Determinant factors affecting farmers’ income of rice farming in Indonesia

M Salam¹, A N Sari¹, R Bakri¹, M Arsyad¹, Saadah¹, M H Jamil¹, A N Tenriawaru¹ and A I Muslim²

¹Department of Socio-economics of Agriculture, Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia
²The United Graduate School of Agriculture Sciences, Kagoshima University, Japan

Email: muslimsal@yahoo.com

Abstract. Indonesian people consume rice as their staple food, therefore rice farming is the main source of farming and livelihood for rural residents in Indonesia. Various policies that have been taken by the government to encourage increase in production and productivity of this commodity, but the results have not reached what was expected. This study aims to analyze the factors affecting income of rice farming in Indonesia. The data were analyzed using Multiple Linear Regression Analysis Model (MLRAM). As the results, it found that the significant factors affecting farmers’ income of rice farming in District Maros, South Sulawesi Province, Indonesia were productivity, selling prices, and production costs of the rice farming managed by an individual farmer. Then, the MLRAM is a good model in predicting the income of rice farming in the district. In general, these findings are a substantial indicator that imply the importance of improving farm management in order to increase productivity, stabilize selling prices and reduce production costs for rice commodity. By improving farm management, it is expected to encourage farmers to increase their income from rice farming specifically and encourage rural economic growth in Indonesia generally.

1. Introduction

One of food crop commodities in Indonesia is rice (*oryza sativa*), which the production is still as staple food for Indonesian people. Rice is one of the commodities that has bright prospects to increase farmers’ income [1]. Agricultural sector in Indonesia has been consistently became priority and central attention of the country government’s development strategies. The sector has contributed in the national economic development by leading employment, food, raw material of various industries, and foreign exchange earning [2].

South Sulawesi Province is the largest producer of food crops in Eastern Indonesia. The title as a national granary strengthens South Sulawesi’s position as a potential producer of food crops, especially rice and corn commodities as a mainstay of food crops [3]. This province, whose capital is Makassar City, has 23 cities/districts. One of the district that contributes high amount of rice production in this province is Maros District.

Maros District, with an area of 1,619.11 km², has a harvesting area and rice production of 52,414 ha and 309,209 tons respectively with productivity of 5.89 tons/ha. Rice commodity is still the main livelihood source for residents in Maros District [4]. Various policies have been taken by the Maros District’s government to encourage the increase of production and productivity of this commodity,
however the results have not reached what was expected. Various problems faced by farmers in effort to increase farmers’ income from their rice farming have been mentioned by the researchers. Fluctuating rice production and volatile rice price are the factors that negatively affect farmers and at the same time also harm consumers. Furthermore, the situation is causing a gap between production and consumption. Therefore, this study aims to analyze the factors affecting income from rice farming in Indonesia.

2. Research Method
The research was conducted in Maros District, South Sulawesi Province. The location was chosen purposively because Maros District is one of the biggest rice producing regions in South Sulawesi Province. Furthermore, paddy productivity in this area is high. Maros District is directly adjacent to Makassar City, the capital of South Sulawesi Province to the north. Hence, the market for selling the rice is relatively near and easy to be accessed by the farmers. The research was conducted in April - May 2019.

Determinant factors affecting farmers’ income from rice farming were analyzed by Multiple Linear Regression Analysis Model (MLRAM), through three steps, as follows:

Step 1. Classical assumption test. The prerequisite to use MLRAM is the data have to be normal before running the model in any statistical packages (SPSS in this case). Moreover, one of the important assumptions in application for the MLRAM is that there is no exact linear relationship between any of the independent variables in the model constructed [5]. It means that there should be no multicollinearity when two or more variables (or combination of variables) are highly correlated with each other [5,6]. Another point before running MLRAM is the problem of heteroscedascity, the disturbance variances are not the same at all point [7]. Therefore, normality, multicollinearity, and heteroscedascity tests were done before doing further test to the model.

a. Normality test
The test aims to examine whether the dependent variable and independent variables both have normal distributions or not. Normality test can be done by drawing normal probability plots that compare the cumulative distribution of the normal distribution. A good model for regression should have normal or near normal data distribution. In principle, normality can be detected by looking at the spread of data (points) on the diagonal axis of the graph [8]. A normal distribution will form a diagonal straight line, and ploting data will be compared to a diagonal line.

b. Multicollinearity test
The test aims to verify whether there is a high or perfect correlation between the independent variables. In this research, the Variance Inflation Factor (VIF) method was used for the multicollinearity test. To find out whether multicollinearity occurs in a regression model can be seen from the VIF value. If the tolerance value > 0.01 and <10, there will be no multicollinearity.

c. Heteroscedasticity test
A good regression model is when heteroscedasticity does not occur (homoscedasticity). Heteroscedasticity is when the variance is not constant at each regression point, resulting in an increase in the value of error (μ). The way to detect it is by looking at the plot graph between the predicted value of the dependent variable and the residual. Detection of the presence or absence of heteroscedasticity can be done by looking at the presence or absence of certain patterns on the scater plot graph between value of the dependent variable and the residual where the X axis is Y’ (predicted Y) and the Y axis is residual (Y’ - Y) which has been distudentized.
Step 2. Building the Multiple Linear Regression Analysis Model (MLRAM)

Multiple Linear Regression Analysis Model (MLRAM) is “an extremely powerful [and useful] model that enables the researcher to learn more about the relationships [between some independent variables and a dependent variable] within the data being studied” [9]. In this research MLRAM was constructed to investigate the statistical relationship between the dependent variable of IRF (Income of the Rice Farming) and the other 13-variables in the model as for independent variables. The model was developed based on 74 set of data collected randomly in Maros District, South Sulawesi Province, Indonesia. The MLRAM is of the form as in Equation 1. Meanwhile, the description of each of variable in the MLRAM as in Equation 1 shown in Table 1.

\[ IRF = a + b_1 \text{Prod} + b_2 \text{SP} + b_3 \text{PC} + b_4 \text{UreaC} + b_5 \text{SP36C} + b_6 \text{ZAC} + b_7 \text{NPKC} + b_8 \text{TSPC} + b_9 \text{SponC} + b_{10} \text{GallC} + b_{11} \text{FiliaC} + b_{12} \text{ScoreC} + \varepsilon \] ………………………… (Eq.1)

### Table 1. Variable name, description of the variables and measurement unit of the MLRAM as in the Equation 1

| Variable Name | Description of the Variables | Measurement Unit |
|---------------|------------------------------|------------------|
| IRF           | Income of the Rice Farming managed by a farmer | IDR/ha |
| Prod          | Production per hectare of a unit individual area of the Rice Farming | ton/ha |
| SP            | Selling price | IDR/kg |
| PC            | Production cost of rice farming per hectare | IDR/ha |
| SC            | Seed cost per hectare | IDR/ha |
| UreaC         | Urea fertilizer cost per hectare | IDR/ha |
| SP36C         | SP36 fertilizer cost per hectare | IDR/ha |
| ZAC           | ZA fertilizer cost per hectare | IDR/ha |
| NPKC          | NPK fertilizer cost per hectare | IDR/ha |
| TSPC          | TSP fertilizer cost per hectare | IDR/ha |
| SponC         | Spontan pesticide cost per hectare | IDR/ha |
| GallC         | Gallery pesticide cost per hectare | IDR/ha |
| FiliaC        | Filia pesticide cost per hectare | IDR/ha |
| ScoreC        | Score pesticide cost per hectare | IDR/ha |

Other Symbols

- \(a\) Constant value
- \(b_{1,13}\) Regression coefficients of the independent variables
- \(\varepsilon\) Error terms

Step 3. The Validation of the MLRAM

In order to test simultaneously the significance for the whole independent variables (IRF, Prod, SP, PC, SC, UreaC, DP36C, ZAC, NPKC, TSPC, SponC, GallC, FiliaC & ScoreC) in the MLRAM (Eq.1) to the dependent Variable IRF, F-test was done [10]. While, t-Test [7] was done to verify the influence of each independent variable to the dependent Variable IRF individually.

**a. F-Test**

If the F-Test value is smaller than the F-table value, then the independent variables simultaneously do not affect the Variable IRF in the MLRAM, and vice versa if the F-Test value is greater or equal to the F-table value, then the independent variables simultaneously have a significant effect at the 95% confidence level to the Variable IRF.
b. **t-Test**

If t-Test value is greater or equal to the t-table, then the individual independent variable (other variables remain constant) significantly affects to the Variable IRF at 95% of confidence level, and vice versa if the t-Test value is smaller than the t-table value then it has no effect on the Variable IRF.

3. Results and discussions

3.1. Results of classical assumptions test

3.1.1. Normality test

The normality test, as we know, aims to test whether the dependent variable and the independent variables both have normal distributions or not in a regression model. A good regression model is having normal or near normal data distribution. A normal distribution will form a diagonal straight line, and plotting data will be compared to a diagonal line. The result of normality test in the research can be seen in Figure 1. In Figure 1, the normality of the plot shows that the data of farmers’ income gathers around the diagonal line and follows the direction of the diagonal line, so it can be concluded that the variable is normally distributed. This indicates that this research is feasible to use parametric tests.

![Graph of normality P-P Plot](image)

**Figure 1.** Graph of normality P-P Plot standardized residual of the determinant factors affecting income of rice farming in Maros District, 2019

3.1.2. Multicollinearity test

The multicollinearity test aims to test whether in the regression model there is a high or perfect correlation between the independent variables. To find out whether multi-collinearity occurs in a regression model can be seen from the VIF (Variance Inflation Factor) value. If the tolerance value > 0.01 and VIF < 10, there will be no multicollinearity. Then, the output of multicollinearity test result of the research can be seen in table 2. Table 2 shows that the all independent variables have a VIF number < 10 and there is no tolerance value is greater than 0.01. It indicates that the model has no indications of having multicollinearity problem.
Table 2. The output of multicollinearity test of the determinant factors affecting income of rice farming in Maros District, 2019

| Coefficients | Tolerance | VIF |
|--------------|-----------|-----|
| Model        |           |     |
| 1            | (Constant)| .521| 1.918|
| Prod         |           | .828| 1.208|
| SP           |           | .647| 1.546|
| SC           |           | .546| 1.832|
| UreaC        |           | .756| 1.323|
| SP36C        |           | .339| 2.947|
| ZAC          |           | .762| 1.313|
| NPKC         |           | .466| 2.145|
| TSPC         |           | .349| 2.869|
| SponC        |           | .483| 2.072|
| GallC        |           | .447| 2.236|
| FiliaC       |           | .322| 3.108|
| ScoreC       |           | .394| 2.536|

a. Dependent Variable: IRF

3.1.3. Heteroscedasticity test
A good regression model is a model that does not have heteroscedasticity. The result heteroscedasticity test of the MLRAM can be seen in Figure 2. In Figure 2, we show that the data spread above and below 0 on the Y axis, so that it can be concluded that there is no heteroscedasticity problem in the MLRAM.

![Scatterplot](image.png)

Figure 2. The output of heteroscedasticity test of the Determinant Factor Affecting Income of Rice Farming in Maros District, 2019

3.2. Results of the MLRAM and discussions
This study analyzes the effect of Variable Productivity (Prod), Selling Price (SP), Production Cost (PC), Seed Cost (SC), Urea Fertilizer Cost (UreaC), SP36 Fertilizer Cost (SP36C), ZA Fertilizer Cost (ZAC), NPK Fertilizer Cost (NPKC), TSP Fertilizer Cost (TSPC), Spontan Pesticide Cost (SponC), Gallery Pesticide Cost (GallC), Filia Pesticide Cost (FiliaC), and Score Pesticide Costs, (ScoreC) to
the Farmers’ Income of Rice Farming (IRF) in Maros District. The output of the regression analysis of the MLRAM can be seen in Equation 2 and Table 3, as follows:

\[
IRF = -27,047.437.642 + 4,264.275Prod + 6,257.323SP - 0.976PC - 0.106SC + 0.063\text{UreaC} + 0.393\text{SP36C} - 0.015\text{ZAC} + 0.007\text{NPKC} - 0.027\text{TSPC} + 0.270\text{SponC} + 0.403\text{GallC} + 0.166\text{FiliaC} + 0.102\text{ScoreC} + \varepsilon \\
\text{…………………} \quad \text{…………………} \quad \text{…………………} \quad \text{…………………} \quad \text{…………………} \quad \text{…………………} \quad \text{…………………} \quad \text{…………………} \quad \text{…………………} \quad \text{…………………} 
\text{Eq. 2}
\]

3.2.1. Validation of the MLRAM

3.2.1.1. Coefficient of determination analysis (R\(^2\))

The Coefficient of Determination (R\(^2\)) essentially measures how far the model's ability to explain the variation of the dependent variable. The value of R\(^2\) lies between 0 to 1 (0 ≤ R\(^2\) ≤ 1). The purpose of calculating the coefficient of determination is to determine the effect of independent variables on the dependent variable. If in the analysis process R\(^2\) is high it means the model is good, however it does not mean the model is bad if the R\(^2\) value is low. Regression model with more than two independent variables should use adjusted R\(^2\) as the Coefficient of Determination [10]. The coefficient of determination of the MLRAM as in table 4.

| Model | Unstandardized Coefficients | Standardized Coefficients |
|-------|-----------------------------|---------------------------|
|       | B                           | Std. Error                | Beta          |
| 1     | (Constant)                  | -27,047,437.642           | 401,360.858   |
| Prod  | 4,264.275                   | 18.833                    | .917          |
| SP    | 6,257.323                   | 87.286                    | .230          |
| PC    | -.976                       | .014                      | -.251         |
| SC    | -.106                       | .122                      | -.003         |
| UreaC | .063                        | .152                      | .001          |
| SP36C | .393                        | .199                      | .010          |
| ZAC   | -.015                       | .300                      | .000          |
| NPKC  | .007                        | .125                      | .000          |
| TSPC  | -.027                       | .145                      | -.001         |
| SponC | .270                        | .337                      | .003          |
| GallC | .403                        | .226                      | .008          |
| FiliaC| .166                        | .179                      | .005          |
| ScoreC| .102                        | .179                      | .003          |

a. Dependent Variable: IRF
Table 4. The coefficient of determination of the determinant factor affecting income of rice farming in Maros District, 2019

| Model Summary<sup>b</sup> |
|---------------------------|
| **Model** | **R** | **R Square** | **Adjusted R Square** | **Std. Error of the Estimate** |
| 1 | 1.000<sup>a</sup> | .999 | .999 | 149,928.358 |

<sup>a</sup> Predictors: (Constant), ScoreC, Sp36C, PC, UreaC, Prod, SP, ZaC, NPKC, SC, SpontanC, GalleryC, TSPC, FiliaC |

<sup>b</sup> Dependent Variable: IRF

Based on the analysis done, the adjusted $R^2$ is 0.999. This means that the Variable Productivity, Variable Productivity (Prod), Selling Price (SP), Production Cost (PC), Seed Cost (SC), Urea Fertilizer Cost (UreaC), SP36 Fertilizer Cost (SP36C), ZA Fertilizer Cost (ZAC), NPK Fertilizer Cost (NPKC), TSP Fertilizer Cost (TSPC), Spontan Pesticide Cost (SpontanC), Gallery Pesticide Cost (GalleryC), Filia Pesticide Cost (FiliaC), and Score Pesticide Costs, (ScoreC) can explain the Variable Income of Rice Farming (IRF) up to 99.9%. While the remaining 0.1% is explained by factors other than the variables examined in the MLRAM.

3.2.1.2. Results of F-Test

The F-test basically shows whether all the independent variables entered in the model have a simultaneous influence on the dependent variable (Variable IRF). The F-Test results can be seen in table 5.

Table 5. The output of f-test of the determinant factor affecting income of rice farming in Maros District, 2019

| ANOVA<sup>a</sup> |
|------------------|
| **Model** | **Sum of Squares** | **Df** | **Mean Square** | **F** | **Sig** |
| Regression | 2,628,665,493,220,738.500 | 13 | 202,205,037,940,056,800 | 8,995,481 | .000 |
| Residual | 1,348,710,762,431,242 | 60 | 22,478,512,707,187 | | |
| Total | 2,630,014,203,983,169,500 | 73 | | | |

<sup>a</sup> Dependent Variable: IRF

<sup>b</sup> Predictors: (Constant), Prod, SP, PC, SC, UreaC, SP36C, ZAC, NPKC, TSPC, SpontanC, GalleryC, TSPC, FiliaC, FiliaC & ScoreC

Table 5 shows the results of the F-test of the MLRAM. Because of the significance values is 0.000 lower than 0.05, it can be concluded that the Variable Productivity (Prod), Selling Price (SP), Production Cost (PC), Seed Cost (SC), Urea Fertilizer Cost (UreaC), SP36 Fertilizer Cost (SP36C), ZA Fertilizer Cost (ZAC), NPK Fertilizer Cost (NPKC), TSP Fertilizer Cost (TSPC), Spontan Pesticide Cost (SpontanC), Gallery Pesticide Cost (GalleryC), Filia Pesticide Cost (FiliaC) and Score Pesticide Costs, (ScoreC) simultaneously affect the Farmers’ Income of Rice Farming (IRF).

3.2.1.3. Results of t-Test

T-test was carried out to determine whether there was a partially significant influence between the independent variables to dependent variable. The results of the t-test of individual independent variables of the Variable Productivity (Prod), Selling Price (SP), Production Cost (PC), Seed Cost (SC), Urea Fertilizer Cost (UreaC), SP36 Fertilizer Cost (SP36C), ZA Fertilizer Cost (ZAC), NPK
Fertilizer Cost (NPKC), TSP Fertilizer Cost (TSPC), Spontan Pesticide Cost (SponC), Gallery Pesticide Cost (GallC), Filia Pesticide Cost (FiliaC) and Score Pesticide Costs (ScoreC) on the Farmers’ Income of Rice Farming (IRF) can be seen in Table 6. Table 6 shows that out of the 13 independent variables analyzed partially, three variables of them (Var. Prod, Var. SP & Var. PC) have an significant influence on the Farmers’ Income of Rice Farming (IRF) and 11 variables have no partial effect on the IRF.

**Table 6.** The output of the t-Test of the determinant factor affecting income of rice farming in Maros District, 2019

| Coefficients | Model | T | Sig. |
|--------------|-------|---|------|
| -67.389      | Prod  | 226.420 | .000 |
| 71.688       | SP    | -68.955 | .000 |
| -868         | SC    | .414    | .680 |
| 1.970        | UreaC | -.051   | .960 |
| .058         | NPKC  | -.189   | .851 |
| .803         | TSPC  | 1.784   | .080 |
| .928         | SponC | .571    | .570 |

a. Dependent Variable: IRF

4. Conclusion

The data used in analyzing the influence of 13 independent variables (Prod, SP, PC, SC, UreaC, DP36C, ZAC, NPKC, TSPC, SponC, GallC, FiliaC & ScoreC) on the Farmers’ Income of Rice Farming (IRF) in Maros District were normally distributed. In addition, there were also no indications of the existence of multicollinearity and heteroscedasticity in the data used. The data were analyzed using Multiple Linear Regression Analysis Model (MLRAM). As the results, it found that the significant factors affecting farmers’ income from rice farming were productivity, selling prices, and production costs in District Maros, South Sulawesi Province, Indonesia. Then, the MLRAM is a good model in predicting the income of rice farming in the district. In general, the findings above are a substantial indicator that imply the importance of improving farm management in order to increase productivity, stabilize selling prices and reduce production costs for rice commodity. By improving the farm management, it is expected to encourage farmers to increase their income from rice farming specifically and encourage rural economic growth in Indonesia generally.

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