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Empowering pearl lobster farmers through synbiotic feed training for disease prevention

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ABSTRACT

Pearl lobsters (Panulirus ornatus) are widely cultivated in coastal areas of Indonesia, including in Ohoidertom Village, Southeast Maluku. However, organism health management greatly affects lobster cultivation, especially in terms of disease prevention and treatment. The objective of the community service activity was to increase the knowledge and understanding of the Sevav Ratut Group about the prevention of pearl lobster diseases using synbiotic feed. The method used was a participatory method through presentations and hands-on practice, including the preparation, implementation, assistance, and evaluation stages. During the implementation stage, the partners directly practised making synbiotic feed from papaya leaves and yoghurt. The feed was then applied to pearl lobsters. During the socialisation and training activities, participants showed a desire to develop. This was demonstrated by their attendance, participation in discussions, and involvement in activities, from instructions on making herbal synbiotic feed to feeding it to cultivated pearl lobsters. The evaluation results showed that participants had a better understanding of the material provided. This was also supported by the active involvement of participants during the discussion sessions and the practical session on making herbal synbiotics. The average score of participants before the test was 37, while their average score after the test increased to 92. This increase indicates that the training activities can enhance participants' understanding of the concept of probiotics.

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1. INTRODUCTION

The pearl lobster (*Panulirus ornatus*) represents the most commercially valuable and highly sought-after species among lobsters. Nevertheless, its aquaculture development faces several critical constraints, including high disease-induced mortality, slow growth rates, and prolonged cultivation cycles (Mohamad et al., 2019). Major infectious pathologies, most notably Milky Haemolymph Disease, frequently lead to catastrophic mortality rates ranging from 70 to 100 percent when inadequately managed (Elviantari et al., 2024; Giri et al., 2023). These pathological challenges similarly afflict the local partner group, the Sevav Ratut Pearl Lobster Farming Community.

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The farming initiative managed by this partner group is based in Ohoidertom Village, West Kei Kecil District, Southeast Maluku Regency, with their operational grow-out site situated in Hoat Dom Bay. The village is located approximately 25.9 km from the university campus, requiring a travel time of roughly 38 minutes. Although the natural resources of Ohoidertom Village comprise timber, sand, and marine biota, the local population primarily derives its livelihood from harvesting and selling timber and beach sand for construction purposes. If sustained over the long term, these activities pose significant threats to ecological integrity. Beyond these exploited resources, Ohoidertom possesses abundant yet underutilized marine potential, specifically the pearl lobster (*Panulirus ornatus*). A small segment of the community engages in wild pearl lobster fishing; however, yields remain sub-optimal due to seasonal limitations and unpredictable catch success per dive. Furthermore, continuous wild harvesting has led to a depletion of natural stocks. To address these issues, a specialized pearl lobster farming group was established in 2018, led by Mr. Athanasius Remetwa.

Figure 1. Sevav Ratut business profile in Ohoidertom Village, Southeast Maluku

Throughout the cultivation process, the partner group has not yet implemented good aquaculture practices, rendering disease outbreaks one of the primary obstacles faced by the Sevav Ratut lobster farmers. Furthermore, the partner lacks adequate technical knowledge regarding both therapeutic treatments for diseased lobsters and preventive management strategies. Such pathological infections significantly suppress appetite, impede growth, elevate mortality rates, and ultimately cause substantial economic losses for the farmers (Hidayati et al., 2023). In addition to technical constraints, the partner group encounters administrative challenges in business management, as they operate without proper financial bookkeeping due to a lack of understanding of standard accounting methods to track business revenues and expenditures. To address these multifaceted issues, targeted intervention is necessary to empower the farming group through training on the utilization of accessible, safe, and environmentally friendly natural products. This initiative aims to enhance the partner's knowledge of lobster disease management and sustainable aquaculture practices, while simultaneously improving their managerial skills through training and mentoring in business administration to ultimately boost overall productivity.

2. METHODS

The methodology employed to address the partner group's challenges encompasses socialization, practical training, and continuous mentoring.

Preparation Stage

During this initial stage, a situational analysis and problem identification were conducted through direct field visits to observe pearl lobster farming operations and engage in discussions with the farmers.

This activity aimed to pinpoint critical operational constraints, particularly regarding lobster diseases, existing therapeutic practices, and the farmers' comprehension of natural remedies, broodstock, egg, and larval handling up to the juvenile stage, as well as seed quality preservation.

Following the identification of these aquaculture challenges, the community service team members were assigned specific tasks aligned with their respective expertise to develop tailored training modules. The instructional materials covered common pearl lobster pathologies, fundamental principles of lobster health management, the application of accessible natural materials for disease treatment, broodstock-to-juvenile management, and seed quality maintenance throughout the cultivation cycle. To support the practical sessions, necessary materials and equipment, such as papaya leaves, yogurt, and simple, locally accessible tools, were carefully prepared.

Figure 2. Initial assessment for problem identification by the community service team

Implementation Stage

Socialization and material delivery

The activity commenced with an interactive socialization session involving direct presentations, discussions, and question-and-answer sessions to ensure full participant comprehension. To facilitate understanding among the farmers, information was conveyed using accessible language supplemented by images and videos. This socialization stage aimed to establish baseline knowledge and prepare participants before proceeding to the practical stage. Visual media, including PowerPoint presentations and short instructional videos, were utilized to stimulate discussion and enhance participant engagement.

Practical training on synbiotic preparation and application

The training initiative centered around this practical stage, where participants actively engaged in the production of papaya- and yogurt-based synbiotics, spanning raw material preparation, mixing, and application within the pearl lobster culture media. The Sevav Ratut farmers were provided hands-on experience in formulating herbal probiotics and administering them directly to their cultured pearl lobsters. The required equipment and ingredients included blenders, spoons, mixing basins, papaya leaves, and commercial probiotics in the form of yogurt. In addition to the academic team members, this session involved third-semester Aquaculture Technology undergraduate students and laboratory technicians.

Evaluation

During this stage, an evaluation was conducted to assess participant competency through interactive discussions and questionnaires administered before and after the training. The pre-test served to determine baseline knowledge, whereas the post-test measured knowledge gain following the intervention. Both assessments evaluated the participants' comprehension of probiotic concepts, synbiotic benefits, and the procedures required for their preparation and application in pearl lobster aquaculture.

As a follow-up action, ongoing mentoring was provided to ensure that each participant mastered the correct procedures and could independently implement them at their respective farming sites. This strategy aims to mitigate disease issues, thereby enhancing productivity and economic yields for the partner group.

Indicators of success

The success indicators for this program required that at least 80 percent of participants understand the causes, symptoms, prevention, and management of lobster diseases based on pre- and post-test scores. Furthermore, at least 80 percent of participants must comprehend good aquaculture practices, and at least 75 percent of group members should be capable of applying natural remedies for disease prevention and treatment. Additional performance metrics include the farmers' ability to monitor lobster health, maintain water quality, manage feeding regimes, and perform routine tank maintenance. Success was also defined by reduced lobster mortality rates and improved survival rates during the grow-out period compared to baseline conditions. Operationally, partners are expected to calculate production costs and profit margins, conduct periodic business evaluations, and maintain simple, standardized bookkeeping records for daily financial tracking.

Mentoring and monitoring

To ensure the effective achievement and sustainability of the program's objectives, weekly monitoring and mentoring sessions were conducted over a three-month period. These site visits involved direct observation of aquaculture practices and business operations while fostering active participation among all group members. At the conclusion of the program, a final evaluation was conducted to benchmark post-intervention progress against initial conditions and ensure long-term operational continuity.

3. RESULTS AND DISCUSSION

Enhancement of Partner Knowledge

During the socialization stage, the partner group gained an in-depth understanding of national aquaculture regulations under Ministerial Regulation of Marine Affairs and Fisheries (Permen KP) No. 12/2020, as well as the critical role of environmental biosecurity. Discussions revealed that local farmers routinely harvested berried (egg-bearing) lobsters and discarded the eggs prior to sale. This practice poses a severe threat to natural lobster populations by exacerbating stock depletion. Furthermore, the farmers exhibited limited technical knowledge regarding lobster seed production, spanning the cultivation stages from eggs and larvae to juvenile sizes. Consequently, their aquaculture operations relied entirely on wild-caught juveniles. To address these gaps, the socialization session also incorporated instruction on business management, basic financial bookkeeping, and profit-and-loss calculations. All

topics elicited high enthusiasm and active participation from the group. Regarding health management, instructional materials focused on probiotics, synbiotics, the dietary benefits of papaya leaves, and the step-by-step preparation and application of synbiotics in lobster farming.

The socialization and training sessions were attended by 10 participants from the partner group. The initiative successfully elevated the farmers' comprehension of synbiotic applications for disease prevention in pearl lobster aquaculture. Pre- and post-test evaluations, each comprising 10 questions, demonstrated a substantial knowledge gain, with the average score increasing by 55 points, from 37 on the pre-test to 92 on the post-test (Table 1).

Table 1. Results of pre-test and post-test evaluation of training participants

Indicators	Pre-Test Score	Post-Test Score
Probiotics knowledge	30	85
Synbiotics comprehension	30	90
Dietary benefits of papaya leaves in feed	50	95
Stages of synbiotic preparation	35	95
Application in pearl lobster aquaculture	40	95
Average	**37**	**92**

Table 1 illustrates an overall improvement across all assessment indicators. Knowledge of probiotics increased from 30 to 50, while comprehension of synbiotics rose significantly from 30 to 90. Similarly, understanding regarding the dietary benefits of papaya leaves in feed improved from 50 to 90. Comprehension of the stages of synbiotic preparation increased from 30 to 55, and the practical application of synbiotics in pearl lobster aquaculture expanded from 40 to 55. These findings demonstrate that the training modules effectively enhanced the participants' understanding of preventive health management in lobster culture.

Figure 3. Socialization material delivery activities

Enhancement of Partner Skills

Prior to the implementation of this community service initiative, the academic team conducted a situational and problem analysis with the partner group. Interviews revealed that the farmers faced severe operational constraints due to high lobster mortality caused by disease outbreaks that the partners had not technically identified. Consequently, the success rate of pearl lobster cultivation in Ohoidertom Village remained low.

To address these challenges, the training workshop focused on synbiotic preparation for disease prevention, given the partners' lack of technical skills in mitigating disease-induced mortality during

the cultivation cycle. During the practical session, the farmers actively participated in formulating herbal synbiotics under the direct guidance of the team. Prior to the hands-on activity, the preparation methods for herbal synbiotic feed had been introduced through the socialization session. Participants were assigned specific roles, including weighing ingredients, processing feed, and mixing formulation components. The equipment and materials utilized comprised mixing basins, blenders, spoons, digital scales, papaya leaves, yogurt, water, and trash fish. Once the herbal synbiotic feed was prepared, participants proceeded to the grow-out facilities to conduct feeding trials on the pearl lobsters.

Figure 4. Synbiotic manufacturing process

The training initiative demonstrated a marked improvement in the technical skills of the partner group. Prior to the training, group members lacked the capability to independently prepare synbiotics and lacked skills in disease management. Following the training, participants were able to produce synbiotics utilizing locally available ingredients and simple equipment. This skill acquisition indicates that the partners can directly adopt and implement the introduced technology within their specific aquaculture operational conditions.

The partner group began to comprehend the practical application of synbiotics as a preventive measure for lobster health management and initiated its implementation in their pearl lobster grow-out operations. Furthermore, they acquired critical competencies in selecting healthy seed stock, managing water quality, maintaining culture containers, and applying these measures as integral components of good aquaculture practices.

Discussion

The practical training session on formulating herbal synbiotics using papaya leaves and yogurt served as the core for transforming the partner group's technical skills. The selection of papaya leaves (*Carica papaya*) as the primary ingredient was based on their bioactive compound profile. Recent research indicates that papaya leaf extract effectively enhances non-specific immune responses, triggers phagocytic activity, and aids in restoring hematological parameters in crustaceans infected by pathogenic bacteria (Meshram et al., 2025). Additionally, papaya leaves are readily available in the local environment.

The combination of yogurt, as a source of lactic acid bacteria and probiotics, and papaya leaf extract generates a synergistic effect known as a synbiotic. The application of synbiotics through feed supplementation or water treatment plays a crucial role in modulating the intestinal microflora of lobsters, which subsequently improves nutrient absorption efficiency and resilience against environmental stress (Butt et al., 2021; Chin et al., 2024; Ringø et al., 2020; Vijayaram et al., 2023). Implementing these natural products offers a safer and more environmentally friendly alternative to chemical antibiotics, which are increasingly restricted in sustainable aquaculture practices (Dawood et al., 2019; Khanjani et al., 2024;

Indira et al., 2019; Limbu et al., 2014; Lulijwa et al., 2020). Furthermore, papaya leaves have been shown to suppress *Vibrio* bacterial populations in Pacific white shrimp (Wicaksono et al., 2020). Consequently, this training not only enhanced participant capabilities but also introduced an adoptable technology aligned with sustainable aquaculture principles.

The Sevav Ratut Pearl Lobster Farming Group has acquired enhanced knowledge and technical competencies through this community service program. The substantial increase in the participants' average score, rising from 37 on the pre-test to 92 on the post-test, demonstrates a significant gain in knowledge. The findings indicate that participants not only comprehended the concepts of probiotics and synbiotics, but were also capable of explaining the dietary benefits of papaya leaves, the synbiotic production process, and its operational application in lobster aquaculture. Furthermore, the farmers' ability to independently formulate synbiotics utilizing locally sourced ingredients and simple equipment highlights a corresponding advancement in practical skills. This capability confirms an effective technology transfer process, demonstrating that the introduced technology aligns with the operational needs and field conditions of the farming group.

This structural advancement in capacity is further evidenced by the shift in the partner group's understanding and technical capability regarding lobster health management. Prior to the program, the farmers lacked comprehension of appropriate preventive measures, resulting in a complete absence of disease prevention practices. Following the training, the partner group recognized the imperative of a preventive approach, adopting synbiotic applications as a core component of health management in aquaculture.

The efficacy of this training program is demonstrated by improved participant evaluation metrics and their successful translation of conceptual knowledge into practical farming operations. The integrated instructional methodology, combining theoretical lectures, interactive discussions, live demonstrations, and hands-on practice, provided a highly effective learning experience. Consequently, participants not only learned the principles of lobster disease control, but also mastered each technical step of synbiotic preparation through to its direct application in lobster feed supplementation.

The partner group's capacity to independently produce synbiotics following the community service initiative ensures program sustainability. This technology can be implemented on a continuous basis without relying on commercial products that are difficult to procure and costly compared to locally available raw materials, such as papaya leaves and yogurt. Furthermore, the farmers acquired foundational skills in basic bookkeeping and business management, which are utilized to enhance the governance of their aquaculture operations.

To ensure program sustainability, ongoing mentoring is essential to guarantee the consistent application of this technology. Regular monitoring of synbiotic application, lobster health, and financial record-keeping is required to maintain and expand program benefits. Consequently, this continuous mentoring is expected to support the group in achieving greater autonomy in managing sustainable lobster aquaculture.

The necessity for long-term monitoring regarding the efficacy of synbiotic use in reducing mortality and enhancing productivity also represents a key challenge. Continuous field evaluation and mentoring are crucial to verify that the introduced technology exerts a measurable impact on aquaculture performance. An additional challenge stems from the fact that continuous lobster production remains highly dependent on seasonal factors and natural resource availability, as most cultured seeds are still sourced from wild catches. Therefore, further mentoring is strongly required to advance the partners' technical skills in pearl lobster seed production and larval disease prevention.

The pearl lobster aquaculture business in Ohoidertom Village possesses significant potential for expansion, driven by the technical and managerial competencies acquired through this community service initiative. Independent synbiotic production has the potential to reduce operational expenditures while promoting environmentally friendly aquaculture practices by minimizing reliance on chemical agents. Concurrently, the implementation of standardized bookkeeping enables the group to systematically plan business strategies, calculate profitability, and qualify for financial support from governmental bodies and financial institutions.

If the introduced technology is consistently applied and backed by sustained institutional support, pearl lobster aquaculture can develop into a highly profitable enterprise for the coastal community of Ohoidertom Village. This development will not only elevate the productivity and income of the farming group but also foster the sustainable utilization of coastal resources, thereby reducing community dependence on wild lobster harvesting.

Ultimately, this program is expected to boost aquaculture production, directly improving partner welfare and generating a positive demonstration effect that encourages other community members in Ohoidertom Village to adopt similar sustainable aquaculture ventures.

4. CONCLUSION AND RECOMMENDATIONS

This community service initiative, centered on training for papaya- and yogurt-based synbiotic feed formulation, successfully enhanced the knowledge and technical skills of The Sevav Ratut pearl lobster farming group regarding disease prevention in pearl lobster culture. The increase in participant comprehension was evidenced by an average score gain from 37 on the pre-test to 92 on the post-test, accompanied by the partner group's capacity to independently produce and apply synbiotic feed utilizing accessible local raw materials. Furthermore, the program strengthened the partners' capacity to adopt good aquaculture practices while establishing foundational knowledge in business management and basic bookkeeping to support the operational sustainability of their lobster farming enterprise.

However, this study has limitations, as the evaluation focused primarily on short-term knowledge and skill acquisition. The longitudinal impacts of synbiotic application on key biological and economic parameters, including survival rates, mortality reduction, overall productivity, and net income growth, have not been quantitatively assessed over an extended period. Based on these limitations, several key recommendations are proposed for future initiatives: (1) Conduct periodic mentoring and monitoring to evaluate the consistency of synbiotic technology adoption and quantitatively measure its long-term effects on lobster survival, productivity, and cultivation success; (2) Expand partner capacity in hatchery management, business development, and marketing strategies to not only strengthen technical cultivation competencies but also boost market competitiveness and enterprise resilience; and (3) Establish strategic partnerships with local governments, the Marine Affairs and Fisheries Department, academic institutions, and support agencies to broaden training outreach, facilitate financing access, and replicate the program across other coastal aquaculture communities.

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