Performance of fishing units based on biological, technical, and financial aspects at the Nusantara Karangantu Fishing Port

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Abstract. The fishing gear used by fishermen at the Nusantara Fishing Port Karangantu consists of a seine net, hand line, trap, drift gill net, fixed gill net, boat lift net, and lift net. The technical development of fishing units at the Nusantara Karangantu Fishing Port must be carried out responsibly so that the potential of fisheries can be optimized using the principle of fishery potential. The dominant fishing gear used at the Karangantu Nusantara Fisheries Port is the drift gill net, lift net and boat lift net. This study aimed to conduct a financial analysis including the Payback Period (PP), Revenue/Cost (R/C) ratio, and profit assessment for the three types of fishing gear. The analyze used Multi Criteria Analysis method. The biological, technical, and financial analysis results showed that drift gill nets are an appropriate fishing unit at PPN Karangantu. The drift gill net fishing unit obtained a V(A) value of 2.39, placing it in the priority order. The second priority order is occupied by the boat lift net with a V(A) value of 1.57, while the third priority order is occupied by the lift net with a V(A) value 1.00.

1 Introduction

Nusantara Karangantu Fishing Port is one of the ports in the Banten region located in the northern part of Serang City. The Nusantara Karangantu Fishing Port is one of the fisheries centers in Banten Province. The fishing vessels used in the Nusantara Karangantu Fishing Port are below 5 GT on the traditional scale.

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The fishing gear unit at the Nusantara Karangantu Fisheries Port consists of seine net, hand line, trap, drift gill net, fixed gill net, boat lift nets, and lift-net. Fisheries statistics from the Nusantara Fishing Port of Karangantu stated that the highest production volume of fishing results was achieved using a variety of fishing units. The volume of fish production landed in 2022 in the boat lift net fishing unit was 648,862 kg, drift gill nets were 269,618 kg, lift nets were 169,109 kg, fixed gill nets were 145,419 kg, hand lines were 19,797 kg, and fishing nets were 122,284 kg.

According to Fisheries Statistics Data at the Nusantara Karangantu Fisheries Port in 2022, the volume of landed fish production is 2,435 tons. The total production volume in 2022 decreased compared to the 2021 data with a value of 2,464 tons and the 2020 data of 2,584 tons. Thus, based on fishery statistical data at the Nusantara Karangantu Fishing Port, judging from the volume of catch production, it indicates a decrease in the volume of catch production. The main catch of drift gill net is mackerel (*Rastrelliger* sp.). The main catch of the boat lift net fishing unit is anchovies (*Stolephorus indicus*), squid (*Loligo* sp.), cob (*euthynnus affinis*), tembang (*Sardinella fimbriata*). The main catch of the lift net fishing unit consisted of anchovies (*Stolephorus indicus*), and tembang fish (*Sardinella fimbriata*).

The technical development of fishing units at the Nusantara Karangantu Fishing Port should be carried out responsibly to optimze fishery potential, adhering to the principle of good utilization of sihery resources [1]. Optimal utilization of fishery resources requires the development of fishing units that are carried out effectively, efficiently and in an environmentally sound manner [1]. Efforts to preserve fish resources should be identified and analyzed by considering the fishing gear units used, with atteintion to biological, technical, and financial aspects [2]. Based on this description, it is necessary to determine the most appropriate and feasible fishing units to developed at the Nusantara Fisheries Port, considering biological, technical and financial aspects. The results of the research are expected to encourage the sustainability of the fishery industry in the Nusantara Karangantu Fisheries Port through the efficient use of fishing equipment, thereby increasing the productivity of catches while considering environmental aspects.

2 Materials and methods

2.1 Research time and location

They should be centred above the tables and flush left beneath the figures. The research began with proposal preparation activities, which were carried out in September. This was followed by the data collection process from October to December 2024 and the data processing process, which took place from December 2024 to February 2025. The research was conducted at the Nusantara Karangantu Fishing Port (Figure 1) through field studies and collection of fishery statistical data from 2018 to 2022. Data analysis using Microsoft Excel software at the Department of Fisheries Resource Utilization, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University.

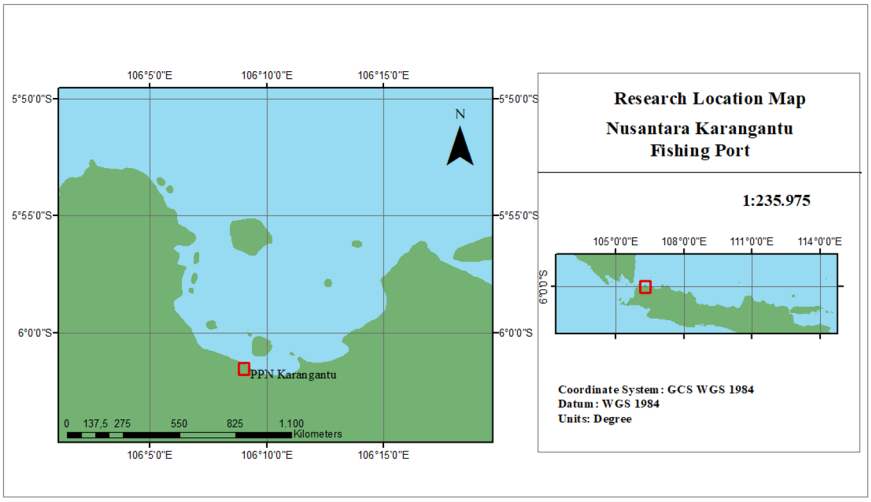

Fig. 1. Map of the research location

2.2 Research tools

The primary research tool used in this study is a questionnaire. The questionnaire contains questions related to biological, technical, and financial aspects as well as activities carried out by fishermen at the Nusantara Karangantu Fishing Port. Other supporting tools used during the research interview process with fishermen at the Nusantara Fishing Port in Karangantu include stationery, laptop, and camera.

2.3 Data processing

2.3.1 Biological analysis

This analysis of biological aspects is conducted to determine whether a fishing unit is well-standardized and does not harm fishery biological resources. The processing of biological analysis data requires an assessment of aspects of criteria such as the length of the fish season (in months), the length of fishing operations (in months), and the selectivity of the fishing unit [3]. The assessment of each criterion can be done using the scoring method based on the established criteria. The scoring criteria in assessing the selectivity of the arrest unit can be seen in Table 1.

Table 1. Interval for determining the selectivity of fishing gear

Value Interval	Indicators	Information
1 – 2	HTU = 10%-20%	Not selective
3-4	HTU = 30%-40%	Less selective
5-6	HTU = 50%-60%	Quite selective
7-8	HTU = 70%-80%	Selective
9-10	HTU = 90%-100%	Highly selective

Source : [3] (Pratama *et al.,* 2020)

2.3.2 Technical analysis

This technical aspect analysis is carried out to identify whether a fishing unit is effective and efficient in carrying out fishing operations. The processing of technical analysis data requires an assessment of aspects such as operation methods, operational reach, and the influence of the physical environment of fishing areas [4]. The scoring criteria for the interval assessment of the selectivity of the fishing unit's operation method are presented in Table 2.

Table 2. Interval for determining the selectivity of the method of operation of the fishing unit

Value Interval	Information
1-2	Difficult
3-4	Keep
5-6	Easy

Source: [4] (Imron *et al.,* 2021)

The analysis of the criteria, examining the influence of the physical environment of the fishing unit, was conducted using an assessment that assigned a score to each fishing unit, categorizing it as significantly influential, moderately influential, or influential. The criteria for the influence of the physical environment of the fishing unit on environment are presented in Table 3.

Table 3. Interval for determining the selectivity of the influence of the physical environment of the fishing unit on the environment

Value Interval	Information
1-2	Highly influential
3-4	Quite influential
5-6	No effect

Source: [4] (Imron *et al.,* 2021)

2.3.3 Financial analysis

The financial analysis in this study includes the calculation of profit, PP (*Payback period*) and *Revenue Cost Ratio* (R/C). The criteria used include annual income, income per trip, income per operating hour, income per workforce, and income per investment cost [5].

2.3.3.1 *Profit*

The primary purpose of doing business is to achieve the highest possible profit. The profit in a business is described as the more profit, the greater the welfare of the business will increase [6]. The Total revenue is found by multiplying the fish catch (Q) amount by the selling price (P) [6]. The profit in using the formula:

$$Profit = Total\ Revenue - Total\ Cost \quad (1)$$

2.3.3.2 *Payback period (PP)*

The criteria for receiving *a payback period* can be seen using the criteria [7]:
Payback period value < 3 Years: Fast return on business capital
Payback period value 3 – 5 Years: Medium return on business capital
Payback period value > 3 years: Slow return on business capital

The calculation of *the payback period* (PP) can be found with the formula:

$$PP = \frac{Initial\ Investment}{Net\ Cash\ Flow\ per\ Period} \quad (2)$$

2.3.3.3 *Revenue cost (R/C) ratio*

*Revenue Cost (*R/C) *Ratio* is a comparison of the total cost of receipt and the total cost of business. The R/C value shows how efficiently a business is run. The greater the R/C value, the greater the increase in profit obtained [8]. The criteria for accepting the R/C ratio can be seen using the following criteria:
R/C < 1 = business suffers losses
R/C > 1 = profit
R/C = 1 = effort to break even
The calculation of *the Revenue Cost (R/C) Ratio* can be found by the formula:

$$R/C\ Ratio = \frac{Total\ Revenue}{Total\ Cost} \quad (3)$$

Information:
Revenue Cost (R/C) Ratio =Acceptance and Fee Ratio

2.4 Combined analysis

The processing of the combined analysis involves a comprehensive assessment that consider biological, technical and economic aspects as criteria to identify superior fishing units among drift gill nets, boat lift nets, and lift nets. After the data are obtained, they are tabulated in Table 4.

Table 4. Combined analysis tabulation

Fishing unit	Criterion						Sum
	X1	UP1	X2	UP2	X3	UP3	
Drift gill net							
Boat lift net							
Lift net							

Information: X1=Biological Aspect, X2=Technical Aspect, X3=Economic Aspect, UP=Priority Order

2.5 Data analysis

Data analysis, in general, as used in this study, employs the MCA (*Multi-Criteria Analysis*) method. The MCA (*Multi-Criteria Analysis*) method is a method used to evaluate and make decisions based on criteria. The MCA (*Multi Criteria Analysis)* method helps ensure that various aspects are considered and that the final decision is the most optimal based on the available information. Standardization with value functions using the MCA method can be used using the formula from [9] (Mangkusubroto & Trisnadi 1985), as follows:

$V\ (X) = \frac{X - X_O}{X_1 - X_O}$, V(A) = $\sum_{i=1}^{i=n} V_{(x1)} + V_{(x2)} + V_{(x3)}$ (4)

Information:
I : 1, 2, 3 …… n
V(X) : Value function of variable X
X : Variable value X
X1 : Highest score on criterion X
X0 : Lowest score on criterion X

The value function of the variable X[V(X)] is a method for standardizing or normalizing the value of the variable X so that it falls within a specific range, typically 0 to 1. This value function is used in several criteria or variables that need to be compared to make an optimal decision. The value function of the variable X[V(X)] in this study can be described by the formula as follows:

$$Aspect\ (criteria) = \frac{Criteria\ value\ -\ lowest\ criteria\ value}{Highest\ criteria\ value\ -\ lowest\ criteria\ value} \quad (5)$$

The aggregate formula used in this study is the sum of various values obtained from from multiple criteria into a single composite score. This composite score is then used to determine the order of priority sorted from highest to lowest score. The aggregate formula in this study can be described with the following formula:

V(A) = $\sum_{i=1}^{i=n} V_{(x1)} + V_{(x2)} + V_{(x3)}$ (6)

Information:
V(X1) : The value of the first function in one criterion
V(X2) : The value of the second function in one criterion
V(X3) : The value of the third function in one criterion

3 Results and discussion

3.1 Fishing seasons

The fishing season in Karangantu is divided into three seasons: the western season, the intermediate season and the eastern season. The months of December to February are included in the western season, March to May are included in the first intermediate season, July to August are included in the eastern season, and September to November are included in the second intermediate season [10] (Ernaningsih *et al.* 2011). The fishing season in Nusantara Karangantu Fishing Port is influenced by wind and sea surface temperatur, fluctuating periodically.

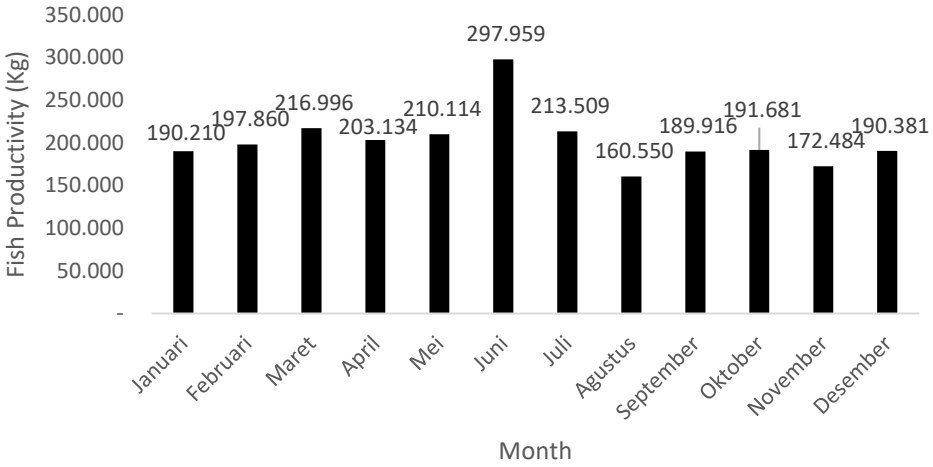

Fig. 2. Fish catch per month in 2022

3.2 Description of fishing unit

3.2.1 Drift gill net

Fishing units refer to boats, fishing gear, and the fishermen who operate them. The type of ship in PPN Karangantu generally uses small (<5 GT) to large (>10 GT) outboard motor boats. The engine used on this outboard motor boat is installed in the stern of the ship and can be easily removed or reinstalled. The dominant types of fishing gear used in the Nusantara Karangantu Fishing Port are drift gill nets, boat lift nets, and lift nets. The number of fishermen used in small boats (<5 GT) typically has a crew of 2-3 crew members, while the number of fishermen used in large boats (>10 GT) usually has a crew of 7-10 crew members. The specifications of the drift gill net fishing unit are presented in Table 5.

Table 5. Drift gill net fishing unit specifications

No	Part	Material	Size	Sum
1	Nets/ waring	PA *monofilament*	The length of one roll is 22 m, a total of 113 rolls. Total net length 2,500 m; Width 24 m; mesh size 3.4 cm	1
2	Ship	Wood	Length 8.5 meters; Width 2.5 m	1
3	Large buoy	Synthetic plastics	Cylinder	70
4	Small float	Synthetic rubber	Oval	1000
5	Large weights	Stone	Oval	2
6	Small weights	Tin	Cylinder	
7	Upper rib strap	PE *mutifilament*	5 mm	2
8	Bottom rail strap	PE *mutifilament*	3 mm	2

3.2.2 Boat lift net

The boat lift net fishing unit at Karangantu Fishing Port utilizes an outboard motor boat compromising two engines with a total power of 190 PK and employs seven crew members to carry out fishing operations. The boat lift net fishing unit is operated at night using an auxiliary device in the form of a lamp light, which serves as an attractant for fish to gather. Boat lift net fishermen in Karangantu Fishing Port departing from the fishing base to the fishing ground take anywhere from 1 to 2 hours with an operating method area of <12 miles. The boat lift net fishing unit conducts fishing operations for three days in one trip. After the boat reaches the fishing area, the fishermen make several setting preparations, including turning off the boat engine, starting the generator, and turning on the lights. The lights used by boat lift net fishermen at Karangantu Fishing Port are two types, namely mercury lamps and set lights. The mercury lamps installed on the boat lift net are 28 pieces with a power of 400 watts, while the set lights used by boat lift net fishermen are 34 pieces with a power of 1,500 watts. The specifications of the boat lift net fishing unit are presented in Table 6.

Table 6. Boat lift net unit specification

No	Part	Material	Size	Sum
1	Nets/ waring	*Polyprophylene*	Length 13 m; Width 13 m; mesh size 0.3 cm	1
2	Ship	Wood	22 meters long; Width 4.7 m	1
3	Frame	Iron	Length 13 m	2
		Bamboo	Length 13 cm	2
4	Ballast	Spherical iron	Diameter 12-13 cm	24-25
5	Bamboo platform	Bamboo	Length 14 m	2
6	Lamp	Mercury lamps	400 watts	28
		Light set	1,500 watts	34

3.2.3 Lift net

The lift net fishing unit at Karangantu Fishing Port utilizes an outboard motor boat as a mode of transportation from the fishing base to the fishing ground. The lift net fishermen number 1-2 people in carrying out fishing operations. The lift net fishing unit conducts fishing operations at night, using lights to lure fish, allowing them to gather. The operation method of the lift net is relatively straightforward, as one or two people can operate it. The lift net fishermen depart when the sun begins to set and arrive at the fishing area within 30 minutes. The setting is carried out by the lift net fishermen, who lower the net using a a bamboo roller. The specifications of the fishing unit for the lift net are presented in Table 7.

Table 7. Lift net unit specifications.

No	Part	Material	Size	Sum
1	Nets/ waring	*Polyprophylene*	Length 9 m; Width 9 m; mesh size 0.3 – 0.5 cm	1
2	Lift net	Bamboo	12 meters long; Width 12 m; Height 13 – 20 m	70 – 100 rods
4	Lamp	LED Lights	50 Watt	6

3.3 Fishing unit productivity

The production of catches from the fishing unit located at the Nusantara Karangantu Fishing Port has fluctuated in the last 5 years. The results of catch production for the period from 2018 to 2022 can be seen in Table 8.

Table 8. Fishing Unit Productivity in 2018-2022.

Year	Productivity (Kg/ship unit/ year)		
	Drift Gill Net	**Boat lift net**	**Lift net**
2018	230.017	929.853	228.534
2019	328.860	789.754	121.148
2020	232.597	894.685	259.642
2021	508.444	577.064	199.806
2022	269.618	648.862	169.109
Average	313.9072	768.0436	195.6478

Source: Nusantara Karangantu Fishing Port statistics

3.3.1 Analysis of biological aspects

Analysis of biological aspects in capture fisheries is a crucial component in sustainable management of fish resources. Biological Assessment is seen based on the length of the fish abundance season, the length of fish operation time, and the selectivity of the fishing unit. The number of fish species compositions caught is directly relatedtot he level of tool selectivity [11] (Wulandari *et al*., 2017). The assessment score of the technical aspect is presented in Table 9.

Table 9. The value of each criterion in the biological aspect and the priority order of each fishing unit in the Nusantara Karangantu Fishing Port.

Fishing unit	Criterion					
	X1	**UP1**	**X2**	**UP2**	**X3**	**UP3**
Drift gill net	8	3	10	1	8 (Highly selective)	1
Boat lift net	9	2	10	1	4 (Less selective)	3
Lift net	10	1	10	1	5 (Quite selective)	2

Information:
X1 = Length of months of the main catch fish abundance season (months)
X2 = Length of fishing operation time (months)
X3 = Selectivity of the catching unit (score)
UP = Priority order

The assessment of the long season of abundance of lift net fish ranks first. The anchovy chart has an abundance season of anchovies (*Stolephorus indicus*) for 10 months (May-February), followed by a boat lift net that catches anchovies and squid (*Loligo* sp) for 9 months (October-June), and a drift gill net for mackerel (*Rastrelliger* sp.) for 8 months (November-June). The assessment of the length of operation of all fishing units ranks first because they have the same operating period of 12 months. The assessment of the selectivity of the fishing gear, specifically the drift gill net, ranks first based in the percentage of the main catch, with value of 80%. The lift net has a value of 40%, and the boat lift net has a value of 50%. Based on a

comprehensive assessment of biological aspects using a value function that includes these three criteria, the results of the assessment are presented in Table 10.

Table 10. The value in the biological aspect after being standarized with the value function of the fishing unit in Nusantara Karangantu Fishing Port.

Fishing unit	Criterion			Sum	UP
	V(X1)	V(X2)	V(X3)		
Drift gill net	0.0	1.0	1.00	2.0	2
Boat lift net	0.5	1.0	0.00	1.5	3
Lift net	1.0	1.0	0.25	2.3	1

Based on the standardized on the biological aspect, the fishing unit of the lift net is in first place. The drift gill net fishing unit ranks second priority, and the boat lift net ranks third priority. The Lift net has an advantage in the assessment criteria for the length of the fishing season and the length of fishing operations compared to other fishing units.

3.3.2 Technical aspect analysis

The assessment of technical aspects related to the methods and fishing tools used is conducted the most efficiently and effectively. The assessment was conducted on the performance of fishing gear, taking into account the physical environmental conditions ofe the fishing area. The technical aspect assessment score is presented in Table 11.

Table 11. Value of each criterion in the technical aspect and priority order of each fishing unit in Karangantu.

Fishing unit	Criterion					
	X1	UP1	X2	UP2	X3	UP3
Drift gill net	4	2	6	2	3	1
Boat lift net	2	3	10	1	2	2
Lift net	5	1	5	3	1	3

Remarks: X1 = Method of operation of the appliance (score); X2 = Operating range (miles); X3 = Influence of the physical environment of the fishing area (score); UP = Priority order

Based on the analysis of the criteria for the operation method of the fishing unit, the lift net has the highest priority. Skoring of drift gill net is second, and the boat lift net is on the third priority scale. The second criterion for the technical aspect is that the reach of the fishing unit of the boat lift net ranks first, while for the drift gill net it ranks second in priority, and lift net ranks third. The third criterion in the technical aspect, namely the influence of the physical environment of the fishing area, indicates that drift gill nets occupy the first priority order, boat lift nets occupy the second priority order, and lift nets occupy the third priority order. Based on a thorough assessment of technical aspects using a value function that includes these three criteria, the results of the assessment are presented in Table 12.

Table 12. The value in the technical aspect after being standardized with the value function of the fishing unit in PPN Karangantu.

Fishing unit	Criterion			Sum	UP
	V (X1)	V (X2)	V (X3)		
Drift gill net	0.67	0.20	1.00	1.87	1
Boat lift net	0.00	1.00	0.50	1.50	2

Table 12. The value in the technical aspect after being standardized with the value function of the fishing unit in PPN Karangantu (continue)

Fishing unit	Criterion			Sum	UP
	V (X1)	V (X2)	V (X3)		
Lift net	1.00	0.00	0.00	1.00	3

Remarks: X1 = Method of operation of the appliance (score); X2 = Operating range (miles); X3 = Influence of the physical environment of the fishing area (score); UP = Priority order

Based on the standardized value function for the technical aspects of the fishing unit, the drift gill net fishing unit has the highest priority, the boat lift net has the second highest priority, and the lift net has the third highest priority. Drift gill nets and lift nets have a more straightforward operation method compared to boat lift nets. The lift net occupies the last priority order because environmental conditions are more influential during fishing operations; for instance, high currents and waves can hinder fishing operations.

3.3.3 Financial aspect analysis

Financial analysis was conducted to assess the level of profit and feasibility of the fishery business, as well as the prospect of sustainability in the fishing unit, which includes drift gill net, boat lift net, and lift net, at the Nusantara Krangantu Fishieries Port. Fixed costs are constantly changing and are not affected by the fluctuations in production prices [12] (Vonna *et al.,* 2016). The fixed cost value is Rp. 46,840,000,- for drift gill net, Rp. 66,200,000,- for boat lift net, and Rp 9,480,000,- for lift net. Variable costs, which are affected by the amount of production, include supplies, oil, diesel, levies, and ice blocks, amounting to Rp 2,501,660,212,- for drift gill net, Rp 6,301,198,014,- for boat lift net, and Rp 965,217,748,- for lift net.

Profits are obtained from the reduction of the total income of fishermen for one year by the total cost, which includes both fixed and variable costs. The drift gill net unit obtained a profit of Rp 2,319,758,172,-, a boat lift net of Rp 5,373,489,383,-, and a lift net of Rp 379,582,772,-. The Revenue Cost (R/C) ratio indicates business efficiency, with values of 1.94 for drift gill net, 1.84 for boat lift net, and 1.39 for lift net, all of which exceed 1, indicating that the business is running efficiently and profitably [13] (Nugroho AY et al., 2021).

The payback period describes the time it takes to return the initial investment, with a slender net requiring about 5 years, 4 months, and 16 days, a boat lift net of 8 years, 4 months, and 25 days, and a chart of 8 years, 11 months and 15 days [7] (Riyanto 2010). Details of the business feasibility analysis for the drift gill net fishing unit, boat lift net, and lift net at the Nusantara Fishing Port are presented Tables 13, 14, and 15.

Table 13. Financial analysis of drift gill net fishing units.

1. Investment		
No	**Description**	**Sum (Rp)**
1	Ship	100,000,000
2	Net Fishing Gear	15,000,000

Table 13. Financial analysis of drift gill net fishing units (continue).

1. Investment		
No	**Description**	**Sum (Rp)**
3	Machine	9,700,000
Total Investment		124,700,000
2. *Fix Cost*		
Depreciation Costs		
No	**Description**	**Sum (Rp)**
1	Ship	10,000,000
2	Net Fishing Gear	7,500,000
3	Machine	1,940,000
Total		19,440,000
Maintenance Costs		
It	**Description**	**Sum (Rp)**
1	Ship	10,000,000
2	Net Fishing Gear	15,000,000
3	Machine	2,400,000
Total		27,400,000
Total Fixed Costs		46,840,000
3. *Variable Cost*		
It	**Description**	**Sum (Rp)**
1	Rations	67,680,000
2	Solar	19,200,000
3	Oil	12,000,000
4	Ice Blocks	13,440,000
5	Profit sharing for fishermen	2,389,340,212
Total Variable Costs		2,501,660,212
4. Total Cost		2,527,500,212
5. Admissions/year		
Production		269.618
Production value		4,868,258,384
Advantage		2,363,500,212

Table 13. Financial analysis of drift gill net fishing units (continue)

5. Admissions/year	
R/C	1,94
Payback Period (years)	5,38

Details of the financial analysis for the boat lift net fishing unit at the Nusantara Karangantu Fishing Port are presented in Table 14.

Table 14. Financial analysis of boat lift net fishing units.

1. Investment		
No	Description	Sum (Rp)
1	Ship	350,000,000
2	Net Fishing Gear	7,000,000
3	Machine	90,000,000
Total Investment		447,000,000
2. *Fix Cost*		
Depreciation Costs		
No	Description	Sum (Rp)
1	Ship	35,000,000
2	Net Fishing Gear	1,400,000
3	Machine	9,000,000
Total		45,400,000
Maintenance Costs		
No	Description	Sum (Rp)
1	Ship	15,000,000
2	Net Fishing Gear	1,000,000
3	Machine	4,800,000
Total		20,800,000
Total Fixed Costs		66,200,000
3. *Variable Cost*		
No	Description	Sum (Rp)
1	Rations	470,400,000
2	Solar	588,000,000
3	Ice Blocks	43,680,000
4	Water	1,822,800
5	Oil	13,440,000
6	Profit sharing for fishermen	5,183,855,214

Table 14. Financial analysis of boat lift net fishing units (continue).

3. *Variable Cost*	
Total Variable Costs	6,301,198,014
4. Total Cost	6,367,398,014
5. Admissions/year	
Production	648.862
Production value	11,740,887,396
Advantage	5,072,655,214
R/C	1,84
Payback Period (years)	8,32

Details of the business feasibility of the lift net fishing unit at the Nusantara Karangantu Fishing Port can be seen in Table 15.

Table 15. Business analysis of the fishing unit of the lift net.

1. Investment		
No	Description	Sum (Rp)
1	Lift net	15,000,000
2	Net Fishing Gear	6,000,000
3	Machine	13,000,000
Total Investment		34,000,000
2. *Fix Cost*		
Depreciation Costs		
No	Description	Sum (Rp)
1	Lift net	1,500,000
2	Net Fishing Gear	1,200,000
3	Machine	1,300,000
Total		4,000,000
Maintenance Costs		
No	Description	Sum
1	Lift net	4,000,000
2	Net Fishing Gear	1,000,000
3	Machine	600,000
Total		5,600,000
Total Fixed Costs		9,600,000

Table 15. Business analysis of the fishing unit of the lift net (continue).

3. *Variable Cost*		
No	Description	Sum (Rp)
1	Lift net	18,000,000
2	Net Fishing Gear	9,000,000
3	Machine	7,560,000
4	Profit sharing for fishermen	921,177,748
Total Variable Costs		955,737,748
4. Total Cost		
5. Admission/year		
Production		169.109
Production value		1,344,800,520
Advantage		379,462,772
R/C		1,39
Payback Period (years)		8,96

The criteria for assessing the financial aspects of fishing units include several key indicators: annual revenue, revenue per trip, revenue per operating hour, labor cost per unit, and return on investment. The annual income is calculated by multiplying the annual production (kg) by the average price of fish. Revenue per trip is obtained by multiplying production per trip by the average price of fish. Income per labor is calculated by dividing the gross income per trip (Rp) by the number of fishermen employed. Details of each financial criterion for each fishing unit at the Nusantara Karangantu Fishing Port are presented in Table 16.

Table 16. The value of the financial criteria of each fishing unit at the Nusantara Karangantu Fishing Port.

Fishing unit	**Criterion**									
	X1	**UP1**	**X2**	**UP 2**	**X3**	**UP 3**	**X4**	**UP 4**	**X5**	**UP 5**
Drift gill net	4.891	2	20.38	2	1.698.264	2	66.370.561	3	44.18	1
Boat lift net	11.485	1	68.36	1	2.278.780	1	61.712.562	2	12.80	3
Lift net	1.186	3	3.29	3	329.453	3	76.764.812	1	25.23	2

Description: X1= Revenue per year (Rp in Millions); X2= Revenue per trip (IDR in Millions); X3= Income per hour of operation (Rp); X4= Income per workforce (Rp/Month); X5= Income per investment cost (Rp)

Based on the analysis using financial criteria, the boat lift net fishing unit ranks first in terms of revenue per year, revenue per trip, and revenue per operating hour due to its higher cacth rates compared to other fishing units. The drift gill net fishing unit is in second place, while the lift net is third for the criterion. For the criteria of income per workforce, the lift net ranks first, followed by the boat lift net and drift gill net in second and third place. In terms of income per investment cost, the drift gill net is in first place, the tread chart is second, and the boat lift net is in last place. The results of the standardization the financial value are presented in Table 17.

Table 17. Value in financial aspects after standardization with the value function of fishing units in Nusantara Karangantu Fishing Port.

Fishing unit	Criterion					Sum	UP
	V(X1)	V(X2)	V(X3)	V(X4)	V(X5)		
Drift gill net	0.36	0.26	0.70	0.31	1.00	2.63	2
Boat lift net	1.00	1.00	1.00	0.00	0.00	3.00	1
Lift net	0.00	0.00	0.00	1.00	0.68	1.68	3

Description: X1= Revenue per year; X2= Revenue per trip; X3= Revenue per hour of operation work; X4= Income per workforce; X5= Income per investment cost

Based on the value function standardized for the financial aspect of the fishing unit, the boat lift net ranks first. The boat lift net fishing unit excels in the criteria of annual revenue, revenue per trip, revenue per hour of operation work. This is because, in one trip, the boat's lift net fishing operation catches the most, resulting in a higher annual income compared to drift gill net and lift net. The drift gill net occupies the second priority order, and the step chart occupies the third priority order.

3.4 Combined analysis

Combined aspect analysis is used to identify fishing units with the highest highest priority based on assessment and standardization in biological, technical, and financial aspects. Fishing units considered superior are those that are environmentally friendly and do not harm the habitat [14] (Dewanti et al., 2018). The assessment of the combined aspects was carried out using new assessment criteria that encompassed biological, technical, and financial aspects [5] (Tangke U, 2011). The assessment of the combined aspect is carried out by calculating using the combined value function of three aspects: biological, technical, and financial. The results of the calculation are presented in Table 18.

Table 18. Assessment of all aspects with the value function of the fishing unit in the PPN Karangantu.

Fishing unit	Criterion			Sum	UP
	V(X1)	V(X2)	V(X3)		
Drift gill net	1.50	1.00	0.45	2.95	1
Boat lift net	0.00	0.57	1.00	1.57	2
Lift net	1.00	0.00	0.00	1.00	3

Description: X1 = Biology; X2 = Technical; X3 = Financial aspect; UP = Priority order

Based on the combined analysis, the drift gill net fishing unit is the most feasible option for development by the Nusantara Karangantu Fishing Port. The assessment of biological, technical, and financial aspects showed that the drift gill net had the highest criterion value compared to the boat lift net and lift net. Ease of operation, low investment costs, strategic

fishing locations, efficient labor, and significant profits make slim nets widely used choice among fishermen at the Karangantu Nusantara Fisheries Port. Thus, if human needs continue to increase annually while the carrying capacity of nature is limited, it can results in damage to natural resources, which adversely affects the survival of fishermen, especially small-scale fishermen [15].

4 Conclusion

Based on the analysis results, the lift net is superior to the boat lift net and the drift gill net in terms of biological aspects. However, in the technical aspect, the drift gill net ranks first, followed by the boat lift net in second, and the lift net in third. Meanwhile, in terms of business feasibility, boat lift net is in first place, followed by drift gill net and lift net. Thus, the most sustainable and expandable fishing unit in the Nusantara Karangantu Fishing Port is the drift gill net, which ranks first with a V(A) value of 2.39. The boat lift net ranks second with a V(A) value of 1.57, while the lift net is third with a V(A) value of 1.00.

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