The Economic Value of Small Pelagic Fisheries in Indramayu Regency, West Java

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

This study aims to analyze the economic value of small pelagic fishing fisheries in Indramayu Regency, West Java. This research was conducted by a survey method using a questionnaire with a purposive sampling method and the data were analyzed descriptively quantitative and qualitative. The benefits of the results of this study are expected to provide information for decision making for the relevant government in formulating policies on fisheries activities, especially small pelagic fish in Indramayu Regency West Java so that they remain sustainable. Catching small pelagic fish is done by purse seine, mini purse seine, Millenium gill net, fishing line, and nylon net. The majority of the ship size used ships with sizes below 20 Gross Tonnage (GT). The types of small pelagic fish caught are Anchovy, Mackerel, Long Jawed Mackerel, Sardine, Scad, Sand Whiting, Tanjan Fish, Rucah Fish and Japuh Fish. The highest acceptance value of small pelagic fish in 2019 is found in anchovies, which is 8.997 billion. So that the highest profit of the highest small pelagic fish obtained in 2019 is found in Anchovy, amounting to 8,780 billion. The Benefit-Cost Ratio (BCR) calculation shows that the BCR value for catching pelagic fish species above is> 1 so that the fishing activity is feasible and can be continued. 99.7% of small pelagic fishing activities are influenced by the GT of the ship, the number of trips (months), and the fishing gear based on the calculation of multiple linear regression analysis.

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1. INTRODUCTION

Small pelagic fish are large groups of fish that form schooling in their lives and have free swimming properties by migrating vertically or horizontally close to the surface with relatively small body sizes [1]. Small pelagic fish become one of the most abundant fishery resources in the Java Sea Fisheries Management Area, with a potential of 340,000 tons per year [2].

Indramayu Regency is an area with the highest level of fisheries production contribution among other areas in the coastal region of northern West Java Province. In 2016 fisheries production in the Indramayu Regency was 147.625,80 tons, about 64,4% of the total fishery production in West Java. With an average number of fishing gear of 9,113 units, the average catch per unit of fishing gear can be calculated at 11.85 tons per unit of fishing gear. The number of capture fisheries FTPs in Indramayu in 2016 was 5,460 dominated by 10-50 GT motor boats [3].

The abundance of natural resources especially fisheries and the community whose profession depends on capture fisheries in Indramayu Regency requires an economic assessment of natural resources and human resources available in Indramayu Regency as information for the government or the community regarding the abundance and types of small pelagic fish and market values small pelagic fish in Indramayu Regency so that the government can make policies regarding catching small pelagic fish so that small pelagic fish resources can be used sustainably. Therefore this study aims to determine the magnitude of the economic value of the market utilization of small pelagic fish resources in TPI Ngupaya Mina, TPI Mina Lestari, and TPI Pabean Udik in Indramayu Regency West Java.

2. MATERIALS AND METHODS

This research was conducted at 3 Fish Landing Bases (PPI) / Fish Auction Points (TPI) in Indramayu Regency, West Java Province, namely TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik. The type of data used uses primary data and secondary data. Primary data obtained through questionnaires and interviews with fishermen include data on sailing costs, fishermen income, the amount of time to sea, and other data. Secondary data was obtained through various relevant data sources in the form of reference books, literature or literature sources, scientific journals and information as well as data sourced from related agencies. These institutions such as the Department of Maritime Affairs and Fisheries of West Java Province. This study uses a survey method, which is a method that uses a questionnaire as an instrument of data collection. The number of respondents who were targeted for filling out the questionnaire in this study was 90 respondents. The data used are primary data and secondary data. Primary data collection in this study was conducted using a purposive sampling method, Purposive sampling is a method of taking samples based on certain criteria determined by researchers objectively [4] with the following criteria:

- The fishermen used as respondents are fishermen who use fishing boats with a size of GT <20 GT.
- The fishermen who were respondents were fishermen whose fishing grounds were around Indramayu waters.
- The fishermen who were respondents were fishermen who used the millenium gill net, purse seine, mini purse seine, fishing line, and nylon net.

2.1 Economic Analysis

Economic analysis in this research includes the calculation of production costs / operational costs, revenue, and the resulting profits. Then the results of the calculation of these three aspects are analyzed using the BCR, and linear regression analysis and economic rent obtained by the government.

2.1.1 Analysis of fish resource value

Analysis of the valuation of small pelagic fish resources using the rent calculation method. Fish resource rent is a type of direct use value and can be calculated using the net price method. The calculation formula using the net price method approach is [5]:

$$RR = TR - TC = \Sigma (p \times h) - \Sigma (c \times E)$$

Keterangan:

RR = *Resource Rent* (Rp)
TR = *Total Rent* (Rp)
TC = *Total Cost* (Rp)
p   = Price (Rp)
h   = number of catches (ton)
c   = cost (Rp)
E   = *effort* (Trip)

2.1.2 Cost analysis

Cost analysis is used to calculate the cost and revenue components resulting from the fishing effort using a fishing net before conducting interviews. The cost components used are investment costs and operational costs. The revenue component is the value of sales of products. If a project shows positive net benefit, then the project plan can be continued. If the opposite is negative, then the project plan is terminated [6].

2.1.3 Benefit cost ratio

Benefit-Cost Ratio (BCR) is a way of evaluating business by comparing the present value of all results obtained by a business with the present value of all business costs. The criteria are as follows:

- If BCR> 1, then the business is profitable and feasible
- If BCR <1, then the business is detrimental so it is not feasible to be carried out
- If BCR = 1, then the business is not profitable and not loss (marginal)

Then the BCR formula can be written as follows for a decrease in the formula used [7]:

$$BCR = \frac{TR}{TC}$$

Explanation :

TR: Total Revenue
TC: Total Cost

2.1.4 Linear regression analysis

The analysis used in this study is multiple linear regression analysis. Multiple analysis is a linear regression to analyze the magnitude of the relationship and the influence of independent variables that number more than two [8]. The regression analysis process is carried out using SPSS software. The equation of the multiple linear regression model is as follows.

$$Y = bo + b_1X_1 + b_2X_2 + b_3X_3 + b_3dA_1$$

Explanation :

Y = fish production /trip (kg)
bo = Constant
b_1X_1 = Large GT ship
b_2X_2 = Number of boat trip (each month)
b_3dA_1 = Fishing gear (*dummy variable*)

3. RESULTS AND DISCUSSION

The number of fishermen used as respondents numbered 90 people, each with 30 people from each TPI. There is a difference in the size of the GT Ship and fishing gear used in the three TPI, namely in the TPI Ngupaya Mina, the fishing gear used is purse seine and mini purse seine; the TPI Baita Mina Lestari fishing gear that is used is Millenium Gill Net; while in TPI Udik Customs, the fishing gear used is nylon net and fishing line. The following is the difference in the size of the GT of the ship on each gear.

The size of the ship's GT will decide the length of time it takes the ship to make an arrest. The larger the size of the GT ship, the longer the time needed in the process of capture so that the number of trips obtained in a month is smaller. The following is the total number of trips taken by respondents in one month.

Small pelagic fish that are the main catch in Indramayu Regency are Long Jawed Mackerel, Anchovy, Sardine, Scad and Mackerel. The production of the most small pelagic fish found in anchovies of 632.137 kg while the smallest fish production is in the Japuh fish with a total of 186 kg. The small pelagic fish catches of Indramayu Regency in 2019.

States based on the results of his research that the obstacles in fishing activities for fishermen in Indramayu Regency include capital, catch season, catchment area, and type of fleet used. The catching season in Indramayu Regency is divided into three seasons, namely peak season (August-November), moderate season (March-July) and famine season (December-February) [9].

3.1 Percentage of Small Pelagic Fishing

Small pelagic fish landed in Indramayu Regency come from fishing vessels that have different types of fishing gear, namely purse seine, mini purse seine, mill net gill, fishing line, nylon net. Following are the percentages of small pelagic fish catches based on the type of fishing gear used.
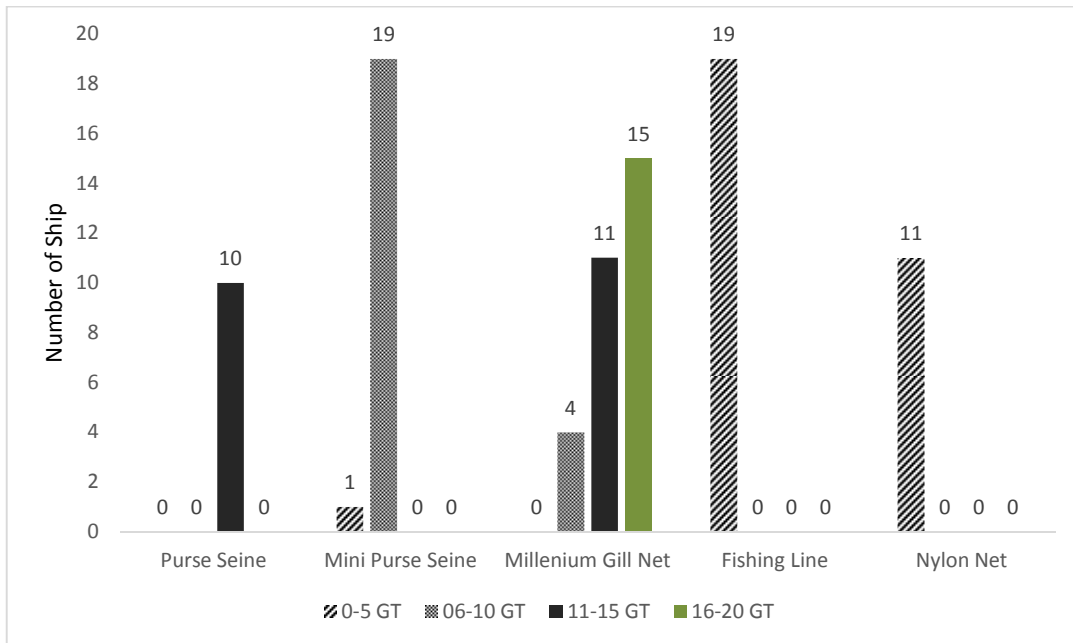

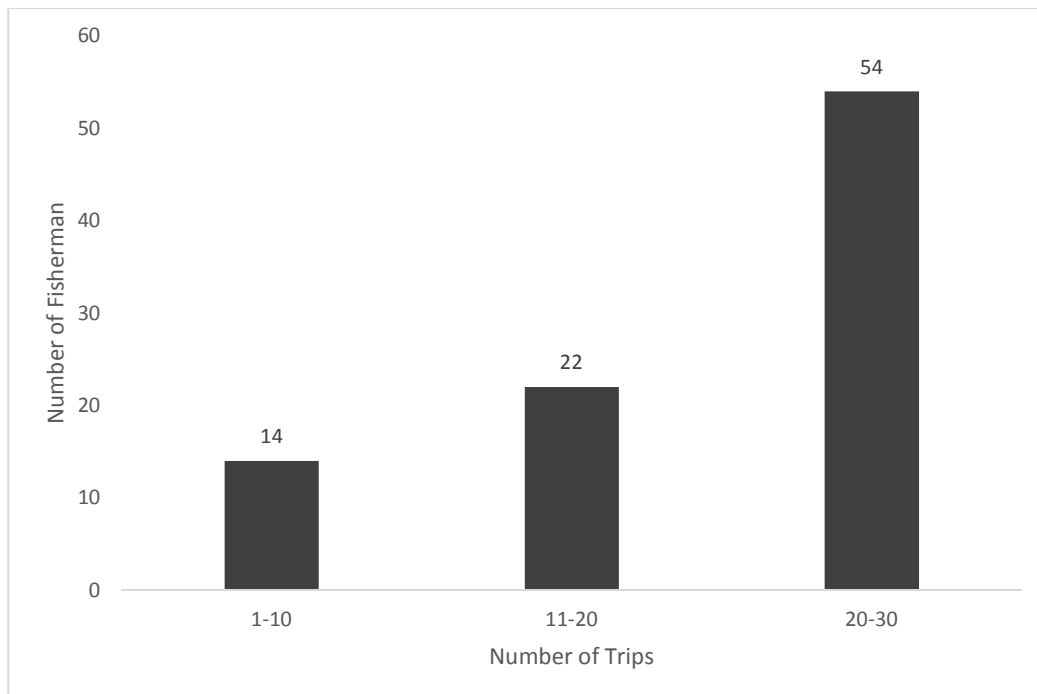**Fig. 1. The size of the GT ship of each fishing gear**

Fig. 2. The total number of trips taken by respondents in a month
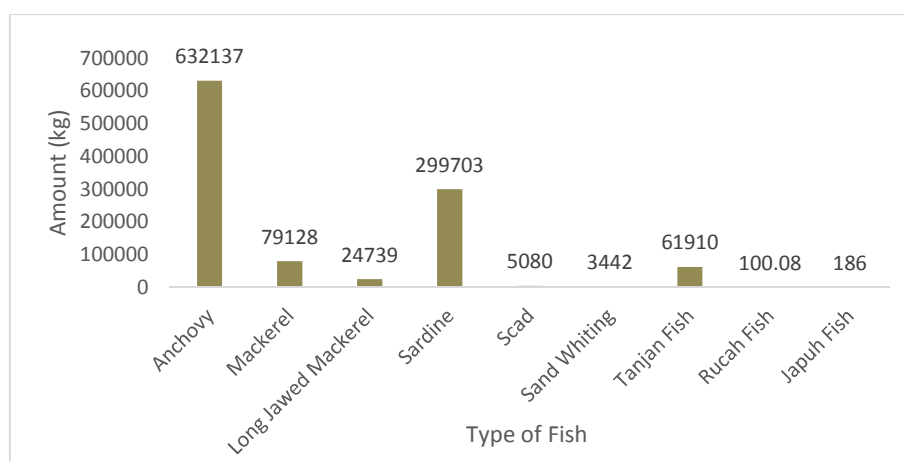
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Fig. 3. The small pelagic fish catches of Indramayu Regency in 2019

Percentage of small pelagic fish catches with Millenium gill net fishing gear is Tanjan fish with a percentage of 11%, Mackerel Fish by 2%, Sand Whiting by 2%, and Long Jawed Mackerel by 1%. The percentage of conversations with purse seine fishing gear shows that the percentage of Anchovy is 54%, Sardine fish 21%, Mackerel fish 7%, and Long Jawed Mackerel 1%. The percentage of catches with mini purse seine fishing gear shows that the percentage of Sardine fish is 35%, Mackerel fish 4%, and Scad 1%. Percentage with fishing gear shows that the percentage of Japuh Fish is 15%, and Rucah fish 24% of fishing gear and 28% of nylon fishing gear.

3.2 Operational Cost

The catches of each fishing gear in TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik are not only focused on small pelagic fish species but many types of fish are based on small pelagic fish, large pelagic fish, and fish demersal. Therefore to get the production cost of small pelagic fish species it is necessary to calculate the percentage of small pelagic fish catches which are then multiplied by the production cost per fishing gear. The following is the value of production per type of small pelagic fish.

The largest total production cost is the production cost of catching anchovy using purse seine fishing gear with a production value/year of Rp. 197,100,000. This is because the percentage of anchovy fishing on trips that use purse seine fishing gear is quite large at 54% and the total overall production cost of catching using purse

seine fishing gear is also quite large at Rp. 365,000,000.

3.3 Revenue

Revenue is the product of the number of catches (kilograms) and the price per kilogram (rupiah) from the sale of catches. The details of receiving catches for 1 year.

The biggest revenue obtained in the efforts of catching small pelagic fish at TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik in Indramayu Regency per year is the revenue from Anchovy fishing using purse seine fishing gear, amounting to Rp. 8,977,054,408. While the smallest acceptance value is the value of Rucah fish with fishing gear, which is Rp. 1,677,600. The price value shown in the table is the price of fish from each catch in the three TPI of Indramayu Regency and the annual average prices.

3.4 Profit

Business analysis is usually used to see the level of success of a business activity. The business analysis aims to find out the magnitude of the benefits derived from the business carried out [10]. The following are the advantages of small pelagic fish catching business at TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik.

The biggest advantage of small pelagic fishing businesses in Indramayu Regency is the profit from Anchovy fishing, which is Rp. 8,779,954,408. All the benefits of small pelagic

fish in TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik in Indramayu Regency are positive, which means that small pelagic fishing efforts in TPI Ngupaya Mina, TPI Baita Mina Lestari and TPI Pabean Udik in Indramayu Regency have no loss. Large profits can be obtained by reducing operational costs incurred [11].

3.5 Benefit Cost Ratio

Benefit-Cost Ratio (BCR) is a way of evaluating business by comparing the present value of all results obtained by a business with the present value of all business costs. The following is an analysis of the Benefit-Cost Ratio (BCR) on small

pelagic fishing business in TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik.

The B/C ratio for all small pelagic fishing businesses in Indramayu Regency has a value of more than 1, meaning that the business is feasible to run and can be continued. Large B/C ratio is assessed from the ratio of benefits and costs in one year. If a B/C ratio value of more than one is obtained, the business is feasible and can be continued, if the B/C ratio value is equal to one then the business is at the break-even point and if the B/C ratio value is less than one, then the business it is not feasible and cannot be continued.
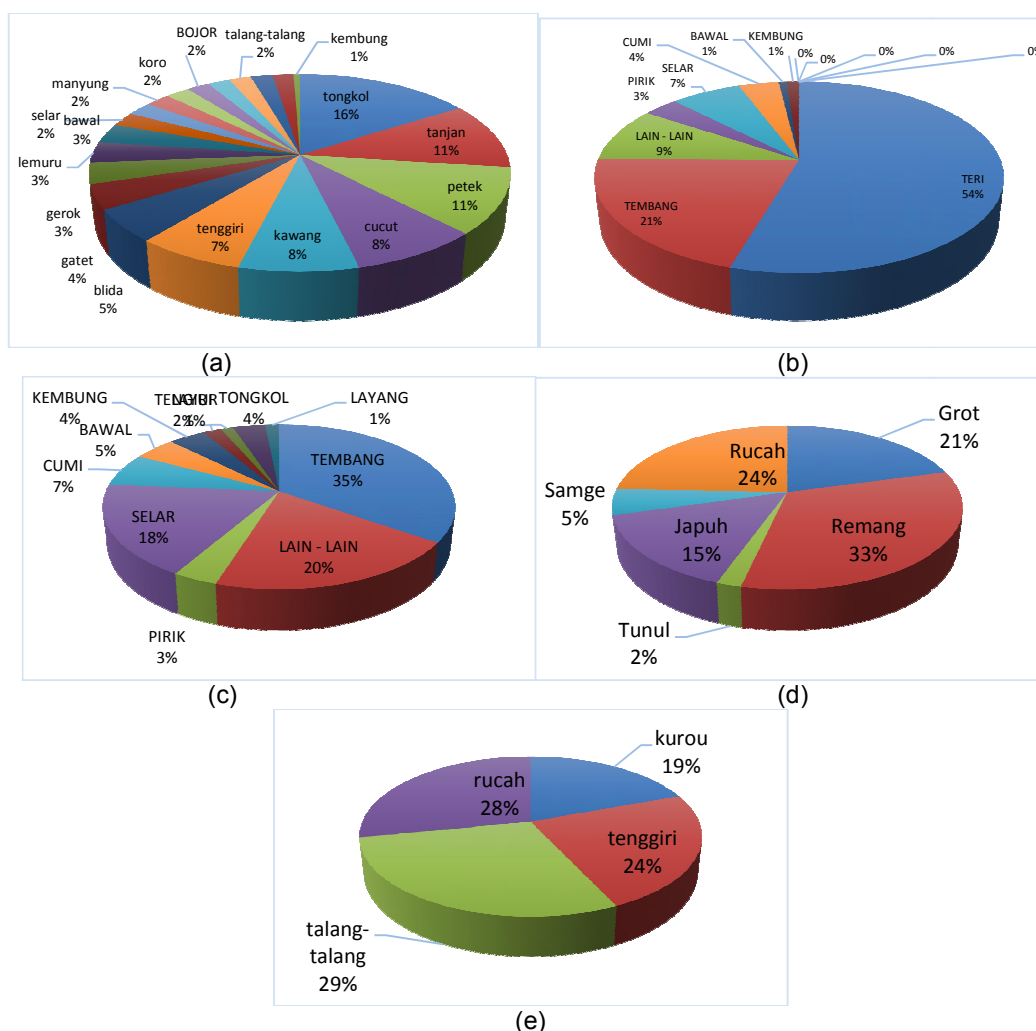

Fig. 4. (a) Percentage of small pelagic fish in gill net millenium, (b) Percentage of small pelagic fish in purse seine, (c) Percentage of small pelagic fish in purse seine mini, (d) Percentage of small pelagic fish in fishing rod, (e) Percentage of small pelagic fish in nylon net

Table 1. Operational costs for small pelagic fishing at TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik in 1 Year

Fish Name	Fishing Gear	Catch Percentage	Cost of Trip Production/Year (RP)
Bojor	*Gill net millenium*	2%	Rp. 6.100.000,-
Japuh	Pancing	15%	Rp. 1.875.000,-
Kembung	*Gill net millenium*	1%	Rp. 3.050.000,-
Kembung	*Purse seine*	1%	Rp. 3.650.000,-
Kembung	*Purse seine mini*	4%	Rp. 9.720.000,-
Layang	*Purse seine mini*	1%	Rp. 2.430.000,-
Rucah	Jaring nylon	28%	Rp. 3.500.000,-
Rucah	Pancing	24%	Rp. 3.000.000,-
Selar	*Gill net millenium*	2%	Rp. 6.100.000,-
Selar	*Purse seine*	7%	Rp. 25.550.000,-
Selar	*Purse seine mini*	18%	Rp. 43.740.000,-
Tanjan	*Gill net millenium*	11%	Rp. 33.550.000,-
Tembang	*Purse seine*	21%	Rp. 76.650.000,-
Tembang	*Purse seine mini*	35%	Rp. 85.050.000,-
Teri	*Purse seini*	54%	Rp.197.100.000,-

Table 2. Revenue of small pelagic fish catching businesses at TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik for 1 Year

Fish Name	Fishing Gear	Price (Rp/Kg)	Catch (Kg)	Total (Rp)
Bojor	*Gill net millenium*	12.000	3.442	41.304.000,-
Japuh	Pancing	18.520	186	3.444.720,-
Kembung	*Gill net millenium*	12.000	540	6.480.000,-
Kembung	*Purse seine*	14.459	9.844	142.334.396
Kembung	*Purse seine mini*	13.451	14.859	199.868.409
Layang	*Purse seine mini*	13.520	5.085	68.749.200
Rucah	Jaring nylon	11.377	308	3.504.116
Rucah	Pancing	13.184	230	3.023.320
Selar	*Gill net millenium*	16.500	4.092	67.518.000
Selar	*Purse seine*	14.161	28.107	398.023.227
Selar	*Purse seine mini*	14.887	51.021	759.549.627
Tanjan	*Gill net millenium*	2.500	67.522	168.805.000
Tembang	*Purse seine*	14.338	260.537	3.735.579.506
Tembang	*Purse seine mini*	14.887	160.602	2.390.881.974
Teri	*Purse seini*	14.161	633.928	8.977.054.408

Table 3. Profit of small pelagic fish catching businesses at TPI Ngupaya Mina, TPI Baita Mina Lestari and TPI Pabean Udik for 1 Year

Fish Name	Fishing Gear	Profit (Rp)
Bojor	*Gill net millenium*	35.204.000
Japuh	Pancing	1.569.720
Kembung	*Gill net millenium*	3.430.000
Kembung	*Purse seine*	138.684.396
Kembung	*Purse seine mini*	190.148.409
Layang	*Purse seine mini*	66.319.200
Rucah	Jaring nylon	4.116
Rucah	Pancing	32.320
Selar	*Gill net millenium*	61.418.000
Selar	*Purse seine*	372.473.227
Selar	*Purse seine mini*	715.809.627
Tanjan	*Gill net millenium*	135.255.000
Tembang	*Purse seine*	3.658.929.506
Tembang	*Purse seine mini*	2.305.831.974
Teri	*Purse seini*	8.779.954.408

Table 4. Benefit-cost ratio of small pelagic fish catching businesses at TPI Ngupaya Mina, TPI Baita Mina Lestari and TPI Pabean Udik for 1 Year

Fish Name	Fishing Gear	BCR
Bojor	*Gill net millenium*	6,8
Japuh	*Pancing*	1,8
Kembung	*Gill net millenium*	2,1
Kembung	*Purse seine*	39,0
Kembung	*Purse seine mini*	20,6
Layang	*Purse seine mini*	28,3
Rucah	*Jaring nylon*	1,00
Rucah	*Pancing*	1,0
Selar	*Gill net millenium*	11,1
Selar	*Purse seine*	15,6
Selar	*Purse seine mini*	17,4
Tanjan	*Gill net millenium*	5,0
Tembang	*Purse seine*	48,7
Tembang	*Purse seine mini*	28,1
Teri	*Purse seini*	45,6

Table 5. Rent obtained by the government of small pelagic fish catching businesses at TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik for 1 Year

Fish Name	Fishing Gear	Profit (Rp)	Economic Rent Value (%)	The Rent Obtained (Rp)
Bojor	*Gill net millenium*	35.204.000	2,25	792.090
Japuh	*Pancing*	1.569.720	2,25	35.319
Kembung	*Gill net millenium*	3.430.000	2,25	77.175
Kembung	*Purse seine*	138.684.396	2,25	3.120.399
Kembung	*Purse seine mini*	190.148.409	2,25	4.278.339
Layang	*Purse seine mini*	66.319.200	2,25	1.492.182
Rucah	*Jaring nylon*	4.116	2,25	92,61
Rucah	*Pancing*	32.320	2,25	727
Selar	*Gill net millenium*	61.418.000	2,25	1.381.905
Selar	*Purse seine*	372.473.227	2,25	8.380.647
Selar	*Purse seine mini*	715.809.627	2,25	16.105.717
Tanjan	*Gill net millenium*	135.255.000	2,25	3.043.238
Tembang	*Purse seine*	3.658.929.506	2,25	82.325.914
Tembang	*Purse seine mini*	2.305.831.974	2,25	51.881.219
Teri	*Purse seini*	8.779.954.408	2,25	197.548.974
Total:				**370.463.937,61**

Table 6. Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. Error	Beta		
1(Constant)	42.180	20.511		2.056	.043
d_Nylon Net	-29.627	5.328	-.064	-5.561	.000
d_Fishing Line	-29.578	6.378	-.069	-4.637	.000
d_Purse Seine	511.716	3.818	.988	134.020	.000
d_Mini Purse Seine	40.731	3.843	.104	10.598	.000
Trip	-.482	.679	-.016	-.710	.480
GT_Ship	-.494	.950	-.016	-.520	.605

a. Dependent Variable: Production

3.6 Rents Obtained by the Government

States that economic rent is defined as an economic surplus that is the excess of the total production value above the total production cost [12]. In relation to fisheries business, economic rent is a form of mutually beneficial cooperation between individual entrepreneurs who provide

Table 7. Anova

Model		Sum of Squares	Df	Mean Square	F	Sig.
		ANOVA[b]				
1	Regression	2.373.588,740	6	395.598,123	4,41803	0.000[a]
	Residual	7.342,249	82	89,540		
	Total	2.380.930,989	88			

a. Predictors: (Constant), GT Ship, Mini Purse Seine, Purse Seine, Millenium Gill Net, Nylon Net, Fishing Line, Trip a month, b. Dependent Variable: Production of small pelagic fish

Table 8. Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
		Model summary		
1	0.998[a]	0.997	0.997	9.46254

a. Predictors: (Constant), GT Ship, Purse Seine, Mini Purse Seine, Millenium Gill Net, Nylon Net, Fishing Line, Trip a month

capital and officials who provide facilities, incentives, and protection. The government as the official who oversees and provides facilities, incentives, and protection for fishing activities in Indramayu Regency receives an economic rent of 2.25% of the total profits or profits. The following details of the rents obtained by the government from each of the results of small pelagic fishing in Indramayu Regency.

The amount of economic rent obtained by the Indramayu Regency government from the results of small pelagic fishing in TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik in 2019 amounted to Rp. 370,463,937,61. The highest economic rent is obtained from anchovy fishing using purse seine, which is Rp. 197,548,974, - while economic rent was obtained from catching Rucah fish with a nylon fishing gear, amounting to Rp. 92.61, -. This is because anchovy is the main catch target and also has a high economic value in Indramayu Regency while Rucah is caught fish with very low economic value.

3.7 Linear Regression Analysis

The analysis used is multiple linear regression analysis between the production of small pelagic fish with fishing activities such as the number of trips (months), boat GT, and fishing gear. Fishing gear variables are categorical, so the dummy variable is used to quantify quantitative variables. The following are the results of multiple linear regression analysis between small pelagic fish production and fishing activities.

According to Table 8, multiple linear regression equations are $Y = 42,180 - 0,494X_1 - 0,482X_2 - 29,627dA_1 - 29,578dA_2 + 511,716dA_3 + 40,731dA_4$. From the equation it can be concluded that the value of GT -0.494

indicates that each GT of a ship increases by 1% then the production of small Pelagic fish will drop by 0.494 kg. The coefficient of the trip value -0.482 indicates that every number of trips is 1% lower then production of small Pelagic fish will decrease by 0.482 kg. Significant value of the nylon net, the fishing line, the purse seine, and the mini purse seine are worth < 0.05, which means that variables have a significant effect on the production of small pelagic fishes.

From the Table 7, it can be seen that the value of F is 4.418 and p <0.05 which means all independent variables (Ship GT, number of trips (months), purse seine fishing gear, mini purse seine fishing gear, millenium gill net fishing gear, fishing gear nylon nets and fishing gear) play a role in the production of small pelagic fish catches.

Based on the table it can be seen that the effective contribution of independent variables (Ship GT, number of trips (months), purse seine, mini purse seine, Millenium gill net, nylon net, and fishing gear) to the production of a catch of small pelagic fish is 99.7% (R square = 0.997). The remaining 0.3% is explained by other factors outside the variable.

4. CONCLUSION

The results of the feasibility analysis of the small pelagic catching fisheries business at TPI Ngupaya Mina, TPI Baita Mina Lestari, and TPI Pabean Udik as a whole achieved the benefits and value of Benefit Cost Ratio (BCR) of all types of small pelagic fish which is positive or> 1 means that the business is feasible and can be continued. Then based on the results of multiple

linear regression analysis it can be seen that the production of small pelagic fish 99.7% is influenced by the GT Ship, the number of trips (months), and also the type of fishing gear.

5. SUGGESTION

The results of this study are expected to supplement government data regarding the process of catching small pelagic fish in Indramayu Regency, West Java. Besides that the government is expected to pay more attention to the preservation of small pelagic fish so that the existence of small pelagic fish can be conserved and can be used sustainably.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company   rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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