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Effectiveness of Participatory Extension on Farmers' Knowledge, Attitude, and Skills in Using *Beauveria bassiana* for Rice Bug Control

Eny Wahyuning Purwanti*), Himmata Suryanit, Suryaman Sule

Sustainable Agricultural Extension Study Program, Department of Agriculture, Agricultural Development Polytechnic of Malang, Jl. Dr. Cipto No. 144 A, Lawang, Malang, East Java, 65200 Indonesia
*)*E-mail correspondence:* enywah17@gmail.com

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ABSTRACT

This study aimed to determine the effectiveness of a participatory extension approach in promoting the utilization of the entomopathogenic fungus Beauveria bassiana as a biological control agent for rice bug infestation in rice fields. A quasi-experimental design with pretest-posttest measurement was employed, utilizing participatory action research methodology. The participatory extension process involved the identification of local potential, collaborative planning with farmers, and farmer-inclusive evaluation, utilizing the POAC (Planning, Organizing, Actuating, Controlling) management cycle. The intervention targeted members of the Rukun Tani Farmer Group, with extension materials sourced from literature review and applied research. The "Demonstration Plot" method was employed, using folders and real objects as media. Data were collected through knowledge tests (pre-post), attitude questionnaires, and skill observation checklists. Extension effectiveness was evaluated by measuring farmers' increase in knowledge, attitude level, and skills regarding the application of B. bassiana. Evaluation results demonstrated a significant difference in the level of knowledge before and after the extension. Attitude evaluation yielded an average score of 88.45%, falling into the positive category, which indicated a high level of interest from the target group in the material presented. Furthermore, the skill evaluation, assessed using an observation checklist, concluded that farmers' skills in applying B. bassiana were in the high category. These findings suggest that the participatory extension approach effectively enhanced farmers' adoption of this environmentally friendly pest control technology.

Keywords: *participatory extension, pest control, POAC, rice bug*

INTRODUCTION

Food security stands as a strategic issue for national development. Thus, the agricultural sector playing a principal role as the main food supplier. Also, it plays roles as primary driver of development, and a key instrument of economic growth. The rapid pace of population growth necessitates a corresponding increase in food production (Harini & Ariani, 2019; Munir et al., 2023). Given that rice is the staple food for the Indonesian population, this dependency has continually increased the demand for rice (Rumawas et al., 2021).

Lemahbang Village is a region with significant agricultural potential, primarily focused on rice cultivation, encompassing a substantial area of 231.39 hectares of rice fields, making it the third-largest rice-producing area in Sukorejo District. The majority of the population in Lemahbang Village are employed as farmers. However, according to the Lemahbang Village program report, the village experienced a significant decline in rice production in 2023, with output decreasing by 52 units (Program Desa Lemahbang, 2023). Observations revealed that several major rice pests, attack the rice fields in Lemahbang Village, including rice stem borers, brown planthoppers, and the rice bug (walang sangit). Among these, the rice bug is considered the most detrimental, frequently leading to crop failure. Infestations by the rice bug cause the grain to become empty or sterile, which can reduce the quality and quantity of the rice harvest by up to 50% (Sumini et al., 2018). Furthermore, the rice bug is deemed hazardous due to its resulting impact on lowering rice productivity and overall quality (Purwaningsih et al., 2018).

Farming practices in Lemahbang Village remain heavily reliant on the use of chemical pesticides in rice cultivation. Farmers commonly apply these pesticides without proper consideration of the recommended dosage or appropriate application guidelines. They frequently neglect identifying target pests, use excessive dosages, and employ overly frequent applications without regard for the potential consequences. According to Hardiansyah et al. (2023), the inappropriate use of chemical pesticides can lead to pest resistance, environmental contamination in the rice fields, and the presence of harmful chemical residues in the consumed rice, posing a risk to human health.

Biological control agents, conversely, prevent the development of pest resistance or resurgence, curb the spread of infection sources, and are environmentally friendly (Athifa et al., 2018). One effective biological control strategy involves utilizing beneficial microorganisms—known as natural enemies—to suppress plant-damaging organisms. These microorganisms offer several advantages: they are more selective toward target pests, do not induce resistance or resurgence, and leave no harmful residues on crops or in the surrounding environment. A prominent natural enemy is *Beauveria bassiana*, an entomopathogenic fungus that causes disease in its host insects. This fungus produces enzymes such as chitinase, esterase, lipase, and protease, which are instrumental in breaking down the insect's outer cuticle (Sopialena et al., 2021). Given the existing agricultural issues in Lemahbang Village, there is a clear need for innovation dissemination focusing on the use of the biological agent *B. bassiana* to control the damaging rice bug in rice crop.

Even though numerous studies have evaluated *B. bassiana*'s biological efficacy and technical application parameters, very few have rigorously examined the process by which farmers actually adopt biological control agents in practice — particularly through structured agricultural extension programs. Most prior extension studies addressing *B. bassiana* have focused narrowly on knowledge transfer and technical skill acquisition, overlooking the attitudinal dimension that mediates the translation of knowledge into sustained behavioral change (Ajzen, 1991). Studies that do examine farmer adoption of biological control technologies largely rely on cross-sectional surveys of adoption rates rather than measuring the impact of specific participatory extension interventions on the simultaneous development of knowledge, attitude, and skills as interrelated constructs (Ahmad, 2017; Vinelly et al., 2018). Furthermore, although the Knowledge-Attitude-Practice (KAP) framework has been widely applied in health communication research, its application within agricultural extension — particularly for evaluating the effectiveness of participatory extension on biological pest control adoption — remains underexplored. Previous studies have not adequately examined the sequential and interdependent relationships among knowledge acquisition, attitude transformation, and skill development as outcome variables of a single structured extension program. This constitutes a significant methodological and theoretical gap in the agricultural extension literature.

This study addresses these gaps by evaluating the effectiveness of a participatory extension approach in promoting the adoption of B. *bassiana* as a biological control agent for rice bug infestation, explicitly framed within the KAP theoretical model. The study's primary emphasis is on farmer behavioral change — not merely the transmission of technical information, but the holistic transformation of farmers' cognitive understanding (knowledge), evaluative disposition (attitude), and psychomotor capabilities (skills) through active, participatory engagement. First, knowledge is operationally defined as farmers' cognitive comprehension regarding the biological characteristics of *B. bassiana*, its mechanisms of action against rice bugs, appropriate application procedures, dosage calculations, timing considerations, and safety precautions. Second, attitude refers to farmers' evaluative judgment, affective response, and psychological disposition toward adopting *B. bassiana* technology, encompassing their perceived usefulness, environmental benefits, economic viability, and willingness to replace or reduce chemical pesticide usage. Third, skills represent farmers' psychomotor competencies and practical abilities to correctly execute *B. bassiana* application procedures in actual field conditions, including preparation of fungal suspensions, calibration of application equipment, proper spraying techniques, and adherence to safety protocols. These three constructs exist in a sequential and interdependent relationship: knowledge acquisition serves as the cognitive foundation that influences attitude formation (knowledge → attitude), while positive attitudes subsequently enhance motivation and facilitate skill development and application (attitude → skills). Moreover, enhanced skills reinforce positive attitudes through successful practice experiences, creating a positive feedback loop (skills ↔ attitude). The participatory extension approach was hypothesized to simultaneously influence all three constructs, with the ultimate goal of achieving comprehensive behavioral change toward sustainable pest management practices.

The target for this extension program was the Rukun Tani Farmer Group, selected because they are one of the most active farmer groups in Lemahbang Village. This group is characterized by also by their proactive engagement in implementing innovations received from local extension workers. Classified as an intermediate-level farmer group (tingkatan madya), they possess a sufficient capacity to rapidly absorb and respond to new information, which facilitates the effective diffusion of knowledge and innovation to surrounding farmers (Vinelly et al., 2018).

The extension activities were conducted using a participatory approach, encompassing all stages from the identification of local potential and planning to organizing, implementation, and final evaluation. Participatory extension is considered an effective method because it actively involves farmers in the decision-making process (Ahmad, 2017). Through this participatory model, farmers were not merely recipients of information on the effective control of rice bugs using *B. bassiana*, but were encouraged to be actively involved in the extension process itself. To achieve the goals of participatory extension, the program utilized the POAC management cycle (Planning, Organizing, Actuating, and Controlling). By executing the planning, organizing, implementation, and evaluation stages collaboratively with the farmers, their participation was maximized, thereby increasing their motivation to cooperate and fostering a shared sense of responsibility for the successful implementation of the activities.

Based on this framework, this study aimed to determine the effectiveness of a participatory extension approach in enhancing farmers' knowledge, transforming their attitudes, and developing their practical skills toward the utilization of B. bassiana as a biological control agent for rice bug infestation in rice fields.

METHODS

The study was conducted in Lemahbang Village, Sukorejo District, Pasuruan Regency, from December 2023 to March 2024. This research employed a quasi-experimental design with a one-group pretest-posttest approach, combined with participatory action research (PAR) methodology. The extension method is participatory, specifically utilizing applied research in a demonstration plot, and targeted members of the Rukun Tani Farmer Group (100 farmers). The majority of members of the Rukun Tani Farmers Group exhibit distinctive characteristics. Most are elderly farmers (>50 years old) graduated from a junior high school. Despite their advanced age, their educational background is considered middle-level, resulting in limited literacy skills in understanding the innovations provided by extension workers. Furthermore, the farming experience of the group's members varies, ranging from 10 to 50 years.

The study examined three key dependent variables: (1) farmers' knowledge regarding *B. bassiana* application, (2) farmers' attitudes toward biological control adoption, and (3) farmers' skills in implementing *B. bassiana* technology. The independent variable was the participatory extension intervention utilizing the POAC (Planning, Organizing, Actuating, Controlling) management cycle.

Data were collected using primary and secondary sources. Primary data consists of data on the intensity of rice bug infestation, data on costs and results of rice farming, and the results of extension evaluations. The extension effectiveness evaluation was conducted through three measurement instruments:

1. Knowledge Assessment: A structured knowledge test consisting of 10 question items, multiple-choice and short-answer questions covering *B. bassiana* biology, application techniques, and pest control mechanisms was administered before (pretest) and after (posttest) the extension intervention. The validity and reliability of the instrument were carried out using the expert judgment method. The knowledge level was categorized as low (0-54%), moderate (55-79%), and high (80-100%).
2. Perception Measurement: A rating-scale questionnaire with 1 to ten scale (strongly disagree to strongly agree) was used to assess farmers' evaluative disposition toward *B. bassiana* adoption. The questionnaire contains 10 items statement, covered perceived usefulness, environmental awareness, economic considerations, and willingness to adopt the technology. The validity and reliability of the instrument were carried out using the expert judgment method. Attitude scores were calculated as percentages and categorized as negative (<60%), neutral (60-79%), and positive (≥80%).
3. Skill Evaluation: An observation checklist was employed to assess farmers' psychomotor abilities in *B. bassiana* application procedures, including preparation of fungal suspensions, equipment calibration, spraying techniques, and safety protocol adherence. The validity and reliability of the instrument were carried out using the expert judgment method. Skills were observed during hands-on demonstration sessions and scored using predetermined criteria (rubric), categorized as less skilled (score < 35), moderate (35 – 70) and very skilled (score > 70).

Extension evaluation was conducted on 20 members of the farmer group. The sample was determined purposively based on the active participation of the farmer group members in extension activities. Statistical analysis was performed using paired samples t-test (or Wilcoxon signed-rank test for non-normally distributed data) to determine the significance of knowledge improvement between pretest and posttest scores. Descriptive statistics were used to analyze attitude and skill evaluation results.

RESULTS AND DISCUSSION

Implementation of Planning, Organizing, Actuating and Controlling in the Extension Program

Planning in the extension program consists of laboratory research on *B. bassiana* viability. Viability assessment of *B. bassiana* fungal suspension constituted a critical preliminary step in validating the biological control agent's efficacy. Laboratory testing conducted at the Plant Pest and Disease Laboratory of Politeknik Pembangunan Pertanian Malang revealed a spore density of 2.36×10^7 conidia/ml. This concentration substantially exceeded the minimum standard threshold of 1×10^6 spores/g established by the Directorate of Plantation Protection, Ministry of Agriculture (2014), indicating optimal viability for field application.

The high spore density obtained in this study aligns with findings from Juliartawan et al. (2022), who demonstrated that *B. bassiana* suspensions with concentrations of 10^7 conidia/ml achieved 100% mortality rates in rice bug populations. The elevated conidial concentration ensures adequate pathogen load for successful infection of target insects through cuticular penetration and subsequent colonization of the hemocoel. This density threshold represents a critical determinant of entomopathogenic efficacy, as insufficient spore concentrations may result in suboptimal infection rates and compromised pest control outcomes. Systematic extension program planning in the study by Ediset et al. (2024) was conducted through data collection and condition analysis. Planning was shown to be associated with a "good" level of innovation adoption by the target population. This aligns with the emphasis on technical validation of *B. bassian*a viability as the basis for extension program planning.

Organizing in the extension program is the dem-plot activity. Dem-plot used as comparative field trials examining *B. bassiana* application versus conventional farmer practices. The plant clinic and field demonstration approaches used in the Plant-wise program in China and several developing countries have been shown to improve the quality of integrated management recommendations, including a sharp increase in biological control recommendations and high levels of farmer adoption (Toepfer et al., 2020). This is consistent with the use of comparison plots of *B. bassiana* versus farmer practices. In Japan (Kusama & Yamanaka, 2020), the deployment of natural enemy-based IPM relies heavily on demonstration trials designed in collaboration with extension workers and farmers, which improve knowledge and skills and accelerate the diffusion of IPM.

The intensity of damage to rice grains was analyzed using an independent samples T-test. The data wereollected from ten sampling plots, known as "ubinan," established within the demo-plot. Each sampling plot contained 25 clumps, resulting in a total population of 250 clumps. Five sample clumps were observed from each of the ten plots, yielding a total of 50 plant samples. Nurani et al. (2022) suggest that a diagonal sampling technique is appropriate for population assessment within each plot. The results of the independent samples T-test analysis revealed a statistically significant difference between the application of *B. bassiana* and the farmers' conventional methods (using insecticides).

The *B. bassiana* treatment plots exhibited a mean grain damage rate of 28.58%, compared to 32.20% in control plots managed according to prevailing farmer pest management protocols. Statistical analysis using independent samples t-test ($\alpha = 0.05$) confirmed these differences as significant ($p = 0.0197 < 0.05$), thereby rejecting the null hypothesis of equivalent damage intensity between treatments.

The 3.62 percentage point reduction in grain damage attributable to *B. bassiana* application represents a meaningful improvement in pest suppression efficacy. While the absolute magnitude of reduction appears modest, the biological and economic significance becomes apparent when considering the scale of rice production in Lemahbang Village. With 231.39 hectares of rice cultivation, even marginal improvements in pest control translate to substantial aggregate yield preservation and economic benefits for the farming community.

Actuating cycle implemented with a farm economic analysis. Economic viability constitutes a critical determinant of agricultural technology adoption, as farmers operating under resource constraints prioritize innovations that demonstrably enhance farm profitability. Comparative economic analysis of *B. bassiana* application versus conventional practices revealed substantial differences in production costs, revenues, and net returns that favor biological control adoption.

Total production costs for *B. bassiana* plots amounted to Rp 12,225,800 per hectare, compared to Rp 12,490,800 for conventional management, representing a cost saving of Rp 265,000 (2.1%). While this difference appears modest in percentage terms, the primary economic advantage derives from enhanced productivity rather than input cost reduction. The B. bassiana treatment yielded 4,968 kg/ha of harvested grain, compared to 4,075 kg/ha under farmer practices—a 21.9% yield advantage attributable to more effective pest suppression.

The combination of marginally lower costs and substantially higher yields generated marked differences in gross revenues and net incomes. Gross revenues from *B. bassiana* plots totaled Rp 31,795,000 compared to Rp 26,080,000 for conventional management, yielding net incomes of Rp 19,569,400 and Rp 13,589,200 respectively. The Rp 5,980,200 income advantage (44% higher) for *B. bassiana* adopters demonstrates compelling economic incentives for technology uptake.

Benefit-cost ratio (BCR) analysis provides a standardized metric for comparing investment efficiency across alternative production systems. The *B. bassiana* treatment achieved a BCR of 2.6, indicating that each rupiah invested in production generated Rp 2.60 in gross returns. The conventional system yielded a lower BCR of 2.08, though both values exceed the threshold of unity required for economic viability. These findings align with results reported by Wafa (2022), who documented similar BCR values (2.6) for rice production systems incorporating *B. bassiana* for pest management.

At the micro level, Colmenarez & Vasquez (2024) show that successful biological control often results in increased yields and reduced control costs, thereby increasing farmer income and investment viability.The economic superiority of *B. bassiana* application derives primarily from yield protection rather than input cost savings. The modest difference in material costs between biological and synthetic insecticides suggests that price competitiveness alone provides insufficient motivation for technology switching. However, when effectiveness differentials are incorporated—particularly in contexts where pest resistance has compromised synthetic insecticide performance—the economic calculus shifts decisively in favor of biological alternatives.

Several caveats merit consideration in interpreting these economic findings. First, the analysis assumes stable output prices (Rp 6,400/kg) and does not account for potential price premiums that may accrue to organically or sustainably produced rice in differentiated markets. Second, the single-season timeframe precludes assessment of longer-term economic benefits associated with reduced environmental contamination, preserved soil health, and sustained natural enemy populations. Third, the analysis does not incorporate the value of reduced human health risks associated with minimized synthetic pesticide exposure, which may constitute significant but unquantified benefits.

The Controlling step of POAC were done by set the extension program through a sequenced series of group meetings and field activities spanning four months, with progressive skill development scaffolded across multiple contact points. The initial session (January 10, 2024) focused on conceptual knowledge transmission through lecture and discussion formats, covering *B. bassiana* biology, infection mechanisms, application protocols, and comparative advantages relative to synthetic insecticides. The 20 participating farmers demonstrated active engagement through questioning behavior and animated discussions, suggesting genuine interest in the subject matter rather than passive reception of information. Subsequent sessions integrated field-based learning through participatory demonstration plot activities. Three application sessions (December 29, 2023; January 6, 2024; January 13, 2024) engaged farmers in hands-on spraying operations, concentration calculations, and timing decisions under varying crop growth stages. The participation of 3-7 farmers per application session, while representing a minority of total membership, likely reflected opportunity costs associated with labor time allocation during peak agricultural activity periods rather than disinterest in the technology. The intensive engagement of participating farmers in practical skill development activities suggests the emergence of a cadre of early adopters positioned to serve as peer educators within the broader farming community.

The final extension session (March 6, 2024) emphasized knowledge synthesis and evaluation through presentation of demonstration plot results, economic analysis, and participatory discussion of implementation experiences. The attendance of 20 farmers and participation of extension service staff and university supervisors elevated the event profile and provided external validation of program importance. The enthusiastic questioning behavior and requests for follow-up training in *B. bassiana* mass production indicate sustained interest extending beyond passive information reception to active technology appropriation and adaptation. During the extension activities, the skills of the Rukun Tani Farmer Group members were evaluated through direct observation to assess their proficiency in preparing the necessary tools and materials, measuring the concentration, and determining the application dosage. However, the success of implementing recommendations is greatly influenced by farmers' perceptions of effectiveness, feasibility, social support, and the role of referents (extension workers, peers), so program control mechanisms need to include monitoring changes in attitudes and behavior, not just technical indicators (Constantine et al., 2023).

Knowledge Acquisition Outcomes

The knowledge assessment component revealed statistically significant learning gains attributable to the extension intervention. Pre-test scores averaged 46 (range: 10-80), indicating substantial knowledge deficits regarding *B. bassiana* biology, application techniques, and pest control mechanisms prior to instruction (Figure 1). Post-test scores improved to a mean of 79.5 (range: 50-100%), representing a 33.5 percentage point increase in knowledge levels. Paired-samples t-test analysis confirmed this improvement as statistically significant ($p < 0.0001$), providing strong evidence that the extension program successfully achieved its knowledge transmission objectives.

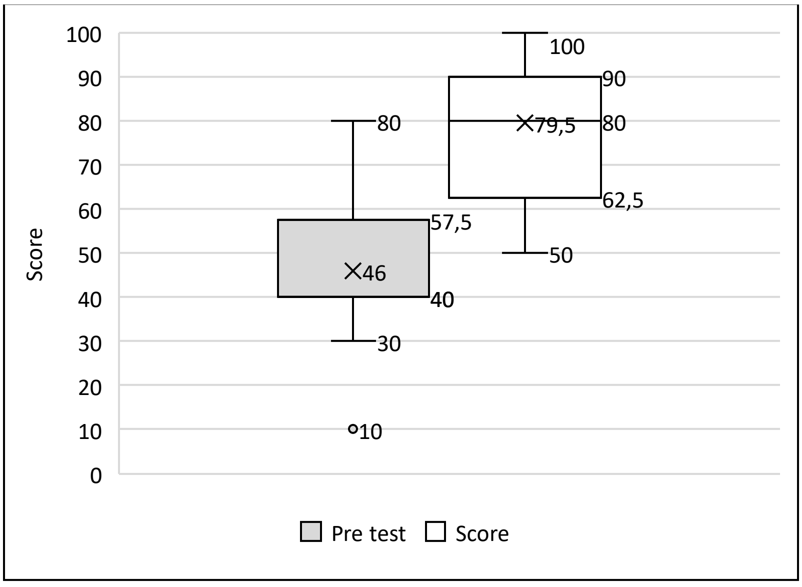

Figure 1. Distribution of Pre and Post test Score in Boxplot

The magnitude of knowledge gain observed in this study compares favorably with outcomes reported in similar agricultural extension evaluations. The 72% relative improvement in test scores (from 46 to 79.5) suggests effective knowledge transfer despite the technical complexity of entomopathogenic fungal biology and the moderate educational backgrounds of participants. The post-intervention mean score of 79.5 indicates that most farmers achieved high knowledge levels according to the predetermined classification scheme, though the persistence of some scores in the moderate range (50-79.5) suggests opportunities for enhanced instructional effectiveness through revised pedagogical approaches or extended contact time.

The item-level analysis of test responses provides insights into specific knowledge domains where learning was most successful versus areas requiring additional instructional emphasis. Questions addressing basic concepts such as *B. bassiana* identity as an entomopathogenic fungus and its selective toxicity to target insects showed near-universal correct responses post-intervention, suggesting effective communication of fundamental principles. However, questions requiring application of knowledge to novel situations—such as determining appropriate concentration adjustments for varying field conditions—exhibited greater response variability, indicating that higher-order cognitive skills may require more extensive practice and problem-solving activities than single-session instruction can provide.

The substantial knowledge gains documented through pre-post testing validate the extension program's pedagogical effectiveness while simultaneously raising questions about knowledge retention and application in authentic farming contexts. The artificial testing environment may not accurately predict knowledge accessibility during actual decision-making situations when farmers must recall and apply learned information without external prompting. Furthermore, the immediate post-test administration (following the same-day instruction) precludes assessment of long-term retention, which may decline over time without reinforcement through repeated application experiences.

Attitude Formation Analysis

The attitude assessment revealed overwhelmingly positive evaluative dispositions toward *B. bassiana* adoption following the extension intervention. The mean attitude score of 88.45% on a 100-point scale substantially exceeded the threshold for positive attitude classification (≥80%), with 15 of 20 respondents (75%) scoring in the positive range. one respondent exhibits negative attitudes (<60%), and 4 respondents exibit neutral attitudes, suggesting near-universal favorable reception of the biological control technology among program participants (Figure 2).

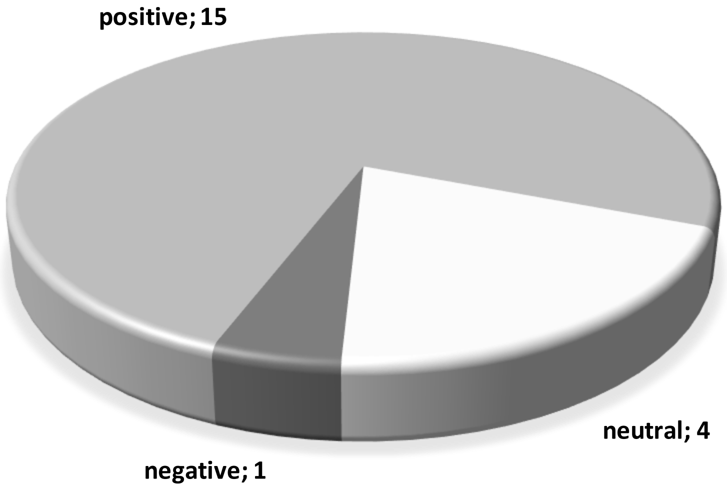

Figure 2. Pie diagram of Attitude

The uniformly positive attitudinal outcomes reflect successful persuasion regarding multiple dimensions of *B. bassiana* utility and desirability. Item-level analysis reveals particularly strong agreement with statements regarding environmental sustainability benefits, efficacy in pest suppression, and economic advantages relative to synthetic insecticides. These favorable evaluations likely derive from the compelling empirical evidence presented through demonstration plot results, which documented measurable yield advantages and income gains attributable to biological control adoption. The concrete financial benefits demonstrated through economic analysis may have particular persuasive power among resource-constrained farmers for whom abstract environmental considerations alone provide insufficient motivation for practice change.

The attitude measurement also identified perceived barriers that may constrain adoption despite generally favorable evaluations. Several respondents expressed concerns regarding the complexity of concentration calculations and application timing decisions, suggesting that psychomotor skill development and simplified decision aids may be necessary to translate positive attitudes into behavioral implementation. Additionally, questions regarding the commercial availability and cost of *B. bassiana* products indicate that supply chain development and market infrastructure remain important adoption determinants beyond individual farmer attitudes and knowledge.

The cross-sectional attitude assessment conducted immediately following the intervention precludes evaluation of attitude stability over time. Social psychological research demonstrates that attitudes formed through direct experience and behavioral engagement exhibit greater temporal stability and predictive validity for future behavior than attitudes based solely on verbal persuasion (Nurfathiyah & Rendra, 2020). The hands-on demonstration plot participation by a subset of farmers may have fostered more robust attitude formation compared to passive information reception by other participants, suggesting potential differential adoption trajectories between active and passive learners.

Skill Development Assessment

The psychomotor skill evaluation revealed a dominant very skilled levels among participating farmers in *B. bassiana* preparation, calibration and application procedures. The mean skill score of 93% indicates that most farmers successfully demonstrated competence across the evaluated skill domains: preparation, calibration and application tecniques. The skill component breakdown shows particularly 95% in preparation activities, 93.3% in application and 90% calibration, with slightly lower but still very skilled.

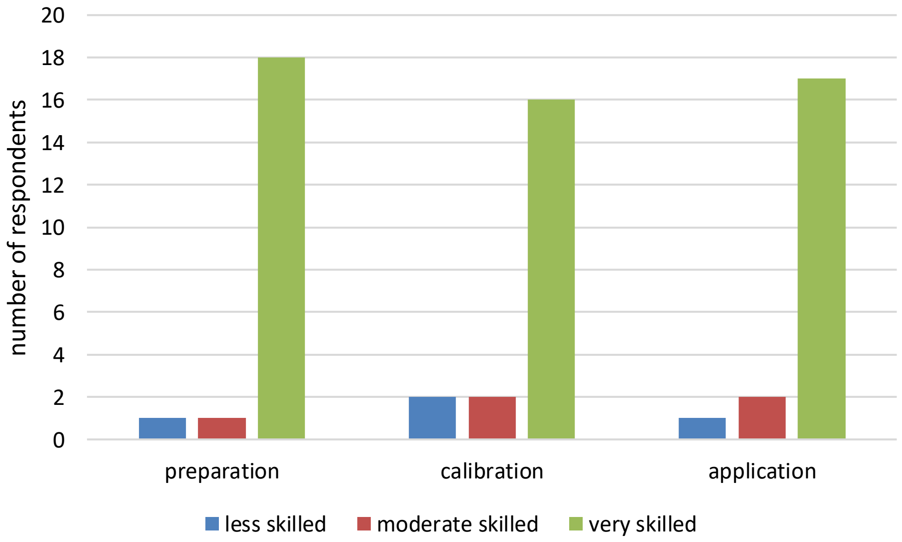

Figure 3. Distribution of respondents' skill levels across three process stages: preparation, calibration, and application

The high skill attainment levels suggest that the hands-on demonstration methodology effectively facilitated procedural learning despite the technical complexity of entomopathogenic fungal application. The tactile and visual experience of manipulating equipment, measuring volumes, and calculating concentrations under expert supervision appears to have successfully translated abstract procedural knowledge into operational competence. The immediate feedback and error correction opportunities inherent in supervised practice sessions enabled rapid skill acquisition and refinement.

However, several methodological limitations constrain interpretation of these skill assessment results. First, the evaluation occurred in controlled demonstration settings with expert supervision and immediate assistance available—conditions differing substantially from independent farm application contexts. The transition from supervised demonstration to autonomous implementation may reveal previously undetected skill deficits or procedural errors. Second, the small sample size (n=20) and convenience sampling of farmers participating in application sessions may have introduced selection bias favoring more motivated or technically confident individuals. Third, the absence of follow-up skill assessments precludes evaluation of skill retention and degradation over time without reinforcement through regular practice.

The high skill demonstration performance combined with expressed concerns regarding technical complexity in the attitude survey presents an apparent paradox warranting explanation. This discrepancy may reflect differential self-efficacy perceptions between observed skill performance and anticipated autonomous implementation. While farmers successfully executed procedures under expert supervision, they may lack confidence in their ability to independently troubleshoot problems or adapt procedures to novel situations without external support. This suggests that sustained technical assistance and peer mentoring systems may be necessary to consolidate skills and build implementation confidence beyond initial demonstration training.

CONCLUSION

Interventions in rice cultivation methods within the Rukun Tani farmer group were conducted through extension training using the POAC management cycle. The planning concept was implemented through validation tests of extension materials, specifically the use of *B. bassiana* to control rice pests. The organization and actualization of extension training involved active participation in the form of demonstration farms, allowing farmers to evaluate the results of *B. bassiana* application both ecologically and economically. Control mechanisms were implemented by scheduling extension activities while simultaneously evaluating both knowledge, attitudes, and skills. The knowledge evaluation showed a significant increase from 46 to 79.5. The attitude evaluation showed a total score of 88.45 out of 100, indicating that the target group was interested in implementing the extension materials. The skills evaluation showed an average score of 93 out of 100, indicating that farmers were able to propagate isolates and apply them for sustainable pest control efforts.

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