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TECHNICAL EFFICIENCY ANALYSIS OF SUPERIOR RICE FARMING USING THE DIRECT SEED PLANTING METHOD IN PADDY FIELDS OF KUSAN TENGAH SUB-DISTRICT, TANAH BUMBU DISTRICT, INDONESIA

Zulkipli*, **Yanti Nuri Dewi**, **Ferrianta Yudi**
Master's Study Program of Agricultural Economics, Faculty of Agriculture,
University of Lambung Mangkurat, South Kalimantan, Indonesia
*E-mail: bainmtk@gmail.com

ABSTRACT
This study aims to analyze the influence of the use of factors of production on the production of superior rice farming, the level of technical efficiency and the factors causing inefficiency in the Tablea method of superior rice farming techniques. The results of the analysis show that the production factors that have a significant effect on the production of superior rice using the Tablea method are the production factors of large areas of land, seeds, fertilizers, liquid medicine and labor. The value of the technical efficiency index of rice farming using the Tablea method is 0.9262. Factors causing technical inefficiency in rice farming using the Tablea method are the age of the farmer, the education level of the farmer and the farmer's length of experience in farming.

KEY WORDS
Technical efficiency, superior rice, technology.

The shifting cropping system has been cultivated for generations, which uses a lot of labor and time. The increase in farm production results is relatively small compared to the previous results. The government has worked around this problem by introducing rice cultivation with the Tablea system. The Tablea system of rice farming hides it by using direct seed planting tools or can be directly sown at a certain distance and using better varieties that have been introduced in the study.

Based on the development of rice production in South Kalimantan Province in 2020 it decreased by 208,411.61 tons (16%) compared to 2019. This was because the rice harvest area decreased by 64,219.17 ha (18%) compared to 2019 (BPS South Kalimantan Province, 2021).

This is not the case in Tanah Bumbu District, where this area is showing positive growth both in terms of harvested area and production. Paddy harvested area actually increased by 1,070.89 ha (9%), which was also followed by rice production which increased by 1,952.61 tons (4%), compared to the previous year (BPS Province of South Kalimantan, 2021). In addition, the increase in production in Tanah Bumbu Regency increased allegedly due to the application of the Tabela rice farming method in paddy fields.

Tanah Bumbu Regency is a district where most of the farmers are cultivating rice using the Tabela method and a transplanting system. Planting techniques applied in agriculture are always intended to increase yields and to increase the productivity of rice farming by developing technology from the transplanting system through the seedbed to the Tablea system and the timing of planting, also determines the productivity to be obtained. The main drawback of applying the Tablea cropping method is the increased need for seeds and it can only be applied in areas where air conditions can be controlled. The Tablea method is more effective because it can speed up the time for supplies and does not require more workers so that the costs incurred are relatively less, this is the factor that causes the production results obtained by farmers to be quite good and profitable. Thus the table rice farmer system must be able to allocate production factors that are used efficiently to produce maximum profits.

The purpose of this research:

- analyze the influence of the use of factors of production on the production of rice farming with the Tablea method;

- analyze the level of technical efficiency of rice farming with the Tablea method;
- analyze the factors that cause the technical inefficiency of rice farming with the Tablea method.

METHODS OF RESEARCH

This research was conducted in Kusan Tengah District, Tanah Bumbu Regency, South Kalimantan Province. This research was conducted from March to July 2022.

In this study, the data used were primary data obtained by direct interviews with table farmers as research respondents. In addition, secondary data is needed to support primary data obtained from literature studies, related institutions or agencies.

The influence of the use of factors of production on the production of rice farming using the Tabela method using the Cobb-Douglas production function model equation, with a stochastic frontier approach using the Ordinary Least Square (OLS) method (Coelli *at al*., 1998):

$$ln\ Y = \beta_0+\beta_1\ ln\ X_1+\beta_2\ ln\ X_2+\beta_3\ ln\ X_3+\beta_4\ ln\ X_4+\ \beta_5\ ln\ X_5+\beta_6\ ln\ X_6\ +v_i-u_i$$

Where:

Y: paddy production using the Tablea method (kg);
X_1: area of farming land (ha);
X_2: seeds (kg);
X_3: fertilizer (kg);
X_4: liquid medicines (liters);
X_5: solid drugs (gr);
X_6: labor (HKO);
B_0: constant coefficient;
β_1, β_2, β_3, β_4, β_5, β_6: coefficient;
v_i-u_i: *error term* (v_i is the noise effect, u_i is the model's technical inefficiency effect).

The level of technical efficiency of rice farming with the Tablea method can be measured using the formula:

$$TE_i = \frac{Y_i}{Y_i^*}$$

Where:

TE_i: technical efficiency achieved by the i-th observation;
Y_i: actual output of superior rice plants (kg);
Y_i^*: output limit (potential) of superior rice.

Factors that cause technical inefficiency of rice farming using the Tablea method mathematically:

$$u_i = \delta_0 + \delta_1 Z_1 +\delta_2 Z_2 +\delta_3 Z_3$$

Where:

u_i: technical inefficiency effect;
δ_0: constant;
$\delta_1, \delta_2, \delta_3$: coefficients of inefficient estimators;
Z_1: farmer's age (years);
Z_2: farmer's education (years);
Z_3: farming experience (years).
t-test:

$$t_{statistics} = \frac{\delta_i}{Se(\delta_i)}$$

Where:

b_i: the regression coefficient of the independent variable i-th;

Se (b_i): standard error of the i-th estimated regression;

The hypothesis:

- H_0: $\delta_i = 0$;
- H_1: $\delta_i \neq 0$.

The test criteria are tested with a confidence level of 95% or α = 5%:

- H_0 is rejected, if $|t_{statistics}| > t_{table\ (\alpha/2,\ n-k-1)}$;
- H_0 is accepted, if $|t_{statistics}| \leq t_{table\ (\alpha/2,\ n-k-1)}$.

RESULTS AND DISCUSSION

The model used to estimate the production function of superior rice farming using the Table method is the Cobb-Douglas Stochastic Production Frontier function model using Ordinary Least Square (OLS) parameters. The OLS method for estimating the factors of production used in lowland rice farming activities is Tablea method. The initial production factors that are thought to influence the production of superior rice using the Tablea method are land area, use of seeds, fertilizers, liquid medicines, solid medicines and labor.

Table 1 – Estimation of the Cobb-Douglas production function using the OLS method

Input Variables	Coefficient	$t_{statistics}$
Constant	7.0382	16.2055*
Land area (X_1)	0.0104	1.4288
Seed (X_2)	0.4271	4.5086*
Fertilizer (X_3)	0.0265	2.3629*
Liquid medicines (X_4)	-0.0324	4.5927*
Solid drugs (X_5)	-0.0103	1.0503
Labor (X_6)	0.0901	1.7784*
Sigma-squared	0.0254	
Log-likelihood OLS	28.7808	

*Note: *real at the level α = 5% (t_{table}=1,67412).*
Source: Primary data processing, 2022.

The sigma-square value of 0.0254 is small enough so that it can be concluded that the error term inefficiency in superior rice farming with the Tablea method is normally distributed. The log likelihood value with the OLS method (28.7808) means that the data on the production function using the OLS method is good and in accordance with the conditions in the field. Based on the results of the analysis, the estimation of the Cobb-Douglas production function with the OLS method is obtained by the function model:

$$ln\ Y = 7{,}0382 + 0{,}0104\ ln\ X_1 + 0{,}4271\ ln\ X_2 + 0{,}0265\ ln\ X_3 - 0{,}0324\ ln\ X_4 - 0{,}0103\ ln\ X_5 + 0{,}0901\ ln\ X_6$$

The interpretation of each factor of production in the best model of the stochastic frontier production function of the OLS method is as follows:

Land Area (X_1). The production factor of land area has no significant effect on superior rice production at the level of α = 5% with an estimated parameter value or production elasticity of 0.0104. This figure indicates that the addition of land area by 1% with other inputs remains constant and can increase rice production by 0.0104%. This is not in accordance with the results of Askalani's research (2021) that land area has a positive influence on paddy rice production in Sustainable Food Crops Agricultural Land (LP2B) in Batu Mandi District, Balangan Regency. According to Nadiar (2017), stated that the results of the study showed that land area had a significant effect on organic rice production in tidal land in South Kalimantan.

Seeds (X_2). The seed production factor has a significant effect on the production of superior rice at the level of α = 5% with an estimated parameter value or production elasticity of 0.4271. This figure indicates that the addition of 1% seed with other inputs can still

increase rice production by 0.4271%. By using the description of the production curve, the position of using the number of seeds factor is in production area II (rational area) for the use of production inputs. Farmers are still rational if they wish to increase the use of seeds to obtain higher production, even though the additional production to be obtained is not large.

Seed is a means of production that determines the success of farming. The better the quality of the seeds, it will increase production and can facilitate maintenance. The superior rice varieties used by farmers are Mekongga and Ciherang. In rice farming, seeds have a very important role. Seed quality is one of the factors that will affect rice production. This is in accordance with Askalani's research (2021) that the number of seeds has a positive influence on lowland rice production in Lowland Rice Farming Land in Sustainable Food Crops (LP2B) in Batu Mandi District, Balangan Regency. According to Nadiar (2017), stated that the results of the study showed that the number of seeds had a significant effect on organic rice production in the tidal land of South Kalimantan.

Fertilizer (X_3). The fertilizer production factor has a significant effect on the production of superior rice at the level of α = 5% with an estimated parameter value or production elasticity of 0.0265. This figure indicates that the addition of 1% fertilizer with other inputs can still increase rice production by 0.0265%. By using the description of the production curve, the position of the use of the factor in the amount of fertilizer is in the production area II (rational area) for the use of production inputs. Farmers are still rational if they wish to increase the use of fertilizers to obtain higher production, even though the additional production to be obtained is not large. This is not in line with Askalani's research (2021) that N fertilizer and NPK fertilizer have no significant effect on paddy rice production in Sustainable Food Crops (LP2B) in Batu Mandi District, Balangan Regency.

Liquid Medicines (X_4). The production factor of liquid medicines has a significant effect on the production of superior rice at the level of α = 5% with an estimated parameter value or production elasticity of -0.0324. This figure indicates that the addition of liquid medicines by 1% with other inputs can still reduce rice production by 0.0324%. This is not in accordance with Askalani's research (2021) that drugs have no significant effect on paddy rice production in Sustainable Food Crops (LP2B) in Batu Mandi District, Balangan Regency. According to Nadiar (2017), stated that the results of the study showed that vegetable pesticides had no significant effect on organic rice production in tidal land in South Kalimantan.

The increasing number of liquid medicines used up to the recommended limit for the use of liquid medicines, the high-yielding rice production using the Tabela method will increase. The use of doses and types of liquid medicines must be paid close attention because in the OPT control section there are main factors to increase the quality and quantity of production.

Solid Drugs (X_5). The production factors of solid drugs have no significant effect on the production of superior rice at the level of α=5% with an estimated parameter value or production elasticity of -0.0103. This figure indicates that the addition of solid drugs by 1% with other inputs can still reduce rice production by 0.0103%. This is in accordance with Askalani's research (2021) that drugs have no significant effect on paddy rice production in Sustainable Food Crops Agricultural Land (LP2B) in Batu Mandi District, Balangan Regency. According to Nadiar (2017), stated that the results of the study showed that vegetable pesticides had no significant effect on organic rice production in tidal land in South Kalimantan.

The increasing number of solid drugs used up to the BPTP recommendation limit for the use of solid drugs will increase the production of superior rice using the Tabela method. The use of doses and types of solid drugs must be very concerned because in the OPT control section there are main factors to increase the quality and quantity of production.

Labor (X_6). The labor production factor has a significant effect on superior rice production at the level of α = 5% with an estimated parameter value or production elasticity of 0.0901. This figure shows that adding 1% of the workforce with other inputs can still increase rice production by 0.0901%. By using the description of the production curve, the position of the use of the number of labor factors is in the production area II (rational area) the use of production inputs. Farmers are still rational if they wish to increase the use of labor

to obtain higher production, even though the additional production to be obtained is not large. This is in accordance with Askalani's research (2021) that labor has a significant effect on paddy rice production in Sustainable Food Crops Agricultural Land (LP2B) in Batu Mandi District, Balangan Regency. According to Nadiar (2017), stated that the results of the study showed that labor had a significant effect on organic rice production in the tidal land of South Kalimantan.

The Tablea method of superior rice farming is said to be technically efficient if it is able to produce a number of outputs using fewer inputs or is able to produce maximum output from the use of a certain number of inputs. The level of technical efficiency is generated from the Cobb-Douglas production function model using the frontier stochastic approach with the *Frontier 4.1* program. The advantage of the frontier stochastic approach is that apart from generating estimated parameters that affect production, it can also determine the technical efficiency level of each farmer, as well as identify factors that affect technical efficiency.

Based on the results of the analysis, the efficiency per individual respondent obtained an average efficiency index value of 0.9263 and a maximum of 0.9800 while a minimum index of 0.4028. Thus, the technical efficiency in this model, on average, the respondent farmers each has the opportunity to be able to maximize efficiency results.

Table 2 – The distribution of the technical efficiency index of respondent farmers in the superior rice farming method is Tablea

Distribution of technical efficiency index	Number of farmers (people)	Percentage (%)
0.3000 ≤ TE < 0.5000	1	2
0.5000 ≤ TE < 0.7000	0	0
0.7000 ≤ TE < 0.9000	9	15
0.9000 ≤ TE ≤ 1.0000	50	83
Amount	60	100
Average	0.9263	
Maximum	0.9800	
Minimum	0.4028	

Source: Primary data processing, 2022.

From the distribution of the technical efficiency index of the respondent farmers in the high-yielding rice farming method in the Tabela method, it shows that 59 farmers (98%) have efficient index values in the superior rice farming method in the Tablea method, while the remaining 2% (1 farmer) are in the low efficient category (value efficiency <0.70) in the superior rice farming method Tablea. The technical efficiency index value is categorized as efficient at 0.70 (Kumbhakar and Lovell, 2000). This shows that the selection of paddy fields cultivated by farmers for superior rice farming with the Tablea method in the Central Kusan District, Tanah Bumbu Regency is appropriate.

In contrast to the production function which is determined by the use of production inputs, the inefficiency function is determined by other factors outside of inputs related to the managerial aspects of farmers. Factors that are thought to influence the level of technical efficiency of the superior rice farming method in the study were: the age of the farmer, the education level of the farmer and the length of experience in farming. The result of the estimation of this inefficiency function is a simultaneous result which is processed together with the production function using the Cobb-Douglas model with the OLS method.

Table 3 – Estimation of the effect of technical inefficiency on the stochastic frontier production function of superior rice farming using the Tablea method

Input Variables	Coefficient	$t_{statistics}$
Intercept	0.6899	0.7301
Farmer's age (Z_1)	0.0451	6.3059*
Farmer's education (Z_2)	-0.4631	-5.8321*
Farming experience (Z_3)	-0.0297	-1.6472

*Note: *real at the level α = 5% (t_{table}=1,67412).*
Source: Primary data processing, 2022.

Farmer Age Factor (Z_1). Based on Table 3, the results of the estimation of the effect model of technical inefficiency show that the age factor with a t-hit of 6.3059 is greater than the t-tab of 1.67252 at the level of α = 5% gives a real or positive effect on the technical inefficiency of superior rice farming . The coefficient value is positive at 0.0451. The positive sign indicates that the increasing age of the farmer will increase the technical inefficiency of 0.0451% in superior rice farming. This means that the older the farmers are, the more inefficient they are in running superior rice farming. This is in line with the notion that the older the farmer is, the lower his working capacity and technical ability will have a negative impact on technical efficiency. This result is supported by the results of Askalani's research (2021) which found that the age factor of the farmer has a significant effect on the level of technical inefficiency with an estimated positive sign coefficient using the MLE method of 0.0151. This means that if the farmer's age is increased, the inefficiency will increase so that the farming efficiency decreases. However, it is inversely proportional to the results of Nadiar's research (2017), saying that the age of the farmer has no significant effect on the level of technical inefficiency in organic rice farming in South Kalimantan.

Based on the results of the study, that the average age of rice farmers with the Tablea system in Kusan Tengah District, Tanah Bumbu Regency is 47 years. Responding farmers to the Tablea system of rice as many as 57 people are of productive age, meaning that physically farmers have the ability to cultivate rice and can contribute to physical abilities which will later affect productivity. However, 3 farmers are of unproductive age, meaning that physically the farmer's ability to manage table rice farming has decreased. Based on the results of the study, the largest age group was between 40-49 years, namely 26 farmers (43%), while the smallest was in the 60-69 year age group, namely 7 farmers (12%).

Farmer Education Factor (Z_2). The education factor is the amount of time (years) spent by farmers undergoing their formal education. This variable is considered as a proxy for the farmer's managerial ability. The longer farmers receive formal education; it is thought that it will encourage farmers to be more efficient in the production process and the allocation of the use of production inputs in accordance with their level of knowledge. Higher education should be able to encourage farmers to adopt better cultivation technologies and use a combination of production inputs proportionally. Education factor is one of the important factors in causing the technical inefficiency of farming.

Higher education can encourage farmers to apply more proportional farming technology using production inputs. The level of education is very influential on the mindset of farmers in making decisions, the higher the level of education, the faster and more precise in making decisions. The level of education of farmers will affect the way of implementation or decision making in managing their farming to increase production, especially the table system rice production. The higher the level of education achieved, the farmer will be more careful about the possible risks that will be faced. Limitations of education will close their horizons in thinking, so they think more short and straight forward. The level of education will also affect the process of accepting new technology that is introduced, where they do not immediately accept or reject without practice and concrete evidence of the changes they feel from the new technology.

Based on Table 3, the t-hit value of (-5.8321) is greater than the t-tab of 1.67252 at the level of α = 5% which has a significant effect on technical inefficiency of superior rice farming using the Tablea method. The coefficient value is negative, which is -0.4631 indicating that the longer the farmer's education will reduce technical inefficiency by 0.4631% in superior rice farming.

The negative value on the coefficient of the education level variable is as expected. This phenomenon indicates that the higher the education, the higher their ability to adopt technology and be able to use inputs proportionally so that it will increase performance in farming superior rice. Variable level of length of education has a significant effect on technical inefficiency indicating that the cultivation of superior rice farming using the Tablea method in the research area is the ability of farmers to master land conditions, systems and cultivation that are suitable for paddy fields because they use superior rice seeds, so it takes a long period of education to apply the technology the.

This result is supported by the results of Askalani's research (2021) which found that the education factor of farmers has a significant effect on the level of technical inefficiency with an estimated negative sign coefficient using the MLE method of -0.0790. This means that if the education level of farmers is increased, the inefficiency will be reduced so that farming efficiency will increase. However, it is inversely proportional to the results of Nadiar's research (2017), saying that the education level of farmers has no significant effect on the level of technical inefficiency in organic rice farming in South Kalimantan.

Length of Experience in Farming (Z_3). In several previous studies, experience was considered as a proxy for farmer age, especially in traditional farming systems. The more experience farmers have in cultivation activities, the more efficient they are in carrying out farming activities because they already know cultivation activities well compared to other farmers who are just trying these cultivation activities. Therefore, the estimated value of the farmer's experience factor is expected to be negative, meaning that more and more experienced farmers encourage these farmers to be more technically efficient or minimize the effects of technical inefficiency.

Long experience in farming can encourage farmers to apply farming technology more proportionally using production inputs. Farming experience influences the behavior of farmers in managing their farming. Usually farmers have longer farming experience and a lot of knowledge in farming so they tend to be careful in making decisions. Respondent farmers who have farming experience range from 11-35 years, with an average of 20.45 years of farming experience.

Based on Table 3, the length of experience of farming has a t-hit value of (-1.6472) which is smaller than the t-tab of 1.67252 at the level of α = 5%, meaning that the length of experience of farming has no significant effect on the technical inefficiency of farming Tablea method superior rice. This is in accordance with Nadiar's research (2017), which states that farmers' length of farming experience has no significant effect on the level of technical inefficiency in organic rice farming in South Kalimantan. However, on the contrary, the results of Askalani's research (2021) found that the factor of length of experience in farming had a significant effect on the level of technical inefficiency with an estimated coefficient with a negative sign using the MLE method of -0.0260. This means that if the farmer's farming experience is increased, the inefficiency will be reduced so that farming efficiency will increase.

CONCLUSION

Based on the results and discussion that has been described regarding the technical efficiency of the Tablea method of superior rice farming in paddy fields, Central Kusan District, Tanah Bumbu Regency, several conclusions were obtained, namely:

- The production factors that have a significant effect on the production of superior rice in the Tablea method are the factors of production of land area, seeds, fertilizers, liquid medicines and labor. The production factor that has no significant effect on the production of superior rice is the production factor of solid medicines;
- The technical efficiency index value of rice farming using the Tablea method is 0.9262. The results showed that 98% of the farmers, the efficiency index distribution was classified as efficient in the Tablea method of superior rice farming, while the remaining 2% belonged to the low efficient category;
- Factors that cause technical inefficiency of rice farming with the Tablea method, namely the age of the farmer, the level of education of the farmer and the length of experience in rice farming.

Recommendations:

- Maintaining arable land area, increasing the use of labeled superior seeds, and the level of technical efficiency, as well as the use of drugs is not excessive;
- It is expected that there will be the development of agricultural extension agents, especially those who have specialization (specific expertise) in the table superior rice commodity so that it is more effective in educating and assisting table superior rice

farmers;

- The need for counseling regarding the use of solid and liquid drugs that are the right type, amount and method of application in handling OPT control in superior rice farming, so that the use of these drugs functions effectively in preventing pest and disease attacks;
- Farmers actively participate in various formal and non-formal counseling and educational activities held by the local regional government to improve the technical efficiency of rice farming at the farmer level;
- For further research, it is expected to add the variables of tilled land ownership status, seed labels, land management systems, harvesting systems and non-formal education as factors that influence the inefficiency of the Tablea method of superior rice farming.

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