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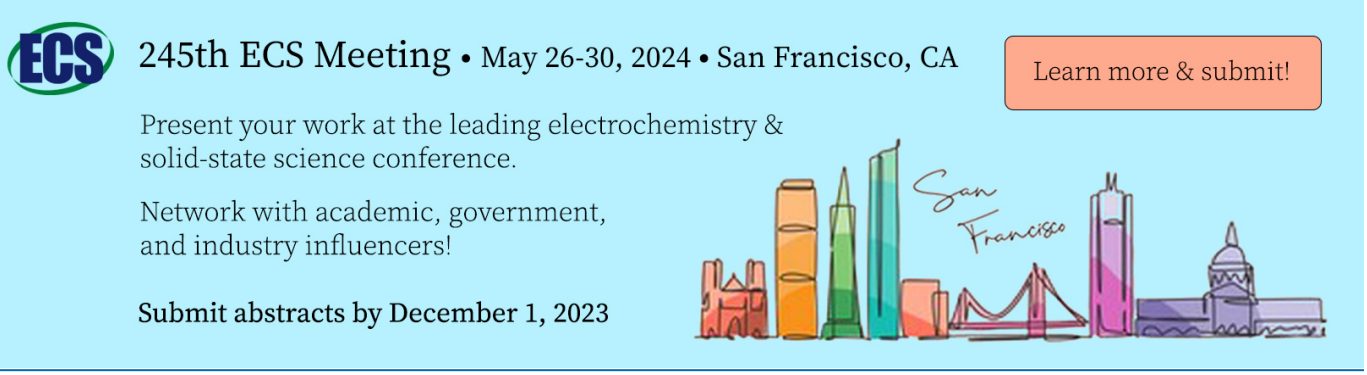

A cost benefit analysis of blue swimming crab gillnet fishery in Pangkajene Island, South Sulawesi

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Abstract. Blue swimming crabs (*Portunus pelagicus*) are an important capture of the gillnet fisheries practiced around Pangkajene waters. The fisheries have been monitored by the Indonesian Blue Swimming Crab Association (APRI) by deploying enumerators who collect some data on the volume and size of crabs captured by fishermen. Information on the economic aspect of the fisheries, i.e., the business feasibility, has not been studied. The method in this study is observation and interviews. Based on monitoring data for 5 fishing units, the financial performance of the crab fisheries was evaluated. The fishing units were selected on the basis of records on eligible crabs. The available data collected from June 25th to July 5th, 2022, were processed and analyzed for calculations of business profit/loss analysis, benefit-cost ratio (B/C), break even point (BEP), and payback period (PP). The results showed that the blue swimming crab-catching business using net fishing gear is, on average feasible and profitable fishing gear with a Benefit Cost Ratio value of 1.36. Based on the calculation of the pay pack, the average period is 1, which means that fishermen only need one year to return the total capital. It is concluded that the crab fishing business is generally feasible financially.

Keywords: blue swimming crab, Pangkep Regency, financial feasibility

1. Introduction

Blue swimming crab (*Portunus pelagicus*) is one of the exportable commodities to Singapore, Hong Kong, Japan, Malaysia, Taiwan, and the United States. The high market demand and better price of crab can increase the income of fishermen [1]. The capture fisheries system is composed of three main components, namely the natural subsystem (biology and aquatic environment), the human subsystem, and the management subsystem, among the three main components having various forms of complex interactions [2]. The dynamics of the capture fisheries system include aspects of fish resources, fishing fleets, and fishing communities. Fish resources are controlled through population dynamics in nature in the form of reproduction and death processes. Fishing fleets vary in capital dynamics as investment in new vessels and fishing gear depreciates over time. A high utilization rate will lead to a decrease in stock and will affect the economic value of the crab capture fishery business. This condition may increase fishing effort exceeding the optimum level that threatens the sustainability of the resources [1], [3], [4]. Therefore, a monitoring program is important to determine fish resource utilization status and measure the fisheries' performance.

The Indonesian Blue Swimming Crab Association has conducted monitoring programs on the crab fisheries by deploying enumerators in some product areas. One of the areas is Lempangeng Village, Boddie Village, Mandalle District, Pangkajene Islands Regency, where fishermen capture the blue swimming crabs using bottom gillnets. Fisheries monitoring programs usually cover data collection on the volumes and values of the captured fish. Moreover, fisheries managers can also evaluate the feasibility of the fishing business as one of the economic indicators of fisheries management outcome. Fishing intensity in tropical waters is significantly affected by sea conditions, especially where small-sized boats are operated. The number of fishing trips may vary among seasons due to the reluctance of fishermen to work in high-risk environments. Furthermore, the low catch during poor fishing season potentially makes the revenue cannot compensate for the cost. Therefore, the volume of fishing trips per year and the associated cost and catch will determine the financial performance of fishing units. The present study is focused on the financial performance of the fishing units engaged in the crab fisheries in Kampung Lempangeng, Boddie Village, Mandalle District - Pangkajene Island Regency, South Sulawesi Province. The results of this study can be used as a reference point or baseline data for the evaluation of the fisheries in the future.

2. Research methodology

This research was conducted at the Lempageng Village, Boddie Village, Mandalle District, Pangkep Regency fishing net unit. The method used in this research is a case study method with data collection by observation and interviews. The observation method is a method that is carried out by systematically observing and recording the symptoms or phenomena being investigated. In contrast, the interview method is a method that is carried out by collecting data systematically based on the objectives of the research conducted [5].

The data used in this study were obtained from records made by enumerators deployed by the Association of Crabs Business of Indonesia (APRI) in Pangkajene Island Regency. During the data collection from June 25th to July 5th, 2022, in Kampung Lempangeng, Boddie Village, Mandalle District - Pangkajene Island Regency, South Sulawesi Province, observation was carried out to find general information on fishing boats and specification of the bottom gillnets. Five fishermen representing five fishing units were selected as respondents based on the records of the catch and net profit during 2021. The financial analysis aims to determine estimates in terms of funding and cash flow so that it can be known whether the business is feasible or not; financial analysis is an analysis that compares costs and benefits to determine whether a business will be profitable during the life of the business [6]. Evaluation of the feasibility of the crab fishing units was made by calculating the profitability of the business, benefit/cost ratio (B/C ratio), the break even point (BEP), and payback period (PP).

The business of catching crabs (*Portunus pelagicus*) in the waters of Lempageng Village, Boddie Village, Mandalle District, Pangkep Regency, will look for the initial value of departure (Debriefing), profit levels per month and year, losses for fishermen or people who have a crab catching business.

2.1. Profit/loss analysis

According to [7] profit/loss is a systematic report on income, expenses, and profit/loss obtained from a company during a certain period. Profit/loss analysis in this study was carried out to calculate the total income or revenue (TR) from fishing operations, the total cost of business operation (TC), and gross profit. The income was the market value of the captured crabs. The costs include variable costs and fixed costs. The calculation of profit/loss can be formulated as follows:

$$Profit(lost) = Total\ revenue - Total\ cost \quad (1)$$

2.2. Benefit Cost Ratio (BCR)

Emphasizes the value of the comparison between the benefits to be obtained and the costs and losses to be borne (Cost) by comparing the present value of all the results obtained by a business with the present value of all business costs [8], [9]. The BCR was calculated by dividing the present value of the total

benefits (B) by the present value of the total costs (C) [8]-[10]. If BCR > 1, then the business is profitable and feasible; if BCR = 1, then the business is neither profitable nor loss (Marginal); and finally, if BCR < 1, then the business is detrimental, so it is not feasible to carry out and can be written as follows,

$$BCR = \frac{TR}{TC} \quad (2)$$

Information:
TR = Total Revenue
TC = Total Cost

2.3. Break Event Points (BEP)

Break Event Points (BEP) is a technical analysis to study the relationship between fixed costs, variable costs, profits, and sales. BEP in research is a quantity of products (captured crabs) that creates a total revenue that is equal to the total cost of expenditure for obtaining the products [11]. In other words, BEP is a volume of products when total revenue = total Cost or TR = TC. The break-even point gives a clue that the production level has resulted in the same amount of revenue as the production costs incurred. In addition to production volume, unit price, and profit, the break-even analysis provides information about the relationship between fixed and variable costs. To calculate the break even point, the following formulation is used [12],

$$BEP = \frac{Fixed\ Cost}{1 - {variable\ cost}/{production\ volume}} \quad (3)$$

2.4. The payback period (PP)

The payback period (PP) indicates the length of time required for cumulative present value cash inflows to equal the total amount of present value of investment [13]. If the payback period is less than the target return on investment, then the investment project is feasible. If the payback period is greater than the target return on investment, then the project is not feasible [14]. The faster the return on investment of a business, the better the business because the smoother the capital turnover. Such a faster return will enable investors to improve or replace some less productive assets. Payback period calculations can simply be done with the formula,

$$PP = \frac{Amount\ of\ annual\ investment}{profit} \quad (4)$$

3. Results and discussion

3.1. Fishing practices

A fishing unit for crabs in the studied area can be described as a functional unit consisting of 1-3 fishermen, one boat, and a set of bottom gillnets. The principle dimensions of fishing boats used for fishing the crabs are 6-11 m in length, 1.10-2.30 in breadth, and 0.75-1 m in depth. Each boat is powered by a 15-20 HP outboard motor. The gillnets are made of net materials of PA monofilament no. 20, diameter 0.2 mm, mesh size of 3.5 inches or 8.75 cm, length per piece is 16.5 meshes/m, and height is 7-9 meshes. The net material was vertically spread by a float line of 61 m and a sinker line of 50 m. One boat carried 8 – 10 sets (with a length of 250m per set) of gillnet, resulting in a total length of 2000 – 2500 m.

One fisherman operates the net to save operational costs main catch of the net is crabs. The net will be set in the sea at 07.30 WIB for 30 minutes and left by the fishermen for 19 hours while waiting for the net to be lifted. The hauling process for fishing gear is carried out before sunrise at 04.00 WIB for 2-3 hours. The majority of fishermen determinized the fishing area by their previous fishing experience. The distance to the fishing ground could take 10-20 minutes, with the depth of the fishing waters of the nets around 7-10 meters from the surface.

Table 1. Specifications of fishing gear that are often used in Lempageng Waters.

No	Part Name	Description
1	net body	
	1. Net Material	*PA Monofilament* No. 20 0.2 mm
	2. Net Diameter	3.5 inches (8.75 cm)
	3. *Mesh size* Net	
	4. Number of meshes	
	a. Long	16.5 eyes/m
	b. Tall	7-9 eyes
2	Rise straps up and straps down	
	1. rope material	*PE multifilament*size 0.2 cm 2 mm
	2. rope diameter	50 m
	3. Length per tinting	
3	life rope	
	1. rope material	*PE multifilament* size 0.2 cm 2 mm
	2. rope diameter	61 m
	3. Length per tinting	
4	weight rope	
	1. rope material	*PE multifilament* size 0.2 cm 2 mm
	2. rope diameter	50 m
	3. Length per tinting	

3.2. Catching season

Operations of these fishing units are affected by the sea conditions related to the local climate pattern. While other fishers prefer to stay away from rough seas, crab fishers intensify their fishing trips during the westerly monsoon season in December to March when the winds blow stronger, and the sea waves are higher than in the other periods [15]. Such wind-generated waves are able to stir up mud deposits in the shallow waters, which are likely to increase the productivity of fishing operations. Fishing operations then continue in the period when the east winds generate lower sea waves. The poor fishing season occurs during the beetle season, and the fishers are in a difficult time because the capture of crabs is very low. According to states of [15], the crabs will move away from the fishing locations or migrate to find more appropriate environmental conditions, i.e., water temperature and salinity.

The fishing intensity in the 5 months (November – April) of the western monsoon season was 15 - 20 trips per month, while during the 5 months (May – October) of the easterly monsoon season was 25 - 30 trips per month and during the 1 month (October – November) of poor fishing season was 15 - 25 trips per month.

3.3. Financial analysis

3.3.1. Profit/loss analysis. The annual profit per fishing unit was Rp220,545 - 31,133,173.80, averaging Rp 15,349,936.28 per year. The annual fixed costs were Rp22,570,000 to Rp34,190,000 with an average of Rp27,068,000 while the variable costs were Rp9,240,000 to Rp13,480,000 with an average of Rp10,376,000.

3.3.2. Benefit Cost Ratio (BCR). The B/C ratio of the fishing operation of the gillnet for crabs ranged from 1.00 to 1.67, with an average of 1,36. This BRC value is more than 1 (one), which means that the crab industry is feasible.

With the same results as [16], the financial analysis of blue swimming crab in Banten Bay, west Java, shows that the revenue-cost ratio (R/C) of the gillnet and pots is greater than 1, so those two tools are profitable. The value for pots is slightly higher than for bottom gillnets, it is 1.45, and for bottom gillnets, it is 1.39. While according to [17], blue swimming

crab (*Portunus pelagicus*) fishing businesses in Rembang district that used collapsible traps obtained an R/C value 1.20. The value of the R/C ratio is > 1, implying that the business is considered profitable and feasible to run. According to [19], increasing the R / C ratio can be done by reducing production costs by not using bait. According to [18] the financial analysis of crab fishing efforts in South Konawe, Southeast Sulawesi, the average value of the benefit cost ratio (B/C) of fishing efforts with collapsible traps using peppered fish bait is greater than 1 (2.19) if the value of B/C> 1 then the investment is feasible, whereas if using anchovy bait, the value of B/C <1 (0.5), then the investment is not feasible to carry out. According to [20], a business is said to be feasible and provide benefits if the B/C value is greater than one. The greater the B/C value, the greater the value of the benefits that will be obtained from the business. The B/C ratio obtained is more significant than one, making the business feasible.

3.3.3. *Break Event Points* (BEP). This fishing business's break even point (BEP) ranged from Rp22,570,000 to 34,190,000 with an average of Rp27,068,000. The higher income was around Rp. 29,952,545.40 to Rp. 77,003,173.80, an average of Rp. 52.973.936,28.

3.3.4. *Payback* period (PP). The study of the financial aspect is used to find out how long it will take to return the investment costs. The payback period of crab fishing ranged from 0.54 - 1.21 years, with an average of 1 year.

The difference with the results from [16] is that the fastest payback period (PP) in the blue swimming crab business in Banten Bay, West Java, is on a boat with pots of 3.26 years, or about 3 years and 3 months. Meanwhile, the PP for a boat with bottom gillnets is 4.11 years, or around 4 years and 11 months. [17] has the same results as the business in Rembang, namely that the payback period is 3 years, 3 months, and 3 days, which is considered fast. If the rate of return on capital is faster than the predetermined period, the business is considered feasible. A faster return on investment capital is preferable because it shows smoother capital flow. The longer period of PP is on South Konawe [18], so using different baits requires different times. The best PP for catching crabs with folding traps using peppered fish bait is 1 year, 6 months, and 3 days, while when using anchovy bait due to losses, the PP value is 6 years, 9 months, and 10 days. With similar results, [21] reported that the average payback period for crab fishing with traps in Tegal waters was 4.4 years or 4 years and 4 months.

4. Conclusion

The crab fishery in Lempageng Village using gillnet with approximately 8 – 10 sets (total length of 2000-2500 m) was carried out on one boat consisting of 1-3 fishermen with just one fisherman as the net operator to save operational costs. From the financial point of view, the crab fishery business using gillnet is considered feasible as BRC > 1 amounted to 1.36 with a payback period from 0.54 -1.21 years with an average of 1 year. This means fishermen only need one year to return the total capital, so the crab-catching business is feasible.

5. Recommendation

Increasing profits, fishermen must reduce expenses to increase catches. There is a need for further research related to fishing nets from a social and technical aspect.

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