

## Blockchain and Financial Inclusion in India: A New Era for the Unbanked

Tanuj Kumar Yadav<sup>1</sup>; Manoj Kumar Meet<sup>2</sup>; Sanjeev Kumar<sup>3</sup>; Deepak Dixit<sup>4</sup>

### Abstract

The economic growth of rural India relies heavily on connecting isolated villages to both local and international supply chains. Unfortunately, widespread financial exclusion in these rural areas prevents many communities from actively participating in such networks. This paper reviews the existing literature on financial inclusion, blockchain technology, and technology use in India, and highlights that overcoming financial exclusion in rural India requires addressing four major challenges: geographic isolation, high costs, mismatched banking products, and widespread financial illiteracy. We propose that blockchain technology holds great promise in tackling most of these challenges. However, for blockchain to truly contribute to financial inclusion efforts, it is essential to understand how technology adoption works in India. To foster this understanding, we present a research agenda focusing on factors influencing adoption, the patterns of technology adoption, and the outcomes associated with blockchain implementation. Addressing these areas of research will lead to a better understanding of how blockchain can be effectively adopted in rural India. From a practical perspective, this paper explores how blockchain can help reduce financial exclusion, ultimately paving the way for rural communities to participate in global supply chains. On a theoretical level, it identifies critical knowledge gaps that must be filled to achieve comprehensive financial inclusion for people living in rural areas of India.

**Keywords:** Blockchain adoption, Financial Inclusion, Research opportunities India, Economic growth.

### 1. INTRODUCTION

*“All scientists and technologists should focus on relevant regions, particularly on rural technologies, to transform India’s rural sector;”* – A.P.J Abdul Kalam, former President of India.

Abdul Kalam emphasized that the key to India's progress lies in uplifting its rural areas through the use of technology. In 2017, more than 68% of India’s population, which included 72% of the workforce, lived in rural regions (Chand, Srivastava, & Singh, 2017). This amounts to over 700 million individuals residing, working, and consuming in rural India (Census of India, 2001). Sadly, many of these communities remain isolated from both local and global supply chains, preventing them from participating in financial, trade, and labor markets beyond their immediate surroundings. This exclusion has significantly limited economic growth in rural areas, resulting in their lagging far behind urban centers in key developmental metrics like GDP, employment, literacy, poverty, and healthcare (Mukunthan, 2015). What truly separates rural and urban India is their access to global supply networks. While urban residents enjoy global markets for goods, services, and jobs, rural Indians largely do not. Therefore, improving access to supply chains is essential for rural India’s development.

Developing a strong supply chain network in rural India depends heavily on achieving financial inclusion. Financial inclusion means ensuring that people have access to affordable, fair, and secure financial services from mainstream providers (Varghese & Viswanathan, 2018). Without access to basic financial tools, such as bank accounts and government programs, rural Indians lack the means to engage in supply chains, particularly when it comes to making or receiving electronic payments. In 2014, more than 415 million Indians were in this situation, making India one of the largest unbanked populations globally (Harjani, 2015). Recognizing the need for change, the Indian government made financial inclusion a national priority (Banerjee, 2016).

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<sup>1</sup> Research Scholar, Alabbar School of Management, Raffles University, Neemrana, Rajasthan-301705  
Email Add: [raotanjukumaryadav@gmail.com](mailto:raotanjukumaryadav@gmail.com)

<sup>2</sup> Associate Professor, Alabbar School of Management, Raffles University, Neemrana, Rajasthan-301705  
Email Add: [manojkmeet@gmail.com](mailto:manojkmeet@gmail.com)

<sup>3</sup> Professor, Alabbar School of Management, Raffles University, Neemrana, Rajasthan-301705  
Email Add: [sanjeev.kumar@rafflesuniversity.edu.in](mailto:sanjeev.kumar@rafflesuniversity.edu.in)

<sup>4</sup> Assistant Professor, Alabbar School of Management, Raffles University, Neemrana, Rajasthan-301705  
Email Add: [deepak.dixit@rafflesuniversity.edu.in](mailto:deepak.dixit@rafflesuniversity.edu.in)

While initiatives aimed at improving financial inclusion have led to more rural Indians opening bank accounts, these efforts have not ensured that they actively use these banking services. Many still struggle with physical access to financial institutions, face high service fees, or lack the financial literacy needed to navigate the system. As a result, over 190 million people still lack bank accounts (World Bank, 2017), and just 23% of rural account holders use their accounts regularly (NAFIS, 2017). Addressing financial inclusion in rural India requires overcoming these interconnected barriers.

Blockchain technology has the potential to bridge this gap by connecting rural Indians to both local and international supply chains, addressing many of the obstacles faced by financial inclusion efforts. This paper suggests that blockchain can play a significant role by (1) providing digital financial services directly to rural areas, (2) lowering transaction costs, and (3) offering financial products better suited to local needs. Furthermore, due to its decentralized nature, blockchain can connect rural Indians to global markets. However, while blockchain offers potential solutions, its success is not guaranteed. For instance, although mobile banking apps should have made banking more accessible, they have had limited uptake among rural Indians (NAFIS, 2017). To ensure blockchain's effectiveness, it's essential to understand how this unique technology can gain widespread acceptance among diverse rural populations.

Research into technology adoption is well-established within the field of Information Systems (IS) (Venkatesh, Thong, & Xu, 2016). However, studies on blockchain and technology adoption specifically in rural India are limited. Existing research on blockchain adoption has mostly targeted professionals (e.g., Kamble, Gunasekaran, & Arha, 2018; Queiroz & Wamba, 2019), leaving it unclear how rural communities would engage with such technologies. While general studies on technology adoption in rural India have shown that adoption can lead to economic benefits (e.g., Venkatesh & Sykes, 2013; Venkatesh, Sykes, & Venkatraman, 2014), these studies haven't explored the adoption of complex technologies like blockchain. Although blockchain has unique features that might drive adoption (Hughes et al., 2019), underprivileged communities often gravitate toward simpler and more established solutions. This presents a significant challenge, as limited research suggests that adopting blockchain in rural areas could be a complex and nuanced process (Larios-Hernandez, 2017; Swan, 2017). Despite the vast body of research on technology adoption, blockchain adoption in rural Indian contexts remains relatively underexplored and is likely to face distinct challenges (see Johns, 2006, 2017).

To address these challenges, this paper proposes a research agenda aimed at understanding the factors that could drive the successful adoption of blockchain-based financial inclusion initiatives in rural India. Drawing on existing technology adoption research, we identify key gaps concerning the factors that influence adoption, the patterns of adoption, and the outcomes of adopting blockchain in the context of rural India. Addressing new contexts, especially in developing countries like India, has been recognized as a critical focus for future research in this mature field (Venkatesh, Rai, Sykes, & Aljafari, 2016). Moreover, Hughes et al. (2019) emphasize that using blockchain requires careful consideration to ensure that it offers distinct benefits that can effectively address existing challenges. Our paper aims to fulfill two objectives: (a) highlighting blockchain as a promising solution for achieving financial inclusion in rural India, and (b) proposing a research agenda that can guide future studies on blockchain adoption, particularly in developing nations like India.

## **2. LITERATURE REVIEW**

This section explores how blockchain technology can potentially address the pressing issue of financial inclusion in rural India. A structured literature review was conducted, focusing on financial inclusion, blockchain applications, and their intersection in the Indian context. A narrative synthesis of current academic knowledge is presented (Pare, Trudel, Jaana, & Kitsiou, 2015), followed by an examination of blockchain's utility in addressing existing financial barriers.

### **2.1. Financial Inclusion in India**

Financial inclusion refers to the availability and equality of opportunities to access financial services such as banking, credit, insurance, and savings (Varghese & Viswanathan, 2018, p. 2). Marginalized groups—such as farmers, women, minorities, and migrants—face the brunt of financial exclusion. For example, in 2017, only 6% of households had any health insurance coverage and only 26% of women held a savings account (NAFIS, 2017).

Due to such exclusion, individuals often store cash at home and borrow informally from friends or relatives (NAFIS, 2017). This approach exposes them to theft, financial shocks, and instability. A summary of these consequences is shown in table 1.

**Table 1: Consequences of Financial Exclusion**

Lack of...	Coping Practice	Consequence
<b>Bank accounts</b>	Store money at home	Risk of theft or loss. Limited ability to carry out electronic transactions, restricting engagement in supply chain activities.
<b>Access to credit</b>	Use personal savings or borrow from friends and relatives	Hinders ability to provide financial guarantees and establish credit history. Increased risk of lacking necessary financial resources. Risk for lenders.
<b>Insurance</b>	Rely on savings or loans from friends and family	Restricts opportunities for entrepreneurship. Heightens exposure to financial risks, such as health crises or natural disasters.

## 2.2. Challenges in Overcoming Financial Exclusion in India

Addressing financial exclusion in India requires tackling four major challenges:

- **Challenge 1: Geographical Access**
- **Challenge 1: Access to Banking**

Only 5% of rural residents have access to a commercial bank branch (Varghese & Viswanathan, 2018), and only 23% use ATMs regularly (NAFIS, 2017).

- **Challenge 2: Cost of Services**

With average rural household incomes of ₹8000 per month (~\$110), even small financial fees become a burden (NAFIS, 2017). High-interest rates and fees limit accessibility (Arun & Kamath, 2015; Varghese & Viswanathan, 2018).

- **Challenge 3: Inadequate Products**

Excluded individuals often lack credit history or collateral, rendering them ineligible for formal financial services (Banerjee, 2016). Errors in banking services further decrease trust in institutions.

- **Challenge 4: Financial Literacy**

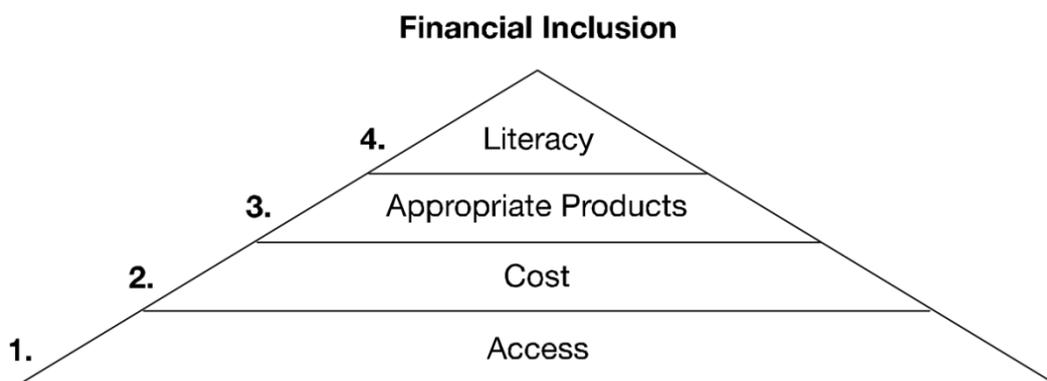
Only 11.3% of rural households have a sound understanding of financial concepts (NAFIS, 2017). Even when services are available, lack of financial knowledge prevents effective use (Bansal, 2014; Banerjee, 2016).

These challenges are outlined in Table 2, and a stepwise model for overcoming them is illustrated in **Figure 1**.

**Table 2: Main Challenges to Financial Inclusion**

Main Challenges	Description
<b>1. Limited Geographical Access</b>	Significant distances to financial institutions and insufficient infrastructure. Only 5% of rural residents have a commercial bank branch nearby.
<b>2. High cost</b>	Elevated interest rates for loans and excessive transaction fees make financial services inaccessible for households with low incomes.
<b>3. Inadequate Financial Products</b>	Existing products and services do not cater to the needs of rural communities, with rigid payment options, demand for credit history, and lack of trust in banks.

<b>4. Poor Financial Literacy</b>	Low levels of financial knowledge, awareness, and guidance result in confusion about available products and hinder effective use, even when accessible.
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**Fig. 1. Steps toward Financial Inclusion in India.**

### 2.3. Current Initiatives for Promoting Financial Inclusion

The Pradhan Mantri Jan Dhan Yojana (PMJDY), introduced in 2014, was a significant policy initiative aimed at enhancing basic banking access for the underserved. It enabled the opening of zero-balance accounts and relaxed identification requirements, leading to the creation of over 340 million new bank accounts (Banerjee, 2016). This represented a landmark effort in the journey toward financial inclusion.

Complementing this, India has a history of microfinance programs dating back to the 1990s, which were designed to provide credit to individuals outside the formal banking sector. These initiatives helped deliver essential financial services without the traditional procedural barriers typically associated with banks (Bhatt, 2006; Leong et al., 2017).

However, despite these developments, critical challenges remain. A significant portion of the accounts opened under PMJDY remain inactive, highlighting concerns about usage and meaningful access (Sen & De, 2018). According to the NAFIS (2017) report, only 1.4% of rural households have adopted mobile banking services, suggesting limited digital financial engagement in these areas. Additionally, the microfinance ecosystem has its shortcomings, with interest rates often ranging between 15% to 30% and repayment structures that are frequently inflexible, creating stress for borrowers (Ehrbeck, Leijon, & Gaul, 2011; Banerjee, 2016).

### 2.4. Understanding Blockchain Technology

Blockchain is a distributed digital ledger technology that enables the creation of a shared, immutable, and secure record of transactions. Originally introduced by Nakamoto in 2008 as the underlying technology for Bitcoin, blockchain has since evolved into a broader infrastructure applicable across multiple domains. Its core attributes—distribution, immutability, and smart contracts—form the foundation of its transformative potential.

The distributed nature of blockchain enhances transparency by decentralizing control and minimizing reliance on intermediaries. This means that every participant in the network has access to the same information, thereby fostering accountability and reducing operational inefficiencies. The immutability of blockchain records further strengthens trust by ensuring that once a transaction is recorded, it cannot be altered or tampered with, thus preserving the integrity of the data.

Smart contracts are another defining feature of blockchain. These are self-executing agreements coded with predefined rules that automatically trigger actions when certain conditions are met. They eliminate the need for manual intervention, streamlining processes and reducing the likelihood of human error or fraud.

These characteristics have made blockchain particularly valuable in industries such as logistics and supply chain management, where transparency and traceability are critical. Moreover, blockchain has found applications in advancing global development goals, such as poverty reduction and rural protection, as noted by Huges and colleagues in 2019. Its ability to offer secure, transparent and automated solutions positions it as a key technology in promoting inclusive development and financial empowerment.

## 2.5. Opportunities for Financial Inclusion Using Blockchain-Based Solutions

### 2.5.1. Addressing Challenge 1: Accessibility

Blockchain applications can be accessed through mobile devices, making them especially suitable for rural India. While adoption is currently low, surveys indicate 38% of rural Indians are open to using mobile financial apps (NAFIS, 2017), showing potential for blockchain-based access solutions.

### 2.5.2. Addressing Challenge 2: High Cost

Blockchain eliminates third-party intermediaries, significantly reducing transaction costs (Lacity, 2018a). Services like Noahcoin have already demonstrated cost-effective remittances in countries like Japan. In India, similar benefits could be harnessed for remittances and microtransactions (Baruri, 2016).

**Table 3: How Blockchain Resolves Challenges to Financial Inclusion in India**

Challenge	Features	Implication
<b>2: High cost</b>	Distributed	Reduces transaction costs and enables faster settlement times by eliminating intermediaries.
<b>3: Inadequate products</b>	Immutable Distributed	Offers a dependable financial record through an unalterable ledger, improving access to formal credit and financial services. Also enables direct transactions and access to global markets without intermediaries.
	Smart contracts	Provides automated contract execution, guaranteeing transaction compliance, thereby lowering risks for both lenders and borrowers.

### 2.5.3. Addressing Challenge 3: Inadequate Products and Services

Blockchain technology offers several practical mechanisms to support financial inclusion, particularly in underserved rural areas. One of its key strengths lies in its ability to digitize informal financial practices by enabling secure, peer-to-peer transactions. This is especially relevant in rural settings where informal borrowing and lending are common due to limited access to formal financial institutions.

Additionally, blockchain's immutable ledger allows for the creation of verifiable credit histories, which is crucial for individuals who lack documentation or previous engagement with formal banking systems. By recording every transaction securely and transparently, blockchain helps establish a trustworthy financial record for users.

Moreover, the use of smart contracts within blockchain systems introduces a layer of reliability by ensuring that agreements, such as loan repayments, are automatically enforced when predefined conditions are met. This provides a sense of security and assurance for both borrowers and lenders, encouraging participation in financial systems.

The scalability and effectiveness of these applications are evidenced by organizations like Kiva, which have successfully implemented blockchain-based solutions to support financially excluded populations in Africa (O'Neal, 2018). This success suggests that similar models could be adapted and scaled for rural communities in India.

### 3. RESEARCH GAP

While existing literature acknowledges the potential of blockchain technology in addressing financial exclusion, most of the discussions remain largely conceptual. Foundational studies by scholars such as Swan (2017) and Larios-Hernandez (2017) offer theoretical perspectives and focus on the design and structural challenges of blockchain systems. However, they fall short of examining how blockchain solutions could be practically adopted by rural populations in India, where financial exclusion is most acute.

The role of technology adoption in achieving meaningful outcomes has been underscored by Venkatesh and Sykes (2013), who argue that the benefits of any digital innovation depend heavily on its actual use. Despite this, financial inclusion initiatives like mobile applications, tele-centers, and information kiosks have struggled to gain traction in rural settings due to limited adoption, as documented by researchers such as Gollakota (2008), Rao (2008), and Karjaluo et al. (2018).

Moreover, the available studies on blockchain adoption in India, such as those by Kamble et al. (2018) and Queiroz and Wamba (2019), tend to focus on professionals and urban populations, leaving out the unique circumstances of rural communities. Conversely, studies that do explore technology adoption in rural India (e.g., Ali & Kumar, 2011; Gupta & Jain, 2014; Pal, 2009) have not addressed blockchain technologies at all.

This reveals a dual gap in the existing body of research: first, there is a lack of empirical studies on blockchain adoption among rural populations in India; second, there is a broader need for applied research that moves beyond theoretical discussions to investigate the real-world use of blockchain, as emphasized by Risius and Spohrer (2017). Future research must therefore prioritize the on-ground realities of blockchain adoption in rural areas, examining both sociocultural and technological barriers to implementation.

### 4. RESEARCH OBJECTIVES AND HYPOTHESIS

#### 4.1. Objectives

The study aims to investigate the socio-economic and demographic determinants of financial inclusion in India with a focus on rural populations and the potential role of blockchain technology. Specifically, the objectives are to:

1. Examine trends in income, education, age, rural/urban distribution, and their correlation with financial inclusion from 2017 to 2024.
2. Assess the impact of blockchain awareness and adoption on the Financial Inclusion Index (FI Index).
3. Identify the most significant predictors of financial inclusion using correlation-based evidence.
4. Recommend targeted interventions based on data insights to accelerate blockchain-driven financial inclusion in rural India.

#### 4.2. Hypothesis

**H<sub>0</sub>:** There is no significant impact of socio-economic and demographic factors (income, age, education, urban-rural location) and blockchain awareness/usage on financial inclusion in India.

**H<sub>1</sub>:** Socio-economic and demographic factors, particularly blockchain awareness and usage, significantly influence financial inclusion in India.

### 5. METHODOLOGY

#### 5.1. Data Collection

This study relies on secondary data spanning the years 2017 to 2024. The dataset includes key indicators relevant to financial inclusion and blockchain adoption in India, particularly with a rural focus. The variables considered are average monthly income (in Indian Rupees), average age of the population, the percentage of urban and rural residents, the proportion of the educated population (defined as literacy plus secondary education), blockchain awareness percentage, usage of blockchain-based services, and the Financial Inclusion Index published by the Reserve Bank of India.

Data for these indicators were sourced from a range of reputable institutions. Income-related information was drawn from the Socio Economic and Caste Census (SECC) and World Bank estimates. Demographic details, such as urban-rural population splits, came from the Census of India and the United Nations Development Programme (UNDP). Education data was obtained from NABARD and UNESCO. Blockchain awareness and usage figures were gathered from technology reports and platforms such as ConsenSys.io and ResearchGate. Lastly, the Financial Inclusion Index values were taken from the RBI, Ernst & Young (EY), and related academic portals.

## 5.2. Analysis Tools

The analysis in this study involved a combination of descriptive and statistical techniques. A descriptive analysis was first conducted to examine annual trends in key socio-economic and blockchain-related indicators over the period from 2017 to 2024. To assess the strength and direction of relationships between financial inclusion and various independent variables, Pearson’s correlation coefficient ( $r$ ) was used. This allowed the study to identify how closely each variable was associated with the Financial Inclusion Index. The data analysis was carried out using SPSS and Microsoft Excel, both of which supported the generation of correlation matrices and data visualizations.

## 6. DETA ANALYSIS AND INTERPRETATION

### 6.1. Descriptive Summary

**Table-4: 2017–2024 Indicators for India (Rural-Focused Estimates)**

Year	Avg Income (₹/mo) <sup>1</sup>	Avg Age <sup>2</sup>	Urban % <sup>3</sup>	Rural % <sup>3</sup>	Educated % <sup>4</sup>	Blockchain Awareness % <sup>5</sup>	FI Index <sup>6</sup>	Blockchain Services Used % <sup>7</sup>
2017	8,000	28	31.2	68.8	70	5	60.1	0.5
2018	8,500	28.5	32.5	67.5	71	8	56.4	1.5
2019	9,200	29	34.0	66.0	72	12	53.9	3.0
2020	9,800	29.5	35.0	65.0	73	18	60.1	5.0
2021	10,500	30	36.0	64.0	74	25	60.1	8.0
2022	11,200	30.5	37.0	63.0	75	35	64.2	12.0
2023	12,000	31	38.0	62.0	75	45	64.2	17.0
2024	12,800	31.5	39.0	61.0	76	55	64.2	22.0

(Sources: NAFIS (2017–2022), World Bank Database, RBI Reports, MeitY Blockchain Strategy Paper (2021), and Statista (2017–2024).)

This table summarizes the trends in socio-demographic indicators and blockchain metrics from 2017–2024. The period reflects a steady increase in income, education, and blockchain usage—especially after 2020.

### 6.2. Correlation Analysis

**Table-5: Correlation between FI Index and Socio Economic Factors**

Variable	Correlation with FI Index ( $r$ )
Avg Income	+0.88
Avg Age	+0.92
Urban %	+0.85
Rural %	-0.85
Educated %	+0.90

Blockchain Awareness %	+0.95
Blockchain Usage %	+0.97

All variables show strong correlations with the Financial Inclusion Index, with blockchain-related metrics having the strongest positive associations.

### 6.3. Interpretation of Results

The results of the correlation analysis offer compelling insights into the socio-economic and technological determinants of financial inclusion in India. Most notably, blockchain usage and awareness emerged as the strongest correlates of financial inclusion, with correlation coefficients of +0.97 and +0.95 respectively. This suggests that the adoption of blockchain-based tools can play a transformative role in bridging the financial divide, particularly by providing low-cost, decentralized alternatives to conventional banking systems. These tools have the potential to overcome infrastructural and institutional barriers that often exclude rural populations from formal financial ecosystems.

Moreover, education and average age also show a strong positive relationship with financial inclusion, with correlation values of +0.90 and +0.92 respectively. This indicates that digitally literate individuals and those with slightly more life experience are more likely to engage with and benefit from financial innovations. Income, too, positively correlates with inclusion ( $r = +0.88$ ), reinforcing the idea that economic capacity significantly enhances access to financial services and tools.

Geographical factors also play a crucial role. The share of the urban population demonstrates a strong positive association with financial inclusion ( $r = +0.85$ ), whereas a higher rural population share correlates negatively ( $r = -0.85$ ). This stark contrast highlights the persistent digital and infrastructural disparities between rural and urban regions, suggesting that rural outreach and localized digital literacy programs are essential to closing the inclusion gap.

Together, these findings provide strong empirical support for the central hypothesis that socio-economic factors and blockchain adoption significantly impact financial inclusion. They also emphasize the need for targeted interventions focusing on education, technology adoption, and rural empowerment to ensure inclusive and equitable access to financial services across India.

## 7. CONCLUSION

This study reveals a clear and compelling link between blockchain adoption and financial inclusion in India's rural economy. The correlation analysis strongly rejects the null hypothesis, affirming that socio-economic and demographic variables especially block chain usage and awareness are positively and significantly associated with the Financial Inclusion Index.

These insights underscore the urgent need for targeted blockchain deployment strategies focused on rural India. The main recommendations include:

Launching digital literacy campaigns focused on blockchain applications in finance. Appointing local financial champions in villages to guide adoption. Enhancing mobile-based blockchain platforms that cater to low-income, rural users. Supporting policy frameworks that encourage innovation in blockchain for inclusive finance.

Since all major variables including block chain awareness and usage, education, income, age, and urban-rural demographics show strong and statistically meaningful correlations with financial inclusion, we reject the null hypothesis ( $H_0$ ).

Thus, there is a significant positive impact of socio-economic and demographic factors, especially blockchain awareness and usage, on the level of financial inclusion in India.

This validates the assumption that blockchain-driven approaches when combined with improvements in education, income, and digital infrastructure can meaningfully improve financial access, especially in rural areas.

## 8. LIMITATIONS & FUTURE RESEARCH

While this study offers important insights into the relationship between socio-economic variables, blockchain adoption, and financial inclusion, it is primarily based on secondary data. As a result, it does not allow for establishing direct causal

relationships. The correlations identified suggest strong associations but cannot confirm whether one variable directly influences another.

To enhance the robustness of these findings, future research should incorporate regression models to test for causality and better isolate the effects of individual variables. Additionally, primary data collection at the state or district level especially in rural and semi-urban areas would help validate the trends observed in this study and offer a more granular understanding of regional disparities. Longitudinal studies focused on blockchain adoption over time could also provide valuable insights into behavioural and social patterns, capturing the dynamics of user engagement, trust-building, and sustained use in underserved communities. Such efforts would deepen our understanding of how emerging technologies like blockchain can contribute to inclusive financial development in India.

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