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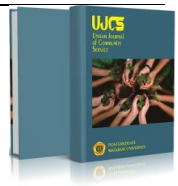

Empowering Cilembu Sweet Potato Farmers Through Education and Utilization of Local Plant-Based Biopesticides: an Environmentally Friendly Solution to Reduce Dependence on Chemical Pesticides

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Abstract: Cilembu sweet potato farmers' dependence on synthetic chemical pesticides raises concerns about their impact on health, the environment, and agricultural sustainability. This Community Service Program (PKM) aims to empower farmers through education and training in the production of biopesticides from locally sourced plants. Implementation methods include outreach, demonstrations of biopesticide production from materials such as neem and soursop leaves, and hands-on field training. The results of the activities indicate an increase in farmers' understanding and skills in utilizing biopesticides as an environmentally friendly pest control alternative. The program concludes that education and utilization of locally sourced plant-based biopesticides have proven effective as a practical solution to reduce dependence on chemical pesticides while simultaneously supporting sustainable agriculture for Cilembu sweet potato farmers.

Keywords: Cilembu Sweet Potato, Botanical Biopesticides, Farmer Empowerment, Chemical Pesticides, Sustainable Agriculture.

Introduction

In both global and local contexts, agriculture plays a central role in ensuring food security. For Indonesia, this sector is a source of livelihood for many people, particularly in rural areas. However, recent years have been marked by a major challenge for farmers: the excessive use of chemical pesticides. The effectiveness of synthetic pesticides in controlling pests is only temporary, as they actually cause long-term negative effects such as environmental pollution, reduced biodiversity, pest resistance, and health risks for both farmers and consumers (Roosma Ria et al., 2024).

In the context of agricultural sustainability, the use of botanical pesticides is considered an environmentally friendly alternative to synthetic pesticides. Botanical pesticides are more easily degraded naturally and have a lower risk of environmental pollution and residues in crops. The use of botanical pesticides can be part of an integrated approach to sustainable pest and plant disease management, considering their benefits and limitations while maintaining the balance between the environment and human health (Area, n.d.).

Cilembu Village is located in Pamulihan District, Sumedang Regency, West Java. This area is situated at an altitude of 700–900 meters above sea level, has a cool climate, and fertile soil, suitable for growing Cilembu sweet potatoes (Ipomoea batatas var. Cilembu). These sweet potatoes are known for their sweet and chewy taste, especially when baked, making them highly marketable in local and national markets. Over the past three years, land productivity has declined due to excessive use of chemical pesticides, microclimate changes, and pest attacks such as leaf caterpillars (Spodoptera litura) and stem borers. According to the Sumedang Regency Agriculture Office (2022), approximately 63% of farmers reported decreased yields

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and quality of sweet potato due to poorly managed pests.

The Sawah Lega Farmers Group has been active since 2014, with 32 members. They manage approximately 25 hectares of land for Cilembu sweet potato cultivation. The majority of its members are aged 35–55 and have secondary education. The organizational structure consists of a chairperson, secretary, treasurer, and field coordinator. Although active in production, the group has not received training in environmentally friendly agriculture or digital business management. Technology use is still minimal, with no organized production and distribution recording system or digital business mapping (Yusuf et al., 2020).

The main problems faced by the Sawah Lega Farmers Group encompass both upstream and downstream aspects of the farming system:

1. Dependence on chemical pesticides, which are used in excessive doses without understanding the long-term impacts on the environment and health.
2. Farmers' limited knowledge of environmentally friendly pest control alternatives, such as locally sourced plant-based biopesticides, despite the abundant availability of plants such as neem, tobacco, citronella, and garlic around the village.
3. The absence of ecologically based standard operating procedures (SOPs) for production and pest control, resulting in inconsistent crop quality.

To address these issues, outreach and training on locally sourced plant-based biopesticides (neem leaves, garlic, and lemongrass) are needed to reduce the use of hazardous pesticides. Through this outreach, farmers are introduced to natural ingredients readily available locally. This innovation not only helps maintain the agricultural ecosystem but also increases the productivity and quality of the harvest (Aceh, 2020).

Method

The proposed approach and application of technology and innovation to address the issues of farmer groups has been mutually agreed upon, including the appropriateness of work volume, priority scale, and partner participation in program implementation, evaluation of program implementation and sustainability in the field, and the roles and duties of each team member according to their competencies and student assignments.

This activity was implemented through several systematic and structured stages involving the Sawah Lega Farmers Group, Cilembu Village, Pamulihan District, Sumedang Regency, including socialization, training, technology implementation, mentoring, and program sustainability.

Table 1. Details of Activity Implementation Stages

No	Activity Stages	Details	Expected output
1	Socialization	Communicating the program's objectives and benefits to partners, including the activity agenda.	Partners' initial understanding of the program's urgency and benefits.
2	Training	Training on local plant-based biopesticide production and farmer data management.	Farmers understand biopesticide production techniques and data recording.
3	Mentoring and Evaluation	Direct assistance in biopesticide application, evaluation, and marketing.	Farmers are able to implement the practices independently and consistently.
4	Program Sustainability	Monitoring results, developing standard operating procedures (SOPs), and developing sustainability strategies.	Standardized SOPs, and partners are ready to continue the program independently.

Result and Discussion

Pre-Training

The "Empowering Cilembu Sweet Potato Farmers through Education and Implementation of Local Plant-Based Biopesticides" program, implemented by Winaya Mukti University, involved 21 members of the Sawah Lega Farmers Group in Cilembu Village. This activity included education on biopesticides based on local plants such as neem leaves, citronella, and garlic. Prior to the training, a baseline survey using questions (Table 2) revealed that farmers frequently use chemical pesticides to control major pests.

Table 2. Pre-Training Questions

No	Questions
1	What type of chemical pesticide is most frequently used by Cilembu sweet potato farmers, and how does it affect crop yields?
2	What types of pests or diseases most frequently attack Cilembu sweet potato plants, prompting farmers to use pesticides?
3	What are the negative impacts of chemical pesticide use on farmers' health and the surrounding environment?
4	Why do farmers still rely on chemical pesticides rather than biological or natural pesticides?

Table 2 shows questions that can help in understanding the problem and help identify key issues

such as dependence on chemical pesticides due to limited knowledge about biological alternatives.

Training

This training implements the Technology Implementation phase, where farmers are taught to independently produce and apply biopesticides. Neem plants can be used as botanical pesticides because they contain the active compound azadirachtin. Neem botanical pesticides are toxic and act as repellents, antidotes, and inhibit insect egg-laying. Neem plants can also kill insects because they contain azadirachtin, which kills insects by inhibiting feeding and disrupting their growth and reproduction (Killa et al., 2023).

From the existing problems, this program can increase the capacity and independence of farmers who are members of the Sawah Lega Farmers Group in Cilembu Village in managing Cilembu sweet potato farming in an environmentally friendly and sustainable manner through education on local plant-based biopesticides, providing education and training to farmers on the manufacture and use of local plant-based biopesticides, and establishing a pilot demonstration plot for integrated pest control based on biopesticides (Darusman et al., 2024).

Figure 1. Introduction to Local Plant-Based Biopesticides

(Listiyani, 2025) stated that one of the main advantages of plant-based biopesticides is their ability to maintain the balance of agricultural ecosystems. Thus, research and innovation from universities truly provide tangible benefits to society. Beyond this success, the implementation of locally based plant-based biopesticides could become a model for wider adoption, both nationally and internationally, as part of sustainable agriculture.

Farmers were given an explanation about the benefits of neem leaves as a substitute for chemical pesticides, farmers were invited to identify natural pesticide ingredients such as neem leaves and liquid soap as an adhesive (Amalia et al., 2023). The community service team demonstrated the extraction process directly by grinding 200 grams of neem leaves and adding approximately 50 ml of water, then taking the juice or water from the neem leaf extract. After that, mix the neem leaf extract with a 10 ml soapy water solution. This neem leaf extract can be applied after leaving it for 1 night in a dark glass container, for its use concentration, it is 10% per 1 liter of water.

Figure 2. Making Biopesticides

This neem leaf biopesticide practice is effective as part of integrated pest management. This method is more economical and environmentally friendly, although its effectiveness depends on consistent application and weather conditions. Overall, this practice empowers farmers to be self-sufficient, contributing to a reduction in dependence on chemical pesticides.

Evaluation

The evaluation process for this program can be measured through a questionnaire containing statements. Each questionnaire response contains three statements to assess participants' responses to the training, material delivery, technology implementation in the field (IPM demonstration plots & environmentally friendly cultivation standard operating procedures), and assistance with biopesticide production and use in the field.

Table 3. Response Level Statements

No	Question
1	Comprehensive Training Material
2	Application of Technology in the Field (IPM Demonstration Plot & Environmentally Friendly Cultivation Standard Operating Procedures)
3	Assistance with Biopesticide Production & Use in the Field

The level of learning is assessed through 3 statements that measure the increase in knowledge, understanding, and provision of new skills.

Table 4. Learning Level Statements

No	Statement
1	Gained knowledge about locally based biopesticides.
2	Improved understanding of biopesticide use in the field.
3	This training has a positive impact on suppressing pests and diseases in cassava crops.

From these 3 statements, it can be assessed whether participants understand the use of biopesticides and whether they can be applied in their cultivation activities as a substitute for chemical pesticides.

Table 5. Evaluation Data

Question	Response	Learning	Behavior	Indicator Outcome
1	82.15	78.60	84.20	79.10
2	78.50	75.45	82.80	80.25
3	84.75	77.80	85.60	78.90
4	76.30	80.10	84.00	81.45
5	-	-	-	82.50
average	80,42	77,99	84,15	80,44

Based on data analysis, the average score for the reaction level, which consists of four statements, was 80.42, while the average score for the learning level was 77.99. Furthermore, the behavior level, which also consists of four statements, achieved an average score of 84.15.

Overall, the evaluation results showed scores ranging from "agree" to "strongly agree," indicating that the biopesticide mentoring activity received a positive response from participants. This indicates that participants were not only satisfied with the training but also experienced increased knowledge, understanding, and practical skills in producing and using biopesticides on agricultural land (Hanafi et al., 2024).

From a learning perspective, participants were able to understand the concept of environmentally friendly agriculture, including the correct procedures for producing and applying biopesticides. Improved scores for the behavioral aspect indicate that participants not only understand the theory but also apply the knowledge gained from utilizing biopesticides in their agricultural practices (Hanafi et al., 2024).

This activity has had tangible positive impacts, such as reduced pest infestations, increased production cost efficiency, and improved cassava harvest quality. Furthermore, the participants demonstrated a strong commitment to continuing the sustainable use of environmentally friendly technologies on their respective fields (Ai Komariah et al., 2024).

Thus, the overall average score, which ranged between "agree" and "strongly agree," indicates that the biopesticide production and use assistance program was successfully implemented and achieved its intended objectives. The program was effective in increasing farmers' competence, awareness, and motivation to implement sustainable agricultural practices (Nurhasana, 2021).

Conclusion

Evaluation results using the Kirkpatrick model showed that after participating in the biopesticide mentoring, participants were able to better absorb and understand the training materials, interact effectively in practice groups, and independently implement biopesticide production on their respective plots.

Knowledge of integrated pest management and environmentally friendly cultivation significantly increased, along with awareness of reducing dependence on chemical pesticides. Average scores for four key indicators: Reaction (80.42), Learning (77.99), Behavior (84.15), and Results (80.44), indicate that this activity successfully increased farmers' ability and awareness to implement environmentally friendly agriculture (Noertjahyani et al., 2019).

This training activity was implemented at a total cost of IDR 40,566,000,00 and will be followed by the provision of biopesticide compounding equipment to participating farmer groups. This assistance is expected to support farmers' inability and independence in producing and using biopesticide, while simultaneously expanding the application of environmentally friendly technology in the surrounding area.

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