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Digital Financial Services and Access to Formal Finance in Rural India: An Empirical Study

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Abstract – **The aim of this study is to explore the potential of digital financial services (DFS) in enhancing rural households' access to formal financial services in India. The study uses primary data collected through a structured questionnaire from 402 respondents to examine the linkages between multidimensional access to formal finance, including savings, credit, insurance, and payment services, and DFS awareness, intensity of usage, digital literacy, trust and perceived security, and barriers to digital adoption. Descriptive statistics, reliability analysis, correlation analysis, and hierarchical regression were employed to analyse the data. The results suggest that the intensity of DFS use, digital literacy, and trust and perceived security are important positive drivers of access to formal finance. The relationship between DFS usage and formal financial access is further moderated by education and network quality. Awareness of digital platforms is fairly high, although the rate of usage of these services and the extent of engagement with formal financial products remain modest. Key challenges include low levels of digital literacy, poor connectivity, and cybersecurity concerns. The results indicate that, with adequate investments in digital literacy, trust-building, and reliable infrastructure, DFS can enhance rural financial inclusion. This study provides empirical evidence and policy recommendations for policymakers, banks, and FinTech companies interested in strengthening formal financial inclusion in rural India.**

Keywords **- Digital Financial Services (DFS), Formal Finance, Financial Inclusion, Rural India, Digital Literacy, Financial Technology (FinTech).**

I. INTRODUCTION

1. Background of the Study

Financial Inclusion is one of the key components of inclusive economic development in India. Formal financial services, which encompass regulated banks, savings institutions, credit, insurance, and payments, allow rural households to effectively manage their resources, increase resilience, and limit their reliance on informal finance. The Indian financial landscape has undergone a swift transition towards digitalization, with the increasing affordability of mobile connectivity, the spread of digital public goods, and FinTech innovation. While all these developments have been progress, it is important to consider whether digital channels are effectively translating to tangible inclusion results, and if not, who is more and less likely to benefit in these areas.

2. Digital Financial Services in Rural India

Digital financial services (DFS) in rural India refer to various online financial products and services, such as mobile banking, Unified Payments Interface (UPI) and digital payments, internet banking, Aadhaar-based payment services, digital wallets and FinTechs. These channels help to reduce physical branch visits, cut transaction costs and extend the reach of formal institutions to a larger extent. Studies indicate a positive correlation between the adoption of FinTech and financial access and savings behavior among the rural population (Asif et al., 2023; Goswami et al., 2022). Despite this, uptake and usage levels vary depending on infrastructure, literacy and confidence of users.

3. Access to Formal Finance

Formal finance is a multifaceted concept that includes having and using a savings account, institutional credit, insurance, pension and investment products, and access to government-financed financial services. Although there is progress in account penetration, there remain low levels of formal credit, insurance, and long-term savings among rural households (Bharat et al., 2022; Demirgüç-Kunt et al., 2022). The problem of moving from basic access to meaningful use remains a challenge.

4. Problem Statement

Even with the growth of digital financial infrastructure, there are still substantial gaps in formal financial access in rural India. Limited technical ability, lack of connectivity, financial constraints, trust issues, cybersecurity worries, and lack of digital literacy remain key barriers to effective and long-term DFS adoption and use (Azeez & Akhtar, 2021; Buteau et al., 2021; Cnaan et al., 2023). This means that the ability of digital channels to enhance formal inclusion is underutilised.

5. Research Gap

Although the linkages between FinTech, digital payments, and financial inclusion at the aggregate level are well documented, there are still limited primary data studies that directly link the use of DFS to the multidimensional aspect of accessing formal financial services at the household level among the rural population. Several studies consider digital adoption and formal access as different outcomes and focus more on mechanisms and barriers than on the micro-level.

6. Objectives of the Study

The study aims to:

- Analyze awareness and adoption of digital financial services by rural people.
- Evaluate access to formal financial services in rural areas of India.
- Examine the link between the use of digital financial services and access to formal finance.
- Discuss the key challenges in the adoption of DFS in rural areas.

7. Research Questions

The study addresses the following research questions:

- Does digitisation of financial services increase access to formal financial services?
- What are the most frequently used digital financial services among rural households?
- What are some of the challenges to digital financial services in rural areas?

II. REVIEW OF LITERATURE

1. Concept of Digital Financial Services

Digital financial services (DFS) are those formal financial services that are delivered via a digital channel, such as mobile banking, internet banking, digital payments, Aadhaar-enabled services, digital wallets, and FinTech platforms. They are growing in India as a consequence of digital public infrastructure, penetration of smartphones, and regulatory support for interoperability. DFS significantly lowers transaction costs, diminishes reliance on brick-and-mortar branches, and expands formal financial services to geographically less accessible groups (Arner et al., 2020; Malladi et al., 2021). In rural areas, they are used as alternatives to and are complementary to conventional banking systems (Asif et al., 2023; Goswami et al., 2022).

2. Digital Financial Inclusion

Digital financial inclusion is defined as the use, availability, usability, awareness, and cost of technology-enabled financial services (Khera et al., 2021; Demirgüç-Kunt et al., 2022). Theoretical approaches highlight that technical tools do not necessarily promote inclusion; digital literacy, trust, and the infrastructure required to enable meaningful use of digital channels are key to inclusion (Senyo & Osabutey, 2021; Lyons et al., 2022). Digital inclusion is seen in emerging economies as a way to make the financial lives of households more formal and to create greater economic resilience.

3. Formal Financial Access in Rural Areas

Formal financial access is measured as a combination of savings account ownership and use, access to institutional credit, insurance, pension plans, and the use of government-supported services in rural India. Although there has been success in account penetration, the depth of usage is still shallow. Most households hold accounts mainly to receive transfers but also use informal sources for credit and risk management (Bharat et al., 2022; Saravanabhavan & Rajeev, 2024). Complementary capabilities and trust are needed to ensure that digital channels work effectively, but they can help overcome distance and cost barriers.

4. Empirical Studies on Digital Finance and Financial Inclusion

International evidence demonstrates that digital payments and mobile money have a positive impact on financial inclusion and resilience in developing countries (Sahay et al., 2020; Ozili, 2021; Shen et al., 2021). These trends are also echoed by Indian studies, which reveal a positive relationship between the use of FinTech and financial inclusion (Asif et al., 2023) and between FinTech users and financial outcomes such as savings and formal access (Goswami et al., 2022) in rural areas. Digital literacy, education, income, and digital access are important factors affecting adoption, as stated in research conducted in rural areas (Azeez & Akhtar, 2021; Panakaje et al., 2023). However, trust, cybersecurity, and technical capability issues remain and may prevent continued use (Buteau et al., 2021; Cnaan et al., 2023; Nandru et al., 2024).

5. Research Gap and Conceptual Framework

Existing primary household-level evidence that explores DFS usage intensity, digital literacy, trust, and multi-dimensional access to formal finance in rural India is still limited. In many studies, the impact of digital adoption and formal access is studied in isolation, and micro-level pathways remain under-studied (Jha & Dangwal, 2024).

The conceptual framework suggests that the intensity of DFS use, digital literacy, and trust/perceived security are key independent variables affecting access to formal finance. The following variables are used as controls and moderators:

- Socioeconomic characteristics: Education and income.
- Infrastructural characteristics: Smartphone ownership and internet connectivity.

6. Hypotheses

- H1: The use of digital financial services is significantly and positively correlated with access to formal financial services in rural India.
- H2: Digital literacy has a significant and positive relationship with access to formal finance.
- H3: Trust and perceived security have a significant and positive effect on DFS use and access to formal finance.
- H4: Socioeconomic and infrastructural factors have significant moderating effects on the relationship between DFS usage and access to formal finance.

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III. RESEARCH METHODOLOGY

1. Research Design

This study uses descriptive and analytical research. The descriptive component shows the awareness, uptake, and constraints on the use of digital financial services (DFS) among rural households. The analytical part compares the use of DFS to access to formal finance and tests the hypothesized links statistically.

2. Nature of Data

This study uses only primary data. Primary data were deemed necessary for capturing household-level experiences, perceptions, usage intensity, and barriers not captured in secondary or aggregated data.

3. Data Collection Instrument

The data were gathered using a structured questionnaire that was filled out through face-to-face interviews. There were closed-ended and scaled items in the instrument. Digital literacy, perceived security, ease of use, and trust were measured using a five-point Likert scale, where "Strongly Disagree" is equal to 1 and "Strongly Agree" is equal to 5. Dichotomous and ordinal items were used to measure usage frequency and access to formal financial products. The questionnaire was pre-tested on a small pilot sample to ensure clarity and cultural relevance prior to the actual testing.

4. Population of the Study

The target population includes adult members of rural households who are existing or potential users of formal and digital financial services. The emphasis on rural residents provides for the analysis of the particular constraints related to infrastructure, literacy, and levels of trust that rural people face.

5. Sampling Technique and Sample Size

A multi-stage sampling method was used in the present study. Districts were purposively selected to capture diversity in digital infrastructure and banking density. Simple random sampling was used to select villages in the selected districts, and systematic sampling was used to select households from local village registers. One eligible adult respondent per household was interviewed.

The sample size was calculated for large populations using Cochran's formula:

$n_0 = (Z^2 \times p \times q) / e^2$

Where:

Z = 1.96 represents a 95% confidence level

p = 0.5

q = 0.5

e = 0.05

This yielded a minimum sample size of 384. Allowing for non-response, the target sample size was set at 420. A total of 402 valid responses were used for analysis after the data cleaning process.

6. Variables of the Study

Independent Variable: Digital Financial Services (DFS)

Digital Financial Services is measured in terms of awareness, accessibility, frequency of use, diversity of platforms, and platforms used, including mobile banking, UPI, digital wallets, Aadhaar-enabled services, and FinTech platforms.

Dependent Variable: Access to Formal Finance

Access to Formal Finance is measured as a multidimensional construct comprising bank account ownership and usage, formal credit access, savings behaviour, insurance coverage, and participation in government financial schemes.

Supporting Variables

- Digital literacy
- Internet/network availability
- Trust and perceived security
- Education
- Income
- Age
- Gender

These variables serve as controls and moderators of the basic relationship.

7. Statistical Tools

Data analysis was carried out using descriptive and inferential analysis.

Descriptive Analysis

- Percentage analysis
- Mean
- Standard deviation

These were used to summarize demographic characteristics, awareness, usage, and barriers.

Reliability Analysis

- Cronbach's alpha was used to test the reliability of the multi-item scales.

Inferential Analysis

- Pearson correlation analysis was used to examine associations between variables.
- Multiple regression analysis was used to test the relationship between DFS use and access to formal finance.
- Interaction terms were added to assess moderation effects.
- Chi-square tests were used for categorical associations where appropriate.

Standard statistical software was used for all analyses, and diagnostic checks were performed for multicollinearity and model fit.

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8. Ethical Considerations

Participation was voluntary. Participants were informed that the study was conducted for academic purposes, their responses would be kept confidential, and they had the option of withdrawing at any point. No personally identifiable information was retained beyond the data collection period, and the data were used only for research purposes.

IV. DATA ANALYSIS AND RESULTS

1. Demographic Profile of Respondents

The final analytical sample comprised 402 valid responses. Table 1 presents the demographic profile. Males accounted for 54.2 per cent and females for 45.8 per cent. The largest age group was 26–45 years (61.4 per cent). Educational levels were distributed as follows: primary or below (32.1 per cent), secondary (28.6 per cent), and higher secondary or above (39.3 per cent). Nearly half of the respondents (47.8 per cent) reported monthly household income below ₹15,000. Smartphone ownership was relatively high at 78.6 per cent.

Table 1: Demographic Profile of Respondents (N = 402)

Characteristic	Category	Frequency	Percentage
Gender	Male	218	54.2
	Female	184	45.8
Age	18–25 years	59	14.7
	26–45 years	247	61.4
	Above 45 years	96	23.9
Education	Primary or below	129	32.1
	Secondary	115	28.6
	Higher secondary & 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 Ownership	Yes	316	78.6
	No	86	21.4

2. Awareness of Digital Financial Services

Table 2 reports awareness levels across major digital financial services. UPI recorded the highest awareness (82.3 per cent), followed by mobile banking (74.6 per cent). Awareness of digital wallets stood at 61.2 per cent, Aadhaar-enabled payment services at 58.7 per cent, and internet banking at 49.5 per cent. Overall, 86.1 per cent of respondents were aware of at least one form of DFS.

Table 2: Awareness of Digital Financial Services (N = 402)

Digital Financial Service	Aware (n)	Percentage	Not Aware (n)	Percentage
UPI / Digital Payments	331	82.3	71	17.7
Mobile Banking	300	74.6	102	25.4
Digital Wallets	246	61.2	156	38.8
Aadhaar-enabled Payment Services	236	58.7	166	41.3
Internet Banking	199	49.5	203	50.5
At least one DFS	346	86.1	56	13.9

3. Usage Pattern of Digital Financial Services

Table 3 presents usage patterns. UPI was the most widely used service (68.4 per cent), followed by mobile banking (52.7 per cent). Digital wallets were used by 41.3 per cent, Aadhaar-enabled services by 34.8 per cent, and internet banking by 22.6 per cent. The mean intensity of DFS usage was 3.24 (SD = 0.87) on a five-point scale.

Table 3: Usage Pattern of Digital Financial Services (N = 402)

Digital Financial Service	Users (n)	Percentage	Non-Users (n)	Percentage
UPI / Digital Payments	275	68.4	127	31.6
Mobile Banking	212	52.7	190	47.3
Digital Wallets	166	41.3	236	58.7
Aadhaar-enabled Payment Services	140	34.8	262	65.2
Internet Banking	91	22.6	311	77.4

Table 4: Frequency of DFS Usage (N = 402)

Frequency of Use	Frequency	Percentage
Regular (weekly or more)	160	39.8
Occasional (monthly)	114	28.4
Rare / Never	128	31.8
Mean Intensity Score (SD)	3.24 (0.87)	–

4. Access to Formal Financial Services

Table 5 summarises access to formal financial services. Bank account ownership was nearly universal (94.5 per

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cent). Regular account usage stood at 71.2 per cent, formal credit access at 38.6 per cent, insurance coverage at 29.4 per cent, and participation in pension or investment products at 18.7 per cent. The composite formal finance access index had a mean of 2.87 (SD = 1.12).

Table 5: Access to Formal Financial Services (N = 402)

Formal Financial Service	Access / Usage (n)	Percentage
Bank Account Ownership	380	94.5
Regular Account Usage	286	71.2
Formal Credit / Loan Access	155	38.6
Insurance Coverage	118	29.4
Pension / Investment Products	75	18.7
Composite Access Index – Mean (SD)	2.87 (1.12)	–

5. Barriers to Digital Financial Adoption

Table 6 presents the major barriers reported by respondents. Lack of digital literacy (46.3 per cent) and poor internet connectivity (41.8 per cent) were the most frequently cited constraints, followed by cybersecurity concerns (38.6 per cent) and lack of trust (35.1 per cent).

Table 6: Barriers to Digital Financial Adoption (N = 402)

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 in digital platforms	141	35.1
Technical difficulties	119	29.7
Affordability of data / devices	90	22.4

6. Reliability and Correlation Analysis

Table 7 reports reliability statistics. All multi-item constructs recorded Cronbach's alpha values above 0.80, indicating satisfactory internal consistency.

Table 7: Reliability Statistics

Construct	No. of Items	Cronbach's Alpha
Intensity of DFS Usage	6	0.81
Digital Literacy	5	0.86
Trust and Perceived Security	5	0.83

Table 8 presents the correlation matrix. Intensity of DFS usage showed a significant positive correlation with access to formal finance ($r = 0.48$, $p < 0.01$). Digital literacy ($r = 0.42$, $p < 0.01$) and trust ($r = 0.39$, $p < 0.01$) were also positively associated with the dependent variable.

Table 8: Pearson Correlation Matrix

Variable	1	2	3	4
1. Intensity of DFS Usage	1	–	–	–
2. Digital Literacy	0.51**	1	–	–
3. Trust & Perceived Security	0.47**	0.44**	1	–
4. Access to Formal Finance	0.48**	0.42**	0.39**	1

7. Hypothesis Testing

Hierarchical multiple regression results are presented in Table 9. Intensity of DFS usage ($\beta = 0.31$, $p < 0.001$), digital literacy ($\beta = 0.22$, $p < 0.001$), and trust and perceived security ($\beta = 0.18$, $p < 0.01$) all exerted significant positive effects on access to formal finance, supporting H1, H2, and H3. Interaction terms indicated that education and network quality significantly moderated the relationship, providing partial support for H4. The adjusted R^2 increased from 0.19 in the controls-only model to 0.44 in the full model.

Table 9: Hierarchical Regression Results (Dependent Variable: Access to Formal Finance)

Predictor	Model 1 (β)	Model 2 (β)	Model 3 (β)
Education	0.21***	0.14**	0.12*
Income	0.18**	0.11*	0.10*
Smartphone Ownership	0.16**	0.09*	0.08
Network Quality	0.12*	0.07	0.06
Intensity of DFS Usage	–	0.31***	0.28***
Digital Literacy	–	0.22***	0.20***
Trust and Perceived Security	–	0.18**	0.17**
DFS Usage × Education	–	–	0.14*
DFS Usage × Network Quality	–	–	0.12*
Adjusted R^2	0.19	0.41	0.44
F-statistic	18.74***	34.62***	28.91***

8. Summary of Major Findings

The analysis reveals moderate awareness and usage of digital financial services, with UPI emerging as the dominant platform. Access to formal finance remains uneven, with high account ownership but limited credit and insurance penetration. Intensity of DFS usage, digital literacy, and trust significantly and positively predict formal finance access. Education and network quality further moderate this relationship. Barriers related to literacy, connectivity, and trust continue to constrain broader adoption.

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V. DISCUSSION

1. Interpretation of Key Findings

The empirical findings show a positive and significant relationship between the intensity of Digital Financial Services (DFS) use and the use of formal financial services by rural households. Those who reported using digital platforms more often and accessing a larger variety of services tended to be more engaged in formal savings, credit, insurance, and payment facilities. Other key predictors were digital literacy and trust, demonstrating that having access to technology alone is not enough for financial inclusion. The moderating effects of education and network quality also imply that access to the benefits of DFS is not equally distributed and is stronger for households with higher educational capabilities and better digital infrastructure.

2. Comparison with Previous Studies

The results are similar to previous studies. In India, positive relationships between the adoption of FinTech and financial inclusion indicators were also reported by Asif et al. (2023) and Goswami et al. (2022). The present study extends this evidence by examining the relationship at the household level using primary data and multidimensional measures of access to formal finance.

The significance of digital literacy aligns with the observations made by Azeez and Akhtar (2021) and Panakaje et al. (2023), while the importance of trust and ongoing security concerns is consistent with the research of Cnaan et al. (2023) and Buteau et al. (2021). The moderating factors identified in this study are also consistent with studies showing that socioeconomic and infrastructural factors influence the outcomes of digital inclusion (Nandru et al., 2024; Shah et al., 2024).

3. Implications for Rural Financial Inclusion

The results indicate that digital financial channels can contribute significantly to financial inclusion in rural India when investments are made in complementary areas such as digital literacy, trust building, and reliable connectivity. Although awareness of DFS is high and usage levels are moderate, a conversion gap exists between awareness and meaningful usage, which needs to be addressed by policymakers and financial institutions.

It is also necessary to increase the depth of formal financial engagement, particularly in credit and insurance services, if digital tools are to take rural households beyond basic account ownership. Digital financial inclusion should therefore focus not only on access and adoption but also on the meaningful and sustained use of a wider range of formal financial services.

4. Role of Banks, FinTech Companies and Government

Banks and FinTech companies can enhance financial inclusion by creating simplified and easy-to-use vernacular interfaces and by increasing agent coverage to provide financial services at the last mile and assist users in completing digital transactions and forms.

Government institutions can play a significant role in improving rural digital infrastructure, launching large-scale digital literacy initiatives, and strengthening consumer protection and cybersecurity regulations.

To overcome the barriers identified in the study, coordinated action by banks, FinTech service providers, and government institutions is required. Such coordinated efforts can promote deeper, more equitable, and sustainable access to formal financial services for rural households through Digital Financial Services.

VI. CONCLUSION AND RECOMMENDATIONS

1. Conclusion

The study explored the correlation between digital financial services (DFS) and access to formal finance among rural households in India based on primary survey data. The results show that greater intensity of DFS usage is positively related to the use of formal financial services, such as savings, credit, insurance, and payment facilities. This relationship is further enhanced by digital literacy and trust and is moderated by education and network quality.

While there is a decent level of awareness of digital platforms, usage and the extent of formal finance engagement are not high. Digital literacy, internet connectivity, cybersecurity issues, and lingering skepticism remain limiting factors for more widespread adoption. The overall results reveal that digital financial services can be an effective catalyst for enhancing the financial inclusion of rural citizens if complemented by adequate capabilities and infrastructure.

2. Recommendations

Based on the results, some practical recommendations can be drawn:

- Digital Infrastructure: Access to digital infrastructure, especially reliable internet connectivity, should be enhanced in rural areas to reduce access barriers.
- Digital and Financial Literacy: Large-scale digital and financial literacy programmes for rural communities, especially women and less-educated groups, are necessary to build capability and confidence.
- Awareness and Usage: Awareness campaigns need to go beyond disseminating information and encourage the active and continued use of digital platforms.
- Consumer Protection and Cybersecurity: A strong consumer protection framework and greater cybersecurity awareness are needed to foster trust among rural users.
- User-Friendly Technology: Banks and FinTech companies should develop technology that is simple, local, and easy to use for rural people.

- Coordinated Last-Mile Delivery: More coordinated last-mile delivery and support are required among banks, FinTech companies, local institutions, and the government.

3. Policy Implications

The results illustrate the need to connect digital financial solutions with broader policies and programmes concerning rural development and financial inclusion. The expansion of digital channels should be accompanied by policies that focus on enabling conditions that affect the value of digital tools in providing meaningful access to formal finance, such as literacy, trust, connectivity, and consumer protection.

Digital financial inclusion can be made more equitable by addressing existing gender gaps and disparities among low-income and less digitally literate populations through targeted interventions.

4. Limitations of the Study

The study was subject to the following limitations:

- Cross-Sectional Design: The cross-sectional design limits the ability to make causal inferences.
- Limited Geographical Coverage: Generalizability is limited because only selected rural areas were covered in the study.
- Self-Reported Data: Recall and social-desirability bias may affect self-reported measures of usage, literacy, and trust.
- Sample Size: The sample size of 402 is sufficient for the analysis used, but larger and more diverse samples would enhance external validity.

5. Scope for Future Research

Longitudinal study designs may be used in future research to monitor changes in digital engagement and formal finance outcomes over time. Mixed-methods approaches could provide a deeper understanding of the behavioural and institutional mechanisms involved.

Comparative studies across states with different levels of digital infrastructure can provide greater insight into contextual differences. There is also a need for experimental testing of digital literacy and trust-building interventions to establish stronger causal evidence. Additional focus is needed on digital financial inclusion from gender and intersectional perspectives.

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