Analysis of affecting factors of Vannamei shrimp (Litopeaneus Vannamei) production farming

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Abstract. Shrimp is one of commodity that has a great demand by consumers both domestically and abroad as an export commodity. There are 2 types of shrimp that are cultivated in North Sumatra, namely Vannamei shrimp and tiger prawns. Cultivation of Vannamei shrimp has grown rapidly, replacing tiger prawns’ cultivation. The objective of the study is to analyse the affecting production factors for cultivating Vannamei shrimp. The research location was determined purposively in Medang Deras District, as it is one of the production centres for Vannamei shrimp. The entire population in the study area was sampled (using the census method). The multiple linear regression analysis method is used to analyse the data that has been collected through a survey using a questionnaire. The results showed that simultaneously, the feed amount, fry number, medicine amount and lime amount significantly affected the production. And partially, the feed amount, medicine amount and lime amount also significantly affected the production, while the fry number insignificantly affected the Vannamei shrimp production. The food amount significantly affected the production with the greatest coefficient value. The lime application at the research location was crucial because it negatively affected the Vannamei shrimp production.

1. Introduction

The marine and fisheries sector is one of the economic sectors that has an important role in national economic, particularly in the provision of food and protein, earning foreign exchange, and providing employment opportunities. Managing and increasing the production of Vannamei, will make a greater contribution to national economic development and can alleviate the poverty of the Indonesian people, especially fishing communities and fish farmers [1].

The Vannamei Shrimp is a major cultivated species and has important market value in the world. The development of Vannamei shrimp cultivation is rapidly replacing tiger prawns. The main reasons for the shift of tiger prawns to Vannamei prawns include the low performance and growth rate of tiger prawns and their high susceptibility to disease. Disease infections that occur in shrimp farming can be an obstacle to increasing shrimp production [2-9].

Figure 1 shows that aquaculture production, especially in shrimp commodity, has always increased from 2012 to 2017, but in 2018 production decreased. Cultivation fishery business in shrimp commodity is expected to have an important role in the long term. The potential for aquaculture production is likely to be one of the driving forces for the country's economic growth.
In Medang Deras District, Batubara Regency is one of the centres for Vannamei shrimp cultivation, where Vannamei shrimp cultivation in the area is quite good in terms of natural resources, human resources and technology application. Vannamei shrimp production in this area needs to be increased following the increasing of demand from within and outside the country as an export commodity. This study aims to analyse the affecting production factors for cultivating Vannamei shrimp. After finding the Vannamei shrimp production affecting factors, then these factors can be managed to produce the better production.

2. Methods

2.1. Types of data
The types of data used in this study are secondary data and primary data. Primary data obtained from direct interviews with Vannamei shrimp farmers using a questionnaire. Secondary data were obtained from the Department of Marine Affairs and Fisheries, the Central Bureau of Statistics, and other related agencies.

2.2. Analysis methods
To analyse the influencing production factors for cultivating Vannamei shrimp in Medang Deras District, Batubara Regency, multiple linear regression models are used. Multiple linear regression models are used to see how each variable such as number of fry, feed, lime, and medicine affects the production of Vannamei shrimp farming which are expressed in terms of the following functions:

\[ Y = (\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \mu) \]  

Where:
Y: Production of Vannamei Shrimp (kg)
X1: Number of fry (tail)
X2: Feed (kg)
X3: Lime (kg)  
X4: Medicines (kg)  
β0: Intercept  
β1-β6: Regression Coefficient  
μ: Error Term

Before the model is used, a classic assumption test and goodness of fit of the model will be carried out. The assumption test carried out include:

1. Normality Test
Normality testing aims to determine whether the data used has been normally distributed. The normality test can be done with the Kolmogorov Smirnov test, by looking at the significance value [11].

2. Heteroscedasticity Test
The heteroscedasticity test aims to see whether in the regression model there is an inequality of variance from one residual observation to another in the regression model. If the residual variance from one observation to another is constant, it is called homoscedasticity or heteroscedasticity does not occur. A good regression model is one that has homoscedasticity or does not occur heteroscedasticity [12].

3. Multicollinearity Test
The multicollinearity test is the presence of a perfect or definite linear relationship (correlation) among some or all of the variables that explain the regression model. The data used is the use of logged factors. A good regression model should not have a correlation between the independent variables. The presence or absence of multicollinearity in the regression model can be seen from the tolerance and VIF (Variance Inflation Factor).

The test of Goodness of Fit carried out include:

1. Test Coefficient of Determination (R2)
The coefficient of determination refers to the ability of the independent variable (X) to explain the dependent variable (Y). R2 value is maximum 1 and smallest 0 (0 < R2 < 1). If R2 is equal to 0, the regression line has no effect on the variant of the dependent variable 0.

2. F test (simultaneous variable effect test)
The F test is used to test the accuracy of the model, whether the predicted value is able to describe the real conditions.

3. T test (Partial Variable Effect Test)
The T test is a partial test of the influence of the independent variable on the dependent variable used to determine whether the independent variable partially has significant or not significant effect on the dependent variable. The level of significance (α) used in social science is 5%.

3. Results and discussion

3.1. Results of the regression analysis of factors affecting the production of Vannamei shrimp
The result of regression equation of the factors that influence the production of Vannamei shrimp farming is as follows:

\[ Y = -0.039 + 0.110X1 + 0.934X2 - 0.225X3 + 0.001X4 + \mu \]  

Where: \( R^2 = 0.989 \)  
\( \text{Sig F} = 0.000 \)  
\( \text{Sig t} = X1 (0.061) \ X2 (0.000) \ X3 (0.001) \ X4 (0.039) \)

The coefficient of determination R-Square is 0.989. This means that it is 98.9%. The dependent variable (Vannamei shrimp pond production) can be explained by the independent variables (number
of fry, amount of feed, amount of lime and amount of medicine) while the remaining 1.1% is
explained by other variables not included in the estimation model.

The simultaneous test obtained F count of 1083.034 and a significance level of 0.00. F count > F
table at the confidence level of 95% (1083.034 > 2.61) and the significance value is smaller than α
(0.00 < 0.05), it can be concluded that hypothesis is accepted and hypothesis 0 is rejected so that the
variable number of fry, amount of feed, the amount of lime and the amount of medicine
simultaneously have a significant effect on the production of Vannamei shrimp in Medang Deras
District, Batubara Regency.

The estimation results obtained partial test results and regression coefficients for each variable as
follows:
1. Number of fry
   The t-count value of the number of fry (X1) is 1.917 < from t table 2.05954 and a significance value
   of 0.061 < of 0.050. Thus, hypothesis is rejected and hypothesis 0 is accepted. It can be concluded
   that there is no significant effect of the number of fry on the production of Vannamei shrimp. This
   is against the theory. According to the theory, the number of fry should have a significant effect on
   production but if the confidence interval is increased to 10 percent or 0.10, then the number of fry will
   have a significant effect. This is just in accordance with the theory. If the number of fry is increased by
   1 tail, the amount of production will increase by 0.110 kg.
2. Amount of feed
   The t-count value of the number of fry (X2) is 35.596 > from t table 2.05954 and a significance
   value of 0.000 > of 0.050. Thus, hypothesis is accepted and hypothesis 0 is rejected. It can be
   concluded that there is a significant effect of the amount of feed on the production of Vannamei
   shrimp. The amount of food has a very significant effect on production and has the greatest coefficient
   value. This means that the provision of food has a significant effect on increasing production. The
   addition of 1 kg of feed will increase the production by 0.934 kg.
3. Amount of lime
   The t-count value of total lime (X3) is (-) 3.441 < from t table 2.05954 and a significance value
   of 0.001 < of 0.050. Thus, hypothesis is accepted and hypothesis 0 is rejected. It can be concluded
   that there is a significant effect of the variable amount of lime on the production of Vannamei shrimp. In
   this case, if more lime is used, it will reduce production. However, the application of lime at the
   research location is very good even though the value of the β coefficient is negative (-) in this case it is
   (-3.441). This result shows that the monitoring carried out by the workers should be very good when
   there is a change in pH so they immediately apply the lime to the pond with the right dose. The normal
   pH value for the growth of Vannamei shrimp is in the range of 7.5 - 8.5 [13]. Daily pH changes can
   cause stress in aquatic animals. Thus, liming is used to increase total alkalinity and is necessary for the
   stability of the buffer waters and reducing fluctuations in daily pH.
4. Amount of medicine
   The t-count value of the number of medicine (X4) is 2.120 > from the t table 2.05954 and a significance
   value of 0.039 > of 0.050. Thus, hypothesis is accepted and hypothesis 0 is rejected. It can be
   concluded that there is a significant effect of the variable amount of medicine on the production of
   Vannamei shrimp. Medicine has a significant effect on production but the coefficient value is the
   smallest, if the drug is added by 1 kg it will only increase the production by 0.001 kg but the effect is
   still positive.

4. Conclusions
Simultaneously, the feed amount, fry number, medicine amount and lime amount significantly
affected the production. And partially, the feed amount, medicine amount and lime amount also
significantly affected the production, while the fry number insignificantly affected the Vannamei
shrimp production. The feed amount, medicine amount and lime amount affected the Vannamei
shrimp production positively, but the fry number insignificantly affected negatively. The food amount
significantly affected the production with the greatest coefficient value. The lime application at the research location was crucial because it negatively affected the Vannamei shrimp production.

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