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SOCIAL ECONOMIC FACTORS AFFECTING THE TECHNICAL INEFFICIENCY OF SHALLOTS IN MALANG DISTRICT

Sri Hindarti*, **Arief Joko Saputro, and Lia Rohmatul Maula**
Agribussines, University of Islam Malang, East Java, Indonesia

*Correspondence Email: srihin@unisma.ac.id

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ABSTRACT

The trend of the need for shallots in Indonesia from year to year for consumption increased during 2005-2018. The increasing demand for shallots every year requires efforts to increase production quantity to meet the needs of shallots and reduce the number of imports. On average, onion farmers have not achieved efficient farming, so their farming is not optimal in increasing the amount and value of income which is heavily influenced by socioeconomic factors of farmers. The purpose of this study is to analyze technical efficiency and analyze socioeconomic factors that affect the technical inefficiency of shallot farmers. The method used is the DEA VRS Efficiency Model and Tobit regression analysis. The results show that the average technical efficiency of shallot farmers is total technical efficiency (TE CRS) 0.700, pure technical efficiency (TE VRS) 0.837, and scale efficiency 0.830. Factors influencing the technical inefficiency of shallot farmers in Malang district include land area, farmer groups, farming experience, and farmers' income.

Keywords: *social, economic, inefficiency, DEA, shallot*

BACKGROUND

Shallots are one of the horticultural crop commodities that are widely consumed by the community as a mixture of cooking spices. In addition, red onions are also sold in processed forms such as onion extract, powder, essential oil, fried onions, and even as a medicinal ingredient to lower cholesterol levels and blood sugar, prevent blood clots, and reduce blood pressure and improve blood flow. According to Suryani (2012), shallots are non-horticultural commodities that are widely consumed by the public and have the wide-open potential not only for domestic needs but also for the country.

National consumption of shallots in the last five years was an average of 6.67% per year, and the average national consumption was 822.52 thousand tons in 2017-2021 growth 3,8% per year (BPS, 2021). The production of shallot has increased in 2017-2021 from 1,47 million ton to 2 million tonnes with an average growth per year at time is 7%. Central Java is province with the largest shallot production in 2021 contributed 28.15% of national shallot production with harvested area of 55,98 thousand hectares. East Java is in second place contributing 24.99% with shallot production reached 500,99 thousand tonnes and a harvested area of 53.67 thousand hectares (BPS, 2021).

Malang Regency is one of the third largest shallot-producing districts in East Java. Meanwhile, the district with the most significant contribution was still Nganjuk Regency, which was 16,245 tons,

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followed by Probolinggo Regency at 6,683 tons, then Malang Regency at 5,071 tons, and Sampang Regency at 3,173 tons (BPS, 2021). One of the shallot production centers in Malang Regency is Purworejo Village, Ngantang Subdistrict, and Tawangargo Village, Karangploso Subdistrict, an area with extensive land tenure for shallots and one of the shallot production centers in Malang Regency.

The increasing demand for shallots every year requires efforts to increase production quantity to meet the needs of shallots and reduce the number of imports. On average, onion farmers have not achieved efficient farming, so their agriculture is not optimal in increasing the amount and value of income. Previous research stated that the farmer's farming performance was not optimal due to farmers' socio-economic factors influencing technical inefficiency. The socio-econimic factor farmers' that can lead production disparities, including farmer age, education, participation in farmer groups, farming experience, number of family members, the status of the farmer, land ownership, farms' distance to home, and communication using extension workers (Ali & Jan, 2017; Saputro et al., 2021; Kusnadi et al., 2011).

The size of the household, education level and livestock holding contribute to technical efficiency, but Total farm size harms technical efficiency (Debebe et al., 2015). Technical efficiency also varies by specific farm attributes such as educational seed type, land irrigation machine type and extension services. All these factors can have a positive effect, but land rent can have a negative impact (Nargis & Lee, 2013). The other result shows that access to extension services, family size participation in credit access, and agreement soil testing before planting agricultural experience contributed to technical efficiency (Ambetsa et al., 2020).

The optimal performance of farmers in farming is not only influenced by production inputs but also by socioeconomic factors from farmers. Socioeconomic factors of farmers will then affect management and decision-making in agriculture. Efforts to improve the performance of farmers, especially shallot farmers, to achieve optimal productivity and make policies that are right on target are by analyzing the factors that affect technical inefficiency. Based on this description, this research was conducted with the objectives of 1) analyzing the technical efficiency of shallot farmers and 2) analyzing socioeconomic factors that affect the technical inefficiency of shallot farmers in Malang Regency.

RESEARCH METHODS

Data

The data needed in this study are divided into two types: primary and secondary data. This is done by interview method to obtain preliminary data, namely conducting interviews using questionnaires as research instruments that have been prepared for respondents (shallot farmers). Secondary data was obtained from the Central Statistics Agency, village offices, and other institutions. The required data include data on the number of shallot farmers, the amount of shallot production, and other data.

Samples

The research location was chosen purposively in Malang Regency, one of the shallot production centers in East Java, namely Ngantang District, representing the highlands, and

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Karangploso District, meaning the lowlands. Sampling method in this study used simple random sampling. The methods used to determine the sample is using the Slovin formula as follows:

$$n = \frac{N}{1+Ne^2}$$

Information:

n : Number of samples

N : Total population

e : Error tolerance limit (error tolerance)

The total population of shallot farmers in Purworejo Village is 396 people, so the entire sample of farmers in Purworejo village in this study is 40 farmers (39,6 farmers by slovin formula). While the total population of shallot farmers in Tawangargo Village is 260 people, the total sample size of Tawangargo village farmers in this study is 40 farmers (26 farmers by slovin formula).

Data Analysis

Data Envelopment Analysis

Data Envelopment Analysis (DEA) is one of the nonparametric frontier methods to measure the efficiency of each respondent, here referred to as the relative decision-making unit (DMU) of a business when the business is around the frontier efficiency processing curve. DMUs on the frontier curve are said to be DMUs that achieve relative efficiency when compared to other DMUs in the model. There are two models in DEA, namely the model with an input orientation based on the assumption of a constant return to scale (CRS) introduced by Charnes Cooper Rhodes (CCR) in 1978 and a model based on the premise of a variable return to scale. (VRS) which was introduced by Banker Charnes Cooper (BCC) in 1984. The DEA CCR model is only appropriate when a DMU is in optimal condition. In contrast, several conditions cause a DMU to not operate at an optimal scale, for example, due to imperfect competition. Or production constraints. CCR models require DMU to linearly increase or decrease input and output without increasing and decreasing inefficiency. Therefore, in this study, to accommodate conditions that are not optimal in rice farming, the DEA model is used with the VRS assumption that does not require changes in input and output of a DMU to be linear or not operating at an optimal scale. The VRS model to measure pure technical efficiency is determined as the following linear programming model originally by Banker et al. (1984).

The approach used in this study to measure the technical efficiency of shallot farmers is the Data Envelopment Analysis (DEA) approach using the Banker, Charnes, and Cooper (BCC) model and the Variable Return to Scale (VRS) orientation. The BCC DEA model with the VRS assumption is often referred to as pure technical efficiency (PTE), which can be systematically described as follows:

$$\begin{gathered} \text{Min}_{\theta\lambda}\theta, \\ St - qt + Q\lambda > 0, \\ \theta xi - x\lambda \geq 0, \\ I1'\lambda = 1 \\ \lambda \neq 0 \end{gathered}$$

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Information:

I1 : Vector Ix1

θ : Proportional input reduction for the i-th DMU

λ : Weight of the j-th DMU

The results of the analysis of the Data Envelopment Analysis approach produce outputs in the form of technical efficiency values assuming that farmers are farming optimally (CRS assumption) and technical efficiency values assuming that farmers are not optimal (VRS). The value of technical efficiency has a range from 0 to 1. Farmers can be technically efficient if they have an ET value = 1, while farmers are said to be technically inefficient if they have an ET value <1. The technical efficiency value obtained from the calculation results is relative, so general conclusions cannot be drawn. The efficiency value shows that a respondent farmer is relatively efficient in the research location compared to other respondent farmers in a specific planting season.

Variabel used that analyzed with DEA including land area (hectares), seeds (kg), TSP fertilizer (kg), KCL fertilizer (kg), manure (kg), pesticide (liter), and labor (day). Meanwhile the output is production of shallot farming which measured with ton per hectares.

Tobit Regression

A second-stage environmental analysis is conducted and after performance evaluation environmental factors related to performance are identified through tobit analysis. Two-level environmental analysis is increasingly becoming a trend in agriculture and agriculture (Liu et al., 2013).

The factors influencing the technical inefficiency of shallot farming in this study were analyzed using the Tobit regression model. The model used in this study refers to the model developed originally by Battese and Coelli (1995) regarding technical inefficiency. The variables used to measure the effect of technical efficiency are assumed to be independent and have a normal distribution with N (μi, 2). The model equation can be written:

$$IT= \delta 0+\delta 1Z1+ \delta 2Z2+ \delta 3Z3+ \delta 4Z4 + \delta 5Z5 + \delta 6Z6+ \delta 7Z7+ \delta 8Z8+Ui$$

Information:

IT : Technical Inefficiency of Shallot Farmers

Z1 : Farmer's Age (years)

Z2 : Farming experience (years)

Z3 : Formal education

Z4 : Number of family dependents (persons)

Z5 : Dummy land ownership status (Owned= 1, Others=0)

Z6 : Dummy participation of farmers in farmer groups (joining farmer groups = 1, not participating = 0)

δ1.., δ7: 1…, 7 = Expected estimator parameter

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RESULT AND DISCUSSION

Technical Efficiency Analysis

Respondent farmers who have a technical efficiency score equal to one are farmers who have the best relative performance when compared to other respondents. The respondent farmers with the best performance are used as benchmarks for other respondents so that inefficient DMUs can improve the input values and the outputs produced by comparing them to efficient DMUs (Lasmini et al., 2016). Measuring farm performance with technical efficiency, allows empirical determination of the degree of variation in performance and potential input reduction while maintaining economic yields (Ullah et al., 2019).

Table 1. Distribution of Total Technical Efficiency, Pure Technical Efficiency, and Efficiency Scale

TE CRS			TE VRS			Scale Efficiency		
Value	**Farmers**	**%**	**Value**	**Farmers**	**%**	**Value**	**Farmers**	**%**
1	13	16	1	28	38	1	13	16
0.771-0.999	21	26	0.869-0.999	13	22	0.798-0.999	38	48
0.538-0.770	24	30	0.735-0,868	16	20	0.593-0.797	20	25
0.305-0.537	22	28	0.601-0,734	23	20	0.388-0.592	9	11
Average	0.700		0.837			0.830		
Std. Dev	0.152		0.164			0.167		

Source: Primary Data, 2021.

Refers to Table 1, on average shallot farmers who become respondents show a total technical efficiency (TE CRS) of 0.700, indicating a technical inefficiency of 30%. Farmers who are efficient and are at an optimal business scale (TE CRS) are 16% (13 people), while most of the others are not operating at an optimal business scale or in a VRS condition. The calculation of technical efficiency with VRS or pure technical efficiency shows an average of 0.837, more significant than the total technical efficiency (TE CRS). Farmers already technically efficient (TE VRS) are 38% (28 people).

The minimum level of pure technical efficiency is 0.601 to 0.734, which means that farmers can still reduce the amount of use of their production inputs by 26.5% to 39.01% to achieve full efficient conditions. Inefficient farmers can potentially improve by reducing the value of inputs and increasing the value of outputs. This can be seen from the actual value currently happening, which is different from the target value used as a reference so that the farmer has a technical efficiency value of 100%.

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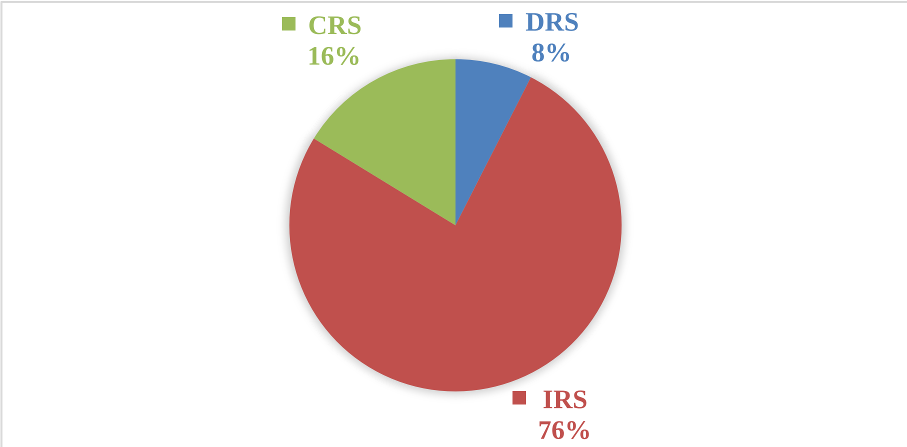

Figure 1. Distribution of Scale Efficiency of Shallot Farmers in Tawang Argo and Purworejo Villages
Source: Primary Data, 2021.

Figure 1 shows that only 16% of farmers are already at the optimal scale. Of the majority of farmers who are not at the optimal scale, 76% are in the IRS condition, and the rest are in the DRS condition (8%). This shows that most shallot farmers can still increase their business scale to achieve technical efficiency (Saputro et al., 2021). Either by reducing the use of its inputs to expanding the scale of its business. Farmers in the DRS condition indicate that the proportion of the increase in production inputs is still more significant than the growth in output.

Analysis of Factors Affecting Technical Inefficiency of Shallot Farming

Based on the estimation results using Tobit regression with the Maximum Likelihood Estimation (MLE) method approach, it is known that the Probability > Chi value is 0.0001 and the Lr Chi-square is 58.81. The Lr Chi-square value is greater than the chi table at a significant level of 0.1 (58.81 > 16.74). This value indicates that all estimation parameters in the model can explain the relationship with technical efficiency. In the results of the Wald test (P > |z|), that four variables have a significant effect on technical inefficiency in onion farming, including the variables of land area, farmer groups, farming experience, and opinions.

The variable land area has a significant influence and is positively related to the 99% confidence level on the technical inefficiency of shallot farmers. This shows that the larger the land the farmer owns, the less efficient his farming will be. The majority of shallot farmers in the research location use human labor in managing their farming, which can cause the more land they have, the more workers employed will increase.

Table 2. Parameter Estimation Results of Factors Affecting Technical Inefficiency of Shallot Farming with Maximum Likelihood Estimation (MLE) Approach.

Parameter	Coefisien	Standard Error	z	P > |z|
Constanta	.4794594	.0874019	5.49	0.000
Age	-.0003517	.001641	-0.21	0.831
Education	-.0227431	.018299	-1.24	0.218
Land area***	1.504.016	.1827332	8.23	0.000
Farmer groups**	-.0817505	.0332141	-2.46	0.016

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Farmer experience*	-.0022732	.0012778	-1.78	0.079
Income***	$-9.03x10^{-6}$	$8.00x10^{-7}$	-11.28	0.000
Log Likelihood	= 58.81	***) significant at α		= 1%
Lr Chi^2 (6)	= 99.43	**) significant at α		= 5%
Prob > Chi	= 0,0001	*) significant at α		= 10%

Source: Primary Data, 2021.

The negative coefficient farmer experience can show that experienced farmers are better at adapting the size of their business to the size of production (Anh Ngoc et al., 2018). Farming experience significantly adversely affects the technical inefficiency of onion farming at the 90% confidence level. It shows that the longer the farmer's knowledge of farming shallots, the less efficient his shallot farming will be. Based on data on the characteristics of respondents, the average experience of farmer farming is 27 years, with the amplest experience being 59 years. Farmers experienced in sugarcane farming tend to be reluctant to innovate compared to more accessible farmers, especially using superior shallot seeds and having higher productivity than non-superior seeds. Related to other research, the higher a person's experience, the higher his empirical knowledge. High knowledge will make it easier for farmers to allocate inputs and outputs. If farmers can achieve higher outcomes, then the level of technical efficiency will increase (Ningsih et al., 2015). However, an experience is not enough to attain higher levels of efficiency unless the farm managers rearrange of inputs (Poudel et al., 2015).

Other study found that cooperative membership has negatively correlated with technical inefficiency, suggesting that higher cooperative membership leads to lower technical inefficiency (Musaba & Bwacha, 2014). Dummy Farmer groups significantly affect the technical inefficiency of shallot farming at the 95% confidence level. The community service farmer group tends to have a lower technical inefficiency value on average than the Mulya farmer group. This is presumably due to the difference in the intensity of meetings between members of the farmer groups in the Karya Bakti Poktan, which are more active than those in the Jaya Tani Farmers Group. In addition, most Karya Bakti farmer groups are more receptive to the adoption of shallot cultivation technology, especially using superior seeds. There is a strong relationship between the role of Gapoktan and the income of farmers (Wulandari et al., 2022).

The income variable significantly affects the technical inefficiency of onion farming at the 99% confidence level. The income of shallot farmers increases and the technical inefficiency will be lower. Technical efficiency can be seen by comparing the production of shallots with production inputs issued by farmers. Farmers who have higher efficiency have a higher ratio of output per input than farmers who have lower efficiency. The higher the efficiency value, the output produced with the same level can be made from lower inputs so that the costs used are lower.

CONCLUSION AND SUGGESTION

On average, the technical efficiency of shallot farmers in Malang Regency respondents shows a total technical efficiency score (TE CRS) of 0.700, pure technical efficiency (TE VRS) of 0.837, and scale efficiency of 0.830. Technical inefficiency in onion farming is caused mainly by the scale of the farmer's business. Based on the efficiency scale, the majority of farmers who are not at the

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optimal scale, 76%, are in the IRS condition, the rest are in the DRS condition (8%), and only 16% of the farmers are already at the optimal scale. The analysis results show that the factors that influence the technical inefficiency of shallot farmers in the Malang district include land area, farmer groups, farming experience, and farmers' income. Factors that do not have a significant effect based on the analysis results include age and education.

Excessive inputs mainly cause the technical inefficiency of shallot farming. In efforts to achieve technical efficiency without reducing production, farmers can reduce the use of their information, especially the use of fertilizers, following the recommended dosage, on time, and on target. Based on the measurement of the efficiency scale, farmers can still improve the efficiency scale. One of the government programs through the Ministry of Agriculture, namely farmer corporations. Farmer corporations, especially shallot farmers corporations in production center areas, are expected to be a solution to accommodate farmers' business scale problems so that their scale can increase and achieve optimal performance.

The policy implication is to increase the efficiency of shallot farming with a massive approach, namely by presenting progressive farmers. The criteria for progressive farmers are farmers with higher technical efficiency than other farmers who know more about farming (Lasmini et al., 2016). Progressive farmers are expected to do their best to get optimum production output and, of course, be trusted by other farmers so that the success achieved by progressive farmers will be an encouragement and motivation for other farmers.

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