

The Effect of Production Factor Utilization on Rainfed Rice Farming Production (A Case Study in Anggaloosi Village, Onembute District Konawe Regency)

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Abstract

This study aims to determine: (1) The effect of production factor utilization on the production of rainfed lowland rice farming in Anggaloosi Village, Onembute District, Konawe Regency; (2) The economic efficiency of production factor use in rainfed lowland rice farming in Anggaloosi Village, Onembute District, Konawe Regency; and (3) The optimal use of production factors in rainfed lowland rice farming in Anggaloosi Village, Onembute District, Konawe Regency. The research was conducted from January to April 2025 in Anggaloosi Village. This study used primary data. The total number of respondents was 43. The analytical methods used were the Cobb-Douglas production function and the marginal product value comparison analysis. The results of the study showed that (1) The factors that had a significant effect on rainfed lowland rice production in Anggaloosi Village, Onembute District, Konawe Regency were land area, urea fertilizer, NPK fertilizer, and pesticides, while seeds and labor had no significant effect on production. (2) The use of production factors in rainfed lowland rice farming in Anggaloosi Village, Onembute District, Konawe Regency has not yet reached an optimal level of economic efficiency—particularly land area, seeds, urea fertilizer, NPK fertilizer, and pesticides—while labor was found to be inefficient. (3) The optimal use of production factors in rainfed lowland rice farming—including land area, seeds, urea fertilizer, NPK fertilizer, pesticides, and labor—still requires further calculation in terms of price and efficiency in order to achieve maximum production.

Keywords: Rainfed Lowland Rice, Production Factors, Economic Efficiency



INTRODUCTION

The agricultural sector is one of the important pillars in economic development at both the national and regional levels. One of the subsectors that plays a major role is the food crop subsector, especially rice. Southeast Sulawesi Province contributes significantly to national rice production. In 2024, the rice harvest area in this province reached 130,308.14 hectares with a production of 552,972.27 tons and a productivity of 4.243 tons/ha. This figure is still below the national average productivity of 5.241 tons/ha, indicating the need for efforts to increase productivity through more optimal utilization of production factors (BPS Nasional, 2024).

The potential for rice development in Southeast Sulawesi is considerable, given that around 28% of the total land area is rice fields that can be utilized. Infrastructure support in the form of the Ameroro Dam and Ladongi Dam further strengthens the region's potential as a food barn. However, the rice field system in Southeast Sulawesi consists of irrigated rice fields and rainfed rice fields, each of which has its own challenges, especially regarding water availability (Thamrin and Ardilla, 2016). This condition has an impact on fluctuations in harvest area, production, and rice productivity in each district.

Konawe District is one of the rice production centers in Southeast Sulawesi with the largest harvest area. In 2024, the harvest area in this region reached 48,743 ha with a production of 216,342 tons and a productivity of 4.43 tons/ha. However, this figure is still below the national average productivity. This indicates that there are constraints in the utilization of production inputs that are not yet optimal. One area of concern is Onembute Subdistrict, particularly Anggaloosi Village, which has ± 110 hectares of rain-fed rice fields. The productivity of rain-fed rice fields in this village is only around 2–3 tons/ha. In addition to water limitations, another problem arises from the exploitation of land for raw materials for brick making, which reduces soil fertility (Yartiwi et al., 2018).

In addition to land factors, rice productivity in Anggaloosi Village is also affected by limitations in other production inputs, such as fertilizers and pesticides, which are relatively expensive, meaning that their use does not comply with agricultural extension recommendations. Another constraint is the low quality of labor, which mostly comes from farming families with limited education, meaning that the use of production factors is often inefficient. On the other hand, the price of dry unhusked rice at the farmer level, which only ranges from Rp 5,000 to 5,400/kg, also reduces farmers' motivation to optimize their farming efforts.

Based on these conditions, it can be concluded that the low productivity of rice paddies in Anggaloosi Village is caused by the suboptimal utilization of production factors, both in terms of land, fertilizers, pesticides, labor, and production output prices. Therefore, research on the effect





of the use of production factors on rainfed rice farming production in Anggaloosi Village, Onembute District, Konawe Regency is important to find strategies to increase the productivity and efficiency of rice farming in the area.

METHOD

Research was conducted in Anggaloosi Village, Onembute District, Konawe Regency, Southeast Sulawesi Province from January 2025 to July 2025. The research location was determined *purposively*, considering that the village is a rain-fed rice field area. The population in this study consisted of 43 rice farmers in Anggaloosi Village, Onembute District, Konawe Regency. The sample in this study was determined using the census technique because the population was less than 100 respondents.

The types of data used in this study consist of primary and secondary data. Primary data was obtained through direct interviews with respondents, namely rice farmers in Anggaloosi Village, Onembute District, Konawe Regency, while secondary data was obtained from relevant agencies, village documentation, and relevant literature. Data collection techniques were carried out through interviews using questionnaires, literature studies to obtain concepts and theories that support the research, and direct observation at the research location to find out the problems faced by farmers in real life. The data was then analyzed using the following analysis techniques:

1. The first objective of the study used the *Cobb-Douglas* analysis method. The analysis method used in this study was the *Cobb-Douglas* production function (Soekartawi 2003), which can be expressed in the following mathematical equation:

$$Y = a \cdot X_{(1)}^{(b)(1)} \cdot X_{(2)}^{(b)(2)} \cdot X_{(3)}^{(b)(3)} \cdot X_{(4)}^{(b)(4)} \cdot X_{(5)}^{(b)(5)} \cdot X_{(6)}^{(b)(6)} e^u$$

To perform estimation, this model can be transferred into a logarithmic function, as follows:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + u$$

Explanation:

Y: Production Volume (Kg)

X₁ : Land area (Ha)

X₂ : Seeds (kg/ha)

X₃ : Urea fertilizer (kg/ha)

X₄ : NPK Fertilizer (kg/ha)

X₅ : Pesticides (Liters/Ha)





X_6 : Labor (HOK)

a : Constant

$b_{(1)}...b_{(6)}$: Regression coefficients for each independent variable $X_{(1)}...X_{(6)}$

u : Error (*Error term*)

The expected signs of the estimated parameters are as follows:

$$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 > 0$$

Regression coefficients are estimated values that describe the relationship between independent variables and dependent variables in a regression model. Regression coefficients are estimated using the least squares method. To test the accuracy of the model, the coefficient of determination (R^2) is calculated using the following formula:

$$R^2 = \frac{JKR}{JKT}$$

Explanation:

R^2 : Coefficient of Determination

JKR : Regression Sum of Squares

SST : Total Sum of Squares

Meanwhile, to determine the combined effect of the independent variables ($X_1, X_2, X_3, X_4, X_5, X_6$) on the dependent variable (Y), an F test is performed as follows:

$$F \text{ Count} = \frac{KTR}{KTS}$$

Explanation:

KTR : Mean Square Regression

KTS : Mean Square Residual

If the independent variables simultaneously or collectively have a significant effect on the dependent variable, then further testing is needed to determine the partial effect of each independent variable (X) on the dependent variable (Y) by performing a t -test, using the following formula:



$$T \text{ Count} = \frac{bi}{sbi}$$

Explanation:

bi: t-Regression Coefficient

sbi: Standard Deviation of the t-Regression Coefficient

- $H_0: b_i = 0$

- $H_1: b_i \neq 0$

- The second objective of the research can be achieved by analyzing the economic efficiency index. Mathematically, the formula used is as follows:

$$\frac{NPMx1}{Px1} = \frac{NPMx2}{Px2} = \frac{NPMx3}{Px3} = \frac{NPMx4}{Px4} = \frac{NPMx5}{Px5} = \frac{NPMx6}{Px6} = 1$$

Where the equation for Marginal Product Value (MPV) is as follows:

$$NPMxi = bi \cdot \frac{y}{xi} \cdot Hy$$

Explanation:

MPVxi = Marginal Product Value of production factor i

bi = Production elasticity/regression coefficient of the i-th production factor

Y = Average production of rainfed rice

X₁ = Average use of the ith production factor

Hy = Selling price of rainfed rice production

Pxi = Price of production factor i

The criteria for economic efficiency used are as follows:

- $\frac{NPMxi}{Pxi} < 1$ means that the use of production factor x is inefficient. To achieve efficiency, production factor x needs to be reduced.
 - $\frac{NPMxi}{Pxi} > 1$ means that the use of production factor x is not yet efficient. To achieve efficiency, production factor x needs to be increased.
- The third research objective is to determine the optimal use of production factors (Xi) in providing maximum profit for rice farmers in Anggalooi Village, Onembute District, Konawe Regency, using the following formula.

$$NPM_{xi} = b_i \cdot \frac{Hy}{x_i} \cdot y$$

Explanation:

X_i = Optimal combination of production factor i

b_i = Production elasticity/regression coefficient of production factor i

Y = Average production of rainfed paddy rice

Hy = Selling price of rainfed rice production

P_{xi} = Price of production factor i

RESULTS AND DISCUSSION

Analysis of Factors Affecting Production

The analysis of factors affecting production was conducted using multiple regression with the Cobb-Douglas production function. The dependent variable (Y) is rice paddy production, while the independent variables (X) include land area (X_1), seeds (X_2), urea fertilizer (X_3), NPK fertilizer (X_4), pesticides (X_5), and labor (X_6). To determine the estimated parameters of the rice paddy production function in the study area, see Table 1 below.

Table 1. Estimation Results of Production Factors on Production Using the Cobb Douglas Production Function in Rice Farming in Anggaloosi Village in 2025

No	Variable	Regression Coefficient		Partial Test
		<i>B</i>	<i>T</i>	<i>Sig</i>
1.	Constant	5.670	18.592	<.001
2.	Land Area (X_1)	.150	3.755	<.001
3.	Seeds (X_2)	.127	1.550	.130
4.	Urea Fertilizer (X_3)	.109	2.502	.017
5.	NPK Fertilizer (X_4)	.234	4.485	<.001
6.	Pesticide (X_5)	.456	2.893	<.006
7.	Labor (X_6)	.025	.396	.695
	F (Simultaneous Test)	51.882		<.001 ^b
	Coefficient of Determination (R^2)	0,896		
	R Value	0,879		

Table 1 shows that the SPSS output results indicate that the significant values of the constant, land area, seeds, urea fertilizer, NPK fertilizer, pesticides, and labor can be arranged



using the regression model equation by looking at the values in the *B* column. The resulting model is:

$$Y = 5.670 \cdot X_1^{0.150} \cdot X_2^{0.127} \cdot X_3^{0.109} \cdot X_4^{0.234} \cdot X_5^{0.456} \cdot X_6^{0.025}$$

The coefficient of determination (R^2) is used to determine the extent to which independent variables influence dependent variables. Its value ranges from 0 to 1, where the closer it is to 1, the greater the influence of the independent variables. The analysis results show an R^2 value of 0.896 and a correlation coefficient (*R*) of 0.879, which means that 89.6% of the variation in rice production can be explained by the variables of land area (X_1), seeds (X_2), urea fertilizer (X_3), NPK fertilizer (X_4), pesticides (X_5), and labor (X_6), while the remaining 10.4% is influenced by other factors outside the research model.

The effect of the combined use of production factors on the amount of rice paddy production can be determined using the *F* test. From the analysis results, an *F* Statistic value of 51.882 with a probability or Sig. of 0.001 was obtained. With a Sig. value of $< \alpha$ (0.05), the results are significant, which means that the independent variables in the research model collectively have a significant effect on rice production in Anggaloosi Village.

The *t*-test was conducted to determine the individual influence of the independent variables studied on the productivity of rice farming in Anggaloosi Village. Based on the condition that the significant value is < 0.05 , the independent variables have a significant effect on the dependent variables. The production factors that influence and do not influence the level of rice farming productivity in Anggaloosi Village are:

1. Land area (X_1) has a positive and significant effect on rice production with a regression coefficient of 0.150 and a significance value of $0.001 < 0.05$. This means that every 1% increase in land area will increase production by 0.150%. This shows that the larger the area of land cultivated, the more crops can be planted and maintained, thereby increasing production (Wulan et al., 2022). These results are in line with the research conducted by Putri and Fahira (2021) in Tambakdahan District, Subang Regency, and Oktavia (2019) in Jangkat District, Merangin Regency, which both found that land area has a significant effect on rice paddy production.
2. Seeds (X_2) have a positive but insignificant effect on rice production, with a regression coefficient of 0.127 and a significance level of 0.130 (> 0.05). This means that every 1% increase in seed use has the potential to increase production by 0.127%, but the effect is not statistically significant. This is thought to be because farmers in Anggaloosi Village generally use seeds from previous harvests or buy them from other farmers, so the seed



quality is not superior and is susceptible to pests and diseases. These conditions result in suboptimal rice productivity. The results of this study are in line with the findings of Saputra and Prihtanti (2022), which show that seed use has no significant effect on rice productivity.

3. Urea fertilizer (X3) has a positive and significant effect on rice production with a regression coefficient of 0.109 and a significance level of 0.017 (<0.05). This indicates that every 1% increase in urea fertilizer use will increase production by 0.109%. Urea containing 46% nitrogen is very important for plant growth, thereby increasing production. This finding is in line with Seprianti's (2023) research, which states that urea fertilizer has a significant effect on rice production in Pemayang District.
4. NPK fertilizer (X4) has a positive and significant effect on rice production with a regression coefficient of 0.234 and a significance level of 0.001 (<0.05). This indicates that every 1% increase in NPK fertilizer use will increase production by 0.234%. The nutrient content in NPK fertilizer is essential for plants, so its proper use can increase stem strength, leaf growth, and crop quality. This finding is in line with Shanti and Nirmala (2020), who stated that NPK fertilizer plays an important role in increasing rice paddy production.
5. Pesticides (X5) have a positive and significant effect on rice production with a regression coefficient of 0.456 and a significance level of 0.006 (<0.05). This means that every 1% increase in pesticide use will increase production by 0.456%. Pesticides are used by farmers to protect crops from pests and diseases, which are among the main causes of reduced production. These findings are in line with the opinion of Manopo et al. (2022), who stated that pest and disease attacks can reduce rice productivity, as well as the research by Megawati et al. (2021) in Ponjong District, Gunungkidul Regency, which showed that pesticides have a positive effect on rice production.
6. Labor (X6) has a positive but insignificant effect on rice production, with a regression coefficient of 0.025 and a significance level of 0.695 (>0.05). This means that every 1% increase in labor only has the potential to increase production by 0.025%, but the effect is not statistically significant. This shows that the amount of labor is not a major factor in increasing production. These results are in line with the research by Alamri et al. (2022) in Bintauna District, Bolaang Regency, which also found that the labor variable has no significant partial effect on rice paddy production.

Efficiency in the Use of Production Factors

In any business, including farming, there is one important thing that farmers must pay

attention to, namely efficiency. The application of efficiency in the use of production factors is very important to produce optimal production and increase profits from farming. Farming has achieved economic efficiency when the ratio between the marginal product value (NPMxi) and the price of production factors (Px) is equal to 1.

Table 2. Economic Efficiency of Factor Use in Rice Farming in Anggaloosi Village, Onembute District, Konawe Regency

Production Factors	Marginal Production Value	Production Factor Price	$\frac{NPM_{xi}}{P_{xi}}$	Description
Land Area	3.731.475	2.000.000	1,86	Not yet efficient
Seedlings	29.809	5.500	5,41	Not yet efficient
Urea fertilizer	23.995	2.700	8,88	Not yet efficient
NPK fertilizer	29.105	2.700	10,77	Not yet efficient
Pesticides	5.325.673	150.000	35,50	Not yet efficient
Labor	29.614	120.000	0,24	Not efficient

Table 2 shows that the use of production factors in rice farming has not yet reached maximum efficiency.

1. Land Use Efficiency, with an NPMxi/Pxi value of 1.86 > 1, indicates that land use in rice farming is not yet economically efficient. Therefore, to achieve efficiency, additional land is needed to optimize production. The average land use in the study area is 1 ha, and the more land used, the greater the production. These results are in line with the research by Maharani et al. (2019), which states that the land area of rice farming in the Sidomakmur I Farmer Group is not yet economically efficient, as well as the research by Ikhbal (2019) in Candipuro District, South Lampung Regency, which also shows the need to increase land area to achieve economic efficiency.
2. Seed Use Efficiency, with an NPMxi/Pxi seed value of 5.41 < 1, indicates that seed use in rice farming is not yet economically efficient. Therefore, to achieve efficiency, it is necessary to increase the amount of seed used in order to optimize production. Planting more seeds will increase the population of rice plants per unit of land, thereby increasing crop yields and productivity. These findings are in line with the research conducted by Laksmayani (2022) in Mepanga District, Parigi Moutong Regency, and Ikhbal (2019) in Candipuro District, South Lampung Regency, which both stated that seed use in paddy



field farming is not yet economically efficient and needs to be increased to achieve optimal efficiency.

3. The efficiency of urea fertilizer use, with an NPM_{xi}/P_{xi} value of $8.88 > 1$, indicates that the use of urea fertilizer in rice farming is not yet economically efficient. The average use of urea fertilizer at the research site was only 113 kg/ha, while the recommendation from the Agricultural Research and Development Center (2020) was 200 kg/ha. This means that to achieve economic efficiency, the use of urea fertilizer still needs to be increased. The results of this study are in line with the findings of Seprianti (2023), who stated that the use of urea fertilizer in rice farming in Pamayung District is not yet economically efficient and therefore needs to be increased.
4. The efficiency of NPK fertilizer use, with an NPM_{xi}/P_{xi} value of $10.77 < 1$, indicates that the use of NPK fertilizer in rice farming is not yet economically efficient or is still insufficient. The average use of NPK fertilizer at the research site was 200 kg/ha, while the recommended use of NPK fertilizer was 300 kg/ha. NPK compound fertilizer contains complete macro nutrients, so its application is very important to support growth and increase rice production. Thus, the use of NPK fertilizer in the research area needs to be increased in order to achieve optimal economic efficiency and productivity. These results are in line with the research by Maharani et al. (2019), which states that the use of NPK fertilizer in rice farming in the Sidomakmur I Farmer Group is not yet economically efficient and therefore needs to be increased.
5. The efficiency of pesticide use is considered to be economically inefficient because the NPM_{xi}/P_{xi} value is $35.50 < 1$. The average pesticide use in the study area is only 2.13 liters/ha, which is still far below the optimal requirement. This inefficiency is due to farmers not knowing the correct dosage and method of application in terms of quality, type, timing, and amount of use. Therefore, pesticide use needs to be increased in order to optimize rice production. The results of this study are in line with Septiani (2023), who states that insecticides as plant pest control agents need to be increased to improve production yields.
6. The efficiency of labor use is considered economically inefficient because the NPM_{xi}/P_{xi} value is $0.24 < 1$. The average labor use of 21 HOK/ha is excessive, so the costs incurred are not proportional to the production generated. This condition indicates that the number of workers needs to be reduced so that the use of production factors is more efficient and agricultural yields are optimal. The results of this study are in line with Maharani, et al. (2019), who stated that labor use is inefficient and must be reduced.



Optimal Use of Production Factors

The inefficient use of production factors needs to be adjusted by adding or reducing inputs at the optimal level. The amount of adjustment is determined economically using the Marginal Product Value (NPM_{xi}) approach, which is equated with the unit price of production inputs (P_{xi}). The calculation of optimal production factors in the study area can be seen in Table 3.

Table 3. Calculation of Optimal Use of Production Factors in the Study Area

Variable	NPM _{xi} /P _{xi}	Average usage	Optimal
Land Area (Ha)	1,86	1	1,86
Seeds (kg)	5,41	101	556
Urea Fertilizer (kg)	8,88	113	1.004
NPK Fertilizer (kg)	10,77	200	2.155
Pesticide (Liters)	35,50	2,13	75,62
Labor (HOK)	0,24	21	5,18

Based on Table 3 above, the calculation of optimal use of production factors in the study area can be explained as follows:

1. The use of production factors in the form of land area has an efficiency index value of > 1, namely 1.86. Thus, it can be concluded that the use of land area as a production factor in the study area needs to be increased. According to the calculations that have been carried out, the recommended land area is 1.86 ha/farmer. Based on the calculations that have been made, farmers must add a significant amount of land, namely 0.86 ha, to achieve economic efficiency.
2. The seed production factor efficiency index value for rice farming is 5.41 (>1), indicating that seed production factor utilization is not yet optimal and still needs to be increased. Average seed utilization in the study area is only 101 kg/farmer, while economically, seed utilization would be efficient if it reached 556.32 kg/farmer. However, based on the recommendations of agricultural extension workers, seed use should only range from 70 to 100 kg/ha, taking into account land conditions and the threat of pests that can damage paddy crops. Thus, seed optimization to 556.32 kg/farmer cannot be achieved by farmers in the study area due to the limited availability of seeds.
3. The urea fertilizer production factor efficiency index value of 8.88 (>1) indicates that its use is not yet optimal and therefore needs to be increased. Given the existing input and output conditions, farmers' ability to increase urea fertilizer use is only 1.004 kg/farmer.



However, technically, local agricultural extension workers recommend a urea fertilizer application rate of 200 kg/ha, which is less than the optimal amount calculated in the study. In practice, farmers are also unable to obtain the recommended amount of urea fertilizer due to limited availability. Therefore, optimizing urea fertilizer use at 1.004 kg/farmer is not possible, so it is best to use urea fertilizer as recommended by extension workers.

4. The NPK fertilizer production factor efficiency index value of 10.77 (>1) indicates that its use is not yet optimal, so additional use is still needed. Given the existing input and output conditions, farmers' capacity to increase NPK fertilizer use is 2.155 kg/farmer. However, technically, local agricultural extension workers recommend an NPK fertilizer application rate of 250–300 kg/ha, which is less than the optimal amount calculated in the study. In reality, farmers are also unable to meet the amount of NPK fertilizer according to the research results due to limited availability. Therefore, optimizing the use of NPK fertilizer at 2.155 kg/farmer is not possible, so farmers should use NPK fertilizer as recommended by extension workers.
5. The efficiency index value for pesticide use in rice farming is 35.50 (>1), indicating that its use is not yet optimal and needs to be increased. The average pesticide use in the study area is only 2.13 liters per farmer, whereas based on input and output conditions, farmers should increase their use to 75.65 liters per farmer. However, the high price of pesticides is a major obstacle, making it difficult for farmers to increase their use in accordance with the calculations. In addition, limited farming costs are another inhibiting factor. Therefore, paddy farmers in the study area only use small amounts of pesticides to control pests in paddy fields.
6. The efficiency index value for the use of labor as a production factor in rice farming is $0.24 > 1$. This means that the use of labor as a production factor is not economically efficient, so it is necessary to reduce its use. The average labor use by farmers in the study area is 21 HOK/farmer. Labor use will be economically efficient with such input and output prices if farmers use 5.18 HOK/farmer. Advances in agricultural technology have made it easier for farmers to manage their crops until harvest, which has reduced the use of labor in farming and thus reduced production costs. Therefore, farmers can optimize the use of labor at 5.18 HOK/farmer with the aim of reducing production costs.





CONCLUSION

Based on the research findings, it can be concluded () that the factors that significantly affect rainfed rice production in Anggaloosi Village, Onembute District, Konawe Regency are land area, urea fertilizer, NPK fertilizer, and pesticides (), while seeds and labor do not have a significant effect.

The use of production factors in rainfed rice farming in Anggaloosi Village, Onembute District, Konawe Regency has not reached maximum economic efficiency. This is particularly true for land area, seeds, urea fertilizer, NPK fertilizer, and pesticides , while labor is not economically efficient.

The optimal use of rice farming production factors in rainfed paddy fields, such as land area, seeds, urea fertilizer, NPK fertilizer, pesticides, and labor, to maximize production still requires calculations in terms of price and efficiency .

Based on the results of the study, there are several recommendations that can be made, namely that farmers should be able to use production factors in accordance with land conditions and regularly check soil fertility so that its use is more efficient. The local government is expected to provide support for the development of rainfed rice farming in Anggaloosi Village, Onembute District, Konawe Regency, so as to increase production and support the food self-sufficiency program towards Indonesia Emas 2045. Meanwhile, future researchers are expected to conduct further research focusing on strategies to increase production on rainfed rice fields.

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