Analysis factors affecting the production of tilapia pond cultivation (case: Belawan Sicanang Village, Medan Belawan District, Medan City)

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Abstract. Aquaculture is the activity of maintaining and harvesting fish production in a controlled environment. The method for cultivating fish in each region varies based on the conditions in the area. The way to cultivate it will affect the production results that will be obtained. This study aims to analyse the factors that influence the results of tilapia pond production in the research area. Cobb-Douglass function analysis is a data analysis method used in this study. This study shows that the number of seeds, feed, labour, maintenance time simultaneously has a significant effect on tilapia production in the study area. But the number of seeds only partially has a significant effect on tilapia production in the study area, while the factors of feeding, labour, and maintenance time do not have a significant effect.

1. Introduction
Indonesian fisheries development is an activity in the effort to develop fisheries for areas that have potential. Within the scope of fisheries, it consists of two resources, namely freshwater fishery resources and sea water fishery resources. Freshwater fisheries can be cultivated in many areas, both in ponds, in rice fields, and in cages. Every year fishery production in Indonesia from 2015-2018 has increased, namely in 201, amounting to 5,363,274.08 tons, in 2016 with a production growth rate of 5.24% amounting to 5,644,326.81 tons, in 2017 with a production growth rate 8.51% in the amount of 6,124,522.80 tons, and in 2018 with a production growth rate of 1.93% in the amount of 6,242,846.00 tons [1-3].

Tilapia (Oreochromis niloticus) is a fish that is very popular with the community because it has a delicious taste of meat and high protein, so that tilapia has a high economic value in society as a public consumption. The increasing demand for fish certainly has a positive meaning for fisheries development, especially for an archipelagic country like Indonesia which has a large enough potential and potential for fisheries development, both catching and aquaculture. Crab production has decreased continuously from 2014 to 2017. This study aims to analyse the strategy for developing a mud crab enlargement business, which is expected to increase crab production in Belawan Sicanang Village, Medan Belawan [4-7].

The condition of the level of tilapia production every year has increased, although not so high. This is thought to be the result of the use of production factors for tilapia aquaculture farmers. The purpose of this study was to analyse what are the factors that influence the production yield in cultivating tilapia fish ponds in Belawan Sicanang Village. The purpose of this study was to analyse the factors...
that influence the production in cultivating tilapia ponds in Belawan Sicanang Village.

2. Materials and methods

The method used to analyse data in measuring the factors that influence the production of tilapia in Sicanang Village was the Cobb-Douglas production function analysis model. The production function with the Cobb-Douglas model in this study was:

\[
Y = \frac{a_0}{(X_1^{b_1})(X_2^{b_2})(X_3^{b_3})(X_4^{b_4})}(e)
\]

Information:

Y = Tilapia Production (kg)

\(a_0\) = Constant

X1 = number of seeds (tails)

X2 = amount of feed (Kg)

X3 = labour (HOK)

X4 = length of maintenance period (days)

e = Confounding Coefficient (error term)

3. Results and discussion

Factors affecting the production result of tilapia farming. Based on the Table 1, the amount obtained greater than the tolerable probability of error, namely \(a\) of 5% or 0.05. It can be written as 0.067 > 0.05. This can be seen between the two, namely the residual distribution with the normal distribution has no difference. Then the conclusion is that the distribution of the residual data model in the Table 1 is normal and so does the production amount model in tilapia cultivation meets the normality assumption.

| Table 1. Normality test. |
|-------------------------|
| **One Sample Kolmogorov Smirnov Test** |
| Unstandardized Residual |
| N | 40 |
| Normal Parameters\(^{a,b}\) | Mean | .0000000 |
| | Std. Deviation | 563.02277503 |
| | Absolute | .206 |
| Most Extreme Differences | Positive | .206 |
| | Negative | -.118 |
| Kolmogorov-Smirnov Z | 1.304 |
| Asymp. Sig. (2-tailed) | .067 |

| Table 2. Linearity test. |
|-------------------------|
| **Variable** | **Sig.** | **Information** |
| Number of Seeds | 0.000 | Non-Linear |
| Feed | 0.185 | Linear |
| Labour | 0.465 | Linear |
| Long Maintenance Period | 0.549 | Linear |

Based on the Table 2, the relationship between, the number of seeds variable and the dependent variable has a non-linear relationship and the relationship between the feed, labour, lengths of
maintenance period variables to the dependent variable are linear.

Table 3. Multicollinearity test.

| Model                        | Collinearity Statistics |
|------------------------------|-------------------------|
|                              | Tolerance  | VIF   |
| (Constant)                   |           |       |
| Number of Seeds              | .788      | 1.269 |
| Feed                         | .919      | 1.088 |
| Labour                       | .723      | 1.383 |
| Long Maintenance Period      | .882      | 1.134 |

In the Table 3, it can be seen that the tolerance value for all models greater than 0.100 and VIF for all models less than 10.00. Then the conclusion obtained is that the model in linear regression in the research data is free from multicollinearity symptoms.

Table 4. Heteroscedasticity test.

| Coefficientsa | Model       | Sig.  |
|---------------|-------------|-------|
|               | Constant    | .712  |
|               | Ln X1       | .174  |
|               | Ln X2       | .359  |
|               | Ln X3       | .279  |
|               | Ln X4       | .701  |

a. Dependent Variable: Abs_Res2

The significance of the Ln x1 variable or the number of seeds is 0.174 > 0.05, Ln x2 or feed is 0.359 > 0.05, Ln x3 or labour is 0.279 > 0.05, and Ln x4 or the length of the maintenance period is 0.701 > 0.05. It can be seen that H0 is accepted and for H1 is rejected, which means that heteroscedasticity does not occur in this model or in other words the regression model is homoscedastic.

In the Table 5, there are the results of the Cobb-Douglas regression model so that it can write down the equation that is:

\[ Y = 83,276 + 0.055X1 + 0.583X2 + 7,857X3 – 1,908X4 + e \]  

(2)

Information:
Y = Tilapia Production (kg)  
a0 = Constant  
X1 = number of seeds (tails)  
X2 = amount of feed (Kg)  
X3 = labour (HOK)  
X4 = length of maintenance period (days)  
e = Confounding Coefficient (error term)

The Table 5 shows that the R² obtained is 0.625. It seen that 62.5% of the dependent variable (tilapia production) can be explained by the independent variables (number of seeds, feed, labour, length of maintenance period). The remaining is as much as 37.5% most likely influenced by
independent variables that are not included in the research variable model.

**Table 5. Tilapia production hypothesis testing.**

| No | Variable                        | Coeff. Regression | Sig. |
|----|--------------------------------|-------------------|------|
| 1  | Constant                       | 83.276            | 0.894|
| 2  | Seed                           | 0.055             | 0.000|
| 3  | Feed                           | 0.583             | 0.185|
| 4  | Labour                         | 7.857             | 0.465|
| 5  | Long Maintenance Period        | -1.908            | 0.549|

R² = 0.625  
F-Count = 14.586  
F-Table = 2.634  
T-Table = 2.03011

The Table 6 shows that there is a significance of F, which is equal to 0.000 < 0.05. It can be seen that H0 is rejected and H1 is accepted, which means that the variable number of seeds, feed, labour, maintenance time has a significant effect on tilapia production in the study area.

**Table 6. Test F statistic.**

| Model   | Sum of Squares | Df | Mean Square | F       | Significance |
|---------|----------------|----|-------------|---------|--------------|
| Regression | 20608056.34   | 4  | 5152014.084 | 14.586  | .000b        |
| Residual | 12362791.16   | 35 | 353222.605  |         |              |
| Total   | 32970847.50   | 39 |             |         |              |

a. Tilapia production  
b. Length of maintenance period, feed, number of seeds, labour

**Table 7. Test t statistic.**

| Coeffa | Unstandardized Coefficients | Standardized Coefficients |
|--------|----------------------------|--------------------------|
| Model  | B | Standard Error | Beta | T | Significance |
| (Constant) | 83.276 | 619.518 | .134 | .894 |
| number of seeds | .055 | .009 | .6985.985 | .000 |
| Feed | .583 | .431 | .1461.353 | .185 |
| Labour | 62.855 | 84.992 | .090 | .740 | .465 |
| long maintenance period | -1.908 | 3.153 | -.067-.605 | .549 |

a. Dependent variable: production of tilapia

3.1. Number of seeds
Based on the partial test results, the estimation results show that the regression coefficient X1 (number of seeds) is 0.055. The significance value of the number of seeds (X1) is equal to 0.000 < 0.05. It can be seen that H0 is rejected and H1 is accepted, which means that the independent variable number of seeds has a significant effect on tilapia production. So in this case the more tilapia seeds that are cultivated in accordance with the available pond capacity, the greater the tilapia fish production. This is related to [1] statement that the density of seeds per hectare according to the standard is 15-30 head
5

per square meter or 150,000-300,000 head per hectare. Meanwhile, in the research area, 10,108 tilapia fish are still cultivated per hectare.

3.2. Feed
Based on the partial test results, the estimation results show that the regression coefficient \( X_2 \) (Feed) is 0.185. The significance value of feed \( t(X_2) \) is equal to 0.185 > 0.05. It can be seen that \( H_0 \) is accepted and \( H_1 \) is rejected, which means that the feed in the form of pellets has no significant effect on tilapia production because in my research that in cultivating tilapia ponds in Belawan Sicanang Village, not all farmers provide pellets as feed. Tilapia fish farmers mostly use natural food in the form of moss in cultivating tilapia fish ponds.

3.3. Labour
Based on the partial test results, the estimation results show that the regression coefficient \( X_3 \) (Labour) is 0.465. The significance value of labour \( t(X_3) \) is 0.465 > 0.05. It can be seen that \( H_0 \) is accepted and \( H_1 \) is rejected, which means that labour does not have a significant effect on tilapia production because in my research that in conducting tilapia pond cultivation in Belawan Sicanang Village, the labour used from within the family is on average, only the head of the family and from outside the family, namely fellow farmers who help each other in tilapia harvesting activities, the salary earned is also based on the tilapia harvest. Meanwhile, farmers (workers from outside the family) carry out the harvesting activity which is the result of tilapia leftover in the pond that has been hooked first.

3.4. Long maintenance period
Based on the partial test results, the estimation results show that the regression coefficient \( X_4 \) (maintenance period) is 0.549. The significance value of length of maintenance \( t(X_4) \) is 0.549 > 0.05. It can be seen that \( H_0 \) is accepted and \( H_1 \) is rejected, which means that the independent variable of the length of the maintenance period has no significant effect on tilapia fish production because in my research that in conducting tilapia pond cultivation in Belawan Sicanang Village, the length of the maintenance period has no effect in determining weight and the size of the tilapia produced. Even though a day or a month is longer than the length of the maintenance period that is usually carried out, the weight and size obtained by the farmers, namely some increase and some are not, is different for each farmer.

4. Conclusions
The conclusion is that simultaneously the independent variables such as the number of seeds, feed, labour, and length of maintenance have a significant effect on tilapia production in Belawan Sicanang Village. Meanwhile partially only the number of seeds has a significant effect on tilapia production, while feed, labour and maintenance time have no significant effect.
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