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Data envelopment analysis on efficiency of shallot production in Tra Vinh, Vietnam

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Abstract. Shallot is a perennial crop that is grown as an annual to harvest bulb seeds and produced widely in Vietnam. This is an easy-to-grow crop, suitable for land conditions in the local area and brings high economic efficiency. Although shallot is a relatively new crop to the farmers in Tra Vinh province, it is considered one of the key crops in the agricultural development strategy of the province. This study was conducted to assess the efficiency of shallot farming in Tra Vinh province using data envelopment analysis (DEA) approach. The findings revealed that the average cost efficiency was 0.770 and only five farms (2.5%) were fully cost-efficient. The score for average allocative efficiency was slightly superior to that for technical efficiency (0.917 and 0.838); thus, inefficient shallot farms could reach higher cost efficiency by increasing technical efficiency. Accordingly, factors influencing technical and cost efficiency in shallot production were determined in this study. Household size and cultivation experience of the farmers demonstrated negative effects on the levels of technical and cost efficiency. The analysis further revealed that those shallot farmers who had larger shallot farm sizes and those who had better access to technical training tended to be more technical and cost-efficient. Consequently, this study suggests that research to improve shallot-farming techniques should be prioritised support and the quality of technical training programmes for local farmers needs to be raised to increase the technical and cost efficiency in shallot production

Keywords: Mekong Delta; Tra Vinh; data envelopment analysis; cost efficiency; shallot production

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INTRODUCTION

Tra Vinh is one of the poor coastal provinces in the Mekong River Delta of Vietnam and 60% of land area of the province is used for agricultural production. Regarding the economic structure in the financial year 2022, three main sectors of agriculture, forestry and fishery contributed 30.29% to the province's GDP (TVPPC, 2022). It therefore indicates that agriculture has been playing a vital part not only for farmers but also for the economic development of the province. Importantly, shallot production grown on coastal sand soil in Duyen Hai district and Duyen Hai town for more than 10 years has brought high economic efficiency for the farmers.

Shallot is currently considered to be an easy-to-grow crop, suitable for land conditions in the local area. Shallot-producing areas tend to increase in recent years. Results of SNV's survey (2022) showed that the total shallot production area of Duyen Hai town is estimated to be about 462 hectares in 2021 and the average yield was about 20-25 t/ha. However, shallot producers have been facing difficulties in production, including small and fragmented production models, limited farming technical competencies, high production costs, overuse of agricultural chemicals, and unpredictable and unfavourable weather leading to unstable production efficiency and profits for growers. W. Huang *et al.* (2020) demonstrated that improving technical efficiency in agricultural production and overcoming shortcomings in agricultural production efficiency is very important, contributing to poverty reduction and building comprehensively moderately prosperous rural areas. In Indonesia, technical efficiency is a main factor in maintaining shallot production (Astuti *et al.*, 2020). In addition, T. Triyono *et al.* (2021) stated that the performance of a farm can be benchmarked by production and efficiency. Therefore, efficiency analysis on shallot production and affecting factors of shallot production have been carried out in many previous studies such as K. Mamary *et al.* (2018), L. Astuti *et al.* (2019), K. Prakoso (2021). This clearly indicates that studies on efficiency of shallot farming have been concerned by researchers to help the producers increase their income.

In Vietnam, although shallot is considered a crop that brings high economic efficiency to farmers, studies on the analysis of the efficiency of shallot production are still few. There was only one study of Q. Nhut *et al.* (2013) estimating technical and cost efficiency for shallot-growing households in Soc Trang province, Vietnam. So far, no research has been conducted in Tra Vinh province to analyse the efficiency of shallot production. In addition, technical efficiency analysis of agricultural production models has received more research attention than cost efficiency analysis while the latter also makes an important and valuable contribution to enhancing farmers' profits through adjustments in production costs. Thus, the purpose of this study was to determine the technical and cost efficiency of shallot farms in Tra Vinh province, Vietnam, and to identify factors that impact the efficiency differential among those farms. The findings of this study may be useful for the government in proposing to appropriate shallot development strategies and for shallot producers in order to improve productivity and profitability.

MATERIALS AND METHODS

Study area. Tra Vinh province is located in the Mekong Delta area of Vietnam and was purposely selected for conducting this study. The area of shallot production in the province has been increasing since 2014. The primary data were collected from Duyen Hai district and Duyen Hai town since they are main areas of shallot production. As stated by SNV (2022), the total area under shallot cultivation was about 462 ha in Duyen Hai town where shallot is mainly produced on sandy coastal areas. This crop is now a strategic commodity of the province.

Procedures. The data comprised 202 shallot farmers using a structured questionnaire. The information of the investigated shallot producers was for the crop season of 2022 (from November 2022 to January 2023) and collected from Mach to June 2023. The information of shallot cultivated area, yield, cost of farming inputs, and characteristics of shallot farmers were gathered and analysed in this study. The authors have conducted interviews to gather shallot farmers's information. All personal information about the farmers was collected with their agreement. This study was approved by the Science and Education Council of Tra Vinh University before conducting the survey under grant contract No. 218/2022/HĐ. HĐKH&ĐT–ĐHTV.

In the DEA model, the output was shallot yield and expressed in kilogrammes. The quantities and respective prices of three input variables were considered in the study analysis regarding shallot bulb seeds, labour (hired labour and family labour), and chemical fertilisers. Whilst the quantities of shallot bulb seeds and chemical fertiliser were expressed in kilogrammes, labour was measured by annual work units (man-days). The input variables of seeds, fertiliser, and labour, which were previously employed by T. Le *et al.* (2019), were used in the current study. Concerning the factors that contribute to the efficiency of shallot production, the characteristics of shallot farmers including the size of the households (persons), the size of the farms (hectares), the level of education, age, cultivation experience (years), membership in the cooperative, credit access and technical training (dummy variables) were investigated.

Data analysis. In this study, DEA was utilised to assess both technical and cost efficiency for shallot farms**,** and then these farms' efficiency levels were determined by using regression models. In agricultural production, technical efficiency refers to the quantity of agricultural products that can be achieved when using inputs such

as seeds, fertilisers, pesticides, and labour resources. Therefore, technical efficiency is a common approach to assessing the efficiency of specific resources. In the DEA approach, the technical efficiency of the shallot farms differed due to the type of return scale chosen. The Charnes, Cooper, and Rhodes (CCR) models result in gross technical efficiency when constant returns to scale are assumed while the Banker, Chames, and Cooper (BCC) models provide a purely technical efficiency estimate (Ramanathan, 2003). This study relied on the VRS assumption to estimate the technical efficiency of shallot producers, which was widely used in previous studies. (Le *et al*., 2019; Hassan, 2021). The DEA model that measures technical efficiency is based on the following specifications:

$$TE_{VRS} = \min_{\theta,\lambda} \theta,$$

Subject to

$$\begin{aligned} Y\lambda - Y_i &\geq 0, \\ \theta X_i - X\lambda &\geq 0, \\ N1'\lambda &= 1, \\ \lambda &\geq 0, \end{aligned} \quad (1)$$

where Y – output vector; X – input vector; θ – scalar; λ – vector of constants that is n x 1. The technical efficiency for the i-*th* farm was displayed by the estimated θ value, which ranges between 0 and 1. Farms were considered technically efficient when their efficiency score was equal to one. In contrast, the efficiency scores were lower than those showing technically inefficient farms.

The Scale Efficiency (SE) is the ratio between TE score under CRS that was achieved by removing the convexity constraint ($N1'\lambda = 1$) in equation (1) to TE score under VRS and expressed as in (2)

$$SE = TE_{CRS}/TE_{VRS}. \quad (2)$$

The DEA cost minimisation was adopted to estimate cost and allocative efficiencies of farms and expressed as in equation (3)

$$\min_{\lambda, x_i^*} w_i' x_i^*,$$

Subject to

$$\begin{aligned} Y\lambda - Y_i &\geq 0, \\ x_i^* - X\lambda &\geq 0, \\ N1'\lambda &= 1, \\ \lambda &\geq 0, \end{aligned} \quad (3)$$

where w_i and x_i^* – input price and quantity for the i-*th* farm; Y_i – output levels. The cost efficiency (CE) of the i-*th* farm was determined by subtracting the minimum cost from the observed cost as follows:

$$CE = w_i' x_i^*/w_i' x_i^*. \quad (4)$$

The cost efficiency score and technical efficiency score were combined to calculate the allocative efficiency (AE), which was expressed as

$$AE = CE/TE. \quad (5)$$

The analysis of shallot farm's efficiency was performed with the DEAP 2.1 software suite (Coelli, 1996). Determinant factors affecting efficiency from shallot farming were examined by the ordinary least squares (OLS) regression model. The empirical model was specified in equation (6)

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + e \quad (6)$$

where Y_i – efficiency score for the i-*th* farm (technical and cost efficiency scores); X_1 to X_7 – age, experience, education level of the farmer, household size, shallot farm size, credit and training access (dummy), respectively; e – error terms.

RESULTS AND DISCUSSION

Descriptive Statistics Characteristics of Farmers and Shallot Farming. Table 1 displays the summary statistics of the variables used in this study. The survey data showed that shallot producers yielded an average of 15.24 t/ha ranging from 5.00 to 26.00 t/ha. This indicated that some farmers could achieve a quite high yield (26.00 t/ha) while others experienced a lower level (5.00 t/ha). SNV (2022) reported that the average shallot yield of farms in Tra Vinh province was about 20-25 t/ha. In comparison to the main shallot-producing province, the study by V. Vellema *et al.* (2017) found that there was a large variation in shallot yields in Soc Trang ranging from 5.00 to 35.00 t/ha in 2017. Noticeably, the reason for this low yield of the sampled growers in this study is because their shallot farming experienced unseasonal heavy rains and major storms which destroyed a large number of shallot growing areas and thereby affected the yields. Farmers in the study area used shallot bulbs bought from the main shallot-producing region in Soc Trang province.

In Vietnam, there is still no research comparing the effectiveness of shallot grown from seeds and bulbs. In Indonesia, T. Triyono *et al.* (2021) compared the income of shallot farming using bulbs and seeds in cultivation. The results revealed that the yield, income, and profit of shallot farming using seeds for cultivating were all higher than those of shallot farming using bulbs suggesting technology changes from using bulbs to seeds for higher profit.

Information related to the characteristics of shallot producers in this study are also revealed in Table 1. It can be seen that shallot farms in the selected sample are quite small in size with an average of only 0.42 ha, ranging from 0.24 to 1 hectare. The average number of household members is four people per family. The shallot farmers have mean age of 49 years, have over six years of schooling and seven years of shallot cultivating experience. In the study area, only 15% of the growers attended the courses in technical training. The low percentage of this factor could be because shallot is a new crop in the province; thus,

research and provincial supporting policies in shallot production are still limited. V. Vellema *et al.* (2017) stated that shallot farming is capital-intensive because of the high input use. However, only 1% of the sampled farmers in this study have availed of credit access. None of these farmers participated in agricultural cooperatives so this variable is not included in the regression analysis.

***Table 1**. The Contribution of agroforestry practice to pesanggem household income*

Variables	Unit	Mean	Minimum	Maximum	Standard Deviation
Output					
Shallot output	kg/ha	15,243.56	5,000.00	26,000.00	4,813.78
Inputs					
Seed bulbs	kg/ha	533.40	350.00	933.00	155.72
Fertiliser	kg/ha	995.77	150.00	3,435.00	436.76
Labour	man-days/ha	283.11	167.00	487.00	45.38
Seed price+	1,000 VND/kg	98.43	30.00	700.00	51.19
Fertiliser price+	1,000 VND/kg	20.35	12.20	25.56	2.61
Labour wage+	1,000 VND/day	213.49	190.00	230.00	5.42
Farm-specific variables					
Shallot farm size	ha	0.42	0.10	2.00	0.24
Household size	persons	3.90	1.00	8.00	1.19
Age of the farmer	years	49.45	26.00	72.00	9.82
Education level	years	6.29	0.00	12.00	2.64
Experience	years	7.26	1.00	20.00	3.25
Training access	dummy	0.15	0.00	1.00	0.36
Credit access	dummy	0.01	0.00	1.00	0.10
Member of agricultural cooperatives	dummy	0.00	0.00	0.00	0.00

***Note:** +1 USD = 23,647 VND (as of January 2023)*
***Source:** ompiled by the authors*

Efficiency Analysis of Shallot Farms. The results of the efficiency analysis for the shallot farms in the study are displayed in Table 2. It can be seen that the average technical efficiency score of the shallot farms was relatively high at 0.838, and average technical efficiency score higher than 0.700 were achieved by over 87% of farmers. Only 28 farms (about 14%) were fully efficient, with a technical efficiency of one, indicating that most farms still have considerable potential to improve their technical efficiency.

The cost efficiency of shallot farms was found to be low while the allocative efficiency score was relatively high. The cost efficiency ranged from only 0.466 to 1, with a mean value of 0.770. In which, over one-fourth of farms acquired a cost efficiency level of less than 0.700. In contrast, the farms' allocative efficiency score was 0.917 and most farms (over 93%) achieved allocative efficiency scores of more than 0.900 (Table 2). However, in both cases, only 5 farms (2.5%) were fully efficient, indicating that approximately 97.5% of farms had cost and allocative inefficiency. Hence, these shallot producers could increase their cost efficiency by improving technical efficiency. Z. Bayramoglu and E. Gundogmus (2008) demonstrated that the improvement of cost efficiency can be achieved through the improvement of both technical and allocative efficiency. If the allocative efficiency was higher than technical efficiency, farms' inefficiency was identified for technical efficiency and *vice versa*. In the current study, the allocative efficiency score was higher than technical efficiency (0.917 of allocative efficiency compared to 0.838 of technical efficiency) implying technical efficiency was identified as the primary cause of inefficiency in shallot farms.

The last column of Table 2 shows the information of scale efficiency. It can be seen that the mean score of scale efficiency was 0.724 showing that the sample shallot farms reached about only 72% of the optimal scale efficiency. Furthermore, technical efficiency scores fell below the average value for over 42% of the farms and out of 8 farms, only 4% were able to scale efficiency. The statistical analysis also clearly revealed that operating at optimal scale was only achieved in less than 4% of shallot farms in the study while the majority of them (95%) were functioning at a sub-optimal scale. It means the farmers were producing on small farms. The results of the analysis of low efficiency at small-scale production and the fact that most shallot farmers experience increasing returns to scale suggest that the efficiency of shallot production can be improved by expanding the scale of production on farms.

A previous study by T. Triyono *et al.* (2021) found that the shallot farming in Indonesia was still allocative inefficiency with an average allocative efficiency of 0.773. In Vietnam, Q. Nhut *et al.* (2013) showed that the averages of technical, allocative and cost efficiency of shallot producers in Soc Trang province were 0.93, 0.66,

and 0.62, respectively. In addition, these farms also achieved a high scale efficiency of 0.98, with 51% of farms operated at increasing return to production scale. In comparison, shallot growers in the current study acquired higher allocative and cost efficiency but lower technical efficiency. Furthermore, a greater percentage of farms was in the increasing return to scale. The reason for the lower technical efficiency and scale inefficiency of shallot farmers in Tra Vinh province could be because shallot is quite new crops in Tra Vinh province, thus the lack of farming techniques prevents the farmers from expanding production areas.

***Table 2**. Efficiency results of shallot farms in Tra Vinh province*

	Technical efficiency	Allocative efficiency	Cost efficiency	Scale efficiency
Summary efficiency				
Mean	0.838	0.917	0.770	0.724
Std. dev.	0.117	0.064	0.126	0.205
Minimum	0.537	0.639	0.466	0.236
Maximum	1.000	1.000	1.000	1.000
Frequency distribution				
<60%	3.96	0.00	11.39	28.22
60-69%	8.42	1.49	16.83	13.86
70-79%	22.28	4.95	25.74	15.35
80-89%	35.64	27.72	31.68	15.35
90-100%	29.70	65.84	14.36	27.23
Fully efficient farms	28.00	5.00	5.00	8.00
Returns to scale				
Constant (%)				3.96
Decreasing (%)				0.99
Increasing (%)				95.05

***Source:** compiled by the authors*

In order to recognise whether inputs have been used properly by farmers, the comparison of input levels between technically efficient and cost-efficient was conducted. The data related to technical efficient input levels were acquired in the technical efficiency DEA model, while the figures of cost efficient input levels were obtained in the cost-minimising DEA model. The input is considered overuse when its ratio is greater than one. The estimated results of the study are shown in Table 3. The mean ratios of three inputs including seed, fertiliser and labour were just a little bit higher than one (1.16, 1.11, and 1.00, respectively) implying that these inputs were properly used. However, the data regarding the percentage of over-use and under-use farms indicated that most shallot growers in the study still did not use these three inputs appropriately. Specifically, almost 97% of farms were underusing and overusing fertiliser and labour. In addition, data presented in Table 1 showed that only 15% of shallot farms were able to access technical training. These may be the reasons for unstable production efficiency and income of local farmers. The findings are in line with a statement from V. Bui and M. Nguyen (2018) that shallot producers in Tra Vinh face several difficulties including high technical risks, small production areas, and experience-based farming.

***Table 3**. The state of inputs used by shallot farmers in Tra Vinh province*

	Seed	Fertiliser	Labour
Mean	1.16	1.11	1.00
Standard Deviation	0.24	0.31	0.13
Minimum	0.63	0.15	0.67
Maximum	2.00	1.96	1.52
Over-using farms (%)	64.85	52.48	38.61
Under-using farms (%)	10.89	44.55	58.91
Proper-using farms (%)	24.26	2.97	2.48

***Source:** compiled by the authors*

Factors Influencing Efficiencies. Regarding determinants of farms' efficiency, the OLS model was used to regress technical and cost efficiency to characteristics of shallot producers. Table 4 displays the results of the regression analysis. It can be observed that many factors had influence on technical and cost efficiency of shallot producers including experience, household size, shallot farm size, and training access. However, credit access, age, and education level of the shallot farmer were found to be irrelevant.

***Table 4**. Determinants of technical and cost efficiency of Tra Vinh shallot farms*

Variables	Technical efficiency		Cost efficiency	
	Coefficients	*t*-value	Coefficients	*t*-value
Age (years)	0.001	0.890	0.001	1.011
Experience (years)	-0.009**	-3.522	-0.012**	-4.479
Education level (years)	0.002	0.539	-0.002	-0.571
Household size (persons)	-0.018**	-2.879	-0.015*	-2.225
Shallot farm size (ha)	0.147**	4.594	0.173**	5.096
Credit access (dummy)	-0.066	-0.873	-0.114	-1.406
Training access (dummy)	0.060**	2.779	0.062**	2.739
Constant	0.852**	14.073	0.797**	12.389
R-square	0.215		0.243	
Sig.	0.000		0.000	

***Source:** compiled by the authors*

The coefficient of cultivation experience of the shallot producer was negative and significant at 1% in both the technical and cost efficiency models, indicating that this factor was not likely to boost the technical and cost efficiency of the shallot farmers (Table 4). It means that less experienced farmers tend to obtain higher technical and cost efficiency than the ones who have more years in shallot farming. Similarly, A. Kumar *et al.* (2020) found that paddy and maize farmers with longer farming experience tend to adopt fewer technologies. This could be explained that less experienced producers are quite flexible and willing to apply advanced techniques in their farming in order to increase farm's efficiency. In addition, S. Sriyadi and A. Yekti (2021) indicated that shallot farmers with more experience are less afraid of risks or able to minimise the risks than those with less experience. However, P. Guha and T. Das (2020) reported that experience assists the farmers in using optimal time and appropriate inputs, and thereby decreases the farms' cost inefficiency.

The technical and cost efficiency of investigated farms is negatively impacted by the size of shallot households. Large household sizes tend to incur less technical and cost efficiency (Table 4). The reason for this can be explained by the fact that growing shallot indeed requires intensive labour and investment. This result is in agreement with the findings of previous studies. For example, A. Pratama *et al.* (2018) demonstrated that due to financial limitations, large households could not optimise the input uses resulting in low production. Similarly, T. Koye *et al.* (2022) also found that the inadequate managing skills of large household sizes in employing the workforce could be the main reason to cause low production efficiency.

The findings showed that the estimated coefficients associated with shallot farm size were all positive and statistically significant at 1%, meaning that the larger shallot farms were more efficient than the smaller ones (Table 4). Additionally, the empirical results of return to scale showed that over 95% of the shallot farmers were operating at increasing return to scale (Table 2). Hence, these investigated farms in this study could increase technical efficiency by expanding their operation scale. This result is consistent with the findings of T. Koye *et al.* (2022) and N. Krasniqi *et al.* (2023). Particularly, T. Koye *et al.* (2022) indicated that farm size is the key input that influences the onion output and that those onion farmers who had larger plot sizes saw a significant improvement in their technical efficiency. In the present study, shallot farmers of Tra Vinh province showed potential to expand their shallot growing area. However, a lack of farming techniques may be the factor that prevents producers from increasing production areas.

Regarding accessing technical training, it was included in the regression model as dummy variable to determine its role in shallot farming efficiency in the study. It was found that both technical and cost efficiency were positively correlated with training access, indicating that training enabled shallot farmers to be more efficient. Especially in the context of this current study, where most growers have less experience in shallot farming. Thus, training could be an important way to keep up with knowledge and advanced technologies in shallot farming in order to promote farming activities more effectively. These findings were in agreement with previous studies by T. Tesema (2021) and G. Mulatu and T. Gemechu (2023). According to L. Astuti *et al.* (2020), farmers who accessed extension services could improve their farming technologies, so their technical efficiency was higher than others who did not receive any counselling. In addition, a study by T. Haryanto *et al.* (2023) observed that participating in agricultural extension programmes such as farmer field school helped the farmers increase technical efficiency.

This study also pointed out that lack of cooperation in production can be considered a limitation of shallot farmers. As can be seen, there is a large variation in shallot yield among surveyed households

and some farmers can achieve a relatively high yield (26,000 kg/ha). This shows that there are some productive farms. Sharing successes and technical advances in farming among farmers is essential. However, the results presented in Table 1 show that all surveyed farmers produced individually, and no one participated in agricultural cooperatives. FAO (2022) noted that agricultural cooperatives offer a diversity of extension services, help smallholder farmers boost yields. The result of T. Le *et al*. (2019) found that farmers in agricultural cooperatives or associations achieved higher efficiency than individual cultivators. Therefore, this study suggests that local authorities need to pay more attention to promoting the establishment, and supporting cooperatives, cooperative groups, and clubs. These could help shallot producers create producing networks, and share effective farming techniques that are useful for improving farming efficiency.

CONCLUSIONS

Shallots have been considered a valuable crop in Tra Vinh province, Vietnam. The production efficiency of crops is a significant factor in improving the livelihoods of farmers, developing the agriculture sector, and the economy of the province. The findings of this study revealed that the estimated technical, allocative, and cost efficiency were 0.838, 0.917, and 0.770, respectively. The low level of cost efficiency of shallot growers in the study was identified as technical inefficiency; hence, the shallot producers could improve their cost efficiency by adjusting farming technologies. An increasing rate of return to scale was observed among most shallot farmers (over 95%) indicating that the technical efficiency of these farms could be increased by expanding their production scale.

Factors influencing technical and cost efficiency in shallot production were also determined. The empirical results of the regression revealed that the technical and cost efficiency levels were negatively influenced by the size of the household and experience of the farmers. The statistical analysis further revealed that achieving higher technical and cost efficiency is more likely to happen for shallot farmers who have larger shallot farm sizes or access to technical training.

As a result, three recommendations have been made in this current study; (1) the local government should prioritise support for research programmes on shallot-farming techniques to improve productivity and production efficiency for the farmers; (2) the operation quality of agricultural extension centres needs to be paid more attention to play an effective bridging role in transferring knowledge and advanced technologies to shallot growers; and (3) shallot farmers should proactively access scientific data and advanced technologies in shallot farming to improve technical efficiency, thereby, they could confidently expand shallot-farm size. Nevertheless, this study focuses only on quantitative analysis, whereas qualitative and natural factors also influence the efficiency of shallot farms. Therefore, future research in shallot farming should take these factors into consideration in order to improve the performance of shallot farms.

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CONFLICT OF INTEREST

None.

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Аналіз оболонки даних щодо ефективності виробництва цибулі-шалот у Тра Віні, В'єтнам

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Анотація. Шалот – багаторічна культура, яку вирощують як однорічну для отримання насіння цибулин і широко вирощують у В'єтнамі. Це легка у вирощуванні культура, яка підходить для місцевих ґрунтових умов і приносить високу економічну ефективність. Хоча шалот є відносно новою культурою для фермерів у провінції Тра Вінь, вона вважається однією з ключових культур у стратегії розвитку сільського господарства провінції. Це дослідження було проведено з метою оцінки ефективності вирощування шалоту в провінції Травінь за допомогою методу аналізу оболонки даних (DEA). Результати дослідження показали, що середня економічна ефективність склала 0,770, і лише п'ять господарств (2,5 %) були повністю економічно ефективними. Оцінка середньої ефективності розподілу ресурсів була дещо вищою за оцінку технічної ефективності (0,917 та 0,838); таким чином, неефективні фермерські господарства шалоту могли б досягти вищої економічної ефективності за рахунок підвищення технічної ефективності. Відповідно, в цьому дослідженні були визначені фактори, що впливають на технічну та економічну ефективність виробництва цибулі-шалот. Розмір домогосподарства та досвід вирощування шалоту-шалот продемонстрували негативний вплив на рівень технічної та економічної ефективності. Аналіз також показав, що ті фермери, які мали більші розміри господарств і мали кращий доступ до технічного навчання, були більш технічно та економічно ефективними. Отже, це дослідження свідчить про те, що дослідження, спрямовані на вдосконалення технологій вирощування шалоту, повинні мати пріоритетну підтримку, а якість програм технічного навчання для місцевих фермерів повинна бути підвищена, щоб підвищити технічну та економічну ефективність виробництва шалоту

Ключові слова: дельта Меконгу; Тра Вінь; аналіз оболонки даних; економічна ефективність; виробництво шалоту