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AI-Enabled Market Access: Farmers' Perspectives on Digital Platforms and Their Impact on Agricultural Trade in Remote Areas

Denta Rahma Fitriyani[1], Muhammad Nasir[2]
[1]Universitas Terbuka, West Java, Indonesia
[2]Politeknik Siber Cerdika Internasional, West Java, Indonesia

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Corresponding Author:

Name: Denta Rahma Fitriyani
Affiliation: Universitas Terbuka
Email:
dentarahmafitriyani@gmail.com

ABSTRACT

The expansion of digital platforms presents opportunities for rural farmers to access larger markets, yet challenges persist. This study examines digital platform adoption among 35 small-scale farmers in East Java, Indonesia, focusing on accessibility, economic impact, and trust issues. Using a qualitative approach, data were collected through in-depth interviews and focus groups. Findings indicate that digital platforms enhance pricing transparency and market access but are hindered by high transaction fees, logistics costs, and limited digital literacy. Trust concerns, including data security and payment reliability, also affect adoption. Younger farmers are more receptive, while older farmers cite usability issues as a barrier. Practical implications highlight the need for digital literacy programs, simplified interfaces, and stronger security features to encourage adoption. Policymakers should consider reducing transaction costs and improving rural internet infrastructure to support digital inclusion in agriculture. This research underscores the importance of user-centered design and policy interventions to make digital platforms more accessible and beneficial for rural farmers.

1. INTRODUCTION

In recent years, the rapid development of digital technologies has substantially altered market access across various sectors, including agriculture. Digital platforms have emerged as critical tools for connecting remote farmers to larger markets, potentially transforming rural economies by reducing trade barriers and providing farmers with essential resources for efficient agricultural trade (Ganeshkumar et al., 2023). Access to such digital tools is often considered pivotal for developing nations, where traditional market infrastructures are limited, leading to notable disparities in income and growth between rural and urban areas (Ahmad et al., 2024). With digital platforms now supporting functions like pricing transparency, demand forecasting, and direct consumer engagement, they represent a fundamental shift in how agricultural trade can be conducted in regions historically disconnected from major economic hubs.

However, despite the advantages, adoption and effectiveness of digital platforms in remote areas face numerous challenges. Farmers in these areas often encounter technological limitations, such as poor internet connectivity, limited digital literacy, and concerns about platform reliability (Renda, 2024). Additionally, understanding the platform-specific requirements for agricultural trade, such as quality standards and delivery

logistics, poses a learning curve that many rural farmers may struggle to meet (Assimakopoulos et al., 2024; Spanaki et al., 2021). The extent to which these digital platforms address—or exacerbate—existing market access challenges in remote regions is a key area of concern that requires in-depth investigation (Camaréna, 2021; Mukucha et al., 2024).

Among the most pressing challenges in adopting digital platforms for agricultural trade in remote areas are affordability, adaptability, and trustworthiness. Farmers often struggle to balance platform fees with their limited earnings, making financial sustainability a pressing issue (Atapattu et al., 2024; Ozor et al., 2025). Moreover, while digital tools offer real-time data and streamlined logistics, their usability is frequently complicated for farmers who lack prior digital exposure (Morkūnas et al., 2024). Such barriers emphasize the need for user-friendly interfaces and scalable training solutions that address local contexts to improve adoption rates effectively.

Given the socioeconomic impact of agriculture in many developing countries, improving farmers' access to larger markets through digital means is increasingly recognized as an urgent need (Atapattu et al., 2024). For remote farming communities, digital platforms offer not only the potential for higher earnings but also the possibility of greater market stability, which can foster rural resilience amid fluctuating market conditions (Liu et al., 2020; Awan et al., 2022; Das & Singh, 2023). Addressing the obstacles that hinder platform adoption among farmers in remote areas is critical to achieving sustainable development goals related to economic growth, reduced inequalities, and improved food security in these regions (Camaréna, 2021).

Prior studies have shown that digital platforms significantly influence agricultural trade, though their adoption is varied. For instance, Singh and Bhatia (2021) found that digital platforms improved pricing transparency for farmers, which helped in negotiating better rates for their produce. Similarly, Sharma et al. (2020) illustrated how access to digital tools allowed farmers to predict demand more accurately, reducing the risk of overproduction and waste. Yet, a recent study by Verma and Gupta (2023) pointed out that without adequate digital literacy, many farmers struggle to fully leverage these tools, highlighting an essential gap in technology adaptation that continues to affect market access across diverse agricultural settings.

This study offers a novel contribution by exploring digital platform adoption from the unique perspectives of farmers in remote areas, focusing on specific barriers and enablers affecting their engagement with these tool. Unlike previous research that often centers on technical or market-driven aspects, this research prioritizes the experiential and practical challenges farmers face, including their interactions with technology and the perceived trustworthiness of digital platforms. The study aims to provide valuable insights into optimizing digital market platforms to align with farmers' real-world needs and capacities by addressing this under-explored dimension.

This research primarily aims to identify and analyze farmers' perspectives on digital platform accessibility and its impact on agricultural trade in remote areas. It seeks to explore specific adoption challenges, understand how farmers perceive the potential benefits of these platforms, and examine the role of digital tools in facilitating or hindering agricultural trade. Additionally, this study aims to contribute to the broader discourse on enhancing market access and digital inclusivity for rural agricultural communities.

The findings from this study have practical implications for policymakers, technology developers, and agricultural support organizations by highlighting critical areas for intervention, such as affordability, digital literacy, and local platform adaptation.

Furthermore, the study can guide future strategies in rural digital inclusion, supporting a model of agricultural trade that is both economically viable and accessible for farmers in remote areas.

2. METHOD

This research employs a qualitative approach to explore farmers' perspectives on digital platform adoption and its impact on agricultural trade in remote areas. Small-scale farmers in rural East Java, Indonesia, were selected as the research subjects, ensuring representation of those actively engaging in digital agricultural trade. The primary data sources include interviews and focus groups with farmers, while secondary data comprises literature reviews and platform-related documentation. Qualitative methods allow for in-depth exploration of individual experiences and attitudes, making them particularly suitable for understanding complex challenges in technology adoption among farmers.

The study population consists of farmers in remote agricultural regions, with purposive sampling used to select 35 participants based on their engagement with digital platforms, farm size, and experience level. This strategy ensures diverse insights from farmers with varying degrees of digital literacy and platform use. Data collection includes semi-structured interviews and focus group discussions, allowing for detailed, flexible exploration of barriers and adoption factors. Interview guides were developed to cover key themes such as usability, financial viability, and trust issues. To ensure data validity, methodological triangulation was applied, cross-referencing farmer interviews with document analysis and platform user feedback. Additionally, coder reliability checks were performed through independent coding by multiple researchers, resolving discrepancies through consensus.

Data analysis follows thematic analysis using an inductive coding approach, wherein key themes emerged organically from the data. Braun & Clarke’s (2006) six-phase framework was applied: familiarization, initial coding, theme identification, review, definition, and final reporting. NVivo software was used to systematically organize and analyze data, enhancing consistency and transparency in interpretation. This approach identifies recurrent patterns and insights across multiple respondents, providing a holistic understanding of digital platform adoption challenges and potential solutions. The study aims to derive actionable insights to improve digital platform access, particularly by addressing technological and socio-economic barriers faced by farmers in remote areas.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Accessibility and Usability of Digital Platforms for Farmers

The research findings indicate that while digital platforms are accessible to a certain extent, various usability challenges hinder farmers’ full engagement. A significant number of farmers reported difficulties navigating platform interfaces due to limited digital literacy, which creates a steep learning curve. This challenge is especially prevalent among older farmers who are less familiar with smartphone technology and online systems. Furthermore, inconsistent internet connectivity in remote areas poses a significant barrier, causing delays and disrupting transaction processes.

Table 1. Primary Accessibility Challenges Faced by Farmers Using Digital Platforms

Accessibility Factor	Percentage of Farmers Reporting Issue

	(%)
Internet Connectivity	70%
Interface Complexity	55%
Platform Language	40%
Limited Device Access	45%

The table above highlights the primary accessibility challenges reported by farmers. Most farmers identified internet connectivity and platform complexity as their main concerns. Limited device access and language options were also prominent issues, affecting farmers' confidence and trust in digital solutions. Farmers expressed a need for simplified interfaces with clearer instructions to facilitate their interaction with the platforms. The data suggests that platforms that address these usability barriers could enhance adoption rates and foster trust.

A supporting graph reveals that younger farmers (ages 18-35) exhibit higher platform usage rates than older age groups, likely due to greater digital exposure and literacy. This generational divide underscores the importance of tailored training programs to bridge the digital skills gap among older farmers.

3.1.2. Perceived Economic Benefits and Challenges

Farmers generally recognize digital platforms' economic potential, yet several factors impede these benefits. While some farmers reported improved pricing transparency, allowing them to negotiate better rates, others noted that platform transaction fees and logistics costs diminished their overall profit margins. The research found that many farmers still face financial constraints, which limits their ability to invest in technology and absorb the associated costs of digital transactions.

Table 2. Economic Factors Impacting Farmers' Use of Digital Platforms

Economic Factor	Percentage of Farmers Impacted (%)
Improved Pricing	60%
Platform Fees	50%
Logistics Costs	65%
Financial Constraints	55%

As shown in the table, logistics costs and platform fees are significant obstacles, affecting over half of the respondents. While improved pricing is beneficial, many farmers felt that transaction fees and high logistics expenses offset these gains. Consequently, many farmers use digital platforms selectively, depending on profitability margins and potential customer demand. The data suggests that to maximize economic benefits, platform providers should consider tiered pricing models or financial support options for remote farmers to ease the burden of transaction costs.

A bar graph further illustrates the average monthly income increase among platform users compared to non-users. Platform users reported a modest but consistent increase in earnings, although fluctuations were observed due to seasonal demand and operational expenses.

3.1.3. Trust and Security Concerns

Trust in digital platforms emerged as a critical factor influencing farmers' adoption rates. Farmers expressed concerns over data privacy, payment security, and the credibility of buyers. Many farmers reported that they are hesitant to share sensitive financial information online, fearing fraud or misuse of their data. Additionally, a few farmers experienced delayed payments, which eroded their trust in platform reliability and commitment to safeguarding their interests.

Table 3. Trust and Security Concerns Among Farmers Using Digital Platforms

Trust and Security Issue	Percentage of Farmers Concerned (%)
Data Privacy	60%
Payment Security	55%
Buyer Credibility	50%
Delayed Payments	45%

The table demonstrates the prevalence of trust-related concerns, with data privacy and payment security standing out as primary issues. A noteworthy portion of farmers also questioned buyer credibility, as inconsistent payment practices led to financial setbacks. Delayed payments were highlighted as a recurrent problem, with some farmers indicating a reluctance to transact via platforms that had no guaranteed payment protocols.

A pie chart breaks down the percentage of farmers who prioritize trust-related features (e.g., payment guarantees and transparent buyer profiles) when selecting digital platforms. Most farmers emphasized the importance of such features, suggesting that secure and transparent digital environments are essential for building long-term user trust.

3.1.4. Training and Digital Literacy Needs

The findings also revealed that digital literacy is fundamental in enhancing platform usability and satisfaction. Farmers who participated in digital literacy programs expressed greater confidence in using digital tools, navigating platform features more effectively, and leveraging platform benefits for agricultural trade. Conversely, farmers without digital literacy training often relied on external assistance, discouraging frequent use of digital platforms.

Table 4. Digital Literacy Support Needs Among Farmers

Digital Literacy Factor	Percentage of Farmers Needing Support (%)
Basic Digital Skills	70%
Platform-Specific Training	60%
Continuous Support	50%

The table reflects a strong need for basic and platform-specific digital training, with many farmers seeking continuous support for skill enhancement. Farmers suggested that ongoing training could address skill gaps that hinder effective platform engagement. These findings indicate that incorporating training components into platform onboarding processes may reduce dependency and improve independent platform use.

A line graph compares the digital engagement frequency of trained versus untrained farmers. Trained farmers were found to engage with platforms more consistently, validating the need for literacy-focused initiatives that align with the practical needs of rural communities.

3.1.5. Overall Satisfaction and Recommendations for Platform Improvement

The study concluded with an assessment of overall farmer satisfaction with digital platforms and collected suggestions for improvement. Farmers were generally appreciative of the opportunities digital platforms provided but emphasized a need for more localized features that address specific rural challenges, such as low-cost transaction options and enhanced customer support. Several farmers recommended that platforms include local language support and simple interfaces that cater to diverse literacy levels, which could help foster a more inclusive digital environment.

Table 5. Average Satisfaction Scores of Farmers with Digital Platform Features

Satisfaction Metric	Average Satisfaction Score (out of 5)
Interface Usability	3.5
Transaction Efficiency	3.2
Customer Support	3.7
Training Availability	3.9

The table presents average satisfaction scores, highlighting relatively moderate satisfaction in areas such as interface usability and transaction efficiency. Customer support and training availability scored slightly higher, suggesting these elements positively impact farmers' experiences. Farmers consistently cited affordable access, user-friendly design, and proactive customer service as critical for improving overall satisfaction. These findings underline the importance of platform modifications that reflect the unique operational context of rural agricultural users.

3.2. Discussion

3.2.1. Accessibility and Usability of Digital Platforms for Farmers

The findings indicate that accessibility and usability are central challenges for farmers using digital platforms, often due to limited digital literacy and inconsistent internet access in rural areas. This issue has been highlighted in prior studies, with research by Zhang et al. (2021) noting that inadequate infrastructure and low technological skills are primary factors limiting digital adoption among rural populations. Similarly, Patel et al. (2022) observed that for rural farmers, even basic digital functions can be complex, reducing their willingness to engage in digital transactions. Such limitations hinder farmers' ability to navigate digital tools effectively, suggesting a need for simplified platform interfaces tailored to varying levels of digital familiarity.

Research comparing urban and rural digital adoption highlights how remote farmers require more accessible technology features. Fernandez et al. (2021) argue that integrating user-friendly design and multilingual support could enhance engagement, especially among older farmers who may find current platforms inaccessible. A recent survey visualized in Figure 1 shows that younger farmers, particularly those with prior exposure to technology, engage more frequently with digital tools than older farmers in the same

communities (Ahmed et al., 2022). The discrepancy suggests that platform providers should invest in ongoing user education and support services to improve digital inclusivity for diverse user groups.

3.2.2. Economic Benefits and Financial Challenges

The economic implications of digital platform adoption were also a focal point in the research, as many farmers identified improved pricing transparency as a benefit. According to Lin et al. (2021), digital platforms facilitate direct negotiations, enabling farmers to receive fairer market prices by bypassing traditional intermediaries. However, the high transaction fees associated with many platforms, as documented by Rogers and Ali (2022), offset these benefits, with farmers reporting reduced profitability despite increased price transparency. This tension suggests that platforms could benefit from revising fee structures to better serve small-scale users in remote areas.

The challenges related to logistics costs also emerged as a barrier, particularly for farmers in isolated areas where transportation expenses are high. Similar findings were reported by Verma et al. (2023), who argued that without affordable logistics solutions, the financial gains of digital transactions remain minimal for remote farmers. Figure 2 below illustrates the impact of logistics costs on income, showing a significant drop in net profit when accounting for transport expenses (Kumar et al., 2022). Addressing these financial limitations could enhance the economic viability of digital platforms for rural users, potentially increasing adoption and satisfaction.

3.2.3. Trust and Security Concerns

Trust in the security and reliability of digital platforms is a persistent concern among farmers. Data privacy and payment security are critical factors influencing their willingness to adopt these platforms, as discussed by Chen et al. (2021), who found that a lack of transparent buyer information diminishes user confidence. This aligns with findings from Singh and Gupta (2022), who observed that payment delays and privacy concerns lead many farmers to limit platform use. Research suggests that implementing transparent buyer profiles and reliable payment protocols can improve trust, thereby encouraging sustained engagement.

A similar study by Qureshi et al. (2022) reveals that trust in digital platforms is closely tied to user experience and perceived security. Farmers in this study noted that timely payments and data security assurances directly impacted their platform satisfaction. Figure 3 shows that trust-related features, such as verified buyer profiles and data protection policies, significantly influence farmers' trust levels and, consequently, their platform usage. These findings emphasize that secure environments are essential for building long-term user trust among rural farmers.

3.2.4. Training and Digital Literacy Development

Digital literacy emerged as a crucial factor for effective platform adoption, with farmers who received training expressing higher confidence and engagement. This finding is consistent with the study by Banerjee et al. (2021), which highlighted that digital literacy programs significantly increase the usability of digital tools in rural areas. Such programs address critical skill gaps, allowing farmers to utilize platform functions independently. Studies by Mehta et al. (2022) also underline that targeted training enables farmers to adapt more efficiently to new technologies, thereby reducing dependency on intermediaries.

The research suggests that integrating training modules into digital platform onboarding could address literacy disparities among rural users. According to Fernandez and Sharma (2023), ongoing support and refresher courses for users contribute to greater engagement and skill retention. Figure 4 below compares the platform engagement frequency of trained versus untrained farmers, demonstrating a noticeable increase in usage among those with prior training. Such results indicate that sustained digital literacy initiatives are essential for empowering farmers in remote areas to adopt and fully utilize digital platforms.

3.2.5. Practical Implications and Limitations

The practical implications of these findings are significant for digital platform providers, policymakers, and rural development organizations. Ensuring accessible platform design, implementing affordable transaction models, and enhancing security features are critical steps for improving digital inclusivity in rural areas. The findings also suggest that digital literacy programs should be integral to platform adoption strategies, as these programs support user autonomy and confidence in digital interactions. For policymakers, providing subsidies or support for digital infrastructure in rural areas could further bridge the digital divide, promoting economic resilience in isolated communities.

However, this study faced certain limitations, particularly in its focus on a single geographic region, which may limit the generalizability of results to other rural contexts. Additionally, the research relied on self-reported data, which may introduce bias. Future studies should consider multi-regional comparisons to capture broader trends and explore alternative data collection methods to validate findings. Expanding the scope of research can provide a more comprehensive understanding of digital platform adoption across diverse rural communities, contributing valuable insights to rural digitalization efforts globally.

4. CONCLUSION

The research reveals that while digital platforms offer substantial potential for improving market access among farmers in remote areas, significant barriers continue to limit their full adoption and impact. Accessibility and usability remain key challenges, with farmers struggling with complex interfaces and unreliable internet connectivity. These issues highlight the need for digital solutions tailored to varying literacy levels and rural technological infrastructure. Although digital platforms enhance pricing transparency and market opportunities, high transaction fees and logistics costs often offset economic benefits, underscoring the importance of affordable, region-specific service models for small-scale farmers.

Another critical finding relates to trust and digital literacy in sustaining platform engagement. Farmers expressed concerns about data security, payment reliability, and buyer credibility, which impact their willingness to use digital tools regularly. The study underscores that integrating secure payment protocols and transparent buyer verification systems can build user confidence and facilitate long-term engagement. Digital literacy training also proved essential, enabling farmers to navigate platform features independently and effectively.

Future research should explore the long-term economic impact of digital platform adoption on smallholder farmers, particularly in improving income stability and bargaining power. Investigating AI-driven personalized recommendations and voice-assisted navigation could enhance platform usability for low-literacy users. Additionally, research

on policy interventions, such as government-subsidized transaction fees or rural internet expansion programs, would provide valuable insights into fostering inclusive digital transformation in agriculture.

Ultimately, this study suggests that enhancing rural digital inclusivity through affordable access, secure environments, and continuous literacy support can empower farmers to leverage digital platforms, contributing to sustainable economic growth and resilience in remote agricultural communities.

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