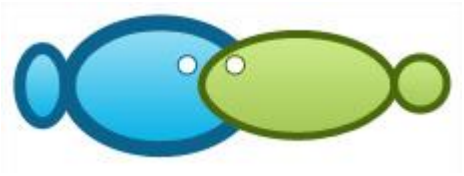

General overview of the financial aspects of lift net fisheries operations in Pangandaran, West Java, Indonesia

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Abstract. Set lift net is a traditional fishing gear used by Pangandaran fishermen. The information about the existence and the operation of the set lift net in Pangandaran is still limited. The purpose of this study was to determine the economic conditions of lift net fishing in Pangandaran, consisting of: the number of fishing gear operating, the type of lift net construction, the number of fishermen involved, the number of fish collectors who collect the catch of the lift nets and the potential of the fish resources available in the lift net capture area. This data is important to determine the feasibility of the operation of a set lift net as fishing gear. The analysis used in this research was descriptive, with financial analysis using several indicators, such as profit and loss, benefit-cost (B/C) ratio and payback period (PP). There are two types of lift nets in Pangandaran, set lift net and floating lift net. The set lift net is more dominant with 38 units, while the floating lift net only consists of 8 units. The dominant catch by set lift net consisted in small shrimps with a percentage of approximately 83% of the total catch, with an average catch of 26.2 kg trip^{-1} (CPUE). Observation data were obtained from 11 small shrimp collectors. The indicators derived from the fish catching analysis and from the business feasibility evaluation suggested that a fishing business centered on the set lift net technology is viable, with a positive profit and loss balance (total revenue greater than total cost) a PP of 0.69 years (8 months 1 weeks), and a B/C ratio of 1.42 (>1).

Key Words: financial, profit and loss, B/C ratio, payback period, CPUE.

Introduction. Pangandaran is an area located in the West Java Province, Indonesia. Pangandaran Regency consists of 10 districts with 93 villages with Parigi as the capital city. The tourism industry is one of the main driving sectors of Pangandaran's economy. Pangandaran offers various tourist attractions such as natural beauties, landscapes, marine reserves, and fisheries. The development of the fisheries sector is demonstrated by the increasing number of fishing vessels operated annually in this area (Akbarini et al 2013). The fisheries sector is one of the driving sectors for the economic and domestic income of Pangandaran Regency. Besides that, based on geographical conditions, Pangandaran Regency is located directly facing the Indian Ocean so that it has considerable marine biodiversity potential (Anwar 2018; Dewanti et al 2018). To understand the contribution of the fisheries sector to Pangandaran's economy, it is important to collect information on local fishermen. Information about Pangandaran set lift net is still limited although it is an important element to be integrated in the overviews and projections of the fisheries sector productivity.

Fishermen in the Pangandaran area operate various types of fishing gear, one of which is a lifting net, more precisely a fixed lift net. The fixed lift net is a series or rectangular bamboo arrangement that is planted at the bottom of the water so that it stands firmly above the water. A net is installed in the middle of the construction. The

step chart is passive and the operation uses a light to collect fish (Silitonga & Hartoko 2014).

The Pangandaran fishery lift net was first introduced to fishermen through the migration of Bugis fishermen who settled in Pangandaran during the New Order. Since then, fishermen have begun to know and understand how to build and operate the lift net. The operation of lift net fishing gear in Pangandaran has become a polemic in the last few years due to a plan to ban fishing operations using fishing gear, but some fishermen still use it, due to the low investment and operating costs, and easy handling (Susaniati et al 2013). In 2006, when the tsunami struck Pangandaran, all the set lift nets in the area were uprooted and could not be operated, so that fishermen had to rebuild them.

In 2009 there was an organization that oversaw all Pangandaran fishermen, namely Pangandaran Set Lift Net Fishermen Association (PNBP), where there were listed around 40 units of set lift net, until 2019. Latest data show that the set lift net operated in Pangandaran waters was reduced to 38. In addition, there are around eight units of floating lift net, but this floating lift net is not registered in the PNBP membership.

According to Nurhayati (2013), fisheries potential in Pangandaran decreased so that proper supervision and management is needed. Limited information regarding Pangandaran's lift net prevents further investigations on the economic status of the fishing activity. Besides, the utilization level of this fishing gear became unpredictable, calling for updated information about the corresponding operations in Pangandaran, such as the number of fishermen, number of operating set lift net, the number and type of catches and also the stakeholders involved.

The availability of the information related to the Pangandaran set lift net is intended to support both future policy projections and academics research. Set lift net is a fishing gear commonly used to capture small shrimp. It is based on the principle that a light source, as stated by Jayanto et al (2016), stimulates fish to approach an area where catching can be done manually with fishing nets or fishing rods.

Set lift net is used by Pangandaran fishermen because it is relatively affordable, compared to other fishing gear. In general, the fishing industry is considered a risky activity, where fishermen put themselves in the highest level of risk with the smallest income as an output. Fishermen income can be improved by maximizing the productivity of fishing gear in order to increase the amount and value of the catch. Set lift net is a type of fishing gear that targets the small pelagic fish such as small shrimp and anchovies.

Based on local fishermen, the set lift net is a very productive fishing gear and can improve the fisheries economy and the fishermen income. In addition, the operation and maintenance techniques of set lift net are relatively easier compared to other fishing gear. A study on the feasibility of a lift net fishing gear from a financial perspective, based on several indicators such as profit and loss, B/C ratio and payback period, but also a complementary analysis related to the available resources contained in the lift net capture area using catch per unit effort (CPUE) data would be necessary. The results of such an analysis are revelatory for the condition of Pangandaran lift net fisheries, in terms of economy and resources.

Fishing gear in Pangandaran targets the small pelagic fish such as rebon shrimp and anchovy, which is in line with Gustaman (2012). Based on local fishermen, the lift net fishing is a very productive method. In addition, the operation and maintenance techniques are relatively easier compared to other fishing gear. In order to improve the community's economy, it is necessary to optimize the lift net fishing. The current study is based on several performance indicators, while studying the feasibility of lift net fishing.

Material and Method

Data collection. The current research was based on a descriptive method with a case study approach. According to Nazir (2005), a case study is a research method that aims to provide a general conclusion through a detailed description of the background, traits and characteristics of a case or status of an individual. The sampling method

(respondents selection) used in this research was the purposive sampling method for the selection of a representative population, able to understand and answer the research topic and requests.

The respondents chosen in this study were 18 fishermen from a total population of 38 set lift net owners in Pangandaran. An interview was conducted directly with the 11 fish collectors from the set lift net, in order to provide consistent supporting data for the study. Direct field observations were performed, such as: conducting interviews with fishermen, participating in fishing activities at sea and directly measuring the length, wide and depth of the structure of lift net fishing gear, in order to collect accurate data on the Pangandaran lift net efficiency, namely the volume, type and method of capture.

Data analysis. The observations are presented using a descriptive analysis method where the data produced is displayed on diagrams, tables and images facilitating their analysis. In addition, CPUE analysis was used to determine the condition of fish resource utilization, followed by the calculation of several financial indicators of the fishing business feasibility. Extracted indicators included profit/loss balance, payback period and benefit/cost ratio, calculated by considering different aggregation levels.

CPUE analysis. The CPUE rate calculation aimed to identify the catch share per unit of fishing effort (Wulriyanti et al 2004). The formula used is as follows:

$$CPUEi = \frac{Ci}{fi}$$

Where:
Ci - i^{th} catch (ton);
fi - i^{th} arrest attempt (trip);
CPUEi - total catch of i^{th} catch (tons $trip^{-1}$).

Profit and loss analysis. According to Farchan (2006) and Dirja (2019), an analysis of profit and loss is the difference between the total amount of income (sales) and the total amount of costs incurred. If the balance is positive, the activity is profitable. Profit and loss analysis is one of the main indicators evaluated in order to determine the feasibility of a fish capture type of business. The amount of revenue that comes during the production period is obtained from the sales price of the catch while the costs incurred include fixed costs and variable costs (Sumardika 2013). Profit and loss can be calculated using the following formula:

$$Profit\ Loss = TR - TC$$

Where:
TR - total revenue;
TC - total cost.

Payback period. According to Nugraha & Wibowo (2014), the payback period is the time needed to recoup investment using the annual cash flow. The value of this ratio is compared with the maximum period of received payments. Sumardika (2013) explains the formula for calculating the return period as follows:

$$PP = \frac{Cost\ of\ Project/Investment}{Annual\ Cash\ Inflows} x\ 1\ year$$

Benefit cost ratio (B/C ratio). The benefit-cost ratio is calculated based on the interest rate. This analysis is intended to compare of revenue and production costs used (Karningsih et al 2014). The smaller the value of this ratio, the greater the risk of experiencing losses for the fishermen (Umar 2005). The formula of benefit-cost ratio, according to Sumardika (2013) and Wismaningrum et al (2013), is as follows:

$$B/C\ Ratio = \frac{Total\ Income}{Total\ Cost}\ x\ 1\ year$$

Where:
B/C<1- unacceptable;
B/C=1- indifferent;
B/C>1- acceptable.

Results

Construction of Pangandaran set lift net. In general, lift nets in Pangandaran have the same shape and construction, with few differences such as the dimensions of the chart and natural factors like: water depth, wave height and bottom structure, affecting the gear size and quantity of material.

The main material used to build a lift net by Pangandaran fishermen is Betung bamboo (*Dendrocalamus asper)* (Figure 1), due to its strong structures and longer and wider size compared to other types of bamboo. The size of the bamboo used to construct the set lift net must at least exceed the depth of the waters for the bamboo material used as a pole.

Figure 1. Bamboo Betung (*Dendrocalamus asper)* used to build a set lift net (original).

The form of fixed lift net fishing can be seen in Figure 2 (left). The construction design and specifications corresponding to the dimensions of the largest lift net of Pangandaran are shown in Figure 2 (right) and listed in Table 1, respectively.

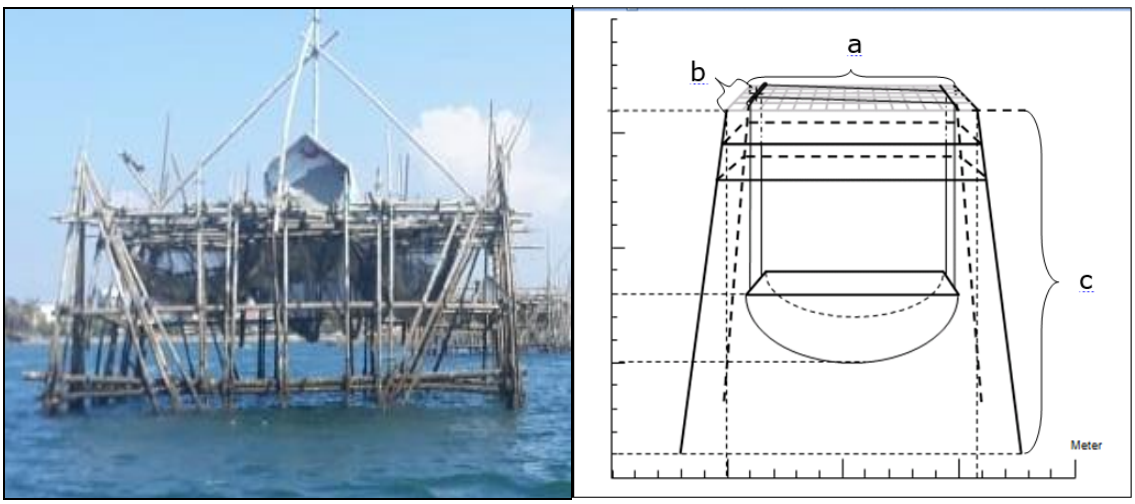

Figure 2. Pangandaran lift net (original).

Table 1

Lift net dimension

Information	*Size*
Dimension	
Length (Figure 2 - a)	10.9 m
Width (Figure 2 - b)	10.7 m
Height (Figure 2 - c)	15 m
Length of fishing gear	10 m
Width of fishing gear	10 m
Weight of fishing gear	106 m
Height from water surface	3 m
Catchment weight	200 kg
Average current speed	0.62 m s^{-1}
Wave height (max)	2.28 m
Size of supporting tool (*roller)*	
Length	8.87 m
Diameter	0.25 m
Thickness	0.025 m

Lift net operating area. Lift nets in Pangandaran, in particular the set lift nets, operate in waters near nature reserves with an average depth of 12 meter from the surface of the water. The closest set lift net position takes about 10 minutes of travel, while to get to the furthest set lift net takes about 20 minutes of travel. The distribution of the catchment area or location where the anchor chart is built is concentrated in the territorial waters at the northeast of the Pangandaran nature reserve.

The area that is used as the operating site or the place where the set lift net is built has a water base in the form of sand and mud and some coral. The area is also relatively safe because it does not face directly with waves or oceans, other than that the current that is around the fishing operation area is relatively safe. The operating area of the set lift net can be seen in Figure 3.

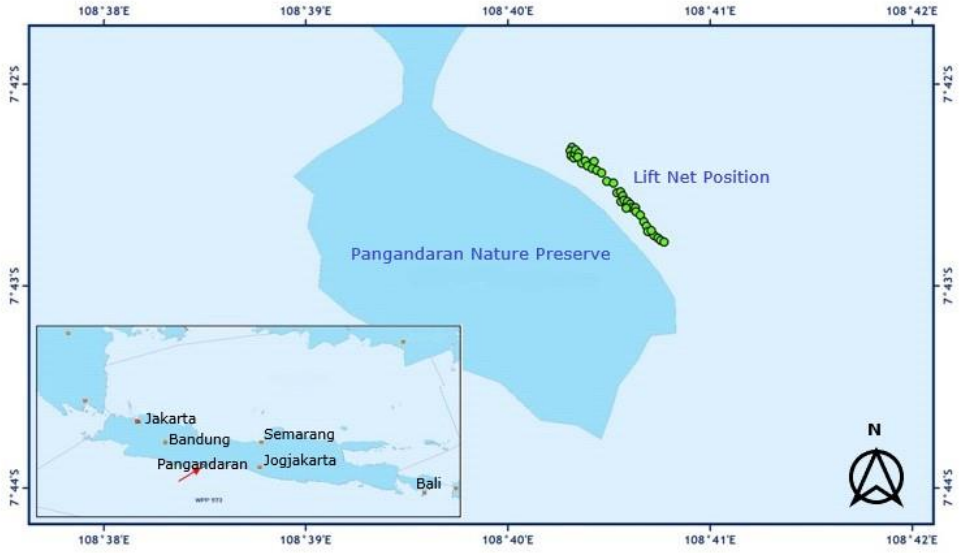

Figure 3. Set lift net operation area.

Production and composition of catch chart. Production data of lift nets catch are difficult to analyze due to the absence of a definite data collection process. Catch data from only 10% of the 38 units of set lift net were recorded by the auction or fishing port. This is because most of the set lift net catches are sold without going through the public auction process at the fish auction place (TPI). Therefore, to obtain data on estimated

production and catch composition, field observations were conducted and embedded directly in the process of catching fish with a set lift net, especially for the commodity of small shrimp.

The composition of set lift net catchment consists of several types of fish with different sizes. Data on fish species and average catch volume of the trip can be seen in Table 2 and in Figure 4.

Table 2

The catch of Pangandaran fishermen per trip

Scientific name	*Total (kg)*	*Average (kg)*	*Percentage (%)*
Trichiurus lepturus	54.10	3.38	7.09
Decapterus sp.	0.25	0.02	0.03
Acetes indicus	667.25	41.7	87.39
Penaeus semisulcatus	0.20	0.01	0.03
Fenneropenaeus merguiensis	0.10	0.01	0.01
Loligo sp.	13.00	0.81	1.70
Caranx ignobilis	5.00	0.31	0.6
Sepiadariidae	12.50	0.78	1.64
Leiognathus equulus	10.60	0.66	1.39
Caranx melampygus	0.50	0.03	0.07

Based on the data obtained from observations of the fish capture process with the lift net and from the catches measuring, it could be concluded that the most captured commodity was *Acetes indicus* of the total catches obtained by the set lift net in one fishing trip. The second commodity was *Trichiurus lepturus* from the total catch, followed by *Loligo* sp., *Sepiadariidae*, *Leiognathus equulus*, *Caranx ignobilis*, *Caranx melampygus*, *Decapterus* sp., and *Penaeus semisulcatus*, while the lowest commodity catchment was *Fenneropenaeus merguiensis*.

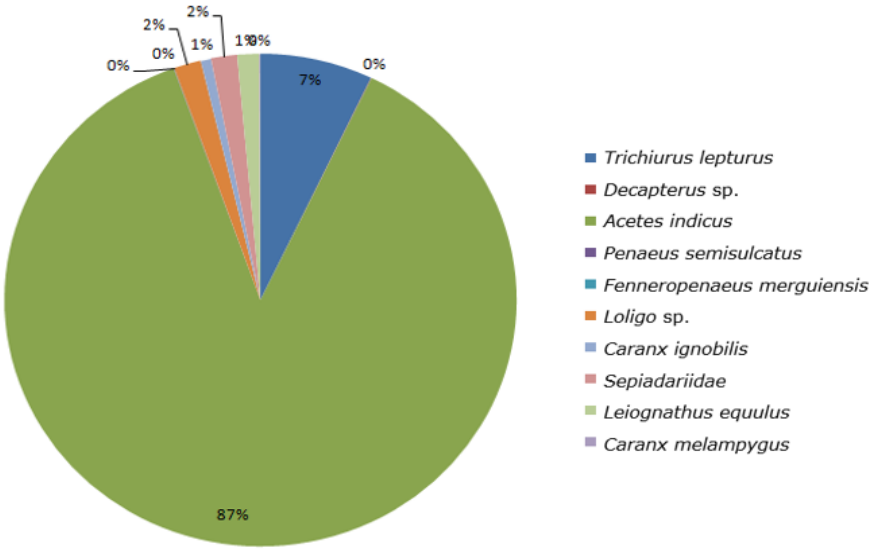

Figure 4. Percentage of fish production in one fishing trip.

Resource analysis. Utilization of fish resources must use the principle of prudence, with the aim to preserve the resource and regulate the competitive access, at each potential fishing location. The current study focused on the rebon shrimp, with a total production reaching 87% of the composition of the total catches within the Pangandaran area. Unfortunately the rigorous fish resource quantities captured in this region is not recorded by the authorities and the actual status of the rebon shrimp resources carrying capacity is still unknown. Based on the results of interviews conducted with fishermen and

collectors, a general description of small shrimp catches has been obtained, but the data are essentially based on estimations of the average income by set lift net over the past few years (Figure 5).

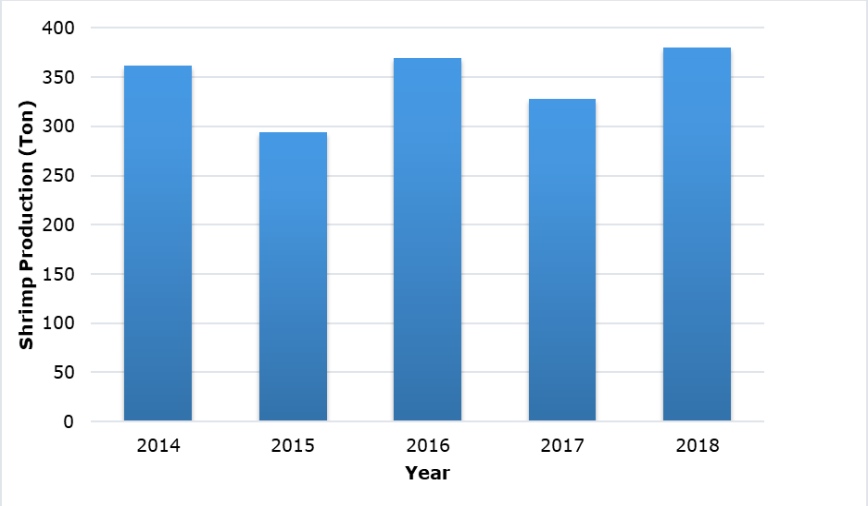

Figure 5. Pangandaran small shrimp production.

Figure 6 shows that Pangandaran's small shrimp production is very volatile from year to year. According to fishermen's explanations, the year difference in shrimp production is based on weather conditions. The production data is the result of observations and interviews with all parties who may provide catch data, in particular the collectors, which are the buyers of the catch production of the lift net fishermen, from the 38 fixed lift nets and 8 floating lift nets. Based on the data obtained, the average production of small shrimp on each trip (CPUE) was 26.2 kg trip^{-1}. The CPUE value of the lift net can be seen in Figure 6.

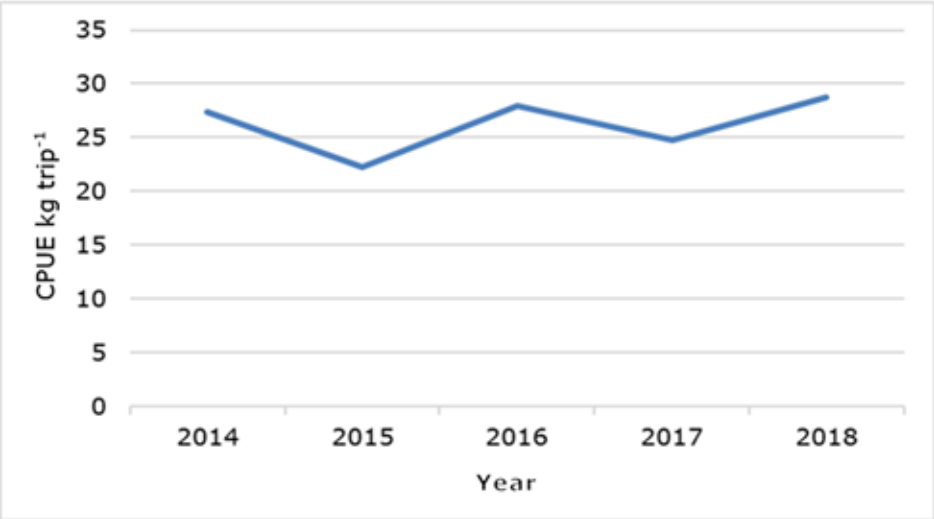

Figure 6. CPUE small shrimp in 2014-2018.

Financial aspects

Investment cost. According to Sumardika (2013), the investment costs are generally incurring at the beginning of a business activity or project, in a considerable amount. Farchan (2006) added that investment represents the capital required on production purposes, addressing the infrastructure, facilities and supporting activities needs. The investment costs in the fish catching business include: building, elevator net, boat, fishing gear andother equipments in use for a long duration. The average amount of

investment costs incurred by fishermen in the lift net fishing operations in Pangandaranbased on interviews with 16 respondents was 2,671.13 USD.

Fixed cost. Fixed costs are expenses which did not occur within one production cycle, but shared expenses. In the lift net fishing gear fishing business activities they encompass license costs, annual maintenance, depreciation of investment goods and boat rental. The results of interviews with 20 respondents or about 50% of the total number of fishermen, who operate lift net fishing gear, showed that the total fixed costs incurred by fishermen each year amounted 562.05 USD and the average cost of the annual assets depreciation amounted 646.54 USD. Consequently, the total amount of fixed costs incurred each year is 1,208.59 USD. The fixed costs of each fishing operation can be derived from the total fixed costs incurred each year. The average effort by fisherman is 348 fishing trips. It can be found that the fixed costs incurred for each trip are 3.47 USD.

Variable cost. Variable costs are proportional to the activity intensity, consisting of material costs for operations, variable labor costs, fuel oil and consumable supply costs. Other costs include bonuses that must be given to employees as a form of appreciation for the success and loyalty of work. Also, there are costs associated with community contributions and the social security. In fish-catching operations, variable costs are commonly incurred by the fisherman when carrying out the capture, including the cost of supplies, the cost of the battery charger and fuel costs. The average total variable costs incurred by fishermen on each fishing trip was around 3.03 USD.

Sales income. Revenue and profit are the result of the sale of catches obtained during the capture trip. Sales income usually obtained by Pangandaran fishermen can be seen in Table 4, corresponding to an average catch by fishing trip, where the data comes from the description of 50% of the population of lift net fishermen respondents.

Table 4

The income of Pangandaran lift net fishermen

Respondent/fishermen	*Income trip^{-1} (USD)*
Respondent 1	3.60
Respondent 2	42.12
Respondent 3	16.62
Respondent 4	0.86
Respondent 5	37.05
Respondent 6	8.27
Respondent 7	4.32
Respondent 8	39.21
Respondent 9	3.60
Respondent 10	10.86
Respondent 11	3.51
Respondent 12	48.92
Respondent 13	0.54
Respondent 14	9.35
Respondent 15	0.72
Respondent 16	22.66
Average trip^{-1}	15.76

From the catches data as shown in Table 4, it can be seen that the income of fishermen in single fishing operations is 15.76 USD per day or 5,485.77 USD year^{-1}. Values were obtained from the average catches of 38 Pangandaran lift net fishermen.

Feasibility analysis of set lift net fishery business

Profit and loss analysis. Fish catching business can be categorized as profitable if the value of income exceeds the value of expenditure costs, according to the profit and loss equation (3). In a per trip reasoning, for a fixed cost of 3.47 USD a variable cost of 3.03 USD and a total income of 15.76 USD, the calculated result is 9.26 USD (total revenue, TR, reduced by total cost, TC). The calculations are detailed in the Table 5.

Table 5

Analysis of profit and loss fisheries business using the lift net

Information	*Year (USD)*	*Per trip day^{-1} (USD)*
Maintenance costs	562,05	1.62
Cost of depreciation	646,54	1.86
Variable cost	1,056.22	3.04
Total cost (TC)	2,264.81	6.51
Total revenue (TR)	5,485.77	15.76
Total (TR-TC)	3,220.96	9.26

Based on the results shown in Table 5 it can be seen that the average fisherman profit is 9.26 USD trip^{-1} and 3,220.96 year^{-1}. The results have exceeded the costs incurred by fishermen so it can be concluded that the fish catching business using a set lift net is the type of business that is profitable and feasible based on profit and loss analysis.

Payback period. According to Indradi et al (2012), the payback period (PP) is the activity time needed to recoup investment expenditure (initial cash investment), by using the net cash flows (profits). The calculated PP by catch reached 0.69 years, the equivalent of 8.2 months.

Benefit cost ratio (B/C ratio). The B/C ratio obtained by lift net fishermen is >1, namely 1.42, indicating that fishing activities using the lift net are included in the profitable businesses category. Based on interviews with local fishermen and fish collectors, the B/C ratio was fluctuating in time. A reasonable income resulted from a high productivity conjugated to good sales prices.

Discussion. Pangandaran lift net fishing consists of two different types, namely fixed lift net and floating lift net. The existence of a fixed lift net is more dominant than a floating lift net where the number of fixed lift net is 38 units, while the floating lift net chart consists of 8 units. The main target catches of Pangandaran lift net fishermen were small pelagic fish, where many types of marine biota that are caught by lift net fishermen were rebon shrimp and anchovy. The shrimp can reach 87% of the total catch.

Based on the results of interviews with collectors in Pangandaran, the production of rebon shrimp every year is very volatile but in economic terms fishing business using charts is included in the category of profitable businesses. This is evidenced by the results of the financial analysis using 3 indicators, namely profit and loss, B/C ratio and PP, which are satisfactory, showing that the business can be continued and is profitable.

Conclusions. Pangandaran lift net fisheries consist of two types, fixed lift net and floating lift net. The fixed lift net was dominating with 38 units, while only 8 floating lift net operated in the Pangandaran waters. The lift net in Pangandaran had relatively the same construction, with comparable performances. The dominant catch component was the small shrimp, which was approximately 83% from the total catch with the average catch on each trip (CPUE) being 26.2 kg trip^{-1}. The captured small shrimps were sold by fishermen to collectors, then dried and sold to various areas outside Pangandaran. Catch data obtained through interviews with fishermen showed that the cumulative production of small shrimp catches varied from year to year. The results of the business feasibility evaluation showed that fish capture business using a set lift net was categorized as a viable business, based on several indicators, such as the profit and loss indicator with TR>TC, the PP of 0.69 years (8 months, 2 weeks), and the B/C ratio which was 1.42.

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