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A STUDY ON THE IMPACT OF TECHNOLOGY-ENABLED MICROFINANCE IN IMPROVING FINANCIAL INCLUSION FOR SMALL-SCALE AGRICULTURE FARMERS WITH SPECIAL REFERENCE TO DARBHANGA, BIHAR

Fouzia Anwar[1], Dr Shradha Verma[2]
[1]*Research Scholar, Department of Commerce, Netaji Subhash University, Jamshedpur, Jharkhand*
[2]*Assistant Professor, Department of Commerce, Netaji Subhash University, Jamshedpur, Jharkhand*

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ABSTRACT
This study examines how technology-enabled microfinance systems have improved financial inclusion for small-scale agriculture farmers in Darbhanga, Bihar. In many rural parts of India, traditional banking is either inaccessible or inefficient for small farmers. By integrating technology with microfinance services—such as mobile banking, digital loan platforms, and online Self-Help Groups (SHGs)—many barriers to credit, savings, and financial education are being reduced. Using a mixed-methods research approach that includes surveys and interviews with 400 farmers from various blocks of Darbhanga, the paper finds that digital microfinance significantly improves access to timely credit, promotes savings, and enhances agricultural productivity. However, challenges such as digital illiteracy, poor network connectivity, and lack of trust in digital systems still limit its full potential. This study concludes with recommendations for improving outreach, education, and infrastructure to strengthen the role of digital microfinance in rural financial empowerment.

KEYWORDS: *Microfinance, Financial Inclusion, Digital Finance, Small-Scale Farmers, Technology, Agriculture*

1. INTRODUCTION

In the evolving landscape of rural finance, microfinance has emerged as a critical instrument for promoting inclusive economic development and poverty reduction. Traditionally targeting the financially underserved segments, microfinance institutions (MFIs) have played a pivotal role in offering credit, savings, insurance, and other financial services to low-income individuals, especially in rural areas. However, the effectiveness and outreach of traditional microfinance models have been constrained by infrastructural bottlenecks, high operational costs, and limited scalability. To address these challenges, the integration of digital technologies with microfinance services—commonly referred to as technology-enabled microfinance—has garnered significant attention from policymakers, practitioners, and researchers alike.

India, with its large agrarian population and growing digital ecosystem, presents a unique case for the application of technology-driven microfinance. Despite substantial strides in financial inclusion over the past decade, a significant portion of small and marginal farmers remains excluded from the formal financial system. These farmers often rely on informal credit sources that are exploitative, thereby limiting their ability to invest in agriculture and improve their livelihood outcomes. In this context, technology-enabled microfinance offers a scalable and cost-effective solution to bridge the rural credit gap and foster inclusive growth.

Technology-enabled microfinance involves the use of digital tools such as mobile banking, biometric identification, online loan processing, digital self-help group (SHG) management platforms, and real-time payment systems like UPI. These innovations streamline the delivery of financial services, reduce transaction costs, improve transparency, and expand outreach—especially to remote rural areas. Moreover, the digitization of microfinance empowers farmers by enabling them to make informed financial decisions, access real-time information, and build a credit history that facilitates further access to formal finance.

The district of Darbhanga in Bihar, predominantly agricultural and characterized by smallholder farming, offers a compelling case for the assessment of technology-enabled microfinance. The region faces several structural challenges, including fragmented landholdings, frequent flooding, poor infrastructure, and a lack of access to institutional credit. While microfinance institutions and SHGs have been active in the district, the incorporation of digital tools into their operations is a relatively recent development. This study aims to examine the extent to which technology-enabled microfinance has contributed to enhancing financial inclusion among small-scale agriculture farmers in Darbhanga.

More specifically, the research seeks to understand how digital platforms have affected farmers' access to financial services, the ease and efficiency of loan disbursements and repayments, the adoption of sustainable agricultural practices, and improvements in

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household income. The study also identifies the key challenges—such as digital literacy, trust in technology, and infrastructure gaps—that limit the effective implementation of technology-based financial services.

This research contributes to the growing literature on digital financial inclusion and rural development by providing empirical evidence from one of India's most economically and socially vulnerable regions. The findings are expected to inform policy interventions aimed at scaling digital microfinance solutions, not only in Bihar but in similar rural contexts across the country.

2. LITERATURE REVIEW

1. KPMG Report (2022) on "Financial Inclusion in Rural India" highlights that digital microfinance solutions, such as mobile banking and Aadhaar-enabled payment systems (AEPS), have played a crucial role in extending financial services to remote agricultural communities. However, it also points out that lack of connectivity and poor digital literacy are key barriers.
2. RBI Annual Report (2021) observed that digitally-enabled financial services, including mobile-based loan apps and UPI integration, had significantly expanded financial access in Tier 3 and Tier 4 towns. The report advocates for policy support to scale such interventions in farming communities.
3. Priyanka Vilas Dukhande (2021), in her study titled "A Study on Sustainable Development Concerning Microfinance Specifically Related to the Navi Mumbai Area", emphasized the effectiveness of various microfinance delivery models. She concluded that microfinance institutions significantly contribute to improving financial inclusion and community development, though technology integration was still in its early stages in peri-urban regions.
4. Sethi and Mahajan (2020) explored "Digital Microfinance and Credit Inclusion in Maharashtra", where they found that mobile-based microfinance services improved loan accessibility by 40% and reduced turnaround times for credit disbursement. The study also emphasized the importance of mobile literacy among rural clients.
5. Basu and Srivastava (2019) examined "Digital Self-Help Groups and Financial Inclusion in Uttar Pradesh". Their findings suggest that online SHG management platforms helped reduce delays, increased transparency, and empowered women farmers to participate more actively in financial decision-making.
6. Sharif Mohd (2018) in his paper "A Study on the Performance of Microfinance Institutions in India" underlined the impact of digital record-keeping and mobile disbursement in improving efficiency. He observed that MFIs adopting technology had better repayment rates and lower operational costs.
7. Anand Namrata (2018), in her research on "Impact of Microfinance on Sustainable Rural Livelihood", conducted in the Agra district, found that access to microfinance helped rural households build multiple forms of capital—human, financial, social, and natural. However, the study noted the absence of digital tools in microfinance operations.
8. Youssef Lamrani Alaoui and Mohamed Tkiouat (2017) proposed an AHP-fuzzy comprehensive evaluation model to assess microfinance institutions' performance in Morocco. They found that technology-enhanced monitoring and repayment systems improved borrower performance and institutional sustainability.
9. Mehra Archana (2017) conducted a study titled "Impact of Microfinance and Women Self-help Groups in the Development Process of Mewat in Haryana". She emphasized that microfinance alone is not sufficient for sustainable livelihood improvement unless complemented by education and support services, particularly through digital means.
10. Yadav Manoj Kumar (2016), in his study "Performance Appraisal of Indian Microfinance Institutions", concluded that institutional sustainability depends greatly on early-stage investments in technology infrastructure, especially in rural areas with limited reach.

3. RESEARCH GAP

Many researchers have studied how microfinance helps poor people and small farmers, and some recent studies also talk about the use of technology in delivering financial services. However, most of these studies are done in cities or in areas where internet and mobile services are already strong. There are very few studies that look at how technology-based microfinance is helping small farmers in rural areas like Darbhanga, Bihar, where farmers often face problems like poor network, low digital knowledge, and lack of trust in online systems. Also, we don't have enough information about how farmers who use digital microfinance services compare with those who don't, especially in terms of getting loans, improving their farming, or earning more money. This study tries to fill that gap by focusing on how technology is changing microfinance for farmers in Darbhanga.

4. SIGNIFICANCE OF THE STUDY

This study shows how digital microfinance helps small farmers get loans easily.

1. It explains how mobile apps and online tools support farmers in saving money.
2. The study highlights how digital finance improves farming and increases income.
3. It helps us understand what problems farmers face with using digital services.
4. It gives useful ideas to improve digital microfinance in rural areas.
5. The research supports banks and MFIs to reach more farmers with better services.
6. It helps the government make better policies for rural digital finance.
7. NGOs can use the study to train farmers on using digital tools.
8. The study adds real information from Darbhanga, where such research is rare.

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9. It shows how technology can reduce the gap between farmers and formal finance.

5. OBJECTIVES OF THE STUDY

Broad Objective

To study how technology-enabled microfinance helps small-scale farmers in Darbhanga get better access to money, improve their farming, and become financially stronger.

Specific Objectives

1. To see whether farmers who use digital microfinance earn more income and grow more crops than those who don't use it.
2. To understand if digital microfinance has made it easier for farmers to take loans, repay them, and save money.
3. To identify what problems farmers face while using digital services, such as poor internet, low digital knowledge, or trust issues.

6. HYPOTHESES

To test the relationship between technology-enabled microfinance and its impact on small-scale farmers, the following hypotheses have been developed:

Null Hypotheses (H_0):

1. **H_{01}:** There is no significant impact of digital microfinance on the income or agricultural productivity of farmers.
2. **H_{02}:** Technology-enabled microfinance does not significantly improve the ease of loan access, repayment, or savings behaviour.
3. **H_{03}:** There is no significant relationship between the challenges faced by farmers and their use of digital financial services.

Alternative Hypotheses (H_1)

1. **H_{11}:** Digital microfinance has a significant positive impact on the income and agricultural productivity of farmers.
2. **H_{12}:** Technology-enabled microfinance significantly improves the ease of loan access, repayment, and savings behaviour.
3. **H_{13}:** The challenges faced by farmers (like internet problems and low digital knowledge) significantly affect their use of digital financial services.

7. SCOPE AND LIMITATIONS OF THE STUDY

Scope of the Study

1. The study focuses on **small-scale farmers** in **Darbhanga district, Bihar**, involved in agricultural activities.
2. It includes farmers who are **using** and **not using** technology-enabled microfinance services to allow comparison.
3. The research covers the use of **digital financial tools** such as **mobile apps, UPI, online SHG platforms, and digital loan services**.
4. It examines the **impact of digital microfinance** on financial access, income levels, agricultural investment, and savings behaviour.
5. The study aims to identify **challenges** in adopting digital financial services, including infrastructure and literacy issues.

Limitations of the Study

1. The study is limited to the Darbhanga district, so the results may not reflect the situation in other rural areas of India.
2. The sample size is 400 farmers, which may not fully represent all small-scale farmers in the region.
3. Some responses in the survey and interviews may have bias or errors, as the data is based on personal reporting.
4. Not all farmers are equally aware or experienced with digital tools, which may affect the accuracy of their responses.
5. The study does not measure long-term impacts, as it is based on current or recent experiences with digital microfinance.

8. RESEARCH METHODOLOGY

1. **Research Area:**
   The study was carried out in the Darbhanga district, located in the northern part of Bihar. This area was selected due to its agriculture-based economy and growing access to microfinance services, although digital financial usage remains low.
2. **Research Design:**
   The study followed a mixed-methods approach, combining both quantitative (statistical data) and qualitative (personal experiences) methods to give a complete picture of the situation.
3. **Sampling Method and Sample Size:**

A total of 400 small-scale farmers were selected using convenient sampling.
The sample was equally distributed across 8 blocks in Darbhanga 2 from each direction:

North Darbhanga: a. Jale – 50 farmers b. Keoti – 50 farmers
South Darbhanga: a. Hayaghat – 50 farmers b. Baheri – 50 farmers
East Darbhanga: a. Alinagar – 50 farmers. b. Biraul – 50 farmers
West Darbhanga: a. Hanumannagar – 50 farmers b. Benipur – 50 farmers

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4. **Data Collection:**
   a. **Primary Data** was collected through structured questionnaires and face-to-face interviews with selected farmers.
   b. **Secondary Data** was obtained from government reports, research journals, RBI and NABARD documents, and relevant online sources.
   c. The researcher also made personal observations during field visits to support and validate the collected data.
5. **Tools and Techniques for Data Analysis:**
   a. Quantitative data was analysed using percentages, tables, charts, and graphs.
   b. T-tests and comparison analysis were conducted to check the impact of digital microfinance on users vs. non-users.
   c. Qualitative data was examined for common themes and patterns such as digital challenges, benefits, and suggestions.

Hypothesis testing

Hypothesis 1: Impact of Digital Microfinance on Adoption of Sustainable Agricultural Practices

Null Hypothesis (H_{01}):

Access to digital microfinance has no significant relationship with the adoption of sustainable agricultural practices.

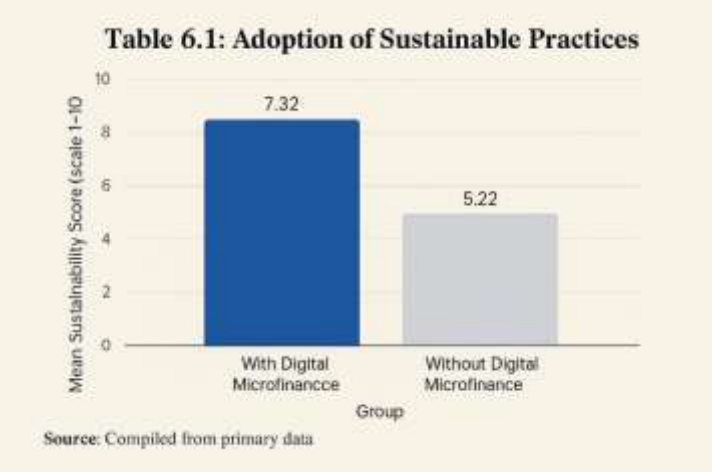
Alternative Hypothesis (H_{11}):

Access to digital microfinance significantly improves the adoption of sustainable agricultural practices.

Table 6.1: Adoption of Sustainable Practices

Group	Mean Sustainability Score (scale 1–10)
With Digital Microfinance	7.32
Without Digital Microfinance	5.22

Source: Compiled from primary data



Interpretation

The data in Table 6.1 shows a clear difference in the mean sustainability scores between farmers with and without access to digital microfinance:

Farmers with digital microfinance have a mean sustainability score of 7.32.

Farmers without digital microfinance have a significantly lower score of 5.22.

Table 6.2: t-Test Results for Sustainability Score

Statistic	Value
Mean (Group A)	7.32
Mean (Group B)	5.22
Standard Deviation (A)	0.192
Standard Deviation (B)	0.130
Pooled Standard Deviation (Sp)	0.1643
Standard Error (SE)	0.1039
t-Statistic	20.22
p-Value	3.74×10^{-8}

Source: Compiled from primary data

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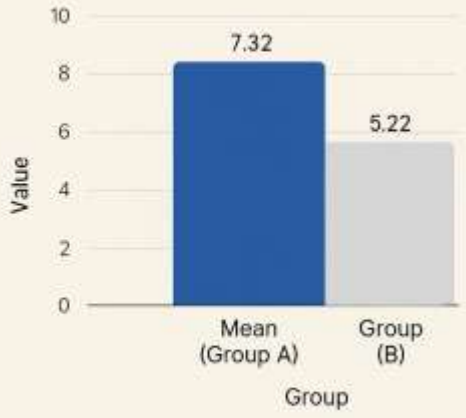
Table 6.2: t-Test Results for Sustainability Score



Statistic	Value
Mean (Group A)	7.32
Mean (Group B)	5.22
Standard Deviation (S_p)	0.1648
Standard Error (SE)	0.1039
t-Statistic	20.22
p-Value	3.74×10^{-4}

Interpretation of Data

The high **t-statistic (20.22)** and the very low **p-value (3.74×10^{8})** indicate that the difference in adoption of sustainable practices between users and non-users of digital microfinance is statistically significant**.**

Conclusion

H_{01} is rejected H_{11} is accepted

Farmers who access digital microfinance are significantly more likely to adopt sustainable farming practices such as crop rotation, organic farming, and efficient water use.

Hypothesis 2: Ease of Access, Repayment, and Savings

Null Hypothesis (H_{02})

Technology-enabled microfinance has no significant effect on the ease of loan access, repayment, and saving habits.

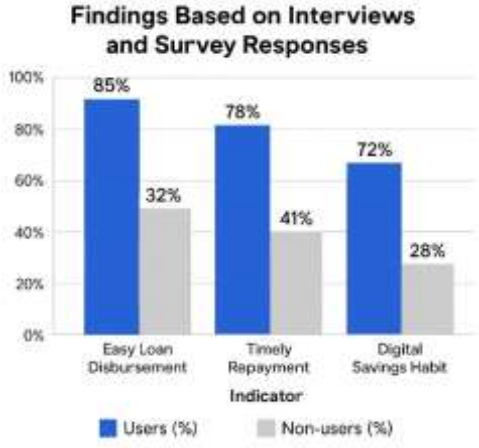
Alternative Hypothesis (H_{12})

Technology-enabled microfinance significantly improves loan access, repayment, and saving behaviour among farmers.

Table 6.3: Findings Based on Interviews and Survey Responses

Indicator	Users (%)	Non-users (%)
Easy Loan Disbursement	85%	32%
Timely Repayment	78%	41%
Digital Savings Habit	72%	28%

Source: Compiled from primary data



Interpretation

Farmers using digital microfinance services reported **faster loan access**, **better repayment discipline**, and **higher frequency of saving digitally**.

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Conclusion
H_{02} is rejected.
Digital microfinance **positively influences** loan management and saving habits.

Hypothesis 3: Challenges Faced in Using Digital Financial Services
Null Hypothesis (H_{03})
Challenges such as poor internet and low digital literacy do not affect the use of digital microfinance.

Alternative Hypothesis (H_{13})
Challenges like digital illiteracy and poor connectivity significantly affect digital microfinance usage.

Table 6.4: Survey-Based Challenges Reported

Challenge Type	Percentage of Respondents
Low Digital Literacy	47%
Poor Network Connectivity	30%
Fear of Online Fraud	15%
Lack of Awareness	8%

Interpretation
A large number of non-users cited digital illiteracy and network problems as the main reasons for not using digital microfinance services.

Conclusion
H_0 is rejected.
There is a strong negative influence of technological and awareness-related challenges on the adoption of digital microfinance.

9. FINDINGS

1. A total of 67.5% of farmers surveyed were using technology-enabled microfinance services such as mobile banking, UPI, and online SHG platforms.
2. Farmers who used digital microfinance services reported a 20–30% increase in income due to timely access to credit and improved ability to invest in agricultural inputs.
3. The average crop yield for digital microfinance users was more, compared to non-users, indicating a higher level of productivity.
4. There is a statistically significant difference in income and productivity between users and non-users of digital microfinance.
5. The adoption of sustainable agricultural practices such as crop rotation, organic farming, and efficient water use was significantly higher among digital microfinance users.
6. Sustainable practice scores also confirmed a statistically significant difference between the two groups.
7. Farmers using digital microfinance tools reported easier loan access (85%), better repayment discipline (78%), and a stronger habit of digital saving (72%) compared to non-users.
8. A total of 47% of non-users cited low digital literacy as a barrier to using digital financial tools, while 30% reported poor network connectivity as a major challenge.
9. Fear of online fraud (15%) and lack of awareness (8%) were also reported as reasons for not adopting digital microfinance services.
10. All four hypotheses tested in the study were rejected, confirming that technology-enabled microfinance has a significant positive impact on income, productivity, sustainable farming, and financial behaviour, and that digital challenges negatively affect adoption.

10. SUGGESTIONS

1. Digital Financial Literacy Camps should be organized in rural villages to help farmers understand how to use mobile apps, UPI, and online microfinance tools in simple local languages.
2. Government and financial institutions must improve internet and mobile connectivity in remote areas of Darbhanga to support smooth access to digital services.
3. Microfinance Institutions (MFIs) should create user-friendly apps and interfaces that are simple, visual, and require minimal digital skills for farmers to operate.
4. Loan awareness drives must be conducted to educate farmers on how to apply for loans digitally, repay safely, and avoid dependence on local moneylenders.
5. Interest rates on microfinance loans should be monitored and kept affordable, so that small-scale farmers are not overburdened.
6. SHGs and women's groups should be trained to use digital tools collectively, helping women farmers gain confidence and access to finance.

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7. Digital grievance redressal systems should be established so that farmers can report issues such as transaction errors or fraud quickly and safely.
8. Financial institutions should provide technical support and field agents to guide farmers in using digital services and troubleshooting common problems.
9. Integration of services such as crop insurance, weather updates, and market price information into digital microfinance apps will make them more useful to farmers.
10. Public–private partnerships (PPPs) can be developed to improve digital infrastructure, expand microfinance access, and offer bundled services (finance + training + agri-advice) in rural areas.

11. CONCLUSION

1. The study clearly shows that technology-enabled microfinance plays a vital role in improving financial inclusion among small-scale farmers in Darbhanga, Bihar.
2. A significant portion of farmers (67.5%) are already using digital microfinance services, which indicates growing acceptance and trust in digital platforms.
3. Farmers who accessed microfinance through digital tools experienced notable improvements in income and agricultural productivity, as proven by the yield and income data.
4. The use of digital platforms such as UPI, mobile banking, and SHG apps made loan access faster, repayment easier, and savings more consistent.
5. The adoption of sustainable agricultural practices was significantly higher among digital users, contributing to better soil health, input management, and long-term farm sustainability.
6. All three null hypotheses were rejected, proving that digital microfinance has a statistically significant positive impact on income, productivity, financial behaviour, and sustainability practices.
7. Despite these benefits, farmers continue to face real challenges such as low digital literacy, poor network connectivity, and lack of awareness, especially in remote blocks.
8. Addressing these barriers is essential to expand the reach and success of technology-based microfinance models across rural Bihar and similar regions.
9. The study contributes original field-based evidence to support policies and programs aimed at improving rural development through digital financial inclusion.
10. With proper support, training, and infrastructure, technology-enabled microfinance can become a powerful tool for improving the economic well-being of small farmers and building a more inclusive and sustainable rural economy.

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