Efficiency of drift gillnets in nagan raya district, aceh, indonesia

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Abstract. The achievement of technical and economic efficiency is one indicator in assessing the fishing process's capability. The purpose of this study was to formulate production factors of drift gillnets at The Kuala Tadu and The Kuala Tuha fishing base and to calculate the technical and economic efficiency of the use of production factors for drift gillnets at both locations. Production factors that support the success of drift gillnets operation are net depth, net length, boat size, amount of fuel, trip duration, mesh size, and engine power analyzed using the Cobb-Douglas approach. The results showed that the equation of production function for drift gillnet is $\mathrm{LnY} = 3.110 + 0.112\ \mathrm{LnX}_2 + 0.191\ \mathrm{LnX}_3 + 0.105\ \mathrm{LnX}_4 + 0.251\ \mathrm{LnX}_6$ with a value of R^2 is 0.833. The technical efficiency study of 20 units of drift gillnets showed that the value of production elasticity (EP) for using production factors for net length (0.112), vessel size (0.191), amount of fuel (0.105), and mesh size (0.251) was < 1. It means that the use of factors of production is no longer efficient. The economic efficiency of using the variable production factors of drift gillnets is no longer efficient because the value of NPMxi/BKMxi <1.

1 Introduction

Nagan Raya Regency is a new district formed as a result of the expansion of West Aceh Regency. This area has a lot of potential, especially those related to marine products, such as fisheries resources [1]. The water area in Nagan Raya Regency is a coastal area that is active as a fish catcher. This region has an excellent diversity of natural resource potential, both biological natural resources and non-biological natural resources. These potential resources can be utilized by residents living in coastal areas who earn their living as fishermen [2].

Fishermen in Nagan Raya Regency have a high dependence on fisheries resources as their main source of livelihood and almost all fisheries activities are based in coastal areas [3]. Fishermen's catches in Nagan Raya Regency will be landed at fish landing sites. The fish landing site (TPI) is one of the fisheries facilities in Nagan Raya Regency. These landing places include The Kuala Tadu fishing base and The Kuala Tuha fishing base.

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One of the fishing tools used at The Kuala Tadu fishing base and The Kuala Tuha fishing base is drift gillnets. The number of fishing gear used at The Kuala Tadu fishing base and The Kuala Tuha fishing base is 12 and 8 units respectively. The total catch production at The Kuala Tadu fishing base decreased in April by 48.05% and at The Kuala Tuha fishing base in March by 38.07%. The decrease in the amount of catch production is due to March and April entering the transition season and western season [4].

Based on previous research, the fishermen's problem always face is the lack of knowledge about how to use production costs to achieve efficient and optimal fishing [5]. According to [6] stated that production factors experienced an increase in prices which caused catches to tend to be uncertain so that fishermen's income tended to be uncertain. Fishing success is the main factor that is influenced by the level of fishing effort carried out by drift gill net fishermen in the use of production factors.

Achieving technical and economic efficiency, especially at The Kuala Tadu fishing base and The Kuala Tuha fishing base, can be achieved if fishermen know the production factors that influence their fishing efforts. If the use of production factors can be carried out appropriately and pursued well, then the fishing operation can be carried out carried out more efficiently, so that optimal fishing success can be achieved. Based on this description and supported by the existence of The Kuala Tadu fishing base and The Kuala Tuha fishing base which have the potential to be developed, research is needed regarding the technical and economic efficiency of production factors in drift gill net fishing units at The Kuala Tadu fishing base and The Kuala Tuha fishing base.

2 Material and Methods

2.1 Location and time

This research was carried out for 1 month from February to March 2022. Located at the Kuala Tadu and Kuala Tuha fishing base, Nagan Raya district, Aceh, Indonesia.

2.2 Sampling procedure

The research method used in this research is a survey method and interviews with 20 fishermens at the both fishing base.

2.3 Data Analysis

2.3.1 Formulation of Production Factors

This research can formulate production factors for drift gillnet fishing units. Before researchers can formulate it, this research must be tested first. The testing stages are carried out in 2 steps, namely:

1. Classic Assumption Test:
    a. Normality test
    b. Heteroscedasticity Test
    c. Multicollinearity Test
    d. Autocorrelation Test

2. Analysis of Production Factors

Production factor analysis is an analysis that explains the relationship between production and the production factors that influence it. According to [7], for observing the influence of certain factors of production on overall output in actual circumstances is impossible. Therefore, the relationship between production factors and output needs to be simplified in the form of a model. The variables used in drift gillnet must have different sizes so that the influence of these variables can be seen. Quantitative relationships between production factors obtained at The Kuala Tadu fishing base and The Kuala Tuha fishing base, namely net depth (X_1), net length (X_2), boat size (X_3), amount of fuel (X_4), trip duration (X_5), mesh size (X_6), engine power (X_7), with production can be calculated based on the Cobb-Douglas production function. For this reason, the Cobb-Douglas Logarithmic Model can be seen as follows:

$$\mathrm{Ln}Y = \mathrm{Ln}a_1 + b_1\mathrm{Ln}X_1 + b_2\mathrm{Ln}X_2 + \ldots + b_n\mathrm{Ln}X_n + \mathrm{Ln}\ e \qquad (1)$$

Where:
a = Intercept
b_1, b_2 = Production elasticity
Y = Catch production (kg)
X_1 = Net depth (m)
X_2 = Net length (m)
X_3 = Boat size (GT)
X_4 = Amount of fuel (liters)
X_5 = Trip duration (hours)
X_6 = Mesh size (inches)
X_7 = Engine power (PK)

To take into account the test, the coefficient of determination is then calculated, the percentage of influence of the independent variable on the dependent variable as a whole is shown by the coefficient of determination (R^2). This test is intended to find out how much influence the independent variable can have on the dependent variable. Then a statistical test is carried out on the production function. The tests carried out in this case are testing the estimator model (f test) and testing the regression parameters (t test).

2.3.2 Technical and Economic Efficiency

1. Technical Efficiency

The regression coefficients b1, b2…bn from the Cobb Douglas production function are the production elasticities of the input variables. The magnitude of production elasticity (Ep) can be used to measure the level of technical efficiency and economic efficiency of using variable inputs. The level of technical efficiency in input use is achieved if Ep = 1, if the value of Ep < 1 then the use of the input is inefficient and if the value of Ep > 1 then the use of the input is inefficient [7].

2. Economic Efficiency

Economic efficiency can be achieved if we can maximize profits. This means equating the marginal product of each production factor with its price [8].

According to [9], economic efficiency is achieved by looking at the comparison between the value of marginal product (NPM) of each input and the input price or marginal factor cost (BKM) = 1.

$$\frac{bx\ Y\ x\ Py}{X} = Px \qquad (2)$$

$$NPM = \frac{b\ x\ Y\ x\ Px}{X} \qquad (3)$$

$$BKMx_i = Px \tag{4}$$

$$\frac{NPMx_i}{BKMx_i} = 1 \tag{5}$$

Where:

NPM = Marginal product value
BKM = Marginal factor costs
Px = Price production factors or marginal factor costs x_i (BKM x_i)
x_i = Production input
Py = Production cost
Y = Production
X = Number of production factors
b = production elasticity

In many cases the reality of NPMxi/BKMxi is not always equal to 1, what often happens is as follows [8]:

a. $NPMx_i/BKMx_i > 1$: meaning that the use of input X is not yet efficient, to achieve efficiency input X needs to be increased.
b. $NPMx_i/BKMx_i < 1$: meaning that the use of input X is inefficient, to achieve efficiency, the use of input X needs to be reduced.

3 Results and Discussions

3.1 Formulation of production factors

Production factor data obtained from the drift gillnet was tested using the classic assumption test, which consists of the normality test, heteroscedasticity test, multicollinearity test, and autocorrelation test. The results are as follows:

1. Normality Test

The Normality Test can be said to be normally distributed if the points are spread evenly on a diagonal line. The test results in this research can be seen in Figure 1. Figure 1 shows the normality test for the dependent variable, that the points are spread evenly around the diagonal line and the distribution follows the direction of the diagonal line or in other words has a normal distribution. This means that the model is suitable to be used to predict production results using Cobb Douglass regression analysis.

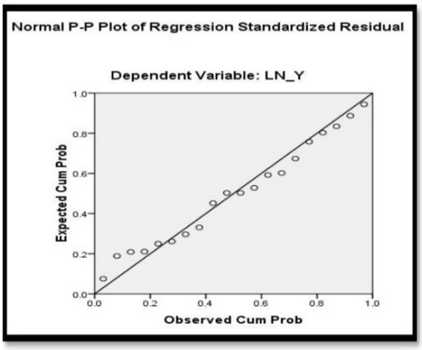

Fig. 1. Normality test

2. Heteroscedastiсy Test

The heteroscedasticity test functions to see whether the variance of the observation residuals is related between variables or not. If these variables are related, then the independent variable of drift gillnets has symptoms of heteroscedasticity. The test results show the dots resulting from processing between the independent variable and the dependent variable spread over the Y axis and do not have a clear pattern (wavy, widening, then narrowing) in the Scatterplot image, the dots spread above and below the number 0 on the Y axis. It is concluded that this research meets the requirements of the heteroscedasticity test because the independent variables do not show symptoms of heteroscedasticity (Figure 2).

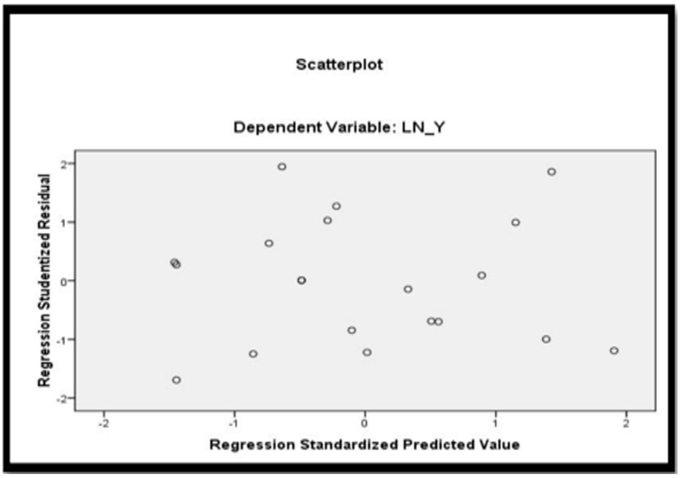

Fig. 2. Scatter plot

3. Multicollinearity test

The multicollinearity test can determine the relationship between independent variables by using a table of statistical coefficients on the VIF value. The multicollinearity test was carried out using SPSS version 16.0. The results of the multicollinearity test can be seen in Table 1.

Tabel 1. Statistical Coefficient

No.	Collinearity Statistics		
	Model (Constant)	**Tolerance**	**VIF**
1.	Ln X_1	0.622	1.608
2.	Ln X_2	0.499	2.003
3.	Ln X_3	0.301	3.324
4.	Ln X_4	0.367	2.722
5.	Ln X_5	0.765	1.308
6.	Ln X_6	0.684	1.462
7.	Ln X_7	0.469	2.134

Based on Table 1 above, the results of the calculations in the multicollinearity test show that almost all of the independent variables do not contain multicollinearity interference so that the regression model is suitable for use. The requirements for the multicollinearity test is value VIF < 10 and tolerance value > 0.100.

4. Autocorrelation test

A good regression equation does not have autocorrelation problems. If autocorrelation occurs then the equation is not good and is not suitable for prediction. The autocorrelation test was carried out using SPSS version 16.0 and can be seen in Table 2 below:

Table 2. Durbin Watson

Number	Durbin Watson	Terms Description
1	1.992	1< DW < 3 Autocorrelation does not occur

From the results of Table 2 above, the Durbin-Watson test value is found to be 1.992 and the condition is that there is no autoscorrelation if the DW value is between values 1 to 3, then with the DW results that have been calculated, namely 1.992, it is indicated that there is no correlation. The calculation of the coefficient of determination (R^2) essentially aims to measure how capable the model is of dependent variation. If the R^2 value is small, the ability of the independent variables to explain variable variations is limited. The magnitude of the influence of the independent variable on the value of the dependent variable can be determined by looking at the determination value from the calculation results using SPSS version 16.0. Based on these calculations, the output can be seen in Table 3 as follows:

Table 3. Coefficient of Determination

Model	No	R	R *Square*	*Adjusted R Square*	*Standard error*
1.	1	0.913a	0.833	0.736	0.079

a. Predictors: (Constant), engine power, mesh size, trip duration, net length, net depth, amount of fuel, boat size
b. Dependent variable: Fishing catch

Based on the dependent variable in Table 3 above, there is a coefficient of determination (R^2) of 0.833 or 83.3% and a correlation coefficient of 0.913. The coefficient of determination value shows that the independent variable used in the model influences 83.3%. Meanwhile, the remaining 16.7% is influenced or explained by other variables not included in this research model. These other factors are thought to include environmental factors or conditions of fishing areas such as weather, fishing season and resource conditions. The standard error of estimation (0.079) measures the level of error of the regression model in predicting the Y value.

The results of the Cobb-Douglas analysis which are tested simultaneously will provide information regarding whether the independent variables have a joint influence on the dependent variable. For more details, see Table 4 as follows:

Table 4. ANOVA table analysis of production function

Source	df	Sum of Squares	Mean squared	F-test	F-table	*P-value*
Regression	7	0.382	0.550	8.540	2.910	0.001
Residual	12	0.77	0.006			
Total	19	0.459				

Based on Table 4 above, it shows that Fcount (8.54) > Ftable (2.91) with a confidence level of 95%. Based on the results of these calculations, the gill net fishing unit (Xi) has a significant influence simultaneously (together) on the catch (Y) of drift gill nets. In partial testing, meaning individually, the t-test is used as a basis for decision-making to see the influence of each production factor variable on catch results.

Table 5. Regression coefficient values and production function T-test

Source	Coefficient	Standard Error	T-test	Sig.
Intercept	3.110	0.863	3.602	0.004
Ln X_1	-0.024	0.139	-0.170	0.868
Ln X_2	0.112	0.790	1.423	0.180
Ln X_3	0.191	0.115	1.658	0.123
Ln X_4	0.105	0.308	0.339	0.740
Ln X_5	-0.479	0.163	-2.943	0.012
Ln X_6	0.251	0.068	3.686	0.003
Ln X_7	-0.339	0.179	-1.892	0.083

T-table with a 95% confidence interval is 2.09

The coefficient value of net depth (X_1) with a coefficient value of -0.024 shows the variable does not affect the catch production of gillnet assuming other variables have a fixed value. However, different from the research of [10], the deeper the net, the more fish can be caught, this makes it more difficult to escape because the net coverage traps the fish quite deeply.

The net length coefficient value (X_2) shows the influence on the production of gillnet catches with a coefficient value of 0.112, which means that every 1 unit of net length (meter) will cause the production of catches to increase by 0.112% assuming the other variables are constant. According to [11], the length of the net determines how much space the fish caught in the net can move, so the longer the net, the greater the chance that the fish will be caught. However, in this study, the effect of net length did not have a significant effect on catch results.

The coefficient value of ship size (X_3) shows that there is an influence on the production of gillnet catches with a value of 0.191, which means that every increase in ship size (GT) affects the catch by 0.191%. During the fishing process, the boat is in a stationary position so that it does not affect fishing operations [12]. In this study, small boats were also able to get more catches compared to large boats.

The coefficient value for the amount of fuel (X_4) shows the influence on the production of gill net catches with a coefficient value of 0.105, which means that every additional 1 liter of fuel will cause the additional production of catches to increase by 0.105%, assuming the other variables are fixed. According to [13], fuel is a very important production factor in the fishing business, because the greater the amount of fuel used, it is hoped that fishermen will have more freedom to go to fishing grounds and get more catches. However, in contrast to this research, the fuel variable itself does not have a real effect on the increase in catch production.

The coefficient for the duration of the trip (X_5) shows the influence on the production of gillnets catches with a coefficient value of -0.479, which means that any time spent at sea will cause the production of the catch to not affect production assuming other variables have a fixed value. This decrease was based on the fact that the trip length variable had been excessive. The increase in trip length showed that it had no real effect on catch results. This is slightly inconsistent with research by [5], which states that fishing time is an important part of a fishing business, therefore the variable trip duration statistically has a real and positive effect on catch results. Other research by [13], stated that the longer the time the net is submerged or the longer the time at sea, the more fish will be caught.

The mesh size coefficient value (X_6) shows the influence on the production of gill net catches with a value of 0.251, which means that each additional mesh size can influence catch results. The addition of every 1-inch mesh will provide an increase of 0.251% in the production of drift gillnet catches. According to [14], stated that the larger the mesh size, the larger the size of the fish caught, and the fewer the number, conversely the smaller the mesh size, the smaller the size of the fish caught but the greater the number. Therefore, the use of small nets must be avoided to minimize the catch of juvenile fish [15]. However, the difference thing with this research is that a large number of mesh sizes are used to provide varying catch results starting from the type and size. The value of the mesh size variable shows a real influence on catch results, which means that the number of types of mesh sizes used will have a real effect on the production of drift gill net catches.

The engine power coefficient value (X_7) also shows an influence on the production of gillnet catches with a value of -0.339, which means that any increase in engine power will not affect the catch. According to [16], the engine power variable does not have much influence on ship speed because the gillnet operates passively which does not require ship movement during fishing operations. Ship movements are usually carried out during the hauling process, where when the ship is moved slowly it will make the process of lifting the net onto the ship easier.

Cobb-Douglass function regression equation on changes in catch production (Y) has the model $\text{Ln}Y = 3.110 – 0.024\ \text{Ln}X_1 + 0.112\ \text{Ln}X_2 + 0.191\ \text{Ln}X_3 + 0.105\ \text{Ln}X_4 – 0.479\ \text{Ln}X_5 + 0.251\ \text{Ln}X_6 – 0.339\ \text{Ln}X_7$. This equation shows that only 4 variables have positive values or in other words have an influence on increasing catches. These four variables are net length, ship size, amount of fuel, and mesh size. However, of these four variables, only the mesh size variable has a real effect. This is following research by [17], where the mesh size variable has a real influence, so the latest Cobb-Douglass function obtained is $\text{Ln}Y = 3.110 + 0.112\ \text{Ln}X_2 + 0.191\ \text{Ln}X_3 + 0.105\ \text{Ln}X_4 + 0.251\ \text{Ln}X_6$.

3.2 Technical and economic efficiency

Technical efficiency analysis focuses on independent variables that have significant values, while the variables that have positive values are net length (X_2), boat size (X_3), amount of fuel (X_4), and mesh size (X_6). The independent variable can be said to have achieved technical efficiency if the EP value = 1, if EP > 1 then the use of the input is not efficient, and if the EP value < 1 then the use of the variable input is also inefficient. Table 6 shows that the variables net length, ship size, amount of fuel, and net mesh size have significant positive values, so the level of technical efficiency is seen based on these four variables. The production elasticity values for net length, ship size, amount of fuel, and mesh size show EP values < 1, which means that the production input variables have not yet reached technical efficiency.

Table 6. Technical efficiency of the drift gillnet

No.	Variable	Average	E.P
1.	Net depth	3 m	-0.024
2.	Net length	117 m	0.112
3.	Boat size	3.4 GT	0.191
4.	Amount of fuel	26 Litres	0.105
5.	Trip duration	6 hours/trip	-0.479
6.	Mesh size	2 inches	0.251

7.	Engine power	25 PKs	-0.339

Viewed from an efficiency perspective, based on Table 6, the technical efficiency of the drift gillnet for production factors, variables of net depth, trip duration, and engine power has a negative production elasticity value (Ep<1) which indicates that the use of production factors is no longer efficient. This means that there has been excessive use of production factors by the drift gillnet fishing unit in its fishing operations during the western season. According to [6], it states that increasing the use of these production factors can result in total production decreasing so to achieve efficiency in the use of these production factors, it is necessary to reduce the use of production factors. Efficiency depends on reducing the amount of resources used, so the use of net depth, trip duration, and engine power needs to be considered.

The production factors for net length, ship size, amount of fuel, and drift gill net size are at the rational production stage because they are between 0<Ep<1, which means that with the use of production factors, the length of nets used by fishermen when fishing is appropriate. and obtain maximum catches without the need to reduce or add production factors. The production factors of vessel size and the average amount of fuel of 3.4 GT and IDR 181,650 used by fishermen at TPI have also entered the appropriate and balanced stage, however, these production factor variables do not have a significant effect on the production of drift gillnet catches. Meanwhile, the variable average mesh size used is 2 inches, which has also entered the appropriate and balanced stage and this variable has a real influence on the amount of catch production. This is also following research conducted by [18], that a mesh size of 2 inches has a real influence on gillnet catches.

Using the Cobb-Douglas production function model with regression coefficient values, apart from showing the elasticity of each variable concerned, the total of the regression coefficient values of the 7 production factor variables is an estimate of the state of the business scale of the ongoing production process. The total production elasticity in the model is 0.659, this shows that the business scale level is on the decreasing return to scale, meaning that the proportion of additional production factors exceeds the proportion of additional production. If too many things are added to the production process, the number of products produced will not increase [19]. This shows the resources used in the fishing process using drift gill net fishing gear.

The analysis of economic efficiency in this research also only focuses on the use of statistically significant variables, namely positive elasticity values, namely the variables net length (X_2), ship size (X_3), amount of fuel (X_4), and mesh size (X_6). The four variables analyzed show that the length of the net, the size of the ship, the amount of fuel, and the mesh size are not economically efficient (NPMxi/BKMxi < 1), the use of input X needs to be subtracted. The estimated results of calculating the economic efficiency of using inputs in the drift gill net fishing unit can be seen in Table 7 below. Economically, efficiency will be achieved in conditions where the price is equal to the value of the marginal product [20]. If the price of each production factor i (Pxi) is the marginal factor cost (BKM) and the marginal product multiplied by the price level of the catch (Y) is the marginal product value (NPM), then the condition of economic efficiency is achieved at NPMxi=BKMxi [8].

Based on Table 7, it can be seen that the use of production factors for drift gillnet fishing units is in an economically inefficient condition. Where the variables net length, ship size, amount of fuel, and mesh size have NPM/BKM values smaller than one. So it is necessary to review how production factors are used during the fishing process so that operational costs can be saved when using them. According to [7], the failure to achieve economic efficiency in the use of production factors causes a tendency for drift net fishermen to not carry out the fishing process. According to [21], weather is also a factor that fishermen consider when facing the western season which causes fishermen not to go to sea. Usually, they will only repair damaged fishing equipment. However, based on interviews, the decline in fish prices from drift gill net catches is also the main reason fishermen do not use gillnets. This is what causes catch production to decrease.

Table 7. Economic efficiency of drift gillnet

Description	**Variables**			
	Net lenght	**Boat size**	**Mesh Size**	**Fuel**
• Average use	117	3	2	181,650
• Elasticity of catch	0.112	0.191	0.251	0.105
• Marginal product	0.009	0.554	1.238	5.705
• Average price of catch (Rp)	30,500	30,500	30,500	30,500
• Value of marginal product (NPM) (Rp)	288.170	16,911.083	37,779.899	174,002.5
• Input prices (BKM) (Rp)	45,833	26,384.375	235,750	181,650
• Economic efficiency index	0.001	0.001	0.166	0.966
Decision	Not efficient	Not efficient	Not efficient	Not efficient

4 Conclusions

The conclusions that can be obtained from this research are: Production factors for fishing using gill nets are depth net (X_1), net length (X_2), ship size (X_3), amount of fuel (X_4), trip time (X_5), mesh size (X_6), and engine power (X_7) simultaneously or together influence the catch (Y). However, partially or individually only the mesh size (X6) has a real influence on the catch (Y). So the formulation obtained from the Cobb-Douglass production factor is $LnY = 3.110 + 0.112\ LnX_2 + 0.191\ LnX_3 + 0.105\ LnX_4 + 0.251\ LnX_6$.Technical efficiency in the variables net length, ship size, amount of fuel and mesh size is at a production elasticity of $0<Ep<1$ which states that these variables are inefficient. Meanwhile, the economic efficiency of the variables net length, ship size, amount of fuel, and mesh size is at a value of NPM/BKM < 1, where the use of input X is not efficient. To achieve efficiency, the use of input X needs to be reduced.

References

1. Muhtarom, A. J. Penelitian Ekonomi dan Akuntansi (JPENSI), **2**, 1-15 (2017)
2. Lasabuda, R. J. Ilmiah Platax, **1**, 92-101 (2013)
3. Diana, F., M. Rizal. J. Perikanan Tropis, **3**, 153 (2016)
4. Dinas Kelautan, Perikanan dan Pangan Kabupaten Nagan Raya (Dinas Kelautan Perikanan dan Pangan, Nagan Raya, 2022)
5. Sukiyono, K., Romdhon, M. M. IJFST, **11**, 99-104 (2016)
6. Aprilla, R.M., Mustaruddin, E.S. Wiyono, N. Zulbarnaini. J. Teknologi Perikanan dan Kelautan, **4**, 9-20 (2013)
7. Soekartawi, Teori ekonomi produksi dengan pokok bahasan analisis fungsi Cobb-

Douglas (Raja Grafindo Persada, Jakarta, 1994)
8. Soekartawi, Prinsip ekonomi pertanian (Rajawali Press, Jakarta, 2003)
9. Nicholson W, Teori Mikro Ekonomi, Prinsip Dasar dan Perluasan (BinaRupa Aksara, Jakarta, 1995)
10. Pratama, M. A. D., T. D. Hapsari, I. Triarso. Jurnal Saintek Perikanan, **11**, 120-128 (2016)
11. Kurnia, D. R., P. Sukardi, A.Iqbal. Marlin, **2**, 131-140 (2021)
12. Aji, I.N., B. A. Wibowo, Asriyanto. J. of Fisheries Resources Utilization Management and Technology, **2**, 50-58 (2013)
13. Widiyanto, A.T., P. Pramonowibowo, I. Setiyanto. J. of Fisheries Resources Utilization Management and Technology, **5**, 19-26 (2016)
14. Irpan, A., D. Djunaidi, R. Hertati. SEMAH Jurnal Pengelolaan Sumberdaya Perairan, **2**, 12-15 (2018)
15. Fachrudin., H. Hudring, Identifikasi jaring insang (gillnet) (Balai Besar Pengembangan Penangkapan Ikan, Jakarta, 2012)
16. Muna, N., B.Ismail, B. Jayanto. J. of Fisheries Resources Utilization Management and Technology, **5**, 38-47 (2016)
17. Putri, V.L, F. Khuromah, A. D. P. Fitri. Indonesian Journal of Fisheries Science and Technology, **13**, 126-132 (2018)
18. Anggrayni, F. D., M. Zainuri. J. Ilmiah Kelautan dan Perikanan, **3**, 85-92 (2022)
19. Damayanti, H. O. Jurnal Litbang, **12**, 83-92 (2016)
20. Lestari, H. S., E. Lisarini, A.S. Alam, R.T.D. Jatmika. J. of Agricultural Sciences and Veteriner, **10**, 260-268 (2022)
21. Tiro, A. R., M. Irianti. Jurnal Abdimasa Pengabdian Masyarakat, **6**, 59-64 (2023)