International Journal of Economic Research

ISSN : 0972-9380

available at http: www. serialsjournal.com

Volume 14 • Number 10 • 2017

The Cobb-Douglass Production Function Model on Trawling Fishermen in Probolinggo, East Java

Mimit Primyastanto

Lecturer at Faculty of Fisheries and Marine Sciences of Brawijaya University, Indonesia
E-mail: mimitp@ub.ac.id and mimitprimyastanto@gmail.com

Abstract: This research was conducted in the city of Probolinggo, East Java. The aims of this research were to analyze the production factors that affected the production from trawling fishermen, as well as the performance of the fish-catching enterprise and profit-sharing system of trawling fishermen. The sampling technique used was simple random sampling with 44 trawling fishermen as respondents. This research utilized quantitative research. Data sources were made up of primary and secondary data. Data collection was performed through observation, interviews, documentation, and questionnaires. The kinds of data used were descriptive qualitative data and descriptive quantitative data. Analysis of the data utilized the Cobb-Douglass production function model analysis and enterprise performance analysis. Using a regression analysis with the Cobb-Douglass production function model, the equation :

$$Y = -25.78\ X1^{0.938}\ X2^{-0.319}\ X3^{-0.646}\ X4^{1.050}\ X5^{1.467}\ X6^{1.731}\ X7^{-1.179}\ X8^{0.171}\ X9^{0.502} e^{u}$$

was obtained. Production factors (education, experience, age, capital flow, trips, distance, crew, bag length, and ship carrying capacity) had real influence on the catch from trawling fishermen. Enterprise performance analysis showed that catching fish with trawls was feasible and profitable since the R/C value was at 1.9. Profit was measured at IDR 794,888,738, while earnings were at 89 %, and BEP unit value was 9,457 kg.The profit-sharing system that is implemented by trawling fishermen in the city of Probolinggo, which splits 50 % of the net profit for the ship owner or owner of the trawling ship and 50 % of the remaining net profit for the entire crew of a ship. Certain crew members that double as or take up certain positions stand to earn additional wages. A captain would receive double, one part for being a crew member and another for being the captain. An engineer would receive one and a half, one part for being a crew member and the remaining for being the engineer. This works out as follows: Net profit: IDR 794,888,738. Ship owner receives 50 %: IDR397,444,369. Crew receives 50 %, divided thusly: Captain receives 1 × 2/ (8.5) × IDR 397,444,369 = IDR 93,516,322 Engineer receives 1 × (1.5)/ (8.5) × IDR 397,444,369 = IDR 70,137,2425 other crew members receive 5 × 1/ (8.5) × IDR 397,444,369 = IDR 93,516,322 (IDR 46,758,161 each)

Keywords: Cobb-Douglass Production Function Model, Enterprise Analysis, Profit-Sharing System, Trawling, Fishermen

1. INTRODUCTION

Facts show that Indonesia is the largest archipelagic country in the world with 17,504 islands, a coastline stretching 81,000 km and 5.7 million km^2 of water, which makes up 62 % of its territory. This wide expanse of coastlines and seas contain a great amount of resources that have not been optimally utilized as development potential. As the world population grows, demand for fishery products whether from domestic or international markets are estimated to increase further (Dahuri *et al.*, 2001 in Tajerin *et al.*, 2007). Thus, one of the sources of growth that can lead to further development in this country and will allow escape from an economic crisis is the fishery sub-sector.

According to Cholik. F. (2006), the utilization of fishery production resources is divided between two groups, which are sea fishery production and general fishery production. Up to 2005, the percentage of sea fishery production still showed around 70 %. At 4,653,010 tons, the catch for sea fishery production is still far greater than the 312,000 tons caught for general fishery production. This shows that the potential for fishery resources from general fishery has not been optimally utilized. Its utilization can be in the form of catching, farming, and using cages and floating nets.

A certain study or analysis needs to be done on trawling fishermen in regard to the use of trawls. A study of the production factor aspect would be one that is related to the use of trawls to catch fish, which is also related to the technical production factors which affect catch results. By understanding and considering those factors, it is expected that the use of trawls to catch fish in the city of Probolinggo will result in optimal catch and benefit the fishermen. Because of the expanded business opportunity that results from the use of trawls, the conservation of maritime resources in Probolinggo also needs to be considered so that massive exploitation of maritime resources and overfishing does not occur.

The goal for this research is to analyze the production factors that affect the production from trawling fishermen, as well as to analyze the performance of the fish-catching enterprise and profit-sharing system of trawling fishermen at the Mayangan Fish Port of the city of Probolinggo.

2. RESEARCH METHODS

This research was conducted in Probolinggo. The sampling technique used in this research was random sampling where respondents were selected in a random manner (Arikunto, S. 2006). The sample size used in the research was determined using the Slovin formula and 44 respondents were obtained out of a population of 2,282 people.

The data obtained in this research was composed of primary data obtained through interviews with respondents and questionnaires. Secondary data came in the form of literature review and documents from the Mayangan sub-district.

Descriptive qualitative analysis was performed to understand the condition of Mayangan sub-district and the characteristics of trawling fishermen, and descriptive quantitative analysis was performed using the Cobb-Douglass production function model (Soekartawi, 2003) and multiple linear regression to find out the influence of production factors on trawling fishermen, as well as performance analysis to find out the feasibility of the fish-catching enterprise and profit-sharing system of trawling fishermen (Campbell and Lindner, 1990).

3. RESULTS AND DISCUSSION

3.1. Classical Assumptions Testing

Normality Test

Normal P-P Plot of Regression Standardized Residual

Dependent Variable : Ln Hasil Produksi

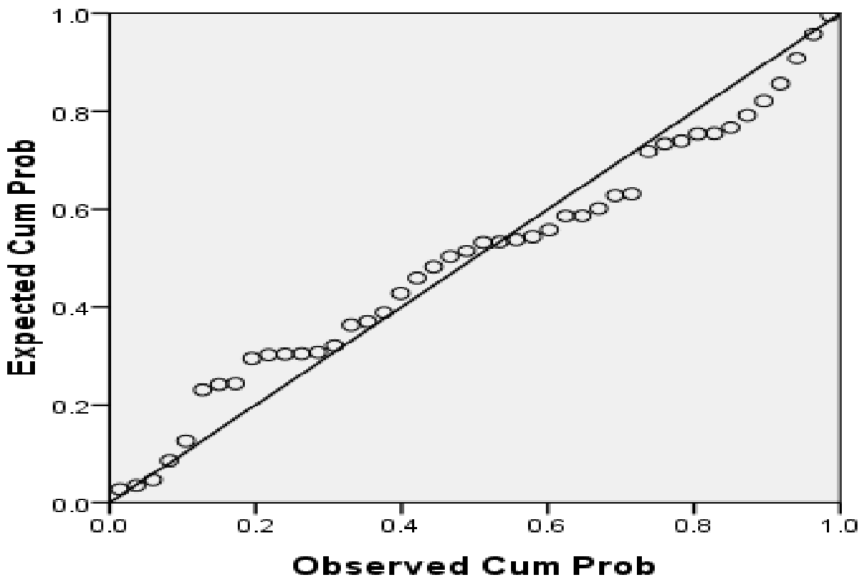

Figure 1: Graph of the Normality Test for Production Factors

Based on the graph, the spread of data from production variables are spread out in a straight line that approaches the upper-right. Therefore, the results of the data analysis show that normality is met.

Table 1
Results of the Kolmogorov-Smirnov Test

		Unstandardized Residual
N		44
Normal Parameters[a]	Mean	.0000000
	Std. Deviation	.34508536
Most Extreme Differences	Absolute	.090
	Positive	.081
	Negative	-.090
Kolmogorov-Smirnov Z		.598
Asymp. Sig. (2-tailed)		.866

a. Test distribution is Normal.
Source: Primary Data

Based on the results, the Kolmogorov-Smirnov Test indicated a Sig value of 0.866. Since it is larger than the trust threshold (α) of 0.05, it can be concluded that the assumption of normality is met.

Table 2
Multicollinearity Test of Production Factors

Variable	*Collinearity Statistics*	
	Tolerance	*VIF*
(Constant)		
Education	.611	1.637
Experience	.406	2.460
Age	.428	2.338
Capital Flow	.516	1.937
Trip	.155	6.455
Distance	.152	6.560
Crew	.581	1.721
Bag Length	.402	2.490
Ship Carrying Capacity	.567	1.762

Source: Primary Data

Based on the table above, the tolerance value for each independent variable used in the research were greater than 0.10 and the VIF values were less than 10 (Priyatno, Duwi. 2008). It can be said that the regression equation used in this research is free from multicollinearity.

Autocorrelation Test

To check whether there is autocorrelation or not, the Durbin-Watson method can be used with these conditions:

- 1.65 < DW < 2.35 : no autocorrelation
- 1.21 < DW < 1.65 : inconclusive
- DW < 1.21 or DW > 2.79 : autocorrelation

Table 3
Model Summary (b)

Model	*R*	*R Square*	*Adjusted R Square*	*Std. Error of the Estimate*	*Durbin-Watson*
1	.941	.885	.854	.38808	1.660

(a) Predictors: (Constant), Education, Experience, Age, Capital Flow, Trip, Distance, Crew, Bag Length, Ship Carrying Capacity
(b) Dependent Variable: Productivity
Source: Primary Data

From the above analysis, the Durbin-Watson value was found to be 1.660. It follows that there is no autocorrelation, since the DW value is between 1.65 and 2.35.

Table 4
Results of the Heteroskedasticity Test for Production Factors

Model	*t*	*Sig.*
(Constant)	-3.945	.000
Education	2.775	.009
Experience	-2.091	.044
Age	-2.193	.035
Capital Flow	4.396	.000
Trip	2.097	.043
Distance	4.607	.000
Crew	2.174	.037
Bag Length	2.068	.046
Ship Carrying Capacity	2.239	.032

a. Dependent Variable: Abs Residual

Source: Primary Data

From the previous table, the Sig values were less than 0.05. As such, from the above data it can be concluded that that the parameter coefficient is significant and there is no heteroskedasticity.

Table 5
Results of the Regression Analysis

Model	*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*
	B	*Std. Error*	*Beta*		
(Constant)	-25.778	6.534		-3.945	.000
Education (X_1)	.938	.338	.207	2.775	.009
Experience (X_2)	-.319	.152	-.191	-2.091	.044
Age (X_3)	-.646	.295	-.194	-2.193	.035
Capital Flow (X_4)	1.050	.239	.356	4.396	.000
Trip (X_5)	1.467	.700	.310	2.097	.043
Distance (X_6)	1.731	.376	.687	4.607	.000
Crew (X_7)	-1.179	.542	-.166	2.174	.037
Bag Length (X_8)	.171	.083	.190	2.068	.046
Ship Carrying Capacity (X_9)	.502	.224	.173	2.239	.032

Source: Primary Data

The equation below is used:

$Y = \alpha .X1^{b1}\ X2^{\ b2}\ X3^{\ b3}\ X4^{\ b4}\ X5^{\ b5}\ X6^{\ b6}\ X7^{\ b7}\ X8^{\ b8} X9^{\ b9} e^{u}$

And this becomes:

$Y = -25.78\ X1^{0.938} X2^{-0.319} X3^{-0.646} X4^{1.050} X5^{1.467} X6^{1.731} X7^{-1.179} X8^{0.171} X9^{0.502} e^{u}$

The value α = -25.778 is the constant that shows how large the value of is without the influence of the variables of education (X_1), experience (X_2), age (X_3), capital flow (X_4), trips (X_5), distance (X_6), crew (X_7), bag length (X_8), and ship carrying capacity (X_9). This means that without these variables, productivity trawling fishermen does not become larger or smaller.

The value b_1 = 0.938 is the coefficient of education (X_1) which shows that if the fishermen become more educated by 1 %, there would be a significant increase in productivity from trawling fishermen by 0.938 %, with the assumption that the other independent variables remained equal or *ceteris paribus*. According to the research by Primyastanto. M, *et al.* (2013a), with increased education, fishermen become more capable in financial management, increasing their income and decreasing their spending.

The value b_2 = -0.319 is the coefficient of experience (X_2) which shows that if the experience of fishermen is elevated by 1 %, there would be a significant decrease in productivity from trawling fishermen by -0.319 %, with the assumption that the other independent variables remained equal or *ceteris paribus*. This is appropriate considering that the experience of trawling fishermen in Mayangan is still lacking at only 1-10 years. According to Primyastanto, M.*et al.*(2013b), the more experience that a fisherman has, the more capable the fisherman is in determining signs or characteristics of fishing ground that contains more resources, so that this would result in a greater catch. In addition, fishermen with greater experience can recognize the signs of bad weather and avoid its repercussions.

The value b_3 = -0.646 is the coefficient of age (X_3) which shows that if the age of fishermen is greater by 1 %, there would be a significant decrease in productivity from trawling fishermen by -0.646 %, with the assumption that the other independent variables remained equal or *ceteris paribus*. This is appropriate considering that trawling fishermen in Mayangan is dominated by young fishermen of 20-25 years. However, fishermen who are too old can cause a decrease in fishermen income. Still, fishermen who are too old are kept around for the reason that their experience is still reliable.

The value b_4 = 1.050 is the coefficient of capital flow (X_4) which shows that if the capital flow of fishermen are increased by 1 %, there would be a significant increase in productivity from trawling fishermen by 1.050 %, with the assumption that the other independent variables remained equal or *ceteris paribus*. According to a study by Heryansyah (2013), capital significantly affects fishermen productivity. This means the more that fishermen spend on their catch, the greater their productivity would be.

The value b_5 = 1.467 is the coefficient of trips (X_5) which shows that if fishermen make 1 % more trips, there would be a significant increase in productivity from trawling fishermen by 1.467 %, with the assumption that the other independent variables remained equal or *ceteris paribus*. A study by Rachman. S,*et al.* (2013) showed that the greater the frequency of trips made by fishermen to make their catch, the more of the catch they would make.

The value b_6 = 1.731 is the coefficient of distance (X_6) which shows that if fishermen increase their fishing distance by 1 %, there would be a significant increase in productivity from trawling fishermen by 1.731 %, with the assumption that the other independent variables remained equal or *ceteris paribus*. According to a study by Heryansyah (2013), distance significantly affects fishermen productivity. This means the farther fishermen go to make their catch, the greater their productivity would be.

The value b_7 = -1.179 is the coefficient of crew (X_7) which shows that if fishermen have a larger crew by 1 %, there would be a significant decrease in production results from trawling fishermen by -1.128 %, with the assumption that the other independent variables remained equal or *ceteris paribus*. This is appropriate considering that the typical fishermen crew exceeds eight people on a ship. The more crew there is on a ship, the less productive fishermen would be, and thus the less their income would be, because of the increased profit sharing.

The value b_8 = 0.171 is the coefficient of bag length(X_8) which shows that if the length of the trawl bags were increased by 1 %, there would be a significant increase in productivity from trawling fishermen by 0.171 %, with the assumption that the other independent variables remained equal or *ceteris paribus*. A study by Primyastanto, M.*et al.* (2013c) showed that the longer the bag on the fishing device, the greater area is covered. Thus there would be a greater chance of catching larger schools of fish.

The value b_9 = 0.502 is the coefficient of ship carrying capacity (X_9) which shows that if the capacity of trawling ships is increased by 1 %, there would be a significant increase in productivity from trawling fishermen by 0.502 %, with the assumption that the other independent variables remained equal or *ceteris paribus*. This is because the more that a ship can carry, the greater the catch that can be carried by the ship. Fishermen do not return before they have filled their ships to capacity (Primyastanto, M. 2014)

The value e is the error term or other beyond human control that can affect the trawling fishery enterprise such as weather conditions, waves, and natural disasters.

3.2. Statistical Testing

Table 6
Coefficient of Determination values for Production Factors

Model	R	R *Square*	*Adjusted* R *Square*	*Std. Error of the Estimate*	*Durbin-Watson*
1	.941	.885	.854	.38808	1.660

a) Predictors: (Constant), Education, Experience, Age, Capital Flow, Trip, Distance, Crew, Bag Length, Ship Carrying Capacity
b) Dependent Variable: Productivity
Source: Primary Data

Based on this table, the Adjusted R Square showed a value of 0.854. This means the independent variables of education (X_1), experience (X_2), age (X_3), capital flow (X_4), trips (X_5), distance (X_6), crew (X_7),

Table 7
F-Test Values

Model	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Regression	39.296	9	4.366	28.991	.000***
Residual	5.121	34	.151		
Total	44.416	43			

a) Predictors: (Constant), Education, Experience, Age, Capital Flow, Trip, Distance, Crew, Bag Length, Ship Carrying Capacity
b) Dependent Variable: Productivity
Source: Primary Data

bag length (X_8), and ship carrying capacity (X_9) affected the productivity of trawling fishermen by 85 %. The remaining 15 % is influenced by other variables outside of the independent variables, including weather conditions, waves, and natural disasters.

Based on this table, the F-count value was fund to be 28.991 with an F-count sig. of 0.000. In order to obtain the F-table value, a statistics table was used; the df value was 9 and the residual value was 34, so the F-table value was 2.97. It can be seen that the F-count value (28.991) is larger than the F-table value (2.97) or significant by (0.00) less than α (0.05).

Table 8
t-Test Values

Variable	*t-count*	*t-table*	*Sig.*	*Notes*
Education (X_1)	2.775	1.697	0.009***	Significant
Experience (X_2)	-2.091	1.697	0.044**	Significant
Age (X_3)	-2.193	1.697	0.035**	Significant
Capital Flow (X_4)	4.396	1.697	0.000***	Significant
Trips (X_5)	2.097	1.697	0.043**	Significant
Distance (X_6)	4.607	1.697	0.000***	Significant
Crew (X_7)	-2.174	1.697	0.037**	Significant
Bag Length (X_8)	2.068	1.697	0.046**	Significant
Ship Carrying Capacity (X_9)	2.239	1.697	0.032**	Significant

Source: Primary Data
Remarks:
***: significant to 99%
**: significant to 95%
*: significant to 90%

Based on the results of this table, which is the output of the regression model, the following can be explained below.

(a) The Effect of Education (X_1) on Trawling Fishermen Productivity (Y).
Based on partial data analysis, the t-count value for education (X_1) for trawling fishermen productivity was 2.775. As such it can be concluded that the t-count (2.775) is greater than the t-table (1.697) which means that H_0 is rejected and H_1 is accepted, and thus the variable of education (X_1) significantly affects, in partial, the dependent variable of trawling fishermen productivity (Y). This leads to the conclusion that the productivity of trawling fishermen is much determined by the education of the fishermen. Education affects trawling fishermen productivity significantly because the more educated fishermen are, the more information they will obtain. The implication is that education must be more prioritized to develop talent, knowledge, and skills of fishermen in catching fish (Primyastanto, M. 2015)

(b) The Effect of Experience (X_2) on Trawling Fishermen Productivity (Y).
Based on partial data analysis, the t-count value for experience (X_2) for trawling fishermen productivity was -2.091. As such it can be concluded that the t-count (-2.091) is less than the t-table (1.697) which

means that H_0 is accepted and H_1 is rejected, and thus the variable of experience (X_2) significantly affects, in partial, the dependent variable of trawling fishermen productivity (Y). This leads to the conclusion that fishermen experience affects the fish-catching enterprise. The implication is that fishermen experience is needed so that fishermen can understand where to find potential areas for catching fish.

(c) The Effect of Age (X_3) on Trawling Fishermen Productivity (Y).

Based on partial data analysis, the t-count value for age (X_3) for trawling fishermen productivity was -2.193. As such it can be concluded that the t-count (-2.193) is less than the t-table (1.697) which means that H_0 is accepted and H_1 is rejected, and thus the variable of age (X_3) significantly affects, in partial, the dependent variable of trawling fishermen productivity (Y). This leads to the conclusion that fishermen age affects the fish-catching enterprise. The implication is that the older the fishermen become, the lower the income for trawling fishermen will be, since they will no longer be at a productive age (Eide *et al*, 2003).

(d) The Effect of Capital Flow (X_4) on Trawling Fishermen Productivity (Y).

Based on partial data analysis, the t-count value for capital flow (X_4) for trawling fishermen productivity was 4.396. As such it can be concluded that the t-count (4.396) is greater than the t-table (1.697) which means that H_0 is rejected and H_1 is accepted, and thus the variable of capital flow (X_4) significantly affects, in partial, the dependent variable of trawling fishermen productivity (Y). This leads to the conclusion that the productivity of trawling fishermen is much determined by the capital that fishermen spend. Capital affects fishermen production significantly because the more capital is spent, the greater the productivity will be.

(e) The Effect of Trips (X_5) on Trawling Fishermen Productivity (Y).

Based on partial data analysis, the t-count value for trips (X_5) for trawling fishermen productivity was 2.097. As such it can be concluded that the t-count (2.097) is greater than the t-table (1.697) which means that H_0 is rejected and H_1 is accepted, and thus the variable of trips (X_5) significantly affects, in partial, the dependent variable of trawling fishermen productivity (Y). This leads to the conclusion that the productivity of trawling fishermen is much determined by the trips that fishermen make. Trips affect fishermen production significantly because the more trips they make, the more they will catch. There are trawling fishermen that go on trips that last only three to four days, while others may go for one week. The length of the trip itself is affected by the catch as well as the weather and waves. Fishermen that catch more in a short time will make quick returns to sell their catch (Panayotou, T. 1985).

(f) The Effect of Distance (X_6) on Trawling Fishermen Productivity (Y).

Based on partial data analysis, the t-count value for distance (X_6) for trawling fishermen productivity was 4.607. As such it can be concluded that the t-count (4.607) is greater than the t-table (1.697) which means that H_0 is rejected and H_1 is accepted, and thus the variable of distance (X_6) significantly affects, in partial, the dependent variable of trawling fishermen productivity (Y). This leads to the conclusion that the productivity of trawling fishermen is much determined by how far fishermen go out to sea. Distance affects fishermen production significantly because the farther they go out to sea, the more they will catch. The implication is that to determine how far to go, fishermen have to determine the fishing grounds first. Mayangan fishermen on average venture as far as Gili Island in the Madura Strait because of the abundant fishery resources there (Primyastanto, 2016).

(g) The Effect of Crew (X_7) on Trawling Fishermen Productivity (Y).
Based on partial data analysis, the t-count value for crew (X_7) for trawling fishermen productivity was -2.174. As such it can be concluded that the t-count (-2.174) is less than the t-table (1.697) which means that H_0 is accepted and H_1 is rejected, and thus the variable of crew (X_3) does not significantly affect, in partial, the dependent variable of trawling fishermen productivity (Y). This leads to the conclusion that the productivity of trawling fishermen is influenced by the crew size. The implication is that the greater the crew size, the less the productivity will be. Income will also decrease due to greater profit sharing.

(h) The Effect of Bag Length (X_8) on Trawling Fishermen Productivity (Y).
Based on partial data analysis, the t-count value for bag length (X_8) for trawling fishermen productivity was 2.068. As such it can be concluded that the t-count (2.068) is greater than the t-table (1.697) which means that H_0 is rejected and H_1 is accepted, and thus the variable of bag length (X_8) significantly affects, in partial, the dependent variable of trawling fishermen productivity (Y). This leads to the conclusion that the productivity of trawling fishermen is much determined by the length of the bag that fishermen use on their trawls. The implication is that the longer the bag of the trawl, the more fish will be caught (Rania, A.F. *et al*, 2015).

(i) The Effect of Ship Carrying Capacity (X_9) on Trawling Fishermen Productivity (Y).
Based on partial data analysis, the t-count value for bag length ($_{X8}$) for trawling fishermen productivity was 2.393. As such it can be concluded that the t-count (2.393) is greater than the t-table (1.697) which means that $_{H0}$ is rejected and $_{H1}$ is accepted, and thus the variable of ship carrying capacity ($_{X9}$) significantly affects, in partial, the dependent variable of trawling fishermen productivity (Y). This leads to the conclusion that the productivity of trawling fishermen is much determined by the carrying capacity of the ships that fishermen use. The implication is that the greater the carrying capacity of the ships, the more fish that can be held in the ship (Hoff and Frost, 2008)

3.3. Enterprise Performance Analysis

Table 9
Costs and Capital (1 year)

No.	*Type of Value*	*Value (in Rp.)*
1.	Fixed Capital	475,370,000
2.	Depreciation	29,449,500
3.	Fixed Costs	38,049,500
4.	Variable Costs	850,680,000
5.	Total Cost	888,729,500

Table 10
Enterprise Performance Analysis (1 year)

No.	*Type of Value*	*Value*
1.	Income	Rp. 1,704,000,000
2.	R/C Ratio	1.9
3.	Profit	Rp. 794,888,738
4.	Earnings	89%
5.	BEP	
	• BEP Unit	9,457 Kg
	• BEP Sales	Rp 56,790,298

3.4. Profit-Sharing System for Fishermen

The profit-sharing system that is implemented by trawling fishermen in the city of Probolinggo, which splits 50 % of the net profitfor the ship owner or owner of the trawling ship and 50 % of the remaining net profit for the entire crew of a ship. Certain crew members that double as or take up certain positions stand to earn additional wages. A captain would receive double, one part for being a crew member and another for being the captain. An engineer would receive one and a half, one part for being a crew member and the remaining for being the engineer. This works out as follows:

Net profit: IDR 794,888,738

Ship owner receives 50 %: IDR397,444,369

Crew receives 50 %, divided thusly:

Captain receives 1 × 2/ (8.5) × IDR 397,444,369 = IDR 93,516,322

Engineer receives 1 × (1.5)/ (8.5) × IDR 397,444,369 = IDR 70,137,242

5 other crew members receive 5 × 1/ (8.5) × IDR 397,444,369 = IDR 93,516,322

(IDR 46,758,161 each)

4. CONCLUSION AND SUGGESTIONS

4.1. Conclusion

Based on the research, the following can be concluded:

1. Based on a regression analysis with the Cobb-Douglass production function model the equation of

   $$Y = -25.78\, X1^{0.938} X2^{-0.319} X3^{-0.646} X4^{1.050} X5^{1.467} X6^{1.731} X7^{-1.179} X8^{0.171} X9^{0.502} e^{u}$$

   was obtained. Statistical testing on the regression equation model showed that the nine production factors of education, experience, age, capital flow, trips, distance, crew, bag length, and ship carrying capacity have a real influence toward the catch of trawling fishermen. This means adjustments to the aforementioned nine production factors can increase fishing productivity.

2. Enterprise performance analysis on trawling fishery can be said to be profitable because of the revenue to cost ratio which is greater than 1 (1.9), profit (IDR. 794,888,738), earnings (89%),

and BEP unit value (9,457 kg). The profit sharing system, which splits 50% each of the profits to the ship owner and crew, is further adjusted for the crew members, which receive different amounts based on their positions.

4.2. Suggestions

Based on the research, it is suggested that:

1. Trawling fishermen in the city of Probolinggo should increase their knowledge of science and technology in order to modify trawls to be more environmentally friendly.
2. The local government, in particular the Maritime and Fishery Service, should talk to, advise, and train fishermen in catching fish.
3. Scholars should conduct further research on production factors of fishermen with other fishing devices such as seines and gill nets.

5. ACKNOWLEDGEMENTS

We thank three anonymous referees whose comments on the submitted draft proved most useful. Funding to pay the Open Access publication charges for this article was provided by the Faculty of Fisheries and Marine Sciences of Brawijaya University and DIKTI.

REFERENCES

Arikunto, S. (2006), *Prosedur Penelitian Suatu Pendekatan Praktik*. PT. RinekaCipta. Jakarta.

Dahuri *et al.,* (2001), *dalam* Tajerin *et al.*, 2007. *Keterkaitan Sektor Perikanan Dalam Perekonomian Indonesia: Pendekatan Model Input-Output*. Jurnal Kebijakan dan Riset Sosial Ekonomi Kelautan dan Perikanan. Vol.2 No.1, 2007.

Campbell, H.F. and Lindner, R.K. (1990), *The production of fishing effort and the economic performance of licence limitation programs,* Land Economics, 66 : 56-66.

Cholik, Fuad *et al.*, (2006), *60 Tahun Perikanan Indonesia*. Masyarakat Perikanan Nusantara. Jakarta: 360 hlm; 21 Cm.

Eide, A., Skjold, F. Olsen, F. and Flaten, O. (2003), *Harvest functions : the Norwegian bottom trawl cod Fisheries*. Marine Resource Economics, 18: 81-94.

Heryansyah, (2013), *Analisis Faktor-Faktor yang Mempengaruhi Produksi Nelayan Di Kabupaten Aceh Timur.* Jurnal Ilmu Ekonomi Pascasarjana Universitas Syiah Kuala. Volume 1, No. 2, Mei 2013. ISSN 2302-0172.

Hoff, A. and Frost, H. (2008), *Modelling combined harvest and effort regulations the case of Dutch beam trawl fishery for place and sole in the North Sea.* ICES Journal of Marine Science, 65 : 822-831.

Panayotou, T., (1985), *Production Technology and Economic Efficiency: A conceptual framework.*(ed. T. Panayotou) Small-scale fisheries in Asia. Ottawa, Canada, IDRC.

Primyastanto, M. (2012a), *Policy (Kebijakan) Pengelolaan SDI (Sumberdaya Ikan) Pada Perikanan Over Fishing (Lebih Tangkap). Aplikasi Teori Ekonomi Produksi Perikanan*. Cetakan Pertama. Elektronik Pertama danTerbesar di Indonesia. Malang.

Primyastanto, M., Soemarno. Anthon Efani dan Sahri Muhammad. (2012b), *Kajian Ekonomi Rumah Tangga Nelayan Payang di Selat Madura, Jawa Timur*. Wacana vol. 15, No.2. 2012.

Primyastanto, M, Soemarno, Efani A. dan M .Sahri, (2013a), *Faktor yang Berpengaruh terhadap Pendapatan dan Pengeluaran Nelayan payang Jurung di Selat Madura.* Jurnal Wacana. ISSN :1411-0199, E-ISSN : 2338-1884, Vol. 16, No. 1 (2013).

Primyastanto, M, Soemarno, Efani A. and M. Sahri, (2013b), *Economics of Household Analysis and Influence on Poverty of Payang Fisherman at Madura Strait***.** International Journal of Innovetive Social Sciences & Humanities Research Vol 1 No. 1, 2013, Seahi Publications. p. 43-51.

Primyastanto, M, Soemarno, Efani A. and M .Sahri, (2013c), *A Study of Household Economics on Small Scale Fisheries at Madura Strait***.** International Journal. *European Journal of Economics and Development,* Bell Press.Vol 10, 2013. ISSN (online) 2668-3466.p. 95-101.

Primyastanto, M. Soemarno, Efani A. M .Sahri, and Zainal. A. (2014), *Study on Entrepreneurship Spirit and Production Factors Affecting Sail Income of Madura Strait Fishermen*Jurnal International Journal of Civil & Enviromental Engineering IJCEE/IJENS. ISSN : 2077-1258 (online) 2227-2763 (Print). Vol.14, No.01. 2014.

Primyastanto, M, (2015), *Economic Analysis of Pandega Fishermen Household At Madura Strait to Keep Food Security*. International Journal of Oceans and Oceanography ISSN 0973-2667 Volume 9, Number 2 (2015), pp. 97-104.

Primyastanto, M, (2016), *Effect the usage of axle and second ship helper on fish capture of purse seine fishermen in Banyuwangi District, Indonesia***.** Asian Journal of Microbiology, Biotechnology and Enviromental Sciences. ISSN 0973-2667 Volume 18, Number 2 (2016), pp. 297-303.

Priyatno, Duwi. (2008), *5 Jam Belajar Olah Data Dengan SPSS 17*. Andi Yogyakarta: Jogjakarta.

Rachman, S. Purwanti, P. Primyastanto, M. (2013), *Analisis factor produksi dan kelayakan usaha Alat tangkap payang di Gili ketapang kabupaten Probolinggo Jawa Timur.*Jurnal ECSOFiM Vol. 1 No. 1, 2013.

Rania, A.F. Efani A. and Primyastanto. M. (2015), *Model Fungsi Produksi Cobb-Douglass Pada Nelayan Cantrang Di Probolinggo, Jawa Timur.* Skripsi. Tidak dipublikasikan. FPIK UB, Malang.

Soekartawi. (2003*), Teori Ekonomi Produksi.* PT. Raja Grafindo Perkasa. Jakarta.