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# EFFICIENCY ANALYSIS OF RICE FARMING IN MUARA TELANG DISTRICT OF BANYUASIN REGENCY (INDONESIA) USING THE STOCHASTIC FRONTIER APPROACH

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## ABSTRACT
Banyuasin Regency is the biggest contributor to rice production in South Sumatra with a 34.22 percent of 539,316 ha harvested area. The largest rice production center in Banyuasin Regency is in Muara Telang District. This research will analyze the efficiency of rice farming in Muara Telang District, Banyuasin Regency using Stochastic Frontier Analysis method. The SFA method describes the maximum production that can be generated from the production inputs used. This research shows that there are efficiency differences caused by input factors and other external factors. Input factors that affect the efficiency level are seeds, fertilizers and pesticides, but the most affecting input factor is land area, meaning that traditional agriculture still relies on land area. Other external factors which are farmer age, farmer education, and farming experience have a negative and significant effect on rice farming efficiency.

## KEY WORDS
Farming, rice, production, factors, efficiency.

Rice production in Indonesia is currently concentrated on Java and Sumatra Islands. One of the provinces that have the largest rice barn in Sumatra is South Sumatra. In the New Order era, many rice fields were opened for transmigration programs. In general, the agricultural sector contributed 19.57 percent to the total GRDP of South Sumatra, meaning that the agricultural sector has a high influence on economic growth in South Sumatra (Oktavia et al., 2015). On Figure 1 shown the Food Consumption per Capita in South Sumatra Province from 2013 to 2020.

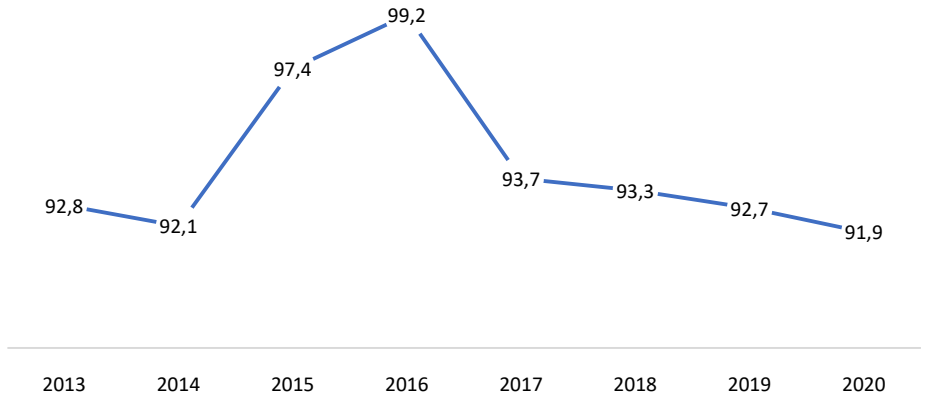


Figure 1 – Food Consumption in South Sumatra Province in from 2013 to 2020 (kg/capita/year).
Source: Food Security Statistics: Ministry of Agriculture Republic Indonesia 2021

Since 2013 food consumption in South Sumatra were increasing and achieved the highest consumption needs in 2016 with the amount of 99.2 kg but decreased to 93.7 kg in 2017 and continued to decrease until 2020. The decline in consumption was because of the

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people reduce consuming rice and switch to consuming wheat-based food, this is in line with previous research by Ariani (2014). In addition, according to the Ministry of Agriculture in 2015, the downward trend in rice consumption is thought to be due to an increase in people's welfare and awareness about health thus they consume rice substitutes. Table 2.2 shows that harvested area in South Sumatra is 539,316 ha in 2020, where Banyuasin Regency is the biggest contributor to rice production in South Sumatra with a harvested area of 34.22 percent.

Banyuasin Regency has succeeded in maximizing swampland into productive agricultural land. If rice production is converted into rice, the potential for rice production in Banyuasin Regency reaches 52 tons in the 2019 planting season. With a harvested area of 209 ha, the total production is 906 tons of GKG, equivalent to 520 tons of rice. Based on table 2.3, the population in South Sumatra, especially in the three rice-producing areas, has increased every year. Banyuasin Regency is the largest rice producer in South Sumatra with a harvested area of 211,187 ha. Potential locations are spread across 21 sub-districts such as Rantau Bayur at 6.99 percent, Muara Telang at 17.87 percent, Tanjung Lago at 6.84 percent, Air Saleh at 15.26 percent, Makarti Jaya at 4.94 percent, Sumber Marga Telang at 4.55 percent, Muara Sugihan at 13.51 percent, Penuguan Strait at 6.40 percent, with four potential sub-districts to be developed namely Penungguan Strait, Rantau Bayur, Tungkal Ilir, and Rambutan. One of the largest rice production centers in Banyuasin Regency is in Muara Telang District.

In general, the difference is caused firstly by socioeconomic factors and secondly by technical factors (Hamdan, 2011). Meanwhile, according to Effendy (2010) the variables that have a significant influence on rice production are land area, number of seeds, labor, and fertilizers. Furthermore Mahananto et.al. (2009) in Wadu et al. (2019) found that the use of pesticides, the distance between the cultivated land and the farmer's house, aslo the irrigation system affect the rice production. In addition, Basorun & Fasakin (2012) stated other variables such as the marital status of rice farmers, the area of planted land, the availability of the rice market, the number of workers involved in the production, and the use of agro-chemicals. In this case, the production input management must consider the optimization principle to achieve optimal production with effective and efficient input allocation.

In line with that statement, to achieve efficiency and fulfill rice needs, Mulyono (2017) said the strategy to improve food security was starting from production inputs and production facilities, as well as post-harvest activities, namely distribution, management and marketing. The production factors that will be analyzed in this study are land area, use of seeds, number of pesticides consisting of herbicides, insecticides and fungicides, number of fertilizers, number of workers inside and outside the family. This research will use the stochastic production function analysis method. The stochastic production function analysis describes the maximum production that can be generated from the production inputs used. Then from each sample, it will be known the value of its technical efficiency using production efficiency analysis.

## LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Baihaki (2021) found empirically that land, seeds, fertilizers, pesticides and labor have a significant effect on production in rice farming. Technical efficiency level in rice farming ranges from 0.71-1.00 with an average of 0.92. Age and experience have a positive and significant effect on the efficiency level achieved by farmers, while education has no significant effect. Similar research was conducted by Novia & Satriani, (2020) which explained that the factors influencing the production in rice farming were the number of seeds, the amount of fertilizer, the amount of pesticides used and the area of arable land. Technical efficiency levels of rice farming are range from 0.61 to 0.80 (40 percent); 0.81 – 1.00 (26 percent); less than 0.60 (34 percent). Sulistya & Waluyati (2020) discussed the technical efficiency level, allocative and economic, they found the sources of technical inefficiency in rice farming on narrow land. The sources of technical inefficiency are

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education, experience, number of productive family members, and number of parcels (land plots). The number of family members of productive age and the number of parcels will increase technical efficiency. Variables that have an effect on minimizing production costs are the amount of production, the price of NPK phonska fertilizer, organic fertilizer, and labor wages. Pipih & Aliudin (2020) examined the effect of input use and price efficiency level on the input use for rice farming with a technical irrigation system and a pumping system, which found that the efficiency level for rice farming with a technical irrigation system and low-cost rice farming with a pumped system is inefficient. Ho (2019) examined the technical efficiency and scale of agricultural economies with the result that estimated yield scale as the coefficients total of the Cobb-Douglas production frontier model is 0.3801 which implies that agriculture operates at a decreasing yield scale. Kara et al (2019) analyzed the technical efficiency and risk in agricultural production with the results that seeds, fertilizers, agricultural chemicals and labor inputs positively affect rice yield. The production technology that characterizes rice farming in the research area shows an increase in yield scale. Fertilizers and agrochemicals are estimated to decrase the variance in the output value, while seeds and labor are estimated to increase the variance in the output value. Chandio et al (2019) discussed technical efficiency of agriculture in Sindh, Pakistan and explained that credit, farm area, fertilizer, and labor have a significant effect on rice productivity. In addition, a larger and significant elasticity scale is found on credit while a larger and significant marginal effect is found on farm size. Furthermore, the average technical efficiency is 0.97, which means that 97 percent of rice farmers are technically efficient.

Hernawati & Sudantha, (2018) found that the value of economic efficiency for seed and pesticide production factors showed a negative number, meaning that the use of these production factors in rice farming was too much and would reduce the income. Donkoh (2013) found the factors that determine technical efficiency of farmers include education and the application of modern inputs such as seeds and chemical fertilizers. Kallika et al (2012) found that technical efficiency ranges from 49.69 to 97.17 percent with an average of 85.35 percent. Gender, agricultural experience, good agricultural practices (GAP), and crop intensity were contributed positively to agricultural technical efficiency.

Production is the final result in a process or economic activity by utilizing several inputs or inputs. The inputs in rice farming include land area, use of seeds, use of fertilizers, use of pesticides, and labor. The output in rice farming is rice production. The model used to determine the production factors that affect rice production is the Cobb-Douglas stochastic production function, while the results of technical efficiency in this research are examined to see the factors that affect technical efficiency using panel data regression analysis. The difference between this research and previous research is that this research was conducted in the transmigration area and the efficiency results were reviewed to determine the factors that affect technical efficiency. Based on the theoretical discussion and previous research, the conceptual framework in this research is as follows:

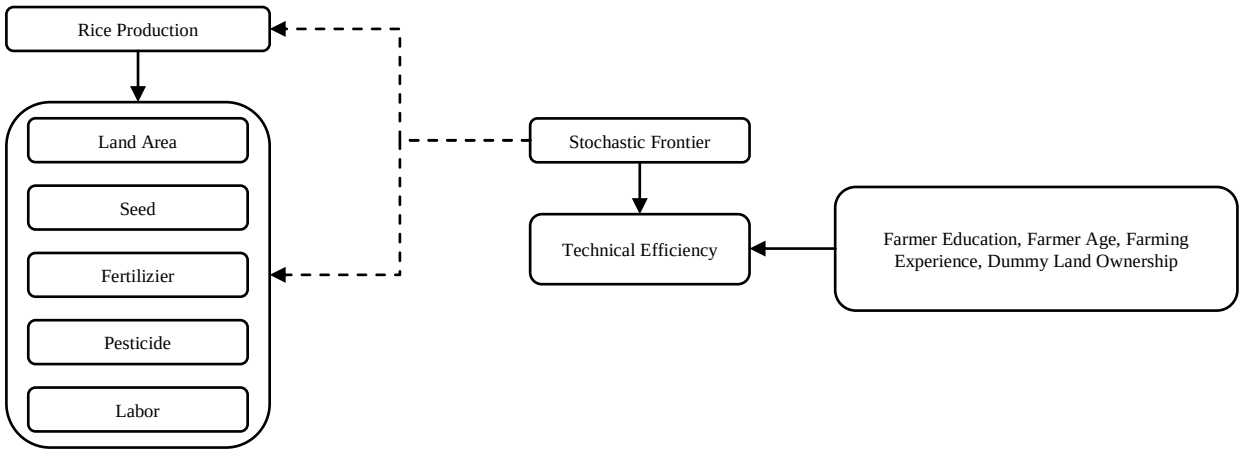


Figure 2 – Conceptual Framework

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## MATERIALS AND METHODS OF RESEARCH

This research was conducted in Muara Telang District, Banyuasin Regency, South Sumatra Province with the consideration that based on data, Muara Telang District has the largest first harvest area in Banyuasin Regency, South Sumatra Province. Data collection period in this research was carried out during the 2019-2021 planting season. This research was conducted by field survey with in-depth interviews of 100 agricultural households determined by the stratified random sampling method which is classified based on the small, medium and large land area. The analysis technique used is quantitative which consists of two stages, which are analysis of the frontier production function and multiple linear regression.

*Stage I.* Data analysis with the SFA approach was carried out using the Frontier 4.1 application. The Stochastic Frontier Analysis standard function with the production function has the following general form (log):

$$\text{Ln } P_{it} = \beta_0 + \beta_1 lnLL_{it} + \beta_2 lnPL_{it} + \beta_3 lnPK_{it} + \beta_4 lnPP_{it} + \beta_5 lnTK_{it} + v_{it} - u_{it} \quad (1)$$

Where P = Rice production; $\beta_0$= Unknown parameter; LL = Land area; PB = Seeds use; PK = Fertilizer use; PP = Pesticide use; TK = Agricultural labor; $V_i$= *Random error;* $u_i$= Farmer technical inefficiency i; $i$ = 1,2,3 … N (Total observations); t = Year (2019-2021); $\beta_0$ = Unknown parameter.

*Stage II.* Data analysis in Stage II used panel data regression to determine four factors that are thought to have an effect on technical efficiency, namely farmer education, farmer age, dummy membership in farmer groups: 1 = Participate in farmer group, 0 = Does not participate in farmer group with the following equation:

$$ET_{it} = \alpha + \beta_1 PD_{it} + \beta_2 UM_{it} + \beta_3 PU_{it} + \beta_4 DK_{it} + \varepsilon_{it} \quad (2)$$

Where ET = Technical Efficency; $\alpha$ = constant; PD = Farmer education; UM = Farmer age; PU = Farming Experience; DK = Dummy land ownership; $\beta_1, \beta_2, \beta_3, \beta_4$ = Coeficient of each related variables in this research; $i$ = 1,2,3 … N (Total observations); t = Year (2019-2021); $\varepsilon$ = Error of term.

## RESULTS AND DISCUSSION

Based on the estimation results of the frontier production function in the rice industry using Frontier 4.1C, the following outputs are obtained:

Table 1 – Estimation Results of Stochastic Frontier Production Function

| Variables | Coefficient | Standard-Error | t |
|---|---|---|---|
| Constant ($\beta_0$) | 0.131361 | 0.204317 | 6.42930 |
| Land area ($\beta_1$) | 0.732215 | 0.118367 | 6.18595 |
| Seed ($\beta_2$) | 0.343459 | 0.534288 | 6.42836 |
| Fertilizer ($\beta_3$) | 0.116771 | 0.323789 | 3.60639 |
| Pesticide ($\beta_4$) | 0.102492 | 0.379670 | 2.69951 |
| Labor ($\beta_5$) | 0.230214 | 0.884960 | 2.60141 |
| Sigma-squared | 0.733714 | | |
| Gamma | 0.639892 | | |
| LR-Test | 0.607883 | | |
| Mean Technical Efficiency | 0.947928 | | |

*Source: Processed Data (2021).*

Based on the Frontier 4.1C output, the equation can be described into the previous model so that the following model will be obtained:

$$LnPit = 0.131361 + 0.732215LNLL + 0.343459LNPP + 0.116771LNPK + 0.102492LNPP + 0.230214LNTK$$

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The coefficient on each independent variable shows the elasticity to the dependent variable which can be described from the estimation results of the frontier production function. The coefficient value of land area to the rice production output value is 0.732215. The positive sign indicates that there is a positive influence between the variable land area and the rice production output value. This relation shows when there is an increase in land area by 1 hectare (Ha) it will increase the output value by 73.22 percent.

The coefficient value of seed on the rice production output value is 0.343459. The positive sign indicates that there is a positive influence between the seed variable and the rice production output value. This relation shows when there is an increase in the use of 1 kilogram (kg) seed, it will increase the output value by 34.34 percent.

The coefficient value of fertilizer on the rice production output value is 0.116771. The positive sign indicates that there is a positive influence between the fertilizer variable and the rice production output value. This relation shows when there is an increase in the use of 1 kilogram (kg) fertilizer, it will increase the output value by 11.67 percent.

The coefficient value of pesticide on the rice production output value is 0.102492. The positive sign indicates that there is a positive influence between the pesticide variable and the rice production output value. This relation shows when there is an increase in the use of pesticide by 1 percent, it will increase the output value by 10.24 percent.

The coefficient value of labor on the rice production output value is 0.230214. The positive sign indicates that there is a positive influence between the labor variable and the rice production output value. This relation shows when there is an increase of working hours by 1 percent, it will increase the output value by 23.02 percent.

Efficiency is one of the indicators used to evaluate the farming business performance. The higher the ability of the farm in creating efficiency in the production process, the better the performance shown. It is the same with rice farming in Muara Telang District, Banyuasin Regency, where the higher the level of efficiency that can be achieved, the better the performance shown. The efficiency level of rice farming in Muara Telang District, Banyuasin Regency based on Frontier 4.1C output can be seen in Table 2.

Table 2 – The Efficiency Level of Rice Farming in Muara Telang District, Banyuasin Regency, 2019-2021

| Efficiency Level | 2019 | | 2020 | | 2021 | | Mean |
|---|---|---|---|---|---|---|---|
| | Persons | Frequency | Persons | Frequency | Persons | Frequency | |
| 0.8341-0.8639 | 1 | 1.01 | 1 | 1.01 | 0 | 0.00 | 0.67 |
| 0.8639-0.8938 | 1 | 1.01 | 2 | 2.02 | 0 | 0.00 | 1.00 |
| 0.8938-0.9237 | 11 | 11.11 | 10 | 10.10 | 12 | 12.12 | 11.00 |
| 0.9237-0.9536 | 36 | 36.36 | 44 | 44.44 | 36 | 36.36 | 38.67 |
| > 0.9536 | 50 | 50.51 | 42 | 42.42 | 49 | 49.49 | 47.00 |

*Source: Processed Data (2021).*

Based on the results of Frontier 4.1C, the output is obtained as shown in the table above. During those 3 years, the highest efficiency level of rice farming in 2019 which more than 0.95 with 50 persons responded or 50.51 percent frequency; highest mean was also in the efficiency range of more than 0.95 by 47 people or 47.00 percent frequency. The lowest efficiency level is in the range of 0.83-0.86, by 0.67 percent or less than 1 or equal to 1. From the results, as a whole we can see that the majority efficiency level of rice production in Muara Telang District, Banyuasin Regency from 2019 to 2021 is high. This condition indicates that the overall allocation of inputs including land area, seeds, fertilizers, pesticides and labor encourage an increase in output. The high technical efficiency value shows that farmers in Muara Telang District are able to allocate resources or inputs to produce maximum output.

The best model selection is determined from the Chow, Hausman and Langgrange Multiplier tests. Based on these test, it can be seen that the Fixed Effect Model (FEM) is the best model because it shows the highest coefficients and has varying cross-sectional value,

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while the Random Effect Model (REM) shows no vary or is equal to zero in the cros-sestional value variation. The estimation results using multiple regression can be simplified as follows:

Table 3 – Fixed Effect Model: Impact of Education, Age, Farming Experience, and Land Ownership Status on Efficiency (Dependent Variable: Production Efficiency; N: 300)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.981755 | 0.006638 | 147.8994 | 0.0000 |
| PD? | -0.002553 | 0.000325 | -7.856534 | 0.0000 |
| UM? | -0.000341 | 9.75E-05 | -3.502149 | 0.0005 |
| PU? | -0.000242 | 1.88E-05 | -12.84797 | 0.0000 |
| DK? | 0.005204 | | | |
| Fixed Effects (Period) | | | | |
| 2018--C | 0.000354 | | | |
| 2019--C | -0.000390 | | | |
| 2020--C | 3.61E-05 | | | |
| R-squared | 0.029287 | | | |
| Adjusted R-squared | 0.009409 | | | |
| S.E. of regression | 0.025833 | | | |
| F-statistic | 1.473335 | | | |
| Prob (F-statistic) | 0.187025 | | | |

*Source: Processed Data (2021).*

Based on the equation of the regression results above, it can be analyzed the effect of each independent variable on the dependent with the following equation:

$$ET = 0.981755 - 0.002553PD - 0.000341UM - 0.000242PU + 0.005204DK$$

The coefficient results can be interpreted as follows:

1. The constant value (β0) = 98.17 can be interpreted if the farmer education, farmer age, farming experience and dummy land ownership are considered constant or zero, the efficiency level is 98.17 percent. This means that the level of efficiency without farmer education, farmer age, farming experience and land ownership is 98.17 percent;
2. The coefficient value (β1) = -0.0025 means that the farmer education variable is negatively related to the efficiency level, if a farmer takes 1 year of formal education, it will reduce the level of efficiency by -0.002 percent;
3. The coefficient value (β2) = -0.0003 means that the farmer age variable is negatively related to the efficiency level, if there is an increase in the farmer age by 1 year it will reduce the efficiency level by -0.03 percent;
4. The coefficient value (β3) = -0.0002 means that the farming experience variable is negatively related to the efficiency level, if there is an increase in the length of farming by 1 year it will reduce the efficiency level by -0.000242 percent;
5. The coefficient value (β4) = 0.0052 means that the land ownership variable is positively related to the efficiency level, if there is an increase in land by 1 hectare it will increase the efficiency level by 0.0052 percent.

*Efficiency and Production Inputs.* Rice production is based on the efficiency level which as a whole is dominated by high efficiency levels, but there are differences in efficiency which are explained by the characteristics of farmers and other external factors. The most prominent difference related to internal factors is the use of land area where farmers with high land area have a high efficiency, this dominance causes different levels of efficiency, beside other inputs that cause differences in efficiency, namely the use of seeds, fertilizers, pesticides and labour. This result is in line with other researches proof that rice production is determined by the optimal allocation of inputs in maximizing output. Vu (2012) found that land area enhancement, use of fertilizers and pesticides as input allocations will significantly increase the efficiency of rice output in Vietnam. Contrast with the findings of Wang et al., (2020) shows that land and labor significantly increase the technical efficiency level every year, but land area has risks due to a higher proportion than labor and rental costs, this condition will decrease farmer efficiency level. Those variables will be an indicator for

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determining technical efficiency which will be analyzed based on its effect on efficiency. The estimation results show that the use of land inputs has a positive and significant relationship with the farm production efficiency. This condition is explained that every enhancement in land area, it will increase production efficiency. In general, this condition explains that rice production is inseparable from the land area that is used in rice production. The wider the land area, the higher the production capacity, thus it can be confirmed that the production capacity will be increased.

Although production capacity is inseparable from other variables, land area is a determining factor for rice production efficiency considering the amount of rice harvested depends on the amount of land used. Based on descriptive analysis, it shows that the highest efficiency level is dominated by respondents who have a large land area where this land area will affect the amount of rice to be sown, overall it can be concluded that the enhancement of land area will encourage additional production capacity so that this enhancement land will have an impact on increasing ready-to-harvest rice. In line with this, rice seeds have a significant effect on the efficiency of rice production. This condition explains that an enhancement in land area will increase production capacity, especially the use of more seeds. Overall, the increase in rice seeds will determine the increase in efficiency, the more rice seeds are sown, the more output will increase. This is inseparable from rice seeds which are assumed to be the main raw material in the production process where the higher the use of raw materials in rice seeds and the higher proportion of rice seeds in the allocation of inputs, the higher the increase in output. Mitigation in the agricultural production process cannot be separated from the use of fertilizers and pesticides in increasing production efficiency. The estimation results show that these variables have a positive and significant effect on increasing efficiency. It is explained that the use of fertilizers and pesticides is used to overcome the risk of production failure, which increasing the growth and quality of the rice plant itself and to overcome the plant pests problem.

In general, the efficient use of labor in terms of labor productivity in producing higher output will be in line with the increase in farm business performance. The estimation results show that labor has a positive and significant effect on production efficiency. This explains that labor produces high productivity in maximizing output. Although categorized in general, labor has a risk when labor productivity is in the low production process, it will result a higher labor costs so that the production process is not efficient, but, based on the descriptive analysis description, the labor is measured by the number of working days which on average can categorized as high. The high working days illustrates high labor productivity, so this condition has an impact on increasing overall rice production. Thus, this analysis can be concluded that the use of production inputs can maximize output. The output maximization has an impact on increasing production efficiency. Based on this research of rice farming, the coefficient value of land area is a determinant to increasing output. While the variables of seeds, fertilizers, pesticides and labor are inputs that support the enhancement in land area because land area is a key factor in production capacity. If land area is enhanced then all variables will follow or it will affect the increase in seeds, fertilizers, pesticides and labor.

The results of the conclusions comparison analysis prove that the use of production inputs will maximize production are in line with Effendy (2010) which stated that one of the variables that has a significant effect on rice production is land area. Baihaki (2021) mentioned that the seed variable has a positive and significant effect on production. Kara et al. (2019) explained that seeds, fertilizers, agricultural chemicals and labor inputs positively affect rice yields. Wadu et al., (2019) m found that the use of pesticides, the distance between the cultivated land and the farmer's house, and the irrigation system affect the rice production. Meanwhile, the labor input studied by Chandio et al (2019) has a significant effect on the agricultural production efficiency.

*Efficiency and Socio-Economic Variables.* Differences in efficiency levels are not only determined by internal factors, which production input variables, but differences in efficiency levels are also analyzed based on socio-economic characteristic variables such as education, age, farming experience and land ownership. The estimation results of this research find that several socioeconomic variables have been shown to reduce production

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efficiency. In general, the analysis is carried out in several stages, the first is farmer age, it shows a negative and significant relationship which means that every increase in age will reduce efficiency. This is explained descriptively which the farmers age is categorized as being in the middle-aged and elderly age group. If the dominance of farmers is classified in the elderly category, it will cause the problem to production process because the productivity is decrease and affect the farming business performance. Research on the factors that affect production efficiency is in line and consistent with the results by Wang et al., (2020) which found that the decrease in efficiency was determined by external factors such as age and number of dependents. The findings prove that farmers with elderly age category and an increase in the number of dependents have a significant impact on decreasing production efficiency.

The second is an analysis of efficiency based on education where the estimation results show that education is negatively related to efficiency. The research is in line with the research by Wang et al., (2020) which explained that low level of farmer education is in line with decreasing in efficiency. Education is indeed a key factor in increasing productivity, but this analysis is irrelevant considering that on average, farmer education is categorized as basic. This is the reason the increase in education tends to encourage a decrease in production due to the dominance of farmers who have low education. The results of this research are not in line with the research by Kea et al., (2016) which found that an overall increase in education led to an increase in production efficiency. Based on the farming activities, intensive education and training at the beginning of transmigration, the agricultural infrastructure that built have an impact on sustainable education, but the agricultural infrastructure is relatively unmaintained so it affects the sustainability of farmer education and causes changes in natural conditions on peatlands which have an impact on soil quality.

The third is farming experience analysis, this research comprehensively rejects the hypothesis which means that the farmer education and farming experience tend to decrease rice production. This condition explains that these variables are irrelevant because the determinants of production are not socio-economic variables because there is a fairly deep boundary between agricultural and social technicalities. In general, this condition needs to consider the variables of age, education and experience in farming because of their significant influence on production efficiency, which means that these variables play an important role in production efficiency.

Final synthesis of the contradictory results in this research when it is only associated with education and experience, it is not sufficient in determining the increase in rice production. Agriculture has a more difficult mechanism so that experience and education alone are not sufficient in determining the increase in rice production. However, education and experience must also be based on sustainable efficiency improvements such as support for agricultural programs and the development of agricultural technology to produce higher output. The rejection of the hypothesis that experience and education had a negative and significant relationship to efficiency was strengthened by Nguyen et al., (2019) which revealed that variations in socio-economic variables such as experience and education need to be reviewed comprehensively because their influence is very low and is not sufficient to be a reference for increasing production.

The last analysis is related to land ownership which significantly increases the efficiency. This study confirms that land ownership is relevant in determining the difference in efficiency among farmers where farmers who own their own land will produce higher efficiency than those who do not own land. Farmers who do not own land will spend higher production costs due to additional land rent costs, thus affecting lower efficiency. Based on a continuous analysis, land rent will reduce production capacity and although output maximization is achieved, but the increased of rental costs as an inputs proportion will decrease an efficiency level due to higher cost input allocation than other inputs. The results of this research are in line with research by Wang et al., (2019) which found that land ownership is a determinant of agricultural output. Land area with land ownership will have an impact on increasing rice production efficiency. Consistent with this finding, Kea et al., (2016) stated that the efficiency of rice production depends on the proportion of land area in the

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production process which is required to be higher than other inputs, especially rice agriculture. Contrast with research by Najjuma et al., (2016) in Kenya, the proportion of land area as input allocation will produce higher input costs, thus become risk of decreasing efficiency in the future.

## CONCLUSION

Estimating the Cobb-Douglass production function using the SFA approach, rice farming in Muara Telang District, Banyuasin Regency, South Sumatra Province is in an efficient condition with the output elasticity on labor shows an increasing yield scale. However, there are efficiency differences which are explained by input factors and other external factors. The most prominent difference related to input factors is the land area where farmers with high land area have high efficiency. The productive land area is different at the individual level causing a different level of efficiency between individuals. An important input that also determines the efficiency level is the capital input component, namely seeds, fertilizers and pesticides, but the most dominant influence is land area, meaning that traditional agriculture still relies on land area or has a diversification pattern that is not intensive yet.

The influence of several external factors on the efficiency of farming, namely age, education, and farming experience have a negative and significant effect on rice production efficiency. It is explained that education and experience alone are not sufficient in determining the increase in production which based on the farming activities, intensive education and training at the beginning of transmigration, the agricultural infrastructure that built have an impact on sustainable education, but the agricultural infrastructure is relatively unmaintained so it affects the sustainability of farmer education and causes changes in natural conditions on peatlands which have an impact on soil quality.

## SUGGESTIONS

Variable land area is the most important aspect for increasing the farming efficiency. Farming businesses start their activities by seeking large rice fields in order to increasing rice production, so they make land area as a source of farming expansion. Thus it is needed to take strategic steps in achieving sustainability of land quality which measures by the soil on agricultural land.

The efficiency of SFA output is influenced by external factors such as age, education, farming experience, and land ownership, which are important for the success of farming activities to increase production. Thus, farming businesses need to make efforts to sustain business activities in terms of age, education, farming experience and land ownership that supported by adequate agricultural infrastructure, agricultural programs and the development of agricultural technology to produce higher output.

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