Production Analysis and Allocative Efficiency of Rice Farming

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Abstract

This study aims to determine the influence of production factors on production and the allocative efficiency of using production factors in rice farming in Tampabulu Village, North Poleang District, Bombana Regency. The sample in this study was determined using the Slovin method, while the data analysis method employed was multiple linear regression analysis with the Cobb-Douglas function and allocative efficiency analysis. The results indicate that the use of production inputs such as land area, urea fertilizer, organic fertilizer, and seeds significantly affects production. In contrast, the use of labour, KCL fertilizer, and pesticides does not significantly affect rice farming production. The use of production inputs like land, urea fertilizer, KCL fertilizer, and organic fertilizer is not yet efficient, as indicated by an NPMX/Px value greater than 1, suggesting that these inputs should be increased. Conversely, the use of labour, pesticides, and seeds in rice farming is inefficient, as shown by an NPMX/Px value of less than 1, indicating that these inputs should be reduced to achieve optimal usage.

Keywords: Efficiency, Rice Farming, Production

A.   Introduction

Indonesia is an agrarian country with abundant agricultural wealth (Yuliana, Ekowati, & Handayani, 2017). Rice is one of the primary agricultural commodities with significant potential in Indonesia (Juliyanti & Usman, 2018). However, ironically, national rice production has not yet shown significant progress. Farmers, who are the backbone of national rice production, have not consistently benefited from government policies intended to support them (M. Salam et al., 2019). Indonesia has the highest per capita rice consumption in the world. In 2017, the per capita rice consumption in Indonesia was nearly 150 kg per person per year, with a population of 252.17 million people and a growth rate of 1.31% (Nurul C, Muslich Mustadjab, & Fahriyah, 2018).

The demand for food, particularly rice, is expected to increase year by year in line with the growing population and the development of the economic conditions of society (Hussain et al., 2020). The application of agricultural technologies, such as the use of high-quality seeds and balanced fertilizers, has significantly contributed to improving agricultural yields (Singh, Mishra, Bisht, & Joshi, 2021). However, on the other hand, farmer organizations (farmer groups) largely seem unable to gather sufficient funds or capital to meet their farming needs, especially in providing production inputs in the right quantities and at the right time (Niang et al., 2017).

The production factors available to farmers are generally limited, yet farmers also aim to increase their agricultural production (Devkota et al., 2019; Van Oort et al., 2015; Zhang et al., 2022). This situation requires farmers to utilize their production factors efficiently in farm management. One method to assess the efficient use of production factors in rice farming is by calculating allocative efficiency (Saito et al., 2021). Allocative efficiency reflects the relationship

between cost and output (Nursalam, Kartomo, Kasmin, & Suparman, 2023), and it is achieved when farmers can maximize profits by equating the marginal product value of each production factor with its price. By understanding the optimal use of production factors, maximum profit can be achieved with minimal costs (Amini, Rohani, Aghkhani, Abbaspour-Fard, & Asgharipour, 2020). Bombana Regency is one of the key rice production centers in Southeast Sulawesi, particularly in Tampabulu Village. The average production output by farmers in this area tends to be higher compared to rice farmers in other regions of Southeast Sulawesi, with average yields reaching up to 6 tons per hectare per planting season.

Table 1. Land Area and Rice Production in Bombana Regency, 2019 – 2023

No	Year	Land Area (Ha)	Production (Tonnes)	Production Changes (%)
1	2019	14.936	72.873	-
2	2020	16.496	82.662	13,43
3	2021	19.217	77.935	-5,72
4	2022	19.753	84.615	8,57
5	2023	19.970	94.512	11,71

Source: Bombana Regency Statistics Agency, 2024

Table 1 shows that, in general, over the past five years, rice production in Bombana Regency has consistently increased. A decline occurred only in 2017, amounting to 5.72%. This decrease in production is suspected to be due to unpredictable seasonal changes and pest infestations. Farmers can achieve allocative efficiency once they understand which production factors affect rice farming in Tampabulu Village. A common issue in rice farming activities, including in Tampabulu Village, is the variation in yields received by each farmer. This occurs not only due to differences in the land area cultivated by each farmer but also because of differences in the volume of production inputs used, ultimately leading to varying levels of efficiency. This study aims to identify the factors affecting production and allocative efficiency in rice farming in Tampabulu Village, North Poleang District, Bombana Regency.

B. Methodology

1. Population and Sample

The population in this study consists of all the rice farmers in the research location, totaling 144 households. To reduce the respondent population, the researcher used the Slovin formula for sample selection. The sampling method in this study was determined using the Slovin formula (Sari, Sari, & Sari, 2022) with the following equation:

$n = \dfrac{N}{N.d^2 + 1}$ ....(3.1)

Information;

n   = Number of sample

N   = Number of population

d^2 = The precision level is set at 10%.

Settlement:

$$n = \frac{144}{144.\,0{,}1^2 + 1}$$

$$n = \frac{144}{2{,}44}$$

$$n = 59$$

The sample size in this study is 59 households, representing the population in Tampabulu Village, North Poleang District, Bombana Regency. The method used to select the respondents was simple random sampling, where each subject in the population had an equal chance of being selected as a sample.

2. Technique of Data Collection

The data collection techniques in this study will involve interviews, where the researcher meets directly with respondents to obtain the desired data. Literature review, which involves gathering data from institutions and literature related to the research. Field observation, involves directly observing the area of the research site and the conditions of the farming activities.

3. Technique of Data Analysis

The data analysis techniques used in this study are tailored to the objectives intended to be achieved, as follows:

To determine the impact of production factor usage on the production volume of rice farming, multiple linear regression analysis is used, specifically the Cobb-Douglas production function. According to (AlHadi & Partini, 2020; Kartiasih & Setiawan, 2019), the Cobb-Douglas function is an equation involving two or more variables, where one is called the dependent variable or the explained variable (Y), and the others are called independent variables or explanatory variables (X). The relationship between Y and X is resolved through regression, meaning that variations in Y are influenced by variations in X. Mathematically, the Cobb-Douglas function can be expressed as follows.

$$\text{Log Y} = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 + \beta_5 \log X_5 + \beta_6 \log X_6 + \beta_7 \log X_7 + \text{et} \quad (3.2)$$

Information:

$\text{Log}Y$ = The production volume of rice farming (Kg)

$\text{Log}X_1$ = Land area (ha)

$\text{Log}X_2$ = Number of labor (HOK)

$\text{Log}X_3$ = Number of urea fertilizer (Kg)

$\text{Log}X_4$ = Number of KCL fertilizer (Kg)

$\text{Log}X_5$ = Number of organic fertilizer (Kg)

$\text{Log}X_6$ = Number of pesticide (Liter)

$\text{Log}X_7$ = Number of seed (Kg)

ß_0 = Intercept coefficient

$\text{ß}_1 - \text{ß}_4$ = Regression coefficient.

ε = Error term

Criteria:

$H_0 = 0$: The independent variable does not affect the dependent variable.

$H_1 \neq 0$: The independent variable affects the dependent variable.

To determine the allocative efficiency of production factor usage in rice farming, the following equation is used (Kyaw, Ahn, & Lee, 2018):

$$\text{NPM} = \text{Px} \quad \text{...}(3.3)$$

$$\text{NPM/Px} = 1 \quad \text{...}(3.4)$$

$$\text{bYPx / X} = \text{Px} \quad \text{...}(3.5)$$

or

$$\text{bYPy / Xpx} = 1 \quad \text{...}(3.6)$$

Information:

b   = Elasticity of production for production factor x

Y   = Production

Px   = Price of production factor x

X   = Amount of production factor x

Py   = Price of production Y

The criteria for assessing allocative efficiency in this study are as follows:

NPMX/Px = 1,   The use of production inputs is allocatively efficient.

NPMX/Px > 1,   The use of production inputs is not yet allocatively efficient, so an increase in their usage is necessary.

NPMX/Px < 1,   The use of production inputs is not allocatively efficient, so a reduction in their usage is necessary.

C. Findings and Discussion

1. Factors Affecting Rice Farming Production.

In this study, the production inputs for rice paddy farming that were examined include the number of seeds, the amount of KCL fertilizer, the amount of urea fertilizer, the number of pesticides, and the amount of labour used. The detailed impact of the use of these production inputs on rice paddy farming production at the research location is presented in the following table.

Tabel 2. Output of Multiple Linear Regression Analysis of Factors Affecting Rice Paddy Farming Production in Tampabulu Village, North Poleang District, Bombana Regency, Year 2024.

Independent Variable	Coefficients (Beta)	t_{hitung}	Sign	
Constant	2,076	10,801	0,000	s
Land Area	740,332	162,823	0,000	s
Amount of Labor	-3,127	-0,724	0,472	ns
Amount of Urea Fertilizer	0,259	2,834	0,007	s
Amount of KCL Fertilizer	0,115	1,320	0,194	ns
Amount Organic Fertilizer	0,236	1,861	0,049	s
Amount of Pesticide	0,040	0,240	0,812	ns
Number of Seed	0,294	3,468	0,001	s
R-Squared	0,928			
F_{hitung}	54,322		0,000	
F_{tabel}	2,13			
t_{tabel}	1,675			
α	0,05			
n	59			

Source: SPSS Output, 2024

Table 2 shows that the production factors of land area, the amount of urea fertilizer, the amount of organic fertilizer, and the number of seeds are production factors that have a significant effect on rice paddy production at a 95% confidence level. Meanwhile, the production factors of the amount of labor, the amount of KCL fertilizer, and the number of pesticides is production factors that do not have a significant effect at a 95% confidence level.

2. Allocative Efficiency of Rice Farming

Efficiency is the ability to achieve an expected result (output) by minimizing the input sacrificed. An activity is considered efficient if it accomplishes its goals (output) with the least amount of sacrifice (input), thereby defining efficiency as the absence of waste (Entezari, Wong, & Ali, 2021). Efficiency is also defined as the effort to use the smallest possible input to obtain the largest possible production. Such a situation occurs when farmers can ensure that the marginal production value (NPM) for an input is equal to the price of that input (Px). (Akter, Parvin, Mila, & Nahar, 2019). The results of the allocative efficiency analysis of rice paddy farming at the research location are presented in the following table.

Table 3. Allocative Efficiency Analysis of the Use of Production Factors in Rice Paddy Farming in Tampabulu Village, North Poleang District, Bombana Regency, 2024.

Variable	Bi	Y	Py	X	Px	PMx	NPMx	NPMX/Px
Land Area	740.332	7,567.69	4,200	1.02	500,000,000	5492748.11	23,069,542,065,62	46.14
Number of labors	-3.127	7,567.69	4,200	33.58	90,000	-704.71	-2,959,782.60	-32.89
Urea fertilizer	0.259	7,567.69	4,200	160.41	1,900	12.22	51,319.33	27.01
KCL fertilizer	0.115	7,567.69	4,200	374.56	2,400	2.32	9,758.63	4.07
Organic fertilizer	0.236	7,567.69	4,200	2.75	100,000	649.45	2,727,670.66	27.28
Pesticide	0.14	7,567.69	4,200	5.88	50,000	180.1830952	0.04	0.00000086
Seed	1.717	7,567.69	4,200	25.53	9,500	508.959018	0.12	0.00001276

Source: Data Processed, 2024

Table 3 shows that the use of production facilities such as land area, urea fertilizer, KCL fertilizer, and organic fertilizer is still not significant, as indicated by an NPMX/Px value greater than 1. To achieve efficiency, the use of these production facilities needs to be increased (Muslim Salam et al., 2022). The potential for expanding land area in rice paddy farming at the research location is still feasible, as there is still a significant amount of vacant land (forest areas) on the outskirts of the rice fields.

Table 3 also shows that the use of production facilities such as labour, the number of pesticides, and the number of seeds is inefficient, as indicated by an NPMX/Px value of less than 1. To make the use of these production facilities efficient, their usage needs to be reduced. Generally, the use of labour in the agricultural sector becomes inefficient because most of thelabourr in this sector is not trained (Novitaningrum, Supardi, & Marwanti, 2020). The labour used is not specified according to their skills; instead, the samelabourr is employed, and in some cases, family members assist in the rice paddy farming process (Putra, Antara, & Oka Suardi, 2018).

D. Conclusion

The use of production facilities such as land area, urea fertilizer, organic fertilizer, and seeds has a significant effect on rice paddy farming production (at a 95% confidence level) in Tampabulu Village. Meanwhile, the use of production facilities such as labour, KCL fertilizer, and pesticides does not have a significant effect on rice paddy farming production (at a 95% confidence level). The use of production facilities such as land, urea fertilizer, KCL fertilizer, and organic fertilizer is still inefficient, as indicated by an NPMX/Px value greater than 1, suggesting that the use of these production facilities needs to be increased to optimize their usage. Conversely, the use of production facilities such as labour, pesticides, and seeds in rice paddy farming in Tampabulu Village, North Poleang District, Bombana Regency, is inefficient, as indicated by an NPMX/Px value less than 1, which means that the use of these production facilities needs to be reduced to optimize their usage.

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