Farmers' perceptions and willingness to adopt mobile forecasting applications for crop production and subsidized fertilizer distribution

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Abstract. Fluctuations in the production and prices of strategic commodities remain a major challenge in Indonesian agriculture, compounded by the suboptimal distribution of subsidized fertilizers. Mobile forecasting applications offer potential to predict yields and fertilizer needs adaptively. This study analyzes farmers' perceptions and willingness to adopt the application in four districts in the Special Region of Yogyakarta with a sample of 80 farmers. Data were collected through Likert-scale questionnaires and open-ended questions, then analyzed using Spearman's correlation. Findings show that farmers' perceptions were moderate (mean score 3.57), with the highest ratings for ease of use, while perceived direct benefits on income and price risk remained uncertain. Willingness to adopt was high (mean score 3.82), reflecting readiness to adjust planting schedules, provide production data, and attend training. However, concerns over internet costs and rural infrastructure persist. Spearman's correlation revealed a very strong relationship between perception and willingness to adopt ($r = 0.774$; $p < 0.01$). Overall, farmers show cautious optimism toward mobile forecasting. Adoption will require supportive strategies including training, socialization, extension, and affordable access. The study

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highlights the potential of mobile forecasting to improve production efficiency and fertilizer distribution if implemented consistently and sustainably.

1 Introduction

Disparities in planting seasons and crop production for key commodities such as rice, chili, and shallots continue to pose serious challenges for Indonesia's agricultural sector. These imbalances trigger supply fluctuations, price instability, and broader risks to national food security. In 2024, the national harvested area of rice reached 10.05 million hectares with a production of 53.14 million tons of GKG declining by 1.6% compared to 2023 and contributing to falling farm-gate prices [1]. Similar seasonal patterns occur in chili and shallot production, where simultaneous harvests across major producing regions cause oversupply and sharp price drops. In Yogyakarta (DIY), for instance, the overlapping harvest of chili and shallots often pushes prices down to IDR 2,500–3,000/kg, reflecting weak coordination in planting and distribution systems [2]. These challenges align with global findings, where synchronized yield changes heighten price volatility, undermine trade and insurance systems, and worsen supply demand uncertainties [3].

In addition to production issues, farmers also struggle with limited fertilizer availability. The problem is driven by inaccurate data, rising production costs, and inefficient implementation of subsidy distribution policies. Misallocation of subsidized fertilizers often leaves farmers' actual needs unmet an issue consistent with experiences of smallholder farmers in many developing countries [4]. Global research highlights the importance of precision nutrient management and technology-based solutions for boosting fertilizer efficiency and ensuring sustainable agricultural practices [5]. Innovations such as IoT systems, AI-based yield prediction, and integrated soil and weather monitoring have shown strong potential for improving coordination, forecasting, and decision-making in agri-food supply chains [6]. These technological advances support the development of mobile forecasting tools to generate real-time estimates of crop production and fertilizer demand.

However, a major barrier lies in the low digital literacy of Indonesian farmers. More than 60% of farmers are above 45 years old, and only a small portion are familiar with internet-based technologies [1]. Similar international studies confirm that age, digital skills, and trust in technology significantly influence the adoption of precision agriculture tools [7]. Therefore, before implementing mobile forecasting applications, it is crucial to understand farmers' perceptions, readiness, and willingness to adopt such technologies. This study aims to assess these factors, recognizing that successful adoption is essential for enhancing policy accuracy, strengthening fertilizer distribution, improving price stability, and supporting sustainable crop production and farmer welfare.

2 Methods

2.1 Study area and sampling

This study was conducted in the Special Region of Yogyakarta (DIY), which was selected purposively as it represents one of the major production centers for rice and chili in Indonesia. The research location was determined using purposive sampling, a method commonly applied in social and agricultural research to select respondents who are considered most relevant to the research objectives. Samples were selected purposively from four villages with the highest rice and chili production in each regency of DIY, namely Hargobinangun Village (Sleman), Sriharjo Village (Bantul), Panjatan Village (Kulon Progo), and Semin

Village (Gunungkidul). The respondents consisted of active rice and chili farmers engaged in farming activities during the most recent planting season in 2025. A total of 80 respondents were involved, with 20 farmers representing each village. Data collection was carried out through structured interviews and questionnaires containing both closed- and open-ended questions in September 2025.

2.2 Analytical Methods

2.2.1 Analysis of farmers' perceptions and willingness to adopt

Farmers' perceptions of the use of a mobile forecasting application were analyzed using a five-point Likert scale, ranging from "strongly disagree" [1] to "strongly agree" [5]. Eight indicators were employed to assess dimensions of knowledge, attitudes, and trust toward digital technologies. The willingness-to-adopt instrument in this study was developed based on established technology adoption models, particularly the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). In the agricultural context, Michels et al. [8] demonstrated that perceived ease of use of digital applications is a key factor prior to farmers' consideration of economic benefits. Similarly, Khanal et al. [9] highlighted that although smallholder farmers in developing countries face limitations in digital literacy, they still show readiness to adopt digital services, including willingness to pay additional costs and share data, provided that tangible benefits are evident. Drawing upon these frameworks, this study formulated 13 indicators of willingness to adopt mobile forecasting, covering dimensions of readiness to try, routine use, learning, training participation, data provision, financial expenditure, and intention to rely on the application in agricultural decision-making.

2.2.2 Spearman's rank correlation analysis

To measure the relationship between farmers' perceptions and their willingness to adopt mobile forecasting applications, Spearman's rank correlation test was employed. This method was deemed appropriate because both variables were ordinal, measured on a Likert scale, and did not require the assumption of normal data distribution. In this study, the test was used to evaluate both the direction and strength of the association between variables, with the significance level set at $\alpha = 0.05$. Spearman rank correlation data analysis test using SPSS application.

3 Results and discussion

3.1 Results

3.1.1 Analysis of farmers' perceptions and willingness to adopt

The results of this study indicate that farmers' perceptions of mobile forecasting technology to support agricultural production and the distribution of subsidized fertilizers obtained an average score of 3.57, which falls into the moderate category (Figure 1). This value suggests that farmers hold a fairly positive view of the potential of digital applications, but they are not yet fully convinced of their effectiveness in practice. This condition is reasonable since the application is still at the conceptual stage; therefore, farmers' assessments reflect expectations rather than empirical experience. This finding is consistent with previous studies, which explained that smallholder farmers' access to digital agricultural services often

fosters initial positive perceptions, but adoption intentions remain low without empirical evidence of benefits. Similarly, it has been shown that European farmers had positive perceptions of smartphone-based agricultural applications, yet their confidence in the actual benefits was still limited to the pre-adoption phase [8].

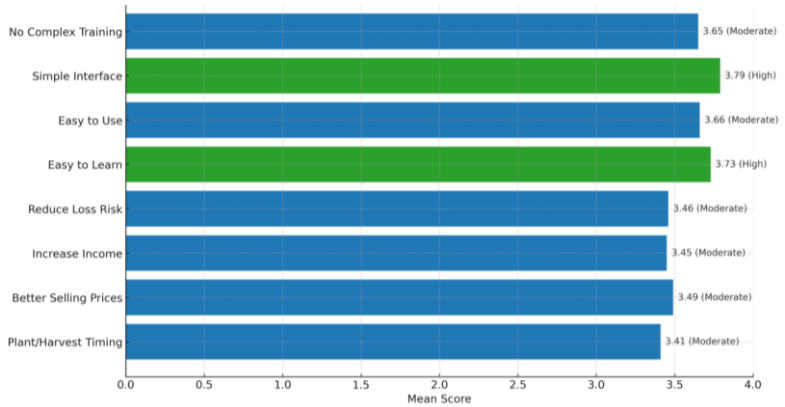

Fig. 1. Farmers' perceptions of mobile forecasting applications

The highest-scoring indicators were found in the statements that the application interface would be simple and easy to understand (3.79) and easy to learn (3.73), both of which fall into the high category. This emphasizes that the dimension of ease of use represents the most prominent aspect of farmers' perceptions. These findings are consistent with previous studies in India, which demonstrated that farmers are more likely to accept agricultural digital applications based on technical simplicity, even though the economic benefits have not yet been realized [10]. Conversely, indicators related to the direct benefits of the application obtained lower scores, such as determining planting/harvesting time (3.41), increasing income (3.45), and reducing price fluctuation risks (3.46). All of these fall within the moderate category, indicating farmers' doubts that digital applications would significantly impact production outcomes or economic well-being. This aligns with the findings from South Asia, which emphasized that although farmers show positive perceptions toward the potential of digital technology, costs, skills, and empirical evidence of benefits remain barriers to converting perception into full adoption [11].

The context of the Special Region of Yogyakarta further reinforces these results. Previous research reported that chili farmers in Sleman and Bantul continue to rely on traditional cropping patterns despite the availability of digital information, indicating a gap between technology availability and utilization [12]. Similarly, low levels of digital literacy have been emphasized as a major barrier to the use of agricultural information technology among rice farmers in Yogyakarta. This condition is not only local but also reflects the national context, where the dominance of older farmers and low technological literacy in Indonesia present structural challenges to adopting modern agricultural innovations. Thus, the relatively low perception of the tangible benefits of digital applications in both Yogyakarta and Indonesia more broadly is not merely a matter of technological availability but also of socio-demographic constraints that limit adoption.

Accordingly, the average score of 3.57 can be understood as a form of cautious optimism, reflecting an initial readiness without full confidence in the tangible benefits. However, this position is still a valuable asset, as it demonstrates farmers' openness to digital innovation. Perceptions in the moderate category indicate that mobile forecasting applications hold practical potential, provided that they are accompanied by socialization, field demonstrations, and institutional support. If these strategies are implemented, farmers' initial optimism may

develop into stronger confidence. This is consistent with findings in India, which revealed that the adoption of digital agricultural applications increased significantly following short training sessions and local assistance [10]. Therefore, the results of this study provide an optimistic foundation that mobile forecasting applications in Indonesia will not only be perceived as easy to use but may also prove beneficial in enhancing production stability and the distribution of subsidized fertilizers, provided that supporting strategies are consistently implemented.

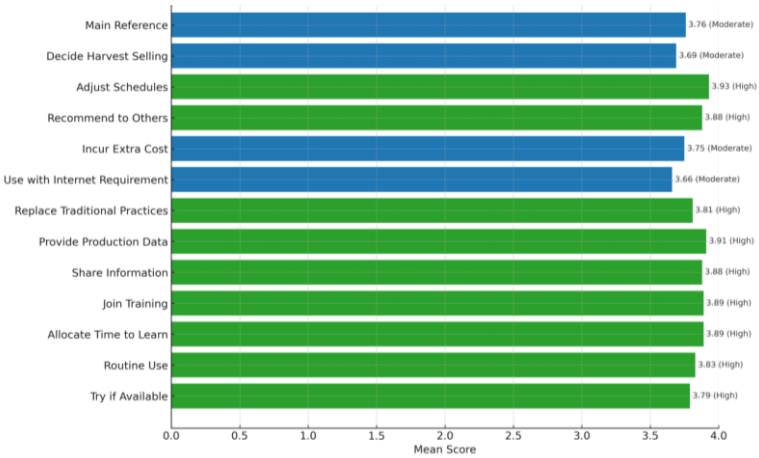

Fig. 2. Farmers' willingness to adopt the mobile forecasting applications

The findings indicate that the level of willingness to adopt the mobile forecasting application reached an average score of 3.82, which falls into the high category (Figure 2). This result reflects that farmers demonstrate a strong readiness to adopt digital applications, particularly when the application is proven to be beneficial and easy to use. The highest indicators were farmers' willingness to adjust planting and fertilization schedules based on application recommendations (3.93), followed by the willingness to provide production data (3.91) and to participate in training or socialization related to the application (3.89). These results suggest that farmers are open to integrating digital applications into their decision-making processes, especially in technical aspects directly related to agricultural production.

Relatively lower scores were found in indicators related to willingness to use the application despite requiring internet access (3.66) and to incur additional costs such as internet quota (3.75). This suggests that, although farmers are generally optimistic about the potential benefits of the application, concerns remain regarding financial burdens and the limitations of rural digital infrastructure. These findings align with evidence from China, which emphasized that limited digital literacy and the cost of digital services in rural areas remain major barriers to agricultural technology adoption [13]. Similarly, research in Nigeria reported that although smartphone-based agricultural applications were perceived as useful, internet costs and weak rural connectivity reduced adoption interest [14]. In addition, studies in China and Europe have highlighted that perceived ease of use and information access through mobile applications are critical factors in driving adoption, but digital infrastructure continues to be a significant constraint [9].

Overall, the results demonstrate that while farmers remain cautious about costs and infrastructure risks, they maintain a generally optimistic socio-psychological attitude toward the presence of mobile forecasting applications. This finding is consistent with evidence from India, which reported that willingness to adopt mobile-based agricultural applications

increases significantly when supported by socialization and local facilitation [10]. Therefore, it can be concluded that there is substantial potential for mobile forecasting applications to be accepted among rice, chili, and shallot farmers in Indonesia, provided that implementation strategies address affordability, internet accessibility, and institutional support.

3.1.2 Spearman's rank correlation analysis

The results of the Spearman correlation test presented in Table 1 indicate that farmers' perception has a very strong relationship with the willingness to adopt mobile forecasting, with a correlation coefficient of 0.774 and a significance value of $p = 0.00$ (<0.01). The positive correlation suggests that the more favorable the farmers' perception of the mobile forecasting application, the higher their willingness to adopt it. The strength of this relationship falls within the category of very strong (≥ 0.70), leading to the conclusion that perception serves as a key determinant in shaping farmers' intention to adopt technological innovations.

Table 1. Spearman Correlation Test Results

Variable	Correlation Coefficient	p-Value
Participation and willingness to adopt	0.774	0.00

These quantitative findings are reinforced by the results of the qualitative analysis derived from the open-ended questions. The majority of farmers emphasized that the application should provide features such as market price forecasts, weather information, recommendations for planting and harvesting times, as well as fertilizer requirement estimates. Such expectations indicate a strong demand for the application to help reduce market uncertainty and production risks. Several farmers also suggested the inclusion of educational modules, such as crop management tips, pest control strategies, and information on plant diseases, to enhance its practical usefulness. Nevertheless, a number of concerns were expressed, including administrative costs, internet data expenses, data security, potential system errors, and difficulties of use among elderly farmers. Some respondents even stated a preference for traditional approaches, such as relying on middlemen or farmer groups for market information.

The integration of quantitative and qualitative results highlights that although farmers' perceptions are generally positive and strongly correlated with their willingness to adopt, several barriers remain significant. Costs, digital literacy, and trust in technology represent the primary challenges that must be addressed through strategies such as awareness campaigns, training, farmer mentoring, and institutional support. These findings are consistent with prior research, which emphasized the importance of capacity building for smallholders to fully benefit from digital services, as well as evidence from South Asia identifying infrastructure limitations and operational costs as key obstacles to the adoption of digital agricultural technologies in developing countries [15].

The integration of quantitative and qualitative findings provides a comprehensive understanding of farmers' readiness to adopt mobile forecasting applications. While statistical evidence confirms a strong positive relationship between farmers' perceptions and their willingness to adopt, qualitative insights reveal specific expectations and practical concerns that shape this readiness. Together, these findings indicate that the success of mobile forecasting in agriculture depends not only on technological design but also on addressing socio-economic barriers through capacity building, institutional support, and inclusive implementation strategies.

4 Conclusions

Farmers' perceptions of the mobile forecasting application were generally moderate more favorable toward ease of use than direct economic benefits while their willingness to adopt was high, indicating strong readiness to try the technology. Positive perceptions significantly increased adoption willingness, and farmers expressed expectations for features such as market price information, weather forecasts, and recommendations for planting, harvesting, and fertilizer use, alongside concerns about cost, data security, and limited rural digital infrastructure. These findings highlight the need for capacity-building through outreach and training, improvements in rural connectivity, assurance of affordability and data protection, and the development of a user-friendly application equipped with relevant features that directly support farming decisions and strengthen sustainable production and food security.

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