

Empowerment of Lobster Farmers Based on Renewable Energy in Supporting the Blue Economy in Sawarna Village, Banten Province

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Abstract: This Community Partnership Program (PKM) was implemented to support the empowerment of a group of lobster farmers in Sawarna Village, who face various challenges in managing their farming business. The problems faced by lobster farmer groups in the village are lack of access to stable energy and limited management knowledge, which has an impact on the sustainability of the lobster farming business. The purpose of this service is to improve the knowledge and skills of lobster farmers in business management and adopt renewable energy technology as a solution to limited energy access. The method used in this activity is the Participatory Rural Appraisal approach, which involves farmers actively through socialisation, training, technology application, mentoring, and continuous program evaluation. The results of this service showed an increase in the ability of partners in business management, digital marketing, and the application of renewable energy technology in the form of solar power systems to support cultivation operations. In addition, there was a significant improvement in the quality of management after the training, with participants showing improved financial, marketing, and operational management. The conclusion of this activity is that the application of renewable energy technology and improved management capacity through training and mentoring can successfully support the sustainability of the lobster farming business in Sawarna Village, thus helping farmers to face the environmental and economic challenges faced in the long term.

Keywords: Community Partnership Service (PKM); Lobster Farmers; Blue Economy; Renewable Energy; Hybrid PLTS; MSME Management; Sawarna Village

Introduction

Blue Economy State is a concept of sustainable and inclusive economic development, with an emphasis on the responsible and sustainable use of marine resources. The main principle of the Blue Economy is to maintain a balance between economic activities and environmental conservation, especially marine ecosystems. Through this approach, marine resource management is not only oriented towards economic growth, but also towards the sustainability of the ecosystem for future generations.(Silver et al., 2015). The implementation of

the Blue Economy covers various sectors such as fisheries, marine tourism, and renewable energy derived from the sea, all of which contribute to economic development while reducing negative impacts on the environment.(Voyer et al., 2018).

In the context of the Blue Economy, the priority programs of the MMAF Policy focus on sustainable management of marine resources, to encourage responsible fishing practices, which are in line with the principles of the Blue Economy, aiming to ensure that economic activities provide maximum benefits to local communities while maintaining the health of marine

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ecosystems.(KKP, 2023; Minister of Maritime Affairs and Fisheries, 2024).

However, the biggest challenge faced in implementing the Blue Economy is climate change. Climate change has a direct impact on the health of marine ecosystems, which then affects the sustainability of marine resources such as lobsters. Global warming causes increased sea temperatures, changes in ocean current patterns, and increased sea acidity, all of which can damage the natural habitat of lobsters and reduce fisheries productivity.(Gattuso et al., 2015). Therefore, it is important for Blue Economy policies to integrate climate change mitigation strategies to ensure the sustainability of marine ecosystems and the economic well-being of communities dependent on marine resources.(Kaczan et al., 2023; Lam et al., 2020; Le Blanc et al., 2017).

In this context, marine biota cultivation activities in ponds use the Recirculating Aquaculture Systems (RAS) system. The RAS system has been successfully used for commercial lobster cultivation in Europe.(Drengstig & Bergheim, 2013), so that lobster cultivation in ponds using the RAS system is one way to adapt and innovate to face the challenges posed by climate change.(Attramadal et al., 2021; Dos Santos et al., 2022; Roy, 2018).

Sawarna Village, which is located in Lebak District, Bayah Regency, Banten Province, is famous for its coastal potential, namely Ciantir Beach, Tanjung Layar Beach, Legon Pari Beach, and Karang Taraje Beach.(Sawarna, 2022). In addition, there are lobster commodities that are important assets to support the lives and economy of local communities. This creates opportunities for the community in lobster cultivation, especially in Rock Lobster (*Panulirus Penicillatus*). Lobster is one of the important fishery commodities and has high economic value.(Indradinata & Samputra, 2023). As a commodity with high export value, lobster plays a role in contributing to the local economy and national food security.(FAO, 2024).

Based on the results of the team's previous research in 2023, it shows that the situation in Sawarna Village reflects the urgent need for a more integrated and collaborative strategy among stakeholders, including fishermen, cultivators, government, private sector, and educational institutions to ensure the development of a sustainable lobster industry.(Reztrianti et al., 2023). This Community Service Initiative is a response to the need for an integrated and collaborative strategy in Sawarna Village, involving stakeholders to ensure the sustainability of the lobster industry.

The lobster farmer group in Sawarna Village is a partner in this service, consisting of two groups. The first, under the leadership of Kang Alit, is in Leles Village and has been operating for two years (Figure 1. Left Photo). The second, led by Kang Konot in Ciantir

Beach, has been operating for three years (Figure 1. Right Photo). The farmer's activities in both locations involve close cooperation with fishermen, where farmers routinely buy fishermen's catches at fair prices and in accordance with market standards. This practice not only supports the sustainability of the farmer's business, but also contributes to the local economy.



Figure 1. Kang Alit and Kang Konot's rearing pond
(Source: PDP Documentation, 2023)

Sawarna Village often experiences power outages that can last between 6 to 48 hours. This is due to the lack of adequate infrastructure and limited access to alternative energy. This condition is very detrimental to farmers because the aeration and temperature control systems that are vital for the survival of lobsters cannot function without electricity. The incident in November 2023, the death of lobsters with a total of 50 kg occurred due to a long power outage, causing a loss of -/+ Rp 30,000.00 for the farmers.

Lobster farmers in Sawarna village also experience limitations in knowledge and management skills, this can hinder the management and development of their cultivation businesses effectively and reduce the potential for growth and sustainability of the business. In addition, lobster farmers face environmental challenges and the impacts of climate change, affecting marine ecosystems and lobster habitats that often appear only at certain times (seasonal). Farmers need adaptation strategies and sustainable cultivation practices to reduce environmental impacts and ensure the sustainability of marine resources and their cultivation businesses in the face of climate change.

The aim of this Community Partnership Service (PKM) is to overcome various problems faced by lobster farming groups in Sawarna Village, to improve their knowledge and skills in management, and to support the adoption of digital technology and alternative energy using solar power.(Hernawati et al., 2022; Khairul Nugraha et al., 2023).

This service is also directly related to the Sustainable Development Goals (SDGs), especially SDG 1 (No Poverty) in increasing business productivity and efficiency.(Küfeoğlu, 2022a), so that it can reduce poverty, SDG 7 (Affordable and Clean Energy) through the application of renewable energy(Estevão & Lopes, 2024), SDG 9 (Industry, Innovation, and Infrastructure) application of the latest innovations and technologies in lobster cultivation(Küfeoğlu, 2022b), especially the cultivation of rock lobsters in ponds, SDG 8 (Decent Work and Economic Growth) by promoting economic

growth through skills improvement and opening up wider market access(Bilek-Steindl & Url, 2022), and SDG 14 (Life Below Water), supports sustainable management and conservation of marine resources.(Neumann et al., 2017). This initiative is designed to have a direct impact on improving the economic welfare of farmers and their positive

contribution to the local and national economy in the context of the blue economy.

To determine priority issues in this PKM activity, the team conducted an in-depth analysis of the existing conditions of the partners. Through interactive discussions and direct observations at Kang Alit's residence, the team has identified the challenges faced by the partners.

Table 1. Priority Problems and Solutions

Fields	Sub-Problems	Solution
Production	<ul style="list-style-type: none">• Frequent power outages with no alternative energy sources available.• Lack of supporting facilities such as chest freezers to minimize losses caused by power outages.• Absence of essential supporting facilities such as protein skimmers, temperature control tools, water quality equipment, and salinity regulation tools for lobster productivity.	<ol style="list-style-type: none">1. Renewable energy as an alternative energy solution.2. Provision of supporting facilities, such as chest freezers, to store deceased lobsters to retain their economic value.3. Training and mentoring on the use and operation of alternative energy sources.4. Provision of supporting facilities based on partner needs, such as protein skimmers, temperature control devices, water quality tools, and salinity regulation tools to reduce lobster mortality rates.
Business Management	<ul style="list-style-type: none">• Limited knowledge and skills in business management, including operational management, financial management, and human resource management.• Restricted capital for investment due to the absence of access to financing support.	<ol style="list-style-type: none">5. Training and mentoring on easily understandable entrepreneurship topics, including business management and simple financial recording for small and medium enterprises (SMEs).6. Training and mentoring in business proposal creation to support partners in becoming more professional and trustworthy, facilitating access to external financing.
Marketing	<ul style="list-style-type: none">• Limited knowledge and skills in effective marketing strategies.• Lack of access to broader and more profitable markets.• Limited knowledge and skills in product promotion.	<ol style="list-style-type: none">7. Training and mentoring on developing effective marketing strategies through digital marketing.8. Training and mentoring on leveraging social media to expand market access.9. Training and mentoring on creating engaging digital content for product branding using Canva.

(Source: Primary Data, 2024)

These solutions are developed to address specific problems experienced by partners, with the aim of improving partner welfare and supporting environmental sustainability and fisheries resources.

Method

The approach used to implement this activity is Participatory Rural Appraisal (PRA). The PRA approach is to formulate plans and policies in rural areas by involving the community to the maximum.(Rayesa et al., 2023). Through this PRA approach, the Sawarna village community, especially lobster farmers, are actively and effectively involved. The suitability and effectiveness of the program can be obtained for the community to ensure the sustainability of the program.(Hernawati et al., 2022). The method used to solve the problems faced by partners is by providing socialization, training in management and modern cultivation practices, application of technology, mentoring and evaluation, and program sustainability (Figure 2.).

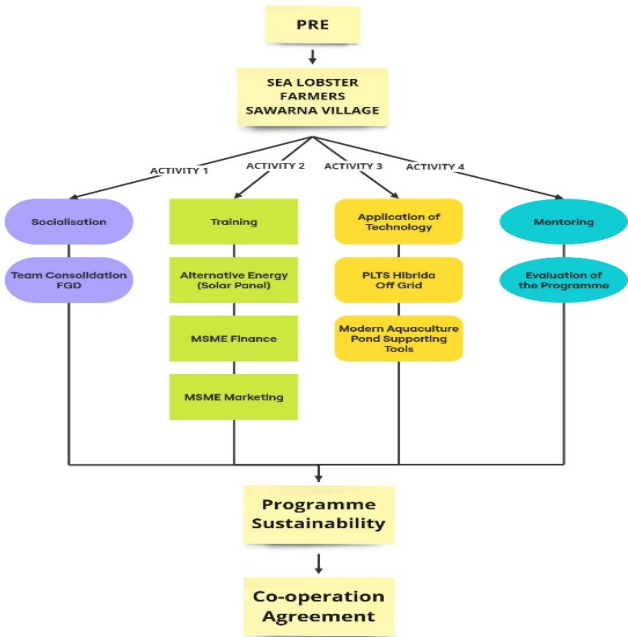


Figure 2. Method of Implementing PKM 2024 Activities
(Source: Primary Data, 2024)

Results and Discussion

Socialization

Activity 1, we held an initial meeting at Darma Persada University, East Jakarta on June 24, 2024 to discuss the implementation of activities to be carried out in Sawarna Village, Banten Province. This activity is part of the initial stage of the 2024 Community Partnership Service program that we initiated to discuss the use of alternative energy and the integration of digital tools in our partners' business operations.

Next, on June 26, 2024, the team conducted an FGD with stakeholders. The FGD was attended by the Head of Sawarna Village, Mr. Iwa Sungkawa, S.Pd, Secretary of Sawarna Village, Mrs. Holisho, Director of BumDes Warna Jaya, Mr. Jetri Andarka, and partners. The event began with an introduction to the objectives and benefits of the program that we will run. We emphasize the importance of exchanging information and knowledge, which is the foundation of this collaboration. We also explain in detail about the technology and training that we will implement. It is important for us to ensure that every step and benefit of this activity is well understood by our partners.

This meeting was not only a forum for us to convey plans and programs, but also a means for partners and stakeholders to feel more involved and contribute to designing the activities they will participate in. The togetherness and openness in the meeting promised a good start to what we hope will be a productive and ongoing collaboration (Wismanu et al., 2023).

Training

Activity 2 on August 11, 2024, the team provided a series of training at the partner's location. The training was attended by 2 groups of lobster farmers. This activity is designed to improve the partner's capabilities in production, business management, and marketing through five training modules that we have determined, and according to the needs and conditions of the partner (Figure 2.).

Partners are taught how to utilize the hybrid solar panel system, which is very important considering the frequent power outages in Sawarna village. This training activity also emphasizes business and financial management for MSMEs. This training is designed to provide an in-depth understanding of the importance of effective financial management in running a business. Partners are taught how to manage cash flow, create simple financial reports, and understand the basics of financial planning for small businesses. This knowledge is expected to help partners improve the efficiency of their financial management, which ultimately contributes to the sustainability of their businesses.

In addition to financial management, the training also focuses on marketing management, especially

effective marketing strategies for MSMEs. Partners are trained to use digital platforms and applications such as Canva to market their products through social media. The goal of this training is to increase the visibility and market access of partner products, so they can reach more consumers and increase sales. This training also includes techniques for creating attractive digital content and marketing strategies tailored to the needs and characteristics of their target market.



Figure 2. Pre and Post PKM Training (Source: PKM Documentation, 2024)

The following is a histogram image based on the results of the pre- and post-training implementation that has been carried out:

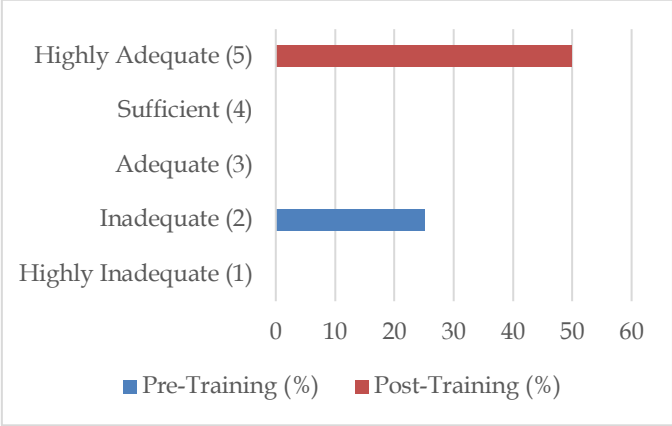


Figure 3. Pre and Post Training (Source: Primary Data, 2024)

Based on Figure 3., before the training, 58.3% of participants were at rating 3, indicating that the organization's management system covering financial management, marketing, and performance management was still in the moderate category, but not yet adequate. After the training, there was a significant increase in management quality, with 70% of participants giving a rating of 5. This indicates that the training conducted has succeeded in improving the management system in the aspects of financial management, marketing, and performance management.

Application of Technology

Activity 3, we apply technology to support cultivation production (Figure 5.), Hybrid Off PLTS: 1000 VA, 24 V, with 800 Wp Solar panels. 2x100Ah VRLA Deep Cycle Battery which will be used in one of the partner ponds measuring 2.5 mx 5.5 m. The provision of this tool is to support lobster cultivation operations that require a stable and environmentally friendly energy supply. This is to help partners overcome frequent power outages and energy savings can be applied to support operational efficiency of the business (Saepul Uyun et al., 2022; Yandri et al., 2020).

In addition, the team also provided business support tools, such as two 210-liter chest freezer packages, and digital tools such as protein skimmers, temperature, water, and salt salinity control devices for partners. These supporting tools are to minimize economic losses due to lobster deaths by maintaining their selling value through frozen storage and can adopt modern and sustainable cultivation practices (Figure 4.).



Figure 4. Implementation of PKM Technology
(Source: PKM Documentation, 2024)

Program Assistance and Evaluation

Activity 4, provide ongoing mentoring before and after training, especially to carry out all activities 1-4, and monitor the application of science and technology that has been provided (Figure 5.), especially monitoring the Hybrid PLTS that has been implemented, and evaluating its development and impact on partners to determine the sustainability of the program (Figure 5.).



Figure 5. Periodic Checking of Hybrid PLTS
(Source: PKM Documentation, 2024)

Program Sustainability

This activity was realized in a Cooperation Agreement (PKS) event held at the Sawarna Village Hall on September 11, 2024. This activity was attended by partners, Lecturers as a service team, academics, Head of Sawarna Village Mr. Iwa Sungkawa, S.Pd, Secretary of Sawarna Village Mrs. Holisho, and Director of BumDes Warna Jaya Mr. Jetri Andarka, marking the symbolic handover and cooperation agreement for the sustainability of the PKM program in 2024 (Figure 5.). This partnership is expected to support partners on an ongoing basis, with regular monitoring and additional training as needed in the future.

The program's sustainability plan includes continuous mentoring, monitoring of the technology implemented, and periodic training to ensure that partners remain empowered and can adapt to changing conditions or markets. In addition, the program will also involve further collaboration between universities to conduct deeper research and community service in Sawarna village, which will strengthen the capacity and

diversification of partner businesses as well as the needs of the Sawarna Village community in the future.



Figure 6. Sustainability of the 2024 PKM Program
(Source: PKM Documentation, 2024)

Conclusion

Through this collaboration, not only are technical capabilities enhanced, but also the economic and social independence of partners is strengthened, enabling them to not only survive, but also thrive in the face of future challenges. This PKM activity focuses on empowering lobster farmer groups in Sawarna Village through the application of renewable energy technology to support the sustainability of the blue economy. The problem of limited energy infrastructure and management knowledge is overcome through intensive training, socialization, and the application of alternative energy technology such as the Hybrid PLTS system and digital tools to support business.

The implementation of this program has resulted in several achievements, including improving management skills, marketing, and sustainable lobster production. The use of renewable energy can overcome

frequent power outages, making lobster cultivation operations more efficient and environmentally friendly. Post-training assistance also helps partners implement new technologies and strategies to increase productivity and economic stability.

Through close collaboration between farmers, academics, village government, and partners, this activity has had a significant positive impact on the sustainability of the economy and ecosystem in Sawarna Village and opened up opportunities for future lobster business development. Recommendations for the sustainability of the program are as follows:

1. **Renewable Energy Network Development.**
The Hybrid PLTS system has proven effective in overcoming power outages, so the scope of renewable energy use such as solar and wind power needs to be expanded to reach more farmers.
2. **Increasing Business Management Capacity.**
Advanced programs are needed to deepen management aspects, such as financial record keeping, market analysis, and expansion strategies, so that farmers can be more independent and professional.
3. **Regular Integration of Digital Technology.**
Farmers need to continue to improve their ability to utilize digital technology, not only for marketing but also for business operations, such as inventory, production control, and monitoring the cultivation environment.
4. **Increasing Collaboration Between Stakeholders.**
Collaboration between local governments, educational institutions, the private sector, and farming communities must be strengthened to ensure sustainable support, including collaborative programs such as applied research and mentoring.
5. **Monitoring and Evaluation of Program Sustainability**
The program needs to be continuously monitored and evaluated periodically to ensure its sustainability and impact on the local economy, as well as to provide feedback for further development.
6. **Diversification of Cultivation Business.**
Given the dependence on lobsters which is affected by seasons and environmental changes, diversification of other marine commodity cultivation efforts needs to be explored to maintain income stability.

By implementing these recommendations, it is hoped that the development of lobster cultivation businesses in Sawarna Village can continue sustainably and independently.

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