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Risk Control Model of Paddy Rice Farming Production and Farmers' Behavior in Tanjung Jabung Barat (Moscardi and De Janvry Approach Method)

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Abstract**—** *The role of rice farming in meeting rice needs is linear with the behavior of farmers responding to production risk. Farmer behavior determines the magnitude of production risk and farmer decision-making. The behavior of farmers is risk averse, risk neutral, or risk taker. Assessing the actual production function, the frontier production function, the risk function, and farmer behavior are helpful as benchmarks to make it easier to answer what factors determine the level of efficiency and use of optimal production input scenarios to achieve optimal production. The purpose of this study is (1) to analyze the response and production risk response to the use of production inputs. (2) Analyzing the behavior of farmers in responding to production risks. (3) Building a model for handling production risks and farmer behavior. The research was conducted in Tanjabbar Regency which was determined proportionally, the sample size was based on the slovin method as many as 122 farmers, and the sampling method was simple random sampling. The method of data analysis is the Cobb-Douglass production function, the Cobb-Douglass risk function, the behavior of farmers using Moscardi and De Janvry, and the production risk management model and the behavior of farmers using the kumbakar function. Cultivation technology carried out by farmers is still conventional with the use of production inputs that are still below the recommended dose. The productivity obtained by farmers is low, and the production risk is high. The determinants of the productivity function of lowland rice farming are urea, SP36, KCL, and organic fertilizers. Optimal use of these production inputs will be able to reduce the occurrence of production risk. Farmers' behavior in responding to production risks is to avoid risk and is mainly determined by the demand for urea and SP36 fertilizers. Sources of technical inefficiency mostly come from a narrow land area. Production risk control can be done by increasing productivity through the use of optimal production inputs, especially urea, SP36, and organic fertilizers, as well as the intensification of land area.*

Keywords**— Response, Production Risk, Farmer Behavior, Optimal Production.**

I. INTRODUCTION

Nationally, rice farming is cultivated by approximately 18 million farmers and contributes 66 percent to the gross domestic product (GDP) of food crops. Not only that, rice farming has provided income and employment opportunities for the total household, which exceeds 21 million with a contribution of 25 to 35% of its income. Therefore, rice continues to be a strategic commodity in food security and the national economy, as well as being the main basis for future agricultural revitalization. Significantly, national rice production has increased almost three times from 1970 to 2020. This condition is certainly related to the increase in planted area and productivity. The increase in rice productivity reached 87.6% in the period 1970 to 2020 with a productivity of 5.56 tons/ha in 2020, while for 1970 it was 2.42 tons/ha. The area has increased during this period by 39.8 percent. In 1970 the harvested area was 8.3 million hectares and became 11.6 million hectares in 2019. Nationally, the increase in rice production cannot be separated from government policies in the fields of intensification, extensification, and policies for agricultural machinery assistance, particularly government policy support, institutional engineering, technology cultivation, as well as superior varieties (Research and Development Center, 2021).

Jambi Province is ranked 18th as a national rice producer. Harvested area in 2014 was 121,722 ha and became 140,992 ha in 2020 or an increase of 15.83%. Production in 2014 was 587,384 tons and became 729,424 tons in 2020 or an increase of 24.18% per year. Productivity in 2014 was 48.26 quintal/ha and became 51.74 quintal/ha in 2020 or an increase of 7.2% per year. For Jambi Province, the Tanjabbar Region is the third place as the center for rice production. In 2014 the harvested area of lowland rice was 8,403 ha, and production was 32,730 tons with productivity of 38.95 quintal/ha. In 2020 there was an increase so that the harvested area became 9,569 ha, production of 50,118 tons with the productivity of 52.37 quintal/ha for Tanjabbar Regency, the center of rice production is Batang Asam District during the period 2014-2020 harvested area of 2,850 ha with a production of 19,730 tons with productivity 5.8 tons/ha.

The role of rice farming in meeting rice needs always goes hand in hand with the behavior of farmers in responding to production risks. Farmer behavior determines the magnitude of production risk or is related to decision-making. There is a difference between farmers who are afraid of risk and those who like risk. If farmers are risk averse, they will use fewer inputs and be careful about using inputs. Meanwhile, farmers who are risk-takers will use more inputs. (Pujiharto, 2017).

Farmers' decision-making takes the risk of being influenced by the behavior of farmers and affects the demand for production inputs. The amount of use of production inputs will affect the allocation and application of production inputs. Farmers in farming need to make decisions regarding risk-taking whether they are risk takers, risk-averse, or risk-neutral. In this regard, facing production risk is determined by the farmer's response (behavior) to production risk-taking attitudes and depends on the courage to take risks. If the courage of farmers is greater in facing risks, the use of production inputs in farming will be even greater. In this regard, production risk is determined by the degree of behavior and response of farmers in responding to production risks and depends on the level of response of farmers in the use of production factors.

II. RESEARCH METHODS

This research was conducted in Tanjabbar Regency with the research locus of Batang Asam District as the production center. The research area took two villages which were carried out purposively with the consideration that these locations had the potential for the development of rice farming. The research locus was Rawa Medang village and Sri Agung village. The sample size used the slovin method with a precision level of 10%. From a farmer population of 1,820 households, the number of samples was 122 households. The sampling method uses Simple Random Sampling with a random table.

Data analysis method

The analysis of the Cobb-Douglas production function, both the actual production function and the frontier production function, refer to Soekartawi (2006) and Tasman, A (2008).

The form of the Cobb-Douglas production function to analyze the actual production function is the Ordinary Least Square (MOLS) method.

$$Y_0 = \beta_0 X^{b1}$$

$$Y = b_0 X1^{b1} X2^{b2} X3^{b3} X4^{b4} X5^{b5} X6^{b6} X7^{b7} X8^{b8} X9^{b9} e^{u}$$

$$Ln\ Y = Ln\ a + b1 Ln\ X1 + b2 Ln\ X2 + \cdots + bn Ln\ Xn + V$$

The form of the Cobb-Douglas production function to analyze the frontier production function is the Maximum Likelihood Estimation (MLE) method.

Mathematically the stochastic frontier function is significant in the following equation:

$$Yi = x1\beta + (Vi - Ui);\ \text{where } i = 1,2,3,\ldots N$$

The form of the transformation of the stochastic frontier function is significant as follows:

$$LnY = \beta_0 + \beta 1 LnX1i + \beta 2 LnX2i + \beta 3 LnX3i + \beta 4 Lnb4i + \beta 5 LnX5i + \beta 6 Lnb6i + \beta 7 LnX7i + \beta 8 LnX8i + \beta 9 LnX9i + (vi - ui)$$

The general form of the function is transformed by the equation notation as follows:

$$\ln PRO = b_0 + b_1 \ln LT + b_2 \ln BE + b_3 \ln PN + b_4 \ln PP + b_5 \ln PK + b_6 \ln PO + b_7 \ln PT + b_8 \ln PJA + (vi - ui)$$

Where :

PRO = Production Produced by Farmers (kg)

b0 = Constant

LT = Use of Planted Area (ha)

BE = Seed Use (kg)

PN = fertilizer use N (kg)

PP = Use of Fertilizer P (kg)

PK = Use of Fertilizer K (kg)

PO = Use of organic fertilizer (kg)

PT = Use of drugs (ml)

PJA = use of labor (HOK)

b1-b8 = Estimating Parameters For Variable LT...PJ

A u = Error

E = 2.718 (Natural logarithm)

Test the hypothesis using the value (p-value),

- p.value > α (0.05), > α (0.01); Ho accepted
- p-value < α (0.05), < α (0.01) ; Ho rejected

Cobb-Douglas Risk Production Function Analysis

The CD production function model of the risk function is as follows:

$$LnY\ \sigma 2=(Yi-\hat{y}i)^2 = Ln + \alpha 1 LnX1i + \alpha 2 LnX2i + \alpha 3 LnX3i + \alpha 4 Lnb4i + \alpha 5 LnX5i + \alpha 6 LnX6i$$

$$+ \alpha 7 LnX7i + \alpha 8 LnX8i + \alpha 9 LnX9i + \varepsilon$$

Yi : production of paddy rice farming

Ŷ : Frontier production of paddy rice farming

The general form is transformed into the application model as follows:

ln PRO* = b0* + b1* lnLT* + b2* lnBE* + b3* lnPN* + b4* lnPP* + b5* lnPK* + b6* lnPO* + b7* lnPT* + b8* lnPJA*

PRO* = Production Produced by Farmers (kg)

b0*= Constant

LT*= Use of Planted Area (ha)

BE*= Seed Usage (kg)

PN* = fertilizer use N (kg)

PP* = Fertilizer Use P (kg)

PK* = Use of Fertilizer K (kg)

PO*= Organic Fertilizer Use (kg)

PT*= Drug use (ml)

PJA* = use of labor (HOK)

b1*-b8*= Estimating Parameters For Variable LT*...PJA*

Farmer Behavior Measurement

The method used to measure the behavior of farmers using the Moscardi and de Janvry method with the model:

There are three categories of classification of farmer behavior towards risk, namely:

$$K(s) = \frac{1}{\theta}\left(1 - \frac{PxiX}{Pyfi\mu y}\right)$$

Where:

θ= Coefficient of variation of production (θ = Va / Ea) ,where Va = Standard deviasion and Ea = Average production of rice farming

Py= Price of Product

fi= Elasticity input to production

X_i= The number of factors of production – i

Px_i= Price of factors of production – i

μy= Production average

K(s)= Estimated parameter (Parameter) of the behavior of farmers facing the risk

There are three categories of classification of farmer behavior towards risk, namely:

1. Low risk category if risk taker (likes risk) with (0 < K(s) < 0.4)
2. Moderate risk if risk neutral (risk-neutral) with (0.4 < K(s) < 1.2)
3. High category risk if risk averse (avoiding risk) with (1,2 < K(s) < 2.0)

Production Risk Control Model and Farmer Behavior

Pujiharto and Wahyuni (2017), Production risk control models and farmer behavior are formulated from the optimal production function. The optimal production function is formulated from the optimal production input model by Tasman, A (2008) and Soekartawi (2012) with the following econometric equation;

ln PRO = b0** + b1** lnLT** + b2** lnBE** + b3** lnPN** + b4** lnPP** + b5** lnPK** + b6** lnPO** + b7** lnPT** + b8** lnPJA****

Where:

PRO** = Production Produced by Farmers (kg)

b0**= Constant

LT**= Use of Planted Area (ha)

BE**= Seed Usage (kg)

PN** = fertilizer use N (kg)

PP** = Fertilizer Use P (kg)

PK** = Use of Fertilizer K (kg)

PO**= Organic Fertilizer Use (kg)

PT**= Drug use (ml)

PJA** = use of labor (HOK)

b1**-b8**= Estimating Parameters For Variable LT**...PJA**

The optimal use of production inputs for controlling production risk and farmer behavior is;

Land Area : □1* = (-FX1)/□*

So that, : $X1 = -\frac{\beta 1^{*}\pi^{*}}{Fx1}$

Seeds : □2* = (-FX2)/□*

So that, : $X2 = -\frac{\beta 2^{*}\pi^{*}}{Fx2}$

Urea : □3* = (-FuX3)/□*

So that, : $X3 = -\frac{\beta 3^{*}\pi^{*}}{Fux3}$

SP_{36} : □4* = (-Fsp36X4)/□*

So that, : $X4 = -\frac{\beta 4^{*}\pi^{*}}{Fsp36x4}$

KCL : □5* = ($-F_{KCL}$X5)/□*

So that, : $X5 = -\frac{\beta 5^{*}\pi^{*}}{FKCLx4}$

Labor : □6* = (-WX6)/□*

So that, : $X6 = -\frac{\beta 6^{*}\pi^{*}}{FWx6}$

Organic Fertilizer : □7* = (-pX7)/□*

So that, : $X7 = -\frac{\beta 7^{*}\pi^{*}}{Fpx7}$

Chemical Insecticide : □8* = (-pX8)/□*

So that, $X8 = -\frac{\beta 8^{*}\pi^{*}}{Fpx8}$

III. RESULTS AND DISCUSSION

Analysis of the Productivity Function of Lowland Rice Farming

The input variables used in farming will be described and analyzed in the frontier production function model. Productivity analysis aims to determine the variables that affect the productivity of lowland rice farming in the research area. The results of the estimation of the production function can be seen in Table 1.

Table 1. Results of Estimating the Productivity Function of Paddy Rice Farming in the Research Area, 2022

Variable	Productivity Function			
	Coefficient	**Std.Error**	**T-Statistic**	**Prob.**
X1_SEEDS	0,1935	0,0546	3,5439	0,0000
X2_UREA	0,3742	0,0858	4,3613	0,0000
X3_SP36	0,615	0,0367	16,757	0,0003
X4_KCl	0,0546	0,0356	1,533	0,0435
X5_ORGANIC	0,1093	0,0812	\1,3460	0,0261
X6_DRUGS	0,1267	0,0548	2,3120	0,0333
X7_LABOR	0,1856	0,0452	4,106	0,0000
R-squared	0,834352			
Adjusted R-squared	0,854862			

Table 1 shows that the model is free from the classical assumption test. The Durbin Watson stat value is 1.605998, which means the model is free from autocorrelation, meaning that there is no correlation between the residuals in one observation and other observations in the regression model. The value of Adjusted R-Squared = 0.863924 means that 86.39% of rice production variables (output) can be explained together by production input variables (seeds, urea fertilizer, SP36 fertilizer, KCl fertilizer, organic fertilizer, drugs, and labor). while the remaining 13.61% is determined by other factors outside the model. The coefficient value of the variable productivity of seeds, urea fertilizer, SP36 fertilizer, KCl fertilizer, organic fertilizer, medicine and labor were respectively 0.397494; 0.124915; -0.024508; 0.080550; 0.127330; -0.042369; 0.297411. Variable seeds, urea fertilizer, SP36 fertilizer, KCl fertilizer, organic fertilizer, medicine, and labor are added by 10% with the assumption that ceteris paribus will increase the productivity of each by 3.97%; 1.24%; -0.24%; 0.80%; 1.27%; -0.42%; 2.97%.

The value of $\sum\beta_1$ = 0.960823 < 1, means that each additional use of production factors by 10% will increase productivity by 9.60%. The scale of lowland rice farming in area II is Decreasing Return to Scale, meaning that each addition of the same proportion of production inputs will result in a decrease in additional production output. **The seed variable (X1)** has a very significant effect. on productivity assuming the use of other inputs ceteris paribus. Consistent with Sutawati's research (2014) regarding the use of seeds that are still not optimal and have a significant effect on the output of lowland rice farming. **The variable urea fertilizer (X2)** has a very significant effect on productivity with the assumption that the use of other inputs is ceteris paribus. This is in line with Damayanti's research (2014) that the use of urea fertilizer has a positive and very significant effect on the productivity of lowland rice farming. **The SP36 fertilizer variable (X3)** has no significant effect on increasing productivity assuming the use of other inputs ceteris paribus. Consistent with Nurani's research (2014) that the addition of SP36 fertilizer will reduce the productivity of lowland rice farming. **KCl fertilizer variable (X4)** has a significant effect on increasing productivity assuming the use of other inputs ceteris paribus. Consistent with research by Sutawati (2014) that increasing rice productivity can be done by increasing the use of KCl fertilizer. **The organic fertilizer variable (X5)** has a very significant effect on increasing productivity with the assumption of using other inputs ceteris paribus. Consistent with research Firmana (2016) that the coefficient value of organic fertilizer is positive, which means that the use of organic fertilizers can increase the value of the efficiency of lowland rice farming techniques, and Conscience (2014) that the addition of organic fertilizer use will increase productivity paddy rice farming. **The drug variable (X6)** has no significant effect on increasing productivity with the assumption that the use of other inputs is ceteris paribus. In contrast to Wulandari (2017) that drugs are positive and have a very significant effect on lowland rice productivity. **The labor variable** has a very significant effect on increasing productivity with the assumption that the use of other inputs is ceteris paribus. Consistent with the research of Nainggolan et al (2016) that the use of labor in lowland rice farming has a significant effect on production.

Analysis of the Technical Efficiency of Lowland Rice Farming Using the Stochastic Frontier Approach

The value of technical efficiency is categorized as quite efficient if ET > 0.7 and categorized as not efficient if ET ≤ 0.7. Coelli (1998) in Silitonga (2016) that the value of the technical efficiency index analysis results is categorized as efficient if it produces a value > 0.7 as the efficiency limit. Farmers who have a technical efficiency index below 0.7 can be targeted for counseling on improving farming management and agricultural techniques. The results of the analysis of technical efficiency in lowland rice farming can be seen in Table 2.

Table 2.Technical Efficiency in Lowland Rice Farming in the Research Area, 2022

Technical Efficiency	Number of Farmers (Person)	Percentage (%)
0.40 – <0.50	12	9,83
0.50 – <0.60	27	22,13
0.60 – <0.70	46	37,70
0.70 – <0.80	29	23,77
0.80 – <0.90	8	6,55
Total	**122**	**100**
Lowest Technical Efficiency	**0.48**	
Highest Technical Efficiency	**0.87**	
Average Technical Efficiency	**0.66**	

Source: Primary Data Results, 2022

Table 2 shows that the average ET = 0.66, meaning that the average productivity achieved by lowland rice farmers is around 66% of the frontier production. In order to achieve efficiency in the use of inputs in the production process, it is necessary to increase as much as 34%. The average lowland rice farming is still not technically efficient. The results of the technical efficiency analysis also show that the lowest technical efficiency for rice farmers is 0.48 and the highest is 0.87. That is, the opportunity to increase production by 13 - 52 percent. Consistent with research by Nainggolan et al (2019) that 40.23% of farmers have ET values > 0.7. Consistent with Febriansyah (2019) that the level of efficiency is low <0.7, which means that farmers have not optimized the use of production inputs properly and have not used them as recommended.

Rice Farming Production Risk Analysis

The Just and Pope production risk function model equation consists of a production function and a production variance function. The most commonly used functional format in the framework of the Just and Pope production risk model is the Cobb-Douglas function in natural logarithm form. The production risk of lowland rice farming is known in the use of lowland rice production factors and can be analyzed using the Just and Pope production risk function model.

Table 3. Results of Estimating the Risk Function of Rice Field Farming in the Research Area, 2022

Variable	Risk Function			
X	Koefisien	Std.error.	T.statistic	Prob.
X1_SEEDS	0,1258	0,0851	0,1478	0,0426
X2_UREA	-0,3654	0,1436	2,5446	0,0047
X3_SP36	-0,4362	0,1054	4,1385	0,0014
X4_KCl	-0,1534	0,0712	2,1545	0,0412
X5_ORGANIC	-0,0562	0,0293	1.9181	0,0183
X6_DRUGS	-0,0815	0,0541	1,5065	0,0346
X7_LABOR	-0,1252	0,0417	3,0024	0,0053
X8_LAND_AREA	0,0765	0,0323	2,3684	0,0167
R-squared	0,794556			
Adjusted R-squared	0,811544			

Table 3, shows that the production risk function model provides a coefficient of determination (Adjusted R-squared) of 0.8113 This shows that 81.10% of the diversity of lowland rice production risks can be explained simultaneously by factors of seed production, urea fertilizer, fertilizer SP36, KCl fertilizer, organic fertilizer, liquid insecticide, labor, and land area. The results of the analysis obtained Fcount of 349.54 with Prob. 0.0000 which means that the independent variables present in the model simultaneously have a significant effect on the risk of lowland rice production. Prob value. < α (0.05) shows the results that have a significant effect, meaning that the independent variables contained in the model jointly affect the risk of lowland rice production. **The seed variable (X1)** has a negative and significant effect on production risk. That is, the seed variable is a risk-reducing factor. Consistent with the research of Suharyanto (2015) that the production risk regarding the use of seeds has no significant effect on reducing the risk of lowland rice farming production. **The variable urea fertilizer (X2)** has a negative and significant effect on the risk of lowland rice production. That is, the variable urea fertilizer is a risk-reducing factor. Consistent with Apriana (2015) it is significant that the chemical fertilizer variable is a production variable that can reduce production risk. **The SP36 fertilizer variable (X3)** is positive and has no significant effect on the risk of lowland rice production. That is, SP 36 fertilizer is a risk-increasing factor. The results of this study are not in line with the research of Malik et al (2019) that the SP36 fertilizer variable is a variable that has a negative and significant effect on production risk. **The KCl fertilizer variable (X4)** is positive and has a significant effect on the risk of lowland rice production. This means that the KCl fertilizer variable is a risk-increasing factor. Consistent with Apriana's (2015) research, it is significant that the chemical fertilizer variable is a production variable that can reduce production risk. **The organic fertilizer variable (X5)** is positive and has a significant effect on the risk of lowland rice production. That is, organic fertilizer is a risk-increasing factor. The results are different from Apriana (2015) that the chemical fertilizer variable is a production variable that can reduce production risk. **The drug variable (X6)** is negative and has a significant effect on the risk of lowland rice production, meaning that the drug variable is a risk-reducing factor. Consistent with Puspitasari (2011) who indicates that pesticides are a risk-reducing factor. **The labor variable (X7)** is positive and has a significant effect on the risk of lowland rice production. That is, labor is a risk-increasing factor. Consistent with Tahir (2011), it is significant that labor will increase production risk. **The variable land area (X8)** is positive and has a significant effect on the risk of lowland rice production. That is, land area is a risk-reducing factor. Apriana (2015), that land area has a very significant effect on the risk of lowland rice production. The results are different from Apriana (2015) that land input is an input that is a risk-increasing factor.

Farmers' Behavior Against Risk

In this study, the measurement of farmers' behavior towards risk uses the Moscardi and de Janvry method. The Moscardi and de Janvry method is a risk measurement that is carried out by selecting the most significant variable that determines the level of farmer behavior in avoiding risk. The equation of the Moscardi and de Janvry method uses the Cobb-Douglas production function based on the production function, production variations, product prices, and factors of production.

To determine farmers' behavior towards risk or K(s) value, namely the production function. The most significant inputs and the greatest coefficients are selected as inputs of urea and SP36 fertilizers. Urea fertilizer has a probability of 0.0000 and SP36 has a coefficient of 0.131570. Therefore, the variables urea fertilizer and SP36 fertilizer are used as parameters for determining the category of farmer behavior towards the risk of lowland rice farming. Farmer's behavior towards risk can be seen in Table 4.

Table 4. Farmers' Behavior Against Risks in Research Areas, 2022

Urea Fertilizer Variable		
Risk Behavior Criteria	**Frequency (Farmers)**	**Percentage(%)**
Risk Taker	5	4.09
Risk Neutral	41	33.60
Risk Averse	76	62.29
Total	**122**	**100.0**
SP_{36} Fertilizer Variable		
Risk Behavior Criteria	**Frequency (Farmers)**	**Percentage (%)**
Risk Taker	4	
Risk Neutral	28	
Risk Averse	90	
Total	**122**	**100,0**

Table 4 shows that most of the farmers who use the urea fertilizer variable as a parameter for determining behavior with the criteria of avoiding risk (risk averse) which is 78.72 percent and while farmers using SP36 fertilizer as a parameter for determining behavior with the criteria of all farmers avoiding risk (risk aversion). averse). Lowland rice farmers' aversion to risk is motivated by the use of production inputs. Farmers have a tendency to risk-averse behavior causing the allocation of production inputs below the optimum level so that in the end it will result in a low level of productivity. Capital in farming is still very limited, especially for farmers who control narrow lands causing the level of technology adoption to be low which results in low farm productivity.

Low productivity faced by farmers affects the desire of farmers in carrying out their production activities, if there is an increase in the price of production inputs, the demand and use of production inputs will decrease. Lack of farming capital will also lead to a lack of input, which creates production risks and causes farmers to be afraid of risk. Increased productivity affects the desire of farmers to carry out their production activities, if there is an increase in production input prices, the demand and use of farmers' production inputs will decrease. Lack of capital Farming will also cause a lack of input, which creates production risk. Ermelinda's research (2019) shows that all respondents are risk averse. The result of determining farmer's behavior towards risk with urea fertilizer variable. Ermelinda (2011), that all farmers are risk averse. By using the classification of farmer behavior towards risk according to Moscardi and de Janvry, it can be concluded that most of the lowland rice farmers in the study area have risk-averse behavior in the category of risk (1.2 < K(s) < 2.0).

The Influence of Socio-Economic Factors on Technical Inefficiency of Paddy Rice Farming

There are many factors that influence the failure to achieve technical efficiency in the production process, one of which is socio-economic factors. Therefore, the analysis of the sources of technical inefficiency aims to answer what are the causes of technical inefficiency. The sources of technical inefficiency can be seen in Table 5.

Table 5. Result of Estimated Sources of Technical Inefficiency

Variable	Coefficient	Std. Error	t-Statistic	Prob.

Z1	0.1487	0.4052	0.36697	0.0007
Z2	-0.1514	0.4376	-0.34597	0.0002
Z3	-0.0451	0.4011	-0.11244	0.1675
Z4	-0.1145	0.6321	-0.18114	0.0433
Z5	-0,.0676	0.0213	3.17370	0.0048
C	0.4876	0.2247	2.17000	0.0051

Table 5 shows that the value of Adj R2 = 0.578721, this means that 57.87% of technical inefficiency can be explained jointly by socio-economic factors, while 42.13% is influenced by factors outside the model. Variables that have a significant effect on technical inefficiency in lowland rice farming in the study area at the level of α = 0.05 are the variables of age, farming experience, and the distance between the land and the farmer's house. While the variables that are not significantly different from technical inefficiency are education and the number of family members.

The estimation results of the age variable (Z1) have a positive and significant effect on technical inefficiency. The results of the significance test obtained the value of Prob. 0.0003 < α (0.05) which means that it is significantly different. Regression coefficient β 1 = 0.0872 which means that the age elasticity is positive for technical inefficiency, in other words, the age of the farmer has a significant effect on increasing the technical inefficiency of rice farming. This is in line with the increasing age of farmers, the ability to work, the desire to take risks, and the desire to carry out new innovations which are decreasing so that the level of technical efficiency decreases. Consistent with Rika's research (2017), the age of farmers significantly affects technical efficiency.

The education variable (Z2) has a negative and no significant effect on technical inefficiency. The results of the significance test obtained Prob. 0.1730 > α (0.05) which means the difference is not significant. Regression coefficient β 2 = -0.1001 which means that the elasticity of education is negative for technical inefficiency, in other words, a change in the level of education results in a decrease in the level of technical efficiency. The influence of education in the study was due to the fact that the farmers had long experience in farming lowland rice so the farmers worked on farming based on previous experience so that farming would increase and be technically efficient. Consistent with Fauziyah (2010) which has a significant negative effect on education and technical efficiency of farming.

The farming experience variable (Z3) has a negative and significant effect on technical inefficiency. The results of the significance test obtained the value of Prob. 0.0266 < α (0.05) which means significantly different. The regression coefficient β 3 = -1.974 means that the elasticity of farming experience is negative for technical inefficiency, a change in the increase in the level of farming experience will result in a decreasing level of inefficiency. More farming experience can allocate the use of farm productivity inputs better because it will allocate the use of inputs based on previous farming experience so that farming is more technically efficient. Consistent with Firmana (2016) which has a significant positive and significant effect on farming experience to increase the technical efficiency of lowland rice farming.

The variable number of family members (Z4) is negative and has no significant effect on the level of technical inefficiency in lowland rice farming. The results of this study are in line with research conducted by Saptana (2011) that the ratio of the number of working-age household members to the total household members has a negative but not significant effect on the technical inefficiency of curly red chili farming in Central Java Province.

The variable distance between the land and the farmer's house (Z5) is positive and has a significant effect on the technical inefficiency of lowland rice farming. Farmers who are close can control farming at any time, while farmers who have more land to farm will find it more difficult to control their farming so the level of technical efficiency of farming can be reduced. Muslimin's research (2012) found that the distance between the farm and the farmer's house has a negative and significant effect on increasing the technical inefficiency of farming.

Production risk control model

The optimal lowland rice farming production function model can be obtained by optimizing the productivity function, minimizing the production risk function, and the source of technical inefficiency with the following model:

$$TP = f(E_T) - F(\sigma^2) - F(Z)$$

$$f(E_T) = \mathbf{0{,}1258 + 0{,}1935\ lnBE + 0{,}3742\ lnPN + 0{,}1615\ lnPP + 0{,}0546\ lnPK + 0{,}1093\ lnPO + 0{,}1267\ lnPT + 0{,}1856\ lnPJA}$$

$$F(\sigma^2) = \mathbf{0{,}1258 - 0{,}3654\ lnBE^* - 0{,}4362\ lnPN^* - 0{,}1534\ lnPP^* - 0{,}0562\ lnPK^* - 0{,}0815\ lnPO^* - 0{,}1252\ lnPT^* + 0{,}0765\ lnPJA^*}$$

$$F(Z) = \mathbf{0{,}4876 + 0{,}1487\ lnLT^{**} - 0{,}1514\ lnBE^{**} - 0{,}0451\ lnPN^{**} - 0{,}1145\ lnPP^{**} - 0{,}0676\ lnPK^{**}}$$

IV. CONCLUSION

Cultivation technology carried out by farmers is still conventional with the use of production inputs that are still below the recommended dose. The productivity obtained by farmers is low, and the production risk is high. The determinants of the productivity function of lowland rice farming are urea, SP36, KCL, and organic fertilizers. Optimal use of these production inputs will be able to reduce the occurrence of production risk. Farmers' behavior in responding to production risks is to avoid risk and is mainly determined by the demand for urea and SP36 fertilizers. Sources of technical inefficiency mainly come from a narrow land area. Production risk control can be done by increasing productivity through the use of optimal production inputs, especially urea, SP36, and organic fertilizers, as well as an intensification of land area.

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