Analysis of Inputs use in Rice Farm Management at Sekotong, West Lombok, Indonesia

By

Riyan Adiputra S
Muslich Mustadjab M
Suhartini S
Wen-I Chang
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Riyan Adiputra S¹*, Muslich Mustadjab M², Suhartini S³, Wen-I Chang⁴

¹²³Department of Agriculture Economics, University of Brawijaya Malang, Indonesia.
⁴Department of Agribusiness Management, National Pingtung University of Science and Technology, Taiwan.

Emails: ²muslich@ub.ac.id, ³hartiniub@yahoo.com, ⁴dearafrica@gmail.com

*Corresponding Author’s Email: kon.riyan@gmail.com, Phone: (+62)85646756228

ABSTRACT

Farm management had several constraints such as limited water availability, excessive use of production factor(s), and declining productivity. Goal of farming activity is not only seen from the increased production but also from how the increased production can increase the farmers income. Therefore, the aim of this research was to know the factors that affect fertilizer and labor usage in the research area, and also the factors that affect rice production. Location of research was determined purposive to be in Sekotong, West Lombok, Indonesia. The data was obtained through simple random sampling. The data analysis method used 2SLS (two Stage Least Square). The result of this research found that the factors that affect fertilizer usage are land area, total cost of labor, and age of farmers. Factors that affect labor usage are farmer education, total cost of labor, and number of family. Factors that affect rice production are land area, seed, pesticide, and fertilizer.

Keywords: rice farm management, 2SLS, production factor, rice production.

INTRODUCTION

The Agricultural sector has an important role in Indonesia. In addition to producing commodities to meet the needs for food, agriculture also provided a source of livelihood. There are as much as 44.3 percent of people in Indonesia earning a living as farmers (Indonesia Central Bureau of Statistic, 2012). The agricultural sector includes crops, horticulture, fisheries, husbandry and forestry. In the early stages of development, the agricultural sector is underpinning of economics, because the agricultural sector makes a very large proportion in economics. It makes the agricultural sector as a potential market for domestic products, goods production as well as for consumers, especially foodstuff crop. Rice is one of the foodstuffs that communities in Indonesia consume and are still very dependent on that commodity (Sianipar et al., 2009).

Indonesia is the third largest rice consumer in the world after China and India. Indonesia has been importing rice for decades as supply is not sufficient to meet an unexpected rice demand during disasters or time of failed crops. The biggest Indonesia rice import in 1999 was about 4.7 million tons of rice and had to pay 280 U.S. dollars per ton to fulfill the needs of domestic rice (Dawe, 2002). Demand for rice continues to increase in line with the growing population and increasing income. Domestic rice production tends to increase, meanwhile the production tends to be smaller and unable to offset increased level of rice demand (Sidik, 2004).

West Nusa Tenggara Province is one of Provinces that supports national food supply especially rice. West Nusa Tenggara contributed more than 40 thousand tons of domestic rice supply every year and is the major producing area for food stock nationally (Department of Agriculture, West Nusa Tenggara, 2008). West Lombok Regency is a one of the regions in West Nusa Tenggara, which has the potential area to increase rice productivity. Sekotong sub-district is one of the ten sub-districts located in West Lombok regency. Total area Sekotong sub-districts is 330.45 km². The territories in Sekotong sub-district are mostly dry land and most of the farmers in this area planted rice. Land condition in research areas is wetland rainwater, whereas, this land gets water from rain to irrigate. So, farmers can plant rice in their land only twice for one year.

In general applicability, rice farm management had several constraints such as limited water availability, excessive use of production factor(s), and declining productivity. Production process that includes processing activities, planting, maintenance, harvesting and post harvest needs a certain cost to do all production activities. In farm management, the goal is to achieve a high level of income and use effective and efficient input (Soekartawi, 2002). Condition of farm management that produces maximum profit must be maintained and thus will continue to increase their farming quality.
Rice farm management in Sekotong sub-district can be said to be well managed if in view from the result of the produce. However, those results do not always indicate positive impact. If viewed from the application of rice farm management in Sekotong sub-district, it has not been managed well either, since most of the usage production inputs are excessive as it was not done according to dosage recommendations. This means that the ability of farmers to make final decision for used production input is not optimal, but also determined factors that are out of farmers control such as availability of irrigation water, climate or weather, fertility of land, price production inputs, price outputs, institution of farming and others.

All of these variables will integrate with each other and will determine the optimum production levels to be accomplished. The problem is whether farmers have understood and are able to allocate optimally, this production input that exists during the production process. The production input that it uses has been optimum and which are not. Thus, the problems in this research were formulated as follows; The extent to which factors might affect rice production and the usage of rice farming inputs to production that would have an impact on increased income farming in Sekotong, West Lombok.

METHODOLOGY

Model Specification

Model is an actual explanation of the phenomenon of a system or process (Dodge and Gemessa, 2012). Econometric model is a picture of the actual phenomenon of a system or a process, which includes one or more explanatory variables. A good model should meet the criteria of econometrics (direction and magnitude of the parameters), test statistics, mathematics, and econometric assumptions (Gujarati, 2004).

Figure 1 shows the relationship between endogenous variables and exogenous variables, where there exist a relationship between factors of production with production and the effect on income. In the analysis procedures, a model formulated in the form of systems simultaneous equations. The variables that need to be defined in the model are: land, seed, fertilizer, pesticides, labor and production, input prices, costs, wages, income, revenues, and selling price.

![Simultaneous Model](image_url)

**Description:**

- **Endogenous Variable**
- **Exogenous variables**

**Fertilizer Used In Rice Farm Management**

Fertilizer requirements depend on land area used for rice farm management, price of fertilizer, cost of labor used, age, and cost of pesticide. More larger land area usage for rice farm management need to use more fertilizer.
Price of fertilizer is inversely proportional to using fertilizer, if the price of fertilizer is expensive, then uses of fertilizer will be reduced, as well as the cost of labor utilization will be inversely proportional to fertilizer usage, age is one of the factors that influence the decision of management fertilizer usage and cost of pesticide also influence the decision making in farming activity.

Equation fertilizer for rice farming is as follows:

\[ FERT = f (LA, FTPR, TCL, AGE, PESC) \]  
\[ \log FERT = a_0 + a_1 \log LA + a_2 \log FTPR + a_3 \log TCL + a_4 \log AGE + a_5 \log PESC + \epsilon_i \]

Description:

- **FERT**: Fertilizer (Kg)
- **LA**: Land (Ha)
- **FTPR**: Fertilizer Price (Rp/kg)
- **TCL**: Labor Cost (Rp/season)
- **AGE**: Age of Farmer (Years old)
- **PESC**: Pesticide Cost (Rp/Liter)
- **a_0, a_1, ..., a_5**: Parameter
- **\epsilon_i**: Disturbant term

**Labor Used In Rice Farm Management**

Labor used requirements depend on land area used for rice farm management, wages demanded by workers in the form of labor costs overnight in one growing season. If the wages labor is too high, then the farmer will reduce his working hours or the amount of labor used and can also seek other employment criteria for cheaper wages. Farmers education level is one of the factors in farm management. High level of farmers education, then the knowledge or information about rice farming amongst other factors will have an influence on farm management. Also, the number of family dependents will have an influence on farm management. Just as increase in family dependents influence greatly the expenditure that must be spent for their viability. On the positive side, the number of families can be of help in rice farm management, thus reducing spent labor costs by farmers in rice production process.

Equation of labor uses for rice farming is as follows:

\[ TPD = f (LA, EDU, TCL, NOF) \]  
\[ \log TPD = b_0 + b_1 \log LA + b_2 \log EDU + b_3 \log TCL + b_4 \log NOF + \epsilon_i \]

Description:

- **TPD**: Total Labor (HOK)
- **LA**: Land (Ha)
- **EDU**: Education of Farmer
- **TCL**: Labor Costs (Rp/season)
- **NOF**: Number of Family (Person)
- **b_0, b_1, ..., b_4**: Parameter
- **\epsilon_i**: Disturbant term

**Model of Production in Rice Farm Management**

A production factor will work when there are several factors that influence it. In the agricultural sector, there are several factors that can influence, which aims to produce maximum output and management of farmers, it is necessary to combine the factors of production that are owned. The production factors usage by farmers in the process of rice farm management activities in the research area are land area, seeds, fertilizers, pesticides, and labor.

Equation model of production rice farm management is as follows:
PROD = f (LA, SEED, FERT, PEST, TPD) 

\[ \text{LogPROD} = c_0 + c_1 \text{LogLA} + c_2 \text{LogSEED} + c_3 \text{LogFERT} + c_4 \text{LogPEST} + c_5 \text{LogTPD} + \varepsilon_i \]  

Description:

\begin{align*}
\text{PROD} & : \text{Production (Kg)} \\
\text{LA} & : \text{Land (Ha)} \\
\text{SEED} & : \text{Seeds (Kg)} \\
\text{FERT} & : \text{Fertilizer (Kg)} \\
\text{PEST} & : \text{Pesticides (Liter)} \\
\text{TPD} & : \text{Total Labor (Person per day)} \\
\end{align*}

\[ c_0, c_1, \ldots, c_5 \] : Parameter \\
\[ \varepsilon_i \] : Disturbant term

RESULTS AND DISCUSSION

Model Estimation Results

Factors that Influence on Fertilizer Usage

Based on analysis by 2SLS method (two Stage Least Square) value equation can be obtained for the fertilizer usage.

Table 1: Parameter Estimation Results of Fertilizer Usage

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>6.3239</td>
<td>4.9396</td>
<td>0.0001</td>
</tr>
<tr>
<td>LA</td>
<td>0.5420</td>
<td>2.8963 ***</td>
<td>0.0079</td>
</tr>
<tr>
<td>FTPR</td>
<td>1.36E-05</td>
<td>0.1060</td>
<td>0.9165</td>
</tr>
<tr>
<td>TCL</td>
<td>6.52E-08</td>
<td>2.6240 **</td>
<td>0.0149</td>
</tr>
<tr>
<td>AGE</td>
<td>0.0128</td>
<td>2.2148 **</td>
<td>0.0365</td>
</tr>
<tr>
<td>PESC</td>
<td>-0.1058</td>
<td>-1.0563</td>
<td>0.3013</td>
</tr>
</tbody>
</table>

\[ R^2 = 0.727 \]
\[ \text{Adjusted } R^2 = 0.671 \]
\[ F\text{-statistic} = 12.595 \text{ F-table } = 2.53 (\alpha = 5\%) \]
\[ T\text{-table} = 2.042 (\alpha = 5\%) \]
\[ \text{Durbin-Watson} = 1.3012 \]

*** indicates statistically significant at 1% level. 
** indicates statistically significant at 5% level.

From the data in table 1, the equation can be obtained as:

\[ \text{LogFERT} = 6.3239 + 0.5420 \text{LogLA} + 6.52E^{-08} \text{LogTCL} + 0.0128 \text{LogAGE} \]  

It can be seen that not all independent variable is statistically significant or in the other words, only land area, labor cost and age have significant impact on fertilizer usage, meanwhile fertilizer price and pesticide cost have no significant impact on fertilizer usage.

Factors that Influence on Labor Usage

Based on analysis by 2SLS method (two Stage Least Square) value equation can be obtained for the labor usage.

From the data in table 2, the equation can be obtained as:

\[ \text{LogTPD} = -4.5918 + 0.2320 \text{LogEDU} + 0.6923 \text{LogTCL} + 0.0409 \text{LogNOF} \]
It can be seen that not all independent variables are statistically significant or in the other words, only education, labor cost, and number of family have significant impact on labor usage, meanwhile land area have no significant impact on labor usage.

Table 2: Parameter Estimation Results of Labor Usage

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-4.5918</td>
<td>-2.4504</td>
<td>0.0216</td>
</tr>
<tr>
<td>LA</td>
<td>-0.1718</td>
<td>-0.9699</td>
<td>0.3414</td>
</tr>
<tr>
<td>EDU</td>
<td>0.2320</td>
<td>2.0862 **</td>
<td>0.0473</td>
</tr>
<tr>
<td>TCL</td>
<td>0.6923</td>
<td>5.2955 ***</td>
<td>0.0001</td>
</tr>
<tr>
<td>NOF</td>
<td>0.0409</td>
<td>2.3217 **</td>
<td>0.0287</td>
</tr>
</tbody>
</table>

R² = 0.777
Adjusted R² = 0.741
F-statistic = 21.715  F-table =2.53(α = 5%)
T-table = 2.042(α = 5%)  Durbin-Watson= 1.458

*** indicates statistically significant at 1% level.
** indicates statistically significant at 5% level.

Factors That Affect Rice Production

Based on analysis by 2SLS method (two Stage Least Square), value can be obtained for the rice production equation.

Table 3: Parameter Estimation Results of Rice Production

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>6.7929</td>
<td>8.1244</td>
<td>0.0001</td>
</tr>
<tr>
<td>LogLA</td>
<td>0.5426</td>
<td>1.9842 *</td>
<td>0.0588</td>
</tr>
<tr>
<td>LogSEED</td>
<td>-0.0055</td>
<td>-2.0843 **</td>
<td>0.0479</td>
</tr>
<tr>
<td>LogFERT</td>
<td>0.0010</td>
<td>1.7749 *</td>
<td>0.0886</td>
</tr>
<tr>
<td>LogTPD</td>
<td>-1.1914</td>
<td>-0.8942</td>
<td>0.3801</td>
</tr>
<tr>
<td>LogPEST</td>
<td>0.2794</td>
<td>2.5099 **</td>
<td>0.0192</td>
</tr>
</tbody>
</table>

R² = 0.774
Adjusted R² = 0.727
F-statistic = 16.160  F-table =2.53(α = 5%)
T-table = 2.042 (α = 5%) , 1.310(α = 10%)  Durbin-Watson = 1.300

** indicates statistically significant at 5% level.
* indicates statistically significant at 10% level.

From the data in table 3, the equation can be obtained as:

LogPROD = 6.7929 + 0.5426 LogLA − 0.0055 LogSEED + 0.001 LogFERT+0.2794 LogPEST  (9)

Based on autocorrelation test (dU<d<4-dU), the Durbin-Watson value obtained from the model equations fertilizer usage by 1.300, dU value in this study which is 1.0706. Value of d is greater than dU and less than 4-dU which is 1.0706 < 1.300 < 2.700. So, H₀ is rejected, which means that there is no autocorrelation, either positive or negative.

The coefficient of determination (R²)

In this research, the value of R² is 0.774 or 77.40%, it can be said that the ability of exogenous variables to provide information on the endogenous variable is relatively high. It can be concluded that the variable land area, seed, fertilizer, labor, and pesticide have amounted to 77.40% on the effect of an increase or decrease in the rice production, while the remaining 22.6% is explained by other factors not included in the model because it cannot be measured quantitatively.
Diversity analysis (F-test)

F-test is a test that aims to determine the significance of the value of $R^2$. Data processing of the F-test using Eviews 6, F-statistic values obtained at 16.160. F-table value with 95% confidence level ($\alpha = 0.05$) by 2.53. From these results it can be concluded that the value of the F-statistic (16.160) > F-table (2.53). So, that all the exogenous variables which include land area, seed, fertilizer, labor, and pesticide affect the endogenous variables; that is rice production.

Coefficient and t-test

A t-test aims to determine the effect of independent variables on the dependent variable partially. The t-test is done by comparing the value of t-statistic with a value of t-table, with a 95% confidence level ($\alpha = 0.05$) and a 90% confidence level ($\alpha = 0.10$), the obtained value of t-table by 2.042, and 1.310. The results of regression analysis of independent variables that affect rice production can be seen in Table 3.

Value of regression coefficient on land area has a positive sign and the magnitude is 0.5426 and the t-statistic value 1.9842. Value of the t-statistic greater than the t-table is 1.9842 > 1.310 with $\alpha = 10\%$. Statistically, land area significantly affects rice production in the study area. This suggests that, there is an increasing land use for farming, and then the greater resulting production and otherwise. Increasing of land area will increase by 0.5426 units’ rice production.

Value of the regression coefficient has a negative sign on the seed and the magnitude is 0.0055 and the t-statistic value 2.0843. Value of the t-statistic greater than the t-table is 2.0843 > 2.042 with $\alpha = 5\%$. Statistically, seed significantly negatively affect rice production in the study area. This suggests that, if more seeds are used for farming, then the production of rice produced will decline. Increasing the amount of seed will reduce rice yield by 0.0055 units.

Regression coefficient on fertilizers has a positive sign and the magnitude is 0.001 and the t-statistic value 1.7749. Value of the t-statistic greater than the t-table 1.7749 > 1.310 with $\alpha = 10\%$. Statistically, fertilizers have a positive effect on rice production in the study area. This suggests that, the more fertilizer is used for farming, the greater the production of rice. Increasing the amount of fertilizers will increase the production of rice, but the amount is not too big that is 0.001 units.

Value of the regression coefficient on labor has a negative sign and the magnitude is 1.1914 and the t-statistic value 0.8942. Value of the t-statistic is smaller than the t-table value which is 0.8942 < 1.310 with $\alpha = 10\%$. It can be concluded that labor allocated in rice farming in the study area is not statistically significant on rice production.

Value of the regression coefficient on the pesticide has a positive sign and the magnitude is 0.2794 and the t-statistic value 2.5099. Value of the t-statistic greater than the t-table is 2.5099 > 2.042 with $\alpha = 5\%$. Statistically, fertilizers had a positive effect on rice production in the study area. This suggests that, pesticides usage for farming has an impact on the rice production. Pesticide use can provide an additional amount of rice production but, the amount is not too large, namely 0.2794 units.

CONCLUSION

Factors that affect fertilizer usage in this study are land area, labor costs, and the farmers’ age which has a positive sign. Respondent sample that have wide land area or increasing land used for rice farming need more usage of fertilizers. Labor cost has a role in using of fertilizers, higher labor costs incurred then, would in return bring about the benefit of a better use of fertilizer so that farmers do have optimal fertilization. For farmer’s age, the age of farmers experienced in using fertilizers is increasing, so that would help to bring about the optimal use of fertilizer.

Factors that affect labor usage in this study are the level of education, labor costs, and number of family which has a positive sign. The higher Education level would increase the usage of labor, by having higher education level then, the workforce will be able to have more information and able to apply technological innovations in farming. For labor cost, it has a role in using of labor; the higher the wages of farmers then, the higher quality of the farmers. So, that the increase in labor cost will provide a quality of workforce. Labor often used in farming activities comes from family members. Increasing use of labor from family members will improve the labor usage for farming.

Factors of production used in rice farm management in this research are land area, seed, fertilizer, pesticides and labor. The variables that have significant effect on production of rice farm management are seeds, pesticides, fertilizers and land area. Meanwhile, labor utilization factor was not statistically significant. For factor: land area, fertilizer, and pesticide has a positive sign. It means that increased use of land area, fertilizer, and pesticide will increase rice production. For seed that has a negative sign, it means that increased use of seed can reduce rice production.
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COMPETING INTEREST

Authors have no competing interest to declare.

AUTHORS’ CONTRIBUTION

All authors contributed to this work. Riyan Adiputra Setiawan participated in drafting the article, data analysis, interpretation of data, and also designed the manuscript. M. Muslich Mustadjab, Suhartini, and Wen-I Chang participated in revising critically for important intellectual content and gave final approval of the version to be submitted and any revised version.

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