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Corporate Farming as an Effort to Increase Rice Farming Production in Central Java

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Abstract: This study aims to estimate production factors and technical efficiency of rice farming using the corporate farming model. The research location was determined purposively in Sukoharjo Regency, Central Java. The research sample is 51 corporate farmers determined by census. The analytical method uses the stochastic frontier 4.1.C computational program with the Maximum Likelihood Estimation (MLE) method. The estimation results show that the factors that influence rice production are land area, Urea fertilizer and NPK fertilizer. While the value of the technical efficiency of rice farming in the corporate farming model is 0.75 (75%). Farmers still have the opportunity to increase their efficiency by 25%.

Keywords: Corporate farming; Production factors; Technical efficiency

Introduction

Land is the main factor of production of rice farming. In fact, the current availability of agricultural land shows small (narrow) scale due to conversion and fragmentation (Iskandar et al., 2020). The industrial, service, housing and agro-tourism sectors are the causes of the narrow scale of farming. Production also decreased. Meanwhile, the increasing population has an impact on the national food crisis (Kusumastuti et al., 2018).

According to Subejo et al. (2019) the land cultivated by the majority of farmers is less than 0.5 ha. The narrow arable area causes farmers to be faced with two conditions, firstly continuing commercial farming and secondly releasing production resources by seeking another profession. In this case, agrarian reform plays an important role as access to increased production resources through the expansion of arable land. In principle, the wider the arable land will enable farmers to increase production and productivity. Ideally, farmers should have a minimum land area of 0.65 ha to achieve their degree of welfare (Susilowati et al., 2016).

Statistically, the total population of Indonesia has increased significantly every year. As of 2017 the population reached 261.9 million people, an increase of 1.22% from the previous year. Meanwhile, FAO, with a range of 2009-2050 estimates that the population of Indonesia in 2035 will reach 305.6 million people. This illustrates that Indonesia's population is high. Automatically the fulfillment of national food will be higher than the available population.

Efforts to increase production to support national food fulfillment are the application of the corporate farming model. Corporate farming is an activity of combining farming land to be managed jointly by farmers and integrated in one management (Dalimunthe et al., 2018). The application of the corporate farming model is actually a productive step as a medium for managing small expanses of land. Furthermore, Swain et al. (2012) said that corporate farming is not just collective land management, but as a business organization to meet market needs. Thus farming becomes a potential business as a source of income. Pamungkas et al. (2018) revealed that expanding arable land is not just increasing production but has another function, namely creating aesthetic value.

One of the areas that implements the corporate farming model is Sukoharja Regency, Central Java. Paddy production and productivity in Sukoharjo

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Regency experienced fluctuations in the period 2010-2016. Production increased significantly starting in 2012 amounting to 16.32%. The increase in production was due to an increase in harvested area, productivity and improvements to agricultural systems. However, it can be seen that after 2012 it has decreased, although it has systematically increased in the 2013-2016 period.

Table 1. Harvested Area, Production and Productivity of Rice in Sukoharjo from 2009-2015

Year	Harvest Area (Ha)	Production (Ton)	Productivity (Ku/Ha)
2010	45.083	261.358	57.97
2011	35.082	190.411	54.28
2012	52.041	346.039	66.49
2013	47.783	328.967	68.85
2014	49.028	310.276	63.29
2015	49.764	374.546	75.26
2016	54.339	391.675	72.08

Production and productivity fluctuations of farmers is a combination of the working of many factors. Such as the use of land area, seeds, fertilizers, pesticides, labor availability, changes in input and output prices to climate change (Coelli et al. (2005); Handani et al., 2017). Thus production is closely related to farmer efficiency in the allocation of the use of production factors. Both in increasing the amount of use that is still lacking and reducing the amount that exceeds the recommendation. To prevent a decrease in production or to maintain stability and even increase, it is necessary to know the factors that affect rice production. This study aims to estimate the technical efficiency of rice farming using the corporate farming model in Sukoharjo Regency, Central Java. Given the importance of increasing farm production as an effort to fulfill national food.

Method

The research location was determined purposively at the Association of Independent Farmers Groups in Sukoharjo Regency, Central Java. Sukoharjo Regency was chosen as the research location because it is one of the regional rice production centers as well as a national rice barn (Sadali, 2018). In addition, as one of the areas for developing an agricultural system based on corporate farming. The research sample was taken using a census of 51 corporate farming farmers. With the distribution of the Ngudi Rahayu farmer group 7 farmers, the Asri Rata farmer group 16 farmers, the Ngudi Rejeki farmer group 13 farmers and the Ngudi Mulyo farmer group 15 farmers.

Estimating the technical efficiency of rice farming using the corporate farming model using the stochastic frontier 4.1.C program with the Maximum Likelihood Estimation (MLE) method. The frontier stochastic production function is used to calculate the technical efficiency of the corporate farming model of rice farming as follows.

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_{3.} + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + (v_i - \mu_i) \quad (1)$$

Where Y is paddy production (kg), β_0 is intercept, β_1 - β_6 is estimating parameter, X_1 is land area (ha), X_2 is amount of Urea fertilizer (kg), X_3 is amount of SP-36 fertilizer (kg), X_4 is the amount of NPK fertilizer (kg), X_5 is the amount of pesticides (liters), X_6 is the labor force (HOK), vi is the error term (an error beyond the control of the farmer) and μi is the effect of technical inefficiency (an error that the farmer can control). The expected value of the parameters β_1-β_6 > 0, if the input use is increased then the output value of farming will increase.

Technical efficiency measurement using frontier stochastic described by Jondrow et al. (1982) technical efficiency is the ratio of observed output or actual production (Yi) to the highest output or potential production (Yi*) at the level of available technology. Technical efficiency values range from zero to one (0 <Tei< 1). This means that the closer to number one the farm shows full efficiency. Technical efficiency is formulated as follows.

$$TE_i = \frac{Yi}{Yi^*} = \frac{E\,(Yi|Ui,Xi)}{E\,(Yi|Ui=0,Xi)} = [\exp(-\mu_i)] \quad (2)$$

Result and Discussion

Combined Use of Factors of Production

The average production of corporate farming model of rice farming is 6.66 tons/ha. This production is still far from the farmers' expectations of more than 7 tonnes/ha. The area of land cultivated by corporate farming farmers as a whole averages 0.42 ha. Thus, farmers still have a shortage of 0.23 ha to reach the prosperous level (Susilowati et al., 2016). The status of the land area to be corporate is privately owned (96%), the remaining 4% are leased farmers.

The use of corporate farmer seed production factors varies. Among others, Mikongga, IR 64, Inpari 32, Sunggal, Bagendit, Ciherang, Pak Tani, PP 64 and Denok. The average use of rice seeds is 64.2 kg/ha per growing season. This amount is higher than the recommendation of 20-25 kg/ha. The main factor causing the high use of these seeds is generally farmers apply 1 stake 5 sacks of rice seeds equivalent to 25 kg per 4,000 m^2. In addition, it is customary for farmers to use large quantities of seeds as stock for embroidering dead rice plants. The most widely planted varieties are Ciherang and IR 64.

The majority of corporate farming farmers use three types of macro fertilizers including Urea fertilizer, SP-36

fertilizer and NPK fertilizer. The average use of Urea fertilizer was 263.01 (kg/ha), SP-36 fertilizer was 233.73 (kg/ha) and NPK fertilizer was 322.30 (kg/ha). The use of inorganic fertilizers exceeds the recommended dosage for Sukoharjo Regency. The recommendation for Urea fertilizer is 250 (kg/ha), SP-36 fertilizer is 75 (kg/ha) while NPK fertilizer is 50 (kg/ha) (Ministry of Agriculture, 2007). The habit of farmers using fertilizer in large quantities is adjusted to the conditions of the plants (Safaruddin, 2022). Generally, farmers apply fertilization twice per planting season (Firmana et al., 2016).

Pesticides are chemicals used by farmers to maintain rice plants against plant pest attacks that cannot be predicted beforehand (Javaid et al., 2022). The types of pesticides used by corporate farming farmers include Spontan, Megarhizo, Dharmabas, Trisula, Dupont, Prevaton, Virtako, Starban and Gemari. The average use of pesticides by farmers is 2.5 liters/ha. However, the average distribution of pesticide use fluctuates greatly depending on the intensity of pest attacks (Öztaş et al., 2018; Bagheri et al., 2019; Akter et al., 2018).

The production factors for the workforce of corporate farmers include seeding, land management, planting, and harvesting, the rest is done independently. The average HOK of all corporate farming rice farming in Sukoharjo Regency per planting season is 14.81 HOK with an average allocation of 2.73 HOK or 19% for semi-corporate activities, the remaining 81% for corporate.

Factors of Production Stochastic Frontier Model

The model used to obtain the production function as well as the efficiency value is the Cobb-Douglas stochastic frontier Maximum Likelihood Estimation (MLE) computational frontier 4.1c method. The results of the stochastic frontier estimation are presented in Table 2. The sigma squared value (σ^2) of 0.0020 is significant at the level $\alpha = 1\%$. This means that the error term inefficiency (μi) is normally distributed. The Gamma (γ) value is 0.9999 with a t-ratio value of 41.85 indicating 99.99% residual variation in the model is more dominant due to technical inefficiency (μi) the remaining 0.01% is caused by noise in the measurement. If all error terms are caused by noise (vi) the value of the inefficiency coefficient parameter becomes meaningless (Kusnadi et al., 2011).

Table 2. Estimation of the Stochastic Frontier Production Function for Rice Farming Corporate Farming

Variable	Sign of Hope	Coefficient	Std.Error	t-ratio
Constant	+/-	0.2992	0.6678	0.4480
Land area	+	1.1370***	0.1204	9.4404
Urea Fertilizer	+	-0.1765**	0.0705	-2.5010
SP-36 Fertilizer	+	-0.0379	0.0387	-0.9779
NPK Fertilizer	+	-0.1346**	0.0610	-2.2069
Pesticide	+	0.0135	0.0316	0.4271
Labor	+	0.0140	0.0440	0.3193
Sigma-squared		0.0020	0.0031	6.3909
Gamma		0.9999	0.0000	41.853
Log likelihood function OLS		34.090		
Log likelihood function MLE		39.123		
LR test of the one-sided error		10.066		

*** α = 1% (t-table = 2.6799); ** α = 5% (t-table = 2.0095); * α = 10% (t-table = 1.6765)

The value of the MLE log likelihood function (39.123) is greater than the OLS log likelihood function (34.090). This shows that the model in this study is good enough to describe the actual conditions of corporate farming rice farming. Based on the results of the analysis of the stochastic frontier production function variable land area, Urea fertilizer and NPK fertilizer have a significant effect on the production of rice farming. Land area has a positive effect on production in line with the research of Ishaq et al. (2017) and Suharyanto (2015) stated that the wider the arable land, the higher the rice production. This concept is the basis for the establishment of a corporate farming model of agriculture. Meanwhile, the production factors of Urea and NPK fertilizers had a significant effect on production but were contrary to the expected sign. This means that the use of production factors of Urea and NPK fertilizers reduces rice production. This result is not in line with the findings of Yoko et al. (2017) and Yuliana et al. (2017). Whereas NPK fertilizer and Urea fertilizer have a significant effect on increasing national rice production. The high allocation for the use of Urea and NPK fertilizers is the main cause of the decline in farmer production. They argue that the more fertilization the higher the production (Riyadi et al., 2015).

Technical Efficiency of Rice Farming Corporate Farming

Technical efficiency is generated through the ratio of actual production (Yi) to potential production (Yi*) at the level of available technology. It is said to be technically efficient if the use of less input produces

higher output. Table 3 shows that the technical efficiency value of corporate farming in Sukoharjo Regency is in the range of 0.56 to 0.99 with an average of 0.75. This shows that farmers are only able to achieve 75% rice production with the use of sacrificed inputs. However, farmers still have the opportunity to increase their potential production by 25%. This potential can be fully achieved through the managerial use of production factors. Planting simultaneously so that plant pests can be anticipated. Use of homogeneous varieties and increase activity within the group and involve more field workers.

Table 3. Distribution of Corporate Farming Technical Efficiency Values of Rice Farming

Technical Efficiency Value	Number of Farmers	Percentage
0.56-0.63	5	9.80
0.64-0.72	15	29.41
0.73-0.81	18	35.29
0.82-0.90	6	11.76
0.91-1.00	7	13.73
Total	51	100.00
Minimum	0.56	
Maximum	0.99	
Average	0.75	

Determining whether technical efficiency is efficient or not efficient refers to the average value of technical efficiency obtained and then compared with a value of 1. If the value of technical efficiency is equal to 1, corporate farming is technically efficient. Conversely, if it is less than 1, corporate farming is not technically efficient. Table 4 shows that the T test value is 0.000 (α = 1%). This means that the corporate farming model of rice farming is not fully efficient.

Table 4. T-test Average Technical Efficiency of Corporate Farming Rice Farming Against Value 1 (95 % Confidence Interval of The Difference)

	t	df	Sig.(2-tailed)	Sig.(2-tailed)	Lower	Upper
ET	-15.894	50	0.000	-0.2422	-0.2728	-0.2116

*** α = 1%

Conclusion

The corporate farming model is a strategy to increase national rice production. In addition, this model is an anticipatory measure for massive land conversion due to population growth, demand for land for the economy, services, industry and fragmentation. The estimation results show that the production factor that influences rice production is land area. Meanwhile, Urea and NPK fertilizers had a significant but negative effect on corporate farming rice production. The farmer's technical efficiency value is 0.75 or 75% of the use of production factors on actual production.

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