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Hand line fishing financial analysis at Palabuhanratu Archipelagic Fishing Port, Sukabumi Regency

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A B S T R A C T :

Palabuhanratu is a fishing port located in Sukabumi Regency, West Java, Indonesia. Palabuhanratu Archipelagic Fishing Port is dominated by handline fishing gear and the fishing targets are hairtail fish and big eye fish. The purposes of this study were to analyze the technical aspects of handline fishing, financial aspects including capital, costs, income and profit from fishing, meanwhile the feasibility study of handline fishing analysis calculating the value of R/C Ratio, NPV, IRR, and PP in Palabuhanratu Archipelagic Fishing Port. The research sampling method used was the census method with a total of 25 fishermen as respondents. Feasibility study analysis were used NPV, R/C Ratio, IRR and PP. Handline consists of main line, branch line, fishing line, wire, sinker, bait, and hook. Handline fishermen consist of 2 persons. Fishing trip operation of handline is one day fishing start from 04.00 PM-06.00 AM. The main catch of handline fishing is demersal fish, namely hairtail fish and big eye fish. there are three hairtail fishing seasons in Palabuhanratu Archipelagic Fishing Port, namely the low season, regular and peak season. The average capital of the handline fishing business is 68,535,000 IDR. The average total cost is 114,475,98 IDR per year. The average income is 138,758,360 IDR, and the average profit is 24,282,372 IDR per year. The results of the business feasibility analysis on the floating handline fishing business in the NPV aspect averaged 418.458.590,64 IDR. The average value of IRR reached 18%. The average R / C Ratio value is 1.21. And the PP value is for 4 years.7 months.

Keywords: Fishing Business Feasibility, Hairtail Fish, Line Fishing, Palabuhanratu Archipelagic Fishing Port

Introduction

Sukabumi Regency, West Java, is home to a fishing port known as Palabuhanratu Archipelagic Fishing Port. This port is predominantly characterized by the use of handline fishing gear. Sukabumi Regency is one of the locations in Fisheries Management Area 573, which encompasses the southern Indian Ocean in the coast of Java Island. According to Nurmasari *et al*. (2023), Sukabumi is located in the central area of Sukabumi Regency, West Java Province. Palabuhanratu encompasses various zones in Sukabumi, including tourist destinations, fisheries hubs, fishing activities, shipping, cooperatives, and more. With a total area of approximately 689.25 hectares, Palabuhanratu offers numerous opportunities for business ventures in the fisheries sector. In the fisheries industry, the dominant fish species vary depending on the season and the environmental conditions of the sea. However, hairtail fish are the most commonly found species in the waters of Palabuhanratu Archipelagic Fishing Port. Hairtail fish are easily recognizable due to their long, slender, sword-like bodies and lack of scales. Scientifically, they are known as *Trichiurus* sp.

The vast waters at Palabuhanratu Archipelagic Fishing Port can be utilized by fishermen by operating environmentally friendly and non-destructive fishing gear. Various types of fishing gear are available at Palabuhanratu Archipelagic Fishing Port, including set traps, handlines, longlines, purse seines, and rampus nets. Among these, fishing rods are considered simple and environmentally friendly tools. According to Dewi *et al*. (2020), the basic principle of fishing with a rod is quite simple: bait is put on the hook and connected to a line. When a fish bites the bait, the hook catches the fish, and the fisherman then pulls the fish onto the boat or to shore. Fishing rods are considered selective fishing gear. The selectivity of fishing rods can be measured based on the size of the hook used. Larger hooks are less likely to catch small fish, while smaller hooks still allow for catching larger fish. Research conducted by Olii *et al*. (2023) showed that the use of hooks of different sizes (numbers 20, 19, and 18) significantly affects the catch of trevally fish. The results indicate that smaller hooks (number 18) can increase the number of fish caught due to better hook placement in the fish's mouth, reducing the likelihood of the fish escaping during retrieval.

The most common demersal fish at the Palabuhanratu Archipelagic Fishing Port is the hairtail fish. The hairtail fish (*Trichiurus* sp.) is a marine species frequently found in tropical and subtropical waters worldwide. Its distinctive features include a long, slender, and flat body. This fish is typically found in coastal waters, especially on sandy or muddy seabeds, and can live at depths of up to approximately 100 meters. As a carnivorous species, the hairtail fish has strong, sharp teeth on both jaws. It holds significant economic value and is sustainably harvested. According to the 2023 statistics from Palabuhanratu Archipelagic Fishing Port, hairtail fish production peak season in December 2023, reaching a total of 3,158,148,000 kilograms with a selling price of 38,000 IDR per kilogram. As a demersal fish, the hairtail fish is also a key export commodity and is widely found along the coasts of Java. Its distribution spans across all coastal waters of Indonesia, including areas such as Tuban, Lawang, Jampang, Palabuhanratu, Cibanteng, Ujung Genteng, and Sukawayana.

The issues faced regarding handline fishing at Palabuhanratu Archipelagic Fishing Port, Sukabumi, pertain to the sustainability and financial efficiency of the fishing business. Although handline fishing is an environmentally friendly method widely used by local fishermen, challenges remain in managing operational costs, the variability of catches, and market uncertainties that affect fishermen's income. Additionally, limited access to modern technology, business capital, and inadequate facilities and infrastructure pose significant barriers to improving productivity and the welfare of fishermen. This situation is further complicated by external pressures such as climate change, competition among fishermen, and regulations that do not yet fully support the sustainability of the practice. Therefore, a comprehensive financial analysis is needed to identify opportunities and challenges, ensuring that handline fishing at Palabuhanratu Archipelagic Fishing Port can develop optimally and sustainably.

Research Method

1.1. Types and method of data collections

The types of data used in this research are primary and secondary data. Primary data includes fishermen's personal data, technical data on fishing gear, and financial aspect data. Secondary data includes production volume and value, fishing gear, fishing fleets, and fisheries fishermen data from 2019 to 2023. The sampling method used is the census method, where the entire population is taken as respondents (Manurung *et al*., 2023). The criteria for respondents in this study are handline fishermen with fishing base at the Palabuhanratu Archipelagic Fishing Port, Sukabumi. The requirements are being a fisherman using handline fishing gear with a 2 GT boat and having good communication skills, both written and verbal. The study population consists of 25 respondents collected with census sampling method. Data collection methods used in this study are observation, interviews, literature review, and documentation.

1.2. Data analysis method

Data analysis consists of technical aspects, economic aspects, and financial feasibility aspects of the fishing business. The technical aspect includes details regarding the construction of fishing gear, its operation methods, fishing locations, types of fish caught, and the best seasons for fishing. The economic aspect encompasses fixed costs, variable costs, total costs, revenue, and profit. The financial feasibility aspect evaluates the R/C Ratio, Net Present Value (NPV), Internal Rate of Return (IRR), Return on Investment (ROI), and Payback Period (PP). Fixed cost is an expense that remains constant over a specific period of time and does not depend on the production volume.

Fixed Costs = Depreciation Costs + Maintenance Costs

a. Depreciation = $\frac{Investment - Residual\ Value\ of\ the\ Asset}{Economic\ Life}$ (1)

b. Maintenance = Maintenance Cost x Maintenance Frequency

Variable costs are expenses that fluctuate based on the level of production or sales of a product or service.

Variable Cost = Provision Costs + Fishermen's Wages (2)

The total cost is the overall production cost incurred, consisting of fixed costs and variable costs over one year.

TC = FC + VC (3)

Whereas:
TC : Total Cost
FC : Fixed Cost
VC : Variable Cost

The revenue comes from the fish catch in each season, which is sold at different prices depending on the fishing season.

TR = Q x P (4)

Whereas:
TR :Total Revenue
Q : Catch (kg)
P : Price (IDR)

The profit in a capture fishing business is the main condition that will ensure the long-term operation of fish catching activities.

π = TR – TC (5)

Whereas:
π : Profit
TR : Total Revenue
TC : Total Cost

In the assessment, the following criteria can be used:
If TR > TC, the business generates profit ($\pi > 0$)
If TR = TC, the business is at the break-even point ($\pi = 0$)
If TR < TC, the business incurs a loss ($\pi < 0$) (Heriani *et al*., 2013).
The Revenue Cost Ratio analysis aims to determine how profitable the fisheries business is. The formula is as follows, according to Hariance *et al*. (2018):

R/C Ratio = $\frac{Revenue}{Total\ Cost}$ (6)

The business feasibility criteria based on the R/C Ratio are as follows:
R/C > 1, the business is profitable;
R/C = 1, the business is in breaks even point;

R/C < 1, the business is not profitable.

Net Present Value (NPV) is the surplus of the present value of future cash inflows that will be generated by a project.

$$NPV = \sum_{t=1}^{n} \frac{Cft}{(1+k)^t} - l_o \quad (7)$$

Whereas:

NPV: Net Present Value (IDR)

Σ: summation symbol

t: time period or year t

n: lifespan of the proposed project

CFt: annual cash flow in period t

Io: initial investment value in year 0 (IDR)

K: interest rate or discount rate (%)

The evaluation criteria for this method are:

If NPV > 0, the proposed project is feasible;

If NPV < 0, the proposed project is non-feasible;

If NPV = 0, the company's value remains unchanged, regardless of whether the proposed project is accepted or rejected (Rumiyanto *et al*., 2015).

Internal Rate of Return (IRR) is an interest percentage that represents the rate of return on invested capital, commonly abbreviated as IRR. The formula for IRR, according to Anggita (2020), is as follows:

$$IRR = P_1 \left[-C_1 \left(\frac{P_2 - P_1}{C_2 - C_1} \right) \right] \quad (8)$$

Whereas:

IRR: the required interest rate (%)

P_1: the first interest rate

P_2: the second interest rate

C_1: the first NPV C_2: the second NPV

A business is considered feasible if IRR > discount rate, whereas it is deemed unfeasible if IRR < discount rate.

Return on Investment (ROI) is a term used to describe the overall rate of return on investment capital in a business or project. It is conducted to measure the return on business operations based on the total assets available (Adiwinata *et al*., 2017).

$$\text{Return on Investment} = \frac{Profit}{Investment} \quad (9)$$

Whereas:

Profit: The business income generated from business activities

Investment: The total capital cost incurred during business activities

Payback Period (PP) is the period required to recover the investment expenditure using cash flows. According to Neliyana *et al*. (2014), it is defined as follows:

$$\text{Payback Periods} = n + \frac{a}{b} \; x \; 1 \; year \quad (10)$$

Whereas:

n: The year in which the investment starts to return

a: The cumulative cash flow in the final year of n

b: The cumulative cash flow in year n

Criteria for the rate of return based on the Payback Period are as follows:

Payback Period < 3 years; The rate of return is categorized as fast.

Payback Period 3 years < Payback Period < 5 years: The rate of return is categorized as moderate.

Payback Period > 5 years: The rate of return is categorized as slow.

Result and Discussion

1.3. The Potential of Capture Fisheries at Palabuhanratu Archipelagic Fishing Port

The dominant fishing gear at Palabuhanratu Archipelagic Fishing Port is hand line fishing gear. The primary fishing gears at Palabuhanratu Archipelagic Fishing Port include beach seines, hand lines, rampus nets, and drifting gillnets. According to statistical data from Palabuhanratu Archipelagic Fishing Port (2024), hand lines are the most widely used fishing gear in the area. Fisheries production encompasses activities related to catching and cultivating various fish species and other marine biota to meet the consumption needs of the community and industry. The value of fisheries production is measured based on the quantity and type of catch or aquaculture output, as well as their market selling prices.

The production quantity and production value of hairtail and purple-spotted bigeye fish at the Palabuhanratu Archipelagic Fishing Port fluctuated annually. The highest production quantity and value occurred in 2023, with a production quantity reaching nearly 250,000 kg and a production value of 9,646,239,000 IDR within a year. In contrast, the lowest production quantity and value were recorded in 2022, with the production of hairtail and purple-spotted bigeye fish being less than 40,000 kg, and the production value amounting to 1,473,051,000 IDR.

1.4. Technical Aspects of Hand line Fishing Gear

Table 1 – Results of Measurements of Hand line Fishing Gear Components.

No	Component	Size or Weight	Material Specification
1.	Reel	Ø 0.15 m	Round-shaped plastic
2.	Main Line	100 m	Nylon monofilament
3.	Branch Line	1 m	Nylon monofilament
4.	Hook	No. 10	Steel
5.	Wire	0.15 m	Aluminum
6.	Swivel	No. 4	Steel
7.	Sinker	500 gr	Stone

Source: Research data, 2024.

The hand line fishing gear at Palabuhanratu Archipelagic Fishing Port consists of a reel, main line, branch lines spaced 2 meters apart, hooks numbered 9 and 10 totaling 50 hooks, swivels numbered 4, wires attached above the hooks, and weights made of stones weighing 500 grams. For waters with moderate to strong currents (such as seas or rivers), the weight can range from 400 to 1000 grams, depending on the current strength. According to Darondo *et al*. (2020), the weight in hand line fishing functions to accelerate the descent of the hooks into the water and to keep the line upright while submerged.

One of the factors affecting the catch is the selection of hooks. Hand line fishermen at Palabuhanratu Archipelagic Fishing Port predominantly use size 9 hooks. Size 9 hooks are suitable and ideal for fishing gear targeting hairtail fish (*Trichiurus spp.*). These hooks are made of iron, making them strong and durable. Size 9 hooks also offer efficiency as they allow for more bait to be used on a single fishing line, increasing the likelihood of a higher catch. The swivels used by the fishermen are size 4. Swivels are utilized to prevent the fishing gear from tangling. According to Bahari *et al*. (2024), swivels are typically made of stainless steel and are designed to prevent the fishing line from twisting during operation. Size 4 swivels are usually made of durable and robust materials, capable of withstanding the pressure exerted by large fish that are the target catch.

Hand line fishing is conducted using a one-day fishing method. The process begins with the preparation stage, during which two fishermen prepare the fishing gear, bait, provisions, and ensure the boat's readiness from midday until the afternoon. The fishermen depart for the fishing ground at 4:00 PM. Upon arrival at the location, the setting and immersing process begins. The fishing line is left submerged for 15–30 minutes, depending on the abundance of fish in the area. After that, the hauling stage is conducted by pulling the fishing line back onto the boat. The main catch is hairtail fish (*Trichiurus spp.*), while the by-catch includes Purple-spotted bigeye fish (*Priacanthus* spp.).

1.5. The Socio-Economic Aspects of Hand line Fisheries

Table 2 – Fisherman's Age Date.

No	Respondent	Age (Years)		
		>15	15-60	<60
1.	Fishermen	-	25	-

Source: Research data, 2024.

Table 3 – Educational Data of Fishermen.

No	Respondent	Education		
		Elementary School	Junior High School	Senior High School
		Total	Total	Total
1.	Fishermen	15	4	6

Source: Research data, 2024.

The characteristics of fishermen can be determined by grouping the age of the respondents based on predetermined criteria. The age distribution of hand line fishermen in the Palabuhanratu Archipelagic Fishing Port is dominated by individuals aged 15–60 years. Formal education provides fishermen with the knowledge and skills necessary to manage natural resources sustainably. Through education, fishermen can understand more efficient and environmentally friendly fishing techniques, as well as how to manage the marine ecosystem they depend on. The average level of education of fishermen at Palabuhanratu Fishing Port is elementary school. According to Konoralma *et al*. (2020), an individual's level of education is estimated to influence the income they earn from their work.

Table 4 – Business Capital for Drift Gillnet Fishing at Palabuhanratu Archipelagic Fishing Port Sukabumi.

Description	Boat (IDR)	shing Gear (IDR)	Engine (IDR)	Total
Minimum	25,000,000	950,000	41,000,000	67,000,000
Maximum	30,000,000	1,000,000	41,500,000	71,950,000
Average	26,320,000	995,600	41,220,000	68,535,000

Source: Research data, 2024.

Table 5 – Cost of Hand line Fishing Business Per Trip at Palabuhanratu Archipelagic Fishing Port Sukabumi.

Description	Cost Type	Minimum (IDR/Trip)	Maximum (IDR/Trip)	Average (IDR/Trip)
Fixed Cost				
1.	Maintenance Cost	11,064	12,840	11,753

2.	Depreciation Cost	100,304	171,402	133,170
Variable Cost				
1.	Supplies Cost	695,000	755,000	728,600
2.	Fishermen Wage (Crew)	680,000	956,500	797,220
Total Cost				
1.	Fixed Costs	112,718	185,592	146,273
2.	Variable Costs	1,375,000	957,255	1,525,820
Total				1,627,093

Source: Research data, 2024.

Table 6 – Annual Operational Costs of Hand line Fishing at Palabuhanratu Archipelagic Fishing Port Sukabumi.

Description	Cost Type	Minimum (IDR/Year)	Maximum (IDR/Year)	Average (IDR/Year)
Fixed Cost				
1.	Maintenance Cost	1,040,000	1,040,000	1,040,000
2.	Depreciation Cost	9,428,571	15,083,333	11,776,108
Variable Cost				
1.	Supplies Cost	58,725,000	70,970,000	64,561,400
2.	Fishermen Wage (Crew)	33,220,500	42,782,000	37,098,480
Total Cost				
1.	Fixed Costs	10,468,571	16,123,333	12,816,108
2.	Variable Costs	94,873,500	109,474,500	101,659,880
Total				114,475,988

Source: Research data, 2024.

The amount of capital required for the hand line fishing business totals an average of 68,535,000 IDR. This capital varies among fishermen, influenced by differences in the purchase price of boats, fishing gear, and engines. The costs in the fishing business are divided into two categories: fixed costs and variable costs. Fixed costs include maintenance costs and depreciation. The hand line fishing business has different fixed costs for each fisherman. Based on the analysis, the average fixed cost per trip for the hand line fishing business at Palabuhanratu Archipelagic Fishing Port Sukabumi is 146,273 IDR. The average annual fixed cost is 12,816,108 IDR. Next, variable costs, which consist of supplies, include fuel, oil, food, and ice blocks. These costs typically change depending on the length of the trip taken for fishing activities. According to the analysis, the average variable cost per trip is 1,525,820 IDR, and the annual variable cost is 101,659,880 IDR. There is also a 3% levy, or 1,350 IDR, from the catch. Total cost refers to the sum of all the costs required to operate the fishing business. This cost is obtained by adding the fixed costs and variable costs in the hand line fishing business at Palabuhanratu Archipelagic Fishing Port Sukabumi. The total average cost is 114,475,988 IDR per year. The hand line fishing business at Palabuhanratu Archipelagic Fishing Port Sukabumi operates on a profit-sharing system of 50% for the fisherman and 50% for the fishing boat owner.

Table 7 – Seasonal Catch Prices.

No	Fish Species	Seasonal Fish Prices (IDR)		
		Low season	Regular season	Peak season
1.	Hairtail	43,000	37,000	35,000
2.	Purple-spotted bigeye	30,000	35,000	35,000

Source: Research, 2024.

Table 8 – Seasonal Average Catches.

No	Fish Species	Average Catch (Kg)		
		Low season	Regular season	Peak season
1.	Hairtail	7	24	51
2.	Purple-spotted bigeye	21	2	5

Source: Research, 2024.

Table 9 – Average Seasonal Income.

No	Fish Species	Average Catch (Kg)			Total
		Low season	Regular season	Peak season	
1.	Hairtail				
2.	Purple-spotted bigeye	3,145,840	26,731,720	108,880,800	138,758,360

Source: Research, 2024.

Hairtail and Purple-spotted bigeye fish are the catches from the trolling line. The prices of the fish vary in each season. The price of hairtail during the low season can reach 45,000 IDR/kg, during the regular season it reaches 37,000 IDR/kg, while during the peak season it reaches 35,000 IDR/kg. In addition to Cutlass, other catches include Purple-spotted bigeye fish. The price of Purple-spotted bigeye fish during the regular and low seasons is 35,000

IDR/kg, while during the peak season it can reach 30,000 IDR. The fishermen's catches differ in each season. The income of fishermen is highly influenced by the amount of fish caught available in each season. According to Achmad *et al*. (2020), during certain seasons, fishermen's income is very high, but in the following seasons, their income is very low, even tends to be nonexistent.

Table 10 – Profit of Hand line Fishing Business at Palabuhanratu Archipelagic Fishing Port Sukabumi.

No	Calculation	linimum (IDR/Year)	aximum (IDR/Year)	Average (IDR/Year)
1.	Revenue	128,791,000	152,004,000	138,758,360
2.	Total Cost	106,947,571	122,592,143	114,475,988
3.	Profit	14,769,856	26,387,500	24,282,372

Source: Research data, 2024.

Based on the data analysis, the results obtained from the fishing business in Palabuhanratu Archipelagic Fishing Port Sukabumi show an average profit of 24,282,372 IDR. The goal of the fisheries industry is to generate the highest possible profit. To achieve high profits, fishermen must obtain a large catch with high economic value and low production costs. According to Anggriani *et al*. (2016), a business is considered profitable if the revenue exceeds the total costs incurred.

1.6. The Financial Feasibility Aspect of Hand line Capture Fisheries

Table 11 – Feasibility of Hand line Fishing Business at Palabuhanratu Archipelagic Fishing Port Sukabumi.

No	Aspect	nancial	Description
1.	NPV	418,458,591 IDR	Feasible
2.	IRR	34%	Feasible
3.	R/C *Ratio*	1.21	Feasible
4.	PP	4.79	4 Years, 7 Months

Source: Research data, 2024.

Based on the data processing results shown in Table X, it is known that the NPV value of the fishing business with trolling fishing gear at a 12% interest rate is Rp418,458,590.64. This value indicates that the fishing business using trolling fishing gear at Palabuhanratu Archipelagic Fishing Port Sukabumi is considered feasible because the NPV value is greater than 0 and positive. According to Indradi *et al*. (2013), NPV helps to measure the profitability of a project or investment by considering both cash inflows and cash outflows from a time perspective. Based on the data analysis, the average IRR value for the fishing business using trolling fishing gear reached 34%. This result shows that the fishing business is profitable and feasible to run in the long term, as the obtained IRR value is higher than the established discount rate of 12%. The higher the IRR value, the more feasible the business is to continue, as it reflects relatively low initial investment costs, higher cash inflows, and limited cash outflows over a certain period.

The R/C Ratio indicates how much revenue is generated compared to the costs in terms of expenditure. This can be seen from the R/C Ratio value greater than 1, along with the total annual income exceeding the capital amount, meaning the business is worth pursuing. This analysis aims to determine how much revenue is obtained for every rupiah spent in the fishing business. According to Faqih and Rangga (2021), if the R/C Ratio is greater than one (R/C > 1), it is considered feasible for to be developed.

The payback period is the period required to recover the initial investment through the cash inflows or profits generated by the project or investment. This analysis aims to determine how long it takes to recover the investment expenditure by using the profits as a reference. Based on the data analysis results, the payback period for the fishing business using trolling fishing gear at Palabuhanratu Archipelagic Fishing Port Sukabumi is 4.79 years. The length of the payback period is influenced by the catch and profits earned by the fishermen. The higher the catch, the greater the profits for the fishermen, which will accelerate the investment recovery time. According to Sandi *et al*. (2022), the payback period is an investment assessment of a project based on the repayment of all investment costs by the net benefits of the project.

Conclusions

The handline fishing gear consists of a mainline made of nylon monofilament, branch lines, hooks of size No. 9, wire, sinkers, and bait. Handline fishermen typically bring two crew members. The primary catch of handline fishing consists of demersal fish, specifically hairtail fish and Purple-spotted bigeye fish. The average capital required for a handline fishing business is 68,535,000 IDR. The average total cost is 114,475,988 IDR, with an average income of 138,758,360 IDR and an average profit of 24,282,372 IDR per year. Based on the results obtained, the feasibility of the handline fishing business at Palabuhanratu Fisheries Port, Sukabumi, is deemed viable. The average NPV value is 418,458,590.64 IDR, the average IRR for handline fishing operations reaches 34%, the average R/C Ratio is 1.21, and the Payback Period for handline fishing operations at Palabuhanratu Fisheries Port is 4.79 years.

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