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TECHNOLOGY UTILIZATION BY UPMS STUDENT FARMERS TO INCREASE SHALLOT PRODUCTIVITY IN NGANJUK REGENCY

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ABSTRACT

The use of technology in shallot cultivation supports work efficiency and agricultural productivity, particularly in Nganjuk Regency, a shallot production center in East Java. However, its implementation still faces obstacles related to costs, skills, land conditions, and weather. This study aims to describe how UPMS student farmers utilize technology in shallot cultivation, including the types of technology used, their application at each cultivation stage, and their relationship with productivity. This study uses a qualitative approach with a descriptive design. Primary data were collected through interviews and observations of UPMS student farmers directly involved in shallot cultivation, while secondary data were obtained from relevant documents and literature. Informants were selected using purposive sampling. The analysis draws on Production Theory and Everett M. Rogers' Diffusion of Innovations Theory, which includes relative advantage, compatibility, complexity, trialability, and observability. The findings show that soil-processing equipment, water pumps, and sprayers help speed up work, reduce labor requirements, and facilitate irrigation and crop maintenance. Initial difficulties in operating the equipment indicate the need for learning and guidance. Informants also tested the technology before using it regularly. ***Conclusion:*** *Technology utilization supports efficiency in shallot cultivation, but an increase in productivity cannot yet be confirmed quantitatively because comparative harvest data before and after technology use are unavailable. Recording harvest yields and production costs is necessary to assess this relationship accurately.*

Keywords: ***Technology Utilization, Student Farmers, Shallots, Diffusion of Innovations, Productivity***

A. INTRODUCTION

Shallots are one of Indonesia's major horticultural commodities, with high economic value and an important role in meeting people's food needs. Statistics Indonesia (BPS) recorded national shallot production in 2025 at 21,861,568.44 quintals, or approximately 2.19 million tons, with a harvested area of 188,561.14 hectares. Based on these two indicators, national shallot productivity in 2025 was approximately 11.59 tons per hectare.

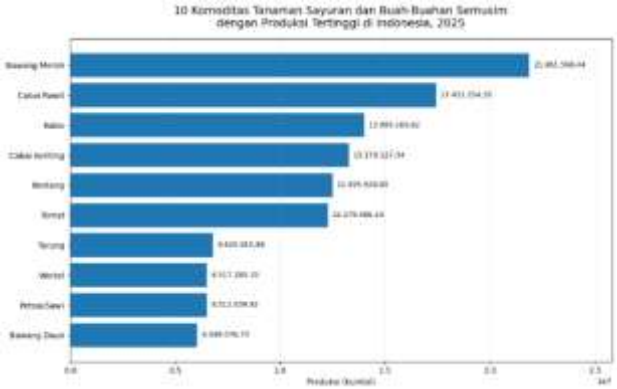


Figure 1. Ten Commodities with the Highest Production
Source: BPS data processed by the researcher (2025)

This production volume indicates that shallot development plays a significant role in supporting food supplies and economic activity in the agricultural sector. However, increased production is determined not only by harvested area, but also by farmers' ability to utilize

inputs, manage farms, and use technology efficiently. Technology has become increasingly important in improving the efficiency and productivity of shallot farming. It can be used at various stages, from land preparation and water management to pest control, the use of production equipment, and post-harvest handling. Technology adoption has a positive and significant effect on shallot farming productivity; therefore, improving farmers' access to technology and their ability to use it is an important factor in increasing productivity. These findings indicate that technology is not merely a production aid, but also an element of farm-management strategy (Fajar et al., 2025).

At the regional level, East Java is one of Indonesia's major shallot-producing areas. BPS recorded East Java's shallot production in 2025 at 5,003,012.27 quintals, or approximately 500,300 tons, with a harvested area of 53,105.19 hectares. Thus, shallot productivity in East Java that year was approximately 9.42 tons per hectare. East Java accounted for around 22.88% of national shallot production, making productivity improvements in this province important to national output.

Table 2. Ranking of Seasonal Vegetable and Fruit Production in East Java Province, 2025

No.	Crop Type	Production (Quintals)
1.	Bird's Eye Chili	6.037.178,26
2.	Shallots	5.003.012,27
3.	Potatoes	2.526.242,32
4.	Cabbage	2.101.790,60
5.	Tomatoes	1.268.102,30
6.	Scallions	1.159.377,98
7.	Watermelon	1.131.047,85
8.	Large Chili	1.045.356,44
9.	Eggplant	941.809,95
10.	Carrots	892.135,58
11.	Chinese Cabbage/Mustard Greens	833.208,09
12.	Chayote	788.540,88
13.	Cucumber	621.278,68
14.	Melon	605.492,80
15.	Curly Chili	356.646,68
16.	Water Spinach	331.999,52
17.	Long Beans	312.706,03
18.	Cauliflower	288.950,90
19.	Green Beans	262.748,41
20.	Spinach	148.956,38
21.	Oyster Mushrooms	128.641,99
22.	Bell Peppers	46.306,75
23.	Strawberries	5.789,14
24.	Garlic	3.243,08

Source: East Java BPS data processed by the author (2025)

Nganjuk Regency is one of the areas that significantly contributes to shallot production in East Java. BPS Nganjuk Regency records shallots as a major commodity in the local horticultural sector. In 2025, shallot production in Nganjuk reached 2,230,924 quintals, or approximately 223,090 tons, while the harvested area was around 20,186 hectares. Based on these figures, productivity was approximately 11.05 tons per hectare. Nganjuk's 2025 production represented around 44.59% of East Java's total shallot production and approximately 10.20% of national production. BPS records the largest production centers in

Nganjuk in 2025 as Bagor and Rejoso Districts, producing 571,720 and 567,106 quintals, respectively.

Shallot production and productivity in Nganjuk have fluctuated in recent years. Production reached 1,939,881 quintals in 2022, declined to 1,837,579 quintals in 2023, rose to 2,055,912 quintals in 2024, and increased again to 2,230,924 quintals in 2025. During the same period, harvested areas were approximately 17,345, 16,918, 20,903, and 20,186 hectares, respectively. This means that production increased in 2025 even though the harvested area decreased compared with 2024. This condition suggests that higher output depends not only on expanding land area, but also on improving yields per unit area through input management, skills, and technology utilization. The 2025 figures in the BPS Nganjuk Regency publication are still marked as provisional. Although several studies have examined technology use in shallot farming, some aspects require further investigation. Pasigai and Paiman (2023) evaluated the roles of technology adoption, capital, and skills in improving shallot productivity in Enrekang Regency and found that technology adoption affects agricultural productivity. Hardianingsih et al. (2025) examined the technical efficiency of shallot farming in Nganjuk Regency, finding an average technical efficiency score of 0.78 and recommending improved management skills, agricultural extension, and technology adoption to increase productivity. Permatasari (2025) analyzed light-trap innovation in shallot cultivation in Sukomoro District, Nganjuk Regency, focusing on farmers' perceptions of innovation characteristics and the factors influencing those perceptions. In addition, Moekani et al. (2023), in a study of millennial shallot farmers in Bantul Regency, found that technology use in land preparation, irrigation systems, agricultural extension, and digital marketing was closely associated with farm technical efficiency.

Based on these studies, research on technology in shallot farming has generally focused on its effects on productivity and technical efficiency, perceptions of particular innovations, or the characteristics of millennial farmers. However, there is still an opportunity to examine technology use in the specific context of UPMS student farmers' shallot farming in Nganjuk Regency, particularly the use of technology at different cultivation stages and its relationship with productivity. Nurmaida et al. (2023) show that technology suitability and advantages, farmers' capabilities, adoption levels, and innovation dissemination are associated with shallot productivity. Therefore, this study focuses on UPMS student farmers to understand the types of technology they use, how it is applied in cultivation activities, and how it relates to shallot productivity in Nganjuk Regency. This approach is expected to provide an empirical description of technology-utilization practices among student farmers.

B. RESEARCH METHODS

This study adopts a qualitative approach with a descriptive design. The qualitative approach was selected because the study seeks an in-depth understanding of technology use by UPMS student farmers in shallot production in Nganjuk Regency. Qualitative methods are used to capture participants' experiences, perspectives, behaviors, and practices in natural settings. Creswell and Poth explain that qualitative research seeks to explore and understand the meanings individuals or groups assign to an issue, using data-collection methods that may include interviews, observations, and documents (Fitrianingsih & Arsal, 2023). This study identifies the types of technology used and examines farmers' experiences in selecting, implementing, and evaluating technology at each cultivation stage.

This study uses Production Theory as its main theoretical framework for understanding technology's role in supporting agricultural production, and Everett M. Rogers' Diffusion of Innovations Theory as a supporting framework for analyzing how UPMS student farmers adopt and use technology. The Diffusion of Innovations Theory is applied through five innovation attributes: relative advantage, compatibility, complexity, trialability, and observability. In

addition, the technology-use process is analyzed through the stages of knowledge, persuasion, decision, implementation, and confirmation. A theory-based conceptual framework can help researchers organize and analyze field data systematically in qualitative research.

The study was conducted in Nganjuk Regency, East Java Province, in 2026. The location was selected purposively because Nganjuk is one of East Java's shallot production centers and is also where UPMS student farmers conduct farming activities. Selecting a location based on the fit between its characteristics and the research focus is common in qualitative research, especially when researchers seek rich information from a setting directly related to the phenomenon under study (Dewi, 2023). The research process included preparation, informant selection, field data collection, data processing and analysis, data-validity verification, and preparation of the research report.

The study used primary and secondary data. Primary data were obtained directly from informants through interviews and observations. The main informants were UPMS student farmers directly involved in shallot cultivation in Nganjuk Regency. Informants were selected through purposive sampling, in which participants are chosen based on specific considerations or characteristics relevant to the research objectives. The main informant criteria were: (1) UPMS students who work as shallot farmers; (2) direct involvement in shallot cultivation; (3) current or previous use of technology in farming; and (4) willingness to share experiences of technology utilization. Purposive sampling is also used in qualitative agricultural research on young farmers' practices and agricultural extension, where informants are selected based on their involvement and relevance to the phenomenon being studied (Dewi, 2023).

C. RESULTS AND DISCUSSION

This study examines the application of technology in shallot cultivation by UPMS students in Nganjuk Regency using the five attributes of Everett M. Rogers' Diffusion of Innovations Theory: relative advantage, compatibility, complexity, trialability, and observability. The data were drawn from interview guidelines used with UPMS student informants who had cultivated shallots for 2–3 years on a plot measuring 100 ru.

Relative Advantage

Technology provides benefits in shallot cultivation, particularly by speeding up work, reducing labor requirements, and making cultivation easier than manual methods. The technologies used by informants included soil-processing equipment, water pumps, and sprayers for crop maintenance. In addition to making work more efficient, technology was considered capable of supporting productivity when used appropriately. Proper irrigation and efficient crop maintenance can potentially support shallot growth.

Nevertheless, informants explained that technology use still requires expenditure on equipment purchase and maintenance. Its economic benefits therefore depend on the costs incurred and the frequency of use. This finding aligns with the concept of relative advantage in Diffusion of Innovations Theory, which refers to the extent to which an innovation is perceived as more beneficial than the previous method. The technical efficiency of shallot farming in Nganjuk Regency can still be improved through appropriate production inputs and technology use. This supports the finding that technology has the potential to improve cultivation efficiency, although its economic benefits must still be weighed against its costs (Krismiratsih & Fibriani, 2025).

In this study, technology's advantages are reflected in time and labor efficiency. However, investment and maintenance costs are disadvantages that must be considered. Technology therefore provides operational benefits, but a net economic benefit cannot be confirmed without data on farm costs and income.

Compatibility

Technology was also considered suitable for informants' circumstances as students who attend lectures while managing agricultural businesses. Informants stated that technology helped them manage their time between studying and cultivation activities. However, technology use still needs to be adapted to land and weather conditions. This finding is consistent with Pustaka Pertanian (2025), which explains that shallot cultivation needs to account for weather, land characteristics, and crop water requirements. This indicates that the suitability of technology depends not only on the equipment's benefits but also on the environmental conditions in which it is used. This shows that technology cannot be applied without considering environmental conditions and crop needs. In Diffusion of Innovations Theory, compatibility refers to how consistent an innovation is with users' needs, experiences, and circumstances. The findings indicate that technology was considered suitable because it helped complete farming tasks and manage informants' time. On the other hand, weather and land conditions limited its use. In other words, the compatibility of an innovation is determined not only by the equipment's function but also by its ability to meet real field needs.

Complexity

The interviews showed that informants experienced difficulties when first using some agricultural equipment. These difficulties involved operating the equipment, determining the correct way to use it, and understanding the appropriate time to use the technology. To address these challenges, informants learned through direct experience, asked more experienced farmers for advice, and observed how the equipment was used before operating it themselves. This finding is consistent with Fitri et al. (2026), who explain that a lack of technical training can lead to suboptimal use of agricultural tools and machinery. This indicates that equipment-operation skills are important in overcoming difficulties in using agricultural technology.

This process helped informants gradually understand how to use the technology. In Diffusion of Innovations Theory, complexity refers to how difficult an innovation is to understand and use. The findings show that technology can make work easier, but users still need the knowledge and skills to operate it. Hands-on learning helped informants reduce these difficulties. A positive finding is that informants tried to overcome challenges through learning and practice. The main obstacle was limited technical knowledge during initial use. Therefore, guidance and training in equipment operation may help farmers use technology more effectively.

Trialability

The interviews showed that informants first tested technology for specific activities, such as land preparation and irrigation. They also conducted small-scale trials to understand the benefits and operation of the technology before using it more regularly. Through this process, informants could learn how the equipment worked and assess its suitability for shallot cultivation. Trying technology was part of the learning process before broader use. Ziana et al. (2023) indicate that shallot-cultivation technology can be tested on a small scale, giving farmers the opportunity to learn about and assess it before wider implementation. In Diffusion of Innovations Theory, trialability refers to the extent to which an innovation can be tested before it is adopted more widely. The interviews indicate that opportunities to experiment helped informants understand the technology through direct experience. However, the interview guide did not provide measurable data comparing productivity before and after the trials. Therefore, the study can conclude that informants tested the technology, but it cannot quantitatively claim that these trials increased harvest yields.

Observability

The interviews showed that the benefits of technology could be observed through faster work, easier irrigation, and more efficient crop maintenance. These benefits encouraged informants to continue using technology when it suited their needs and land conditions. However, informants also explained that final cultivation outcomes were influenced by weather, seed quality, and crop maintenance. Thus, visible improvements in work processes cannot automatically be interpreted as increased harvest yields. In Diffusion of Innovations Theory, observability refers to the extent to which the results of an innovation can be seen by users. In this study, the clearest benefits reported by informants were work efficiency and easier irrigation. Meanwhile, increased productivity requires additional evidence, such as harvest records or production comparisons under comparable conditions. Achmad Dwi Nugroho (2025) discusses optimizing sprinkler irrigation to support shallot growth and yield. This is relevant to the interview findings that irrigation technology can support cultivation, although any increase in informants' harvest yields still requires separate evidence. A positive finding is that the benefits of technology can be experienced in daily cultivation activities. The limitation is that production outcomes are determined by factors beyond technology alone. Therefore, evaluation of innovation success should distinguish operational benefits from production outcomes.

D. CONCLUSION

Based on the findings, technology utilization in shallot cultivation by UPMS student farmers in Nganjuk Regency helps speed up work, facilitate irrigation, and improve the efficiency of crop maintenance. The technologies used include soil-processing equipment, water pumps, and sprayers. Based on the five attributes of Everett M. Rogers' Diffusion of Innovations Theory, the technology was considered to offer relative advantages and to be compatible with informants' needs as both students and farmers. However, implementation still faces challenges related to costs, limited technical knowledge, and land and weather conditions.

Regarding complexity, informants addressed difficulties in operating equipment through direct experience and learning from more experienced farmers. In terms of trialability, informants tested technology for specific activities before using it regularly. Regarding observability, the benefits could be seen in work efficiency and easier irrigation. Nevertheless, increased productivity cannot yet be confirmed quantitatively because comparative harvest data before and after technology use are unavailable. Therefore, technology utilization should be adapted to needs and land conditions and supported by training and guidance for UPMS student farmers. Future research is advised to record production costs and harvest yields to assess technology's benefits for economic efficiency and productivity more measurably.

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