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See, Learn, Apply: Field-Based Education for Rice Planthopper Management

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Fitria Dwita Marlianti*[1], Firos Adel Wahyujarman[2], Irene Putri Keysa Rhamadani[3], Nabil Agustiawan[4], Yosivia Tiara Shieni[5], Melani Artika Sari[6], Analisa Amara Kurniadi[7], Ananta Pratama Ferindia[8], Alvinna Aprilia[9], Rafly Abid Ananda[10], Saprinurdin[11]

Universitas Bengkulu, Bengkulu, Indonesia[1,2,3,4,5,6,7,8,9,10,11]

E-mail: fitriamarlianti@gmail.com

ABSTRACT

Rice planthoppers remain an important constraint in rice production, while farmers' understanding of appropriate management practices is essential for preventing severe crop damage and unnecessary pesticide use. This community service activity aimed to strengthen farmers' self-reported understanding of rice planthopper management through an extension session and direct field demonstration. The activity was conducted in Gelombang Village, Bengkulu Province, Indonesia, in July 2026 and involved 30 rice farmers. A one-group pre-test–post-test design was applied using 20 identical Likert-scale statements. Complete paired responses from 28 participants were analyzed using descriptive statistics and the Wilcoxon signed-rank test, while three additional post-test evaluation items were summarized using frequencies and percentages. The mean score increased from 37.36 in the pre-test to 89.00 in the post-test, with an average improvement of 51.64 points. The difference was statistically significant ($W = 2.00$, $p < .001$), with a very large rank-biserial effect size of 0.990. Twenty-seven of the 28 participants obtained higher post-test scores. The questionnaire also demonstrated high internal consistency, with Cronbach's alpha values of 0.900 for the pre-test and 0.909 for the post-test. In addition, most participants reported that they could follow the demonstrated procedures, felt confident applying rice planthopper management practices, and were willing to adopt appropriate and environmentally responsible management. These findings indicate that combining extension with direct field demonstration can produce a strong immediate improvement in farmers' self-reported understanding. Follow-up evaluation is required to assess long-term knowledge retention and actual implementation in the field.

Keywords: *Agricultural Extension; Farmer Learning; Field Demonstration; Integrated Pest Management; Rice Planthopper Management*

1. Introduction

Rice is a major staple crop that supports food security and rural livelihoods in many Asian countries. Its production, however, is continuously threatened by insect pests, particularly rice planthoppers. Muduli et al. (2021) identified the brown planthopper, *Nilaparvata lugens* (Stål), as one of the most destructive pests of rice in Asia. The insect feeds by inserting its stylets into vascular tissue and extracting phloem sap from rice plants. According to Shi et al. (2023),

severe infestations can cause yellowing, wilting, plant death, and the characteristic drying symptom known as *hopperburn*. Brown planthoppers can also act as vectors of rice viruses, further increasing their potential impact on crop production.

The occurrence and severity of planthopper infestations are closely related to crop-management practices. Fertilizer application, for example, influences not only plant growth but also the interaction between rice plants and insect pests. Zeng et al. (2024) demonstrated that increasing nitrogen input altered leaf-surface structures, shortened the time required by brown planthoppers to locate feeding sites, and increased their field populations. These findings indicate that excessive nitrogen fertilization may create conditions that are more favorable for planthopper development. Balanced fertilization should therefore be explained to farmers as part of pest management rather than solely as a strategy for improving crop productivity.

Chemical insecticides are commonly selected because they can provide rapid suppression of pest populations. Nevertheless, their effectiveness may decline when the same active ingredients are applied repeatedly or without consideration of dosage, timing, and pest density. Resistance monitoring conducted by Song et al. (2023) revealed changes in the susceptibility of *N. lugens* populations to pymetrozine. The finding highlights the importance of rotating insecticides with different modes of action and avoiding unnecessary applications. Furthermore, responsible pesticide use requires farmers to consider environmental and human-health risks in addition to immediate pest mortality (Kvakkestad et al., 2021).

Integrated pest management, commonly abbreviated as IPM, provides a more comprehensive approach to controlling rice planthoppers. Rather than relying exclusively on chemical insecticides, IPM combines preventive, biological, cultural, and chemical measures according to field conditions. Important components include regular crop monitoring, the use of resistant varieties, balanced fertilization, conservation of natural enemies, and need-based pesticide application. Muduli et al. (2021) discussed resistant rice varieties as an important component of sustainable brown planthopper management, while Shi et al. (2023) emphasized the contribution of cultural and biological control to integrated management systems. In practice, these strategies are intended to maintain pest populations below damaging levels rather than completely eliminate all insects from the rice ecosystem.

Despite the advantages of IPM, its implementation depends on farmers' ability to understand and apply the recommended practices. Farmers need to recognize the pest, identify early symptoms, inspect the lower sections of rice plants, and distinguish harmful insects from beneficial organisms. They must also understand when control measures are necessary and which methods are appropriate for different infestation levels. In a study of smallholder farmers, Chepchirchir et al. (2021) found that training, knowledge, and awareness of nonchemical control practices were important factors associated with potential IPM adoption. This suggests that the availability of pest-management technology alone is insufficient when farmers have limited access to clear and practical information.

Farmers' existing practices may also be influenced by their perceptions of chemical and nonchemical control methods. Rahman (2022), for instance, reported that farmers' perceptions played a role in the adoption of IPM in vegetable production. Similar patterns were documented by Nyangau et al. (2022), who found that chemical pesticides remained the principal pest-control method among many surveyed farmers, even though most participants were aware of their possible adverse effects. Educational activities should therefore address both technical knowledge and the reasoning behind recommended management practices.

The relationship between knowledge and technology adoption is particularly relevant in rice-producing communities. Sun et al. (2022) showed that farmers' knowledge influenced their intention to adopt environmentally responsible production technologies, including IPM. Farmers who understand the benefits, procedures, and possible limitations of a technology are generally better prepared to evaluate whether it is appropriate for their farms. Increasing knowledge is consequently an important preliminary outcome, although it does not automatically guarantee that farmers will consistently change their practices.

Agricultural extension can help bridge the gap between technical recommendations and farmers' day-to-day decisions. Through extension activities, farmers can obtain information from qualified agricultural personnel, discuss locally experienced problems, and clarify misconceptions about pest management. Cai et al. (2022) examined farmer field schools as a mechanism for agricultural technology extension and showed their relevance to technology dissemination. In another long-term evaluation, Bajiya and Kumar (2024) assessed the contribution of IPM farmer field schools to rice and vegetable production. Together, these studies indicate that participatory extension can provide a structured environment for improving farmers' understanding of pest-management principles.

The effectiveness of extension may be strengthened when verbal explanations are supported by direct demonstrations. Mgendi et al. (2022) found that participation in agricultural training and demonstration programs increased the adoption intensity of recommended technologies among small-scale rice farmers. Demonstrations enable participants to observe procedures, connect theoretical explanations with actual field conditions, and ask questions during the learning process. Agricultural training may also promote active learning and strengthen farmers' ability to absorb new information, as explained by Yang et al. (2021). For this reason, the planned activity in Gelombang Village combined an extension session with a practical demonstration rather than relying only on a conventional lecture.

Training is also important for introducing pest-management practices that reduce dependence on conventional insecticides. Liu et al. (2022) found that participation in technology training significantly increased farmers' likelihood of adopting biopesticides. Their analysis further indicated that farmers' perceptions of economic and health benefits partly explained the relationship between training and adoption. Extension materials should therefore describe not only how a management practice is performed but also why it is beneficial and what risks may arise when it is applied incorrectly.

Based on preliminary coordination involving KKN Group 93 of Universitas Bengkulu Period 108, the Gelombang Village administration, local farmers, and the Agricultural Extension Center (*Balai Penyuluhan Pertanian* or BPP), rice planthopper management was selected as a relevant community-service topic. The BPP was appointed as the technical resource institution, while the KKN students were responsible for organizing, facilitating, documenting, and evaluating the activity. The program was designed to include an extension session, a direct demonstration of recommended planthopper-management procedures, an interactive discussion, and an immediate evaluation.

Before the activity, the participating farmers' understanding of rice planthopper identification and management had not been systematically measured. Identical pre-test and post-test questionnaires were therefore prepared to assess their self-reported knowledge before and immediately after the intervention. The instrument covered planthopper characteristics, symptoms of infestation, field monitoring, natural enemies, resistant varieties, fertilizer management, insecticide resistance, pesticide selection and dosage, personal protective equipment, spraying conditions, pesticide-container disposal, and IPM principles.

Accordingly, this community-service activity aimed to improve farmers' knowledge of rice planthopper identification, monitoring, and management through agricultural extension and direct demonstration in Gelombang Village. The activity also aimed to compare farmers' pre-test and post-test scores and describe their perceived ability, confidence, and willingness to implement the recommended management practices.

2. Methods

2.1. Activity Design and Setting

This community service activity was conducted in Gelombang Village, Bengkulu Province, Indonesia, in July 2026. The activity was organized by KKN Group 93 of Universitas Bengkulu, Period 108, in collaboration with local agricultural extension officers. The program focused on improving farmers' understanding of rice planthopper identification, monitoring, and management.

Figure 1. *KKN Group 93 of Universitas Bengkulu*

and local Agricultural Extension Center staff at the rice field

A one-group pre-test–post-test design was used to evaluate the immediate change in participants' self-reported understanding. Hassan et al. (2021) applied a comparable design to assess changes occurring immediately after an educational intervention. In the present activity, the same participants completed an identical questionnaire before and after receiving the intervention. The evaluation sequence was as follows:

Pre-test → extension session → direct demonstration → discussion → post-test

This design enabled the organizers to compare each participant's score before and immediately after the activity. However, it did not include a control group and was intended to measure short-term changes rather than long-term knowledge retention or actual adoption in the field.

2.2. Participants

The participants were farmers residing in Gelombang Village who attended the rice planthopper management activity. All farmers who met the participation criteria were invited to become respondents. Therefore, the activity employed total sampling among the farmers present at the event.

Participants were included in the analysis when they:

1. were farmers or were actively involved in rice farming;
2. voluntarily agreed to participate in the evaluation;
3. completed the pre-test before the educational session;
4. attended the extension, demonstration, and discussion sessions;
5. completed the post-test at the end of the activity; and
6. used the same respondent code in both questionnaires.

Participants who completed only one questionnaire, submitted incomplete responses, or used unmatched respondent codes were excluded from the paired analysis. The final number of respondents included in the analysis was 30 farmers.

Each participant received an anonymous code prepared by the organizing committee, such as P001, P002, and P003. The same code was entered in the pre-test and post-test to allow responses to be paired without recording the participant's name or other direct personal identifiers.

2.3. Preparation Stage

The preparation stage included coordination with the village administration and local agricultural extension officers, identification of the main issues related to rice planthopper management, preparation of educational materials, development of the questionnaire, and preparation of the equipment required for the demonstration.

The questionnaire statements were aligned with the material planned for the extension session. Before implementation, the questionnaire and educational materials were reviewed with local agricultural extension officers to ensure that the technical content was appropriate and that the wording could be understood by participating farmers.

The organizing committee also prepared respondent-code cards, attendance records, digital pre-test and post-test forms, internet access, documentation equipment, and printed questionnaires as a backup in case participants experienced difficulties accessing the online forms.

2.4. Extension and Demonstration Procedures

The intervention consisted of an agricultural extension session, a direct demonstration, an interactive discussion, and an evaluation. Before the educational material was presented, the committee distributed respondent codes and assisted participants in accessing the pre-test form. Participants were instructed to answer the questionnaire independently based on their understanding at that time.

The extension session was delivered by local agricultural extension officers. The material addressed the characteristics of rice planthoppers, early infestation symptoms, effects of infestation on rice plants, factors that may increase planthopper populations, and appropriate methods of field monitoring. The session also covered natural enemies, resistant rice varieties, balanced fertilization, insecticide resistance, pesticide selection and dosage, personal protective equipment, appropriate spraying conditions, safe pesticide storage and container disposal, and the principles of integrated pest management.

After the extension session, the participants proceeded to the rice field for a direct field-based demonstration conducted by a representative from the local Agricultural Extension Center (*Balai Penyuluhan Pertanian*, BPP). During this session, the representative demonstrated practical procedures for identifying rice planthoppers, recognizing infestation symptoms, inspecting affected rice plants, and applying appropriate management measures under actual field conditions. The demonstration allowed the farmers to directly observe the recommended practices and relate the information presented during the extension session to conditions in their own fields. The field demonstration lasted approximately 60 minutes.

Participants were subsequently invited to ask questions, discuss planthopper problems encountered in their fields, and clarify management practices with the extension officers. The post-test was administered immediately after the extension, demonstration, and discussion sessions had been completed.

2.5. Evaluation Instrument

The main evaluation instrument consisted of 20 positively worded statements that were administered in both the pre-test and post-test. The items measured farmers' self-reported understanding of:

- planthopper characteristics and infestation symptoms;
- the effects of planthopper infestation;
- factors associated with increasing planthopper populations;
- field monitoring and management decisions;
- natural enemies and resistant rice varieties;
- balanced fertilizer application;
- pesticide selection, dosage, and resistance;
- integrated pest management;
- personal protective equipment;
- appropriate weather conditions for spraying; and
- safe pesticide storage and container disposal.

Each statement used a five-point Likert-type response scale:

Response	**Score**
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4

Strongly agree	5

The wording, order, and response options of the 20 main statements were kept identical in the pre-test and post-test. Consistency between administrations was necessary so that the observed difference reflected changes in responses rather than changes in the instrument. South et al. (2022) emphasized the importance of clearly reporting item construction, response categories, and analytical treatment when Likert-type instruments are used.

The total score was calculated by summing the responses to all 20 items. Therefore, the possible score for each participant ranged from 20 to 100:

$$\text{Total understanding score} = \sum_{i=1}^{20} X_i$$

A higher score indicated a higher level of self-reported understanding of rice planthopper management. Because the statements assessed participants' perceptions of their own understanding, the outcome was interpreted as self-reported understanding, rather than objective factual knowledge.

The post-test contained three additional evaluation statements measuring:

1. participants' perceived ability to follow the demonstrated procedures;
2. confidence in applying the recommended management practices; and
3. willingness to implement appropriate and environmentally responsible planthopper management.

These three statements were analyzed separately and were not included in the main 20-item pre-test–post-test score.

2.6. Data Collection

Both questionnaires were administered using Google Forms. Participants who experienced difficulty operating a mobile device were assisted by members of the organizing committee. Assistance was limited to reading the instructions or statements without explaining the meaning of an answer or directing participants toward a particular response.

Pre-test responses were collected before any educational material was provided. Post-test responses were collected immediately after the completion of the extension, demonstration, and discussion sessions. The organizing committee checked the respondent codes to ensure that the pre-test and post-test records could be paired correctly.

After data collection, responses were exported into a spreadsheet. The data-cleaning process included checking for incomplete questionnaires, duplicate submissions, invalid response values, and unmatched respondent codes. Only complete and correctly paired responses were retained for comparative analysis.

2.7. Data Analysis

Participant responses were processed and analyzed using Python. Descriptive statistics were used to summarize the pre-test and post-test scores, including the mean, median, standard deviation, minimum, and maximum values. Frequencies and percentages were used to describe responses to the three additional post-test evaluation items. The internal consistency of the questionnaire was assessed using Cronbach's alpha. Differences between the paired pre-test and post-test scores were examined using the Wilcoxon signed-rank test or a paired-samples t test, depending on the distribution of the difference scores. Statistical significance was determined at $p < .05$, and an effect size was calculated to describe the magnitude of the observed change.

For each participant, the change score was calculated as:

$$\text{Change score} = \text{post-test score} - \text{pre-test score}$$

Positive values indicated an increase in the participant's self-reported understanding after the activity. The percentage change in the mean group score was calculated as supplementary descriptive information:

$$\text{Percentage change} = \frac{\text{mean post-test score} - \text{mean pre-test score}}{\text{mean pre-test score}} \times 100\%$$

The distribution of the paired change scores was examined before inferential testing. If the paired differences met the assumption of approximate normality, a paired-samples t test was used. When the normality assumption was not satisfied, the Wilcoxon signed-rank test was applied. Statistical significance was determined at $p < .05$.

An effect-size estimate was also reported to describe the magnitude of the observed change, because statistical significance alone does not indicate whether an improvement is practically meaningful. For the Wilcoxon signed-rank test, the effect size was calculated using the standardized *Z* statistic divided by the square root of the number of paired observations.

Internal consistency of the 20-item instrument was examined using Cronbach's alpha as supplementary information. Zakariya (2022) cautioned that a high alpha coefficient should not automatically be interpreted as evidence that an instrument is unidimensional or fully valid. Accordingly, the coefficient was interpreted only as an indication of the interrelatedness of the questionnaire items.

Responses to the three additional post-test evaluation statements were summarized using frequencies, percentages, means, and response distributions. They were not included in the inferential comparison of the pre-test and post-test scores.

2.8. Ethical Considerations

Participation in the evaluation was voluntary. Before completing the pre-test, the farmers were informed about the purpose of the activity, the use of the questionnaire data, the confidentiality of their responses, and their right to decline participation.

No participant names were collected in the questionnaire. Anonymous respondent codes were used exclusively to match pre-test and post-test responses. The collected data were used only for program evaluation and scientific publication. Farmers who did not wish to provide questionnaire data were still permitted to attend the extension and demonstration activities.

3. Results and Discussion

3.1 Data Completeness and Instrument Reliability

A total of 30 farmers completed both the pre-test and post-test questionnaires. All respondent codes were successfully matched between the two measurements. However, two respondents, P015 and P020, had incomplete responses in one or more questionnaire items. Consequently, 28 complete paired responses were included in the analysis of pre-test and post-test scores. The responses of all 30 participants were retained for the analysis of the three additional post-test evaluation items because these items were completed by all participants.

The questionnaire demonstrated high internal consistency. Cronbach's alpha was 0.900 for the pre-test and 0.909 for the post-test. These values indicate that the 20 questionnaire items consistently measured farmers' self-reported understanding of rice planthopper identification and management.

3.2 Changes in Farmers' Self-Reported Understanding

The descriptive analysis showed a substantial difference between the scores obtained before and after the educational activity. The mean pre-test score was 37.36, whereas the mean post-test score reached 89.00. Therefore, the average score increased by 51.64 points.

Measurement	Mean	Median	Standard deviation	Minimum	Maximum
Pre-test	37.36	35.50	9.70	24	72
Post-test	89.00	91.00	8.42	59	96
Score change	51.64	54.50	17.44	−13	68

Table 1. *Descriptive statistics of the pre-test and post-test scores*

The change scores were not normally distributed, as indicated by the Shapiro–Wilk test, $W = 0.619$, $p < .001$. Therefore, the Wilcoxon signed-rank test was used to compare the paired scores. The test revealed a statistically significant difference between the pre-test and post-test scores, $W = 2.00$, $p < .001$. The rank-biserial correlation was 0.990, indicating a very large positive effect.

Of the 28 participants included in the paired analysis, 27 obtained higher post-test scores, whereas one participant obtained a lower score. Overall, these findings indicate that the extension session and field demonstration were associated with a substantial short-term increase in farmers' self-reported understanding of rice planthopper management.

The improvement may be related to the combination of verbal explanations and direct observation under actual field conditions. The participants did not only receive information about rice planthopper management but also observed how the recommended procedures could be implemented in a rice field. Mgendi et al. (2022) similarly found that farmers' participation in agricultural training and demonstration programs supported the adoption of improved rice production practices. This suggests that field-based education can make technical information more concrete and relevant to farmers' daily activities.

Nevertheless, the results should not be interpreted as proof that the participants had permanently mastered or adopted the recommended practices. The questionnaire measured the farmers' perceived understanding immediately after the activity. Therefore, the observed increase represents a short-term change in self-reported understanding rather than evidence of long-term behavioral change.

3.3 Improvement across Questionnaire Items

An improvement was found in the mean score of all 20 questionnaire items. The largest increase occurred in the item concerning the selection of appropriate control measures according to the severity of rice planthopper infestation. Its mean score increased from 1.68 during the pre-test to 4.54 during the post-test.

Other substantial improvements were found in understanding integrated rice planthopper management, recognizing the effects of infestation on rice growth and yield, identifying early infestation symptoms, and safely managing pesticide containers.

Item	Indicator	Pre-test mean	Post-test mean	Increase
10	Selecting control measures according to infestation severity	1.68	4.54	2.86
14	Understanding integrated rice planthopper management procedures	1.86	4.68	2.82
3	Understanding the effects of infestation on rice growth and yield	1.68	4.50	2.82
2	Recognizing early symptoms of rice planthopper infestation	1.82	4.54	2.71
20	Safely storing and disposing of pesticide containers	1.79	4.50	2.71

Table 2. *Questionnaire items showing the largest mean increases*

The largest increase in the selection of control measures according to infestation severity indicates that the activity helped participants understand that pest management should not be conducted automatically or solely through routine pesticide spraying. Appropriate management requires observation of the pest, recognition of infestation symptoms, assessment of field conditions, and selection of control methods according to the level of risk.

The high post-test score for integrated pest management is particularly important because rice planthopper control involves more than chemical insecticides. Resistant rice varieties, field monitoring, fertilizer management, natural enemies, and appropriate pesticide use can contribute to reducing infestation risks. Resistant rice varieties are considered an important and cost-effective component of brown planthopper management because rice plants possess different genetic and biochemical defense mechanisms against the pest (Shi et al., 2023).

The increase in farmers' understanding of fertilizer management was also relevant. Zeng et al. (2024) found that increasing nitrogen application reduced aspects of the physical defense of rice plants and was accompanied by increased brown planthopper populations in field experiments. Therefore, discussing balanced fertilizer use during the activity helped connect crop management practices with rice planthopper risk rather than treating pest outbreaks as an isolated problem.

The activity also addressed the careful selection and use of insecticides. This topic remains important because inappropriate or repeated insecticide use may contribute to resistance problems. Song et al. (2023), for example, reported varying resistance levels of *Nilaparvata lugens* populations to pymetrozine depending on the assessment method. Their findings reinforce the importance of using insecticides according to recommendations rather than relying on uncontrolled or excessive applications.

3.4 Participants' Evaluation of the Field-Based Activity

The three additional post-test items were analyzed separately because they were intended to evaluate participants' responses to the learning process rather than measure changes from the pre-test.

Evaluation item	Mean	Median	Agree or strongly agree
Ability to follow the demonstrated control procedures	4.37	5.00	90.00%
Confidence in applying rice planthopper control practices	4.47	5.00	93.33%
Willingness to implement appropriate and environmentally responsible management	4.43	5.00	90.00%

Table 3. *Participants' responses to the additional evaluation items*

The highest result was found in participants' confidence in applying rice planthopper management practices, with 93.33% selecting agree or strongly agree. In addition, 90% stated that they could follow the demonstrated procedures and were willing to implement appropriate and environmentally responsible management.

These findings suggest that the direct demonstration was understandable and perceived as applicable by most participants. The opportunity to observe practical procedures in the rice field may have reduced the gap between receiving information and imagining how the information could be used in practice. Research involving smallholder farmers has also shown that access to training and knowledge can influence farmers' interest in adopting integrated pest management strategies. Chepchirchir et al. (2021), for instance, found that training was positively related to potential IPM adoption among the farmers studied.

However, confidence and willingness should not be equated with actual implementation. The additional evaluation items were administered immediately after the activity and measured participants' intentions and perceptions. Follow-up observation would be required to determine whether the farmers subsequently applied field monitoring, balanced fertilization, resistant varieties, safer pesticide practices, or other recommended measures.

3.5 Overall Interpretation and Limitations

The combination of extension and direct field demonstration produced a strong immediate educational response. The increase across all questionnaire items indicates that the learning activity addressed several connected aspects of rice planthopper management, including pest identification, infestation symptoms, field monitoring, integrated management, pesticide safety, fertilizer use, and environmental protection.

The field-based approach was particularly valuable because rice planthopper management involves decisions that depend on conditions found directly in the rice field. Farmers need to observe the crop, examine the lower parts of rice plants, recognize changes in plant condition, and select management measures based on the observed infestation. A demonstration can make these procedures easier to understand than an extension session based only on verbal explanations.

Several limitations should nevertheless be considered. First, the activity used a one-group pre-test–post-test design without a comparison group. Therefore, the observed score increase cannot be attributed exclusively to the intervention with the same certainty as a controlled experimental design. Second, the post-test was administered immediately after the activity, meaning that the results only reflected short-term changes. Third, the statements measured self-reported understanding rather than knowledge through objectively scored questions or direct observation of participants' skills. Fourth, the activity involved farmers from one village, so the findings should not be generalized to all rice farmers. Finally, two incomplete paired questionnaires reduced the main analytical sample from 30 to 28 participants.

Despite these limitations, the consistency of the score improvement, the very large effect size, and the positive participant evaluations indicate that extension combined with direct field demonstration is a promising approach for communicating rice planthopper management practices to farmers.

4. Discussion

The findings indicate that the extension and field demonstration produced a substantial immediate improvement in farmers' self-reported understanding of rice planthopper management. The mean score increased from 37.36 in the pre-test to 89.00 in the post-test, and 27 of the 28 participants showed higher scores after the activity. The very large effect size suggests that the observed difference was not only statistically significant but also meaningful in the context of farmer education. This improvement was likely supported by the combination of verbal explanation and direct observation in the rice field. Bajiya and Kumar (2024) similarly reported that participatory and field-based extension activities can strengthen farmers' knowledge and pest-management practices.

Improvements occurred across all questionnaire items, particularly in selecting control measures according to infestation severity, understanding integrated management, recognizing early symptoms, and managing pesticides safely. These findings suggest that the activity encouraged farmers to view rice planthopper control as a decision-making process rather than as routine pesticide application. Muduli et al. (2021) emphasized that rice planthopper management involves various preventive and control components, including resistant varieties, field monitoring, cultivation practices, and appropriate pesticide use. Therefore, farmers need to assess field conditions before deciding which management measure should be applied.

The positive responses to the additional evaluation items also support the practical value of the activity. Most participants reported that they could follow the demonstrated procedures, felt confident applying the recommended practices, and were willing to adopt environmentally responsible management. Agricultural training can strengthen farmers' perceptions and willingness to adopt improved pest-management practices, although actual implementation may also depend on access to inputs, economic considerations, and continued technical support (Liu et al., 2022). Consequently, follow-up assistance from the local Agricultural Extension Center remains important to help farmers apply the knowledge under actual farming conditions.

Despite the strong results, the findings should be interpreted carefully. The activity used a one-group pre-test–post-test design without a control group, and the post-test was administered immediately after the intervention. In addition, the questionnaire measured self-reported understanding rather than objectively tested knowledge or directly observed skills. Confidence and willingness also do not necessarily indicate that the participants will consistently apply the practices in their fields. Nevertheless, the consistent score improvement and positive participant evaluations show that combining extension with direct field demonstration is a promising approach for communicating rice planthopper management practices to farmers.

5. Conclusion

The extension and field demonstration contributed to a substantial immediate improvement in farmers' self-reported understanding of rice planthopper management. The mean score increased from 37.36 in the pre-test to 89.00 in the post-test, with 27 of the 28 participants showing higher scores after the activity. Most participants also reported confidence in applying the demonstrated practices and willingness to implement appropriate and environmentally responsible management.

These findings indicate that combining extension with direct field demonstration can make pest-management information easier for farmers to understand and relate to actual field conditions. However, the results represent short-term self-reported outcomes and do not yet confirm long-term knowledge retention or actual adoption. Follow-up assistance and field observation are therefore recommended to evaluate whether farmers consistently apply the recommended rice planthopper management practices.

References

Bajiya, M. R., & Kumar, R. (2024). Impact of integrated pest management farmer field school programs in the subtropics of Jammu and Kashmir, India. *International Journal of Pest Management, 70*(4), 1315–1330. https://doi.org/10.1080/09670874.2022.2111617

Cai, J., Hu, R., & Hong, Y. (2022). Impact of farmer field schools on agricultural technology extension—Evidence from greenhouse vegetable farms in China.

Applied Economics, 54(24), 2727–2736. https://doi.org/10.1080/00036846.2021.1996530

Chepchirchir, F., Muriithi, B. W., Langat, J., Mohamed, S. A., Ndlela, S., & Khamis, F. M. (2021). Knowledge, attitude, and practices on tomato leaf miner, *Tuta absoluta*, on tomato and potential demand for integrated pest management among smallholder farmers in Kenya and Uganda. *Agriculture, 11*(12), 1242. https://doi.org/10.3390/agriculture11121242

Hassan, S., Venkateswaran, S. P., & Nadarajah, V. D. (2021). Evaluation of immediate impact of faculty development programme using a pretest–post-test study design format. *Innovation and Education, 3*, Article 1. https://doi.org/10.1186/s42862-021-00009-9

Kvakkestad, V., Steiro, Å. L., & Vatn, A. (2021). Pesticide policies and farm behavior: The introduction of regulations for integrated pest management. *Agriculture, 11*(9), 828. https://doi.org/10.3390/agriculture11090828

Liu, Y., Shi, R., Peng, Y., Wang, W., & Fu, X. (2022). Impacts of technology training provided by agricultural cooperatives on farmers' adoption of biopesticides in China. *Agriculture, 12*(3), 316. https://doi.org/10.3390/agriculture12030316

Mgendi, G., Mao, S., & Qiao, F. (2022). Does agricultural training and demonstration matter in technology adoption? The empirical evidence from small rice farmers in Tanzania. *Technology in Society, 70*, 102024. https://doi.org/10.1016/j.techsoc.2022.102024

Muduli, L., Pradhan, S. K., Mishra, A., Bastia, D. N., Samal, K. C., Agrawal, P. K., & Dash, M. (2021). Understanding brown planthopper resistance in rice: Genetics, biochemical and molecular breeding approaches. *Rice Science, 28*(6), 532–546. https://doi.org/10.1016/j.rsci.2021.05.013

Nyangau, P., Muriithi, B. W., Diiro, G., Akutse, K. S., & Subramanian, S. (2022). Farmers' knowledge and management practices of cereal, legume and vegetable insect pests, and willingness to pay for biopesticides. *International Journal of Pest Management, 68*(3), 204–216. https://doi.org/10.1080/09670874.2020.1817621

Rahman, M. S. (2022). Farmers' perceptions of integrated pest management and determinants of adoption in vegetable production in Bangladesh. *International*

Journal of Pest Management, 68(2), 158–166. https://doi.org/10.1080/09670874.2020.1807653

Shi, S., Wang, H., Zha, W., Wu, Y., Liu, K., Xu, D., He, G., Zhou, L., & You, A. (2023). Recent advances in the genetic and biochemical mechanisms of rice resistance to brown planthoppers (*Nilaparvata lugens* Stål). *International Journal of Molecular Sciences, 24*(23), 16959. https://doi.org/10.3390/ijms242316959

Song, X.-Y., Peng, Y.-X., Gao, Y., Zhang, Y.-C., Ye, W.-N., Lin, P.-X., Gao, C.-F., & Wu, S.-F. (2023). Resistance monitoring of *Nilaparvata lugens* to pymetrozine based on reproductive behavior. *Insects, 14*(5), 428. https://doi.org/10.3390/insects14050428

South, L., Saffo, D., Vitek, O., Dunne, C., & Borkin, M. A. (2022). Effective use of Likert scales in visualization evaluations: A systematic review. *Computer Graphics Forum, 41*(3), 43–55. https://doi.org/10.1111/cgf.14521

Sun, X., Lyu, J., & Ge, C. (2022). Knowledge and farmers' adoption of green production technologies: An empirical study on IPM adoption intention in major Indica-rice-producing areas in the Anhui Province of China. *International Journal of Environmental Research and Public Health, 19*(21), 14292. https://doi.org/10.3390/ijerph192114292

Yang, Q., Zhu, Y., & Wang, F. (2021). Exploring mediating factors between agricultural training and farmers' adoption of drip fertigation system: Evidence from banana farmers in China. *Water, 13*(10), 1364. https://doi.org/10.3390/w13101364

Zakariya, Y. F. (2022). Cronbach's alpha in mathematics education research: Its appropriateness, overuse, and alternatives in estimating scale reliability. *Frontiers in Psychology, 13*, 1074430. https://doi.org/10.3389/fpsyg.2022.1074430

Zeng, Z.-X., Shi, J.-H., Qiu, C.-L., Fan, T., Lu, J., Abdelnabby, H., & Wang, M.-Q. (2024). Nitrogen input reduces the physical defense of rice plant against planthopper, *Nilaparvata lugens* (Hemiptera: Delphacidae). *Journal of Economic Entomology, 117*(6), 2440–2449. https://doi.org/10.1093/jee/toae240