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The Evaluation of Smart Fishing Lamps and The Initiation of Co-Operatives Concept

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A B S T R A C T

The use of LEDs in fishing operations has been increasing due to the reduction of fuel consumption and fuel can be replaced by the renewable energy sources, for example solar and seawater energy, which is easy to obtain, cheap, and does not produce waste that harms the environment. The objective of this community development is to test the newly designed smart lamp powered by seawater, and to disseminate the concept of cooperation. The methods used were assisting and coaching in the implementation of the smart lamp and conducting seminars on cooperative concepts. The seawater battery lamp showed stable performance in the voltage range of 2.5 V - 4.5 V within 2 hours of fishing operation. The results of SONAR observations showed that fish began to approach under 10 minutes and gathered at 45 minutes with depths ranging from 1-4 meters. The lamp powered by the fuel oil powered generator is significantly brighter than the lamp powered by saltwater batteries. Some recommendations arise including the necessity for an alternative to zinc as a durable electrode, reduced tool size dimensions, a rust-resistant wire system, fewer cells in one battery unit, brighter lighting, and a more compact tool form design. The catches from both locations are also quite similar, including squid, cuttlefish, crab, and anchovies. The dissemination of the cooperative social entrepreneurship concept were effective shown by the score of intention after the seminar which is increased by 40%. It was recommended to accelerate the establishment of cooperatives to improve the level of living. This community development activities are considered very useful for the fishermen in Palabuhan Ratu and Karang Antu Serang.

Keywords: *Renewable Energy, Fish Lure Lamps, Co-Operatives, Pelabuhan Ratu, Serang.*

INTRODUCTION

The practice of light fishing has undergone a significant evolution since the advent of the incandescent lamp in 1879. The utilization of diverse lighting sources as attractants by fishermen is contingent upon the evolution of technology, the scale of business operations, the type of fishing gear employed, the availability of energy sources and the species of fish being targeted. Since the 1970s, numerous fishing vessels in Indonesia have employed light technology. However, in practice, the consumption of electrical energy remains considerable, particularly given the scarcity and rising cost of fuel oil. The fuel oil required to power fishing lamps in light fishing activities represents up to 30% of all operational costs. In the fishery platform, the fuel component represents a significant proportion of the daily operational costs, accounting for approximately 60% of the total. This renders fishing activities relatively energy-intensive and inefficient. Conversely, the majority of the energy source for fishing lamps is still derived from the utilization of motor fuels, which contributes significantly to environmental pollution. The use of motor is less environmentally friendly because it still uses fossil fuels which are classified as non-renewable energy sources (Putra. 2020). The combustion of fuel in internal combustion engines produces harmful substances that can have a negative impact on human health and the environment. The utilization of non-renewable energy sources gives rise to a number of issues, including the depletion of these resources and the detrimental effects of their utilizations. Consequently, the development of a more efficient and effective replacement lamp technology is required to enhance fishing productivity in light fishing, while simultaneously reducing energy consumption and promoting environmental sustainability. The use of LEDs in fishing operations has been shown to reduce fuel consumption by 16-20.2% (Kuo and Shen 2017; Yamashita 2012). This is because LEDs only require low voltage and current so that their energy sources can be combined using renewable energy sources. The use of energy from seawater as energy sources is one among the right choices. This is because the amount is unlimited, easy to obtain, cheap, the technology is simple, and does not produce waste that harms the environment (Park. 2016; Mourant 2016).

Based on the above discussion, the innovative seawater battery lamp technology was created by fishery scientist in IPB University to reduce environmental issues and improve productivity. The seawater battery lamp technology has been researched and developed since 2017 and has had Intellectual Property Patent Certificate Granted IDS000003193 since 2020. This technology uses light-emitting diode (LED) lamps combined with renewable energy. LED lights have various advantages including high efficiency in energy use, longer technical life, high light illumination levels with low power, and are environmentally friendly as they do not contain mercury (Susanto, 2019).

The body of the lamp seawater battery consists of: PVC pipes, hubcaps, brass bars, wires, zinc, copper and insulators. Meanwhile, the lamp consists of top lights, namely red and green lights, and dip lights, namely blue lights. The lamp with seawater battery is in the form of a tube with a diameter of 4-inch and a height of 40 cm. (Fig.1a). Then for the Mobile Apps smart light system has features: User Management (Register and Login), Location Map, Weather Prediction, Smart Lamp Setting, Fish Catch Report, Device Performance Visualization, Edge Synchronization with server. (Fig. 1b)

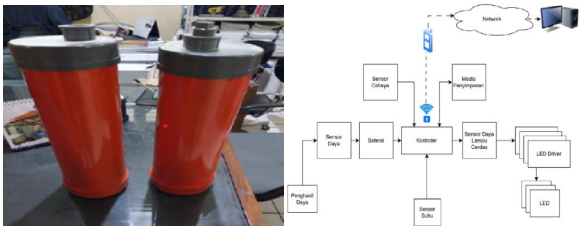

Figure 1. Fishery lamp with seawater battery 1b) Smart Lamp system

The place for the trial of the smart lamp installation is in Pelabuhan Ratu, and Karang Antu Serang, both places were chosen because they are marine areas where fishermen generally fish on platforms using lamps with sources of fuel oil energy, and do not yet have a cooperative.

METHODS

The activities were carried out in accordance with the five community development objectives and indicator of success, described in Table 1 below.

RESULT AND DISCUSSION

Stage 1. Introducing the Program to Fishermen

Conducting a site survey provides accurate and detailed information on the physical, geographical and environmental conditions of an area, which is valuable for informed decision-making and effective planning. The initiation phase was carried out in August 2023. The fishermen platform was assessed, as well as the socialization of the smart lamp using battery from seawater. A review of the facilities at the IPB Marine Field Station in Pelabuhan Ratu was also conducted, as well as a visit to the Karang Antu Port and the fishery vocation campus in Serang. Furthermore, we visited fishing villages in Pelabuhan Ratu and Karang Antu, to have a discussion with fishermen and checked the condition of fishermen's nets. (Fig. 2)

Figure 2. Initiation stage in a) Serang and b) Pelabuhan Ratu

As can be seen in Figure 2, the initiation stage visits were made in two separate places in the North (Serang) and in the South (Pelabuhan Ratu) of the island of Java. We formed a group of fishermen who usually work in platform, and are ready to use seawater battery lamps, obtained support to test the seawater battery lamp in their area.

Stage 2. Mentoring and Installation

Fishermen in Serang and Pelabuhan Ratu are encountering difficulties in boosting their fish

Table 1. Methods of PKM Activities

No	PKM activities	Methods	Indicators of success
1	Introduction	Communication, formed groups of platforms	Understanding the operational aspect of smart lamps
2	Mentoring and Installation	Training and mentoring on the use and application of lamp	Improving the skill to use the smart lamp
3	Field Observation	Visit and observation, data collection	Increase in number of catches, and battery life
4	Evaluation and Refinement	Data analysis	Effectiveness and efficiency of battery, level of illumination
5	Co-operative concepts seminar	FGD and survey about co-operative new business model	Improvement in knowledge level

catch. One promising approach is to employ Fish Lure Smart Lights, using seawater battery, which have the potential to improve fishing efficiency. Nevertheless, fishermen may need training, guidance, and support with installation to fully adopt and make the most of this equipment. The anticipated outcome is that fishermen are knowledgeable about and proficient in operating the equipment (Fig. 3).

Figure 3. Mentoring and Installation assistance in Serang

As can be seen in Figure 3, the installation team provided guidance and mentoring on the smart light product, and together they carried out the installation at night on the fishermen's platform. The results were observed in a visual test to ensure that the fishermen could operate the marine-powered smart lights themselves.

Stage 3. Field Observation

Observing the Fish Attractor Smart Lamp is a key part of studying and researching the technology's performance stability and efficacy, as well as its environmental impact. The observations were made to monitor and analyze the functioning of the saltwater battery, the response of fish to the fish attractor smart lamp, and the device's simplicity of use by fisherman. Observations were carried out in October-November 2023, including two times in Pelabuhan Ratu and two times in Serang. Observations were made by engaging in fishing tools alongside fishermen (Fig. 4)

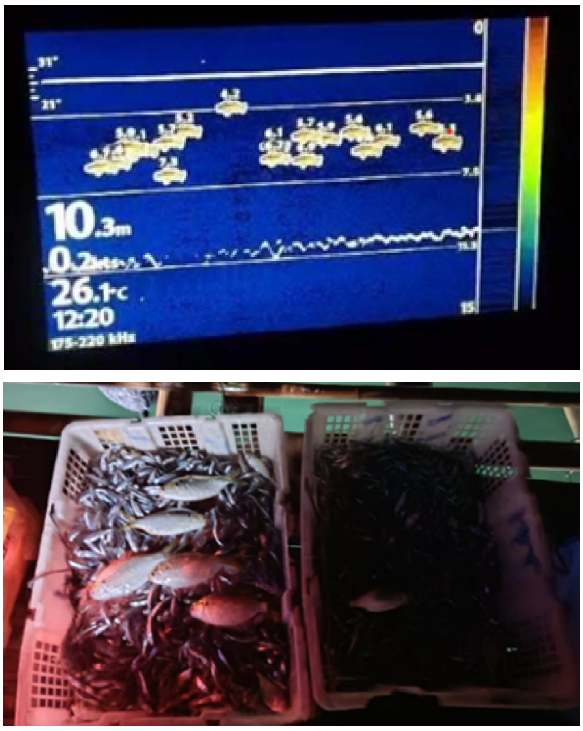

Figure 4. Field Observation using Sonar

As can be seen from Figure 4, the seawater battery showed stable performance in the voltage range of 2.5 V - 4.5 V within 2 hours of fishing operation. The results showed that the average value of current generated was 93.38 mA with a light intensity of 111.77 lux. Seawater battery lights can also power LEDs for 12-24 hours, so this technology has very potential to be developed and then implemented by fishermen. This is certainly a solution to the problems in light fishing in Indonesia related to high operational costs due to unstable fuel prices, and supporting low carbon initiatives.

Meanwhile, the results of SONAR observations showed that fish began to approach under 10 minutes and gathered at 45 minutes with depths ranging from 1-4 meters (Fig. 5).

Figure 5. Field Observation of seawater battery lights

Laboratory tests showed that the seawater battery was able to produce an average voltage and current of 4 V and 500 mA. Meanwhile, in terms of expenditure, seawater battery lights are more efficient than generators, with a comparison of expenditure for generator lights ranging from IDR 50,000-150,000/trip while seawater battery lights are only around IDR 20,000-50,000/trip. Based on the test results, the lamp powered by the generator is significantly brighter than the fish lure lamp powered by saltwater batteries. The catches from both locations are also quite similar, including squid, cuttlefish, crab, and anchovies.

Stage 4. Evaluation and Refinement

The evaluation and improvement of the Fish Attractor Smart Light product is a crucial step in enhancing the technology's performance and effectiveness. The smart lamp can be developed through a systematic review and continuous improvement process to better meet the needs of fishermen, optimize fish harvest, and minimize negative impacts on the environment.

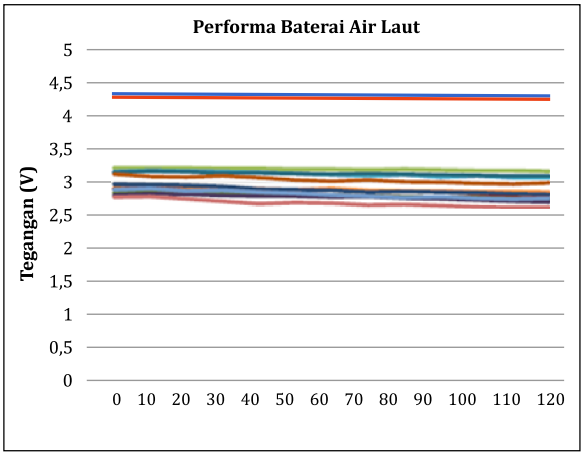

Figure 6. Performance evaluation of lamp powered by seawater battery.

The review addressed the necessary fixes or replacements based on the feedback from fishermen who use the tools. Several factors were identified, including the necessity for an alternative to zinc as a durable electrode, reduced tool size dimensions, a rust-resistant wire system, fewer cells in one battery unit, brighter lighting, and a more compact tool form design.

Stage 5. Introduction to co-operative and initial survey of Co-operative

According to Indonesia Law Number 12 of 1967, Indonesian cooperatives are people's economic organizations with a social character and consist of people, an economic arrangements as joint efforts based on the principle of kinship. The cooperative is expected to become a driver for the growth of entrepreneurs and cooperation so that the facilitation of marketing or promotion, legal protection, and incentives for the development of the business networks. Despite the benefit that cooperative could bring, the

number of cooperatives in Indonesia is decreasing 2% since 2016 (Katadata, 2022). Particularly, the number of co-operatives belong to fishermen is only 1.052 or only 1% out of total 98.638 total cooperative corporation in Indonesia.

Fishermen co-operatives still experience problems such as a low ratio of equity capital (less than 50 percent), the main capital of cooperatives still comes from outside parties, high non-performing loans, while the level of profitability is low. Consequently, economic and social conditions are dwindling in these communities. There are two main challenges in the implementation of co-operative entrepreneurship among fishermen in Indonesia: Firstly, lack of knowledge about co-operative entrepreneurship causing small-scale fishers are not yet become a member of a cooperative. Secondly, when co-operative was built, the management of the supply chain process from fish landing, weighing, and auctioning, mostly done in non-transparent process and involving middlemen mafia outside co-operative, which causing friction and fishermen to often withdraw from the co-operative forum.

The community development team disseminated the concept of cooperatives, followed by interviews and initial surveys. Twenty-five (25) fishermen who had completed the training on the use of smart lights with seawater batteries were given an understanding of cooperatives, followed by a survey on their perception and intention to establish a cooperative (Fig. 7).

Figure 7. Survey on fishermen's perspective in co-operative entrepreneurship model

Following the survey, it was observed that participants' perception and intention to form a cooperative has shown a high level of intention (likert scale 1 – 5. With number 1 indicates a low level of agreement and number 5 indicates a high level of agreement of the statement in the questionnaires). The questionnaire and its results' score are shown in Table 2 below.

Table 2. Questionnaires and Result of Survey

	Score	
	Before	**After**
Perception		
Co-operatives will create more jobs for my community	3	4
Co-operatives will attract more investment to my community	3	4
Our standard of living will improve greatly because of co-operatives	3	4
Co-operatives provide many desirable employment opportunities for residents	2	4
Avg	2.75	4
Intention		
I intend to establish co-operative social entrepreneurship	2	4
I will always try to work in co-operative in my daily life	2	4
I plan to sell fish in auction managed by co-operative	2	4
It is my intention to develop store to sell fish processed product	2	4
Avg	2.4	4

As can be seen in Table 2, the score of perception increased from 2.75 to 4 and the score of intentions increased from 2.4 to 4. Overall, there is an increase of 41%. An increase of more than 30% is considered very effective.

CONCLUSION AND RECOMMENDATION

The community development in Pelabuhan Ratu and Serang objectives of disseminating technology, and management about fishing light powered by seawater, making and installing the lamps in fishermen platforms, and disseminating knowledge of cooperatives social entrepreneurship. The community development has been carried out well and the results are in the form of installing lamp and continual improvement in the design and lifetime of battery, as well as increased positive perspective and intention to establish cooperative institutions. All of these objectives have been successfully implemented. It was suggested that it is necessary to make the design of the battery more compact, use zinc as a durable electrode, use a rust-resistant wire system, and brighter lighting. Similarly, the dissemination of the concept cooperatives has been carried out well and succeeded in increasing the positive perception and intention of fishermen. Further recommendations are to form cooperatives and assist the formation of cooperatives to gain wider market access, and facilitate further training together with the ministry of cooperatives and related agencies on the island of Java.

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