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Improved Fishing Technology for Fishermen Empowerment

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ABSTRACT: The strategic plan (RENSTRA) of the Marine and Fisheries Service (DKP) for 2021–2026 aims to improve the quality of fishing for fishermen through improved fishing technology. However, RENSTRA cannot be implemented due to a lack of data and information related to improved fishing technology. As a result, there is no appropriate implementation strategy or community empowerment action program. This study aims to provide recommendations for improving fishing technology. The research was conducted at fishing centers located in Pambang Pesisir Village and Selat Baru Village. In-depth interviews with fishing communities in both villages provided the necessary data and information. A descriptive analysis was conducted by comparing the current level of technology with more advanced technology. The study findings show that the technology of longline and gillnet fishing is relatively simple (low). Therefore, it is recommended that DKP of Bengkalis Regency improve the quality of fishing technology by increasing vessel size, using marine engines, laminating fiberglass, applying multi-gears, and encouraging day and night fishing.

KEYWORDS: RENSTRA, Fishermen's Center, Fishing Technology, Longline, Gillnet.

I. INTRODUCTION

Fishermen in Bantan Subdistrict play a vital role in fulfilling the demand for fish in Bengkalis Regency, as reported by Muchlizar, Head of the Fisheries Empowerment Division at the Bengkalis Regency Maritime and Fisheries Service (DKP). The fishermen are of great importance and require the support of fisheries centers. These centers are gathering places for fishermen, consisting of land and water. This place serves as an anchorage and berth for fishing boats, as well as a location for loading and unloading fish and replenishing supplies. Additionally, it operates as a fish market where local fishermen can sell their catch. Susi and Hambali [1] identified three fishing centers in the sub-district: Pambang Pesisir Village, Bantan Air Village, and Selat Baru Village. Pambang Pesisir Village and Selat Baru Village boast higher levels of fishing activity and a larger population of fishermen in comparison to the no longer operational Bantan Air Fishing Center, which ceased operations due to coastal erosion [2].

Fishermen based in the fishing center of Bantan Sub-district are traditional fishing communities that operate longline and gillnet fishing gear. The vessels used by fishermen are smaller than 5 GT in size. Ermayanti [3] reported that longline and gillnet fishermen in other areas have embraced advanced technology, such as better fishing gear and larger vessels exceeding 10 GT. However, fishermen in the fishing center of Bantan Sub-district utilize SINP/GPS Garmin devices, compasses, radios, and what is commonly referred to as a "robot" in their fishing activities. These tools aid in navigation and communication, allowing for more efficient and effective fishing practices.

According to Law No. 23 of 2014 [4] and Bengkalis Regent Regulation Number 84 of 2019 [5], the Regional Government of Bengkalis Regency is authorized to empower fishermen and manage and organize fish auction sites. This authority has been put into effect by DKP Bengkalis Regency through the implementation of the 2016-2021 and 2021-2026 Strategy Plans (RENSTRA). The RENSTRA of DKP Bengkalis Regency serves as a comprehensive guide for stakeholders carrying out duties and functions related to program activities and sub-activities. It provides strategic and technical direction to ensure effective implementation.

RENSTRA DKP Bengkalis [6] aims to enhance the proficiency of fishermen in implementing more sophisticated fishing technology at fishing centers. However, insufficient data and information have hindered the achievement of this goal. The absence of adequate data and information has prevented the DKP Bengkalis Regency from developing an effective implementation strategy or a community empowerment program. Without an appropriate implementation strategy or action program for community empowerment to realize RENSTRA, the RENSTRA program will not be optimal. Therefore, this study aims to create recommendations for enhancing fishing technology among fishermen centered around the Bantan District fishing hub in Bengkalis Regency.

The hypothesis used in this study is to develop recommendations for improving fishing technology considering (i) the ability of fishing activities, (ii) increasing the exploitation of fishing gear, (iii) increasing the size of the vessels used, (iv) the use of outboard motorboats, and (v) the use of quality main materials [7]. Syahyuti and Taryoto [8] mentioned that the use of technology leads to a smaller risk of failure, greater certainty of catch, improved quality of fishing, and more people involved in one fishing unit. Thus, it is necessary to conduct an assessment to improve fishing technology as a solution to improve the quality of fishermen.

This research employs a systematic approach to identify problems, opportunities, and obstacles associated with fishing technology and to explore alternative solutions. The survey method is used to gather factual information about fishing technology. Data were collected through interviews with fishermen and other relevant parties, as well as literature study and observation. The data will be analyzed descriptively by comparing the current level of technology with more advanced technology.

This research aims to assist both the central and local governments in developing suitable implementation strategies and community empowerment action plans. It is also anticipated that fishermen will improve their fishing technology's quality through the empowerment programs conducted by DKP Bengkalis Regency. This research can serve as a resource for future studies on fishing technology and its impact on the empowerment of fishermen to enhance their occupational proficiency.

II. MATERIALS AND METHODS

A. Time and Place

The research was conducted from March to May 2023 in the Bantan District Fishermen Center, Bengkalis Regency, Riau. The data collection was focused only on two locations of the fishing centers, namely Pambang Pesisir and Selat Baru (Figure 1). The research location was selected due to the Selat Baru and Pambang Pesisir fishing centers functioning as community economic hubs, with the aim of being developed for the achievement of local government objectives.

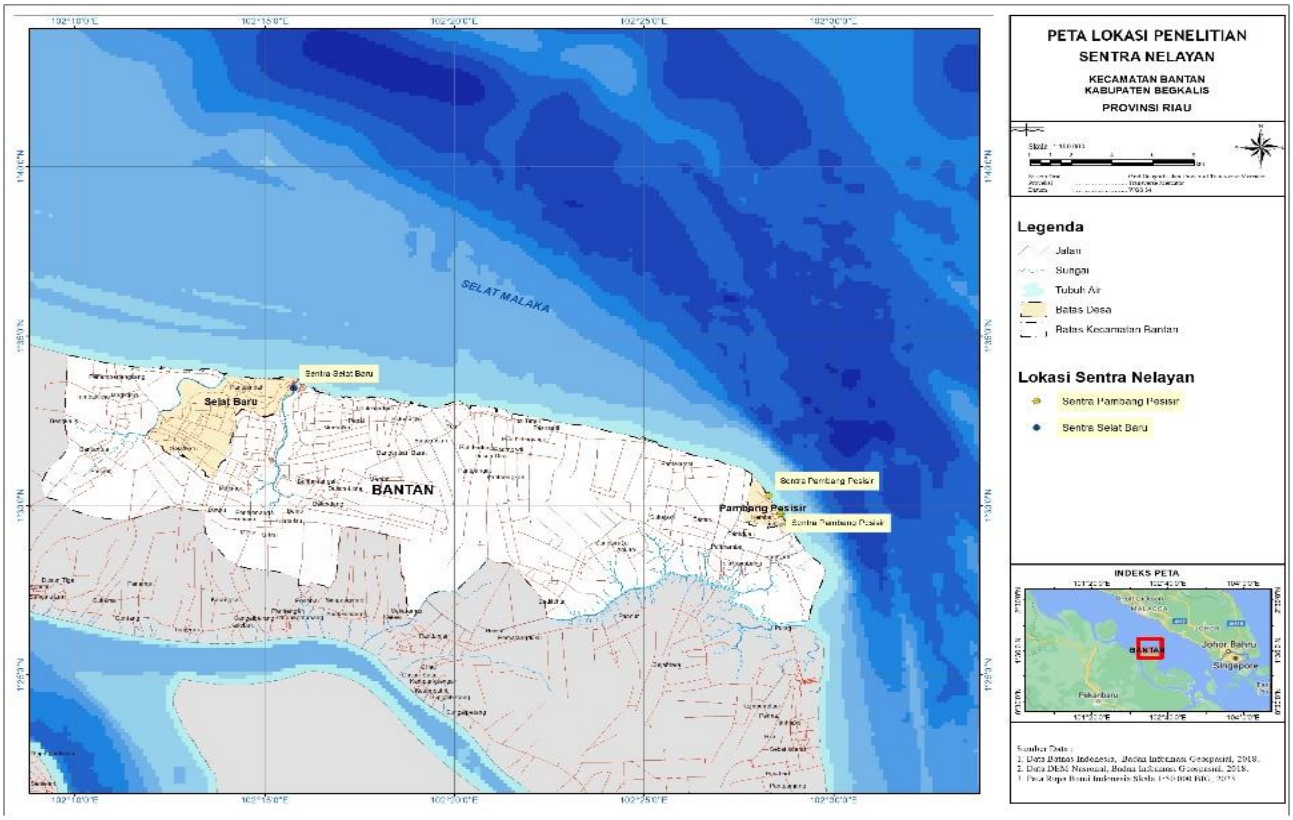

Figure 1. Map of the Research Location.

B. Tools and Materials

The equipment used in this research included a camera to record and document research activities, stationery to record research activities, AutoCAD to design fishing gear, Microsoft Excel for data processing, and Microsoft Word for report writing. In addition, the materials used were questionnaires to obtain primary data.

C. Method of collecting data

The study utilized primary and secondary data. Primary data consisted of: (i) existing conditions of fishing technology used by fishermen (level of fishing gear utilization, ability of fishing activity, driving engine, boat size, main hull material); (ii) level of fishing technology used by fishermen (simple (low), transitional (medium), and modern (high); and (iii) target of fishing technology development. Secondary data were obtained from DKP Bengkalis Regency, Selat Baru Village Office, and Pambang Pesisir Village Office according

to the information needed in this study. The secondary data needed were (i) number of fishers, (ii) age of fishers, and (iii) type and number of fishing gear.

Research data were collected through interviews, a literature review, and field observations. Interviews were conducted with respondents representing fishermen and experts. The representatives of the fishermen group were selected using the accidental sampling method. The selection of this technique was based on the consideration that the respondents have high mobility and activities, making it difficult to ascertain their presence in the fishing centers. Fishermen in both Selat Baru and Pambang Pesisir fishing centers appear heterogeneous because they have two types of fishing technology (longline and gillnet) and different vessel sizes (1–5 GT). Therefore, it is necessary to identify fisher profiles to homogenize the data of fisher respondents. The results of fisher profile identification are then used as a basis for consideration in determining the representation of sub-populations and the number of respondents. This means that the determination of fisher respondents must be able to represent fisher groups based on the location of fishing centers, type of fishing technology, and vessel size. The determination of the number of respondents for each group of fishermen refers to the opinion of Neuman in Fazri et al. [9], which is at least 10% of the population. The number of fishermen in Selat Baru and Pambang Pesisir was 37 and 125, respectively. The number of respondents representing fishermen was 20 out of 12 people from Pambang Pesisir village and 8 people from Selat Baru village. Representatives of longline fishermen were 7 people, and representatives of nets were 13 people.

Expert representatives were selected by purposive sampling with the following considerations: (i) the respondent is an expert in fishing technology; (ii) the respondent has the competence and quality to describe the condition of fishing technology development; and (iii) the respondent has a close relationship between fishermen and the government. The number of respondents representing experts was three people from Bogor Agricultural University.

D. Data analysis

Data processing on fishing technology quality for fisher quality development was conducted through editing and tabulation. Data were categorized into (i) number and type of fishing technologies, (ii) existing conditions of fishing technologies used by fishermen, (iii) level of use of fishing technologies by fishermen, and (iv) target of fishing technology development. The identification of fishing technologies is conducted through descriptive analysis. The findings of the analysis will be presented in the form of graphs and tables. This study concentrates on the diversity of fishing vessels used by fishermen, with an emphasis on the quantity and type of fishing technology used. An examination of the current state of fishing technology used by fishermen examines various criteria, such as the level of gear use, fishing capacity, propulsion engine, vessel size, and hull material. Fishing technology was categorized into three levels: low, medium, and high, with simple technology, transitional technology, and modern technology. The analysis of the development of fishing technology focuses on the type, number, condition, and level of existing fishing technology. Table 1 displays the varying levels of quality in fishing technology.

Table 1. **Fishing technology quality level variables.**

No	Indicator	Improving the quality of capture technology		
		Simple (low)	**Transition (medium)**	**Modern (high)**
1	Ship size	< 10 GT	10 GT – 30 GT	> 30 GT
2	ship engine	Ship without motor	Motorboat	Motorboat
3	Main materials of ship hull	Wood	Fiberglass laminate	Fiberglass or steel laminates
4	Exploitation rate of fishing gear	Using one type of response tool and relying on human labor	Using multi gear and relying on human labor and technology	Using multi gear and relying on technology
5	Capture activity capability	Limited cruising ability and one day fishing	Limited range and capture time of day and night	Wide-ranging capabilities and day and night capture times

Source: Yulianto *et al.* [10], Lidiawati [11], Rusmiyansari and Aminah [7].

III. RESULTS AND DISCUSSION

Existing Conditions of Fishing Technology

Fishermen commonly use two types of fishing gear: a bottom longline and a gillnet. Fishing gear and vessels used in Pambang Pesisir and Selat Baru Villages are of the same construction and type. Fishermen in the aforementioned villages usually engage in one-day fishing. Longline fishermen use one type of fishing gear, specifically longlines and surface gillnets, to obtain bait. These fishermen depend on human labor for fishing activities, and their knowledge is gained from experience and inherited knowledge. Figure 2 shows that each longline unit consists of three baskets, each containing about 800 meters of longline and 300 fishing lines made of nylon monofilament. The typical longline fisherman uses an outboard motorboat (KMT) with an engine power ranging from 6 to 30 horsepower, although the engine is modified from a car engine. These boats are mostly made of wood and usually measure between 1 and 5 gross tons. Due

to their limited range, which is about 13.5 kilometers from the nearest shoreline, fishermen can only operate 2 to 6 sets of bottom longlines per day.

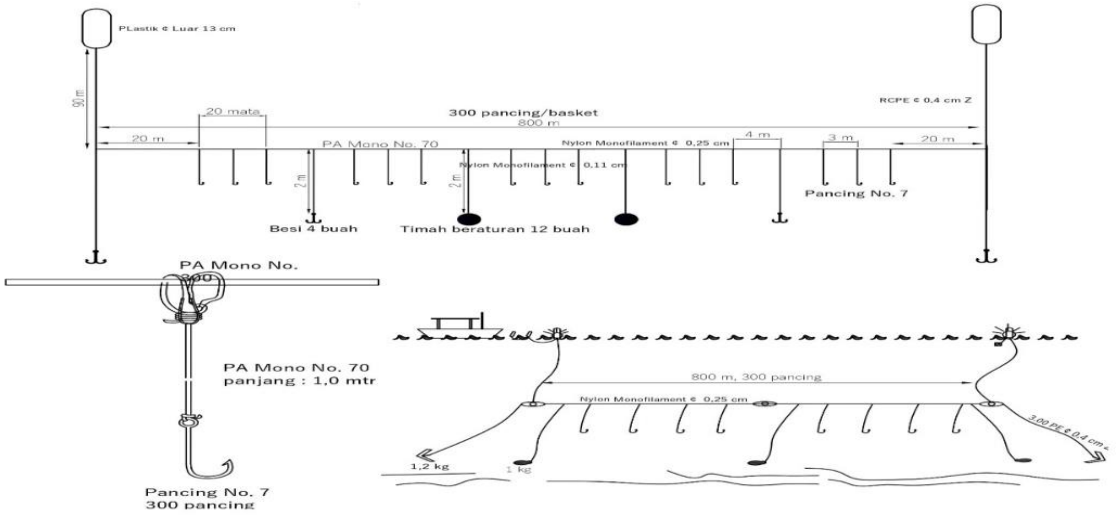

Figure 2. Construction of bottom longline

There are two types of gill nets found at the study site, namely malung nets (Figure 3) and stone nets (Figure 4). Each fishing unit used only one of these types of nets and used tools to transport the nets to the boat. The length and type of gill nets showed considerable variation. One fishing unit consists of 10–70 pieces, with the length of each ranging from 20–242 meters. The mesh size of malung nets is 10.16 cm, while the mesh size of stone nets is 15.24 cm. The variation in mesh size depends on the type and size of fish targeted by the two types of nets. Net fishermen usually use KMT outboard motorboats with modified car engines that have an engine power of 24-80 HP. The main material used to make the boat is wood, and the size ranges from 1-5 GT. The cruising range of fishing boats is limited to about 11.6 miles from the nearest shoreline. This limited range requires fishermen to operate gillnets for only 2 to 4 sessions per day.

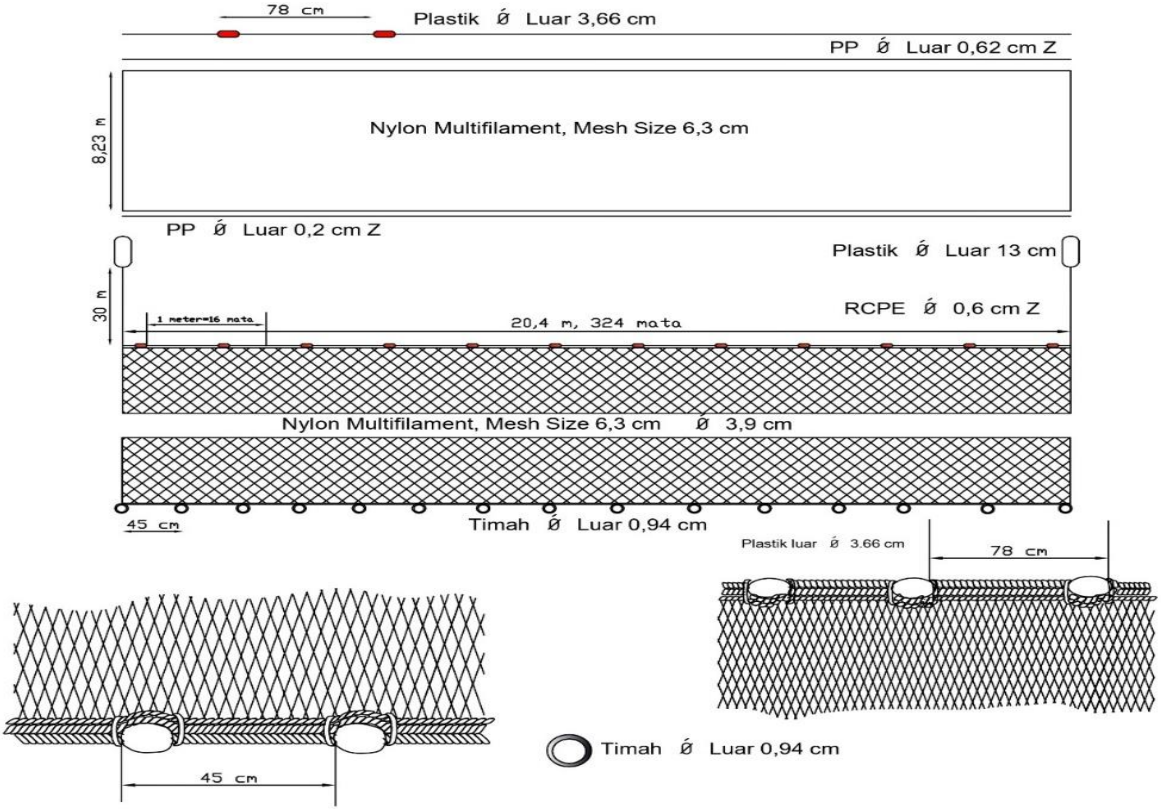

Figure 3. Construction of malung gillnet gear

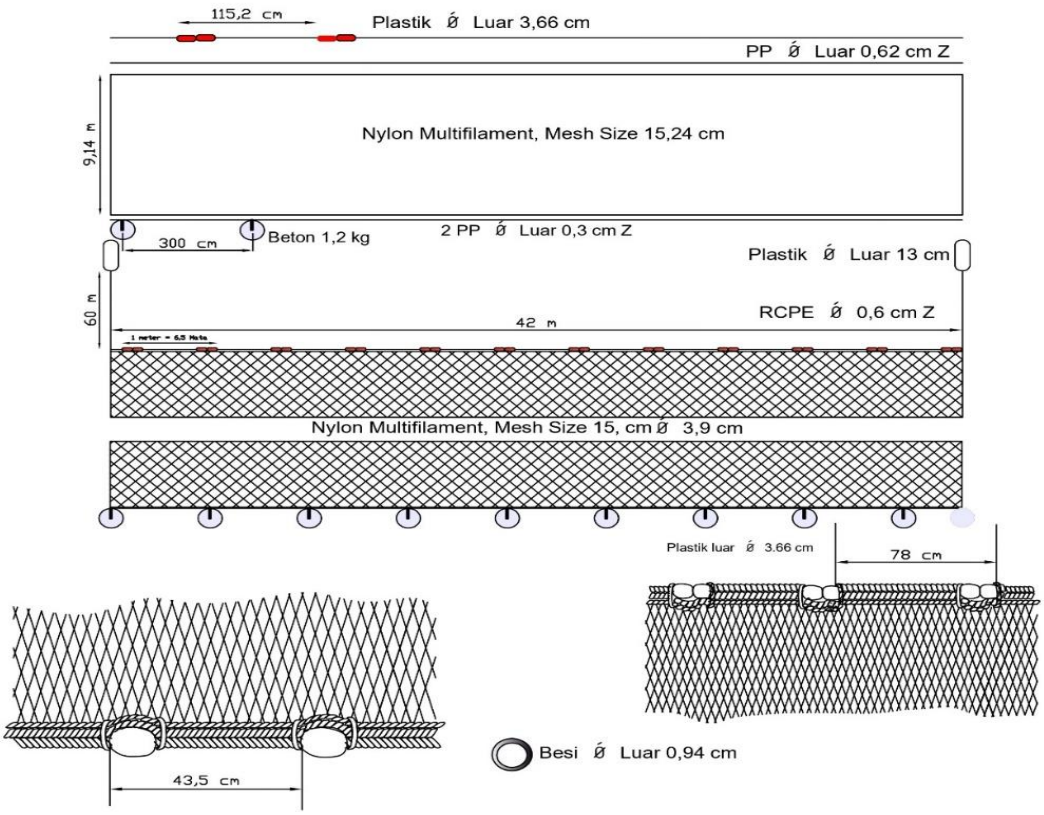

Figure 4. Construction of stone gillnet gear

The analysis of existing fishing technology conditions reveals that longline and net fishing technologies fall under the category of simple (low) technology. To enhance the quality and support the development of fishermen, there is a need to improve the fishing technology classified as simple (low). The use of advanced and modern fishing technology by fishermen leads to the development of their knowledge and potential to optimize marine resources [12].

Fishing Technology Development Targets

Fishermen are only able to conduct one-day fishing due to their limited fishing capabilities. This limited ability causes a low level of exploitation of fishing gear, which in turn limits the area, time, and operation of fishing gear that can be carried out by fishermen. According to Rahmasari [13] findings, limited fishing activity capability leads to longer travel time for fishers to reach the fishing grounds and return to the fishing base. As a result, their ability to exploit fishing gear is compromised [14]. In addition, the limited space available on board makes it difficult for them to conduct fishing activities [15]. Fishermen can improve their fishing ability by adding boat engines and increasing the size of the boat, so they can fish during the day and night. One solution to improve fishing capability is to encourage fishermen to fish during the day and night, so that fishermen can have a longer time to fish [16]. During night fishing, navigational aids such as vessel lights are essential, so it is crucial to provide proper vessel road lighting for this purpose.

The level of fishing gear exploitation in the center of Bantan District is still relatively simple. Fishermen use one type of fishing gear throughout the season, adapting the gear construction to the target fish. However, target fish are not consistently available throughout the season, leading to reduced catches during off-season periods. Simbolon et al. [17] found that the use of one type of fishing gear throughout the season caused fishermen to experience prolonged periods of strangulation. To prevent prolonged strangulation, Wismaningrum et al. [18] suggested using several types of fishing gear that can be operated throughout the fishing season. According to Fauziyah et al. [19], multi-gear fishing gear can assist fishermen in catching fish throughout the season by adjusting between fishing gear and catch targets. The use of multi-gear fishing gear does not require a prolonged lean period, so it does not make fishermen have to look for side jobs.

Optimizing the utilization of multi-gear fishing equipment can be enhanced by implementing fishing aids. According to the Cahyadi and Suwandi [20] report, fishing aids can aid and improve fishermen in carrying out fishing activities, such as identifying potential fishing sites. Longline fishermen do not currently use fishing aids, which can lead to difficulties and increased time spent identifying potential fishing sites. Fishermen who use net fishing gear have started utilizing GPS to determine fishing locations and robots for pulling gear onto their boats. To maximize catch productivity, fishing activity aids and fish collecting aids are recommended, according to Hasan et al. [21]. The utilization of GPS and robots, in combination with lights, for fishing (light fishing), represents a viable alternative to increase the yield of surface gill net catches.

The limited fishing ability of fishermen in one-day fishing is due to inadequate vessel size, engine power, and hull materials. To improve and optimize fishing operations with multi gear, the improvement of these vessel components is very important. Research by Rahmawati et al. [22] showed that maximizing fishing efficiency and gear exploitation can increase catches. However, this requires appropriate vessel size, optimal engine use, and high-quality hull materials for extended service life.

The vessels utilized by longline and gillnet fishermen are relatively small, ranging from 1 to 5 GT. This limited capacity of ships hinders the number of crew members and disturbs their working comfort while fishing [23]. On the other hand, the smaller number of anglers in longline fisheries will cause low catch production. The number of pieces of gillnets that can be loaded in a small vessel is limited, so the productivity of the catch is low. This is in line with Soeboer et al. [24], who found that the smaller number of crew members in longline and gillnet fisheries will cause low catch production and productivity. Ramdhani et al. [25] also reported that the size of the ship will determine how much the ship can accommodate the catch. To increase the catch and the ability of fishing activities, one of the efforts that can be made by fishermen is to increase the size of the ship. Increasing the size of the ship can make fishing farther, and the operation of fishing gear can also be done many times [13].

The inclusion of Andon fishermen in the waters of Bantan District benefits the fisheries in the area. The primary benefit is the shift of local fishermen towards outboard motorboats. Despite this, the motorboats currently utilized by local fishermen are still modified from land-based car engines that run on diesel fuel. This use of outboard motorboats that are altered from car engines is believed to be against their intended purpose. According to Suryana et al. [23], utilizing a modified car engine as a ship engine leads to suboptimal engine power, elongated voyage time to and from the fishing grounds, and decreased catch productivity. Consequently, the performance of vessels equipped with modified car engines must be enhanced by installing suitable engines, such as marine engines. Axelius et al. [26] state that incorporating a marine engine can expand a vessel's cruising range, allowing fishermen to operate in more distant potential fishing grounds from the coast.

Fishermen commonly use wood as the main material for ship hulls. However, this choice results in damage, mold, and weathering of the ship walls [27]. As stated by Atok Abu (an elder of the Selat Baru fishermen), neglecting the monitoring and upkeep of a boat's hull has resulted in recurrent sinkings and endangered the safety of the fishermen. The inability of the hull to withstand large ocean waves is the main cause of these incidents. According to Marzuki et al. [28], laminating the hull of ships is necessary to prevent sinking caused by damage, mold, and weathering. Using fiber to laminate wood-based ships can be one solution to counteract damage, weathering, and mold [29]. Laminating fiberglass ships can also decrease weight and increase stability, resulting in faster movement [30].

Based on this, PEMDA can improve the quality of fishing technology in the fisheries center of Bantan Sub-district, Bengkalis Regency by implementing the following measures: (i) increasing the size of the vessels used, (ii) utilizing marine-engine motorboats, (iii) laminating the main hull material with fiberglass, (iv) exploiting multi gear, and (v) conducting fishing during the day and night and utilizing navigation aids. Improvement of motorboat engines, vessel size, and hull lamination in accordance with their designations are expected to increase the exploitation ability of fishing gear and fishing activities, thereby improving the quality of fishermen. Table 2 shows the targets to be achieved to improve the quality of fishing technology. Efforts to improve the quality of fishing technology must be carried out linearly because fishing technology variables are interrelated.

Table 2. Targets for improving the quality of fishing technology

No	Indicator	Targets quality of capture technology	
		Longline	Gillnet
1	Ship size	Vessel size 5 GT - 10 GT.	Vessel size 10 GT - 30 GT.
2	ship engine	Using marine engine	Using marine engine
3	Main materials of ship hull	fiberglass lamination	fiberglass lamination
4	Exploitation rate of fishing gear	Using multi gear such as gillnet and using GPS and robot fishing aids, as well as light fishing aids for surface gillnet gear.	Using multi gear such as longlines and using light fishing aids for surface gillnet gear.
5	Capture activity capability	Conduct night fishing by utilizing navigational aids such as lights.	Conduct night fishing by utilizing navigational aids such as lights.

CONCLUSIONS

The technological quality of longline and gill net fishing is currently considered to be simple (low). To improve this technology, fishermen can incorporate the following approaches: (1) increasing the size of their vessels, (2) utilizing marine engines, (3) laminating vessels with fiberglass, (4) employing multiple fishing gears, and (5) encouraging fishing activities during day and night while utilizing navigation aids. These improvements should be made in a linear and systematic fashion.

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