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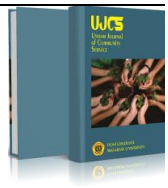

# Empowerment of Lobster Farmers Based on Renewable Energy to Support Blue Economy in Sawarna Village, Banten Province

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**Abstract:** This Community Partnership Programme (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 environmental and economic challenges faced in the long term.

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

## Introduction

State Blue Economy 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 activity and environmental conservation, especially marine ecosystems. Through this approach, marine resource management is not only oriented towards economic improvement, but also towards ecosystem sustainability for future generations (Silver et al., 2015). The implementation of the Blue Economy encompasses various sectors such as fisheries, marine tourism and ocean-derived renewable energy, all of which contribute to economic development while reducing negative environmental impacts (Voyer et al., 2018).

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

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maintaining the health of marine ecosystems (KKP, 2023; Menteri Kelautan dan Perikanan, 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 in turn affects the sustainability of marine resources such as lobsters. Global warming leads to increased seawater temperatures, changes in ocean current patterns, and increased seawater acidity, all of which can damage the lobster's natural habitat and reduce the productivity of the fishery (Gattuso et al., 2015). It is therefore 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 farming activities in ponds using Recirculating Aquaculture Systems (RAS). RAS systems have been successfully used for commercial lobster farming in Europe (Drengstig & Bergheim, 2013), so farming lobster in ponds using RAS systems is one way to adapt and innovate to meet the challenges posed by climate change (Attramadal et al., 2021; Dos Santos et al., 2022; Roy, 2018).

Sawarna Village, located in Lebak District, Bayah Regency, Banten Province, is famous for its potential beach areas, namely Ciantir Beach, Tanjung Layar Beach, Legon Pari Beach, and Karang Taraje Beach (Sawarna, 2022). In addition, there is a lobster commodity that makes an important asset to support the life and economy of the local community. This makes opportunities for the community in lobster farming, especially in Rock Lobster (Panulirus Penicillatus). Lobster is one of the important fishery commodities and has high economic value (Indradinata & Samputra, 2023). As a high-value export commodity, lobster contributes 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 fishers, cultivators, government, private sector, and educational institutions to ensure the sustainable development of the lobster industry (Reztrianti et al., 2023). This service initiative responds to the need for an integrated and collaborative strategy in Sawarna Village, involving stakeholders to ensure the sustainability of the lobster industry.

The lobster farming group in Sawarna Village is a partner in this service, which consists of two groups. First, under Kang Alit's leadership, the Leles Village has been in operation for two years. (Figure 1. Left side photo). The second is led by Kang Konot at Ciantir Beach, and has been operating for three years. (Figure 1. Right Side Photo). The activities of farmers in these two locations involve close cooperation with fishermen, with farmers routinely purchasing fishermen's catches at fair prices that are in line with market standards. This practice not only supports the sustainability of the farmer's business, but also contributes to the economy of the local community.

**Figure 1.** Mr. Alit and Mr. Konot Enlargement Ponds (Source: PDP Documentation, 2023)

Sawarna Village experiences frequent power outages that can last between 6 and 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 lobster survival cannot function without electricity. Last November 2023 incident, the death of lobsters totaling 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 management knowledge and skills, which can hinder the effective management and development of their aquaculture businesses and reduce the potential for growth and sustainability. In addition, lobster farmers face environmental challenges and the impact of climate change, affecting marine ecosystems and lobster habitats that often appear only at certain times (seasonal). Farmers need adaptation strategies and sustainable aquaculture practices to reduce environmental impacts and ensure the sustainability of their marine resources and aquaculture businesses in the face of climate change.

The purpose of this Community Partnership Service (PKM) is to overcome the various problems faced by the group of lobster farmers in Sawarna Village, in improving their knowledge and skills in management, as well as supporting 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 as to reduce poverty, SDG 7 (Affordable and Clean Energy) through the implementation of renewable energy (Estevão & Lopes, 2024), SDG 9 (*Industry, Innovation, and Infrastructure*)

application of the latest innovations and technologies in lobster farming (Küfeoğlu, 2022b), particularly rock lobster farming in ponds, SDG 8 (Decent Work and Economic Growth) by promoting economic growth through skill upgrading and opening wider market access (Bilek-Steindl & Url, 2022), and SDG 14 (*Life Below Water*), supporting 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 the priority problems in this PKM activity, the team conducted an in-depth analysis of the partners' existing conditions. Through interactive discussions and direct observation at Kang Alit's residence, the team has identified the challenges faced by the partners.

| Bidang | Sub Permasalahan | Solusi |
|---|---|---|
| Produksi | • Pemadaman listrik yang sering terjadi dan tidak ada energi listrik alternatif.<br>• Tidak adanya fasilitias penunjang seperti *chest freezer* untuk meminimalisir kerugian yang disebabkan pemadaman listrik.<br>• Tidak adanya fasilitas penunjang seperti *protein skimmer*, alat kontrol suhu, air, dan salinitas garam untuk produktivitas lobster. | 1. Energi terbarukan sebagai solusi energi alternatif.<br>2. Penyediaan fasilitas penunjang penyediaan *chest freezer* untuk menampung lobster yang mati sehingga masih terdapat nilai ekonomisnya.<br>3. Pelatihan dan pendampingan dalam penggunaan dan pengoperasian energi alternatif.<br>4. Penyediaan fasilitas penunjang sesuai dengan kebutuhan mitra seperti *protein skimmer*, alat kontrol suhu, air, dan salinitas garam untuk mengurangi tingkat kematian lobster. |
| Manajemen Usaha | • Minimnya pengetahuan dan ketrampilan manajemen usaha, termasuk operasional usaha, manajemen keuangan, dan sumber daya manusia.<br>• Terbatasnya modal untuk investasi karena tidak ada pendukung akses pembiayaan. | 5. Pelatihan dan pendampingan dengan topik Kewirausahaan yang mudah dipahami, yang meliputi pengelolaan manajemen usaha dan pencatatan keuangan sederhana untuk skala umkm.<br>o. Pelatihan dan pendampingan dalam pembuatan proposal bisnis untuk mendukung mitra lebih profesional dan terpercaya, agar memudahkan mitra untuk mendapatkan pembiayaan eksternal. |
| Pemasaran | • Minimnya pengetahuan dan ketrampilan strategi pemasaran yang efektif.<br>• Tidak adanya akses ke pasar yang lebih luas dan menguntungkan.<br>• Minimnya pengetahuan dan ketrampilan dalam mempromosikan produk. | 7. Pelatihan dan pendampingan dalam menyusun strategi pemasaran yang efektif melalui pemasaran digital.<br>8. Pelatihan dan Pendampingan untuk memasarkan pada sosial media dalam meningkatkan akses pasar yang lebih luas.<br>o. Pelatihan dan pendampingan dalam pembuatan konten digital yang menarik untuk *branding* produk menggunakan aplikasi Canva. |

(Sumber: Data Primer, 2024)

**Gambar 2.** Problem Prioritization and Solution

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

## Method

The approach used to carry out this activity was Participatory Rural Appraisal (PRA). The PRA approach is to formulate plans and policies in rural areas by involving the community as much as possible (Rayesa et al., 2023). Through this PRA approach, Sawarna villagers, 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 to provide socialization, management training and modern cultivation practices, technology application, mentoring and evaluation, and program sustainability (Figure 3).

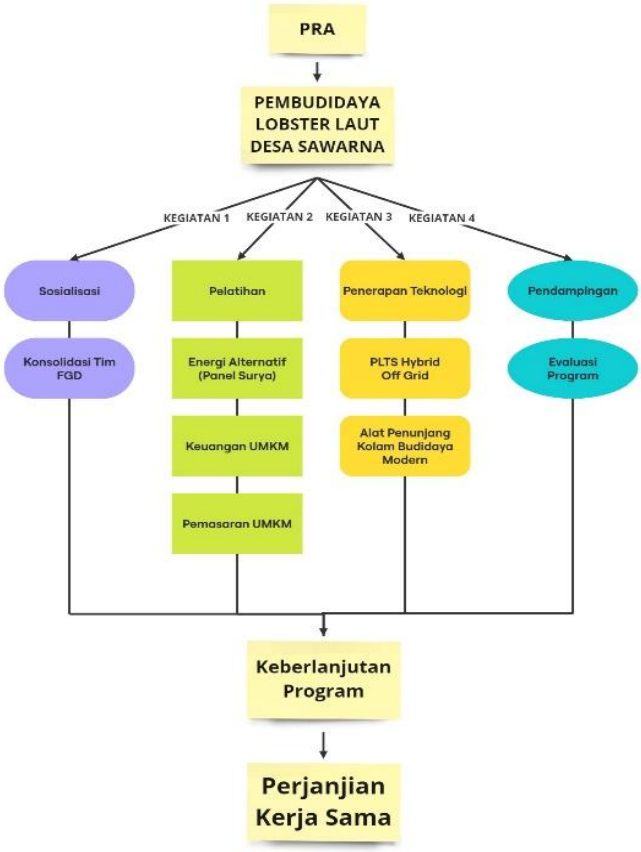


**Figure 3.** PKM 2024 Activity Implementation Method (Source: Primary Data, 2024)

## Result 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 phase of our 2024 Community Partnership Service program that we initiated to address the use of alternative energy and the integration of digital tools in our partners' business operations.

Furthermore, on June 26, 2024, the team conducted FGDs with stakeholders. The FGD was attended by Sawarna Village Head Mr. Iwa Sungkawa, S.Pd, Sawarna Village Secretary Mrs. Holisho, Director of

BumDes Warna Jaya Mr. Jetri Andarka, and partners. The event began with an introduction to the purpose and benefits of the program that we will run. We emphasized 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 is 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 in designing the activities they will participate in. The togetherness and openness in the meeting promises to be a good start for what we hope will be a productive and sustainable collaboration (Wismanu et al., 2023).

*Training*

Activity 3, on August 11, 2024, the team delivered a series of trainings at the partner site. The training was attended by 2 groups of lobster farmers. This activity is designed to improve partners' capabilities in production, business management, and marketing through five training modules that we have determined, and in accordance with the needs and conditions of partners (Figure 3).

Partners are taught how to utilize a 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 UMKM. 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 statements, and understand the basics of financial planning for small businesses. This knowledge is expected to help partners improve the efficiency of their financial management, ultimately contributing to the sustainability of their businesses.

In addition to financial management, the training also focused on marketing management, particularly effective marketing strategies for UMKM. Partners are trained to use digital platforms and apps such as Canva to market their products through social media. The aim of the training is to increase the visibility and market access of partner products, so that they can reach more consumers and increase sales. The training also covers techniques for creating engaging 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:

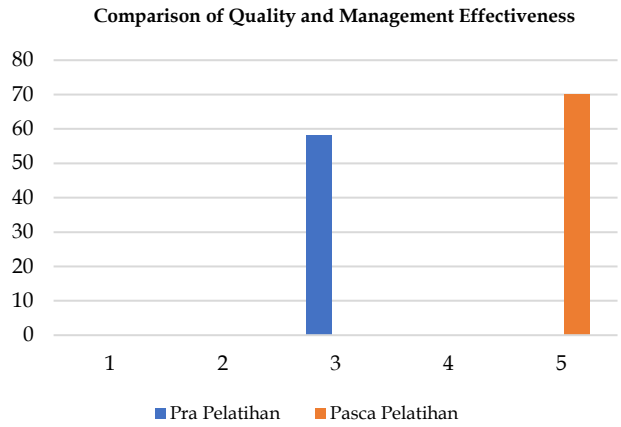


**Figure 3:** Pre and Post Training (Source: Primary Data, 2024)

Based on Figure 3, before the training, 58.3% of the participants were in 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 improvement in the quality of management, with 70% of participants giving a rating of 5. This shows that the training has successfully improved the management system in the aspects of financial management, marketing, and performance management.

*Technology Implementation*

Activity 3, we apply technology in supporting aquaculture production (Figure 5), Hybrid Solar Power Off: 1000 VA, 24 V, with 800 Wp solar panel. 2x100Ah Deep Cycle VRLA Batteries that will be used in one of

the partner ponds with a size of 2.5 m x 5.5 m.m. The provision of this equipment is to support lobster farming operations that require a stable and environmentally friendly energy supply. This is to assist partners in overcoming frequent power outages and energy savings can be applied to support business operational efficiency (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 control devices, water, and salt salinity for partners. This support tool is to minimize economic losses due to lobster mortality by maintaining its selling value through frozen storage and can adopt modern and sustainable aquaculture practices (Figure 4).


**Figure 4:** Application of PKM Technology
(Source: PKM Documentation, 2024)

*Program Assistance and Evaluation*

Activity 4, provide continuous assistance pre and post training, especially to implement all activities 1 - 4, and monitor the application of the knowledge and technology that has been provided (Figure 5), especially monitoring the PLTS Hybrid 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 Solar Power Plant
(Source: PKM Documentation, 2024)

*Sustainability Programme*

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

The program's sustainability plan includes continuous mentoring, monitoring of applied technologies, and periodic training to ensure that partners remain empowered and can adapt to changing conditions or markets. In addition, this program will also involve further cooperation between universities to conduct more in-depth research and service in Sawarna village, which will strengthen the capacity and diversification of partner businesses and the needs of the Sawarna village community in the future.

**Figure 6.** Sustainability Programme PKM 2024
(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 thrive in the face of future challenges.

This PKM activity focuses on empowering lobster farming 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 addressed through intensive training, socialization, and the application of alternative energy technologies such as hybrid solar systems and digital tools to support businesses.

The implementation of this program resulted in several outcomes, including improved management skills, marketing, and sustainable lobster production. The use of renewable energy can overcome frequent power outages, making lobster farming operations more efficient and environmentally friendly. Post-training mentoring also assists partners in applying new technologies and strategies to improve productivity and economic stability.

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

1. Renewable Energy Grid Development.
   Sistem PLTS Hybrid terbukti efektif dalam mengatasi pemadaman listrik, sehingga cakupan penggunaan energi terbarukan seperti tenaga surya dan angin perlu diperluas untuk menjangkau lebih banyak pembudidaya.
2. Improved Business Management Capacity.
   Advanced programs are needed to explore management aspects, such as financial records, market analysis, and expansion strategies, so that farmers can become more independent and professional.
3. Periodic Integration of Digital Technology.
   Farmers need to continuously improve their ability to utilize digital technology, not only for marketing but also for business operations, such as inventory, production control, and monitoring of the cultivation environment.
4. Increased Collaboration Between Stakeholders.
   Collaboration between local governments, educational institutions, the private sector, and farming communities should be strengthened to ensure continued support, including collaborative programs such as applied research and mentoring.
5. Monitoring and Evaluation of Program Sustainability.
   The program needs to be regularly monitored and evaluated to ensure its sustainability and impact on the local economy, and to provide feedback for further development.
6. Cultivation Business Diversification.
   Given the dependence on lobster which is affected by seasonality and environmental changes, diversification of other marine commodity farming businesses needs to be explored to maintain income stability.

By implementing these recommendations, it is expected that the development of lobster farming in Sawarna Village can continue in a sustainable and independent manner.

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