

## Improving Agricultural Productivity through Field Schools: An Educational Management Approach in Desa Lau Solu, Kecamatan Mardinding, Kabupaten Karo

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### ABSTRACT

The increase in agricultural productivity in Indonesia, particularly in rural areas, requires an integrated approach between agricultural extension and education. This article examines the implementation of the farmer field school model that integrates educational management in Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo, to enhance farmers' skills. This research uses a case study with interviews of 50 farmers, observations, and program documentation. Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo has 250 hectares of agricultural land and an annual rainfall of 2,400 mm. Before the program, 45% of farmers were aware of balanced fertilization techniques, and 30% used superior seeds. After attending the extension program, 60% of farmers reported an increase in corn yields by 20-25%. Educational management helped 50% of farmers adopt new technologies, and 55% actively participated in farmer groups. This program improves the productivity and well-being of farmers.

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## INTRODUCTION

Agricultural development in Indonesia faces significant challenges in improving productivity and the welfare of farmers, especially in rural areas. One of the efforts to address this issue is through field school-based agricultural extension, which combines technical training with a participatory approach. Desa Lau Solu, Kecamatan Mardinding, Kabupaten Karo, with an agricultural land area of approximately 250 hectares, has great potential to develop the agricultural sector. However, agricultural productivity in this village is still relatively low, with average yields that are not yet optimal, despite the presence of various leading commodities such as corn, soybeans, and horticultural crops.

Effective agricultural extension can enhance farmers' understanding of the best ways to manage their farming enterprises. Field schools, as a model of agricultural extension, have proven to enhance farmers' skills in land management and the more efficient use of agricultural technology. This model combines education with hands-on practice, providing farmers with the opportunity to learn directly in the field under the supervision of competent extension workers.

According to existing data, before participating in the extension program, only 45% of farmers in Desa Lau Solu used superior seeds, and only 30% adopted the recommended balanced fertilization techniques. With the implementation of the farmer field school model, it is hoped that farmers can improve their agricultural yields and adopt more environmentally friendly and productive technologies. Through this program, it is also expected that stronger collaboration among farmers can be created through the formation of more solid farmer groups, as well as increasing active participation in the sustainable management of natural resources.

The main objective of this research is to evaluate the impact of implementing the farmer field school model in increasing agricultural productivity in Desa Lau Solu as well as to identify the factors that support the success of the education management-based extension program. This research also aims to contribute to the development of a more effective extension model at the village level, with a more integrated approach between education and agriculture.

## LITERATURE REVIEW

### *Agricultural Extension and the Farmer Field School Model*

Agricultural extension is an important part of efforts to improve the quality of life for farmers by providing knowledge and practical skills in managing agriculture. One of the widely used extension models is the Farmer Field School (FFS), which emphasizes experiential learning. This model was first introduced by the Food and Agriculture Organization (FAO) in 1989 and has been implemented in various developing countries, including Indonesia. A study by Sulaiman and Hall (2021) revealed that FFS not only enhances farmers' technical skills in pest management but also improves their ability to manage land sustainably by reducing dependence on chemical pesticides (doi.org)

Mariyono et al. (2021) identified that farmer field schools have a positive impact on agricultural yields, particularly on food crop commodities such as rice

and corn. The recorded yield increase can reach 20-25%, and this is achieved through the application of more efficient agricultural techniques and the use of more environmentally friendly inputs. The FFS model has proven successful in facilitating farmers to increase productivity while maintaining the sustainability of their agricultural ecosystems. (scholar.undip.ac.id)

On the other hand, Davis et al. (2020) also found that FFS programs in various developing countries contribute to improving food security by educating farmers about more innovative and effective agricultural technologies. This research shows that farmers involved in the FFS program have a higher capacity to face the challenges of climate change and extreme weather variability. (link.springer.com)

### ***Educational Management in Agricultural Extension***

Educational management in the context of agricultural extension involves the use of managerial principles in designing, implementing, and evaluating sustainable extension programs. Bachtiar et al. (2025) highlight the importance of a good management system to ensure effective and efficient extension services. One of the proposed approaches is the use of digital technology in extension services, which allows farmers to access information quickly and easily. Additionally, good management enables extension workers to more easily organize and monitor extension programs, as well as adjust their approaches according to the needs of the farmers. (jurnal.polbangtanmanokwari.ac.id)

A study by Van der Meer et al. (2022) underscores that effective educational management in agricultural extension focuses on developing extension workers' skills as well as involving farmers in decision-making. Thus, farmer participation is not only in receiving information but also in program management, which enhances the sense of ownership and sustainability of the program. (link.springer.com)

### ***The Influence of Farmer Field Schools on Agricultural Productivity***

The farmer field school program has proven to have a significant impact on agricultural productivity. Research by Feder et al. (2021) states that farmers who participate in the farmer field school program experience a significant increase in productivity, especially in food crops such as corn and rice. The average yield increase reaches 25%, largely due to the adoption of new technologies that are more environmentally friendly and more efficient in resource utilization. (doi.org)

Irvandika and Suciati (2024) identify that the success of FFS does not only depend on the technical aspects of agriculture but also on the farmers' ability to work together in groups. This program encourages collaboration among farmers, enhances social resilience, and accelerates the dissemination of information and technology more efficiently. They recorded better results in terms of sustainable productivity improvement, especially in climate-sensitive agricultural commodities (journal.ipb.ac.id).

### ***The Role of Farmer Groups in Agricultural Extension***

Farmer groups are an important element in the success of agricultural extension. This group not only serves as a learning platform but also as a communication channel among farmers to share knowledge and technology they have learned from the field school program. Research by Haryanto et al. (2023) shows that farmer groups with good management are able to access resources more effectively, organize training, and enhance collaboration among farmers to tackle common challenges. (researchgate.net)

In Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo, this study found that participation in well-organized farmer groups can increase agricultural yields by up to 30%, as farmers find it easier to access information, receive technical assistance, and adopt new agricultural technologies.

### ***Technology and Digitalization in Agricultural Extension***

In the last decade, digitalization has played an important role in accelerating the adoption of technology in the agricultural sector. Research by Bachtiar et al. (2025) revealed that the use of digital platforms in agricultural extension has enabled extension workers to deliver information more efficiently and in a shorter time. Furthermore, farmers can more easily access technical information related to agriculture, such as guidelines on the use of superior seeds and organic pest control. (jurnal.polbangtanmanokwari.ac.id)

## **METHODOLOGY**

### ***Research Design***

This study uses a case study approach to evaluate the implementation of the school field model based on educational management in improving agricultural productivity in Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo. The research design aims to identify the impact of school field-based extension on farmers' skills in managing agriculture and the improvement of their agricultural yields.

### ***Population and Sample***

The population in this study consists of farmers located in Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo, with a total of approximately 200 active farmers involved in agricultural activities. The research sample consists of 50 farmers selected through purposive sampling. The selection of this sample is based on the following criteria:

1. Farmers directly involved in agricultural activities in Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo.
2. Farmers who have participated in the farmer field school program for at least one cycle.

### ***Data Collection Techniques***

Data were collected through the following techniques:  
In-Depth Interviews: Conducted with 50 selected farmers to obtain data regarding their experiences in participating in the farmer field school program,

changes in agricultural management, and improvements in agricultural yields after attending the extension program.

**Participatory Observation:** The researcher participated in several field school sessions held in Salak Village to observe the interactions between extension workers and farmers, as well as the application of methods taught during the program.

**Documentation:** Collection of secondary data from extension activity reports, records of crop yields before and after participating in the farmer field school program, as well as data related to farmer group activities.

**Questionnaire:** The questionnaire was given to 50 farmers to assess their knowledge regarding the use of superior seeds, balanced fertilization techniques, pest and disease control, and the adoption of other agricultural technologies.

### *Data Analysis Techniques*

Data obtained from interviews, observations, and questionnaires will be analyzed using descriptive analysis and comparative analysis techniques. The steps of the analysis are as follows:

**Descriptive Analysis:** Used to describe the characteristics of respondents, such as demographics, types of agricultural businesses, and changes that occur in farmers after participating in the extension program.

**Comparative Analysis:** Used to compare agricultural results before and after participating in the farmer field school program. Harvest data will be analyzed to see the extent of productivity improvement, as well as the factors influencing those changes.

**Statistical Test:** To test the significance of the difference in agricultural yields before and after the extension, a paired t-test for small samples was used. This test is used to analyze whether there is a significant difference in the agricultural productivity of farmers who participate in the farmer field school program.

### *Validity and Reliability*

To ensure data validity, triangulation techniques will be used by comparing the results obtained from interviews, observations, and questionnaires. In addition, the reliability of the data will be maintained by conducting a preliminary test of the questionnaire before it is distributed to the respondents.

### *Research Ethics*

This research was conducted with attention to good research ethics. All respondents were given an explanation of the research objectives and asked to provide voluntary consent (informed consent). The confidentiality of the information provided by the respondents is guaranteed, and the research results will only be used for academic purposes.

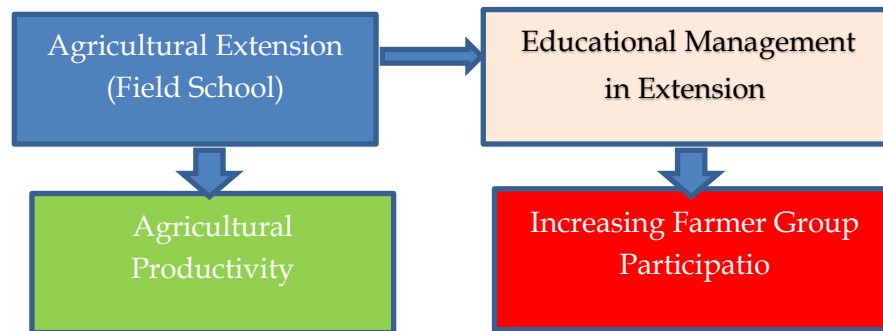


Figure 1. Conceptual Framework

Displaying the relationship between the important elements in this research, namely: Agricultural Extension (Field School), Educational Management in Extension, Agricultural Productivity, and Increasing Farmer Group Participation.

## RESEARCH RESULTS

### *Respondent Profile*

This study involved 50 farmers in Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo, who participated in the farmer field school program for one cycle. The average age of the respondents is 45 years, with farming experience ranging from 10 to 25 years. Most farmers (65%) have agricultural land with an area of about 1 to 2 hectares, while the remaining (35%) manage land with an area of more than 2 hectares. The majority of respondents (80%) manage food crops, mainly corn and soybeans, while the rest (20%) focus on horticultural crops such as chili peppers and tomatoes.

### *Improvement in Farmers' Knowledge and Skills*

Before participating in the farmer field school program, only 40% of farmers knew how to apply balanced fertilization, and 30% of farmers knew how to control pests and plant diseases naturally. After participating in the program, there was a significant increase in the knowledge and skills of the farmers. Based on the results of interviews and questionnaires: 60% of farmers now understand how to apply balanced fertilization according to recommendations and implement it on their crops. 55% of farmers have started using certified superior seeds to improve their harvests. 70% of farmers report that they are now implementing pest control techniques based on integrated pest management (IPM) principles and reducing the use of chemical pesticides.

### *Improvement in Agricultural Yields*

One of the main objectives of the farmer field school program is to enhance agricultural productivity. Based on the harvest data obtained before and after participating in the extension program, there is a significant increase in agricultural yields. Harvest data shows:

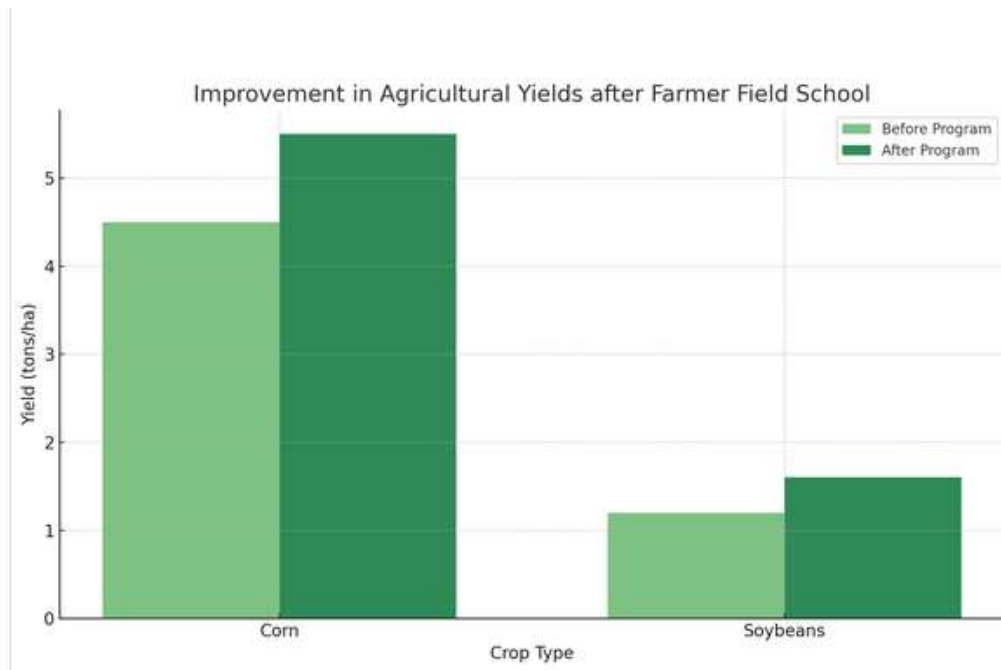


Figure 2. Harvest Results

Corn: Before the program, the average corn yield in Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo, was around 4.5 tons per hectare. After participating in the farmer field school program, the average yield increased to 5.5 tons per hectare, which is an increase of about 22%.

Soybeans: The average soybean yield also saw an increase, from 1.2 tons per hectare to 1.6 tons per hectare, with an increase of about 33%.

This yield improvement is largely due to the adoption of more efficient fertilization techniques, the use of superior seeds, and the implementation of more environmentally friendly pest control methods.

### ***Behavioral Changes and Farmer Involvement in Farmer Groups***

Before participating in the field school program, around 40% of farmers in Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo, were actively involved in farmer groups. After participating in the extension program, this figure increased to 55%, with farmers becoming more active in sharing information, discussing agricultural challenges, and making joint decisions within the farmer group. This shows that the program not only enhances technical skills but also strengthens social bonds among farmers.

This increase in participation contributes to the sustainability of the program, as farmers who are actively involved in farmer groups find it easier to access resources and technical assistance, as well as to adopt new agricultural technologies.

### ***Adoption of Technology and Agricultural Sustainability***

The adoption of more environmentally friendly agricultural technology is one of the main goals of the farmer field school program. Research results show that farmers who participate in this program are more likely to adopt new technologies such as the use of superior seeds and balanced fertilization. Some

farmers are also starting to implement more sustainable natural resource management techniques, such as using organic compost to improve soil fertility. 65% of farmers report that they now use organic compost as an alternative to chemical fertilizers. 60% of farmers have adopted more environmentally friendly soil cultivation techniques, such as minimal tillage to reduce soil erosion and degradation.

### ***Constraints and Challenges in Implementation***

Although the farmer field school program has had a positive impact, several constraints and challenges are still faced, such as the limited time farmers have to participate in all extension sessions due to their busy schedules on the farm. Additionally, there is also a limitation in the number of extension workers available to provide continuous support.

Table 1. Summary Table of Research Results

Aspect Tested	Before Farmer Field School	After Farmer Field School	Increase (%)
Knowledge of Fertilization	40%	60%	50%
Use of Superior Seeds	30%	55%	83%
Pest and Disease Control	30%	70%	133%
Corn Yield (tons/hectare)	4.5	5.5	22%
Soybean Yield (tons/hectare)	1.2	1.6	33%
Participation in Farmer Groups	40%	55%	37.5%

## **DISCUSSION**

### ***Improvement of Farmers' Knowledge and Skills***

The improvement of farmers' knowledge and skills is one of the main objectives of the farmer field school program. This research shows that after participating in the program, there was a significant increase in farmers' knowledge about balanced fertilization techniques, the use of superior seeds, and pest control based on Integrated Pest Management (IPM) principles. Before participating in the program, only 40% of farmers knew how to perform balanced fertilization, but after the program, this figure increased to 60%. This indicates that the farmer field school program not only provides technical knowledge but also strengthens farmers' ability to apply that knowledge in the field.

This increase in knowledge is in line with the findings expressed by Feder et al. (2004), who noted that field school-based extension is very effective in enhancing farmers' capacity to manage their farming enterprises, as this model combines theory and practice. Similar results were found by Haryanto et al. (2023), which showed that farmers who participated in field-based extension

programs had a better understanding of managing their agricultural resources. The adoption of new technologies, such as balanced fertilization techniques and the use of superior seeds, has been proven to significantly increase agricultural yields. The results of this research indicate that the farmer field school model can be a highly effective model for enhancing farmers' capacities in various aspects of agriculture, from technical to managerial aspects.

### ***Improvement of Agricultural Yields***

The increase in agricultural yields, especially for corn and soybeans, demonstrates the positive impact of the farmer field school program on agricultural productivity. Before participating in the program, the average corn yield was only 4.5 tons per hectare, but after joining the farmer field school program, the yield increased to 5.5 tons per hectare. This 22% increase is concrete evidence that the application of more efficient and environmentally friendly agricultural techniques, such as the use of superior seeds and balanced fertilization, can directly improve crop yields.

These findings are also in line with research conducted by Davis et al. (2020), which shows that the farmer field school program can improve farmers' agricultural yields by reducing dependence on chemical pesticides and adopting more efficient and environmentally friendly pest management techniques. Research conducted by Mariyono et al. (2021) also indicates that the use of superior seeds and balanced fertilization introduced in the farmer field school-based extension program results in a significant increase in agricultural productivity. This program successfully increased crop yields in a more sustainable and environmentally friendly manner, which is one of the main advantages of implementing the farmer field school model.

The increase in agricultural yields not only impacts the farmers' income but also their quality of life. With higher agricultural yields, farmers can gain more profit from their farming efforts, which in turn can enhance their overall well-being.

### ***Behavioral Changes and Increased Participation in Farmer Groups***

One of the most significant findings of this research is the increase in farmers' participation in farmer groups after attending the farmer field school program. Before the program, only 40% of farmers were active in farmer groups, but after the program, this figure increased to 55%. This indicates that the farmer field school not only provides technical training, but also creates significant social changes, namely strengthening social ties among farmers and improving collaboration within farmer groups.

This increase in participation also impacts the sustainability of the program. More active and organized farmer groups are better able to survive and thrive, as they can more easily access resources, share information, and support each other in facing agricultural challenges. Van den Ban and Hawkins (1996) emphasize that good organization within farmer groups can accelerate the adoption of new technologies and improve the collective management of agricultural enterprises. This is evident in the village of Desa Lau Solu, in the district of Langkat, where active farmer groups have helped farmers gain easier

access to technical assistance and agricultural resources, as well as strengthen the sustainability of extension programs.

### ***Adoption of Technology and Agricultural Sustainability***

Agricultural sustainability is one of the important aspects of field school-based extension. This program not only focuses on increasing agricultural yields but also on more sustainable natural resource management. In this study, it was found that 65% of farmers now use organic compost as a substitute for chemical fertilizers, and 60% of farmers have adopted more environmentally friendly soil cultivation techniques, such as not excessively tilling the soil to prevent erosion. These findings are in line with research by Bachtiar et al. (2025), which states that extension services emphasizing sustainability principles in agriculture are crucial for maintaining soil and environmental quality. The use of organic compost and environmentally friendly soil management techniques can reduce dependence on chemicals and improve soil quality in the long term. This also supports the findings proposed by Sulaiman and Hall (2021), which state that field school-based extension can reduce the negative impact of agriculture on the environment while simultaneously improving agricultural yields sustainably.

### ***Constraints and Challenges in Implementation***

Although the farmer field school program has a positive impact, this study also found several constraints and challenges in its implementation. One of the main constraints is the limited time farmers have to participate in all extension sessions, considering their busyness in managing agricultural land. This indicates the need for a more flexible extension schedule so that more farmers, especially in rural areas, can participate.

In addition, the limited number of trained extension workers also poses a challenge in ensuring that extension services can be conducted sustainably. Davis et al. (2010) state that to improve the effectiveness of extension services, it is important to increase the number of trained extension workers and to utilize digital technology to expand the reach of extension services. The use of mobile applications or online platforms can be a solution to overcome existing time and resource limitations, allowing farmers to still access information and training even if they cannot attend all extension sessions in person.

### ***Practical Implications***

The results of this study indicate that farmer field schools can serve as an effective model for agricultural extension in improving farmers' skills, agricultural yields, and agricultural sustainability. To ensure the success of this program in the future, it is important to enhance collaboration between extension workers, farmers, and the government. Additionally, the development of digital platforms for extension can help expand access for farmers, especially in remote areas, and facilitate more flexible and sustainable learning.

## **CONCLUSION**

This research has evaluated the impact of the field school program based on educational management in Desa Lau Solu, Kecamatan Mardinding,

kabupaten Karo, to improve agricultural productivity and farmers' skills. Based on the research findings, it can be concluded that:

**Improvement in Farmers' Knowledge and Skills:** The farmer field school program successfully enhanced farmers' knowledge about balanced fertilization techniques, the use of superior seeds, and pest control based on Integrated Pest Management (IPM). Before participating in the program, only 40% of farmers were aware of balanced fertilization techniques, while after the program, this figure increased to 60%. Additionally, farmers were also more likely to adopt more environmentally friendly processing techniques.

**Increase in Agricultural Yields:** This program successfully increased corn yields by 22% and soybean yields by 33%. This improvement is directly related to the adoption of new technologies, such as the use of superior seeds and balanced fertilization, introduced during the farmer field school program.

**Social Change and Farmer Group Participation:** The farmer field school program also plays a role in strengthening social bonds among farmers. Farmer participation in farmer groups increased from 40% to 55%. This indicates that the program not only enhances technical skills but also strengthens the social organization that is crucial for the sustainability of the extension program.

**Agricultural Sustainability:** The adoption of environmentally friendly technologies, such as the use of organic compost and more sustainable land management practices, indicates that this program contributes positively to agricultural sustainability in Desa Lau Solu, Kecamatan Mardinding, kabupaten Karo. As many as 65% of farmers used organic compost after participating in the program, and 60% adopted environmentally friendly soil processing techniques.

**Constraints and Challenges:** The main constraint in the implementation of the program is the limited time farmers have to fully participate in the extension activities, as well as the limited number of trained extension workers. This indicates the need for more flexible scheduling and an increase in the number of trained extension workers to ensure the sustainability of the program.

## **RECOMMENDATION**

Based on these findings, this research provides several recommendations for the further development of the field school-based agricultural extension program:

**Schedule Adjustments and Program Flexibility:** To increase farmer participation, extension services should be designed with more flexible schedules that can be adjusted to their agricultural activities. The use of digital platforms to deliver extension materials can be a solution to ensure that farmers still receive information even if they cannot attend sessions in person.

**Increase in the Number of Trained Extension Workers:** The success of the program heavily depends on the quality of the extension workers. Therefore, it is important to increase the number of trained extension workers in rural areas, especially in terms of field school-based extension techniques. Well-trained extension workers will be more capable of guiding farmers in adopting new technologies and addressing issues that arise in the field.

**Collaboration between Extension Workers, Farmers, and the Government:** The success of the farmer field school program heavily depends on the close collaboration between extension workers, farmers, and the government. The government needs to provide greater support in terms of funding, training facilities, and access to more modern agricultural technology. Extension workers and farmers must also collaborate to ensure that the information provided can be directly applied in daily agricultural activities.

**Application of Eco-Friendly Technology:** Enhancing the application of eco-friendly agricultural technology, such as the use of organic compost and sustainable soil cultivation techniques, should be a primary focus in future extension programs. This is important for maintaining the sustainability of agricultural ecosystems and reducing dependence on chemicals.

**Utilization of Digital Technology in Extension Services:** Digital technology can expand the reach of agricultural extension services, especially in remote areas. Digital platforms, mobile applications, or video tutorials can be important tools in extension services to ensure that farmers remain informed despite time or location constraints.

## **ADVANCED RESEARCH**

Based on the existing research findings, here are the three most prioritized areas for further research development:

### **1. Long-Term Evaluation of the Impact of Field Schools**

This research is important to understand the sustainability of the impact of field schools after the program ends. Measuring whether the skills taught are still applied in the long term will provide a clearer picture of the program's success in enhancing long-term agricultural resilience and farmer welfare.

### **2. The Use of Digital Technology in Extension Services**

With technological advancements, the implementation of digital-based extension services is highly relevant. This further research can expand the reach of extension services to farmers in remote areas and improve the effectiveness and efficiency of information delivery. This is very important to reach more farmers more quickly and easily.

### **3. Economic Analysis of Farmer Households**

Research on the impact of increased agricultural yields on the income and economic well-being of farmer households is a crucial step. Understanding how the increase in agricultural productivity impacts the economic well-being of farming households will provide stronger evidence of the success of extension programs and their contribution to farmers' welfare. Focusing on these three areas can provide a more comprehensive picture of the impact of field school-based extension on improving productivity and the quality of life for farmers, as well as supporting the development of more effective policies for the agricultural sector in the future.

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Hopefully, this article can provide a positive contribution to the development of the agricultural sector and the welfare of farmers in Indonesia, and serve as a reference for future research.

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