True Shallot Seed Efficiency on the Production and Income of Shallot Farmers

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Abstract. Shallot is included in volatile food groups in Indonesia. Any fluctuation in shallot production will influence the inflation level. One of the main problems that reduce local shallot production capacity is high production cost. Local shallot is mainly produced from bulb seeds that consume roughly about 50% of the production cost. Therefore, the government introduced a new seed named True Shallot Seed (TSS). It reduces seed cost up to 10 times the initial cost of bulb seeds and offers higher productivity. However, two critical aspects need to be considered, shallot production efficiency and farmer's income. This research aimed to study the potency of true shallot seeds to the profit efficiency and farmer's income level. The stochastic profit frontier and inefficiency effects model is used to measure the profit efficiency between two groups of farmers. The research was conducted in 3 regions (district), namely, Grobogan, Brebes and Cianjur. The result shows the existence of inefficiency effects in farmers that utilized TSS or Bulb seeds. However, farmers with bulb seeds have a mean profit efficiency of 66%, higher than TSS farmers, with 60% profit efficiency. This means, the farmers who implement TSS is experienced more profit loss than the farmers who do not. This caused by the farmer's failure in the nursery phase of the TSS that reduced the potential production and the existence of some market discrimination to the bulb harvested from TSS crops. Lastly, efficiency differences are primarily explained by age, farming experience, education, and land ownership (tenancy).

Keywords: True Shallot Seed · Efficiency · Stochastic profit frontier analysis · Inefficiency effect

1 Introduction

Shallots (Allium Cepa L. Aggregatum) are horticultural commodities with high economic value for every country in Southeast Asia [1]. Indonesia is one of the ASEAN countries that place shallots as a horticultural commodity of high economic value. Based on economic value, shallot cultivation could produce income for many farmers in several parts of Indonesia with good market conditions and potential as an export commodity [2]. Therefore, shallot commodities are one of the primary sources of spices in Indonesia. Shallots are also included as a group of spices that do not have substitutions as seasonings for cooking purposes [3].

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The role of shallots is significant for the regional and national economy in Indonesia [2]. The resilience of the supply of shallots in Indonesia is the main determinant of its function as the main spice for seasonings in general cuisine. According to a survey from the Central Bank of Indonesia, shallots are one of three horticultural commodities contributing to national inflation [4]. It has implications for the importance of maintaining the productivity of domestic shallots to maintain the stability of prices in general. One of the determinants of productivity is the quality of the seeds used. Generally, shallot farming in Indonesia depends on tuber seeds. However, it turns out that what happened was a decrease in subsequent productivity due to degenerative problems derived from previous crops [5]. Moreover, the tuber seeds needed for one production season are around 1–1.5 tons per hectare. These numbers are enormous, considering this is only for one cultivation cycle in a year [6]. Furthermore, Basuki [7] also revealed that the problem is also followed by the lack of availability of quality tuber seeds. The high demand for seeds among shallot farmers also increases the cost of domestic shallot production.

To overcome this particular issue, the new shallot seed breeding technology is introduced, and the product is called true shallot seed or TSS. The new seeds emerged to overcome degenerative problems and to increase quality seeds production for Indonesian shallots. The advantage of these new seeds is the ability to produce higher crop yields and increase plant resistance to generative or vegetative diseases. Reference Basuki [7] also stated, one hectare of land only requires 3–7 kg of TSS seeds. By looking at this, one could say that TSS can lower the production cost compared to the tuber seeds. Another advantage is that it does not require a large storage warehouse or special transportation to reach the farmers, so it has easier distribution. This is possible because the seeds are only sold in the form of seed sacks. Based on its economic potential, the adoption of TSS technology for agriculture has been widely studied in Indonesia, as was conducted by Sumarni [5] and Nurjanani and Djufry [8]. Both studies concluded that TSS was feasible to be used by farmers because, in each study, the R/C analysis showed values of 1.3 and 3.15. So, it can be concluded that the use of TSS seeds could increase the profit ratio of shallot farmers. Reference Sumarno et al. [9] also stated that in the Gorontalo area, TSS implementation increases the farmer's profit by 2 times the profit from the farmer's that still use tuber seeds by reaching an R/C ratio of 4,26.

Several pilot studies of TSS in Indonesia suggest that this breeding technology can increase farmers' income due to lower production costs. Therefore, it is essential to explore how the use of TSS by shallot farmers can affect the production and profits of the farmers. This is necessary to review the things that need to be considered in an effort to increase farmers income as promised in the beginning. These two things can be a detailed description of how the application of TSS could improve farmers' welfare. The new TSS technology also aims to increase shallot farmers' income to promote the efforts to reduce rural area poverty levels, especially in shallot-producing areas.

The potential of TSS for farmers has become one of the solutions prioritized by the Indonesian Ministry of Agriculture since 2018. Programs to introduce TSS to shallot farmers not only for increasing farmers' welfare but are also intended to meet the need for quality shallot seeds for domestic shallot cultivation. The new seeds are considered very profitable to meet the demand for quality seeds for domestic farmers. According to Nurjanani and Djufry [8], converting tuber seeds to TSS can produce a relatively high ratio of seed propagation. One shallot bulb can produce 200–300 disease-free seeds with a shelf life up to two years. Another promising thing is that the seeds are able to produce uniform shallot bulbs, both when planted in the highlands and lowlands and are free from previous plant diseases [10].

Despite all of the economic benefits the new seeds offered, there are several weaknesses. First, there is no type of seed that can adapt well to different weathers in the production area in Indonesia. Thus, there are still many differences in crop yield productivity. Second, shallot farmers in Indonesia are generally new to seed sowing techniques. As a result, the failure in the seedling and seed germination process becomes very high. Third, the longer harvest period affects the interest of farmers. This will cause additional costs for labor and other production inputs because there is a nursery process before planting. Farmer's who implement TSS need to wait for 3 months before harvest (70–80 days), while tuber seeds only take 2 months to harvest (55–60 days). Therefore, it is still important to study how the implementation of TSS can increase the efficiency of shallot production compared to conventional tuber seeds. This can be observed from the level of profit and production efficiency. Hence, it can be stated that the purpose of this research is: 1) To analyze the level of income and production between true shallot seeds (TSS) with conventional tuber seeds on shallot farmer's, and 2) To determine profit efficiency between true shallot seeds (TSS) with conventional tuber seeds.

2 Methodology

Primary data for the study was accomplished by intensive farm survey in 3 shallot producing regions (district), namely Grobogan, Brebes, and Cianjur. The location of this study was determined purposively considering that the location is included to be the region of the national production centre for shallot commodities [11]. The population to be studied is shallot farmers that implement TSS seeds or conventional tuber seeds at the research site. Data collection methods used are structured questionnaires in forum group discussion (FGD) and in-depth interviews. A total of 125 farm households (consists of 65 TSS farmers and 60 bulbs farmers) were selected from the total of 5 villages selected with purposive sampling, but only 51 households data were used due to several considerations in the completeness of input price data. The study was conducted from November 2020 to March 2021 and it faced some problems with the availability of the TSS Farmers in Java Island. Many TSS farmers helped by the government harvest program experiencing crop failure due to pests and diseases. So, besides the input price data another production decisions data incomplete and cannot be use in our study.

This paper use two different approaches to discuss the efficiency matter. First, descriptive and qualitative approaches in this study will discuss the characteristics of farmers, production decisions, and agricultural land condition. Furthermore, the quantitative approaches in this study take the advantage of the stochastic frontier profit function model and the inefficiency effect model. These two econometric models are used to examine the factors that affect the efficiency of shallot farming and also to measure the efficiency of shallot farming with TSS seeds or conventional tuber seeds. Characteristics of farmers, production decisions and conditions on agricultural land will be discussed through descriptive and qualitative approaches. Furthermore, the stochastic

Table 1. Respondents' distribution

Respondent	Grobogan	Brebes	Cianjur	Total	Percent (%)
	2 Village	1 Village	2 Village		
TSS	14	4	6	24	47
Bulb Seeds	17	5	5	27	53
Total				51	100

Source: Field Survey (2020)

frontier profit function model and the inefficiency effect model are used to examine the factors that affect the efficiency of shallot farming and to measure the efficiency of shallot farming with TSS seeds or conventional tuber seeds.

In order to estimate the level of efficiency, the application of the frontier profit model it must be separated between production frontier model. Although both empirical estimates come from the production function. Profit efficiency is different approach, which accommodates technical, allocative and economic efficiency frameworks into one model system. The consequence obtained in the estimation results later is that the estimator value is more efficient because it is estimated simultaneously [12–15]. This approach occur because one of the problems with using the production function approach in efficiency analysis is that the approach through the production function does not explicitly capture the effects of inefficiency on factor endowments and input-output prices that may vary between farmers or farms, so the estimation results will only determine best production practices of each farmer operating at different optimal levels. Profit efficiency, therefore, is defined as the ability of a farm to achieve highest possible profit given the prices and levels of fixed factors of that farm and profit inefficiency in this context is defined as loss of profit from not operating on the frontier of the maximum value of the profit [15]. Furthermore, the profit efficiency calculation method used in this study refers to the development of a production efficiency model from Coelli [16] by Rahman [12] and Ali [15] who modeled the effect of inefficiency during production to find the level of profit efficiency. In this study, the profit inefficiency faced by the i-th farmer is thought to be caused by several factors that can still be overcome or controlled by the farmer's production decisions. Determinants of inefficiency such as farmer's age, education level, length of farming, access to extension, cropping patterns used, number of household members, use of TSS seeds or tuber seeds, land ownership status, and farmer access to extension and agricultural credit can improve or worsen the production efficiency. The empirical model in this study is based on the translog profit function. The profit function model in this study is as follows:

$$\begin{aligned}\pi_i^* &= \beta_0 + \sum_{k=1}^{5} \beta_i lnP_{ik}^* + \frac{1}{2}\sum_{k=1}^{5}\sum_{l=1}^{5} \gamma_{ikl} lnP_{ik}^* lnP_{il}^* \\ &+ \frac{1}{2}\sum_{i=1}^{5}\sum_{j=1}^{5} \phi_{ikm} lnP_{ik}^* lnZ_{im} + \sum_{m=1}^{2} \tau_{im} lnZ_{im} \\ &+ \frac{1}{2}\sum_{m=1}^{2}\sum_{k=1}^{2} \psi_{imt} lnZ_{im} lnZ_{it} + v_i - u_i \end{aligned} \quad (1)$$

and

$$\pi_i^* = \delta_0 + \sum\nolimits_{i=1}^{n} \sum\nolimits_{d=1}^{d} \delta_{id} W_{id} + \omega \tag{2}$$

The notations in the equation include: (A) π_i^* is normalized profit which is defined as gross income minus variable costs, then divided by the output price faced by the i-th farmer; (B) The notation P_{ik}^*; is the normalized price of the i-th input variables faced by the i-th farmer; with k is the price of seed (1), fertilizer (2), pesticide (3), fungicide (4), and labor (5); Notation (C) Z_{im} is the price of the m-th fixed input used by the i-th farmer; with m is land used and depreciation cost; (D) v is the two sided random error and distributed normally or $N\left(0, \sigma_v^2\right)$; (F) u is the one-sided half-normal error to represents farmers specific economic inefficiencies; (G) Notation W_{id} is the d-th exogenous factor such the i-th farmer; with mostly are socioeconomic factor variables such as age, years of experience, years of education, seed types, land ownership, household size, farming irrigation types, access to agricultural credit and access to extension; (H) ω is truncated random error with $\sigma_\mu^2\left(\left|N\left(\mu_i, \sigma_u^2\right)\right|\right)$.

In addition, to measure the level of profit inefficiency faced by farmers, previous information on profit efficiency estimation can be used to measure the efficiency of the i-th farmer profit at the level of input allocation, technology, and certain limitations. This can be calculated using the formula [12, 17]:

$$\textit{Profit Efficiency}\ (\mathrm{PE_i}) = \frac{\pi_{actual}}{\pi_{frontior}} = E\left[\exp(-u_i)|\varepsilon_i\right] \tag{3}$$

This profit efficiency (PE) value is calculated per individual farmer and will have a value ranging from 0 to 1 ($0 < \mathrm{PE} < 1$). If the PE value = 1, it means that the farmer has gotten the maximum profit from his profit frontier. The closer to the value of 1, the efficiency of profits owned by farmers will reach an efficiency level of 100%. Rahman [12], Kumbhakar [18], Parmeter and Kumbhakar [19] stated that a business could be said to be efficient if the efficiency value is more than 0.7 (>70%), if the value is below that criteria, the business cannot be said to be efficient. The negative sign of the equation states that PE has a negative relationship with profit inefficiency [12, 17, 19–21]. From this equation, it can be seen how much profit the farmer lost due to inefficiency. The greater the profit efficiency value of each shallot farmers has, the smaller profits lost due to inefficiency in production. The parameter estimation of stochastic frontier profit function and profit inefficiency effects was carried out simultaneously using the Frontier 4.1 program developed by Coelli [16]. Parameter testing on both models will only be carried out by performing one-step stage estimation, namely Maximum Likelihood Estimation (MLE). MLE is carried out to find the coefficient value of each variable in the model, namely to estimate the value of the parameter. The goodness of fit from the model equation then compared using Likelihood ratio statistics (LR-Statistic) with the Kodde and Palm Table 1 [22].

This study expects that the variable input prices have a negative relationship with the profit level of the i-th farmer. The factor of planting area and random error during production is expected to have a positive relationship to the profit level of each farmer. Hence, the effect of inefficiency and other additional costs in production is expected to negatively affect the farmer profit level. In addition to the significance of each estimator model, the distribution of variance from the random error variable (v_i) and the profit efficiency effect (u_i) is a concern to see the goodness of fit of the stochastic frontier profit function model. In the stochastic frontier analysis (SFA) method, the estimation of the value of the variance of the error components is obtained through the following calculations:

$$\gamma = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2} \quad (4)$$

The parameter of the variance of the model γ is the ratio of the error to statistically detects the existence of inefficiency effect. If the value of γ equals to 0, there is no inefficiency in farmer production activities. However, if γ equals to 1, there is a dominant inefficiency effect on farmers' production activities. In other words, random noise does not exist at all. For this reason, to measure whether there is inefficiency in the model or not, it will be tested using the Likelihood Ratio (LR) statistical test [12, 17, 19].

3 Results and Discussion

The summary statistics presented in Table 2 reveals that the sample of shallot farmers age ranging between 25 to 70 years old with the average age of 48 years old. This indicates that the majority of the sample farmers are generally dominated by the middle ageman, but the experience was quite large on average with 10 years of experience in shallot cultivation. The data also revealed that 79.4% of the farmer samples are closely connected to agriculture extension officers in their area. Hence, this means that most farmers are experienced, more than enough experience in producing shallots in their land. The average of years of education from farmer samples also show that most of the farmer have 9 years of education. This simply means that most farmers are junior high school graduates. This low level of education also explain why the farmers that implement TSS are basically low,with only 19.4%. Its mainly related to the level of perception of each farmer towards additional activities when using TSS. Most of the farmers always reluctant to try the new seeds, because of fear of failure on the nursery process. Even though the standard operational procedure has been provided and the availability of the extension workers that always ready to teach every the techniques and principles needed by the during the sowing or transplantaion process. More than 76% of the sample of farmers already use an irrigation system, so that the soil and plant fertility are supposed to be better maintained than others who do not. The results also suggest that 55.9% of the farmer samples have polyculture practices to grow other crops or horticulture commodities during or after planting shallots, which can increase their farm's profit, improve soil fertility and cut the reproductive cycle of shallot plant pests. The respondents have a household size ranging from 0 to 6 people at a mean membership of 3. This means that one shallot farmer household, in most cases, has 3 members of a family. The data also revealed that 38.2% of the samples rent their production land. The reason is mostly because they being able to move the place of production if it is felt that the land for production is not fertile anymore.

The maximum likelihood estimates for parameters of the translog stochastic frontier defined by Eq. (1), with given the specifications for the inefficiency effects defined by

Table 2. Summary statistics of inefficiency variables

Variables	Units	Statistics			
		Min	*Max*	*Mean*	*SD*
Age	Years	25	70	48.706	11.052
Experience	Years	2	32	10.176	8.903
Education	Years	5	16	9.618	3.209
Seed types	Dummy	0	1	0.194	0.396
Irrigation types	Dummy	0	1	0.765	0.424
Household size	Person	0	6	3.118	1.157
Land Ownership	Dummy	0	1	0.382	0.486
Crop patterns	Dummy	0	1	0.559	0.497
Access to Extension	Dummy	0	1	0.794	0.404
Access to credit	Dummy	0	1	0.441	0.497

Source: Field Survey (2020)

Eq. (2), were obtained using Frontier 4.1 [16]. The results of estimation are presented in Table 3. The null hypothesis for γ equal to 0 was rejected as indicated on Table 3. It means that the null hypothesis about the absent of economic inefficiency at every level of production was rejected.

As a result, variations between observed profit margins from the frontier profit functions are mainly determined by economic inefficiency effects. This also justified the empirical approach of this study with stochastic profit frontier function. The estimated value of γ is close to 1, establishing a fact that a dominant inefficiencies is exists in implementation of TSS and tuber seeds. This also means that 75.64% of the variation in gross revenue from the profit frontier was due to socioeconomic effects, whilst 24.36% was due to pure noise. Further, a set of hypothesis also tested using likelihood-ratio test statistics. Resulted that the null hypothesis that $\gamma = 0$ at 5% level of significance (LR Statistic12.06 $> \chi^2_{1,0.05} = 2.71$) confirming that inefficiencies exist and indeed stochastic [12, 21]. Same test also conducted on null hyphothesis that ($\gamma = \delta_0 = \ldots = \delta_{10} = 0$) at 5% level of significance (LR Statistic 60,72 $> \chi^2_{11,0.05} = 19.04$). Hence, it is can be concluded that the variability in profits among shallot farmers is explained by the differences in the individual level of technical, allocative and scale efficiencies. The same result was also obtained by the study of Rahman [12] about profit efficiencies between rice farmers that implemented modern and conventional rice has existing economic inefficiency in their production.

Another result in Table 3 also indicated that an increase in the price of seed, fertilizer, pesticide and labor wage could reduce the gross profit of each shallot farmer. Seeds are the important part of shallot cultivation input, if the seed price is raising to some extent, this will make the farmers either buy few seeds, reducing other inputs, buying less expensive seeds that has no quality certificate on it or increasing the output price. This will cause productivity and inflation on shallot output prices [2, 5]. This is why government through

Table 3. Stochastic frontier estimation results

Variables	Parameters	Estimates	T-ratio
Constant	β_0	21.0243	7.71***
lnP*S	β_S	−2.8234	−2.09**
lnP*F	β_F	−2.2979	−2.67**
lnP*P	β_P	−1.8633	−1.97**
lnP*M	β_M	1.7981	0.48
lnP*L	β_L	−2.4932	−2.16**
½(lnP*S × lnP*S)	γ_{SS}	−1.1887	−1.65
½(lnP*F × lnP*F)	γ_{FF}	−0.0043	−0.26
½(lnP*P × lnP*P)	γ_{PP}	−0.3894	−0.31
½(lnP*M × lnP*M)	γ_{MM}	−0.4973	−0.42
½(lnP*L × lnP*L)	γ_{LL}	−0.0228	−1.22
lnP*S × lnP*F	γ_{SF}	−0.0541	−0.65
lnP*S × lnP*P	γ_{SP}	−0.7132	−0.58
lnP*S × lnP*M	γ_{SM}	0.3290	1.33
lnP*S × lnP*L	γ_{SF}	−1.0742	−2.82
lnP*F × lnP*P	γ_{FP}	−0.0768	−0.79
lnP*F × lnP*M	γ_{FM}	0.5611	1.15
lnP*F × lnP*L	γ_{FL}	−0.8440	−2.34**
lnP*P × lnP*M	γ_{PM}	−0.0457	−0.32
lnP*P × lnP*L	γ_{PL}	−0.9713	−0.05
lnP*L × lnP*M	γ_{LM}	0.7694	1.08
lnP*S × lnZA	ϕ_{SA}	0.0349	1.98**
lnP*S × lnZD	ϕ_{SD}	−0.4786	−0.92
lnP*F × lnZA	ϕ_{FA}	0.4553	1.36
lnP*F × lnZD	ϕ_{FD}	−0.0287	−0.70
lnP*P × lnZA	ϕ_{PA}	0.0410	0.33
lnP*P × lnZD	ϕ_{FD}	−0.04697	−0.09
lnP*M × lnZA	ϕ_{MA}	0.0356	1.12
lnP*M × lnZD	ϕ_{FD}	0.0108	0.92
lnP*L × lnZA	ϕ_{LA}	−0.0674	−1,73
lnP*L × lnZD	ϕ_{FD}	−0.0582	−1.54
lnZA	β_A	1.7402	2.21**

(*continued*)

Table 3. (*continued*)

Variables	Parameters	Estimates	T-ratio
lnZD	β_D	−0.0017	−0.21
½(lnZA × lnZA)	ψ_{AA}	−0.0924	−1.97**
½(lnZD × lnZD)	ψ_{DD}	−0.0076	−0.63
lnZA × lnZD	ψ_{AD}	0.0003	0.27
$\sigma^2 = \sigma_v^2 + \sigma_u^2$	σ^2	0.6371	2.34**
$\gamma = \sigma_u^2/\sigma_u^2 + \sigma_v^2$	γ	0.7564	6.91***
Log Likelihood		−161.54	

Seed, S; Fertilizer, F; Pesticide, P; Fungicide, M; Labor, L; Land used, A; Depreciation on capital asset, D.
* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

the Ministry of Agriculture launching many supporting programs to introduce TSS to cut the cost of seeds up to 45% of the initial seeds cost using tuber seeds. Thus, TSS can be implemented when the price of tuber seeds is increases at certain times [2, 5, 7]. The same cases also happen with the price of fertilizer, pesticide and labor wage. An increase on the price of these variables will significantly reduce the gross revenue of each shallot farmer. The use of pesticides plays an important role in Indonesian shallot production, and some of the farmers are depended heavily on pesticides, to avoid crops failure cause by pests [23].

An increase on labor wage can reduce the farmer's potential profit. Because in Indonesia, human labor is still widely used compared to machines in Indonesia Especially if the area of land to be cultivated is quite large (more than 1 hectare), then there will be more human labor hired to maintain the shallot farm. Hence, shallot farming still heavily depended on the availability and level of wages for farm laborers in shallot production. The further result displayed in Fig. 1, the range of profit efficiency (PE) score among the shallot farmers, in general both groups of the farmers with TSS and others with tuber seeds. There is some progressive increase through the range of the profit efficiency scores. The peak proportion was reached at efficiency range of 71% to 80% which is represented by 63% of the total farmer samples. There is also some farmers that reached the range of profit efficiency of 81% to 90% but only in small numbers of 3.7%. The mean of profit efficiency of the shallot farmers was 64% (TSS and bulb users) which implied that 36% of the profit was lost due to economic efficiency at the given input prices and technological-wise. This also can be inferred that the average shallot farm could increase their profits by about 36% by improving their technical, allocative and scale efficiency. This also means that the farmers can change his own production efficiency because some of the socioeconomic aspects are included in the factors that can be controlled (not random noise). This also means that the farmers can change their own production efficiency because some of the socioeconomic aspects are included in the

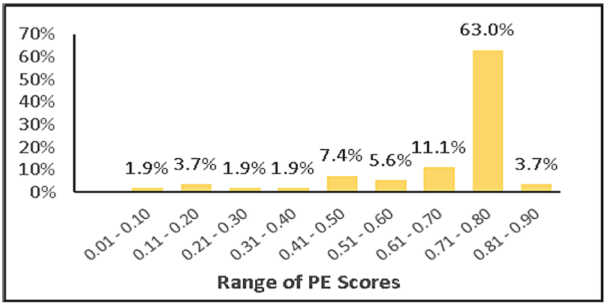

Fig. 1. Profit efficiency distribution.

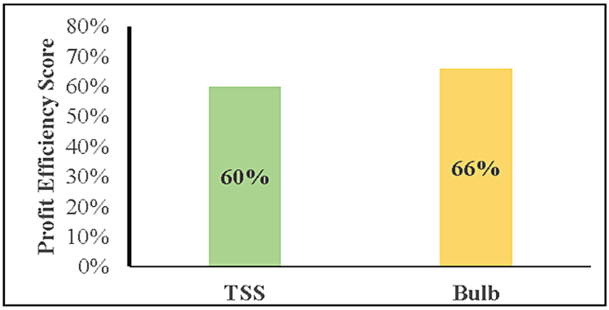

Fig. 2. Average profit efficiency between TSS and Bulb seed farmers.

factors that can be controlled (not random noise). The results depicted in Fig. 2 shows by average, the group of farmers that implemented TSS has a lower profit efficiency than the group farmers that still implemented the tuber seeds in their production. Even though both groups having the benefit-cost ratio (B/C ratio) more than 1 (1.12 for TSS groups and 1.24 for tuber seeds group). It can be inferred that in average, shallot production with tuber seeds give the farmers more higher profit.

Also, the average of TSS farmers have profit efficiency of 60%, whilst average of tuber seeds farmers have profit efficiency of 66%. There is an explanation for this, first, the sample farmers are middle-age man. Also, the application and additional activity as the result of decision of using of TSS bulbs is rather complicated, especially in the nursery process. This process requires the farmers' care and patience until the TSS tuber seeds can be harvested for transplantation into the main planting area. Moreover, this process lasted about 40 days before the seedlings could be harvested. More than 70% (17 samples) of TSS farmers in this study said that this nursery process and technique was challenging to implement, causing farmers to experience 30%-40% seedlings loss, mostly because of diseases caused by pests, fungi and heavy rain. This resulted in a shortage of seeds that to be planted, which causing the farmers to use less land from what they supposed to use. As a result, their productivity on shallot production become less productive as the less land is planted with the new seedlings which affects productivity.

The results found by this study support several reports from various parties regarding variations in TSS productivity in several shallot fields.

Another technical problem faced by TSS farmers is in the marketing process. The fact that most TSS yields, have larger bulbs in sizes and have less than 4 bulb fractions in general, such as the Sanren, Maserati F1 and Lokananta varieties. However, previous varieties such as Tuk-tuk have bulbs size two times larger than the typical onion bulbs. In some places, this form of shallot is less familiar to the demand of wholesalers and consumers of shallots. Occuring some discrimination in the selling price of tubers harvested from TSS, which causes the price to be lower than the price of tuber seed onion bulbs, and later to cause the farmer's profit to decrease drastically.

The impact of some socioeconomic factors in each farmers profit inefficiency is depicted in Table 4. Factors such as years of experience in planting shallot and years of education received significantly reduce the inefficiency effects of shallot production. This was due to the ability of more experienced and educated farmers makes the adoption of best practices in shallot cultivation is easier to implement through continuous learning process. The study conducted by Rahman [12], Jabbar et al. [17] also stated that the amount of experience and education will affect farmer's way of thinking and the level of technology used in shallot cultivation and the quality of production decisions. On the contrary, the numbers of farmer's age significantly increases the inefficiency effects. This was due to limited capacity of understanding new things, especially like new technology or new farming practices [24]. Land ownership also becomes the factor that reducing the inefficiency effects on shallot cultivation. This is mainly because the farmers with rented land always provide more efforts towards the cultivation process. Most of them are highly motivated because the production cost of shallot is higher and they need to makes profit in each planting season in order to ensure the continuity of their business, even though they has limited action to improve the soil since they not own the land

Table 4. Inefficiency effects estimation

Variables	Parameters	Estimates	T-ratio
Constant	δ_0	5.760	0.876
Age	δ_1	0.913	1.99**
Experience	δ_2	−1.029	−2.31**
Education	δ_3	−0.902	−2.67**
Seed types	δ_4	3.458	1.38
Irrigation types	δ_5	1.471	1.29
Household size	δ_6	0.007	0.16
Land Ownership	δ_7	−2.714	−2.04**
Crop patterns	δ_8	−0.705	−1.40
Access to Extension	δ_9	0.806	1.07
Access to credit	δ_{10}	0.277	0.55

** corresspond to 5% significance level

[25]. However, the choice of seeds is not significant in improving or worsen the effect of inefficiencies in farms production. Although by average, the profit gained by TSS farmers are relatively lower than conventional farmers due to some reasons mentioned before. This can also add conclusion that the use of TSS in the farmer sample scope is not significant in improving the profit efficiency on each farmers due to some technical problems in the cultivation process.

4 Conclusions and Policy Recommendations

This study used stochastic profit frontier functions to analyze the profit efficiency of shallot farmer in 3 different regions (district) in Indonesia. This study found that the price of seeds, fertilizer, pesticides and labor wage is significant in reducing farmer's level of profit. Further results in this study also concludes that the sample of farmers are able to attain 64% of profit efficiency in their production activity. Thus, all farms in average is considered not profit efficient. But this indicates that there remains considerable scope to increase profits, especially if the producers stacked to the best farm practices and use the least cost combination of the inputs.

The farm specific variables that significant explain inefficiencies on shallot production in each shallot farmer are years of experience, years of education, land ownership and farmer's age. Other findings are that the average of TSS farmers have profit efficiency of 60% whilst average of tuber seeds farmers have profit efficiency of 66%. Both groups are considered as not profit efficient, but the TSS farmers group has lower profit efficiency. This mainly because the complexity of the nursery and transplantation process (technical and allocative efficiency problems) marketing discrimination. This study also recommends, that in order to increase the popularity and expertise of TSS seeds among Indonesian farmers, the government must assist and supervise nursery practices carried out by farmers through direct assistance so that probability of the failure during seedling and transplanting by the farmers can be minimized. It is also necessary for the government to strengthen the power of formal institutions in wholesale markets where the shallots are sold in order to avoid price discrimination from market traders or distributors. This needed to ensure that the selling price of shallot products from each type of seeds does not fall beside the economic activities.

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