



Digital Financial Services and Formal Financial Access among Rural Households in India: An Empirical Study

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Abstract – Digital financial services (DFS) have become an important mechanism for extending formal financial services to geographically and economically underserved populations. However, the availability of digital channels does not necessarily translate into meaningful or diversified participation in formal finance. This study examines the relationship between DFS usage intensity and access to formal financial services among rural households in India, with particular attention to digital literacy and trust and perceived security. It further examines whether education and network quality condition the relationship between DFS usage and formal financial access. Primary data were collected through a structured questionnaire from 402 rural respondents using a multi-stage sampling procedure. The study employs descriptive statistics, Cronbach's alpha, Pearson correlation, and hierarchical multiple regression with interaction terms. The findings indicate that awareness of DFS is relatively high, but actual usage and engagement with diverse formal financial products remain comparatively limited. Bank-account ownership is high at 94.5%, whereas formal credit, insurance, and pension or investment participation are substantially lower. DFS usage intensity is positively associated with formal financial access, while digital literacy and trust and perceived security also demonstrate significant positive relationships. In the hierarchical regression analysis, the addition of DFS usage intensity, digital literacy, and trust and perceived security increases adjusted R^2 from 0.19 to 0.41. The final model further increases adjusted R^2 to 0.44, with significant interaction effects between DFS usage and education and between DFS usage and network quality. The findings suggest that rural financial inclusion increasingly requires a shift from basic account ownership toward meaningful and sustained use of formal financial products. Strengthening digital literacy, network infrastructure, consumer protection, and trust in digital financial channels can improve the effectiveness of DFS as an instrument of rural financial inclusion.

Keywords – Digital financial services; digital financial inclusion; rural households; formal financial access; digital literacy; trust; perceived security; network quality; India.

I. INTRODUCTION

Financial inclusion has evolved from a policy objective centred primarily on access to bank accounts toward a broader concern with the effective and sustained use of appropriate financial products and services. The expansion of digital technologies has accelerated this transition by enabling financial transactions through mobile phones, internet banking, digital payments, Aadhaar-enabled services, and other technology-enabled channels. Digital financial services can reduce transaction costs, overcome geographical barriers, and connect households to formal financial institutions without requiring frequent physical visits to bank branches (Arner et al., 2020; Khera et al., 2021; Asif et al., 2023).

The Indian financial system has experienced substantial growth in digital financial infrastructure. Mobile banking, Unified Payments Interface (UPI), digital wallets, internet banking and Aadhaar-enabled payment mechanisms have expanded the range of financial services available through digital channels. Nevertheless, digital availability alone does not guarantee effective financial inclusion. The ability of individuals to use these services depends on digital skills, access to suitable devices and connectivity, perceived security, trust, and socioeconomic characteristics.

This distinction is particularly important in rural India. Rural households may possess bank accounts but continue to rely on cash or informal financial mechanisms for

savings, borrowing and risk management. Thus, account ownership should not be treated as synonymous with comprehensive financial inclusion. Recent evidence continues to show that banking access in rural India is relatively widespread, while access to and usage of digital financial instruments remain more uneven. Sutradhar and Ghosh (2026), for example, report that banking access is almost universal across rural India but that payment-card access remains considerably less widespread.

Similarly, recent research on UPI adoption in rural India indicates that socioeconomic characteristics such as education, income and other household characteristics influence the probability of using digital payment services. These findings suggest that the central challenge is increasingly shifting from simply creating access to ensuring meaningful use.

The present study therefore distinguishes between digital financial service usage and formal financial access. DFS usage refers to the intensity and breadth with which households use digital financial channels, whereas formal financial access is conceptualised more broadly through bank-account use, institutional credit, savings, insurance, pension or investment products, and government-supported financial services.

The study focuses on three central explanatory factors: DFS usage intensity, digital literacy, and trust and perceived



ISSN:3048-7722

security. It additionally considers education and network quality as potential moderators of the relationship between DFS usage and formal financial access, while income and smartphone ownership are incorporated as control variables.

The study addresses the following research questions:

1. What is the level of awareness and usage of digital financial services among rural households?
2. What is the extent of access to different formal financial products and services?
3. Is DFS usage intensity associated with access to formal financial services?
4. Are digital literacy and trust and perceived security associated with formal financial access?
5. Do education and network quality moderate the relationship between DFS usage and formal financial access?

Accordingly, the objectives of the study are to:

1. Examine the awareness and usage patterns of digital financial services among rural households.
2. Assess the extent of rural households' access to formal financial services.
3. Examine the relationship between DFS usage intensity and formal financial access.
4. Examine the relationships of digital literacy and trust and perceived security with formal financial access.
5. Assess whether education and network quality moderate the relationship between DFS usage intensity and formal financial access.

The contribution of the study lies in bringing these dimensions together at the household level. Existing research has examined digital financial inclusion, financial literacy, DFS adoption and socioeconomic determinants separately or through broad measures of financial inclusion. A recent systematic review of rural financial inclusion research also identifies fragmentation in the literature and calls for greater attention to underexplored aspects of technology-enabled inclusion and meaningful usage (Keshari & Tiwari, 2026). The present study contributes by examining DFS usage intensity, digital literacy and trust/security alongside a multidimensional measure of formal financial access.

II. REVIEW OF LITERATURE

Digital Financial Services and Financial Inclusion

Digital financial services refer to financial products and transactions delivered through digital channels, including mobile banking, internet banking, digital payments, digital wallets, Aadhaar-enabled services and technology-based financial platforms. Digitalisation can reduce transaction costs and geographical constraints and can make formal financial services more accessible to populations located far from conventional bank branches (Arner et al., 2020; Malladi et al., 2021).

In developing economies, FinTech and digital financial services have increasingly been regarded as mechanisms through which financial institutions can reach underserved populations (Sahay et al., 2020; Ozili, 2021). In the Indian context, empirical studies have reported positive associations between FinTech use and dimensions of financial inclusion (Asif et al., 2023; Goswami et al., 2022).

However, digital access should not be equated with effective financial inclusion. Digital financial inclusion involves not only availability but also the ability and willingness to use digital financial services. Khera et al. (2021) emphasise the importance of measuring multiple dimensions of digital financial inclusion rather than relying on a single indicator.

Recent evidence reinforces this distinction. Sutradhar and Ghosh (2026) show that rural banking access can be almost universal while access to payment cards remains uneven, suggesting that different dimensions of financial inclusion can progress at different rates.

Digital Literacy and Meaningful Financial Usage

Digital literacy represents the ability of individuals to access, understand and effectively operate digital technologies. In the context of financial services, digital capability affects an individual's ability to conduct transactions, navigate digital interfaces, identify risks and make informed decisions.

Azeez and Akhtar (2021) demonstrate the importance of digital financial literacy in rural India, while Andreou and Anyfantaki (2021) show that financial literacy is associated with internet-banking behaviour. Panakaje et al. (2023) similarly demonstrate the importance of financial literacy and financial inclusion in rural socioeconomic empowerment.

The distinction between financial literacy and digital literacy is important. Financial literacy concerns knowledge of financial concepts and products, whereas digital literacy concerns the capability to use digital technologies. Digital financial literacy incorporates elements of both. The present study specifically examines digital literacy as a capability relevant to the effective use of digital financial channels.

Thus:

H2: Digital literacy is positively and significantly associated with access to formal financial services among rural households.

Trust and Perceived Security

Trust is another important determinant of digital financial behaviour. Digital financial transactions expose users to concerns involving fraud, privacy, cybersecurity and transaction failure. These concerns can discourage individuals from adopting or repeatedly using digital channels.



ISSN:3048-7722

Research on digital financial inclusion has emphasised that technology alone cannot guarantee inclusion if users lack confidence in the safety and reliability of digital services (Buteau et al., 2021; Agwu, 2021). Cnaan et al. (2023) similarly highlight the importance of trust and capability in understanding financial inclusion in rural India.

In the rural context, cybersecurity concerns may be especially important because users with limited digital experience may have difficulty distinguishing legitimate transactions from fraudulent communications. Consequently, trust and perceived security can affect not only initial adoption but also continued engagement.

Therefore:

H3: Trust and perceived security are positively and significantly associated with access to formal financial services among rural households.

Socioeconomic and Infrastructural Conditions

Digital financial inclusion does not occur in a social or infrastructural vacuum. Education, income, smartphone ownership and connectivity can influence the capacity of households to adopt and use digital financial services.

Nandru et al. (2024) provide evidence that socioeconomic characteristics influence ownership and use of digital financial services in India. Recent rural evidence also suggests that education, income, infrastructure and access to digital devices shape the effectiveness of digital financial inclusion initiatives.

Education may enhance the ability to understand digital interfaces, interpret financial information and manage transaction-related risks. Network quality may determine whether users can reliably access digital services. Thus, the same level of DFS availability may produce different outcomes across households depending on their educational and infrastructural circumstances.

The present study therefore examines education and network quality as moderators of the DFS usage–formal financial access relationship.

H4a: Education significantly moderates the relationship between DFS usage intensity and access to formal financial services.

H4b: Network quality significantly moderates the relationship between DFS usage intensity and access to formal financial services.

Research Gap

The existing literature establishes that digital financial services can support financial inclusion, but several gaps remain.

First, many studies focus on digital adoption or individual digital-payment behaviour rather than broader formal financial engagement. Second, digital literacy and trust are frequently discussed as enabling conditions but are not

always incorporated simultaneously into household-level models of formal financial access. Third, formal financial inclusion is sometimes represented through account ownership or a single financial-service indicator, despite the fact that households may have bank accounts without using formal credit, insurance or long-term financial products.

Recent research further confirms the importance of distinguishing among dimensions of rural financial inclusion. Sutradhar and Ghosh (2026) identify a substantial difference between widespread banking access and more uneven payment-card access. A recent systematic review also indicates that rural financial inclusion research remains fragmented and that technology-enabled aspects warrant additional investigation (Keshari & Tiwari, 2026).

Accordingly, this study examines whether DFS usage intensity, digital literacy, and trust/perceived security are associated with multidimensional formal financial access, while testing whether education and network quality condition the relationship between DFS usage and formal financial access.

III. RESEARCH METHODOLOGY**Research Design**

The study adopts a cross-sectional, descriptive and analytical research design. Primary data were collected from rural household respondents using a structured questionnaire.

The study examines the relationships among digital financial service usage, digital literacy, trust and perceived security, and formal financial access. The present study conducted in the Ranga Reddy Districts (Yacharam Village and Ibrahimpatnam Village) and the study period was March 2026 – August 2026.

Population and Sampling

The target population comprised adult members of rural households.

A multi-stage sampling procedure was used. Districts were purposively selected, villages were selected using simple random sampling, and households were selected systematically using local village registers. One eligible adult respondent was selected from each household.

The minimum sample size was estimated using Cochran's formula:

$n_0 =$

where:

- $Z=1.96$
- $p=0.50$
- $q=0.50$
- $e=0.05$

The resulting minimum sample requirement was approximately 384 respondents. A larger target was set, and



ISSN:3048-7722

600 questionnaires are distributed. After data screening, 402 valid responses were retained for analysis.

Data Collection Instrument

Data were collected using a structured questionnaire administered through face-to-face interaction. The instrument included demographic characteristics, DFS awareness and usage, digital literacy, trust and perceived security, formal financial access and perceived barriers.

Likert-type items were measured on a five-point scale for the relevant attitudinal and capability constructs.

Variables

Dependent Variable

Access to Formal Financial Services (AFF)

Formal financial access was operationalised through multiple indicators, including:

- bank-account ownership and usage;
- formal credit;
- savings;
- insurance;
- pension/investment;
- government-supported financial services.

A composite formal financial access index was used in the regression analysis.

Independent Variables

DFS Usage Intensity

DFS usage intensity represents the extent and frequency of respondents' use of digital financial services, including UPI/digital payments, mobile banking, digital wallets, Aadhaar-enabled services and internet banking.

The reported mean DFS usage intensity is 3.24 with a standard deviation of 0.87.

Digital Literacy

Digital literacy captures respondents' perceived ability to use digital technologies and digital financial channels.

Trust and Perceived Security

Trust and perceived security measure respondents' confidence in the reliability and security of digital financial transactions.

Moderating Variables

- Education
- Network quality

Control Variables

- Income
- Smartphone ownership

Statistical Techniques

The study uses:

1. descriptive statistics;
2. Cronbach's alpha for internal consistency;
3. Pearson correlation analysis;
4. hierarchical multiple regression;
5. interaction terms for moderation analysis.

The regression models were estimated hierarchically to examine the incremental contribution of DFS usage, digital literacy and trust/security beyond the control variables and to assess moderation effects.

IV. RESULTS AND ANALYSIS

Respondent Profile

A total of 402 valid responses were analysed.

Variable	Category	Frequency	Percentage
Gender	Male	218	54.2
	Female	184	45.8
Age	18–25	59	14.7
	26–45	247	61.4
	Above 45	96	23.9
Education	Primary/below	129	32.1
	Secondary	115	28.6
	Higher secondary and above	158	39.3
Monthly income	Below ₹15,000	192	47.8
	₹15,000–₹30,000	145	36.1
	Above ₹30,000	65	16.1
Smartphone	Yes	316	78.6
	No	86	21.4

The sample is predominantly concentrated in the 26–45 age group. Approximately 78.6% of respondents reported smartphone ownership, indicating relatively substantial device access despite the rural setting.

Awareness of Digital Financial Services

Awareness was highest for UPI and digital payments, followed by mobile banking.

DFS	Aware	Percentage
UPI/digital payments	331	82.3
Mobile banking	300	74.6
Digital wallets	246	61.2
Aadhaar-enabled services	236	58.7
Internet banking	199	49.5
At least one DFS	346	86.1

Overall, 86.1% of respondents were aware of at least one digital financial service.

This indicates that the principal challenge is not necessarily awareness alone. Rather, there appears to be a transition gap between awareness and sustained usage.

Usage of Digital Financial Services

DFS	Users	Percentage
UPI	275	68.4
Mobile banking	212	52.7
Digital wallets	166	41.3
Aadhaar-enabled services	140	34.8
Internet banking	91	22.6



ISSN:3048-7722

The mean DFS usage intensity was 3.24 (SD = 0.87).

Regarding usage frequency:

- 39.8% reported regular usage;
- 28.4% reported occasional monthly usage;
- 31.8% reported rare or no usage.

The results demonstrate that awareness exceeds actual usage across all major DFS categories. The largest difference is observed for internet banking, where awareness is 49.5% but reported usage is only 22.6%.

This awareness–usage gap is an important finding because financial inclusion requires meaningful use rather than mere knowledge of service availability.

Access to Formal Financial Service

Formal financial indicator	Frequency	Percentage
Bank-account ownership	380	94.5
Regular account usage	286	71.2
Formal credit	155	38.6
Insurance	118	29.4
Pension/investment	75	18.7

The findings reveal a substantial difference between basic access and depth of formal financial engagement.

Bank-account ownership is very high at 94.5%, but only 71.2% report regular account usage. More importantly, formal credit, insurance and pension/investment participation are substantially lower.

The composite formal financial access index has a mean of 2.87 and a standard deviation of 1.12.

These results suggest that rural financial inclusion cannot be adequately represented by account ownership alone.

Perceived Barriers to Digital Financial Usage

Barrier	Frequency	Percentage
Lack of digital literacy	186	46.3
Poor/intermittent internet	168	41.8
Cybersecurity/fraud concerns	155	38.6
Lack of trust	141	35.1
Technical difficulties	119	29.7
Affordability of data/devices	90	22.4

The most frequently reported barrier is lack of digital literacy, followed by network limitations and cybersecurity/fraud concerns. These findings support the inclusion of digital literacy, trust/security and network quality in the analytical model.

V. RELIABILITY ANALYSIS

Cronbach's alpha was used to assess internal consistency.

Construct	Number of items	Cronbach's alpha
DFS Usage Intensity	6	0.81
Digital Literacy	5	0.86

Trust & Perceived Security	5	0.83
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All three constructs demonstrate acceptable internal consistency, with alpha coefficients exceeding 0.80. However, Cronbach's alpha demonstrates internal consistency rather than construct validity. Therefore, the final manuscript should not describe these values as proof of validity.

Correlation Analysis

Pearson correlation coefficients are reported below.

Variables	DFS Usage	Digital Literacy	Trust/Security	Formal Finance
DFS Usage	1			
Digital Literacy	.51**	1		
Trust/Security	.47**	.44**	1	
Formal Finance	.48**	.42**	.39**	1

DFS usage intensity has a moderate positive correlation with formal financial access ($r = .48$, $p < .01$). Digital literacy also demonstrates a positive association with formal financial access ($r = .42$, $p < .01$), while trust and perceived security are positively correlated with formal financial access ($r = .39$, $p < .01$).

The correlation results provide preliminary support for H1, H2 and H3.

The strongest correlation among the explanatory variables is between DFS usage and digital literacy ($r = .51$). This is below the level that would ordinarily raise immediate concerns about severe bivariate multicollinearity; however, formal multicollinearity diagnostics should be reported alongside the regression results.

Hierarchical Regression Analysis

Hierarchical multiple regression was employed to assess whether DFS usage intensity, digital literacy and trust/security explain variation in formal financial access after accounting for relevant socioeconomic and infrastructural characteristics.

Model 1: Control Variables

Model 1 includes:

- Education;
- Income;
- Smartphone ownership;
- Network quality.

The model explains approximately 19% of the adjusted variance in formal financial access:

Adjusted $R^2 = .19$; $F = 18.74$, $p < .001$.

Education ($\beta = .21$, $p < .001$), income ($\beta = .18$, $p < .01$), smartphone ownership ($\beta = .16$, $p < .01$), and network quality ($\beta = .12$, $p < .05$) are positively associated with formal financial access.



ISSN:3048-7722

Model 2: Main Predictors

Model 2 adds:

- DFS usage intensity;
- digital literacy;
- trust and perceived security.

The adjusted R^2 increases to .41.

DFS usage intensity has a positive and statistically significant coefficient ($\beta = .31, p < .001$). Digital literacy is also positively associated with formal financial access ($\beta = .22, p < .001$), while trust and perceived security have a significant positive association ($\beta = .18, p < .01$).

Education remains significant ($\beta = .14, p < .01$), while income remains positive and significant ($\beta = .11, p < .05$). The results indicate that DFS-related capabilities and confidence explain substantial additional variation beyond the control variables.

Model 3: Moderation Effects

Model 3 introduces:

- DFS Usage $\times$ Education;
- DFS Usage $\times$ Network Quality.

The adjusted R^2 increases further to .44.

DFS usage remains positive and significant ($\beta = .28, p < .001$), as do digital literacy ($\beta = .20, p < .001$) and trust/security ($\beta = .17, p < .01$).

The interaction between DFS usage and education is positive and significant ($\beta = .14, p < .05$), supporting H4a. The interaction between DFS usage and network quality is also positive and significant ($\beta = .12, p < .05$), supporting H4b.

Smartphone ownership becomes statistically non-significant in the final model, while network quality's direct effect is also non-significant after the interaction term is introduced.

Regression Summary

Predictor	Model 1 β	Model 2 β	Model 3 β
Education	.21***	.14**	.12*
Income	.18**	.11*	.10*
Smartphone ownership	.16**	.09*	.08
Network quality	.12*	.07	.06
DFS usage intensity	—	.31***	.28***
Digital literacy	—	.22***	.20***
Trust/security	—	.18**	.17**
DFS usage $\times$ Education	—	—	.14*
DFS usage $\times$ Network quality	—	—	.12*
Adjusted R^2	.19	.41	.44
F	18.74***	34.62***	28.91***

Importantly, the increase in adjusted R^2 from .19 to .41 and then .44 should not be described as formal ΔR^2 unless the

original regression output provides the actual R^2 -change statistics.

Hypothesis Testing

Hypothesis	Relationship	Evidence	Decision
H1	DFS usage $\rightarrow$ formal financial access	$\beta = .28^{***}$	Supported
H2	Digital literacy $\rightarrow$ formal financial access	$\beta = .20^{***}$	Supported
H3	Trust/security $\rightarrow$ formal financial access	$\beta = .17^{**}$	Supported
H4a	DFS usage $\times$ education $\rightarrow$ formal financial access	$\beta = .14^*$	Supported
H4b	DFS usage $\times$ network quality $\rightarrow$ formal financial access	$\beta = .12^*$	Supported

Note: * $p < .05$; ** $p < .01$; *** $p < .001$.

All five hypotheses are supported by the reported Model 3 results.

VI. DISCUSSION

The findings provide evidence that digital financial service usage is positively associated with formal financial access among the surveyed rural households. The relationship remains statistically significant after controlling for education, income, smartphone ownership and network quality. This finding is consistent with prior research suggesting that digital financial services can reduce access barriers and facilitate greater participation in formal finance (Asif et al., 2023; Goswami et al., 2022).

However, the descriptive findings provide an important qualification. Awareness of DFS is considerably higher than actual usage. While 86.1% of respondents are aware of at least one DFS, usage is lower across individual platforms. This indicates that awareness does not automatically translate into behavioural adoption. Recent rural evidence on UPI similarly demonstrates that socioeconomic characteristics influence the probability of adopting digital payments.

The findings on formal financial access are even more revealing. Bank-account ownership is 94.5%, but formal credit, insurance and pension/investment participation are only 38.6%, 29.4% and 18.7%, respectively. Thus, the study provides evidence of a depth-of-inclusion gap: basic



ISSN:3048-7722

access is substantially more widespread than diversified engagement with formal financial products.

This result is consistent with the broader direction of recent research. Sutradhar and Ghosh (2026) similarly distinguish widespread banking access from more uneven digital financial access in rural India.

The positive association between digital literacy and formal financial access supports the argument that technology must be accompanied by user capability. A digital channel can be technically available but practically inaccessible to individuals who lack the skills or confidence required to navigate it. This is consistent with earlier evidence on digital financial literacy and internet banking behaviour.

Trust and perceived security also demonstrate a positive association with formal financial access. This finding is important because the principal barriers reported by respondents include cybersecurity/fraud concerns and lack of trust. Digital financial inclusion therefore involves both technological availability and psychological confidence in the system.

The moderation results provide additional insight. The positive DFS usage $\times$ education interaction suggests that education strengthens the relationship between digital financial usage and formal financial access. In other words, households with greater educational capability may be better able to convert digital financial usage into broader formal financial participation.

Similarly, the positive DFS usage $\times$ network quality interaction suggests that the benefits associated with DFS usage depend partly on the quality and reliability of connectivity. This finding reinforces the argument that digital financial inclusion is not solely a question of user behaviour; it also depends on the infrastructure supporting that behaviour.

Recent rural India research likewise identifies infrastructure and financial literacy as important conditions shaping the effectiveness of digital financial inclusion.

Theoretical Implications

The findings contribute to the understanding of digital financial inclusion in three ways.

First, they support a capability-oriented perspective in which digital access alone is insufficient. Digital literacy appears to be an important complementary capability that enables households to translate technological availability into financial participation.

Second, the results indicate that trust and perceived security should be considered alongside technological access. Users may have access to digital platforms but remain reluctant to use them if they perceive substantial fraud or security risks.

Third, the moderation results suggest that the relationship between DFS usage and formal financial access is context-

dependent. Education and network quality influence the extent to which DFS usage translates into broader financial participation.

The findings therefore support a conceptualisation of digital financial inclusion as a combination of access, capability, confidence and enabling infrastructure, rather than simply the availability of digital financial products.

VII. MANAGERIAL AND POLICY IMPLICATIONS

Strengthen Digital and Financial Literacy

The strongest reported barrier is lack of digital literacy. Financial institutions, government agencies and community organisations should therefore move beyond awareness campaigns toward practical training covering:

- UPI transactions;
- mobile banking;
- password and PIN security;
- fraud identification;
- grievance mechanisms;
- account-management practices;
- responsible digital borrowing.

Improve Digital Infrastructure

Poor or intermittent internet connectivity is the second most frequently reported barrier. Expanding reliable network infrastructure in rural areas is therefore essential for converting digital-finance availability into effective usage.

Strengthen Consumer Protection and Cybersecurity

Cybersecurity and fraud concerns represent a major barrier. Financial institutions should strengthen:

- fraud-awareness campaigns;
- transaction alerts;
- simple reporting mechanisms;
- local-language communication;
- customer-support systems;
- grievance redressal.

Move Beyond Account Ownership

The high level of bank-account ownership should not be interpreted as evidence that rural financial inclusion is complete. Policy evaluation should include indicators of:

- active account use;
- formal credit;
- insurance;
- pension;
- savings;
- digital payments;
- financial resilience.

Target Education and Capability Gaps

Because education moderates the relationship between DFS usage and formal financial access, interventions should be tailored to users with lower educational attainment rather than assuming that a single digital-finance intervention will work uniformly across households.



Promote Last-Mile Digital Financial Services

Financial institutions and FinTech providers should design interfaces and support mechanisms appropriate for first-time and low-literacy users. Simple interfaces, local languages, assisted transactions and community-level support can reduce the barriers associated with digital adoption.

VIII. CONCLUSION

This study examined the relationship between digital financial services and formal financial access among rural households in India. The results indicate that DFS usage intensity, digital literacy, and trust and perceived security are positively associated with formal financial access. Education and network quality further condition the relationship between DFS usage and formal financial access.

The descriptive findings reveal an important distinction between access and depth of usage. Although 94.5% of respondents report owning a bank account, participation in formal credit, insurance and pension or investment products remains substantially lower. Similarly, awareness of digital financial services exceeds actual usage.

The findings therefore suggest that the next phase of rural financial inclusion should focus not simply on expanding access to accounts and digital platforms but on enabling households to use those platforms confidently, securely and consistently.

Digital financial services can contribute meaningfully to rural financial inclusion when supported by adequate digital literacy, reliable connectivity, trust and effective consumer protection. The positive moderation effects of education and network quality further indicate that digital financial inclusion requires complementary investments in human capability and infrastructure.

Accordingly, the study concludes that meaningful financial inclusion depends on converting digital access into sustained and diversified formal financial engagement.

IX. LIMITATIONS

The study has several limitations.

First, the cross-sectional design limits the ability to establish temporal ordering or causal relationships. The findings should therefore be interpreted as associations rather than causal effects.

Second, the study uses a geographically limited sample, and the districts were purposively selected. Consequently, the results should not be interpreted as nationally representative of all rural households in India.

Third, several variables are based on self-reported responses and may therefore be affected by recall or response bias.

Fourth, the sample size of 402 respondents, while adequate for the reported regression analysis, limits the extent to which subgroup comparisons can be conducted.

Fifth, the study does not establish whether DFS usage directly causes households to adopt formal credit, insurance or investment products. Longitudinal or experimental research would be required to establish causal mechanisms.

X. DIRECTIONS FOR FUTURE RESEARCH

Future studies can extend this research in several directions. First, longitudinal research could examine whether sustained DFS usage results in changes in formal financial behaviour over time.

Second, future research could use larger multi-state samples to improve generalisability.

Third, mixed-method research could investigate why households with bank accounts continue to rely on informal financial mechanisms.

Fourth, future studies could examine whether the relationship differs across gender, age, education and income groups.

Fifth, researchers could distinguish between different forms of DFS, such as UPI, mobile banking, Aadhaar-enabled services and internet banking, rather than treating DFS usage as a single construct.

Finally, future research could investigate whether digital financial inclusion contributes to broader outcomes such as household financial resilience, savings behaviour, access to productive credit, insurance protection and economic empowerment.

REFERENCES

1. Agwu, M. E. (2021). Can technology bridge the gap between rural development and financial inclusions? *Technology Analysis & Strategic Management*, 33(2), 123–133. <https://doi.org/10.1080/09537325.2020.1795111>
2. Andreou, P. C., & Anyfantaki, S. (2021). Financial literacy and its influence on internet banking behavior. *European Management Journal*, 39(5), 658–674. <https://doi.org/10.1016/j.emj.2020.12.001>
3. Arner, D. W., Buckley, R. P., Zetsche, D. A., & Veidt, R. (2020). Sustainability, FinTech and financial inclusion. *European Business Organization Law Review*, 21(1), 7–35. <https://doi.org/10.1007/s40804-020-00183-y>
4. Asif, M., Khan, M. N., Tiwari, S., Wani, S. K., & Alam, F. (2023). The impact of FinTech and digital financial services on financial inclusion in India. *Journal of Risk and Financial Management*, 16(2), 122. <https://doi.org/10.3390/jrfm16020122>
5. Azeez, N. P. A., & Akhtar, S. M. J. (2021). Digital financial literacy and its determinants: An empirical evidence from rural India. *South Asian Journal of*



ISSN:3048-7722

- Social Studies and Economics, 11(2), 8–22. <https://doi.org/10.9734/sajsse/2021/v11i230279>
6. Balasundaram, E., Aranganathan, P., Cailassame, N. S. N., Mathiazhagan, A., Vinoth, A., & Gajendran, A. (2025). The impact of digital financial inclusion on income inequality in rural India: A spatial econometric and mixed-methods analysis. *The Indian Economic Journal*. <https://doi.org/10.1177/00194662251332866>
 7. Buteau, S., Rao, P., & Valenti, F. (2021). Emerging insights from digital solutions in financial inclusion. *CSI Transactions on ICT*, 9(2), 105–114. <https://doi.org/10.1007/s40012-021-00330-x>
 8. Cnaan, R. A., Scott, M. L., Heist, H. D., & Moodithaya, M. S. (2023). Financial inclusion in the digital banking age: Lessons from rural India. *Journal of Social Policy*, 52(3), 520–541. <https://doi.org/10.1017/S0047279421000738>
 9. Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2022). The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19. World Bank. <https://doi.org/10.1596/978-1-4648-1897-4>
 10. Goswami, S., Sharma, R. B., & Chouhan, V. (2022). Impact of financial technology (FinTech) on financial inclusion in rural India. *Universal Journal of Accounting and Finance*, 10(2), 483–497. <https://doi.org/10.13189/ujaf.2022.100213>
 11. Haque, M. I., Azeez, N. P., & Akhtar, S. M. J. (2025). UPI and financial inclusion in rural India: A case study. *Development and Sustainability in Economics and Finance*, 6(1), 100056. <https://doi.org/10.1016/j.dsef.2025.100056>
 12. Joshi, Y., Sharma, M., & Kumar, S. (2021). Dimensions of financial inclusion in India: A qualitative analysis of policy frameworks. *Qualitative Research in Financial Markets*, 13(4), 450–468. <https://doi.org/10.1108/QRFM-06-2020-0098>
 13. Keshari, P., & Tiwari, A. K. (2026). Financial inclusion in rural region—a review and research agenda. *Future Business Journal*, 12, 49. <https://doi.org/10.1186/s43093-025-00714-4>
 14. Khera, P., Ng, S. Y., Ogawa, S., & Sahay, R. (2021). Measuring digital financial inclusion in emerging market and developing economies: A new index. *IMF Working Papers*, 2021(090). <https://doi.org/10.5089/9781513574196.001>
 15. Lyons, A. C., Kass-Hanna, J., & Liu, F. (2022). Building financial resilience through financial and digital literacy in South Asia and Sub-Saharan Africa. *Emerging Markets Review*, 51, 100846.
 16. Malladi, C. M., Soni, R. K., & Srinivasan, S. (2021). Digital financial inclusion: Next frontiers—Challenges and opportunities. *CSI Transactions on ICT*, 9(2), 127–134. <https://doi.org/10.1007/s40012-021-00328-5>
 17. Nair, J., & Jain, M. K. (2022). Unbanked to banked: Reintermediation role of banks in e-government services for financial inclusion in an Indian context. *Journal of Asia Business Studies*, 16(2), 354–370. <https://doi.org/10.1108/JABS-10-2020-0420>
 18. Nandru, P., Chendragiri, M., & Arulmurugan, V. (2024). Socioeconomic determinants of ownership of payment cards, mobile money account, and government remittances of digital financial services: Evidence from India. *Journal of Financial Economic Policy*, 16(2), 247–271. <https://doi.org/10.1108/JFEP-07-2023-0176>
 19. Ozili, P. K. (2021). Financial inclusion and FinTech during COVID-19 crisis: Policy solutions. *International Journal of Financial Studies*, 9(1), 12. <https://doi.org/10.3390/ijfs9010012>
 20. Panakaje, N., Rahiman, H. U., Parvin, S. M. R., Kulal, A., & Siddiq, A. (2023). Socio-economic empowerment in rural India: Do financial inclusion and literacy matter? *Cogent Social Sciences*, 9(1), 2225829. <https://doi.org/10.1080/23311886.2023.2225829>
 21. Sahay, R., Eriksson von Allmen, U., Lahreche, A., Khera, P., Ogawa, S., Bazarbash, M., & Beaton, K. (2020). The promise of FinTech: Financial inclusion in the post-COVID-19 era. IMF Departmental Paper No. 2020/009. <https://doi.org/10.5089/9781513512242.087>
 22. Saravanabhavan, S., & Rajeev, M. (2024). Financial inclusion in India: How far do grassroots institutions matter? *Journal of International Development*, 36(5), 2318–2341. <https://doi.org/10.1002/jid.3897>
 23. Senyo, P. K., & Osabutey, E. L. C. (2021). Unearthing antecedents to financial inclusion through FinTech innovations. *Technological Forecasting and Social Change*, 171, 120970. <https://doi.org/10.1016/j.techfore.2021.120970>
 24. Sutradhar, T. K., & Ghosh, S. (2026). Digital financial inclusion in rural India: Findings from NSS 77th Round Survey. *The Indian Economic Journal*. <https://doi.org/10.1177/00194662261447254>