Exploring the financial well-being of purse seine fishermen: a case study in Lamongan Regency

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Abstract. The purpose of this study was to determine the technical, economic, and financial aspects of purse seine fishing businesses in Lamongan Regency. The method used in the research was descriptive with a case study approach, and the sampling method utilized snowball sampling with 72 respondents who were boat owners. Financial analysis was then conducted by calculating several financial metrics, including profit, net present value (NPV), internal rate of return (IRR), benefit-cost ratio (B/C ratio), and payback period (PP). The purse seine fishing gear consisted of various components such as the net body, headline, lead line, purse line, floats, weights, and rings. The materials used for this fishing gear included polyethylene (PE), polyvinyl chloride (PVC), and tin. The purse seine vessels used vary in size, with the main engine typically being a 120 HP Mitsubishi diesel engine running on solar fuel. The total investment cost for purse seine fishing operations in Lamongan Regency reached Rp 492,000,000. The average annual revenue was Rp 86,535,301, with an average profit of Rp 13,223,068 per year. The financial analysis of the fishing business indicated a NPV of Rp 3,375,786,561, an IRR of 84%, a B/C ratio of 1.2, and a PP of 2 years and 4 months. With these results, it can be concluded that purse seine fishing businesses in Lamongan Regency were financially viable to continue.
Key Words: benefit-cost ratio, financial analysis, Lamongan, payback period, purse seine.

Introduction. Lamongan, located on the northern coast of Java Island, has been bestowed with abundant natural resources, especially in the form of marine products. With a coastline stretching 47 kilometers from Lohgung to Kranji, encompassing 17 villages along its coast, Lamongan has direct access to the rich waters of the Java Sea, making this area play a role as one of the strategic centers of fisheries activities in Indonesia (Dirman et al 2024). The majority of its population, largely dependent on fishing, makes Lamongan one of the most significant fishing centers in Indonesia. Data from the Lamongan District Fisheries Agency (2018) showed that the number of fishermen in the area reached 17,802 people. This figure reflects the strong involvement of Lamongan's community in the fisheries sector and its significance in providing livelihoods for the local population. However, not only does it serve as an important fishing center, Lamongan's natural wealth also substantially contributes to the local economy (Mufid 2018). With the optimal utilization of marine resources, both traditionally and through the development of modern technology, Lamongan has been able to maintain its position as one of the main economic drivers in the northern coastal region of Java Island.

Manaraja et al (2023) stated that the fisheries sector not only plays a role in providing jobs and income for local residents, but also in improving community welfare and increasing regional economic competitiveness. Therefore, it is important for local governments to continue to pay attention to and develop this sector with supportive policies, including sustainable natural resource management and adequate infrastructure development. Thus, Lamongan can continue to be one of the fisheries centers that not only have an impact at the local level, but also at the regional and national levels.

Purse seine is a fishing gear utilized to capture pelagic fish that swim in schools (Okemwa et al 2017). The target species for purse seine fishing are those that form

schools near the surface of the water (Basurko et al 2022). The fishing process using purse seine involves encircling the school of fish with a net to form a vertical wall, which prevents the fish from moving horizontally (Darasi & Akssisou 2019). The bottom of the net is then tightened by pulling the umbilical cord, so that the fish have no way to escape from under the net. This ensures that the fish remain effectively trapped in the net (Swimmer et al 2020). Purse seine fishing requires significant investment capital. This includes the cost of purchasing fishing gear, boat maintenance, and operations such as fuel and labor (Dewi et al 2020). To ensure success and avoid losses, careful planning is crucial for purse seine fishermen in Lamongan Regency. Fishing is an economic activity that relies on various production factors, with the main objective of generating profit. In addition, the success of this activity is also determined by the efficiency of the use of fishing gear and sustainable management of fishery resources (Lloret et al 2018). The success of fishing efforts can be measured by the amount of profit obtained by the practitioners. Therefore, research on the capital needed by purse seine fishermen, the income generated, and whether this fishing method is profitable or not is very important.

Conducting a financial analysis of purse seine fishing operations is essential to assess the potential profits that can be earned (Ekerhovd & Gordon 2020). This analysis includes calculating various parameters such as net present value (NPV), internal rate of return (IRR), benefit cost ratio (B/C ratio), and payback period (PP). The purpose of conducting financial analysis research on purse seine fishing operations in Lamongan Regency is to assess the economic viability and profitability of such ventures: to analyze the technical aspects of purse seine fishing operations in Lamongan Regency; to analyze the economic aspects, including costs, revenue, and profitability, of purse seine fishing operations in Lamongan Regency; and to analyze the financial feasibility of purse seine fishing operations by calculating NPV, IRR, B/C ratio, and PP in Lamongan Regency.

Material and Method

Research methods. This research was conducted in Lamongan Regency, East Java Province, Indonesia (Figure 1) in January-February 2022.

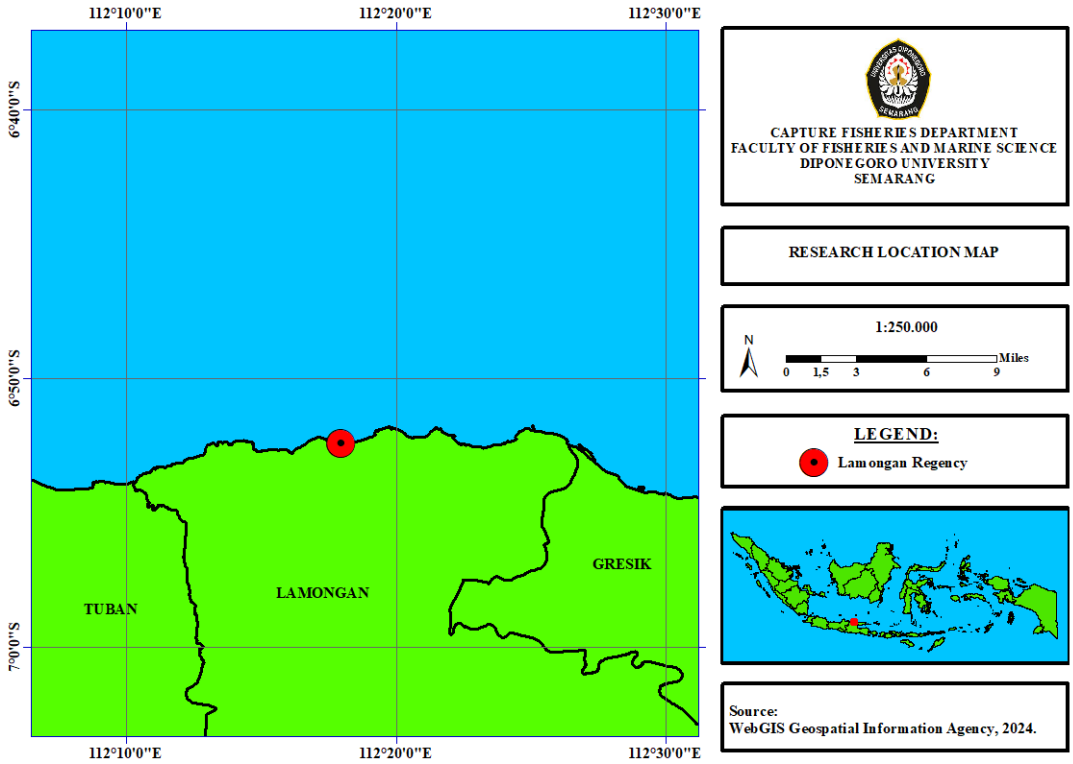

Figure 1. Research location map.

The method used in this research was descriptive method with a case study approach. For sampling, the snowball sampling method was used. This method was chosen because it is difficult to determine who and where the exact respondents are located. Sampling was done by selecting one or two individuals as initial samples, then asking them to recommend others who could be the next samples (Sugiyono 2017). The respondents in the study totaled 72 individuals, all of whom were purse seine fishermen in Lamongan Regency.

The data used in this research consisted of primary and secondary data. Primary data was obtained through direct observation and interviews with boat owners, while secondary data came from sources such as the Lamongan Regency Fisheries Office. The analysis conducted covered three main aspects: technical aspects, economic aspects, and financial analysis of fishing operations using purse seine gear.

The technical aspect analysis focused on measuring the vessel and gear, aiming to describe the technical conditions of the fishing operation, including gear construction, operational procedures, and catch results. Meanwhile, the economic aspect analysis involved evaluating capital, production costs, revenue, and profits associated with the fishing operation. This includes calculating the necessary investment, operational costs, revenue from catch sales, as well as business profitability. Financial analysis was then conducted by calculating several financial metrics, including profit, NPV, IRR, B/C ratio, and PP. This aimed to provide a comprehensive overview of the financial feasibility of fishing operations using purse seine gear.

Profit. According to Damanik & Sasongko (2010), analyzing the profit of fisheries entrepreneurs uses the formula:

$$\pi = TR - TC$$

where: π = profit (IDR);
TR = total revenue (IDR);
TC = total costs (IDR).

Net present value (NPV). NPV is the difference between the present value of investment and the present value of net cash receipts (operational cash flow and terminal cash flow). According to Maryani et al (2021), the NPV formula is as follows:

$$NPV = \sum_{t=1}^{n} \frac{CFt}{(1+i)^t} - C$$

where: CFt = cash flow per year in period t (IDR year^{-1});
C= initial investment in year 0;
i = interest rate (%);
t = th year (1st year, 2nd year…. t year);
n = number of years (5 years, 10 years….n years).

The criteria used were:
- if NPV is positive, then the investment is accepted;
- if NPV is negative, then the investment is rejected.

Internal rate of return (IRR). According to Ira & Setiawan (2023) IRR is a parameter used to measure the rate of return on capital invested in a business. It can be calculated using the formula:

$$IRR = i_1 + \frac{NPV_1}{NPV_1 + NPV_2} \times (i_1 + i_2)$$

where: i_1 = 1st interest rate (%);
i_2 = 2nd interest rate (%);
NPV_1 = 1st NPV (IDR);
NPV_2 = 2nd NPV (IDR).

B/C ratio. According to Yudaswara et al (2018), benefit/cost ratio (B/C ratio) is a comparison between total profits and total costs of a project or business. The B/C ratio calculation was done following the equation:

$$\text{B/C ratio} = \frac{\text{Profit}}{\text{Total cost}}$$

The criteria used were:

- if the B/C ratio is > 1, it means the business is making a profit so it is worth running;
- if the B/C ratio = 1, it means the business has no profit and no loss (break even);
- if the B/C ratio < 1, it means the business is experiencing losses so it is not worth running.

Payback period (PP). According to Arumtyas et al (2023), the PP is used to show how quickly the return period for the original investment is. PP is the ratio between initial cash outlay (initial cash investment) and cash inflow, the results of which are expressed in units of time. PP, if the cash flow from a project is different each year, it can be formulated as follows:

$$PP = n + \frac{(a - b)}{(c - b)} \times 1 \text{ year}$$

where: n = last year's cash flow has not covered the initial investment (year);
a = initial investment amount (IDR);
b = cumulative amount of flows in the 20th year (IDR);
c = cumulative amount of flows in year n+1 (IDR).
The criteria used were:c

- a PP value of less than 3 years falls into the fast recovery category;
- a PP value between 3 and 5 years is considered in the medium recovery category;
- a PP value of more than 5 years is categorized as slow recovery.

Results and Discussion. Based on the research that has been conducted, the results consist of three components, namely technical analysis, economic analysis and financial analysis.

Technical analysis. The purse seine fishing gear operating in Lamongan Regency has a rectangular shape with a total length of 1,500 meters and a depth of 22 meters. The top rope, buoys, weights, rings and corrugated lines are all 1,500 meters long with varying diameters, made from polyethylene (PE) type material. The floats used for the bag, body and wings are made of polyvinyl chloride (PVC) with different lengths and diameters, with a distance between the floats of 55 cm, with the aim of keeping the purse seine net from sinking and preventing the escape of the target fish. The weights used are made of tin (Pb), oval in shape, with one weight weighing 170 grams and a total of 2000 pieces. The weight is 5 cm long and 26.05 mm in diameter. The ring used is made of stainless steel with a diameter of 120 mm for the outside and 16 mm for the shape. The net sections on the top and bottom lines use PE material with a mesh size of 2.8 cm and a vertical length of 0.8 m, aimed at strengthening when removing fishing gear. The wing section is 250 meters long for the left and right, with a net depth of 22 cm, while the body section is 600 meters long with a net depth of 33 cm. The net on the pocket uses polyamide (PA) material with a length of 100 m, a mesh size of 2.6 cm, and a depth of 7 meters with a mesh size of 2.6 cm (Figure 2). Variations in the size of purse seine fishing gear vary greatly in several regions and within the same region. According to Lestari et al (2017), as a comparison, in the Banyuwangi Waters area, East Java, there is a purse seine fishing gear that has a maximum length of 300 meters and a minimum net width of 60 meters and a net mesh size of 1 cm. The fishing fleet used has a maximum size of 30 gross tonnage.

Purse seine ships operating in Lamongan Regency have sizes between 18 and 30 GT, with a ship length (L) of around 14 to 25 meters, a ship width (B) of 3 to 6 meters, and a ship depth (D) of 1.5 to 2.5 meters. This ship is equipped with two types of

engines, namely the main engine and auxiliary engines. The main engine uses a Mitsubishi 120 horse power (HP) diesel engine which uses diesel fuel. Meanwhile, the auxiliary machine uses an axle. Purse seine fishermen in Lamongan Regency operate a daily fishing operation system (one day fishing), which starts from the fishing base at 6.00 WIB and ends at 21.00 WIB. They sail 30 miles from the fishing base to the fishing ground (fishing area) to carry out their fishing operations. The main catch from purse seine fishermen is pelagic fish, namely tuna (*Euthynnus affinis*), lemuru (*Sardinella lemuru*) and tuna walang/baby tuna (*Thunnus albacares*).

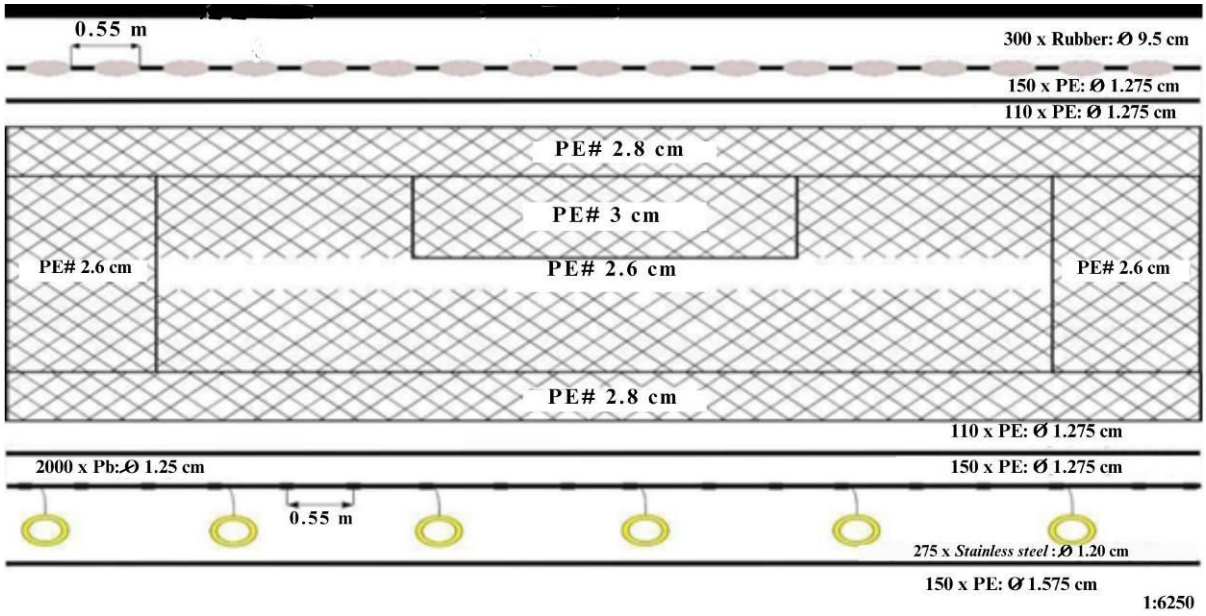

Figure 2. Purse seine design in Lamongan Regency.

Economic analysis. Economic analysis involves evaluating various aspects including capital required, total costs consisting of fixed and variable costs, income earned, and profits generated. Total costs are the sum of fixed and variable costs. Fixed costs do not change depending on factors such as the duration of the capture or the distance traveled (Acharjee et al 2017). On the other hand, according to Parker et al (2013), variable costs are expenses that can fluctuate based on fishing activities, including costs for supplies, fuel, and crew wages. The economic analysis also involves assessing the income derived from selling the catch, which may vary due to changes in fish market prices. Additionally, profit is calculated as the difference between the income earned and the total costs incurred in the fishing operation. For purse seine vessels in Lamongan Regency, these factors are crucial for evaluating the sustainability and profitability of the fishing enterprise.

Information about the economic aspects of the fishing business using purse seines in Lamongan Regency can be found in Table 1. To acquire a boat, the average capital required is IDR 492,000,000 while for fishing gear, the average capital is IDR 226,800,000. The machines used have an average price of IDR 6,912,000. The total capital required for a fishing business using purse seine fishing equipment reaches an average of IDR 725,712,000 per fisherman. Differences in boat prices per fisherman occur due to factors such as size, location of purchase, and quality of the boat. On average, boats owned by fishermen have a size of 18-30 GT. The engines generally used are diesel engines measuring around 120 HP, with the majority of engines being Mitsubishi branded. The economic life of the ship and engine is 10 years each, while for fishing gear it is only 1 year. Purse seine fishing gear has a relatively short economic life because it is susceptible to damage due to kinks and pressure when catching fish. The faster the fishing gear is damaged and the longer the fishing gear used, the greater the capital required (Manurung et al 2023).

Table 1

Economic aspects of purse seine fishing business in Lamongan Regency

No	*Details*	*Average (IDR)*
1.	*Investment cost*	
	Fishing boats	492.000.000
	Fishing gear	226.800.000
	Machine	51.000.000
	Axe	6.912.000
2.	*Fixed cost*	
	Maintenance	15.067.728
	Shrinkage	38.853.550
3.	*Variable costs*	
	Fuel (solar)	678.272
	Ice (cube)	68.464
	Clean water	26.656
	Oil	21.672
	Crew wages	26.992.549
4.	*Profit*	13.223.068

On average, the total depreciation costs in one year for fishing businesses using purse seine fishing gear reach IDR 38,853,550. Fishermen usually make 180 catches a year, which is divided into peak season 60 times, normal season 90 times, and lean season 30 times. Components of depreciation costs include ship depreciation costs of around IDR 19,608,000 per year, axle depreciation costs of around IDR 394,080, and engine depreciation costs of around IDR 2,990,294 per year. Apart from that, there are also other fixed costs which come from the sum of maintenance costs and depreciation costs in one year, which reaches IDR 15,067,728. As explained by Nugroho et al (2019), fishing efforts using the purse seine method require fixed costs which include maintenance costs, depreciation costs and administration costs. This shows that these costs are not influenced by the level of production produced, but are an important aspect in managing fishing businesses.

Fishing using purse seines requires variable costs of IDR 62,236,131 per year. The income from this business is divided equally between the skipper and the crew, where each gets 50% of the income after the cost of supplies is deducted. The variable costs incurred by each skipper tend to fluctuate along with the needs of the boat in carrying out fishing operations, which are influenced by production levels and activity intensity. In this context, these costs also change in line with the output produced: the more units produced, the greater the costs that must be allocated to support business activities. According to Sogn-Grundvåg (2020), variable costs are a type of expenditure that is flexible, depending on the conditions or amount of fish caught. However, it is important to note that variable costs can be zero if no fishing operations are carried out at all. This shows the importance of understanding the cost dynamics in fishing businesses, which is key to effective planning and management.

Annual income from fishing using purse seines reaches IDR 86,535,301. According to Rahim (2011), income in the context of capture fisheries business is the difference between the production value of the catch and the total operational costs incurred by business actors during fishing operations. The average profit from the purse seine fishing business in a year reaches IDR 13,223,068 which is obtained by subtracting the total income of IDR 86,535,301 with total costs of IDR 73,312,233. This finding is supported by Restumurti et al (2016), which explains that profit is additional value obtained from the difference between total revenue and total costs incurred in the production process. Changes in these values reflect economic dynamics in the fishing industry, which can be the basis for more effective management and business development strategies.

Financial analysis. Financial analysis is used to determine the feasibility of the purse seine fishing business. The financial analysis used is NPV, IRR, B/C ratio, and PP with a

project economic life of 10 years. Evaluation of the feasibility of the purse seine fishing business in Lamongan Regency is presented in Table 2. In identifying the parameters to focus on, several assumptions were introduced to clarify the boundaries of the problem in this research regarding the purse seine fishing business in Lamongan Regency:

- first, the project is considered to have an operational life of 10 years, in line with the economic life of investment goods used in fishing business activities using purse seines;
- second, the capital used in the project comes from internal sources;
- third, business revenues are obtained through the sale of fish catches;
- fourth, a discount factor of 6% is used, in accordance with the Micro People's Business Credit (KUR) interest rate in effect in 2023, as the basis for calculating the investment value;
- fifth, to calculate depreciation costs, it is assumed that the economic life of the boat and engine is 10 years each;
- sixth, in the period from the first to the tenth year, there was an annual increase of 5% in price, capital (fishing gear), and depreciation costs. This is an important step in observing and analyzing the sustainability and development potential of fishing businesses in the region.

Table 2

Feasibility of purse seine fishing business in Lamongan Regency

No	*Details*	*Average*
1.	Net present value (Rp), 10 years	Rp 3,375,786,561
2.	Internal rate of return (%)	84%
3.	B/C ratio	1.2
4.	Payback period	2.36

The NPV calculation results from the purse seine fishing business in Lamongan show a positive number, namely 3,375,786,561. This indicates that within a ten year period after paying off the investment costs and relevant interest costs, the income generated reached that amount. With a positive NPV, it can be concluded that investing in purse seine fishing is an option worth considering. The theory exposed by Gürtürk (2019) explains that NPV is obtained from the difference between project income in year t and project costs in year t, which is then calculated using the prevailing interest rate. This emphasizes the importance of careful financial evaluation in measuring the feasibility and potential benefits of investment in the capture fisheries industry. According to Hastuti et al (2013), IRR is used as a method to assess the level of return on investments that have been made. In the IRR projection, the interest rate used is 6%, in line with the People's Business Credit (KUR) interest rate set by Bank Rakyat Indonesia for that period. It was found that the average IRR of the purse seine fishing business unit in Lamongan Regency was 84%, which was calculated by projecting the business for 10 years according to the economic life of the goods involved. These results show that the IRR value far exceeds the specified interest rate, namely 6%. From this analysis, it can be concluded that the purse seine fishing business has proven to be profitable and feasible to continue, considering that the IRR value is significantly higher than the prevailing interest rate. Agbeye (2019) also highlighted that if the IRR surpasses the discount rate, the business is deemed worthwhile to pursue. If the IRR equals the discount rate, the project is considered to be at breakeven. Conversely, if the IRR is below the discount rate, the project should not be continued.

Based on Table 2, it can be concluded that the B/C ratio value of the purse seine fishing business is 1.2. This value shows that the business can be considered worthy of continuing, because the B/C ratio value exceeds 1. This indicates that the income obtained from the business is greater than the total costs incurred, so that the profits generated are able to cover all costs related to the business. In other words, investment in this business can provide profitable returns for business actors. B/C ratio analysis is important in evaluating the economic feasibility of a project, because it can provide a

clear picture of the relationship between income and costs. The success of the purse seine fishing business in achieving a positive B/C ratio value shows the potential to support the growth and sustainability of the fisheries sector in Lamongan district. Therefore, these results provide a strong basis for decision makers to continue and develop the purse seine fishing business in Lamongan Regency.

The results of the PP calculation show a value of 2.36, which indicates that investment capital in the purse seine fishing business in Lamongan Regency can be returned within 2 years, 4 months and 10 days. This indicates that the return on capital occurs quickly. According to research by Syarif et al (2016), PP is used to assess the time period needed to return investment capital. This method helps in determining how quickly investment capital can be repatriated, measured in years and months. PP criteria are generally divided into three categories: capital payback is considered fast if it is less than 3 years, medium if it is between 3-5 years, and slow if it is more than 5 years. By referring to these standards, the calculation results show that the return on capital from the purse seine fishing business in Lamongan Regency is relatively fast. This confirms that this investment is worth considering, because its PP is shorter than the maximum period that is considered reasonable. On the other hand, if the PP of an investment exceeds the specified maximum limit, it indicates that the investment may not be worth continuing.

The purse seine fishing gear used in Lamongan Regency shows very detailed and measurable technical specifications to ensure effectiveness in fishing operations. The Purse Seine is rectangular in shape with a total length of 1,500 meters and a depth of 22 meters, equipped with components such as top rope, buoys, weights, rings and corrugated ropes, all of which have the same length, namely 1,500 meters. The use of PE and PVC materials for ropes and buoys shows the right material selection to ensure durability and optimal performance of this fishing gear. The distance between the buoys set at 55 cm is designed to keep the net afloat and prevent fish from escaping, demonstrating attention to detail for fishing efficiency.

The weight components used in the purse seine are made of tin (Pb) with an oval shape and weigh 170 grams each, a total of 2000 pieces. The use of weights is important to ensure the net can reach the required depth without losing stability. In addition, a stainless ring with an outer diameter of 120 mm is used to strengthen the net structure and make fishing operations easier. The net itself uses PE material with a mesh size of 2.8 inches and a vertical length of 0.8 m to provide additional strength when fishing gear is used. The wings of the net are each 250 meters long and 22 cm deep, and the body parts are 600 meters long and 33 cm deep, showing a design calculated to catch large numbers of fish.

Economic analysis of fishing businesses using purse seine fishing gear in Lamongan Regency highlights the need for a thorough evaluation of various cost and income components. The initial capital required to start this business is substantial, with an average total investment of IDR 725,712,000 per fisherman, which includes the cost of boats, equipment, and machinery. Fixed costs, such as maintenance and depreciation, are significant parts of the total operational costs. Annual depreciation amounts to IDR 38,853,550, and other fixed costs, such as maintenance, total IDR 15,067,728 per year. Fishing activities occur approximately 180 times a year, with variations in operational efficiency due to peak, normal, and lean seasons. These fixed costs remain constant regardless of production levels and must be incurred to sustain the business.

Apart from fixed costs, variable costs also contribute greatly to total operational costs, reaching IDR 62,236,131 per year. These variable costs include fuel, ice, fresh water, oil, and crew salaries, all of which can fluctuate depending on the fishing operation. Income from selling fish catches reaches IDR 86,535,301 per year, with a net profit of IDR 13,223,068 after deducting all costs. The division of income between the captain and crew is carried out fairly, each gets 50% after equipment costs are deducted. By understanding and managing fixed and variable cost components effectively, fishermen can increase the profitability and sustainability of purse seine fishing businesses in Lamongan Regency.

The results of the NPV calculation of IDR 3,375,786,561 shows that the purse seine fishing business in Lamongan Regency has very profitable investment potential. This positive NPV indicates that within a ten year period, after paying off all investment costs and related interest, the income generated is quite significant. The theory explained by Yanto et al (2023) indicates that NPV is derived from the difference between a project's income and its costs for a specific year, with calculations based on the current interest rate. According to Mondal et al (2024), it is important to conduct a comprehensive financial evaluation to assess the feasibility and potential benefits of investing in the fisheries sector.

IRR analysis shows very positive results with a value of 84%. This IRR value far exceeds the interest rate used in the projection, namely 6% which is in line with the People's Business Credit (KUR) interest rate set by Bank Rakyat Indonesia. Hastuti et al (2013) explained that IRR is used to assess the level of return on an investment, and if the IRR exceeds the prevailing interest rate, then the investment is considered profitable and worth continuing. In the case of the purse seine fishing business in Lamongan, the IRR value is much higher than the prevailing interest rate, indicating that this business is very profitable and has bright long-term prospects.

B/C ratio analysis also supports the economic feasibility of purse seine fishing businesses in Lamongan. With a B/C ratio value of 1.2, this business shows that the income obtained is greater than the total costs incurred. This value shows that investment in the purse seine fishing business can provide significant profits for business actors. B/C ratio analysis is important in evaluating the relationship between income and costs, and a positive B/C ratio value shows the potential of this business to support the growth and sustainability of the fisheries sector in Lamongan Regency.

The PP calculation results show a figure of 2.36 years, or around 2 years, 4 months and 10 days. This shows that investment capital can be returned relatively quickly. PP is used to assess the time period required to return investment capital, with a quick return category if less than 3 years. These results show that investment in purse seine fishing in Lamongan Regency can return capital quickly, which confirms that this investment is worth considering. The speed of return of capital that is shorter than the maximum period that is considered reasonable indicates that this business has lower risk and high profit potential.

Conclusions. Purse seine fishing gear consists of several components such as net body, riser rope, ring rope, crimping rope, float, weights and retaining ring. The materials used for this fishing gear vary, including polyethylene, polyvinyl chloride, and tin. The purse seine vessels used vary in size, with the main engine using a Mitsubishi 120 HP diesel engine which uses diesel fuel. The average cost of a purse seine fishing business in Lamongan Regency required for investment capital is IDR IDR 492,000,000. The average income generated is IDR 86,535,301 per year. The average profit obtained is IDR 13,223,068 per year. The financial analysis of the capture fisheries business resulted in an NPV value of IDR 3,375,786,561, IRR 84%, B/C ratio of 1.2 and a payback period of 2 years, 4 months, 10 days. Based on the results obtained, it can be said that the purse seine fishing business in Lamongan Regency is feasible to continue.

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Conflict of interest. The authors declare that there is no conflict of interest.

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