Efficiency analysis of using production factors in paddy rice farming in Macope Sub-District, Awangpone District, Bone Regency

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Abstract. The purpose of this study was to analyze efficiency level of the use of production factors on productivity of lowland rice farming in Macope Village, Awangpone District, Bone Regency. The analysis technique used is the Cobb Douglass function analysis which is transformed into multiple linear regression to see the value of the regression coefficient and price efficiency analysis. The results showed that the variables of land area, seeds, urea, NPK, Tabas, DMA, and labor simultaneously had a significant effect on lowland rice productivity. The variable of land area partially has a significant effect on productivity, however, seeds, urea fertilizer, NPK fertilizer, Tabas pesticide, DMA pesticide, and labor partially do not have a significant effect on productivity. The use of seed production factors and labor is not efficient, while the land area, urea, NPK, Tabas, and DMA are not efficient.

1. Introduction
Agricultural development in general is basically an integral and inseparable part of national development. The development of the food crop sub-sector which is carried out gradually and continuously has resulted in quite encouraging successes in the development of agricultural businesses, increasing production, income, welfare, business fields, and absorption of labor in farming. Food crop agriculture is very relevant to be used as a pillar of the economy in the regions, considering that the economic resources owned by each region that are ready to be utilized to develop the regional economy are food crop agricultural resources such as natural resources, human resources in the fields of agribusiness, technology, and etc [1].

Achieve high productivity is not easy, it takes various supporting factors in order to be successful. This is related to the high costs of production factors, both purchase costs and rental costs. Purchase costs include the provision of quality superior seeds, fertilizers, pests and disease medicines, while the rental costs include labor rental costs, production machinery rental and others. This can further hinder the achievement of food security and increase the welfare of farmers because small farmers will find it increasingly difficult to meet the high costs of production factors [2].

Bone Regency is one of the regencies on the east coast of South Sulawesi Province which is 174 km from Makassar City. The condition of food crops in Bone Regency is supported by existing rice fields in several districts. According to data from the Department of Food Crops and Horticulture in Bone Regency, in 2017 1,207,187 tons of rice and 424,445 tons of corn were produced. Similar to previous years, the economic structure of Bone Regency is still dominated by sectors in Category A,
namely Agriculture, Forestry and Fisheries. It can be seen from contribution of the sectors in Category A to the formation of the total GRDP of Bone Regency in 2017, which is 49.37%. Awangpone sub-district is one of the areas contributing to the economy for the agricultural sector, especially for rice crops, with a planted area of 10.924 ha. The level of productivity of rice farming in Awangpone District is 52.11 Ha [3].

Macope Sub-district still experiences many obstacles which make it difficult to reach an efficient condition. Inefficient use of production factors in rice farming will cause waste of costs. Waste of production factor costs is due to problems such as the use of production factors that are not on time or in quantity. Therefore, proper management is needed by using production factors efficiently in order to increase production and maintain production sustainability. For farmers, farming activities carried out not only increase production but how to increase income through the use of production factors [3].

2. Research methods
This research was conducted in Macope Sub-district, Awangpone District, Bone Regency, South Sulawesi Province. The determination of the research location was carried out by purposive (purposive sampling) with the following considerations (1) Awangpone District is one of the rice production centers in Bone Regency which has the 6th largest rice field harvest area, namely Libureng, Dua Boccoe, Kahu, Bengo, and Tellu Siatinge Districts, (2) easy access to research locations so as to save costs, time and effort, (3) there is the Lappo Ase Monument in Awangpone District which was built in the framework of the Lappo Ase Operation Grand Harvest (OLA) in 1981 as a form of success in agriculture, especially rice, (4) Macope Sub-district was chosen as research location because it is the area with the highest land area in Awangpone District, namely 583.65 Ha. The random sampling method is a sampling technique which all individuals in the population either individually or collectively are given the same opportunity to be selected as members of the sample. The total population in Macope Sub-district is 685 farmers, while the number of samples to be used is 30 respondents [4]. In studies that use statistical data analysis, the minimum sample size is 30 and the proper sample size in the study is between 30 and 500 [5].

2.1. Douglass cobb production function analysis
The cobb douglas production function is a function or equation involving two or more variables, that is, one variable is called the dependent or described variable (Y) and the others are called independent variables or explanatory variables. Douglass's Cobb function model in research :

\[ \ln Y = \ln a + \ln b_1 LL + \ln b_2 B + \ln b_3 PU + \ln b_4 NPK + \ln b_5 T + \ln b_6 DMA + \ln b_7 TK \]

Information :
Y = Rice productivity
a = Constant
b = Regression coefficient
e = Error (disturbance term)
NPK = NPK fertilizer
TK = Labor
LL = Land area
B = Seed
PU = Urea fertilizer
DMA = DMA pesticide
T = Tabas pesticide

2.2. Price efficiency analysis
To measure the level of efficiency in the use of production factors on the productivity of lowland rice farming in Macope Sub-District, Awangpone District, Bone Regency, namely the level of allocative efficiency with the main objective is to measure the success rate of farmers in their efforts to achieve maximum profit, where price efficiency can be achieved when the product value of each input is equal to its marginal cost [6]. Systematically, it can be formulated as follows :

\[ \frac{NPMxi}{Pxi} = k = 1 \]
Information:

\[ \text{NPM}_i = \text{Marginal product value} \]
\[ x_i = \text{Input (unit)} \]
\[ \text{Px}_i = \text{Production price} \]
\[ K = \text{The value of efficiency in the use of production inputs} \]

As for the assessment criteria as follows:

- \( \frac{\text{NPM}_i}{\text{Px}_i} > 1 \), so the use of production factors is not efficient yet.
- \( \frac{\text{NPM}_i}{\text{Px}_i} = 1 \), so the use of production factors is efficient.
- \( \frac{\text{NPM}_i}{\text{Px}_i} < 1 \), so the use of production factors is not efficient.

3. Results and discussion

3.1 The effect of production factors toward the productivity of rice paddy farming

The Cobb Douglass production function is used to identify how the factors of production effects (land area, seeds, urea, NPK, Tabas, DMA, and labor) toward productivity of rice paddy farming. The results of the Cobb Douglass production function analysis can be seen in Table 1.

Table 1. The results analysis of respondent farmers paddy production functions in Macope sub-district, Awangpone District, Bone Regency, 2019.

| No | Production factors (Xi) | Unstandardized coefficients (Bi) | T-count | Significant |
|----|-------------------------|----------------------------------|---------|-------------|
| 1  | (Constant)              | 0.646                            | 0.935   | 0.360       |
| 2  | Land area               | 0.712                            | 3.103   | 0.005       |
| 3  | Seed                    | -0.026                           | -0.107  | 0.916       |
| 4  | Urea fertilizer         | 0.210                            | 1.129   | 0.271       |
| 5  | Npk fertilizer          | 0.154                            | 0.925   | 0.365       |
| 6  | Tabas fertilizer        | 0.303                            | 1.066   | 0.298       |
| 7  | DMA fertilizer          | 0.089                            | 0.514   | 0.612       |
| 8  | Labor                   | 0.087                            | 0.294   | 0.771       |

\[ \text{R Square}= 0.477 \]
\[ t\text{-table}= 2.074 \]
\[ f\text{-score}= 2.863 \]
\[ f\text{-table}= 2.46 \]

The Cobb Douglass function model is based on the results of the analysis in Table 2, namely:

\[
\ln Y = 0.646 + 0.712 \ln LL + (-0.026) \ln B + 0.210 \ln U + 0.154 \ln NPK + \\
(-0.303) \ln T + 0.089 \ln DMA + 0.087 \ln TK + e
\]

3.1.1. Experiment F. From the results of the analysis in Table 1, the 95% trust level, the calculated f score (2.863) is greater than the f table score (2.46), this shows that the independent variables (land area, seeds, fertilizer, urea, NPK, Tabas, DMA, and labor), Simultaneously a significant effect on the productivity of respondent farmers rice paddy in Macope Sub-district, Awangpone District, Bone Regency.
3.1.2. Experiment T. The results of the variable effect test partially using the t experiment in Table 1 indicate that:

3.1.2.1. Land area (X1). In the regression analysis, it was found that the variable land area was positive, so there was a positive effect on rice paddy productivity that regression coefficient showed score of 0.712. So each additional land area of 1 hectare will increase the productivity of rice paddy by 0.712 kg, assumsthat the use of other inputs remains constant.

3.1.2.2. Seed. Based on the regression results, the seed variable is negative. This shows that there is a negative effect on rice paddy productivity with the regression coefficient show score of -0.026, this mean each addition of 1 kg of seeds will reduce the productivity of lowland rice by 0.026 kg, assuming that the score of other inputs is constant.

3.1.2.3. Urea and NPK fertilizers. From the results of the analysis on the t experiment, it was found that the urea variable was positive. This shows that there is a positive effect on rice paddy productivity that the regression coefficient shows a score of 0.210. This means that for each addition of 1 kg of urea, it will increase the productivity of rice paddy by 0.210 kg, assuming that the use of other inputs remains constant. For NPK fertilizer, positive results are also obtained, so there is a positive effect on rice paddy productivity that the regression coefficient shows a score of 0.154. This means that each addition of 1 kg of NPK fertilizer will increase the productivity of rice paddy by 0.154 kg, assuming that the use of other inputs is constant.

3.1.2.4. Tabas and DMA Pesticides. Based on the results of the Tabas variable regression is positive. This shows that there is a positive effect on rice productivity so that the regression coefficient shows a score of 0.303, so that every addition of 1 liter of Tabas will increase rice productivity by 0.303 Kg, assuming that the score of other inputs is constant. As for the DMA, the results are positive, so there is a positive effect on rice paddy productivity, where the regression coefficient shows ascore of 0.089 so that every addition of 1 liter of DMA will increase rice paddy productivity by 0.089 kg, assuming that the score of other inputs is constant.

3.1.2.5. Labor. Based on the regression results, the labor variable is positive. This shows that there is a positive effect on rice paddy productivity where the regression coefficient shows a score of 0.087. This means that an increase in the use of labor increases production, that is, each increase in the outpouring of labor by 1 HOK will increase productivity by 0.087 kg if other factors are considered constant.

3.2 The efficient use of production factors on rice paddy farming productivity
The results calculation efficiency of use of production factors in rice farming of respondent farmers in Macope Sub-district, Awangpone District, Bone Regency, can be seen in Table 2.

Table 2. Analysis of the efficiency of using production factors in maccope sub-distirct, Awangpone District, Bone Regency, 2019.

| No. | Variable     | Coefficient | NPM       | Price       | Efficiency |
|-----|--------------|-------------|-----------|-------------|------------|
| 1.  | Land area    | 0.712       | 17,332,358| 6,000,000   | 2.88       |
| 2.  | Seed         | -0.026      | -11,720.8 | 12,066.67   | -0.97      |
| 3.  | Urea fertilizer | 0.210      | 13,811.93 | 1,800       | 7.67       |
| 4.  | NPK fertilizer | 0.154       | 15,392.54 | 2,400       | 6.41       |
| 5.  | Tabas fertilizer | 0.303       | 8,017,380 | 908,666.67  | 8.8        |
| 6.  | DMA fertilizer | 0.089       | 3,233,649 | 450,000     | 7.18       |
| 7.  | Labor        | 0.087       | 88,381,419| 293,166     | 0.30       |
3.2.1 Land area. a score of $k = 2.88 > 1$, the production factor of the land area is not possible to obtain a price permit, so the area of arable land needs to be increased. In the research area, it is possible to increase the area of arable land to see the conditions of the cropping patterns used by farmers who use the table system or direct seed sowing so that the use of land area and seeds can go in one direction. An increase in land area means an increase in plant population, with an increase in production along with an increase in the number of plants.

3.2.2. Seed. a score of $k = -0.97 <1$, it means that the use of land area for rice paddy farming in terms of price, is not efficient or exceeds the recommended amount so it needs to be reduced in order to maximize lowland rice production which will affect the productivity of rice farmers at the research location. The average use of seeds in one planting season is 54 kg/ha. The recommendation for the use of certified seeds is 25 Kg / Ha so that the use needs to be reduced [7].

3.2.3. Urea fertilizer. A score of $k = 7.67 > 1$, it means that the use of seeds in rice paddy farming in terms of price is not efficient, so it is necessary to add the dose of seed usage, so as to increase the population of lowland rice plants and maximize rice production, which will have an effect on increasing productivity. Rice farmers at the research location. The average use of Urea in one growing season is 370.12 Kg / Ha, while the recommendation from the Department of Food Crops and Horticulture in Bone Regency in 2017 is 400 Kg / Ha so that the use of fertilizers needs to be increased [7].

3.2.4. NPK fertilizer. A score of $k = 6.41 > 1$, it means that the use of NPK fertilizer for rice paddy farming in terms of price is not efficient or insufficient so it needs to be added. The average use of NPK fertilizer in one planting season is 243.55 Kg / Ha, while the recommended amount is 300-400 Kg / Ha. The addition of the NPK fertilizer dosage is expected to meet the needs of sulfur elements for plants, so that, can help increase the size of the seeds and help accelerate plant growth which will affect the productivity of rice paddy farmers in the research location.

3.2.5. Tabas pesticide. A score of $k = 8.8 > 1$, it means that the use of the pesticide Tabas for rice paddy farming in terms of price is not efficient or insufficient, so it needs to be added. The average use of this pesticide in one growing season at the research location is 0.92 Liter / Ha. As for the recommendation to use Tabas according to the Directorate General of Agricultural Infrastructure and Facilities namely 1.75-3.25 Liter/Ha.

3.2.6 DMA pesticide. The use of DMA I pesticides has not yet reached the level of price efficiency, this can be seen from the score of $k = 7.18 > 1$, so its use needs to be increased. The low use of the DMA pesticide production factor in the production process in this research area is probably due to the fact that it is not in accordance with farming guidelines such as in measuring the dose and the low dose which will cause damage to rice and will reduce rice production. The average use of DMA pesticides at the research location is 0.67 Liter / Ha, while the recommended use of DMA according to the Directorate General of Agricultural Infrastructure and Facilities is 0.75-1 Liter / Ha.

3.2.7. Labor. A score of $k = 0.30 <1$, it means that the utilization of labor in terms of price is not efficient, so it is not possible to add labor. This is because the use of these production factors has exceeded the recommended usage, resulting in waste. Therefore, the use of this labor needs to be reduced to obtain a level of efficiency. p-score = 0.042), and the sanitation variable (p-score = 0.024).

4. Conclusion
Based on the research results, the use of seed production factors with a score of $k = -0.97 <1$ and labor with a score of $k = 0.30 <1$ are categorized as inefficient because the efficiency is less than 1. As for
the land area has score of $k = 2.88 > 1$, urea has a score of $k = 7.67 > 1$, NPK with a score of $k = 6.41 > 1$, tabas with a score of $k = 8.8 > 1$, and DMA with a score of $k = 7.18 > 1$, which means that the production factors have not reached the level of price efficiency, this can be seen from the efficiency score is greater than 1.

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