Financial analysis in the exploitation of blue swimming crab *Portunus pelagicus* in Banten Bay, West Java, Indonesia

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Abstract. This study provides information about the effort of catching blue swimming crab *Portunus pelagicus*in Banten bay. The study was conducted from October 2018 to December 2018. The purpose of this study was to determine the technical arrest and financial analysis of *P. pelagicus* fishing business in Banten Bay. Crab catching in Banten Bay is performed by using bottom gillnets and pots. The operation is carried out in groups consisting of four people hitching in a boat. The two fishing gears showed favorable results with the highest income from pots with 5,216.14 USD/year, while the bottom gillnet provided 4,558.28 USD/year. Likewise, the two fishing boats also showed favorable results even though they were not as high as fishing gear profits. The highest income was held by the boat with pots then followed by boat with gillnet, 876.86 USD/year and 694.8 USD/year, respectively.
Key Words: catch, fishing, business, bottom set gillnet, pot.

Introduction. Blue swimming crab *Portunus pelagicus* is one of the relatively large fisheries commodities in Indonesia. The morphology and morphometric of *P. pelagicus* varies considerably from color, pattern of white spots, and carapace, for example, the results of the study of *P. pelagicus* in the waters of West Papua have proven this fact (Hidayani et al 2018). In addition to the consumption of the meat, the remaining processing waste of *P. pelagicus* (lemi) can also be reprocessed to become a food flavor enhancing material (Sasongko et al 2018). The export of *P. pelagicus* in Indonesia has provided foreign exchange of 246.14 million USD in 2015 and has provided support for 65.000 fishermen as well as 130.000 crab peeler (Muawanah et al 2017). The main area of *P. pelagicus* fishing is in the northern waters of Banten Province, as in the waters of the Tangerang and Serang districts. In 2011, the total production of *P. pelagicus* in Banten province reached 642.6 tons, when 90.11% was from Tangerang district and the rest was from Serang district (Ministry of Maritime Affairs and Fisheries 2013). However, it should be noted that the export of *P. pelagicus* from Indonesia are still below Singapore, Vietnam and Thailand (Rasyid 2015).

On the other hand, the high market demand has made the exploitation of *P. pelagicus* less manageable and has resulted in a decline in the *P. pelagicus* populations, as happened in Pangkajene (Wiyono & Ihsan 2018), and Jakarta bay (Jayawiguna et al 2017). To overcome this situation, some scientists finally developed a method of domestication and selective breeding that can make the *P. pelagicus* grow rapidly and produce good quality meat (Fujaya et al 2016).

Although there are positive and negative sides of the exploitation of *P. pelagicus*, good financial management and analysis can certainly reduce the adverse impacts that may occur, and even prove the financial profit from the sale of *P. pelagicus* in Tuban Regency (Nufaiza 2015), and Pekalongan Regency (Tambunsaribu et al 2015). The

purpose of this study was to determine the technical methods and amount of profit from the capture of *P. pelagicus* in Banten Bay.

Material and Method

Research scheme. This research took place in Karangantu, Banten, Indonesia from October to December 2018. The equipment used during this research were ships owned by local fishermen operating in Banten bay which use bottom set gillnet and pots. Data collection methods used was observation and interview. Observations were made to find out the technical scheme of catching *P. pelagicus*. Whereas, interviews were conducted to obtain data and information about the catch and operating costs of the fishing gears.

Data analysis. The collected data were analyzed to determine the amount of profit obtained from the *P. pelagicus* fishing activities in Banten Bay. Financial analyses used were short-term analysis such as income analysis, revenue-cost ratio, payback period, and return of investment (ROI). This financial analysis was carried out separately between fishing gears and fishing boats.

Income analysis. This analysis was intended to determine the amount of profit obtained from a business activity (Djamin 1984). The equation used to calculate was:

$$\pi = TR - TC$$

Where: π = profit, TR = total revenue, TC = total cost.
With the following criteria:

- if TR > TC, then profit is obtained
- if TR < TC, then profit is failed to be obtained
- if TR = TC, break-even point

Revenue-cost ratio analysis. This analysis was intended to determine the extent of benefits obtained from business activities during a certain period (Hernanto 1989; Sugiarto et al 2002). The highest R/C value indicates that the business activity is the most profitable. Calculations can be completed using the following equation:

$$\frac{R}{C} = \frac{TR}{TC}$$

With the following criteria:

- if R/C > 1, the business activity is obtaining profit
- if R/C < 1, the business activity is not obtaining profit
- if R/C = 1, breakeven point

Payback period (PP). PP is the period needed to repay investment expenses (initial cash investment) using cash flow (Umar 2003). The equation for calculating PP was:

$$PP = \frac{Invest}{Benefit} X 1 year$$

Return of investment (ROI) analysis. Calculation of ROI was carried out to determine the amount of profit obtained compared to the amount of investment invested. The formula used was:

$$ROI = \frac{Benefit}{Invest} X 100\%$$

Where:

> 25 % : good
15 – 25 % : passably
5 – 15 % : not recommended
< 5 % : bad

Results and Discussion

Catching techniques. The catching of *P. pelagicus* in Banten bay is done by using 2 (two) types of fishing gear, namely bottom set gillnet and pot.

Bottom set gillnets. The net used to catch *P. pelagicus* (bottom set gillnet) is basically the same as basic gillnet, which consists of top rope, float rope, float, net body, bottom rope, ballast rope, ballast, rope and float sign. The net material is made of PA mono filament with mesh size 4-4.5 inch. One unit of bottom gillnet set usually consists of 16 pieces of gillnets. The body of the net is often damaged due to coral, or other hard objects from the sea floor, or a result of the process of removing *P. pelagicus* crabs from nets body that is very difficult and often results in torned nets, Fishermen sometimes even deliberately cut the net to ease the work. This results in the replacement of the body of the net with the new one and must be done at least once a month. Bottom set gillnet photo could be seen in Figure 1.

Figure 1. Bottom set gillnet (original).

Catch of bottom set gillnets. As a result of operating bottom set gillnets on the sea floor, the catch is dominated by seabed biota. Like the other fishing gears, the catch of bottom set gillnet always consist of targeted catch and bycatch, such as horseshoe crab *Limulidae* (Supadminingsih et al 2019), mud crab *Scylla serrata* and catfish *Siluriformes* (Fazrul et al 2015). A result of research conducted in the waters of Southeast Sulawesi states that the number of *Limulidae* populations has decreased dramatically due to the widespread capture of *P. pelagicus* in the area (Sara et al 2017). *Limulidae* is a protected family according to the Regulation of State Ministry for The Environment of The Republic of Indonesia Number P.20/MENLHK/SETJEN/KUM.1/6/2018. Therefore, bycatch in the form of *Limulidae* (*Tachypleus gigas*, *Tachipleus tridentatus*, and *Carcinoscorpius rotundicauda*) must be reduced to the maximum possible extent. One method that can be used is to standardize the bottom set gillnet (Kumar et al 2013).

Pots. Pot for catching *P. pelagicus* is made from iron frame with 50 cm length, 30 cm width, and 20 cm height. The frame is wrapped in polyethylene (PE) nets, with a mesh size of 1 inch. One unit of blue swimming crab usually consists of 150 pots. Pots photos could be seen in Figure 2.

Figure 2. Pots used for *Portunus pelagicus* catching (original).

Catch of pots. There are various sizes of *P. pelagicus* that are caught, starting from small, medium to large, and, indeed, bycatch such as, conch, octopus, etc. The number of catches every day is uncertain depending on the season and the condition of the waters.

The number of catch and bycatch from pots has proven to be very dependent on the construction of pots and baits used, as proved by the results of research in the waters of North Sulawesi (Chalim et al 2017), Rembang-Central Java (Boesono et al 2016), and Japan (Archdale 2012). One effort that can be done to significantly reduce bycatch is by adding an escape gap in the pots (Rotherham et al 2013).

Fishing boat. Boats used for both fishing gears are relatively the same. The boat is made of wood with an average size of 8.5 m length, 2.78 m width and 0.7 m deepness. The engine used is a diesel engine with 24 HP power. One of boats used could be seen in figure 3.

Figure 3. Fishing boat (original).

Fishing area. The *P. pelagicus* fishing area is in Banten Bay, which is around Kubur Island, Lima Island, Panjang Island, Pamujan Great Island, and Pamujan Small Island. The time needed to get to the fishing area is around 1 to 2 hours. The existence of *P. pelagicus* is grouped in 3 seasons, namely the peak season for 3 months from December to February, medium season for 3 months from September to November, and famine season for 6 months from March to August.

Fishing gear operation. The operation of bottom set gillnets and pots were carried out in groups on one boat. The number of members usually consists of four people including the owner of the boat. Fishermen who use bottom gillnet usually carry out fishing operations from 8:00 to 10:00, while those who using pots operate from 6:00 to 17:00. *P. pelagicus* is easier to catch when there are strong winds than when the weather is calm. This condition usually occurs from December to February. The whole operations are

carried out in one day. Generally, fishermen go to sea almost every day, except Friday or when the weather is unfavorable. Especially for bottom gillnet fishing, in the peak season, they actually go to sea only once every two days. This is because they need one day to repair the damaged net.

Financial analysis of fishing gear. The number of trips to catch *P. pelagicus* with pots is 288 trips/year, more than those who use bottom gillnet, which is 252 trips/year (Table 1). This happen because during the peak season fishermen who use bottom gillnet only work once in two days, while those who use pots can operate almost every day.

Table 1

Number of trips

Fishing gear	*Season (months)*			*Trips/season*			*Total/year*
	Peak	*Medium*	*Famine*	*Peak*	*Medium*	*Famine*	
Bottom set gillnets	3	3	6	36	72	144	252
Pots	3	3	6	72	72	144	288

In Table 2, it can be seen that the production per trip of bottom gillnet is higher than of pots for each fishing trip in each season. During the peak season, gillnet bottom produces 21 kg/trip, while pots only 14.33 kg/trip. But, because the number of fishing trips with bottom gillnet is less than the pots during the peak season, the bottom gillnet production is higher than of pots, with 1,432.8 kg/year and 1,644 kg/year, respectively.

Table 2

Production

Fishing gear	*Production/trip (kg)*			*Production/season (kg)*			*Total production/year (kg)*
	Peak	*Medium*	*Famine*	*Peak*	*Medium*	*Famine*	
B.s. gillnets	21	5	2.2	756	360	316.8	1,432.8
Pots	14.33	4.33	2.08	1,032	312	300	1,644

B.s. gillnets - Bottom set gillnets.

P. pelagicus are not landed through the fish auction site, but are directly sold to crab processors. There are findings which prove that between fishermen and processors as buyers exist indebtedness. Most of the fishermen borrowed money from processors for capital and other purposes, so, for the consequence, they have to sell their catch to the processor. The selling price is determined by the processor unilaterally.

In Table 3, it is shown that the price of the *P. pelagicus* crab is 4.29 USD/kg during the peak season, 4.64 USD/kg during the medium season and 5 USD/kg during the famine season. The total sales price of *P. pelagicus* for a year is the revenue of fishermen. The revenue of fishermen using bottom gillnet is lower than of those using pots, which is 6,495.43 USD/year, and 7,371.43 USD/year respectively.

Table 3

Revenue

Fishing gear	*Price/kg (USD)*			*Revenue/season (USD)*			*Total revenue/year (USD)*
	Peak	*Medium*	*Famine*	*Peak*	*Medium*	*Famine*	
B.s.gillnets	4.29	4.64	5	3,240	1,671.43	1,584	6,495.43
Pots	4.29	4.64	5	4,422.86	1,448.57	1,500	7,371.43

B.s. gillnets - Bottom set gillnets.

Fishermen do not need to buy their own boats, because basically they can rent the boat from boats owners. The equipment used is quite simple. Each fisherman only carries the

fishing gear and bucket for storing the catch. In groups of fishermen who use bottom gillnet, each person usually carries 16 pieces at a price of 28.57 USD/piece, while in the group of fishermen who use pots, each person carries 150 pieces of pots, with the price of a complete set of 2.14 USD/piece. It could be seen in Table 4, the total investment value of bottom gillnet is higher than of pots. The calculation results are 459.29 USD for bottom gillnet and 323.57 USD for pots.

Table 4

Investment

Fishig gear	*Volume (unit)*	*Price/unit (USD)*	*Total price (USD)*
Bottom set gillnets			
- nets	16	28.57	457.14
- buckets	2	1.07	2.14
Total	-	-	459.29
Pots set			
- pots	150	2.14	321.43
-buckets	2	1.07	2.14
Total	-	-	323.57

Fixed cost consists of depreciation and maintenance costs. It could be seen in Table 5 that the lifetime of bottom gillnets and pots are 3 years, but bottom gillnet has a residual value from the remaining lead ballast (3 kg/piece) at a price of 3.57 USD/kg. Even though the bottom gillnet investment value is higher than the pot, the bottom gillnet depreciation cost is lower than of the pot's. Depreciation cost for bottom gillnets and pots are 97.38 USD and 109.29 USD respectively.

Table 5

Fixed cost

Fishing gear	*Total Price (USD)*	*Time (year)*	*Residual (USD)*	*Depreciation (USD)*	*Maintenance (USD)*
Bottom set gillnets					
- nets	457.14	3	171.43	95.24	685.71
- buckets	2.14	1	0	2.14	0
Total	459.29	-	-	97.38	685.71
Pots set					
- pots	321.43	3	0	107.14	107.14
- buckets	2.14	1	0	2.14	0
Total	323.57	-	-	109.29	107.14

The process of releasing *P. pelagicus* from the net which often results in torn net, not only has an impact on fishing trips, but also on maintenance costs. Maintenance of bottom gillnet requires a fee of 3.57 USD/piece for each month, so the total maintenance costs reach 685.71 USD/year. On the other hand, pots have less chance of damage during operation. Because the crab is not twisted against the net, so it is easy to release every crab from the pots. Thus, it results in not only significant time saving, but also cheaper maintenance costs, which is only 0.71 USD/unit for each year. At least, the total maintenance costs are only 107.14 USD/year.

The value of variable cost on bottom gillnets and pots are similar, namely the rental of boat is 0.43 USD/kg of catch and personnel's supplies is 5 USD/trip. There is an additional cost which exists in pots, namely the cost of procuring bait for 2.14 USD/trip. In Table 6 can be seen that the number of variable cost of pots is 1,938.86 USD and this value is far higher than the variable cost of the net of 1,154.06 USD. This is caused by two factors, firstly because of the additional cost of procuring bait, and secondly because

the total production and number of trips to catch *P. pelagicus* with pots is higher than of bottom gillnet.

Table 6

Variable cost

Costs	*Values*	*Total (USD)*
Bottom set gillnets		
- boat rent price	0.43 USD/kg catch	614.06
- supplies	5 USD/trip effort	540
Total	-	1,154.06
Pots		
- boat rent price	0.43 USD/kg catch	704.57
- supplies	5 USD/trip effort	617.14
- baits	2.14 USD/trip effort	617.14
Total	-	1,938.86

Table 7

Financial analysis of fishing gear

Variables	*Bottom set gillnets*	*Pots*
Revenue	4,558.28 USD/year or 379.86 USD/month	5,216.14 USD/year or 434.68 USD/month
Revenue cost ratio (R/C)	3.35	3.42
Return of investment(ROI)	992.47%	1,612.05%
Payback period (PP)	0.10 year	0.06 year

Income with the use of *P. pelagicus* fishing gear is calculated by total revenue (TR) minus the total cost (TC). Table 7 shows that the two fishing gears can still provide profits, but the pots provide greater profits than the bottom gillnet. Profit from pots is 5,216.14 USD/year while bottom gillnet provides 4,558.28 USD/year. Further calculation is the average income per month which is 434.68 USD for fisherman with pots and 379.86 USD for fisherman with bottom gillnet. As compared to the minimum standard salary of Serang City (around 240.47 USD/month), the income of a *P. pelagicus* fisher is much higher.

The standard value of revenue-cost ratio (R/C) is 1. The use of this analysis is to determine the amount of revenue obtained from each rupiah in the business unit of exploiting *P. pelagicus* with bottom gillnet and pots. In Table 7 it can be seen that those capture devices produce R/C > 1, which means that both are profitable. Nonetheless, the value for pots is higher than bottom gillnet, which are 3.42 and 3.35, respectively.

Table 7 shows a very high ROI value, and the highest value is in the pots, which is 1,612.05%, while in gillnet is only 992.47%. The high value of ROI is due to the very low investment value.

Payback period (PP) is useful to find out how long the business can return investment. A quick return on investment is one of the indicators of the business success. In Table 7 it can be seen that a very fast return occurs in both fishing gears. Pots require 0.06 year or 0.74 month followed by nets for 0.10 year or 1.21 month. This also occurs due to the very low investment value in the pots.

Financial analysis of fishing boat. As stated earlier, on one ship there were four fishermen including the boat owner. Thus, the revenue of a boat is the total value of rental payment from the four fishermen. In Table 8, it can be seen that the rental value is set at 0.43 USD/kg catch. The total revenue of a boat with pots is higher than of a boat with bottom gillnet, which are 2,818.29 USD/year and 2,456.23 USD/year, respectively.

Table 8

Revenue

Fishing boat	*Personnel*	*Production /personnel(kg)*	*Production /year (kg)*	*Rent/kg (USD)*	*Revenue/year (USD)*
Boats equipped with B.s. gillnets	4	1,432.80	5,731.2	0.43	2,456.23
Boat equipped with pots	4	1,644	6,576	0.43	2,818.29

B.s. gillnets - Bottom set gillnets.

Investment in this case is for the maintenance of boat and engine only, not including fishing gears. In Table 9, the investment value for boat with bottom gillnets and boat with pots is the same, which is 2,857.14 USD.

The remaining value of the two boats is the same, which are 214.29 USD for boat maintenance and 178.57 USD for engine maintenance. By using the same age assumption for both boats, the depreciation for boat with bottom gillnets and pots will be 300 USD/year.

The maintenance costs for both boats and engines are the same, 107.14 USD/year and 71.43 USD/year, respectively. Thus, the total maintenance cost is 178.57 USD/year.

Table 9

Investment and fixed cost

Fishing boat	*Investment (USD)*	*Time (year)*	*Residual (USD)*	*Depreciation (USD)*	*Maintenance (USD)*
Boats equipped with bottom set gillnets					
- boat	2,142.86	10	214.29	192.86	107.14
- engine	714.29	5	178.57	107.14	71.43
Total	2,857.14	-	-	300	178.57
Boat equipped with pots					
- boat	2,142.86	10	214.29	192.86	107.14
- engine	714.29	5	178.57	107.14	71.43
Total	2,857.14	-	-	300	178.57

Variable cost consists of diesel fuel and lubricants. In Table 10, the value of the variable cost for the two boats are the same, namely 10 L/trip fuel diesel at a price of 0.5 USD/L and 4 L/3 months of lubricant at a price of 1.43 USD/L. The number of fishing trip of boat with pots is higher than boat with bottom gillnets, so the amount of variable cost for pots is higher, which is 1,462.86 USD/year, while the variable cost for gillnet bottom is 1,282.86 USD/year.

Table 10

Variable cost

Fishing boat	*Values*	*Trips/year*	*Total costs (USD)*
Boats equipped with bottom set gillnets			
- diesel fuel	10 L/trip at 0.5 USD	252	1,260
- lubricants	4 L/3 months at 1.43 USD	-	22.86
Total	-	-	1,282.86
Boat equipped with pots			
- diesel fuel	10 L/trip at 0.5 USD	288	1,440
- lubricants	4 L/3 months at 1.43 USD	-	22.86
Total	-	-	1,462.86

The financial analysis of the boat can be seen in Table 11. The two boats are equally profitable, but boat with pots provides greater profits than boat with bottom gillnet. Boat with pots gives a profit of 876.86 USD/year while the boat with bottom gillnets 694.8 USD/year. If the average monthly income is calculated, then the results are, 73.07 USD for boat with pots, and 57.9 USD for boat with bottom gillnet. When compared to fishing gear income, the operating income of this boat is relatively low.

Table 11

Financial analysis of fishing boat

Variables	*Boats equipped with bottom set gillnets*	*Boat equipped with pots*
Revenue	694.8 USD/year or 57.9 USD/month	876.86 USD/year or 73.07 USD/month
Revenue cost ratio (R/C)	1.39	1.45
Return of investment (ROI)	24.32%	30.69%
Payback period (PP)	4.11 years	3.26 years

Revenue-cost ratio (R/C) of the two fishing tools are greater than 1, so those two tools are profitable. The value for pots is slightly higher than for bottom gillnet, for pots is 1.45 and for bottom gillnet 1.39.

The highest return of investment (ROI) is on boat with pots, which is 30.69%. This is a really good value because it exceeds 25%. While the ROI of boat with bottom gillnet is 24.32%. This value is quite good, because it is still in the range of 15-25%.

The fastest payback period (PP) is on boat with pots, which are 3.26 years or about 3 years and 3 months. Whereas, PP for boat with bottom gillnets is 4.11 years or around 4 years and 1 month.

Conclusions. This study has succeeded in providing financial information of *P. pelagicus* exploitation in Banten Bay by using bottom set gillnets and pots. The detailed conclusions of this study are:

- Catching of *P. pelagicus* in Banten Bay is done by using bottom set gillnets and pots. Every operation is carried out in groups on one ship with the same type of fishing gear. The number of members of a group is four includes the boat owners.
- Production per trip of boat with bottom gillnets is higher than of boat with pots, but the number of fishing trips is the opposite. This happen because during the peak season fishermen who use bottom gillnets need one day off to repair the net after each operation.
- The cost for maintaining bottom gillnet is very high, which is about 685.71 USD/year, exceeding the investment cost of only 459.29 USD. This is caused by the high chance of net damaging during the process of releasing the *P. pelagicus* from the net.
- There is a debt-connection between fishermen and crab processors, so fishermen have to sell their catches to processors at prices determined by the processor unilaterally.
- The results of financial analysis show that the two fishing gears provide favorable results. The highest income is on pots, which is 5,216.14 USD/year while on bottom gillnet is 4,558.28 USD/year.
- The results of the financial analysis show that the two fishing boats are profitable, even though the profits given are not as large as profits from fishing gear. The highest income is on boat with pots, which is 876.86 USD/year then followed by boat with bottom gillnet with 694.8 USD/year.

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