



RESEARCH ARTICLE

A study on sustainable technology development of fintech 5.0 in Indian industries

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Abstract

Fintech 5.0 marks the most recent and transformative phase in the evolution of financial technology, characterized by the integration of advanced innovations—such as artificial intelligence, blockchain, and quantum computing—with the principles of sustainable development. This study examines how Indian industries are adopting Fintech 5.0 to enhance operational efficiency, promote financial inclusion, and achieve sustainability goals. Through the analysis of secondary data—including government policies, industry reports, and scholarly literature—the research identifies current trends, opportunities, and barriers. Findings indicate that Indian sectors are increasingly utilizing Fintech 5.0 solutions to enable green finance, lower transaction costs, and boost digital financial literacy among underserved populations. Despite these advancements, the industry faces challenges, including regulatory ambiguity, infrastructural limitations, and heightened cybersecurity risks. By benchmarking global best practices, this paper outlines India's distinct approaches and strategic responses. The study offers practical recommendations to policymakers and stakeholders, contributing to the expanding discourse on Fintech 5.0 and emphasizing its transformative potential for a resilient and sustainable financial future in India.

Keywords: Fintech 5.0, Sustainable development, Indian industries, Digital Transformation, Financial inclusion, Blockchain, Green finance, Artificial intelligence.

Introduction

The financial technology sector, commonly referred to as fintech, has witnessed remarkable evolution over the past few decades. From simple digital payment solutions to complex AI-driven financial models, fintech has continuously adapted to the changing needs of businesses and consumers. Fintech 5.0 represents the latest phase in this evolution, integrating cutting-edge technologies such as artificial intelligence (AI), blockchain, quantum computing, and the Internet of Things (IoT) while prioritizing sustainability, inclusivity, and ethical financial practices. Unlike previous fintech iterations, which primarily focused on efficiency and convenience, Fintech

5.0 emphasizes the alignment of financial innovation with sustainable development goals (SDGs), making it particularly relevant for emerging economies like India.

In India, where the financial landscape is diverse and rapidly evolving, Fintech 5.0 holds immense potential to drive economic growth, enhance financial inclusion, and promote environmentally sustainable financial practices. With increasing smartphone penetration, digital payment adoption, and regulatory support, Indian industries are leveraging fintech solutions to improve efficiency, reduce costs, and enhance customer engagement. However, despite these advancements, challenges such as regulatory ambiguities, cybersecurity risks, and an urban-rural digital divide hinder the full-scale adoption of Fintech 5.0. Additionally, the integration of green fintech initiatives—such as digital banking for paperless transactions, blockchain for carbon credit transparency, and AI-driven sustainable investment solutions—remains underexplored in the Indian context.

This study examines how Indian industries are adopting Fintech 5.0, with a focus on its role in enhancing financial inclusion, optimizing industrial processes, and promoting environmental sustainability. The research assesses current trends, challenges, and opportunities within the Indian fintech landscape, drawing comparisons with global best practices to provide actionable insights.

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How to cite this article: Selvaraj, D. (2025). A study on sustainable technology development of fintech 5.0 in Indian industries. The Scientific Temper, 16(spl-2):34-39.

Doi: 10.58414/SCIENTIFICTEMPER.2025.16.spl-2.06

Source of support: Nil

Conflict of interest: None.

Literature Review

The intersection of financial technology and sustainable development has been a growing area of academic interest. Several studies have explored various aspects of fintech adoption, its economic impact, and its potential to promote financial inclusion.

Fintech Evolution and Sustainable Development

Previous studies have documented the transition from Fintech 1.0, which involved the digitization of traditional banking, to Fintech 4.0, which introduced AI and big data analytics for personalized financial services (Arner *et al.*, 2020). Fintech 5.0 builds on these advancements by integrating ethical AI, blockchain-based transparency, and green finance solutions to align financial growth with sustainability goals (Soni & Raj, 2022).

Financial Inclusion through Fintech

The role of fintech in promoting financial inclusion has been widely discussed in literature. According to Chakraborty and Hossain (2021), mobile payment platforms, such as the Unified Payments Interface (UPI), have significantly expanded financial access in India. Similarly, Kumar *et al.*, (2023) emphasized that fintech solutions, such as micro-lending platforms and digital wallets, have facilitated credit access for small businesses and underserved communities.

Industrial Adoption of Fintech in India

Studies have highlighted how Indian industries are leveraging fintech innovations. For instance, Sharma and Singh (2021) discussed the application of AI and IoT in the manufacturing sector for predictive maintenance and supply chain optimization. In the banking sector, AI-driven customer service automation and blockchain-based secure transactions have improved operational efficiency (Sarma & Rao, 2023). However, research on the specific adoption patterns of Fintech 5.0 in Indian industries remains limited.

Green Fintech and Sustainability

Green fintech has gained traction as financial institutions worldwide explore digital solutions for environmental sustainability. Singh *et al.* (2022) noted that green bonds and blockchain-based carbon credit trading have enabled sustainable investment practices. However, studies on the implementation of green fintech initiatives in India remain scarce, making it a critical area for further research.

Regulatory and Security Challenges in Fintech Adoption

While fintech advancements offer several benefits, challenges such as regulatory uncertainties, cybersecurity threats, and digital literacy gaps persist. Gupta and Sharma (2022) emphasized that India's fintech regulatory framework is still evolving, particularly in relation to blockchain and AI applications. Additionally, cybersecurity reports indicate an

increasing number of financial data breaches, highlighting the need for robust security frameworks (KPMG India, 2023).

Research Gap

While existing literature has extensively covered fintech adoption and its economic impact, certain critical gaps remain: namely (1) Limited Research on Fintech 5.0 Adoption in Indian Industries, (2) Underexplored Link between Fintech and Sustainability in India, (3) Regulatory and Cybersecurity Concerns in Fintech 5.0, (4) Urban-Rural Divide in Fintech Adoption.

Objectives of the Study

This study aims to bridge the aforementioned research gaps by addressing the following objectives: (1) To analyze the adoption trends of Fintech 5.0 across different industries in India, (2) To assess the role of Fintech 5.0 in financial inclusion and digital accessibility, (3) To explore the contribution of Fintech 5.0 to environmental sustainability, (4) To identify the regulatory, cybersecurity, and infrastructural challenges hindering the adoption of Fintech 5.0 in India, (5) To compare India's Fintech 5.0 adoption with global best practices.

Materials and Methods

The research employs a secondary data approach to analyze the adoption and impact of Fintech 5.0 in Indian industries. The methodology involves the following steps:

Data Collection

Sources include government reports (e.g., NITI Aayog, RBI), industry surveys, academic journals, and global fintech studies.

Literature Review

Identifying key concepts related to sustainable technology and fintech development.

Data Analysis

Using qualitative and quantitative data to analyze trends, challenges, and opportunities.

Comparison with Global Practices

Drawing parallels with countries leading in Fintech 5.0 to identify best practices and gaps in India.

Visualization

Tables and charts are used to present findings effectively.

Results

Adoption Trends of Fintech 5.0 Across Indian Industries

The implementation and adoption of Fintech 5.0 technologies have been observed to follow specific patterns across various industries in India (Table 1). These technologies—such as blockchain, AI, big data analytics, IoT, and cloud computing—are being implemented differently

depending on the sector's requirements, market readiness, and infrastructure. A closer look into the industries reveals the following trends:

Banking and Financial Services

Indian banks are significantly adopting Fintech 5.0 technologies to streamline their operations and offer better customer service. Artificial Intelligence (AI) is heavily employed for fraud detection, risk management, and customer service through chatbots. Blockchain is used in creating more secure, transparent, and decentralized systems for transactions and financial management, such as the integration of RippleNet for cross-border payments. Banks like ICICI and HDFC are integrating AI-powered solutions and robotic process automation (RPA) to improve operational efficiency and reduce human error in repetitive tasks.

Retail and E-commerce

E-commerce companies, including Flipkart, Amazon India, and Reliance Digital, are utilizing advanced fintech tools such as digital wallets, UPI (Unified Payments Interface), and blockchain for supply chain management and product authentication. The growth of digital payments, especially UPI, has been rapid in urban and semi-urban markets, boosting the retail sector significantly. Moreover, AI-driven recommendation engines are enhancing customer experiences by offering personalized product suggestions based on consumer data.

Manufacturing

Fintech 5.0 is revolutionizing the manufacturing sector by incorporating IoT and AI into the production lines. Companies are utilizing IoT sensors to monitor equipment performance, prevent downtime, and optimize resource usage. AI is being integrated for predictive maintenance, reducing maintenance costs, and extending the lifespan of machinery. For example, Tata Motors is utilizing AI in its factories to optimize vehicle production, while Bosch is exploring the use of blockchain to improve traceability in its supply chains.

Agriculture

The agriculture sector is beginning to experience the benefits of Fintech 5.0 through IoT, AI, and blockchain-based platforms. Blockchain is utilized to create transparent and traceable supply chains, ensuring fair pricing and reducing the need for intermediaries in the agricultural market. Companies like AgroStar and DeHaat are leveraging fintech to provide farmers with access to financing and market linkages. Additionally, IoT-based solutions are being implemented to optimize irrigation, track soil health, and increase agricultural productivity, which is vital for rural areas.

Table 1: Industry-wise adoption levels of fintech 5.0 in India

Industry	Technologies Used	Adoption Percentage (%)
Banking	AI, Blockchain, Cloud	78%
Insurance	IoT, Predictive Analytics	65%
Retail	Digital Payments, Blockchain	58%
Manufacturing	IoT, Blockchain	49%
Agriculture	IoT, Blockchain	42%

Source: KPMG India (2023). Fintech in India: Driving Digital Transformation, NASSCOM (2023). Emerging Technologies in Indian Industries.

Financial Inclusion and Digital Accessibility

Fintech 5.0 has played a significant role in promoting financial inclusion in India, particularly in rural and underserved areas. Mobile banking apps, digital wallets, UPI, and micro-lending platforms have enabled millions of unbanked individuals to access financial services. Notably, the rise of the Unified Payments Interface (UPI) and mobile wallets has made transactions more accessible, even for people with limited digital literacy.

Growth of UPI

UPI transactions in India have grown at an exponential rate, with the National Payments Corporation of India (NPCI) reporting a transaction volume of over 12 billion transactions in 2023. This highlights the ease of financial transactions for individuals, even in remote areas, through smartphones.

Micro-lending platforms, such as Lendbox and IndiaLends, have democratized access to credit for individuals and small businesses by utilizing alternative credit scoring models that incorporate data from social media activity, mobile usage, and transaction history from digital platforms.

Environmental Benefits through Green Fintech

Fintech 5.0 contributes to sustainable development, particularly through green fintech initiatives. These initiatives utilize blockchain, AI, and data analytics to create sustainable financial products and solutions (Table 2).

Green Finance Initiatives

A growing number of financial institutions in India are now offering green bonds, ESG (Environmental, Social, and Governance) investment products, and climate-linked financing solutions. Yes Bank, for instance, has launched a Green Bond Fund aimed at raising funds for environmentally sustainable projects. The use of blockchain in the green finance sector also ensures transparency in tracking carbon credits, making the trading of these credits more efficient.

Table 2: Environmental benefits of fintech 5.0 adoption

Environmental Benefit	Description	Example
Reduction in Paper Usage	Digital banking processes reduce paperwork.	ICICI, HDFC: Paperless KYC, transactions
Sustainable Financing	Green bonds and sustainable investment funds.	Yes Bank: Green Bond Fund
Transparency in Carbon Credits	Blockchain ensures transparency in carbon credit trading.	PowerLedger: Blockchain-based trading platform

Sources: ICICI Bank Annual Report (2023), Yes Bank Green Bond Fund (2023), PowerLedger (2023)

Digital Banking for Paperless Transactions

Many banks are now encouraging paperless banking through mobile apps and digital KYC (Know Your Customer) processes. This is particularly impactful in reducing paper waste and operational costs. The move towards digital has not only made banking more accessible but also aligned with sustainable practices by reducing carbon footprints.

Challenges in the Adoption of Fintech 5.0

Despite its potential, several barriers hinder the widespread adoption of Fintech 5.0 technologies across India.

Regulatory Challenges

The regulatory landscape for emerging technologies like blockchain and AI remains unclear in India. While the Reserve Bank of India (RBI) has issued guidelines on fintech operations, regulations for blockchain-based services, particularly those related to cryptocurrencies, are still evolving. The lack of a clear regulatory framework has resulted in uncertainty for businesses and investors.

Cybersecurity and Fraud Risks

As digital financial services grow, so does the risk of cyber-attacks and fraud. The lack of sufficient cybersecurity measures in some fintech solutions leaves them vulnerable to hacking. Data breaches and identity thefts have been reported, raising concerns among consumers and businesses alike.

Cost and Infrastructure Barriers

The high initial investment required for implementing Fintech 5.0 technologies poses a barrier, especially for SMEs (Small and Medium Enterprises) that lack the necessary infrastructure and financial resources. While large corporations can afford advanced technologies, smaller companies may struggle to adopt them.

Digital Literacy Gap

A significant challenge remains the digital literacy gap, particularly in rural India. Although smartphone penetration is increasing, many rural populations lack the necessary

skills to effectively use digital financial services, hindering the full-scale adoption of fintech solutions.

Urban-Rural Divide in Fintech Adoption

The adoption of Fintech 5.0 is skewed toward urban areas where digital infrastructure, internet penetration, and tech-savvy populations exist (Table 3). Urban centers like Mumbai, Bengaluru, and Delhi show high adoption rates of digital payments, AI-driven services, and blockchain technologies. In contrast, rural areas face challenges such as poor internet connectivity, low awareness, and limited access to smartphones.

Discussion

The Role of Fintech 5.0 in Promoting Financial Inclusion

One of the most significant impacts of Fintech 5.0 in India has been its role in promoting financial inclusion. According to a study by Soni and Raj (2022), the development of mobile payment platforms, such as UPI, mobile wallets, and micro-lending services, has provided access to financial services for millions of individuals in remote and underserved areas. The findings of this research align with existing literature that emphasizes the importance of digital platforms in increasing financial accessibility. Chakraborty and Hossain (2021) state, “The adoption of UPI has revolutionized financial services by reducing the barriers for rural consumers who previously lacked access to traditional banking services.”

The research indicates that mobile wallets and payment systems, such as Paytm and PhonePe, are driving financial inclusion in India, particularly in rural areas. According to Kumar *et al.* (2023), “UPI has seen exponential growth due to its simplicity and interoperability, facilitating seamless digital payments for the underserved population.” The widespread use of UPI for small-ticket transactions reflects a positive trend toward financial democratization, which is in line with India’s vision of achieving financial inclusion.

However, Sharma and Gupta (2022) argue that despite the rise of mobile financial solutions, the challenges of digital literacy and technological access persist. In rural areas, many

Table 3: Urban vs. rural fintech adoption (2023)

Parameter	Urban Areas	Rural Areas
Internet Connectivity	High (87%)	Moderate (45%)
Fintech Awareness	High (75%)	Low (38%)
Digital Payment Usage (%)	78%	45%
Adoption Rate of Fintech Services	80%	35%

Sources: National Payments Corporation of India (NPCI) Report (2023), Internet and Mobile Association of India (IAMAI) Report (2023), Ministry of Electronics and Information Technology (MeitY) Survey (2023).

users continue to struggle with using smartphones and digital platforms effectively. This gap is a critical barrier to achieving true financial inclusion.

Impact of Fintech 5.0 on the Indian Economy and Industrial Growth

The adoption of Fintech 5.0 technologies has contributed significantly to India's economic growth by improving efficiency in sectors such as banking, retail, manufacturing, and agriculture. The study finds that AI and blockchain technologies are enhancing the transparency and efficiency of financial transactions, boosting investor confidence and driving industrial growth. According to Sarma and Rao (2023), "Fintech 5.0 innovations, particularly blockchain, have brought transparency and security to the financial sector, attracting investments and improving market dynamics."

In the banking and financial services sector, the deployment of AI for customer service and fraud detection has reduced operational costs and enhanced customer satisfaction. A report by The Indian Institute of Management, Ahmedabad (IIM-A) (2022) states, "AI applications in banking are transforming the sector by automating back-office operations and streamlining customer interactions." Similarly, cloud computing and Robotic Process Automation (RPA) are helping financial institutions reduce costs, improve scalability, and enhance data security.

In the manufacturing sector, the integration of IoT and AI has optimized production processes, as observed in companies like Tata Motors and Bosch. Sharma and Singh (2021) highlighted that "Indian manufacturers are adopting AI and IoT to improve operational efficiency and reduce waste, leading to lower production costs and higher output." These advancements are contributing to the sector's competitiveness both domestically and internationally.

However, Mehta *et al.*, (2023) argue that while Fintech 5.0 has spurred growth in many sectors, small and medium enterprises (SMEs) still struggle with high implementation costs and technological limitations. The inability of SMEs to invest in the necessary infrastructure limits the overall scalability of Fintech 5.0's benefits.

Environmental Sustainability through Green Fintech

The research indicates that Fintech 5.0 has been instrumental in driving environmental sustainability through green finance initiatives and digital transformation. As noted in the study by Singh *et al.* (2022), "Green bonds and sustainable finance products powered by blockchain and AI are encouraging investments in renewable energy and climate-conscious projects in India." Platforms like Yes Bank's Green Bond Fund are enabling sustainable development by raising funds for projects that meet environmental standards.

Moreover, the shift towards paperless banking and digital documentation has significantly reduced the environmental footprint of the financial sector. The Indian Ministry of

Finance (2022) reported that "Digital banking initiatives have cut down paper usage in financial transactions by over 30%, contributing to environmental sustainability."

Blockchain is also being utilized to ensure transparency and traceability in carbon credit trading, a crucial aspect of India's commitment to mitigating climate change. According to Chakraborty *et al.* (2021), "Blockchain provides a transparent and immutable ledger for carbon credits, ensuring their proper allocation and reducing fraud in carbon trading systems." This aligns with the sustainable finance initiatives highlighted in the United Nations Sustainable Development Goals (SDGs), where financial inclusion and environmental sustainability are key targets. However, the environmental impact of technology implementation, such as the carbon footprint of data centers supporting cloud computing, is often overlooked. According to Sahani and Agarwal (2023), "The growth of digital infrastructure has led to increased energy consumption, which poses challenges in terms of the environmental impact of Fintech 5.0."

Challenges in the Adoption of Fintech 5.0

While the adoption of Fintech 5.0 technologies presents several benefits, the research identifies multiple challenges hindering their widespread acceptance, especially in rural areas. These challenges include regulatory uncertainty, cybersecurity risks, and digital literacy issues.

Regulatory Uncertainty

A key finding of this study is that regulatory challenges remain a significant barrier to the growth of Fintech 5.0 in India. Although the Reserve Bank of India (RBI) has introduced policies to regulate fintech operations, the absence of clear frameworks for emerging technologies like blockchain, cryptocurrency, and AI leaves businesses and consumers uncertain. Gupta and Sharma (2022) highlight that "The lack of comprehensive regulations has created a fragmented ecosystem, with stakeholders unsure about the legal and operational boundaries of emerging fintech technologies."

Cybersecurity Risks

As digital platforms expand, so do the cybersecurity threats. Hacker attacks and data breaches are increasingly common, posing significant risks to financial institutions and consumers alike. According to a report by KPMG India (2023), "India saw a rise of 24% in cyber-attacks targeting financial institutions in 2022, a trend that is concerning as fintech platforms become more integrated into daily financial transactions." This underscores the need for robust cybersecurity frameworks to ensure consumer trust and prevent financial losses.

Digital Literacy

Despite the rapid growth of digital technologies, digital literacy remains a significant challenge, particularly in

rural India. Many people remain unfamiliar with using smartphones, mobile banking apps, and digital wallets. According to Jain and Verma (2021), "The digital literacy gap in rural India is a critical impediment to the widespread adoption of fintech services, as many consumers struggle with basic digital tools."

Urban-Rural Divide in Fintech 5.0 Adoption

The urban-rural divide remains a persistent issue in India's fintech landscape. While urban areas benefit from better digital infrastructure, rural areas face challenges in terms of internet connectivity, tech infrastructure, and consumer awareness. As the study finds, urban centers such as Mumbai, Bengaluru, and Delhi have witnessed a higher adoption rate of Fintech 5.0 technologies, with UPI, mobile wallets, and blockchain being widely used. In contrast, rural areas still face significant barriers to access.

Patel *et al.* (2022) argue that "Rural regions are lagging in fintech adoption due to low internet penetration and lack of proper digital infrastructure, making it challenging for them to capitalize on Fintech 5.0 innovations fully." While the government's Digital India initiative aims to bridge this gap, progress has been slow, with many rural residents still lacking reliable internet access.

Conclusion

This research highlights the transformative potential of Fintech 5.0 in India across various industries, particularly in promoting financial inclusion, driving economic growth, and fostering environmental sustainability. However, challenges related to regulatory uncertainty, cybersecurity risks, and digital literacy persist. Addressing these barriers will be critical for realizing the full potential of Fintech 5.0 in India. Furthermore, efforts to bridge the urban-rural divide, through improved infrastructure and digital literacy initiatives, will ensure that Fintech 5.0 can benefit all sectors of society.

Acknowledgments

The author thanks the industry experts who shared their knowledge and insights into the current fintech practices in India. Their input was crucial in enhancing the quality of this research.

Conflict of Interest

The author declares no conflicts of interest related to this research.

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