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Capacity Building for Farmers through Training in Appropriate Technology-Based Pest Control for Corn Crops

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Abstract

Corn is a strategic commodity whose productivity is vulnerable to decline due to attacks by plant pests and diseases (PPDs), necessitating appropriate, adaptive, and sustainable control measures. Key challenges at the farmer level include limited ability to identify PPDs and their symptoms, limited access to information and extension services, and a tendency to use pesticides in ways not recommended. This Community Partnership Program aims to enhance farmers' capacity through training in maize pest control using appropriate technology, integrating improved PTO identification literacy, the application of environmentally friendly integrated pest management, and the use of field devices and information technology for diagnosis. The implementation method uses an applied training approach through extension services, demonstrations, field practice, and pre- and post-evaluations to measure improvements in participants' understanding and skills. The results of the activities demonstrate improved farmer ability to identify plant pests and determine rational control strategies, the application of environmentally friendly control alternatives based on biopesticides and biological agents, increased application efficiency through the use of electric sprayers, and improved diagnostic accuracy through the use of applications or expert systems. Overall, this program contributes to strengthening farmer self-reliance and the sustainability of the corn cultivation system.

Keywords: farmer capacity, plant pests, integrated pest management, appropriate technology, corn cultivation.

INTRODUCTION

Corn is a strategic commodity whose productivity is vulnerable to decline due to attacks by plant pests and diseases, including insect pests and diseases; therefore, control efforts are a crucial component of the corn cultivation system (Rachman et al., 2022; Murtopo et al., 2023). Identification studies on hybrid corn indicate that while hybrid varieties may possess certain advantages, insect pests can still be present and have the potential to attack plants, making the need for monitoring and control based on field knowledge still relevant (Murtopo et al., 2023). In line with this, reports from community service activities with corn farmer groups confirm that the emergence of new pests and pest dynamics can contribute to yield losses, necessitating a more systematic and adaptive control approach (Rachman et al., 2022; Khaeruddin et al., 2022).

At the farmer level, one of the main challenges is limited understanding in recognizing pest types and the symptoms of their attacks, even though the ability to identify them early is the basis for making control decisions in the field (Khaeruddin et al., 2022; Fattah & Manga, 2022). This limitation can be exacerbated by limited access to information and a shortage of field extension workers, which in turn increases the risk of misdiagnosis and inappropriate management actions, potentially leading to reduced yields (Fattah & Manga, 2022; Primartadi et al., 2022). These conditions are also correlated with inappropriate control practices, such as the excessive or improper use of pesticides, as reported in the context of corn planting preparation training that highlighted issues regarding pesticide application not in

line with recommendations and a tendency toward excessive pest control (Heryanto & Deden, 2021; Indrawan & Mulyati, 2023).

A widely recommended approach to addressing pest issues sustainably is Integrated Pest Management (IPM), as IPM emphasizes ecosystem management and more environmentally friendly control strategies (Rachman et al., 2022; Suhendar et al., 2023). The implementation of pest control technologies in maize using botanical biopesticides and support for soil management/cropping systems has been reported as an intervention aimed at supporting sustainable agriculture (Rachman et al., 2022). In organic farming, high levels of pest and disease infestation can drive the use of synthetic pesticides (which are inconsistent with organic principles); therefore, strengthening community capacity to produce high-quality biological agents is viewed as a solution that is both effective and environmentally friendly (Suhendar et al., 2023; Umasugi et al., 2021). Within this framework, training on the use of microbial agents (e.g., Trichoderma harzianum) is also reported to aim at enhancing farmers' knowledge of pests and diseases while strengthening cultivation and composting skills that support plant resilience (Umasugi et al., 2021), thereby opening avenues for pest management that reduce reliance on chemical inputs (Suhendar et al., 2023; Indrawan & Mulyati, 2023).

Beyond knowledge and cultivation practices, strengthening pest management in maize becomes increasingly relevant when linked to the use of appropriate technologies (AT). Several studies emphasize that technology (including appropriate technology) is a key enabler of agricultural development, and thus strengthening technology adoption is an integral part of strategies to enhance the performance of the agricultural sector (Arfiansyah et al., 2022; Waluyo et al., 2021). In the context of agricultural extension activities, the limitations of extension services that have not yet addressed effective and efficient appropriate technology (TTG) aspects have driven the application of TTG tools such as electric sprayers in agricultural fields (Setiawati et al., 2023), while in the diagnostic aspect, the development and guidance on using corn disease detection applications (e.g., Corn Disease Detector) as well as expert systems for early pest detection in corn have been developed to address knowledge gaps, accelerate identification based on physical symptoms, and assist in treatment recommendations (Kurniawan et al., 2021; Primartadi et al., 2022).

Based on this synthesis of field needs, the Community Partnership Program (PKM) themed "Enhancing Farmers' Capacity through Training on Corn Pest Control Using Appropriate Technology" was designed as an integrated effort to strengthen farmers' ability to address plant pest issues appropriately, effectively, and sustainably through the integration of knowledge enhancement, practical skills, and technology utilization. This program aims to improve farmers' literacy in identifying types of corn Pests and their symptoms as a basis for rational control decision-making, strengthen skills in applying environmentally friendly Integrated Pest Management (IPM)-based control through the use of biopesticides and biological agents to reduce dependence on synthetic pesticides, and to introduce and train farmers in the use of appropriate technologies, including field equipment such as electric sprayers to improve application precision, as well as information technologies such as diagnostic apps or expert systems to accelerate and enhance the accuracy of pest identification. Overall, the program is expected to foster farmers' autonomy in managing corn pest control in an adaptive, efficient, and sustainable manner.

METHOD

The activity plan was designed as an applied training program that integrates educational sessions, demonstrations, and on-site practical guidance. This approach was chosen because the primary challenges faced by corn farmers generally stem from limited knowledge regarding the identification of plant pests and the determination of appropriate control measures. Therefore, the learning process does not merely focus on conveying concepts but is directed toward mastering operational skills in the use of appropriate technologies (AT) and the ability to make decisions based on field observations. This capacity-building framework aligns with the view that the adoption of agricultural technologies must be internalized through a structured learning process to effectively support sustainable agricultural development.

The preparation phase emphasizes identifying partner needs and developing training materials contextualized to PPD issues in corn crops. Problem mapping was conducted to uncover farmers' limitations in identifying pest types and attack symptoms, the lack of access to adequate extension information, and the tendency to use pesticides contrary to recommendations. Additionally, this phase also considers the readiness to adopt TTG based on local resources as a practical solution in the field. Based on these findings, a training program was developed covering an introduction to Pests and their symptoms, the principles of environmentally friendly Integrated Pest Management (IPM), the prudent use of pesticides, operational guidelines for TTG spraying, and the use of applications or expert systems for diagnosing corn diseases. Evaluation instruments were designed using a pre- and post-training measurement approach to assess changes in participants' understanding and practical competencies.

The implementation phase was carried out through several integrated sessions covering the introduction to corn pests and the identification of symptoms in the field, the application of IPM-based control strategies and environmentally friendly technologies, training on the proper and sustainable use of pesticides, demonstrations and practice sessions on the use of electric sprayers, and guidance on utilizing applications or expert systems for diagnosing corn pests. This series of activities aims to strengthen farmers' ability to detect pest infestations early, select control methods aligned with sustainability principles, and improve work efficiency through technological support. Thus, the implementation of these activities not only enhances knowledge but also yields practical skills that can be directly applied in corn cultivation.

The evaluation and follow-up phase is conducted through measuring participants' understanding before and after the training, as well as assessing practical skills such as the ability to identify symptoms, select control strategies in accordance with IPM principles, and operate the electric sprayer. This evaluation aims to ensure measurable capacity building. Furthermore, follow-up is designed in the form of periodic mentoring during the next planting season so that early identification and IPM-based control practices can be internalized into daily farming activities. This sustainable approach is expected to strengthen farmers' self-reliance while improving the effectiveness of pest control in corn crops on a sustainable basis.

RESULTS AND DISCUSSION

The main results of the activity indicate an increase in farmers' literacy regarding the identification of maize plant pests and their symptoms, which serves as the basis for control decision-making. The ability to recognize pest types, identify signs of

infestation in the field, and link them to appropriate control measures has been successfully strengthened through training. Strengthening this literacy is crucial, given that limited information, access to extension workers, and prior technical knowledge often lead to misdiagnoses and inappropriate management practices, resulting in reduced yields. Thus, the development of farmers' foundational competencies in interpreting symptoms and determining rational responses constitutes a fundamental achievement of the activity.



Figure 1. TTG Training

In terms of the implementation of integrated pest management (IPM) and environmentally friendly strategies, the project successfully introduced more sustainable control alternatives through the use of plant-based biopesticides, biological agents, and soil management practices that support the balance of agricultural ecosystems. Strengthening skills in the production and utilization of beneficial microorganisms, such as Trichoderma harzianum, further supports increased plant resilience while reducing reliance on synthetic pesticides. These results demonstrate that an IPM-based approach not only enhances farmers' technical capacity but also opens opportunities for transitioning toward more environmentally friendly and sustainable farming systems.

Regarding appropriate technology (AT) field equipment, training on the use of electric sprayers contributes to improved efficiency and precision in pest control applications in the field. Farmers acquire skills in selecting, operating, and adjusting the use of equipment to meet control needs, thereby making the application process more standardized and effective. This capacity building underscores that the integration of appropriate technology into agricultural training is a critical factor in supporting productivity and work efficiency in the crop production sector.

Regarding the information-based TTG component, guidance on using applications or expert systems for diagnosing corn pests and diseases has proven to improve the accuracy and speed of symptom-based pest identification. The use of digital tools helps reduce reliance on improperly dosed chemical inputs while addressing the limited access to field experts. Integrating information technology into the diagnostic process strengthens the quality of farmers' decision-making and expands their access to knowledge independently.

Learning evaluations using a pre–post approach demonstrated improvements in participants' conceptual understanding and practical skills, particularly in recognizing pests, selecting control strategies aligned with IPM principles, and using TTG tools and information. These evaluation results also serve as the basis for

planning follow-up guidance in the next growing season to ensure that knowledge- and technology-based control practices are sustainably internalized in cultivation activities.

Nevertheless, variations in the focus of the extension program indicate that the program's effectiveness heavily depends on the integration of various components, ranging from strengthening pest identification literacy, implementing environmentally friendly IPM, using field-based TTG tools, to utilizing information-based TTG for diagnosis. Limitations in extension personnel and information access also underscore the importance of sustainability mechanisms through continuous mentoring, strengthening key farmers as local references, and enhancing the production capacity of biological agents at the community level. With such integration, the training program has the potential to yield long-term impacts on enhancing farmer autonomy and the sustainability of the corn farming system.

CONCLUSION

The Community Partnership Program, which focuses on training in corn pest control supported by appropriate technology, has proven effective in improving pest identification literacy, strengthening skills in the application of environmentally friendly control methods, and enhancing the effectiveness and accuracy of control measures through the use of hardware and information technology. The integration of knowledge enhancement, practical skills, and technology adoption is a key factor in promoting farmer autonomy and the sustainability of the corn farming system. Therefore, continuous mentoring, the empowerment of key farmers, and community capacity building in the use of technology and biological agents must continue to be carried out so that the program's impact can be sustained and expanded in the long term.

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