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Research Paper

Analysis of Rice Production Factor Efficiency in Langkat Regency North Sumatra Province

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ABSTRACT

This study aims to analyze the opportunities to increase rice production in Langkat District through the efficiency of farming production factors. The purpose of this study was to analyze the efficiency of production factors on the production of lowland rice farming in Langkat Regency, North Sumatra Province. Data analysis methods used are Ordinary Least Square (OLS) and Stochastic Frontier Maximum Likelihood Estimation (MLE) Linear Regression with SPSS 24, Eviews 8, and Frontier 4.1 software tools. The results showed that land area variables had a negative and insignificant effect and the use of seeds had a positive and not significant effect on production. Meanwhile the variables of the use of seeds, fertilizers, liquid pesticides, labor in the family and out-of-family labor have a positive and significant effect on the production of wetland rice in the Langkat Regency of North Sumatra Province. The results also showed that wetland rice farming in Langkat District of North Sumatra Province was technically quite efficient with mean efficiency (0.82).

Keywords: Farming, Lowland Rice, Technical Efficiency, Stochastic Frontier

INTRODUCTION

Rice is the main food for most people in Indonesia. With the increasing population in Indonesia, the demand for rice will increase. In March 2016 there was a surge in rice consumption. According to the Central Bureau of Statistics in 2016, the dominant commodity contributing / contributing to deflation in March 2016 was 0.03% rice, so it is estimated that there will be an increase in consumption of rice.

High demand if not followed by an increase in production will cause problems. The program to improve food security is directed at being able to meet the needs of the people in the country from national food production. Various efforts have been made by the government in collaboration with the agricultural service to develop certified superior seeds, spacing technology and most recently the activities of Special Effort for Rice, Corn and Soybean.

North Sumatra is one of the mainstay areas for producing rice. Rice production in North Sumatra during the period of 2012 until 2016 experienced a fluctuating increase. In Table 1, it is known that the harvested area of wetland rice in the area of North Sumatra in 2012 to 2014 has decreased, then again increased in 2015 - 2016. Many factors that can affect the increase or decrease in rice production include climate / weather disturbances and the conversion of paddy fields into plantation land (North Sumatra in Figures, 2017).

Table 1: Harvest Area, Production and Average Rice Production in 2012 - 2016 North Sumatra Province.

Year	Harvest area (ha)	Production (ton)	Average of Production (ton/ha)
2012	7.143.07	3.552.373	49.73
2013	6.973.44	3.571.141	51.21
2014	6.767.24	3.490.516	51.58
2015	7.318.11	3.868.880	52.87
2016	8.266.95	4.387.035,09	53.07

Source: Central Statistics Agency of North Sumatra Province, 2017

The harvested area, production and average production of Regency / City wetland rice in North Sumatra can be seen in Table 1. In table 1 it is known that the top 5 regions have land area, production and the highest production average in North Sumatra Province, among others, namely Simalungun Regency, Deli Serdang Regency, Langkat Regency, Serdang Bedagai Regency and Mandailing Natal District. Langkat Regency is the third place with a harvest area of 79,124.9 ha, production of 409,954.4 tons and an average production of 51.81 kw / ha. However, if viewed from the amount of production and production averages, Langkat Regency is under Serdang Bedagai Regency with a harvest area of 75,618.5 ha, with production of 248,360.3 tons and an average production of 56.33 kw / ha.

Table 2: Harvest Area, Production and Average Rice Production in 5 Districts in North Sumatra, 2016.

Regency / City	Harvest area	Production	Average of Production
	(ha)	(ton)	(ton/ha)
Simalungun	1024375	6345558	61.95
Deliserdang	819555	4897252	59.76
Langkat	791249	4099544	51.81
Serdang Bedagai	756185	4259462	56.33
Mandailing Natal	487163	2483603	50.98

Source: Central Statistics Agency of North Sumatra Province, 2017

The development of lowland rice production in Langkat Regency from 2012 to 2016 has relatively fluctuated. The same thing happened to the harvested area of wetland rice, which also fluctuated relatively. The government's efforts to carry out the Special Effort of Rice, Corn and Soybean Plants have not contributed significantly to the increase in rice production in Langkat District (Rank in Figures, 2017).

Table 3: Harvest Area, Production and Average Rice Production in Langkat Regency.

Year	Harvest area	Production	Average of Production
	(ha)	(ton)	(ton/ha)
2013	80.289	467.121	5,82
2014	65.599	394.399	6,01
2015	79.167	511.729	6,46
2016	78.874	475.525	6,03

Source: Badan Pusat Statistik Kabupaten Langkat, 2017

Based on the rice paddy cultivation guide book published by the Agricultural Technology Research Institute (BPTP) of North Sumatra Province In 2011, if paddy farming is done in a good way then rice paddy farming can produce Dry Grain (GKG) up to 5-8 tons per Ha. By comparing production and production averages from 2013 to 2016, rice production in Langkat Regency is still far from expectations. The slowing down of rice productivity shows that the marginal productivity of paddy fields has approached the maximum level (leveling off). Such productivity conditions can be improved through efforts to improve efficiency, intensify or improve technology. This effort is more feasible given the increasing production through extensification is increasingly difficult and inefficient.

Based on the description above, efforts to increase productivity through efficiency of production factors are important to note. This study will analyze opportunities to increase rice production in Langkat District through the efficiency of farming production. Based on this background, the problem was drawn to examine the factors that influence the efficiency of rice paddy production with the title, "Analysis Of Rice Production Factor Efficiency In Langkat Regency North Sumatra Province".

Hypothesis

Based on the description of problem identification and theoretical basis, the hypotheses of this study are as follows:

1. Land area, use of seeds, number of pesticides, fertilizers, labor in the family and out-of-family labor have a positive effect on the production of rice in the research area.
2. Rice farming in the research area is technically efficient.

MATERIAL AND METHODS

The method of location selection is done purposively. This research was conducted in Langkat District of North Sumatra Province based on the third largest harvest area in North Sumatra Province but in terms of the average production of Langkat Regency is still lower than Serdang Bedagai Regency. Time Data collection in this study was carried out during one planting season, namely the planting season of December 2017 to April 2018.

The method of determining the sample used is Proportionate Stratified Random Sampling. Proportional stratified sampling methods are used because the pre-survey conditions in Langkat Regency indicate that the average production of wet rice in each sub-district is different and stratified (Supriana Tavi, 2016). Therefore to represent several production strata in Langkat Regency, the sample is taken based on the District with the criteria having high, medium and low production averages. Then obtained three Subdistricts that are in accordance with these criteria, among others, Serapit Subdistrict with an average production of 70.09 kw / ha, Sei Bingai District with an average production of 64.17 kw / ha and Sublet District with an average production of 55.29 kw / ha.

The number of rice paddy farmers in Serapit District, Sei Bingai District and Selesai District is 415 farmers. Sampling in this study uses Slovin techniques, according to (Sugiyono, 2011) sampling using the Slovin formula because in sampling, the number must be Representative so that the results of the study can be generalized and the calculations do not require a table of sample numbers, but can be done with simple formulas and calculations.

The Slovin formula for determining samples is as follows:

$$n = \frac{N}{1 + Ne^2}$$

Information :

n = Sample Size / Number of Respondents

N = Population Size

E = Percentage of allowance for accuracy of sampling errors that can still be tolerated: e = 0.1.

In the Slovin formula there are provisions as follows:

E value = 0.1 (10%) for large populations

E value = 0.2 (20%) for the population in small numbers

So the range of samples that can be taken from the Solvin technique is between 10-20% of the study population. The population in this study was 415 farmers, so the percentage of allowance used was 10% and the calculation results could be rounded up to achieve conformity. So to find out the research sample, with the calculation as follows:

$$n = \frac{N}{1 + 415\ (0{,}1)^2}$$

$$n = \frac{415}{1 + 415(0{,}1)^2} = \frac{415}{4.16}$$

$$n = 99.75$$

Based on the above calculations, the respondents in this study were 99 paddy rice farmers in Serapit District, Sei Bingai District and Selesai District, Langkat District, North Sumatra Province.

Data Outliers are cases or data that have unique characteristics that look very different from other observations and appear in the form of extreme values for either a single or combination variable. There are four causes for outlier data, including errors in data entry, failing to specify the missing values in computer programs, outliers not being members of the population we take as samples, outliers coming from the population we take as samples, but the distribution of variables in that population have extreme values and are not normally distributed (Ghozali, 2011). With this problem, the researcher deleted the outlier data. The way to normalize data is to eliminate data that is considered as the cause of abnormal data, so that by removing the data, the data will get closer to the average value (Suliyanto, 2011). After the data outliers are removed, then the data that was originally 99 data becomes 80 data.

The data used to support this research include secondary data and primary data. Primary data is data collected directly from farmers through direct observation and interviews with questionnaire tools. While secondary data was obtained from relevant agencies such as the Agricultural Extension Agency and Langkat District Food Security, North Sumatra Statistics Agency, Langkat Regency Central Bureau of Statistics and other sources.

RESULTS AND DISCUSSION

Level of Factor Efficiency in Rice Production

Analysis of Production Functions Stochastic Frontier

The model used to estimate the production function of wetland rice in the research area is the production model of Stochastic Frontier Cobb Doughlas. The production function model uses the Maximum Likelihood Estimation (MLE) estimation method which is carried out in two stages. The first stage uses the Ordinary Least Square (OLS) method to describe the average performance of the production process of the production factors of wetland rice at the level of technology used by the sample farmers.

OLS (Ordinary Least Square) method is done first to test whether there are violations of assumptions such as (multicollinearity, autocorrelation, and Heteroskedasticity) on the alleged production function. After that, the second stage is done using the Maximum Likelihood Estimation (MLE) method to describe the relationship between production (output) that can be achieved at the level of use of production factors (Input) by sample farmers and to see the level of technical efficiency of farming production factors lowland rice in Langkat Regency.

The expected results obtained by the OLS method indicate that the production function of wetland rice has fulfilled the assumption of the Cobb Doughlas production function, where the linearity of the cobbled production function equation test at the data level has a significance value fitted ^ 2 of 0.3224> 0.1 then H0: The linear model cannot be rejected. Normality test results obtained significance for the production equation (0.125> 0.1) then H0: Normal distribution cannot be rejected. The production equation, also has fulfilled 3 classic assumptions. In the equation there is no multicollinearity, heteroscedasticity, and autocorrelation. Multicollinearity is seen from the VIF value of each variable, where the value (VIF <10) means that there is no correlation between the independent variables. To find out whether there is heteroscedasticity in the data can be seen from the scatterplot. Scatterplot of residual data shows that it does not form a certain pattern, there is no heteroscedasticity. Whereas the autocorrelation obtained by the Durbin Watson value equation 1,041 cannot conclude anything. As shown in Table 4 below:

Table 4: Estimation of Cobb-Douglas Production Function with Ordinary Least Square Method

Variabel Input	Unstandardized Coefficients		Standardized Coeffici	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
C	3,234	0,546		5,926	0,000		
Luas Lahan (ha) lnx1	-0,035	0,031	-0,069	-1,120	0,266	0,849	1,178
Penggunaan Benih (kg/ha) lnx2	0,076	0,075	0,087	1,006	0,318	0,422	2,372
Pestisida Cair (ml/ha) lnx3	0,135	0,049	0,192	2,792	0,007	0,671	1,491
Pupuk (kg/ha) lnx4	0,154	0,077	0,117	2,002	0,049	0,933	1,071
TKDK (HOK/ha) lnx5	0,197	0,056	0,204	3,490	0,001	0,933	1,071
TKDL (HOK/ha) lnx6	0,719	0,101	0,670	7,122	0,000	0,360	2,779
R - Square	0,767						
Adjusted R - Square	0,748						
F Hitung	40,153						
Probability F	0,000						
Durbin Watson	1,041						

nyata pada α 0,1= 10%
Source: Data Primer Diolah, 2018

The coefficient of determination (R2) of the average production function obtained is 0.767. That is, the production inputs used in the production function estimation model can explain 76.7 percent of the variation in rice production factors in the study area. While the remaining 23.3 percent is influenced by other variables not included in the model. The coefficients or parameters of each variable are more than zero or positive, which means that the production function is still in the rational area.

The F-value is 40.157 with a significance value of 0.00 <α 0.1, which means simultaneously the independent variables of land area, use of seeds, liquid pesticides, fertilizers, labor in the family and labor outside the family.

The t test is used to see the effect of each of the production factors (independent) of farming on the expected dependent variable (production). Variables of liquid pesticides (X3), Fertilizers (X4), labor in the family (X5) and outside family labor (X6) have a significant effect on α 0.1. While the input of extensive land production (X1), the use of seeds (X2) does not significantly influence the production of wetland rice in Langkat Regency.

The rank of the Cobb-Douglas production function which is the coefficient in the production function is the production elasticity of each input used in farming. The number of β coefficients of the function is a condition of Return To Scale or scale of results of farming. The number of β coefficients of rice farming production function, namely the sum of the coefficients of the independent variable is 1.17. This figure shows that the scale of rice paddy farming in the study area is in the condition of Increasing Return To Scale. Increasing Return To Scale conditions indicate that changes in production factors such as land area, use of seeds, liquid pesticides, fertilizers, labor in the family and outside family labor will cause changes in the amount of paddy rice production in the research area at an increasing magnitude.

Production function model cobb-doughlas Ordinary Least Square (OLS) with the Semi Log Y equation. From the results of the data analysis the equation is obtained :

$$\ln Y = 3{,}234 - 0{,}035 lnX1 + 0{,}076 lnX2 + 0{,}135 lnX3 + 0{,}154 lnX4 + 0{,}197 lnX5 + 0{,}719 lnx6 + vi - ui$$

The results of the Cobb Doughlas production function analysis with the OLS model show that the production function formed is quite good, which describes the behavior of farmers in the production process. After estimating with the OLS method and there are no problems with multicollinearity and autocorrelation, then the production function model is estimated using the MLE method. The estimation of the stochastic frontier production function model of wetland rice farming in Langkat Regency using the Maximum Likelihood Estimation (MLE) method can be seen in Table 5 below:

Table 5: Estimation of the Production Function Model Cobb Douglas Stochastic Frontier Rice Farming with the Maximum Likelihood Estimate (MLE) Method

Variabel	Koefisien	Standard Error	T - ratio
Stochastic Frontier			
Intersep (lnβ0)	0,337	0,492	6,85538
Luas Lahan (lnβ1)	-0,394	0,292	1,35209
Penggunaan Benih (lnβ2)	0,634	0,749	8,46219
Pestisida Cair (lnβ3)	0,137	0,429	3,19273
Pupuk (lnβ4)	0,148	0,713	2,08165
Tenaga Kerja Dalam Keluarga (lnβ5)	0,197	0,503	3,91233
Tenaga Kerja Luar Keluarga (lnβ6)	0,754	0,972	7,76452
σ2 (sigma square)	0,368	0,662	5,56783
ϒ (gamma)	0,847	0,281	3,01083
Log Likelihood Function (OLS)	-0,180		
Log Likelihood Function(MLE)	-0,172		
LR test of one side error	0,147		

Description: Significant at α 0.1 = 10%
Source: Primary Data Processed, 2018

The initial estimation results using OLS show R2 value of 76.7 percent and there is no multicollinearity problem between variables in the model as indicated by the Variance Inflation Factor (VIF) value which is still below 10. Multicollinearity problems can cause high standard errors so that t-count becomes smaller and can cause the value to be unreal. Based on the MLE method estimating the production function model has a one-sided LR error of 14, 7 which is smaller than X2 on the Kodde and Palm Chi Square Tables at α = 0.1 = 10% i.e. (df: 5, X20.10) = 15,086, so there is no technical inefficiency in the stochastic frontier production function model. The form of the equation is as follows:

$$\ln Y = 0{,}337 - 0{,}394\, lnX1 + 0{,}634\, lnX2 + 0{,}137 lnx3 + 0{,}148 lnX4 + 0{,}197 lnX5 + 0{,}754 lnX6 + Vi - ui$$

The value of the log likelihood function on the production function needs to be considered because it relates to whether or not the model is suspected. The log likelihood function value with the MLE method of - 0.180 in Table 4.11 is greater than the log likelihood function value with the OLS method of - 0.172. This indicates that the production function with the MLE method is good and in accordance with the conditions in the study area.

The parameter used is the parameter of the production function of the stochastic frontier method Maximum Likelihood Estimate. From the results of the Model estimation, the value of ma (gamma) of 0.847 is obtained, where γ is the ratio between the deviation of technical inefficiency (ui) and the deviation that may be caused by random factors (vi). This means that 84.7% of the error term in the production function is caused by the effect of inefficiencies of the respondent farmers and the remaining 16.7% is caused by noise effects such as climate, weather, pest and so on.

The following is an interpretation of each production factor from estimating the stochastic frontier production function model:

Land

Land use has a negative and real effect on the level of trust of 90% of the production of lowland rice farming in Langkat Regency. The value of land elasticity on production is equal to -0,394 which means that with an increase in land area of one percent it will reduce production by -0,394 percent, ceteris paribus. Negative elisticity values indicate that the land is in an irrational area, where the addition of land area can reduce the production of lowland rice farming in Langkat Regency. Land has a negative effect because the land in the research area has experienced a decrease in nutrients, so it cannot provide maximum results. Notohadiprawiryo (2006) explains that marginal matter can be interpreted as land that has low quality because it has several limiting factors if it is used for certain purposes. Actually, the limiting factor can be overcome by input, or costs that must be spent. Without input, it means that cultivation on marginal land will not provide benefits.

Use of seeds

The use of seeds has a positive and significant effect on the level of trust of 90 percent. The elasticity value is 0.634, meaning that by increasing the use of seeds by one percent it will increase production by 0.634 percent assuming other variables remain. Positive production elasticity shows that the use of seeds is in a rational area. This is because seeds hold a very important role in increasing production or in other words production is very responsive to seeds so that by increasing the use of seeds will increase production significantly.

Increased use of seeds can be done by applying a more dense spacing of 20 x 20 cm or 20 x 15 cm given that the spacing used by farmers in the study area is an average of 25 x 20 cm and 20 x 20 cm. This can also be seen from the average seed use in the study area of 33.9 kg / ha.

Liquid Pesticides

The use of liquid pesticides has a positive effect and has an elasticity value of 0.137. This shows that each addition of one percent liquid pesticide will have an impact on production increase by 0.137 percent assuming other production factors remain. The positive elasticity of liquid pesticides indicates that the use of liquid pesticides is in the rational area. Medications also have a significant effect on the level of trust of 90 percent. The use of drugs can still be increased to obtain maximum rice paddy production.

Fertilizer

Fertilizers have a positive and significant effect on the level of confidence of 90 percent. The elasticity value shows a value of 0.148. This shows that every one percent addition of fertilizer will result in a production increase of 0.148 percent assuming other production factors remain. Positive production elasticity shows that the use of manure is in a rational area. The use of fertilizers can still be increased to continue to increase the production of rice in the research area. During this time the lack of fertilizer use was caused by the respondents' farmers in the study area still using fertilizers according to their financial capabilities. The average fertilizer use for wetland rice farmers in the study area is 619 kg / ha. Fertilizers used by farmers in the study area are urea fertilizer, TSP fertilizer, KCL fertilizer, NPK fertilizer, Ponska fertilizer and Za fertilizer. For each addition of every ton of grain, rice plants need nutrients N = 17.5 kg, P as much as 3 kg and K as much as 17 kg (Institute for Agricultural Technology Assessment NAD, 2009).

Labor in the family

Workers in the family have a positive and real effect on the level of trust of 90 percent. The value of labor elasticity in the family is 0.197 which indicates that an increase of one percent in the family workforce will increase production by 0.197 percent, ceteris paribus. The addition of labor in the family will be able to increase the production of rice farming with contributions in the form of activity such as land processing, nursery, planting, fertilizing, weeding, spraying pesticides and harvesting. Lack of use of labor in the family due to the large number of hired laborers considering that farmers in research locations generally prefer to employ other people to manage their farming. The average use of labor in the family shows that there is still little use of labor in the family where for land processing activities 2 hok / mt, 1 hok nursery / pesticide spray mt 2 hok / mt.

Labor outside the family

Out-of-family workers have a positive and real effect on the level of trust of 90 percent. The value of outside family labor elasticity of 0.754 which indicates that an increase in labor in the family by one percent will increase production by 0.754 percent, ceteris paribus. The addition of outside workforce families will be able to increase the production of rice farming with contributions in the form of activities such as land management, nursery, planting, fertilizing, weeding, spraying pesticides and harvesting. However, the use of labor outside the family is widely used in lowland rice farming in the study area because in general farmers in research locations prefer to employ other people to manage their farming. The average use of labor outside the family shows that there are many uses of labor in the family where for land processing activities 12 hok / mt, weeding 2 hok / mt of pesticide spraying 1 hok / mt.

Technical efficiency is analyzed using the stochastic frontier production function model through an output side approach. The category used in research is very efficient if it has a value of 90 0.90, is quite efficient if the value is 0.70- 0.89, and not efficient <0.70 (Coelli and Battese, 1998). Judging from the distribution of technical efficiency values, the number of respondents as many as 59 farmers has an efficiency value of 0.71 71 TE ≤ 0.89, the number of respondents as many as 15 farmers has an efficiency value of TE ≥ 0.90 and as many as 6 farmers respondents have an efficiency value of 0 , 10 ≥ TE ≤ 70. The average value of the technical efficiency of the respondent farmer is 0.82, meaning that technically the respondents of rice paddy farmers in Langkat Regency are quite efficient. In addition, the mean efficiency value of 0.82 also shows that the production factors of wetland rice are at the level of technical efficiency of 82 percent. To reach the level of technical efficiency (TE = 1) respondent farmers can increase the use of production factors by 18 percent. The distribution of the level of technical efficiency factors in the production of wetland rice can be seen in Table 6 below.

Table 6: Distribution of Farmers Based on the Level of Technical Efficiency of Rice Farming

Level of Efficiency	Number of Farmers	Percentage (%)
0,10 – 0,70	6	7,5
0,71 - 0,89	59	74
≥ 0,90	15	18,5
Total	80	100

Source: Primary Data Processed, 2018

The level of technical efficiency can be interpreted as a double face, on the one hand the high level of technical efficiency reflects the farmers' achievement in the managerial skills of rice farming is high and efficient in allocating the use of production factors. High efficiency levels also reflect that a small opportunity to increase productivity is quite high, because the gap between productivity that has been achieved with maximum productivity that can be achieved with the best management system is quite narrow (Noor 1996).

CONCLUSION AND RECOMMENDATION

CONCLUSION

The results of the Cobb Doughlas production function analysis using the Ordinary Least Square (OLS) method indicate that the R-Square value is 0.767. The influential factors of production are variable fertilizers, liquid pesticides, labor in the family and labor outside the family. While the land area variable has a negative and not significant effect on production and the variable use of seeds has a positive and not significant effect on production. The number of β coefficients of rice farming production function, namely the sum of the coefficients of the independent variable is 1.17. This figure shows that the scale of rice paddy farming in the study area is in the condition of Increasing Return To Scale.

The results of Cobb Doughlas production function analysis using the Maximum Likelihood Estimation (MLE) method obtained an average value of respondents' technical efficiency of 0.82 or 82 percent of maximum production. This value reinforces that the production factor of rice paddy farming in Langkat Regency can still be increased by 18 percent to obtain maximum production.

RECOMMENDATION

The results of the analysis of the technical efficiency of the production factors of wetland rice in Langkat Regency show that the area variable has a negative and significant effect on the technical efficiency of rice farming. With the value of elasticity - 0.394 The value of negative land elucidation indicates that the land is in an irrational area, where the addition of land area can reduce the production of wetland rice in Langkat Regency. Land has a negative effect because the land in the research area has experienced a decrease in nutrients, so it cannot provide maximum results. So farmers in the elevated area need to increase nutrient levels on land by increasing fertilizer use and reducing chemical use on land.

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