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Article

A Descriptive Comparison of Farmer Field School (SLPTT) Implementation Quality and Farmers' Knowledge Gains

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ABSTRACT

Agricultural extension is a key tool for supporting farmer capacity building, and the quality of its implementation directly determines the actual effectiveness of extension work. This study focuses on the Integrated Crop Management Farmer Field School (SLPTT) program in Sumenep Regency, Indonesia, to assess the quality of program implementation relative to farmer knowledge improvement. The study employed a descriptive quantitative method, selecting 120 rice farmers from four sub-districts in the regency as survey respondents. A multidimensional index encompassing program socialization, farmer meetings, training consistency, and the role of extension workers was used to evaluate implementation quality, while the magnitude of knowledge improvement was measured by pre- and post-test scores. Results indicated that the quality of program implementation was very high across all study sites, with implementation index scores ranging from 4.38 to 4.69. Farmers in all sub-districts achieved knowledge improvements, with growth rates ranging from 30.58% in Manding District to 112.30% in Kota District, Sumenep. However, high implementation quality does not always result in proportional and synchronous improvements in farmer knowledge. Based on these findings, this study proposes strengthening participatory learning methods, clearly defining the role of agricultural extension officers, and optimizing project effectiveness to adapt to diverse local contexts.

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INTRODUCTION

Rice is the backbone of Indonesia's food system and rural economy. In 2021, rice contributed 38% of the country's total calorie intake. A 2026 study by Nalley et al. (2026), showed that high yielding rice varieties can increase rice yields and advance food security, but providing high yielding seeds and cultivation techniques alone is far from sufficient. A 2026 study focused on smallholder farmers in Indonesia by Dewi et al. (2026), emphasized that three types of additional supporting resources practical knowledge, tailored guidance, and ongoing support are needed to close the production gap.

In contrast to the traditional understanding that considers agricultural extension solely as a one-way channel for technology transmission, this paper argues for reconstructing its core connotation: agricultural extension is a two-way learning process that connects scientific research knowledge with farmers' experiences and decision-making. Studies in Indonesia by Amrullah et al. (2023), and Dewi et al. (2025), confirmed the positive influence of extension services in driving technology adoption, while a regional study spanning Southeast Asia by Chang et al. (2024), identified four dimensions influencing the adoption of sustainable rice cultivation technologies: farmer characteristics, agricultural resources, institutional conditions, and local context.

The series of considerations outlined above fully align with the agricultural development context in Sumenep Regency. Differences among local farmers in planting conditions, access to agricultural technology extension services, and levels of group participation collectively shape their level of engagement in the SLPTT program. Therefore, field investigations into the program implementation process are essential to evaluate whether the planned activities have generated practical learning outcomes and are appropriate to local conditions.

Previous studies have shown that the effectiveness of agricultural extension is not independent, but is influenced by various interrelated factors, including farmers' characteristics, farming experience, access to resources, and the intensity of interactions with extension agents (Bakari et al., 2022; Jamil et al., 2023; Noviyanti & Salampessy, 2023; Salam et al., 2024). Farmers may engage with the same SLPTT activities differently because education, farming experience, access to resources and extension services, training participation, and prior knowledge are associated with their adoption decisions (Chang et al., 2024). Regular interaction with extension agents also provides opportunities to discuss field problems and receive relevant feedback. Farmers' knowledge should therefore be viewed as an immediate learning outcome, distinct from later changes in farming practices, productivity, or income. Thus, even when SLPTT activities are implemented as planned, knowledge gains may vary across locations because of differences in facilitation, participant interaction, and baseline knowledge (van den Berg et al., 2023).

To address these limitations, participatory extension approaches through Farmer Field Schools (FFS) have been developed. This approach positions farmers as the main actors in the learning process, in which they not only receive information but also learn through direct experience, field observation, group discussion, and reflection on the problems encountered in crop cultivation. In the Indonesian context, this approach has been implemented through the Integrated Crop Management Farmer Field School Program, known as SLPTT, which is designed to make the learning process more contextual and better aligned with farmers' local conditions (Mariyono et al., 2021; van den Berg et al., 2021).

Various studies indicate that Farmer Field Schools can improve farmers' knowledge, attitudes, and cultivation practices, and in some cases also contribute to increased productivity and farm efficiency (Banayo & Kato, 2020; Becerra-Encinales et al., 2024; Charina et al., 2026; Mariyono et al., 2021; Prihono & Murdani, 2020; Red et al., 2021). Previous evaluations of Farmer Field Schools indicate that the results can differ from one location to another. In certain areas, these activities have helped farmers improve their knowledge and farming practices quite noticeably, while in other places the impact has been less pronounced. This paper infers from this heterogeneity that the core factors for the program's success are not merely the implementation of relevant activities, but more critically, high quality on the ground execution and supporting field-based assistance.

The success of participatory extension programs depends on how well organizations implement their programs because organizations must guarantee active program activities, extension staff members must deliver high-quality facilitation, farmers must engage in the program, and organizations must provide relevant materials that match local requirements (Becerra-Encinales et al., 2024; Norton & Alwang, 2020; Salam et al., 2024; van den Berg et al., 2021; Wijeratne & De Silva, 2024). The institutional environment, extension

system support, and farmers' economic status all influence how effectively programs work in practice (Dewi et al., 2025; Knook et al., 2020; Takahashi et al., 2020; Yanfika et al., 2024). The assessment of program success needs to track both final results and implementation activities throughout their ongoing development.

Recent studies on agricultural extension and sustainable rice farming have commonly evaluated downstream outcomes, particularly technology adoption, technical efficiency or productivity, and farm income (Amrullah et al., 2023; Chang et al., 2024; Dewi et al., 2026). While existing relevant studies in the field of agricultural extension are valuable, they fail to describe the actual program implementation pathways and explain cross-regional differences in knowledge improvement among farmers. To address this gap, this study develops a four-dimensional implementation index and conducts a descriptive comparative analysis of knowledge change among farmers participating in SLPTT program in Sumenep Regency, Indonesia.

The core innovation of this study lies in clearly distinguishing two core dimensions of the SLPTT program targeting rice: the quality of program implementation and farmer knowledge improvement. The study establishes three progressive research objectives: to describe the quality of program implementation, to measure changes in farmer knowledge, and to compare the levels of these two dimensions across locations.

RESEARCH METHODS

This study adopted a quantitative descriptive design. The population consisted of all rice farmers participating in the SLPTT program in eleven implementing sub-districts in Sumenep Regency: Ganding, Gapura, Sumenep City, Batuan, Manding, Kalianget, Kangayan, Sapeken, Arjasa, Ambunten, and Dungkek. According to official data from the regional agricultural office, a total of 330 farmers registered as participants, with 30 farmers in each sub-district. The sampling frame was drawn from this participant list, which was re-verified by participating farmers and local agricultural extension officers.

This study employed purposive sampling, of the 11 SLPTT program locations, we selected four locations Manding, Sumenep City, Ganding, and Ambunten based on the following criteria: having written records of program implementation, having active farmer groups, and having different agro-ecological and administrative conditions. This sampling approach only captures variation in the program's background context and is not statistically representative. This study cites research by Campbell et al. (2020), and Memon et al. (2025), to confirm that the adopted method meets the methodological requirements.

This study adopted the full census method for sampling, applied this method to 4 selected subregions, and included all eligible SLPTT participants. Ultimately, 30 samples were collected from each subregion, resulting in a total sample size of 120 respondents. The equal number of respondents across sites supported a more balanced descriptive comparison and helped minimize sampling error within the selected subdistricts (Berndt, 2020; Memon et al., 2020). The same set of eligibility criteria was uniformly applied to all 4 subregions to reduce selection bias.

To transform the abstract quality of program implementation into measurable and collectible indicators, this study developed a 1–5 rating scale based on the principles of participatory agricultural extension. This scale measures the level of program implementation across four core dimensions: program socialization, farmer consultation meetings, consistency of field school implementation, and the role of extension officers. Content validity was assessed through expert judgement by three experts representing agricultural extension, SLPTT implementation, and research methodology. All experts agreed that each item was relevant to the dimension being measured, resulting in an item-level content validity index (I-CVI) of 1.00 for all retained items and a scale-level content validity index based on average agreement (S-CVI/Ave) of 1.00. This procedure follows content validation practice in which expert agreement is used to assess item relevance and representativeness (Yusoff, 2019). Measurement consistency was supported through standardized scoring rubrics and enumerator training to ensure consistent interpretation of the 1–5 scale during field data collection.

At the initial stage of the program, the assessed aspects included socialization activities and farmer deliberation meetings (*rembuk tani*). The indicators used included the implementation of activities, the level of farmer attendance, the intensity of discussion, and farmers' involvement in decision-making. These indicators represent the level of farmer participation in the early learning process, which is an important component of the Farmer Field School approach. The assessment was conducted based on the rubric presented in Table 1.

Table 1
Assessment Rubric for Farmer Participation-Based Implementation

Score	Implementation of Activities	Attendance of Participants/Farmers	Discussion Activity	Farmer Involvement in Decision-Making
1	Not implemented	None	None	Not involved
2	Poor	< 40%	Very limited	Passive
3	Moderate	40–60%	Limited	Partially involved
4	Good	60–80%	Active	Majority involved
5	Very good	> 80%	Very active	Participatory

Source: Primary Data Analysis, 2026

Table 2
Assessment Rubric for the Consistency of Farmer Training Session Implementation

Score	Category	Meetings Conducted	Participant Attendance
1	Inconsistent	≤ 3 meetings	< 40%
2	Less consistent	4–5 meetings	40–50%
3	Moderately consistent	6–7 meetings	51–60%
4	Consistent	8–9 meetings	61–80%
5	Highly consistent	All 10 meetings completed	> 80%

Source: Primary Data Analysis, 2026

Table 3
Assessment Rubric for the Role of Extension Agents in SLPTT Implementation

Score	Category	Intensity of Assistance	Discussion Facilitation	Technical Consultation	Monitoring and Evaluation
1	Very low	Extension agent was absent	No discussion	No guidance	Not conducted
2	Low	Present in very limited meetings (<40% of meetings)	One-way discussion	Minimal guidance	Rarely monitored
3	Moderate	Present in 40–60% of activities	Limited discussion	Occasional consultation	Evaluation was not routine
4	Good	Present in 61–80% of activities	Active discussion	Regular consultation	Monitoring was conducted
5	Very good	Present in >80% of activities	Participatory discussion	Intensive assistance	Continuous evaluation

Source: Primary Data Analysis, 2026

Furthermore, at the program implementation stage, the assessment focused on the consistency of farmer training sessions and the level of farmer attendance. The consistency of activities reflects the continuity of the learning process, which is a key characteristic of the Farmer Field School approach. This measurement was based on the number of meetings conducted compared with the planned activities, as well as the level of farmer participation in each meeting. This approach is consistent with the principle of continuous learning in agricultural extension (Takahashi et al., 2020; van den Berg et al., 2021). The assessment rubric is presented in Table 2.

The role of extension agents in program implementation was assessed based on four main indicators: the intensity of assistance, the ability to facilitate discussions, the provision of technical consultation, and monitoring and evaluation activities. These indicators refer to the functions of extension agents as facilitators, mediators, and technical advisors in farmers' learning processes (Jamil et al., 2023; Salam et al., 2024). The assessment of this dimension was conducted using the rubric presented in Table 3.

Learning effectiveness was measured based on changes in farmers' knowledge levels obtained from the pre-test and post-test results. This approach is commonly used in the evaluation of agricultural extension programs to measure improvements in participants' cognitive capacity (Mariyono et al., 2021; Red et al., 2021). Knowledge improvement was calculated using two measures: absolute gain and percentage increase. Absolute gain was used to show the direct difference between post-test and pre-test scores, while percentage increase was used to show the relative improvement compared with the initial pre-test score. The calculations were conducted using the following formulas:

$$AG = Posttest - Pretest \quad (1)$$

$$Percentage\ Increase = \left(\frac{AG}{Pretest}\right) X\ 100 \quad (2)$$

Where AG represents the absolute gain in farmers' knowledge score, Posttest is the knowledge score after participation in the SLPTT program, and Pretest is the knowledge score before participation in the SLPTT program. The percentage increase was then classified into specific categories based on the rubric presented in Table 4.

To obtain a more comprehensive overview of program implementation, this study developed a program implementation index by aggregating four process-based dimensions: program socialization, farmer deliberation meetings, consistency of farmer training session implementation, and the role of extension agents. The index approach was used to simplify multidimensional measurement in the evaluation of agricultural extension programs (Becerra-Encinales et al., 2024). The index value was calculated by averaging the scores of all dimensions in each subdistrict and was then categorized based on the score ranges presented in Table 5.

Data were analyzed using a descriptive quantitative approach to describe the implementation quality of each program dimension and changes in farmers' knowledge after participation in the SLPTT program. Comparative descriptive analysis was then used to compare implementation scores and knowledge improvement across subdistricts. Because the data were aggregated at the subdistrict level and the study did not employ inferential statistical testing, the comparison between program implementation quality and farmers' knowledge improvement was interpreted as a descriptive pattern rather than evidence of a statistical relationship or causal effect.

Table 4
Assessment Rubric for Changes in Farmers' Knowledge

Percentage Increase	Change Category	Interpretation
≤ 10%	Very low	Learning was ineffective
11–25%	Low	Limited improvement
26–40%	Moderate	Learning was moderately effective
41–60%	High	Learning was effective
> 60%	Very high	Learning was highly effective

Source: Primary Data Analysis, 2026

Table 5
Assessment Rubric for Implementation Scores Based on Program Dimensions

Mean Score Range	Dimension Score	Implementation Category	Interpretation
1.00–1.80	1	Very low	The dimension was not implemented
1.81–2.60	2	Low	Implementation was weak
2.61–3.40	3	Moderate	Implementation was adequate
3.41–4.20	4	High	Implementation was good
4.21–5.00	5	Very high	Implementation was optimal

Source: Primary Data Analysis, 2026

Table 6
Characteristics of Respondents by Subdistrict

Characteristic	Manding	Kota Sumenep	Ganding	Ambunten	Description
Number of respondents	30	30	30	30	Equal distribution
Average age (years)	43	52	46	45	Productive to adult age
Dominant education level (years)	12	12	12	12	Relatively homogeneous
Farming experience (years)	13	14	14	16	Relatively long farming experience
Landholding size (ha)	0.80	0.80	0.86	0.73	Small- to medium-scale farming

Source: Primary Data Analysis, 2026

Table 7
Implementation of Program Socialization and Farmer Deliberation Meetings

Program Stage	Indicator	Manding	Kota Sumenep	Ganding	Ambunten	Mean / Category
Socialization	Implementation of activities	5.00	4.00	5.00	5.00	4.75 (Very high)
Socialization	Farmer attendance	5.00	5.00	4.00	4.00	4.50 (Very high)
Farmer deliberation meetings	Discussion participation	4.00	3.00	3.00	3.00	3.25 (Moderate)
Farmer deliberation meetings	Activity agreement	5.00	5.00	5.00	5.00	5.00 (Very high)

Source: Primary Data Analysis, 2026

RESULTS AND DISCUSSION

Characteristics of Farmer Respondents

The characteristics of the respondents indicate that the composition of farmers across the four subdistricts was relatively comparable. As presented in Table 6, the characteristics of the respondents indicate that the composition of farmers across the four subdistricts was relatively comparable. The average age of farmers ranged from 43 to 52 years, the dominant level of formal education was 12 years, farming experience ranged from 13 to 16 years, and landholding size ranged from 0.73 to 0.86 ha.

The relative similarity in these basic characteristics is important because farmers' ability to receive, process, and apply extension materials is influenced by age, farming experience, education, and farming resources. Studies on rice farmers have also shown that these factors are associated with the effectiveness of extension services and farmers' responses to cultivation innovations (Bakari et al., 2022; Jamil et al., 2023; Noviyanti & Salampessy, 2023; Salam et al., 2024).

Implementation of the Initial Program Stages

As presented in Table 7, the initial program stages, which included program socialization and farmer deliberation meetings, showed generally positive results. The implementation of socialization activities obtained a mean score of 4.75, which was classified as very high, while farmer attendance during the socialization stage was also very high, with a mean score of 4.50. In the farmer deliberation stage, the activity agreement indicator achieved a perfect score of 5.00. However, discussion participation reached only a mean score of 3.25 and remained in the moderate category.

These findings indicate that farmer mobilization and attendance were strong at the initial stage of program implementation. However, the depth of participation, particularly in discussion activities, remained lower than attendance and activity agreement. Participation is important in building a common understanding, identifying the barriers and problems in the field, and collaborating in decision making (Knook et al., 2018; Norton & Alwang, 2020; Wijeratne & De Silva, 2024). Improving the quality of the farmer discussion is essential at this stage of program implementation.

Table 8
Consistency of the Implementation of Rice SLPTT Farmer Training Sessions

Subdistrict	Planned Meetings	Score Meetings Conducted	Score Participant Attendance	Consistency Score	Category
Manding	10	5	4	4.50	Highly consistent
Kota Sumenep	10	5	4	4.50	Highly consistent
Ganding	10	5	4	4.50	Highly consistent
Ambunten	10	5	4	4.50	Highly consistent

Source: Primary Data Analysis, 2026

Table 9
Role of Extension Agents in the Implementation of the Rice SLPTT Program

Indicator	Manding	Kota Sumenep	Ganding	Ambunten	Mean	Category
Intensity of visits	5.00	5.00	5.00	5.00	5.00	Very good
Discussion facilitation	4.00	4.00	4.00	4.00	4.00	Good
Technical consultation	5.00	5.00	5.00	5.00	5.00	Very good
Activity monitoring	5.00	4.00	4.00	4.00	4.25	Good

Source: Primary Data Analysis, 2026

Consistency of Farmer Field School Implementation

As shown in Table 8, farmer training sessions were implemented consistently across all study areas. Farmer training sessions were implemented consistently across all study areas. Each subdistrict completed the planned 10 meetings, and the consistency score for this dimension reached 4.50, placing it in the highly consistent category. This score was obtained by averaging two component scores: the score for the number of meetings conducted and the score for participant attendance. The calculation was based on the following formula:

$$CS = (SMC + SPA) / 2 \quad (3)$$

Where CS represents the consistency score of farmer training session implementation, SMC refers to the score assigned to the number of meetings conducted, SPA refers to the score assigned to participant attendance, and 2 represents the total number of indicators included in the consistency dimension. These findings indicate that Farmer Field School activities were implemented in a relatively stable and continuous manner across the selected subdistricts.

Implementation consistency is an important prerequisite for the success of Farmer Field Schools because learning in this model is gradual, repetitive, and directly linked to the dynamics of the growing season. Nevertheless, various evaluations emphasize that activity consistency should be accompanied by adequate facilitation and learning quality, so that program benefits do not remain limited to administrative implementation (Knook et al., 2020; Takahashi et al., 2020; van den Berg et al., 2021).

Role of Extension Agents in Program Implementation

As presented in Table 9, the role of extension agents was one of the most prominent dimensions in the implementation of the rice SLPTT program. The average score for visits and technical consultations was remarkably high and rated at 5.00. Since visits and consultations are noted as "very good," while discussion facilitation and activity monitoring are rated as "good," extension agents served as technical companions as well as providers of information in the context of the field-based learning process.

These findings are consistent with recent studies showing that the effectiveness of agricultural extension in rice farming is associated with extension agents' competence, frequency of interaction with farmers, and the practical relevance of extension materials (Ahmad et al., 2025; Jamil et al., 2023; Muksin & Ansyah, 2025; Salam et al., 2024). The performance of agricultural extension services is also influenced by institutional factors, especially the level of management support and the working conditions experienced by extension agents in carrying out their responsibilities (Dewi et al., 2025).

Table 10
Changes in Farmers' Knowledge Based on Pre-Test and Post-Test Results

Subdistrict	Pre-Test	Post-Test	Absolute Gain	Increase (%)	Category
Manding	64.33	84.00	19.67	30.58	Moderate
Kota Sumenep	41.54	88.19	46.65	112.30	Very high
Ganding	65.90	93.00	27.10	41.12	High
Ambunten	43.67	81.66	37.99	87.00	Very high

Source: Primary Data Analysis, 2026

Table 11
Implementation Scores by Dimension

Dimension	Manding	Kota Sumenep	Ganding	Ambunten	Mean
Program socialization	5.00	4.50	4.50	4.50	4.63
Farmer deliberation meetings	4.50	4.00	4.00	4.00	4.13
Consistency of farmer training sessions	4.50	4.50	4.50	4.50	4.50
Role of extension agents	4.75	4.50	4.50	4.50	4.56

Source: Primary Data Analysis, 2026

Learning Effectiveness of the Rice SLPTT Program

As shown in Table 10, farmers' knowledge scores increased in all selected subdistricts after participation in the rice SLPTT program. The highest absolute gain was recorded in Kota Sumenep, with an increase of 46.65 points, followed by Ambunten with 37.99 points, Ganding with 27.10 points, and Manding with 19.67 points. In terms of percentage increase, Kota Sumenep recorded the highest improvement at 112.30%, followed by Ambunten at 87.00%, Ganding at 41.12%, and Manding at 30.58%. These results indicate that knowledge improvement varied across locations, even though all study sites showed positive learning gains.

Based on the classification rubric, knowledge improvement in Manding was placed in the moderate category, Ganding in the high category, and Kota Sumenep and Ambunten in the very high category. This pattern suggests that the SLPTT program produced positive cognitive learning outcomes, although the level of improvement differed across subdistricts. The higher percentage gains in Kota Sumenep and Ambunten should also be understood in relation to their lower pre-test scores, because lower initial scores can make relative improvement appear larger. This finding is in line with studies on rice farmers showing that Farmer Field Schools and participatory learning can improve farmers' knowledge, attitudes, practices, and even farm profitability when learning materials are applied through appropriate cultivation practices (Banayo & Kato, 2020; Emmanuel et al., 2016; Prihono & Murdani, 2020; Red et al., 2021).

Implementation Dimension Scores

As presented in Table 11, the recapitulation of implementation dimension scores shows that all implementation dimensions were classified as high to very high. The highest mean score was found in program socialization (4.63), followed by the role of extension agents (4.56) and the consistency of farmer training sessions (4.50). The lowest mean score was found in farmer deliberation meetings (4.13), mainly because farmer discussion activities were not evenly distributed across all study areas. These results indicate that the SLPTT program was generally implemented strongly in terms of socialization, training continuity, and extension support, although the quality of participatory discussion still needs to be strengthened.

These results indicate that the SLPTT program was strongly implemented in terms of program socialization, training continuity, extension-agent support, and farmer participation in deliberation meetings. Nevertheless, variations in the scores for the farmer deliberation meetings dimension suggest that strengthening the quality of participatory discussion remains a key area for improvement in the implementation of the rice SLPTT program.

Program Implementation Index and Improvement of Farmers' Capacity

As presented in Table 12, the implementation index of the rice SLPTT program across all subdistricts was classified as very high**.** Manding obtained a score of 4.69, Kota Sumenep 4.38, Ganding 4.38, and Ambunten 4.38. These values indicate that, in general, the program was implemented with very good quality across all study areas.

Table 12
Rice SLPTT Implementation Index across Subdistricts

Subdistrict	Implementation Index	Category
Manding	4.69	Very high
Kota Sumenep	4.38	Very high
Ganding	4.38	Very high
Ambunten	4.38	Very high

Source: Primary Data Analysis, 2026

Table 13
Descriptive Comparison between Program Implementation Index and Knowledge Improvement

Subdistrict	Implementation Index	Increase in Knowledge (%)	Interpretation
Manding	4.69	30.58	Implementation was very high; the increase in knowledge was in the moderate category.
Kota Sumenep	4.38	112.30	Implementation was very high; the increase in knowledge was in the very high category.
Ganding	4.38	41.12	Implementation was very high; the increase in knowledge was in the high category.
Ambunten	4.38	87.00	Implementation was very high; the increase in knowledge was in the very high category.

Source: Primary Data Analysis, 2026

As shown in Table 13, all selected subdistricts reached very high scores in terms of program implementation. However, the level of knowledge improvement varied across locations. Manding, for example, had the highest implementation score (4.69), but the increase in farmers' knowledge was only moderate (30.58%). In contrast, Kota Sumenep and Ambunten recorded very high knowledge improvements of 112.30% and 87.00%, respectively, despite having the same implementation index (4.38) as Ganding. This descriptive pattern suggests that high-quality implementation does not automatically correspond to equally high knowledge gains across locations.

These results are conceptually consistent with studies emphasizing that the impact of agricultural extension is influenced by the institutional context, recipient characteristics, and how knowledge is transformed into practice (Becerra-Encinales et al., 2024; Norton & Alwang, 2020; Takahashi et al., 2020). Recent evidence from Indonesia also suggests that increases in rice productivity and technical efficiency are associated with institutional support, access to extension services, and appropriate agricultural interventions (Charina et al., 2026; Dewi et al., 2026; Yanfika et al., 2024).

This study still has several limitations: First, the analysis only draws on aggregated data from four sub-districts, so the findings generated can only serve as descriptive patterns, and cannot be used as evidence of statistical associations or causal effects. Second, study sites were selected through purposive sampling to capture differences in implementation contexts, meaning the results cannot be statistically generalized to all SLPTT sites in Sumenep Regency or sites in other regions. This study only measures farmers' knowledge improvement using pre-test and post-test scores, and does not examine changes in dimensions such as farming practices. Future research can use individual-level data, apply inferential statistics, and incorporate multiple types of indicators to comprehensively evaluate the effects of the SLPTT program.

CONCLUSION

In general, the implementation of the Integrated Rice Crop Management Farmer Field School Program (SLPTT) in Sumenep Regency has a very high level of program implementation in all selected sub-districts. Program socialization, consistent training, and the role of extension workers demonstrated strong performance, while farmer discussion meetings remained the lowest-scoring dimension. The program has clear strengths in its field implementation, but the quality of farmer participation in discussions still needs to be strengthened. After participating in the SLPTT program, farmers' knowledge increased, although the

magnitude varied across locations. Descriptive comparisons showed that high implementation index scores were not always accompanied by proportional increases in knowledge. This suggests that knowledge gains are shaped not only by program implementation but also by farmers' prior knowledge, the quality of learning interactions, the appropriateness of training materials, and the local context in which extension activities were delivered. This study separates two core dimensions: project implementation quality and farmer knowledge improvement, complementing the existing literature on agricultural extension program evaluation. It clearly defines the attributes of these two key variables. The multidimensional implementation index proposed in this study breaks the limitations of previous extension project evaluations, which only assessed programs based on end-results such as productivity and income. When launching the SLPTT project in the future, in addition to completing the established activities, relevant stakeholders should focus on the quality of implementation, guiding farmers to participate in meetings and discussions, providing supporting local learning resources, strengthening the role of farmer field schools, and continuously improving farmers' capacity.

AI DISCLOSURE STATEMENT

During the preparation of this manuscript, the authors used Grammarly to assist with grammar checking, language editing, translation, and improving academic English writing. All outputs generated by these tools were carefully reviewed, verified, and revised by the authors to ensure the accuracy, clarity, and appropriateness of the content. The authors take full responsibility for the integrity, originality, and final content of this manuscript.

DATA AVAILABILITY

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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