ca-hexaferrite are enhanced, featuring improved M_s (70 emu/g, $x = 0.2$) and lower H_c (90 Oe, $x = 0.2$).

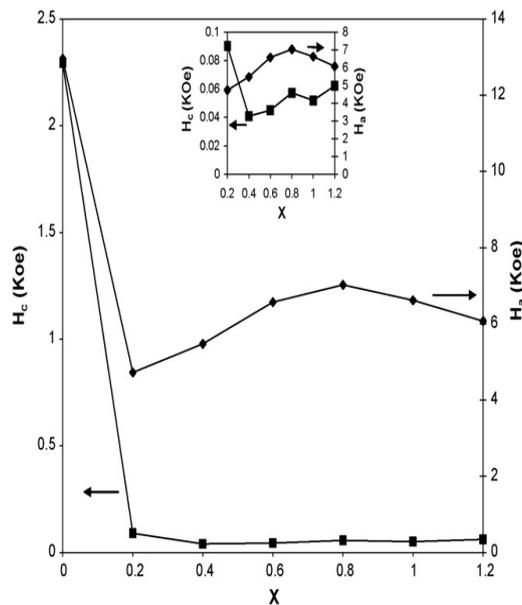


Fig.6: Variation of H_a and H_c in $Ca(CoTi)_{0.5}(MnZn)_{x/2}Fe_{11-x}O_{19}$ ferrite as a function of substitution x . Inset in the figure is for better guide to eye of H_a and H_c variation from samples 0.2 to 1.2.

3.4. Curie temperature

Curie temperature (T_c) exhibits a decreasing trend with the substitution of Mn^{4+} and Zn^{2+} ions, as shown in Fig. 7. This decline is attributed to the replacement of Fe^{3+} ions by Mn^{4+} and Zn^{2+} ions with lower magnetic moments, resulting in a decrease in the number of magnetic ions. The imbalanced spin alignment at lower thermal energy contributes to the observed reduction in Curie temperature (T_c). A similar decrease in T_c due to the substitution of Mn^{4+} and Zn^{2+} ions has been reported in Ba–Cr-hexaferrites by Kim et al. [19] and in Sr–La-hexaferrites by Liu et al. [20].

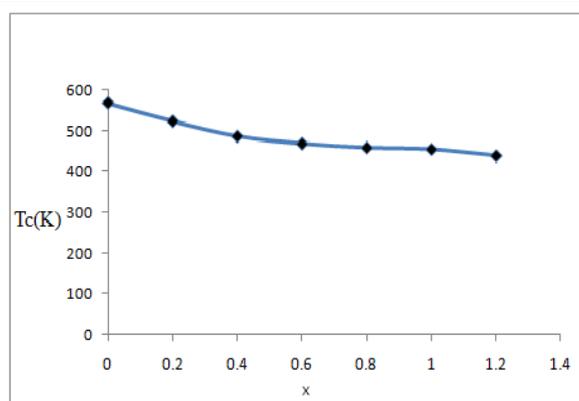


Fig.7: Variation of Curie temperature of $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{x/2}\text{Fe}_{11-x}\text{O}_{19}$ ferrite with Mn and Zn substitution.

Table 1:

Table shows Lattice constants ‘a’ and ‘c’, cell volume, X-ray density (Dx), bulk density (Db) and porosity of $\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{x/2}\text{Fe}_{11-x}\text{O}_{19}$ ferrite.

Compounds	a (Å)	C (Å)	V (cm ³)	Dx (g/cm ³)	Db (g/cm ³)	Porosity (%)	T _C (K)
$\text{Ca}(\text{CoTi})_{0.5}\text{Fe}_{11}\text{O}_{19}$	5.87 0	23.10 9	0.883 1	5.1742	4.8625	0.060 2	568
$\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{0.1}\text{Fe}_{10.8}\text{O}_{19}$	5.87 3	23.12 4	0.798 3	5.1789	4.8821	0.056 4	523
$\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{0.2}\text{Fe}_{10.6}\text{O}_{19}$	5.87 5	23.14 6	0.761 2	5.1911	4.9236	0.051 6	486
$\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{0.3}\text{Fe}_{10.4}\text{O}_{19}$	5.87 8	23.15 7	0.732 9	5.1902	4.9394	0.048 4	468
$\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{0.4}\text{Fe}_{10.2}\text{O}_{19}$	5.87 8	23.17 9	0.632 3	5.1864	4.9463	0.046 3	458
$\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{0.5}\text{Fe}_{10}\text{O}_{19}$	5.88 3	23.18 1	0.630 5	5.2054	4.9786	0.043 6	454
$\text{Ca}(\text{CoTi})_{0.5}(\text{MnZn})_{0.6}\text{Fe}_{9.8}\text{O}_{19}$	5.88 7	23.18 3	0.628 8	5.2136	4.9962	0.041 6	452

Conclusions:

Mn-Zn-substituted Ca-hexaferrites were synthesized using a ceramic technique. The lattice constants 'a' and 'c' increased with the substitution of Mn⁴⁺ and Zn²⁺ ions, leading to a decrease in coercivity and dominant anisotropy effects. Saturation magnetization increased due to the replacement of Fe³⁺ ions in the spin-down state compared to Mn⁴⁺ and Zn²⁺ ions. The transition from a hard phase (undoped ferrite) to a soft phase (doped ferrite) is

evident, indicating a reduction in hysteresis loop area per cycle. Additionally, the Curie temperature decreased with these ion substitutions.

Future Issues

Many scientists has been done work on M-type hexaferrite. To pay attention to the real research on ferrite data obtained from last 25 years and summarized a little in this work. The main application of this developed material is in magnetic recording media, ferrofluids, sensors, microwave absorbing materials, ceramic magnets in loud speakers and rotors in small DC motors etc.

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Dowries and marriages in Shakespeare's plays

Rebika Basumatary

Assistant professor

Department of English, Thong Nokbe College

Abstract

This paper investigates the complex relationship between dowries and marriages in Shakespeare's plays, situating the discussion within the broader socio-cultural framework of the Elizabethan Age. It analyses the pivotal role played by fathers in providing dowries, the expectations and implications such arrangements have for potential husbands, and the degree of agency that brides are able or unable to exercise in this process. Although different characters demonstrate varying attitudes toward the concept of dowries, the consequences of these arrangements whether they result in successful and fulfilling marriages or not underscore the socially and economically dependent status of women during that historical period. Some characters, such as Cordelia and Helena, succeed in demonstrating their personal value beyond material wealth, challenging the prevailing norms to some extent. However, many others remain confined within the rigid economic and social structures that limit their choices. In this way, Shakespeare's plays both reflect and critique the societal conditions that governed women's lives in his time and offer literary insights that complement and deepen our understanding of historical records.

Keyword: Dowries, socio- cultural, Elizabethan age, wealth, demonstrating, women

Introduction:

When reading Shakespeare's plays, one cannot help but notice a recurring theme that resonates even in modern society: the concept of marriage or pre-marital contracts. What may come as a surprise is the frankness with which characters negotiate the terms of these arrangements, particularly concerning dowries. This paper will begin by surveying existing scholarship on the topic, proceed to illustrate the connection between dowries and marriage as portrayed in Shakespeare's works, and finally offer an analysis of the social and economic position of women during the Elizabethan era.

Studies on dowry and marriage are mainly conducted from the historical angle and within an Italian setting. (Molho, 1988) explores the deception and marriage in Renaissance Florence, including in his paper the fact that the guardian of a young, nubile woman deposited dowry Fund in the dowry insurance scheme office. (Guzzetti, 2002) talks about dowries in the fourteenth century Venice (Queller D. E., 1993) discuss the fathers, daughters and dowries in late Medieval and Early

Renaissance Venice; (Labalme, 1999) explain how to and how not to get married in sixteenth century Venice. These three papers all mention the average and highest values of dowry from the fourteenth to the sixteenth century, especially the dowry inflation.

(Pearson, 1967) depicts the Elizabethan domestic life (including their marriages) with hakespeare's plays as her main source of information. (Ranald, 1979) details the marriages portrayed in Shakespeare's four plays, among which dowry forms an important part. (Simms,

2016) specifically analyzes dowry in three Shakespeare plays, displaying that the dowry negotiations and agreements are the most important component of the patriarchal structure of marriage depicted in Shakespeare's plays. (Jacobs, 2001) intends "to compare and contrast the very different literary reactions to a common stimulus: the successive metamorphosis of the marriage law from the thirteenth century all the way up to the middle of the eighteenth." (p. vii) Shakespeare and Middleton portray a range of patriarchal behaviours that related to marriage and money, especially the marriage making negotiations and explicit financial considerations that affected inheritance practices and land distribution from the 1530s throughout the 1620s. Dynes studies the marriage and family in early Elizabethan drama, with Shakespeare's *The Merry Wives of Windsor* being a typical example. (Dolan, 2011) focuses particularly on new research on rates of marriage in early modern England, on married women's agency, will, and work, and on same-sex attachments. They treat literary texts as their subjects, trying to depict the social realities reflected in literary works. However, their emphasis are either on marriage law, or on marriage and family, or set in a limited number of Shakespeare plays. This paper will adopt the same approach, but focus on the dowry-marriage relationship displayed in a far larger number of Shakespeare plays and strive to provide a panoramic picture of the dowry system in the Elizabethan Age.

The Relationship between Women's Dowries and Their Marriages Before our discussion begins, one thing must be made clear: although Shakespeare's plays are set in different milieus, like Italy, France and Vienna, they reflect the English matrimonial law in the Elizabethan Age. "What Shakespeare is doing, in other words, is transferring the English canon and civil law of marriage to Vienna without concerning himself with legal anachronisms." (Ranald, 1979) A dowry (in a broad sense) consists of two parts: the dowry (in a narrow sense) and the jointure. The dowry is an amount of money, goods, and property the bride brings to the marriage.

It can also be called her marriage portion. The jointure is an agreement by the groom's family to guarantee specific money, property and goods to the bride if her husband dies before she does, aside from or in addition to what is in his will. Both parties in a marriage contribute to the dowry.

Stone, a leading historian in the field of social and family history, believes that this dowry system "governed the structure of the English family at all levels of the propertied classes from the sixteenth century on through the nineteenth century." (1977, p. 88) This section will explore the relationship between women's dowries and their marriages from three aspects, namely, for the bride's father, for the future husband, and for the bride herself.

For the bride's father

It was the father's responsibility to provide dowries for his daughters, and "Their marriages would also depend on the dowries their father could provide". (Pearson, 1967) "Among the most honourable deed in a noble man's life was providing for the proper marriage of his daughter. A noble father unable to provide suitable dowries would suffer dishonour, blame and embarrassment." (Queller D. E., 1993) Therefore, (Stone, 1977) believes, "the dowry system, and the cultural obligation to marry off the girls, meant that daughters were a serious economic drain on the family finances". (p. 89)

If a father died, it was the male family member's duty to prepare a dowry, as can be seen in Measure for Measure: Mariana's brother died at sea, and her dowry was lost. "This monetary disaster is perhaps just as devastating to Mariana, since without the promised family money, she loses her fiancé, the 'well-seeming' Angelo." (Tedrowe, 2003) (Spiro, 2020) also concludes that their [Julietta and Mariana] marriages are delayed or cancelled because of complications with their dowries. (p. 101)

She should this Angelo have married; was affianced to her by oath, and the nuptial appointed: between which time of the contract and limit of the solemnity, her brother Frederick was wrecked at sea, having in that perished vessel the dowry of his sister. But mark how heavily this befell to the poor gentlewoman: there she lost a noble and renowned brother, in his love toward her ever most kind and natural; with him, the portion and sinew of her fortune, her marriage- dowry; with both, her combinative husband, this well-seeming Angelo. (III, i.)

In the royal family, the King, as a brother or uncle, usually provided dowries for his sisters or nieces. In King John, he gave his niece Blanch a huge dowry that "shall weigh equal with a queen"

(II. i.) and married her to the French prince, Lewis, as a way to solve international disputes. In King Henry VI, 3, King Lewis XI agreed to marry his sister Bona to Edward, he said, Then, Warwick, thus: our sister shall be Edward's; And now forthwith shall articles be drawn Touching the jointure that your king must make, Which with her dowry shall be uncounterpoised.

(III. iii.)

Clearly, there was a marriage contract concerning the dowry and jointure.

Accordingly, it was the father's privilege to bargain with his daughter's wooers for a higher dower or jointure. In The Taming of the Shrew, the father Baptista was eager to get rid of his shrewish daughter Kate, he did not haggle over terms of the marriage contract. When Petruchio asked: "...

if I get your daughter's love / What dowry shall I have with her to wife?"(II. i.), Baptista immediately gave a seemingly satisfactory offer: "After my death the one half of my lands, / And in possession twenty thousand crowns." (II. i.) Although Baptista did not ask for more, the wooer Petruchio gave a generous jointure:

And for that dowry, I'll assure her of Her widowhood, be it that she survive me, In all my lands and leases whatsoever: Let specialties be therefore drawn between us, That covenants may be kept on either hand. (II. i.)

Soon the contract was settled between the father and the wooer even without the daughter's being notified. But with his outwardly docile daughter Bianca, Baptista acted quite differently. "By weighing his daughter's beauty, age, and sex appeal, a father could establish the price for her hand based on what the market at the time would bear." (Tedrowe, 2003) Since Bianca had more than one wooer, he decided to sell her marriage to the highest bidder:

Faith, gentlemen, now I play a merchant's part, And venture madly on a desperate mart. (II. i.)

'Tis deeds must win the prize; and he of both That can assure my daughter greatest dower Shall have my Bianca's love. (II. i.)

From these few lines, we can conclude that, a dowry could be both a burden to and an opportunity for the father, depending on his financial status and whether his daughter was popular or not. In addition, provided that the dowry was properly settled, the bride's family could also benefit from her dowry. Just as (Tedrowe, 2003) said, "the bargaining he [Baptista] does for his daughters' dowry prices a direct consequence of one family's financial and social situation." (p. 254) "The father of the bride maintained or even gained additional honour or status by insuring that his daughters were properly dowered and married." (Queller D. E., 1993)

For the future husband

The larger dowry you have, the brighter your prospect of marriage will be It is human nature to marry rich, so many examples can be found in this category. As in *The Taming of the Shrew*, Petruchio came purposely to look out for a wife, who, nothing discouraged by these reports of Kate's temper, and hearing she was rich and handsome, resolved upon marrying this famous termagant, and taming her into a meek and manageable wife. The following lines clearly displayed his intention and resolution: ... and therefore, if thou know One rich enough to be Petruchio's wife, As wealth is burden of my wooing dance, Be she as foul as was Florentius' love, As old as Sibyl and as curst and shrewd As Socrates' Xanthippe, or a worse, She moves me not, or not removes, at least, Affection's edge in me, were she as rough as are the swelling Adriatic seas: I come to wive it wealthily in Padua; If wealthily, then happily in Padua.

(I. ii.) If wealthily, then happily in Padua. (I. ii.) In this same play, one of Bianca's wooer, Hortensio, when she proved unresponsive to his love, decided to settle for "a wealthy widow ... a lusty widow now, /That shall be woo'd and wedded in a day." (IV. ii.) Notice that, in his mind, "lusty" and "wealthy" are interchangeable adjectives, equally belonging to the widow; nothing else is required to make her both desirable and attainable. (Jacobs, 2001)

In *The Merchant of Venice*, Bassanio, who had already spent all his own money and hoped to pay off his debts by marrying an heiress, claims, "but my chief care / Is, to come fairly off from the great debts." (I. iii)

In *Much Ado About Nothing*, "from the beginning of his wooing, Claudio seems to be a young man with his eyes set on marrying a rich wife." (Ranald, 1979) Before his wooing, he asked Don Pedro, "Hath Leonato any son, my lord?" Don Pedro answered, "No child but Hero; she's his only heir." (I. i.) Then he confessed that he had liked Hero even before he went to war.

Dowry lost, marriage lost We have talked about Mariana's example; here is another one from *King Lear*. When King Lear tested his three daughters' love toward him, he was dissatisfied

and annoyed by his most beloved daughter Cordelia's answer, "... I love your majesty / According to my bond; nor more nor less."(I.

i.) After beseeching Cordelia to mend her speech a little and getting no improved reply, Lear deprived her of all her dowry, and distributed it to his two sons-in-law, leaving with Cordelia her truth and pride as the dowry, "Let it be so; thy truth, then, be thy dower" "Cornwall and Albany, /

With my two daughters' dowers digest this third: / Let pride, which she calls plainness, marry her."(I. i.)

As Burgundy, one of Cordelia's wooer, learned of Lear's actions, he restated his interest in only what Lear had offered him. He still expected to receive Cordelia along with her dowry, "Royal Lear, / Give but that portion which yourself proposed, / And here I take Cordelia by the hand, / Duchess of Burgundy."(I. i.) As soon as Lear informed him that she no longer carried a dowry, he dropped the idea of marrying her and said, "I am sorry, then, you have so lost a father / That you must lose a husband."(I. i.)

"She is herself a dowry." (King Lear, I. i.) Miracles sometimes did happen. The king of France, another wooer of Cordelia, rescued her from her misery after Burgundy refused to marry her, but only after speaking to Lear. When he first heard of Cordelia's banishing, he thought that it was strange that the one who he loved the most would do something so monstrous as to be stripped of his benevolence. After speaking to Cordelia and listening to what she said, he realized that she had spoken the truth and still loved Lear the most. In his noble sense, he regarded Cordelia's virtues as the most valuable, and took her in.

Fairest Cordelia, that art most rich, being poor;

Most choice, forsaken; and most loved, despised!

Thee and thy virtues here I seize upon:

Be it lawful I take up what's cast away.

Gods, gods! 'tis strange that from their cold'st neglect

My love should kindle to inflamed respect.

Thy dowerless daughter, king, thrown to my chance,

Is queen of us, of ours, and our fair France:

Not all the dukes of waterish Burgundy

Can buy this unprized precious maid of me. (I. i.)

The same thing happened in *The Merry Wives of Windsor*. Fenton was first attracted to woo Anne by Page's money, as he himself confessed, "thy father's wealth / Was the first motive that I woo'd thee, Anne". However, his seduction took a strange turn, when he came to realize that Anne was "of more value / Than stamps in gold or sums in sealed bags; / And 'tis the very riches of thyself /

That now I aim at." (III. IV.)

In *All is Well That Ends Well*, upon hearing Bertram's refusal to marry Helena, the king declared:

"If thou canst like this creature as a maid, / I can create the rest: virtue and she / Is her own dower; honour and wealth from me." (II. iii.) Obviously, in the king's eye, Helena's virtue was her own dower.

For the sake of securing dowry

In *Measure for Measure*, Claudio and Juliet's marriage contract was a "true" one (I. ii), but "their consummated contract is a union that in English law would be valid but irregular, arising from a 'true contract' de praesenti made in secret between the lovers, but not ratified by public ceremony in facie ecclesiae." (Ranald, 1979) Due to the lack of public ceremony, Claudio was considered to have committed fornication, therefore was imprisoned and nearly sentenced to death. Why did he risk his life by not getting married? The fact was that Claudio and Juliet were to be married, but problems with Juliet's dowry delayed the wedding. They wanted to secure the safety of her dowry, lest it should be deprived of as happened in Cordelia's case, if her friend was not in favour of their marriage.

Thus stands it with me: upon a true contract I got possession of Julietta's bed:

You know the lady; she is fast my wife, Save that we do the denunciation lack
Of outward order: this we came not to, Only for propagation of a dower
Remaining in the coffer of her friends, From whom we thought it meet to hide our love
Till time had made them for us. (I. ii.)

For the bride herself Although it was mainly the father's obligation to prepare a dowry, the bride herself could win a dowry for herself. In *All is Well That Ends Well*, Helena, confronted with the huge gap in both social and financial status between her beloved Bertram and herself, was determined to rely on herself and take advantage of the king's disease, Our remedies oft in ourselves do lie, which we ascribe to heaven: the fated sky Gives us free scope, only doth backward pull Our slow designs when we ourselves are dull.

The king's disease- -my project may deceive me, But my intents are fixed and will not leave me. (I. i.) She cured him with her father's special prescription and demanded a special gift from the king: a husband. The king let her choose from his noble bachelors, Fair maid, send forth thine eye: this youthful parcel of noble bachelors stand at my bestowing, O'er whom both sovereign power and father's voice I have to use: thy frank election make; Thou hast power to choose, and they none to forsake. (II.iii.) On hearing Bertram's refusal, the king offered her a noble fame and a huge dowry that was at least equal to Bertram's estate, If thou canst like this creature as a maid, I can create the rest: virtue and she Is her own dower; honour and wealth from me. (II. iii.) Take her by the hand, And tell her she is thine: to whom I promise A counterpoise, if not to thy estate A balance more replete. (II.iii.)

With her determination and the help of this dowry and the king, she finally obtained her marriage. In this same play, Diana won herself a dowry by helping Helena to gain her conjugal rights and finally get her husband back. But Diana's willingness to help came from

Helena's generous offer and her trustworthiness. Take this purse of gold, And let me buy your friendly help thus far, Which I will over-pay and pay again When I have found it. (III. vii.) ... after this, To marry her, I'll add three thousand crowns To what is passed already. (III. vii.) Apart from Helena's offer, the king also told her to "Choose thou thy husband, and I'll pay thy dower." (V. iii.)

CONCLUSION

By surveying existing scholarly work on dowries, particularly those focused on historical and Italian contexts, this study aims to provide a nuanced literary analysis of how dowry negotiations reflect the social and economic status of women in the Elizabethan Age based on Shakespeare's plays. While individual characters like Cordelia, Helena, and Diana demonstrate the potential for agency, the prevailing societal structures often limited their choices and freedoms. This exploration of women's roles highlights a complex tapestry of economic dependency, societal expectations, and emerging individualism. Shakespeare's works serve as a critical lens through which these themes can be examined, revealing both the constraints placed on women and the subtle ways they navigated their social realities. This duality reflects broader societal tensions regarding gender, power, and identity, making it a rich area for further study and discussion.

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Nature's Language: Soundscape Cultural Ecology in Anuradha Roy's The Folded Earth

Manjiri A. Kothale

MA, B.Ed. SET

Dr. Satish G. Kannake

M. A, B. Ed, M.Phil. Ph.D. SET

Assistant Professor in English

S.P College, Chandrapur

ABSTRACT

This research examines the idea of soundscape cultural ecology in Anuradha Roy's *The Folded Earth*, illustrating how the novel uses sound as a key tool for comprehending the connection between identity, memory, and place. The story, which is set in Himalayan town of Ranikhet, creates a rich acoustic world where human voices, customs, and silences blend with the sounds of nature, such as rustling leaves, chirping birds, running rivers, and distant echoes.

His study illustrates how auditory landscapes impact both individual and group belonging by analyzing how sound influences Maya's emotional and cultural journey. The study goes on to say that the *Folded Earth* portrays as a dynamic, communicative force that communicates ecological knowledge and cultural memory, rather than only as a physical or visual presence. This study highlights the function of both natural and man-made sounds increasing a feeling of place and reaffirming ecological identity, drawing on ideas of soundscape ecology and cultural ecology. The study concludes by showing how sound is portrayed in Roy's novel as a tool for both connection and displacement, thereby reaffirming the notion that listening to one's surroundings is essential to comprehending oneself and society.

KEYWORDS: Soundscape, Geophony, Biophony, Anthropophony, Culture, Ecology.

INTRODUCTION

The interdisciplinary area of 'soundscape cultural ecology' studied the interrelationships among sounds, environment, and culture. It investigates how sounds, both natural and man-made, influence ecological systems, cultural behaviours, and identities. As a part of his World Soundscape Project, Canadian composer and environmentalist Murray Schafer originally used the term "soundscape" in his book 'The Turning of the World' (1977). Schafer's work laid the groundwork for understanding how acoustic surroundings impact human behaviours and cultural development. In the middle of 20th century, anthropologist Julian Steward popularized the idea of cultural ecology in 'Theory of culture change: The Methodology of Multilinear.

Evolution' (1955), which examine the relationship between human culture and their surroundings. These concepts are combined in soundscape culture ecology, which emphasizes the acoustic aspects of ecological cultural systems.

The development of human language is an intriguing process that started with early hominids and progressed through modern humans. A primitive system of communication was developed by early people by imitating the sound of animal, wind, water, and other

environmental factors. These sounds were altered, abstracted, and organized into intricate linguistic system over time. In addition to being utilitarian, this process had a close relationship with the ecological and cultural environments in which people lived. By incorporating ecological knowledge and cultural values into its structure, language evolved into a vehicle for identity creation, storytelling, and ritual.

In order to create cultural identity, soundscapes are essential. Bird calls, leaf rustling, and human activity rhythms are just a few examples of the noises that get embedded in a community's collective memory. These sounds create a cultural ecosystem of sound since they are frequently infused with mythological and symbolic connotations. For instance, in many cultures, the cuckoo bird's call has profound cultural and mythological meaning. While the cuckoo is frequently mentioned in poetry and music, its call is connected to love and desire in Indian mythology and the approach of spring and renewal in European folklore. These connections are not merely audible; they are ingrained in the culture and have an impact on rituals, literature, and the arts. These cultural interpretations of the cuckoo's sound show how acoustic aspects are incorporated into cultural narratives, influencing ecological activities and identity formation.

The intricate relationship between sound, culture, and environment is emphasized by soundscape cultural ecology, which provide insight into how societies understand and adapt to their surroundings. Soundscapes can be classified into three broad patterns:

1. Geophony- the sound of the natural world, such as wind, rain, and water currents.
2. Biophony- the collective sounds of living organisms, including birds, insects, and

Mammals Anthropophony- human-made sounds, including speech, music, and mechanicals

noises. Anuradha Roy's 'The Folded Earth', presents a rich tapestry of soundscapes that reflect the intricate relationship between humans and their environment. Set in the Himalayan foothills, the novel vividly captures geophonic, biophonic, and anthropophonic element to create an immersive sensory world. The protagonist, Maya, navigates a landscape where natural sound shape her emotions and memories, while Puran's deep attunement to the wilderness reflects an alternative way of knowing and existing through sound. The novel's portrayal of soundscape highlights how acoustic elements influence cultural narratives, community interactions, and personal identities. By analyzing 'The Folded Earth', through the lens of soundscape cultural ecology, this paper seeks to illuminate the novel's exploration of nature's language as an essential bridge between human and the natural world.

The basic element of the soundscape is made up of Geophony, or the sound produced by non-biological nature components like wind, water, and earth movements. Both human and animal behavior are influenced by these sounds, which provide a continuous backdrop against which life develops. Geophonic elements are very symbolic and useful in many cultures. While the distant rumble of thunder warns of impending storms, the rustle of leaves in the breeze might indicate seasonal changes. These organic noises influence how people perceive time and space, highlighting the connection between nature and culture. Bernie Krause, a pioneering bio acoustician, emphasizes the importance of geophony in shaping ecosystems, stating, "Before there were birds, frog, or any other biological sound producers, there was geophony-

the non- biological sounds that occur in any given habitat, such as the effects of wind in the trees, water in a stream, or waves at an ocean shore” (Krause17) these nature sounds are more than just background noise; they actively influences cultural narratives and ecological consciousness.

In Anuradha Roy’s novel ‘The Folded Earth’, the soundscape of Ranikhet, a Himalayan town, is vividly portrayed, with geophony playing a significant role as one of its components. Geophony, the sound generated by the Earth’s natural processes, is woven into the narrative, creating a rich tapestry of sounds that reflect the town’s cultural ecology. Anuradha Roy skillfully incorporates geophony into the cultural ecology soundscape of ‘The Folded Earth’, highlighting the close bond between people and the natural environment. Ranikhet’s rhythm is shaped by the sound of the Himalayan landscape, which include ‘the distance thunderclap’, ‘gurgling of secret mountain streams’, and ‘the whispering wind through pine forests, Time is reflected in ‘the rustle of dried leaves’ and ‘the creaking of old trees’, and Maya’s solitude is echoed in ‘the qui of snow– capped summits. Charu’s reflection- “That first week in October, I thought I could hear the creaking on its tilted axis, moving further in opposite direction each day, towards cold months,” (TFE 205). It adds another dimension to this geophonic experience, emphasizing how seasonal transitions are felt not just through sight but through sound. The soundscape is altered by the monsoon, which dictates everyday activities and feeling as ‘rain drums against rooftops’ and ‘soil and thunder sweep across valleys. The text brings the reader to a world where the sounds of the Earth actively engage with human existence, going beyond merely describing the natural world. Roy emphasizes cultural ecology through this geophonic symphony, in which human identity is deeply intertwined with nature’s rhythms.

Cultural ecology’s soundscape is greatly influenced by Biography, or the aggregate sound made by non-human species in a given setting. Bird calls, bug chirps, and animal vocalizations are example of natural sounds that traditional societies frequently interpret as a part of their ecological knowledge system, cultural narratives, and rituals. Scholars like Katy Payne have highlighted the interwoven relationship between environment and society through sound, saying.” Biophony is not just a collection of individual sound; it is a complex, ever-changing soundscape that reflects the dynamics of the ecosystem.” (Payne 145). Communities preserve ecological balance by incorporating biophony into their traditions, thereby reaffirming the connection between environmental consciousness and cultural identity.

In ‘The Folded Earth’, Anuradha Roy intricately weaves biophony into the cultural ecology of Ranikhet, portraying the deep connection between human and nature. The novel captures birdsong, animals call, and insect rhythms as integral to daily life. The chirping of thrushes and bulbuls marks the dawn, while Charu’s goats and cows add to the pastoral soundscape with their bells and bleats. Langurs rustling through pine branches and the nocturnal calls of jackals, owls, and cicadas create an immersive auditory experience. Even in silence, nature pulses with life. Diwan Sahib’s observation- “Grown-up Golden Eagles make a two- syllable ‘kee- yep’ sound in a slow, measured series. Their young call piercing, insistent ‘ssseeeeeee- chk’ or ‘Kikiki’ notes.” (TFE 177). It adds to this rich tapestry, illustrating how the sounds of birds not only mark the passage of time but also create a layered sonic environment.

Roy's depiction of biophony underscores how the environment is an active force shaping the characters' emotions and interaction. Maya's journey from urban isolation to solace in the mountains is marked by natural sounds that become symbols of time, memory, and healing.

The land itself seems to communicate- through the warning of animals or the whispers of trees- reinforcing the novel's ecological consciousness and the deep interdependences of nature and human culture. The soundscape's human generated element, Anthropology, is essential to cultural ecology because it captures the relationship between the environment and society. These sounds, which range from the steady pace of footsteps on forest paths to the far of hum of farm equipment, influence how people interact with their environment. R. Murray Schafer, in 'The Soundscape;

Our Sonic Environment and Turning of the World' (1977), emphasizes that "every soundscape is unique according to the time and place of its origin." (Schafer.7) highlighting how human activities imprint themselves onto natural soundscapes. Natural biophony and the sounds of traditional crafts, temple bells, and market banter combine to create a symphony of coexistence in rural areas. Natural elements are frequently overpowered by industrial, transportation, and mechanical disturbances that redefine ecological interactions in urban areas.

By showing how sound not only reflect but also shape ecological and social phenomena, the study of anthropophony in cultural ecology therefore illuminates the changing link between people and their surroundings. Anuradha Roy illustrates the relationship between humans and their surroundings in the Himalayan towns of Ranikhet in 'The Folded Earth', by integrating anthropophony – the manmade sound that blend with nature- into the soundscape of cultural ecology. Diwan Sahib,

who has been greatly influenced by the Jim Corbett, shows his profound knowledge of the forest's auditory environment by practicing mimicking animal and bird cries. His capacity to mimic these noises shows an effort by humans to interact with nature, making it difficult to distinguish between human and non-human voices. Puran Singh's grunts and other vocalizations, which frequently resemble animal sounds, also demonstrate an innate bond with the land and its inhabitants. These sounds demonstrate how human civilization absorbs and reacts to natural noises; they are not merely imitations but rather a way of interacting with the surroundings. 'The clatter of knitting needles' clicks Charu's knitting needles as she works on a sweater, a rhythmic sound that merges with the natural surroundings, 'the ringing of temple bells and religious chant', drifting through the air create a spiritual soundscape that intertwines culture with nature. These sounds signal the rhythm of daily life, marking prayers, festivals, and moments of reflection. 'The echo of footstep on pine needles and village paths', creating a subtle human interaction with the landscape. The sound of wooden doors creaking open, buckets filling with water at a well, and the occasional bark of dog responding to human movement all reinforce this connection.

CONCLUSION

'The Folded Earth's' examination of soundscape cultural ecology highlights the close relationship between the environment and cultural identity by illuminating the ways in which Anuradha Roy skillfully incorporates natural rhythms into human experience. Diwan Sahib is

a character in the book who exemplifies this sensitivity by paying attention to the noises of the mountains, the wind, and the Earth's respiration. His sensitivity to the language of nature serves as a reminder that everything around us is alive and uses biophonic and geophonic aspect to communicate all the time. We must develop this same awareness as stewards of the planet, learning to respect the earth's voice and pay attention to its murmurs. It is very important to urge students to lay their literal and metaphorical ears to the ground in order to understand that the land communicates, breathes, and supports us. In addition to cultivating a greater ecological conscious, listening to these natural symphonies deepens our connection to the living world that supports us.

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A Critical Study of Integral Yoga

Dr. Renu Chaudhary

Assistant Professor

Department of Philosophy

C.M.P. Degree College, Prayagraj

Generally, a human being adopts a natural process to live life that helps maintain physical, mental, social, and spiritual progress. In this context, even today, yoga reflects the relevance of the path of living. This can be observed in relation to the contemporary Indian philosopher, Maharshi Sri Aurobindo, and his thoughts on yoga. For this, it is essential to examine what Maharshi Sri Aurobindo's yoga is and why he designated it as "Integral Yoga." The discussion and analysis of these questions constitute the primary subject of this research paper. The analytical-philosophical method has been employed to elucidate this. Yoga, in general, means union or samadhi (spiritual absorption). In the Bhagavad Gita, it is defined as "**Samatvam Yoga Uchyate**" (Yoga is equanimity) and "**Yogah Karmasu Kaushalam**" (Yoga is skill in action). Maharshi Sri Aurobindo interpreted yoga according to his metaphysical beliefs and termed it "Integral Yoga." Integral Yoga signifies the union with divinity, which can occur at transcendental, universal, or individual levels simultaneously. Additionally, it integrates Hatha Yoga, Raja Yoga, the threefold path (Jnana Yoga, Bhakti Yoga, Karma Yoga), and the path to liberation through the realization of "**Truth.**"

In Integral Yoga:

- **Hatha Yoga** focuses on the body and life-force (prana) as means of spiritual practice.
- **Raja Yoga** emphasizes the mind.
- **Jnana Yoga** engages the intellect and inner vision.
- **Karma Yoga** relies on the will of the doer.
- **Bhakti Yoga** takes devotion and divine beauty as its means.

Through these, one attains divine life. The process of **Hatha Yoga** is psycho-physical, **Raja Yoga** is mental and inner-spiritual, **Jnana Yoga** is intellectual and spiritual, **Karma Yoga** is spiritual and action-oriented, and **Bhakti Yoga** is spiritual, emotional, and aesthetic. However, ultimately, the power of all these practices is essentially one – the "**Soul Power**" (**Atma Shakti**), which leads to the realization of "**Truth.**"

Thus, it can be said that when **Atma Shakti** reaches its peak in one direction, its other potentialities also begin to manifest as real possibilities. This unity of forces shows how Integral Yoga becomes possible.

Maharshi Aurobindo followed a method of integration wherein he adopted the Vedantic approach to achieve the goals of Tantra. In the **Tantric system**, power (Shakti) is primary and is considered the key to the discovery of the soul. However, in **Integral Yoga**, the "soul-person" (Atma Purusha) is central, and he alone is the key to elevating power (Shakti). This integration acknowledges not only the **psychic soul within the human body** but also its

latent energies. This allows an individual to begin their yogic practice from this level itself. The psychic person (Manomaya Purusha), by opening himself directly to the **higher spiritual force and authority**, can elevate his being spiritually. In this way, by attaining the higher power and setting it into action, he can perfect the entire nature (Prakriti).

Methods of Integral Yoga

In Integral Yoga, the techniques of **Hatha Yoga** can be omitted, although partial application is not objectionable. The techniques of **Raja Yoga** can enter as an irregular element, meaning they are used only as a preliminary or situational practice. However, the **triple key of knowledge (Jnana), action (Karma), and devotion (Bhakti)** must certainly be applied through the powers of the **psychic being** (Manomaya Purusha). Thus, through **various small paths**, spiritual powers and divine authority expand to their fullest potential, making human life spiritually free and divine.

To analyze the nature of Integral Yoga, it is essential to clarify Maharshi Sri Aurobindo's concepts of **Hatha Yoga, Raja Yoga, and the Threefold Path (Trimarga)**:

Hatha Yoga

Hatha Yoga aims at **attaining union with the Supreme Being** through effort and **achieving samadhi**. This makes it clear that Hatha Yoga, Raja Yoga, and the threefold path are merely **means to reach samadhi**. However, Hatha Yoga is **rigorous, difficult, and a powerful system**. It is based on the intimate relationship between **body and soul**. In Hatha Yoga, **bondage and liberation, i.e., mortality and immortality, are based on the body itself**.

For a **Hatha Yogi**, the body is not merely a **living material mass** but a **mystical bridge between spiritual and physical existence**. Hatha Yoga attempts to provide the soul, through certain **scientific processes**, with increasing **power, light, purity, and freedom** within the physical body so that it becomes as **naturally accessible** to the soul as the **subtle body**.

Hatha Yoga is a **psychophysical system**, while Jnana Yoga is **psychological**, yet both produce **physical, inner, and spiritual** results. Essentially, both are positioned at **different poles of the same truth**. The three fundamental principles of yoga are:

1. **Purification (Shuddhi)**
2. **Concentration (Ekagrata)**
3. **Liberation (Mukti)**

The ultimate aim of **Hatha Yoga** is to utilize **this liberated power**. It follows a system of **asana (postures) and pranayama (breathing exercises)** as the main methods. Other elements are merely supportive.

Raja Yoga

Raja Yoga **opens all blocked gates of the body through the key of the mind**, whereas Hatha Yoga uses the body and life-force (prana) as its key. In both Hatha and Raja Yoga, **asana and pranayama** play a role.

Maharshi Aurobindo, like **Swami Vivekananda**, accepted the **eightfold path of Raja Yoga**:

1. **Yama** – Ethical discipline
2. **Niyama** – Personal observances
3. **Asana** – Physical postures
4. **Pranayama** – Breath control
5. **Pratyahara** – Withdrawal of the senses
6. **Dharana** – Concentration
7. **Dhyana** – Meditation
8. **Samadhi** – Spiritual absorption

The ultimate goal of Raja Yoga is **to withdraw the mind from the external and mental world and unite with the Divine.**

The Threefold Path (Trimarga)

Integral Yoga incorporates the **threefold path of Karma (action), Jnana (knowledge), and Bhakti (devotion)** as a means to union with the Divine.

- **Karma Yoga** emphasizes **selfless action** without attachment to its fruits.
- **Jnana Yoga** focuses on **self-inquiry and wisdom** to realize the true nature of existence.
- **Bhakti Yoga** is the **path of devotion and surrender to the Divine.**

Conclusion

Integral Yoga integrates **Hatha Yoga, Raja Yoga, and the threefold path** into a **holistic system** where **physical, mental, and spiritual** disciplines harmonize. Maharshi Aurobindo emphasized **the soul's power (Atma Shakti) as the central force** that enables spiritual evolution and divine transformation. The essence of Integral Yoga lies in **synthesizing all these paths** to achieve the **highest realization of truth and divine life.**

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