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# Benefit Cost Ratio of Fisheries Capture of ‘Celong’ Fishing Port, Batang Regency, Indonesia

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**Abstract.** The objective of this research was to calculate the Benefit Cost (B/C) ratio of fisheries capture of ‘Celong’ fishing port. This research used the case study approach. The sampling of research used a purposive sampling method (60 respondents of fishermen). This research showed that B/C ratio of mini trawl (‘arad’), trammel net and gill net were 1.34; 1.10 and 1.20. The B/C ratio can be influenced by some factors, i.e. number of crew, time of operation, working capital (energy and consumption), and fisherman experience. The highest of B/C ratio is mini trawl (‘arad’), but ‘arad’ is prohibited by government (Permen KP No. 71 in 2016) because ‘arad’ is unsustainable fishing gear. We are suggested for fisherman who use ‘arad’ to change fishing gear for sustainability resources interest.

## 1. Introduction

Batang Regency has large capture fisheries potential, so it can contribute to fisheries production in Central Java. One of the fisheries production areas in Batang Regency is the Fish Landing Base (‘pangkalan pendaratan ikan’ or PPI) of Celong. PPI Celong has one fish auction place located in Kedawung Village, Banyuputih District, Batang Regency. Fishermen in Kedawung Village use several fishing gears, i.e. ‘arad’ (mini trawl), shrimp net (trammel net), and gillnet, that are operated at the bottom of the waters to catch demersal fish. The most of the fishermen still use ‘arad’ as a daily fishing gear.

Based on data from the Department of Maritime and Fisheries Affairs in Batang District in 2017, the number of fisheries production in Celong in 2013 was 100,075 kg, then in 2014 amounted to 126,850 kg, in 2015 amounted to 121,330 kg, in 2016 amounted to 233,188 kg, and in 2017 amounted to 342,430 kg [1]. This research is important so that fishermen can choose the most efficient fishing gear without neglecting its ecological aspects (eco-friendly).

One of the fisheries development issues faced by developing countries including Indonesia is how to balance economic goals with the sustainability of fisheries resources. Based on the Regulation of Maritime and Fisheries Minister No. 2 of 2015 which was later replaced by the Regulation of Maritime and Fisheries Minister No. 71 of 2016, concerning the prohibition of trawl fishing and trawl fishing by fishermen in Indonesia [2]. But in reality, many fishermen do not comply with these regulations so that fishing gears that is not environmentally friendly is still used today. This is because fewer fish stocks and erratic fishing seasons make fishermen compete to catch fish by not eco-friendly fishing gear such as ‘arad’ (mini trawl)

Currently, the utilization of fisheries resource potential in Indonesia is increasingly out of control. This is marked by the most phenomenon of overfishing in several Fisheries Management Areas of the Republic of Indonesia (‘Wilayah Pengelolaan Perikanan’ or WPP), including WPP 712 where is the Java Sea region. The factors that causes this overfishing are the increasing number of fishing vessels



and the use of fishing gears that is not selective and destructive of the ecosystem. Actually, the prohibition of environmentally friendly fishing gear has been carried out by the government, but in reality many fishermen in Indonesia are still using prohibited fishing gear such as trawls and seine net. At PPI Celong, most of fishermen still use 'arad' as a daily fishing gear. Therefore, an financial analysis is needed to find out the Benefit Cost Ratio of each unit of fishing gear at PPI Celong, Batang Regency. This research is important so that fishermen can choose the most efficient fishing gear without neglecting its ecological aspects (eco-friendly).

## 2. Research methods

This study used a case study method. The case study concern the problem of benefits and costs of 3 fishing gears, including mini trawl ('arad'), trammel net and gillnet.

### 2.1. Sampling method

The method of respondents sampling used the snowball sampling method. The total respondents were 65 people, including 30 'arad' fishermen, 25 trammel net fishermen, and 10 gillnet fishermen. Primary data was obtained use interview and observation methods. Interviews are conducted to obtain the information of benefit and cost. Total benefit data include benefits in the peak season, regular season and famine season. Total cost consists of fix cost (investment cost) and variable cost or working capital (energy, consumption and auction costs).

Secondary data were obtained from relevant agencies, namely the Marine and Fisheries Agency ('Dinas Kelautan dan Perikanan' or DKP), Fish Auction Place ('Tempat Pelelangan Ikan' or TPI) at Celong. Secondary data obtained included data on fishing fleet, number of fishing gears, fish production and production value during the last five years (2012-2016).

### 2.2. Analysis method

Data analysis is carried out using a financial feasibility analysis, with the economic life of the 15-year project based on the ship's economic age. The discount rate used 12% in accordance with the bank's current interest rate. BC ratio analysis to calculate the comparison between the total benefit and the total cost incurred. The BC ratio formula is as follows:

$$\text{BC Ratio} = \frac{\sum_{t=1}^n \frac{(B_t - C_t)}{(1+i)^t} (B_t - C_t) > 0}{\sum_{t=1}^n \frac{(C_t - B_t)}{(1+i)^t} (B_t - C_t) < 0} \quad (1)$$

Note:

$B_t$  = benefit in year t

$C_t$  = cost (cost) in year t

$i$  = interest rate

$t$  = 1,2,3, ... n

$n$  = economic age

With criteria:

If BC the ratio > 1: profit or feasible to developed

If BC ratio is <1: business loss or improperly to developed

If BC ratio = 1: break event point

## 3. Results and discussion

Fish Landing Base is a mooring place of fishing vessels and auction place of fish. Facilities at the Celong Fish Landing Base include Fish Auction Places, office, freshwater reservoir, breakwater, and drainage for waste water. Fishing vessels are used to catch fish, including storing, freezing or cooling (preserving). The following is data on fishing vessels in Batang Regency in 2012-2017.

**Table 1.** Number of ships and types of fishing gears in PPI Celong in 2012-2017

| Years | Vessel | Gill Net | Trammel Net | Mini Trawl |
|-------|--------|----------|-------------|------------|
| 2012  | 97     | 30       | 25          | 97         |
| 2013  | 98     | 34       | 28          | 98         |
| 2014  | 94     | 35       | 32          | 94         |
| 2015  | 93     | 32       | 27          | 93         |
| 2016  | 98     | 42       | 27          | 86         |

Source: [1]

Based on table 1. it can be seen that the number of fishing vessels at the PPI Celong is between 93 and 98 outboard motors. The size of boats were range of 2-3 GT and the average length was 7.5 m, width 2.8 m and height of 1.0 m. The number of ships fluctuates every year that was influenced by changes in the number of fishermen and the season.

Table 1 also shows the presence of 3 (three) types of fishing gears at PPI Celong, namely gill net, trammel net, and 'arad' (small bottom trawl). One fisherman can have one, two or three fishing gears. However, most fishermen use 'arad' because 'arad' is considered as a fishing gear that can produce the most and profitable catches. The operation of 'arad' also does not require crew, it can be done alone, in contrast to the operation of trammel and net gill which generally use crew services.

### 3.1. Gill net

Gill net is a rectangular fishing gear that operation is done by blocking the fish horde. Gill net is included in the classification of gilled gear. Gill net is a fishing gear that be used daily by fishermen in Celong with the help of one crew ('anak buah kapal' or ABK). The main target species for gill net operation are White Snapper (*Lates* sp), and other fish catches of *Pangasianodon* sp, *Neosilurus* sp, *Chorinemus* sp, *Portunus pelagicus*, and *Scylla* sp. The catch is strongly influenced by the duration of immersing and mesh size. The operation of gill net is done by setting, immersing for 30-60 minutes, and hauling.

### 3.2. Trammel net

Trammel net is a fishing gear that is included in the classification of entangling nets. Trammel net is operated when the shrimp season when only from January to April. This net is only used as a substitute for 'arad' when the shrimp season arrives. Fishermen need to use trammel net during the shrimp season so that the shrimp sold are of good quality and high economic value. The catches of shrimp and fish from trammel net are carefully taken by fishermen so they have high quality. That is different when using 'arad' which shrimp that are caught have low quality so the price of shrimp decreases.

Trammel net at PPI Celong is operated at the bottom of the water so that the captured species are demersal fish and shrimp. This gear consists of 3 layers of net with different mesh size and have rectangular in shape. The operation is done by setting, immersing for 30-60 minutes, and hauling. According to [3], trammel net is a fishing gear that is formed from 3 mesh structures arranged in a long way like gill nets. The inner net is flanked by two outer net sheets, with a larger mesh and functions as a frame

### 3.3. 'Arad' (Small Bottom Mini Trawl)

According to [4], 'arad' on the north coast of Java has a international name is small bottom otter trawl. 'Arad' nets is included in the classification of small bottom otter trawl and commonly used by small

scale fisheries. 'Arad' construction is made of two parts of trawl wings, square parts, net bodies and pockets. 'Arad' is widely operated on the north coast island of Java in shallow sea waters. The operation of 'arad' in PPI Celong is carried out by one ship. The operation of fishing gear is done by one fisherman only, without using the services of the crew. 'Arad' is considered to be the most effective fishing gear to produce large amounts of catch and increase fisheries production. 'Arad' is a fishing gears that operates actively, because this fishing gear moves by being pulled by one ship.

### 3.4. Production and Value of Fish Production

Fishing activity in PPI Celong includes small scale fisheries. Fishermen in TPI Celong do fishing in the morning at 05.00-09.00 or about 4 hours. The catch of fishermen that be auctioned is still in fresh condition, because the fish that have just been caught immediately and auctioned at the Fish Auction Place (TPI) at 10.00 am. The main fishery commodities in PPI Celong are Jerbung or White Shrimp (*Penaeus merguensis*). Shrimp are especial target of trammel net and 'arad'. While the main catch on the net gill is white snapper (*Lates* sp).

**Table 2.** Production and production value at TPI Celong

| Year | Production (Kg) | Value of Product (Rp) | Fishing Vessel (unit) | Product (Kg per unit) |
|------|-----------------|-----------------------|-----------------------|-----------------------|
| 2013 | 100,075         | 1,661,109,500         | 97                    | 1031.70               |
| 2014 | 126,850         | 2,102,331,000         | 98                    | 1294.77               |
| 2015 | 121,330         | 2,029,104,000         | 94                    | 1290.74               |
| 2016 | 233,188         | 2,948,323,000         | 93                    | 2507.40               |
| 2017 | 342,430         | 3,182,719,000         | 98                    | 3494.18               |

Source: [1].

Based on Table 2, it can be seen that the average capture fisheries production at the PPI Celong reaches 184,775 kg and the production value is Rp 2,384,717,300. When viewed in the table, each year fish production is relatively increasing despite a slight decrease in 2014 to 2015. This can be affected by the number of fishing fleets, the number of fishing gear, the number of fishing trips and the season which will further affect fish stocks.

According to Gemaputri [5], the fishing capture has an open access or common property, so that it can provide many job opportunities for everyone. The production of caught fish is influenced by the availability of fish stocks and fishing effort of each fishing gear.

### 3.5. Feasibility study

Feasibility analysis on a fishing activity is needed to find out how feasible the business is in a certain period of time. One method that is often used to determine business feasibility is the Benefit Cost Ratio. Benefit Cost Ratio Calculation in this study is to compare the benefit obtained in a fishery business unit and the total cost incurred. The following are the results of the calculation of the B / C ratio of each fishing business unit in PPI Celong.

**Table 3.** Feasibility of fisheries business in PPI Celong based on BC Ratio

| Category    | BC ratio | Note     |
|-------------|----------|----------|
| 'Arad'      | 1,34     | feasible |
| Trammel Net | 1,10     | feasible |
| Gill Net    | 1,24     | feasible |

Based on Table 3, fisheries business of 'arad', trammel net, and net gill deserve to be continued because it has a BC ratio of more than 1. Every costs of Rp 1000 incurred to run 'arad' business at the PPI Celong, then bring in revenue of Rp. 1340. The same thing also applies to trammel net and gill net, where every costs incurred of Rp. 1000, it will bring in revenues of Rp. 1100 and Rp. 1240 respectively. Value of BC ratio of the three fishing gears shows that has good fishery productivity. Furthermore, these three BC Ratio values can be compared to find out the most beneficial fishing gears in the future. The third difference in these values is influenced by several factors, including the number of workers, the type of fishing gear operation, supplies, length of time of arrest, and the experience of fishermen. According to [6], the BC ratio value also provides an overview of the types of fisheries that are most feasible and profitable to develop in the future.

If the three BC Ratio values are compared, then the feasibility of 'arad' business has the highest value so that 'arad' can be considered as the most beneficial fishing gear at the PPI Celong. This happens because 'arad' is operated by dragging all the biota it passes so it always produces more catches than the gill net and trammel net. According to [7], more fishermen use 'arad' because the fishing gear is very beneficial for fishermen. 'Arad' makes fishermen able to get fish catches from the bottom of the waters to the surface, so that they get more catches

Although 'arad' has the highest BC ratio, the use of fishing gear is prohibited by the government because it is considered not environmentally friendly. Gill net and trammel net as fishing gears that are profitable and environmentally friendly are expected to replace 'arad' so that the sustainability of marine fisheries is maintained.

### *3.6. Eco-friendly vs socio-economic problems*

Large resource potential will provide opportunities for fisheries managers to use. Fisheries managers must be better at utilizing these resources. Management that is not responsible can cause a decrease in fish resources or can be called overfishing. Large resource potential will provide opportunities for fisheries managers to use. Fisheries managers must be better at utilizing these resources. Management that is not responsible can affected to a decrease in fish resources or can be called overfishing [8].

The impact of 'arad' prohibited regulation can result in massive unemployment because not only fishermen are affected, but also workers involved in the capture fisheries sector [9, 10, 11]. In order not to cause socio-economic problems for fishermen, the government should provide information assurance regarding the prohibition of 'arad', and provide understanding to fishermen about the importance of replacing 'arad' with environmentally friendly fishing gear such as gillnet and trammel net [12].

## **4. Conclusion**

There are 3 types of fishing gears at PPI Celong, Batang Regency, namely 'arad', trammel net, and gill net. Based on the results of the study it is known that the BC value of the ratio of each fishing gear is: 'arad' of 1.34; trammel net of 1.10 and gill net of 1.24. The three types of fishing gears show that is economical feasible.

Most fishermen at the PPI Celong disagree with the Permen KP No.71 of 2016 and do not realize it. It is better to conduct further research on environmentally friendly fishing gear in each season of each fishing gear. Modification of fishing gear needs to be done so that fishing gear that not environmentally friendly is no longer operated by fishermen. Mentoring and understanding of environmentally friendly fishing gear needs to be done to maintain operational sustainability from the fishing activities at TPI Celong.

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