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Evaluation of the Effectiveness of Digital Training Program for Farmers in Increasing the Adoption of Modern Agricultural Technology

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Abstract: *Digital transformation in the agricultural sector is an essential agenda in increasing the productivity and efficiency of farming, especially in the era of Industrial Revolution 4.0. This study aims to evaluate the effectiveness of digital training programs organized for farmers in increasing the adoption of modern agricultural technology. The method used is a qualitative approach with a case study design. Data were collected through in depth interviews, direct observations, and the distribution of questionnaires to 20 farmers who participated in the digital training program in Banyumas Regency, Central Java. The results showed that digital training had a positive impact on improving digital literacy, confidence, and technology adoption behaviors, such as the use of weather applications, digital record keeping, and online farm marketing platforms. Findings also showed that technology adoption tended to be higher among farmers who received post training assistance. However, challenges such as device limitations, networks, and technological complexity remain as barriers. This research suggests that digital training programs should be designed contextually and sustainably to enable the effective and inclusive implementation of digital agricultural transformation.*
Keywords: *digital training, modern agricultural technology, technology adoption, farmers, digital literacy.*

1. Introduction

The agricultural sector in Indonesia faces significant challenges in improving productivity and efficiency. Although modern agrarian technologies are available, their adoption rate among farmers remains low. This is due to various factors, including limited access to information and adequate training (Ilham Sahputra et al., 2024; Akihira et al., 2022; Hasibuan, 2023).

According to the 2022 report from the Ministry of Agriculture and Statistics Indonesia (BPS), fewer than 25% of Indonesian farmers have adopted modern agricultural technologies, such as precision irrigation, e-commerce for crop sales, or digital record keeping tools. A World Bank (2021) assessment also notes that digital adoption in Indonesia's agriculture sector lags behind that of neighboring ASEAN countries, mainly due to limited digital literacy and weak infrastructure in rural areas. This low level of adoption presents a significant barrier to improving productivity and competitiveness in the agricultural sector. Although various technologies are available, most farmers still rely on traditional practices and lack access to structured

training programs. These facts underscore the need to understand and assess how digital training programs can bridge the adoption gap and accelerate technological transformation in rural farming.

The urgency of this research lies in the importance of understanding the effectiveness of digital training programs in encouraging the adoption of modern agricultural technology. Appropriate training can enhance farmers' digital literacy and accelerate the adoption of technologies that increase agricultural yields (Sabir et al., 2019; Ramadani et al., 2020; Rusmono, 2021). Digital training in this study refers to structured educational activities designed to improve farmers' ability to use digital agricultural tools and platforms. The Ministry of Agriculture organized the programs in collaboration with local agricultural offices and non governmental organizations (NGOs). The training was delivered through a blended format combining face to face sessions with digital content distributed via WhatsApp groups, online video modules, and interactive applications such as RiTx Farming. The modules covered practical skills such as using weather apps, conducting digital record keeping, and accessing online marketplaces for farm produce. Facilitators and agricultural extension workers served as trainers and post training mentors in the field.

Data show that digital training can enhance farmers' knowledge and skills in utilizing agricultural technology. For example, the use of Android based farming apps has helped farmers to record farming activities and choose actions that suit the land conditions (RiTx Farming, 2023). Additionally, training on the use of agricultural apps has supported farmers' businesses and contributed to achieving the SDGs in villages (Landoy, 2020).

Previous research has addressed various aspects of agricultural technology adoption. However, few have comprehensively evaluated the effectiveness of digital training programs. Some studies have shown that training involving different categories of adopters within a farmer's social environment can increase technology adoption (Akihira et al., 2022).

The existing research gap highlights the need for more in depth studies on how digital training programs can be tailored to meet the specific needs and characteristics of local farmers. Additionally, it is crucial to assess the long term effects of such training on technology adoption and agricultural productivity (Purnama & Santosa, 2021).

This study is conceptually grounded in Rogers' Diffusion of Innovations theory (2003), which explains that perceived benefits, ease of use, and the role of opinion leaders within communities influence technology adoption. In parallel, Knowles' Adult Learning Theory (1980) underpins the design of digital training programs by emphasizing the importance of experiential, relevant, and problem based learning for

adult participants. These two frameworks guide both the structure of the training and the interpretation of farmers' behavioral changes following the training.

The novelty of this research lies in the evaluative approach to the digital training program that has been implemented, with a focus on increasing farmers' adoption of modern agricultural technology. This research will also consider factors such as age, education level, and access to technology in analyzing the effectiveness of the training.

The objective of this study is to evaluate the effectiveness of digital training programs in increasing farmers' adoption of modern agricultural technologies. The study's results are expected to provide recommendations for improving future training programs and supporting government policies that encourage the modernization of the agricultural sector.

2. Method

Research Type and Design

This study used a descriptive qualitative approach to explore and understand the effectiveness of digital training programs on increasing farmers' adoption of modern agricultural technologies. This approach was chosen because it enables researchers to gain an in depth understanding of the perceptions, experiences, and challenges faced by farmers when participating in digital training and applying the agricultural technologies taught. The case study strategy was employed to explore the phenomenon in a particular area intensively and contextually.

Location and Research Subjects

The location of this research was Banyumas Regency, Central Java, which is one of the areas with active implementation of agricultural digital training programs from the Ministry of Agriculture and various agricultural NGOs. The research subjects included:

a) Farmers who have attended digital training programs for at least the last 3 months.
b) Digital training facilitator or organizer.
c) Field agricultural extension workers (PPL) who assist farmers.

Subjects were selected using a purposive sampling technique with the criteria of active participation in the training and partial use of digital technology in their farming practices.

Research Instruments

The main instruments used in this research were in depth interview guides and observation sheets. The interview guide was semi structured to provide flexibility in exploring information from various interviewees according to the research topic. The

observation sheet was used to record training activities and the application of digital technology by farmers in their daily lives.

Data Collection Technique

Data collection was done through three primary methods, namely:

1. In depth Interview
   With farmers, training facilitators, and agricultural extension officers to understand their views on the effectiveness of the training program.
2. Direct Observation
   of training activities as well as digital farming practices carried out by farmers post training.
3. Documentation Study
   Include digital training documents such as modules, teaching materials, activity reports, and visual documentation.
4. The data triangulation technique will be employed to enhance the validity of the findings by comparing the results from the three data collection methods.

3. Result & Discussion

This study involved 20 farmers from three villages in Banyumas Regency who had participated in digital farming training for at least three months. Of these, 65% were between 35 and 50 years old, 25% were over 50 years old, and the remaining 10% were young farmers under 35 years old. Most respondents (70%) had only completed junior high school, and only 15% had completed senior high school. Regarding farming experience, the majority have more than 10 years of experience.

Respondents come from areas with relatively stable internet availability; however, access to digital devices, such as smartphones, is still limited, especially among elderly farmers. Most respondents belong to farmer groups or cooperatives, which are also the primary channels for obtaining digital training information.

In depth interviews were conducted with three training facilitators and two field extension officers from the District Agriculture Office. They stated that the digital training program aims not only to introduce new agricultural technologies but also to form a habit of using technology in farmers' daily activities. One of the facilitators stated:

"We not only provide theory, but guide them to operate agricultural applications, conduct digital record keeping, and utilize the agricultural marketplace."

The training management emphasized a blended learning approach, which combines face to face meetings with online materials accessible through WhatsApp applications or groups. They also mentioned that the success of the training was greatly influenced by the involvement of local leaders and farmer youth as digital change agents.

Questionnaires were distributed to all respondents to assess changes in their behavior and perceptions of agricultural technology following the digital training. Below are the main findings:

a) 85% of respondents expressed more confidence in using Android based agricultural applications.
b) 70% of respondents reported regularly recording farming activities digitally.
c) 65% of respondents started selling their harvested products through local e-commerce platforms.
d) 60% of respondents expressed interest in continuing the advanced training online.

However, 20% of respondents found it difficult to access the full training materials due to network constraints or device limitations. Some also suggested that more intensive mentoring be conducted after the training was completed.

Observations were made of farmers' field practices over a two week period following the training. We observed that most participating farmers began using weather apps to plan planting times, utilizing mobile phone cameras to detect crop pests and diseases, and managing logistics through harvest recording apps.

In the practice of using monitoring drones, only two farmer groups were able to implement it, as they required further technical assistance. Meanwhile, technologies such as soil sensors and automatic irrigation systems are being tested on a limited basis in some of the assisted demonstration plots.

Below is a graph of the level of adoption of agricultural technology before and after the digital training:

Figure 1. Adoption Rate of Agricultural Technology Before and After Digital Training

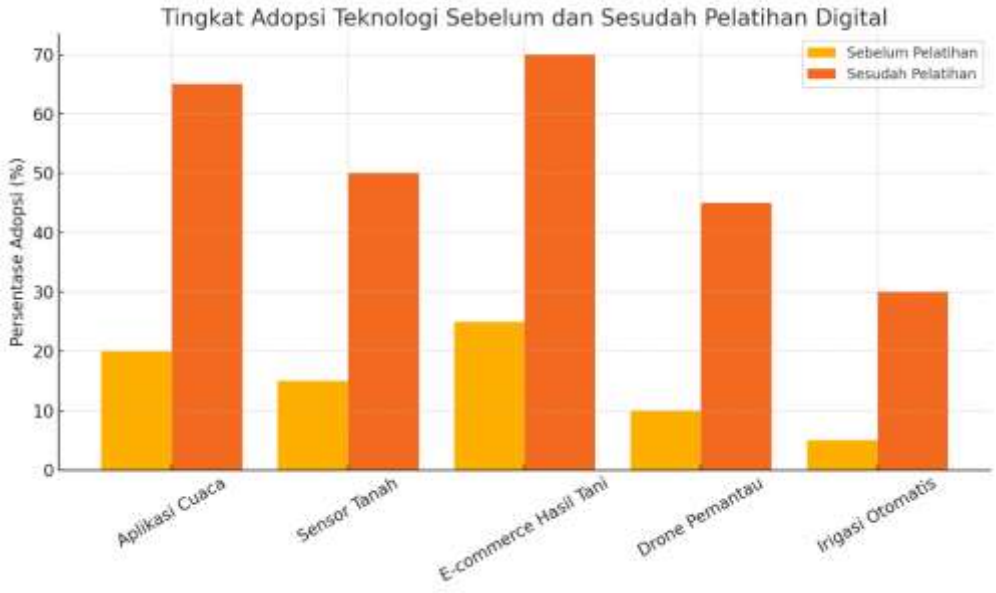

Table 1. Adoption of Agricultural Technology Before and After Training

Technology	Before Training (%)	After Training (%)
Weather app	20	65
Ground sensor	15	50
E-commerce of farm produce	25	70
Monitoring drones	10	45
Automatic irrigation	5	30

The table shows that all types of technologies introduced experienced significant increases in adoption rates, particularly in the use of weather apps (from 20% to 65%) and e-commerce for farm produce (from 25% to 70%).

Interviews with training facilitators and agricultural extension officers revealed that the digital training program focused on enhancing farmers' digital literacy and empowering them to utilize technology based on agricultural applications. The facilitators stated that the training process, conducted both offline and through digital platforms, provides easy access and flexibility for farmers who are spread across various regions.

This finding indicates that digital training serves not only as a means of knowledge transfer but also as a catalyst for shaping a digital mindset among traditional farmers. The use of *blended learning* methods is considered adequate, as it accommodates the diverse characteristics of trainees, who vary in terms of age, educational background, and access to technology. The interviews also revealed that the involvement of local figures (e.g. farmer group leaders) increased farmers' trust and enthusiasm for the training, in line with the findings of Nugroho and Arief (2021) who stated that the success of digital transformation in the agricultural sector is highly dependent on social support and the local environment.

The data from the questionnaire revealed that most farmers experienced an increase in confidence in using technology following the training. As many as 85% of respondents felt more confident, and 70% had already implemented digital harvest recording. This fact demonstrates that digital training is effective in overcoming the primary barriers to adopting agricultural technology, namely fear of technological failure or a lack of confidence.

This reinforces the findings of Putri and Kurniawan (2022) that digital literacy is a key prerequisite for successful technology adoption in the agricultural sector. The increased use of e-commerce platforms (65%) also reflects that training can open new market access for farmers and shorten the distribution chain of agricultural products, supporting arguments from studies such as those conducted by Yuliana and Mahfud (2021) regarding the importance of digital technology in building farmers' independence.

However, some respondents expressed constraints in accessing online materials due to limitations in their devices and networks. This issue needs attention in the development of future training models by integrating solutions such as the provision of inclusive digital infrastructure.

From field observations, it appears that post training technology adoption is promising. Farmers are increasingly utilizing weather applications and digital logbooks to make informed agricultural decisions. This activity shows that the training not only provides theoretical knowledge but also builds practical skills that can be applied immediately.

However, technologies that require high technical skills, such as the use of drones or automated irrigation systems, have not been widely adopted. This indicates that the complexity of the technology is a barrier, and training should be developed more intensively and sustainably. This finding aligns with a study by Wibowo and Suryaningrum (2023), which emphasizes the importance of the reinforcement phase in technology based training to sustain long term adoption.

Observations also show that mentoring by extension workers after training is very important to ensure the continuity of technology implementation. Farmers who received follow up support were more likely to be active in using the technology, while those who did not receive assistance tended to revert to conventional practices.

This research builds upon previous studies on the impact of training on the digital transformation of the agricultural sector. For example, research by Taufik et al. (2020) indicates that digital training has a significant impact on improving agricultural efficiency, particularly in horticultural commodities. However, unlike most studies that emphasize the effectiveness of technology, this study focuses more on the effectiveness of the training program itself, including teaching methods, instructional materials, and mentoring.

The novelty of this research also lies in the integration between the evaluation of training programs and the assessment of technology adoption behavior in the field. Other studies, such as those by Halim and Rahayu (2019), have not fully linked aspects of post training behavior change to real world practices in the field. This study adds this dimension through an observational approach and data triangulation.

The findings of this study provide several important implications. First, the development of digital training should consider an adaptive approach tailored to farmers' varying levels of digital literacy. Interactive and contextualized training modules are more effective than text based classical approaches.

Second, there needs to be an incentive mechanism for farmers who successfully apply the technology in a sustainable manner, such as certification or access to microfinance programs based on digital farming. Third, it is essential to enhance the

capacity of agricultural extension workers in digitalization, enabling them to serve not only as field assistants but also as facilitators of technological transformation.

For policymakers, this study suggests that the success of digital training programs should not only be measured by the number of trainings conducted, but also by the long term *impact* on technology adoption and sustainability.

This study has several limitations that need to be noted. First, the research area is limited to one district, so the results may not necessarily represent conditions in other areas with different geographical and social characteristics. Secondly, the duration of post training observation is still relatively short (two weeks), which is not enough to observe the long term impact of digital training on farmers' productivity and welfare.

Additionally, research instruments such as interviews and questionnaires rely heavily on respondents' openness, which can be influenced by social factors or group pressure. Therefore, further studies are recommended to employ a longitudinal and multi regional approach to enhance the generalizability of the results.

4. Conclusion

This research shows that digital training programs have a significant impact on increasing the adoption of modern agricultural technology among farmers. Through a qualitative approach involving in depth interviews, direct observation, and questionnaires, it was found that digital training can increase farmers' confidence, expand their technological knowledge, and encourage behavioral changes in managing agriculture more efficiently and modernly.

The application of technologies such as weather apps, e-commerce of agricultural products, digital record keeping, and the use of sensors is starting to be integrated in daily farming activities. This demonstrates that when designed with adaptive and contextualized methods, digital training can be an effective strategy for technology based agricultural transformation.

However, technological complexity and limited digital infrastructure remain significant challenges, particularly in the adoption of advanced technologies such as drones and automated irrigation systems. The success of the training also relies heavily on the sustainability of mentoring and support from facilitators and agricultural extension officers.

Thus, this study suggests the need to design training programs that are long term oriented, based on local needs, and equipped with post training technical support. In addition, collaboration among the government, private sector, and farming communities needs to be strengthened so that digital transformation in the agricultural sector can occur evenly, inclusively, and sustainably.

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