

FARMERS' PERCEPTIONS OF ARDUNIO TECHNOLOGY APPLICATIONS IN MUSHROOM FARMING

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Abstract The use of IoT (Internet of Things) in mushroom farming has been proven in several studies to help farmers maintain optimal environmental conditions. Based on several benefits of IoT, it is important to know how farmers perceive and the feasibility of their business. Because the application of a technology to farmers requires an in-depth study and a good response from farmers so that it can provide maximum benefits. This study aims to determine how farmers perceive the use of Arduino in mushroom farming. This study uses a qualitative descriptive method to analyze farmers' perceptions. The results of the study show that the application of Arduino is still dominated by less positive views. Difficulty in use, costs that are considered high, and benefits that have not been felt significantly are the main factors that influence farmers' assessments.

Keyword : Arduino, Farmer's Perception, IoT, Oyster Mushroom, Farming Business

1 Introduction

Mushroom farming is one of the agricultural sub-sectors that has great potential in supporting food security and the farmer's economy. Mushroom farming is one of the profitable agricultural businesses and can increase public awareness of health [1]. In addition, mushroom farming also has the potential for long-term development by increasing mushroom consumption [2], and the development of various mushroom-based food products [3]. This potential makes mushroom farming a viable business for Indonesian people to develop.

One farmer group developing a mushroom farming business is the Sabilulungan farmer group in Sagalaherang Village, Panawangan District, Ciamis Regency. Mushroom cultivation requires optimal environmental conditions, especially in terms of humidity. So far, farmers have only used conventional practices in conditioning the environment where mushrooms are cultivated. Environmental conditions, especially optimal humidity, are one of the important factors in the success of mushroom cultivation. Conditions of temperature, humidity, light, and CO₂ levels at the mushroom cultivation location that are maintained at an optimal range can be a determining factor in the success of mushroom production [4,5].

Arduino technology as a humidity sensor can be a solution to overcome this challenge. The use of IoT (Internet of Things) in mushroom farming in several studies has been proven to help farmers maintain optimal environmental conditions [6]. The use of this technology can be a system to control environmental conditions as optimally as possible automatically [7]. Based on these benefits, it is important to know how farmers perceive them. Because the application of technology to farmers requires in-depth study and good response from farmers so that it can provide maximum benefits. In several studies, it was found that the use of IoT in mushroom farming can make farmers' time more effective and efficient because farmers do not always have to be at the cultivation location full-time [8]. However, in the research locus, it is not yet known how farmers perceive the use of Arduino technology in mushroom

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farming. Therefore, this study aims to determine how farmers perceive the use of Arduino in mushroom farming.

2 Research method

This study is a qualitative study to analyze farmers' perceptions of the application of Arduino technology in mushroom farming. The research method used is a case study on the Sabilulungan Farmer Group, Sagalaherang Village, Panawangan District, Ciamis Regency. This Farmer Group was selected purposively with the consideration that the farming business owned has good potential with environmental conditions that support the mushroom cultivation process. Perception data were obtained by surveying mushroom farmers.

The entire population of the farmer group members, totaling 25 individuals, was used as the sample through saturated sampling, as the population was fewer than 30 individuals. The data were collected using the Focus Group Discussion (FGD) method. This is in line with the statement [9] that saturated sampling can be used for relatively small and homogeneous populations, as well as for research purposes that are limited in scope or can be conducted through Focus Group Discussions.

Farmers' perceptions were analyzed using descriptive statistics to understand the factors that influence the acceptance or adoption of technology. These factors include: (1). Ease of use; (2). Costs incurred; (3). Benefits perceived. In line with previous research [10–14], mushroom farmers' perceptions of Arduino technology include ease of use, operational cost efficiency, and the perceived benefits obtained.

Based on these factors, farmers' perceptions were analyzed using the assessment scale which can be seen in Table 1.

Table 1. Farmers' Assessment Scale for Arduino Technology Applications[15]

No.	Scale (%)	Farmers Perception
1	0 – 20	Very bad
2	21 – 40	Bad
3	41 – 60	Neutral
4	61 – 80	Good
5	81 – 100	Very good

3 Results and discussion

1. Ease of Use Perception

The results of the analysis of farmers' perceptions regarding the ease of using Arduino technology can be seen in Figure 1.

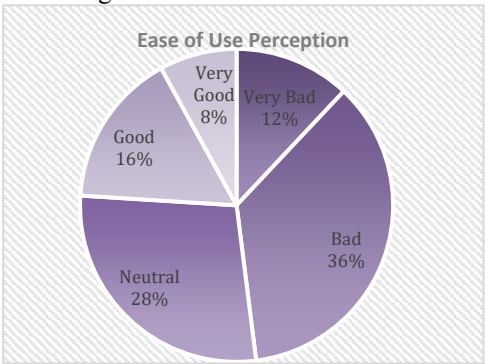


Fig. 1. Ease of Use Perception
Source: Primary Data Analysis (2024)

Figure 1 shows that the majority of farmers perceive Ease of Use as Bad, with a percentage of 36%. The majority of farmers feel that Arduino technology is a complicated technology and difficult to learn, even though they feel it will be useful if it can be used properly. This complexity can be overwhelming for farmers who may not have a background in technology [16]. Adoption of new technologies in the agricultural sector often faces challenges in terms of ease of use, especially among farmers with limited educational backgrounds. Farmers' perception of the ease of use and usefulness of new technologies significantly influences their adoption. Technologies that are perceived as complex or difficult to use are less likely to be adopted, even if they offer substantial benefits [17]. In this context, the majority of farmers find it difficult to use Arduino technology due to a lack of adequate training and technical support.

This situation is in line with research results which show that intensive training and mentoring are needed to increase farmers' comfort levels in using new technology. Government regulations, social networks, and institutional support play a crucial role in the adoption process. These factors can mediate the perceived ease of use and usefulness, thereby influencing adoption behavior [18]. Other studies also emphasize the importance of government support and training because it can increase farmers' awareness and ease in accessing technology [19].

2. Cost Incurred Perception

The results of the analysis of farmers' perceptions of the costs incurred in applying Arduino technology can be seen in Figure 3.

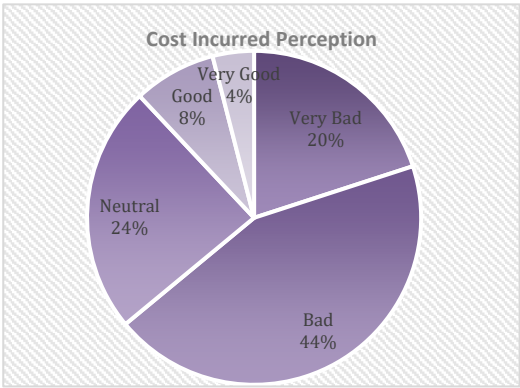


Figure 3. Cost Incurred Perception
Source: Primary Data Analysis (2024)

Figure 3 shows that most farmers perceive Cost Incurred as Bad, with a percentage of 44%. Cost is one of the main barriers to the adoption of new technologies in the agricultural sector. High initial investment costs are a significant barrier to adopting new agricultural technologies, particularly for smallholder farmers. Technologies requiring substantial upfront investment often see low and slow adoption rates [20,21]. In this study, most farmers felt that the costs required for Arduino application were quite high, especially when compared to their income. The cost-effectiveness of IoT-based precision agriculture technologies is a major concern, with many farmers finding the financial burden too high to justify the investment [22,23]. These costs include the purchase of the equipment, installation costs, and routine maintenance. All of these components are essential to ensure the system functions properly and efficiently in the long run. [24].

Previous studies have also found that farmers tend to be hesitant to invest in new technologies without clear guarantees of returns. Several factors, including risk aversion, credit constraints, and the perceived complexity of new technologies, influence this reluctance. Farmers with higher risk aversion are less likely to adopt new technologies and tend to invest less in them. This is particularly evident in cases where farmers participate in production contracts, which can mitigate some risks but still result in delayed or reduced technology adoption [25]. Credit constraints significantly impact farmers' ability to invest in new technologies. Lenders are often reluctant to finance high-return technologies due to the variability of returns and the risk of intentional default by borrowers. Additionally, access to credit and financial support can influence the speed and intensity of technology adoption [21]. Farmers' beliefs about their ability to control outcomes and the expected returns from new technologies play a crucial role. A more external locus of control is associated with lower expected returns and reduced adoption rates [26].

3. Perceived Benefits Perception

The results of the analysis of farmers' perceptions of the benefits felt from the application of Arduino technology can be seen in Figure 4.

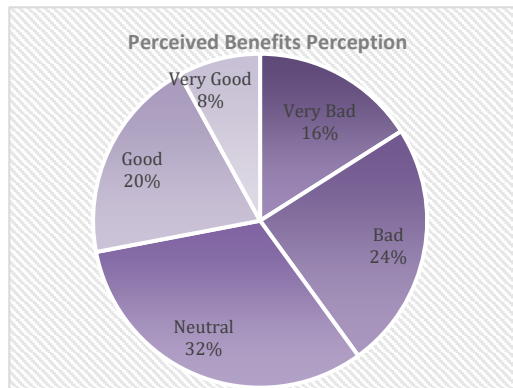


Figure 4. Perceived Benefits Perception
Source: Primary Data Analysis (2024)

Figure 4 shows that most farmers perceive perceived benefit perception as neutral, with a percentage of 32%. This finding is consistent with many previous studies showing that the perceived benefits of new technologies are often not immediately visible to farmers, especially in the early stages of implementation. In developing countries, despite visible benefits, the adoption of new agricultural technologies can be slow [27]. High initial investment costs and the complexity of new technologies are significant barriers. Brazilian farmers, for instance, cite acquisition costs and connectivity issues as major challenges despite recognizing productivity benefits [28]. Some farmers who have seen increased production have given positive assessments, but most still feel that there has been no significant change. This highlights the importance of field demonstrations and successful case studies to increase the perception of the benefits of new technologies. Increasing farmers' awareness and exposure to new technologies through field days and demonstration trials can significantly enhance adoption rates. Providing free access to costly equipment for first-time users also helps [21]. The results of the study related to farmers' perceptions of the application of Arduino are still dominated by less positive views. Difficulty in use, costs that are considered high, and benefits that have not been felt significantly are the main factors that influence farmers' assessments.

These results are in line with many studies that show the need for more intensive training, cost subsidies, and field demonstrations to increase the adoption of new technologies in the agricultural sector. Intensive training, cost subsidies, and field demonstrations are crucial for enhancing the adoption of new agricultural technologies among farmers. These strategies help mitigate barriers such as high initial investment costs, lack of awareness, and uncertainty about the benefits of new technologies. Training a small number of key farmers who then disseminate knowledge to others has proven effective. In Tanzania, this approach led to increased technology adoption and productivity among rice farmers [29]. Subsidizing the initial cost of new technologies can encourage farmers to try them. In Uganda, subsidized grain storage bags led to higher subsequent commercial purchases, indicating that subsidies can help overcome initial resistance and build demand [30]. Organizing field days where farmers can see new technologies in action significantly increases adoption rates. Demonstrations of zero tillage technology in Syria, for example, increased both the speed and intensity of adoption among smallholder farmers [21]. Field demonstrations are effective and cost-efficient, benefiting poorer farmers who might otherwise be unable to access new technologies [31].

4 Conclusion and recommendation

Based on the results of research on farmers' perceptions and feasibility analysis of the application of Arduino technology in mushroom farming, it was concluded that the application of Arduino is still dominated by less positive views. Difficulty in use, costs that are considered high, and benefits that have not been felt significantly are the main factors that influence farmers' assessments.

The recommendation that can be given from the results of this study is the need for intensive training for farmers so that they can apply Arduino technology so that they can provide better economic benefits at more efficient costs.

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