Efficient Production Factors Taking into Account The Risks In Shallot: Case Study in Nawungan Village, Imogiri District, Bantul Regency, DIY

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Abstract. The risks of shallot farming refer to the failure of production and price due to fluctuating prices. These farming risks cause farmers to be reluctant to take risks. Differences in risk aversion between individuals can lead to disparities in decision-making. This research seeks to analyze (1) the behavior of farmers towards the risks, and (2) the efficient use production factors by considering production risks. The study was undertaken through interviews with farmers and other relevant stakeholders and field observations. The total sample of 100 farmers was taken at simple random. The majority of farmers behaved reluctantly toward the risks. The use of production factors for land area, labor and organic fertilizers in the shallot production function is not yet efficient. While the use of seeds, Urea fertilizer, TSP fertilizer, NPK fertilizer, POSKA fertilizer, Curacron EC pesticide, Score pesticide, Sellestol pesticide and Dithane M-45 pesticide is inefficient. It is time for farmers to be advised to use organic fertilizers and organic pesticides as a substitute for inorganic fertilizers and chemical pesticides.

1 Introduction

The most extensively grown product in the horticultural sector is shallots. Shallots are a part of the Liliales order, family Liliaceae, class Monocotyledonous, division Spermatophyta, kingdom Plantae, and species Allium ascalonicum L [1]. Regarding quantity and quality, each region's shallot harvest varies. Each location has a distinct shallot variety due to climate, soil, and geography [2]. Shallot is one of the most valuable commodities due to its tremendous economic worth.

National shallot production per hectare reached 10.06 tons in 2015 [3]. The production of shallots is still far higher in other nations, such as China, where it reached 38.43 tons per hectare. If regular operating standards are followed, the potential for shallot output in Indonesia might reach 17 to 20 tons per hectare [4].

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The revenue, effectiveness, and risk factors that affect shallot farming success. The ability of the farmer to realize their income or gross margin determines the amount of farming efficiency.If a farm's projected earnings or gross margin exceed 75%, it is deemed efficient [5, 6]. Due to the impact of farming risks, farmers are unable to realize their maximum gross margin.

The risks of shallot farming are caused by production and price failures due to price fluctuations.The risks associated with shallot farming are affected by production parameters such as NPK fertilizer, pesticides, and labor [7]. The prevalence of risks discourages farmers from taking risks [7, 8, 9]. Interpersonal risk disparities will result in distinct decision-making [10, 11]. Additionally, socioeconomic variables impact the farmers' behavior toward risks [5].

Socioeconomic factors hinder the implementation of efficient farming management, which in turn reduces the effectiveness of using production factors. The potential rewards that could be lost closely correlate with the degree of risk aversion [12]. The index measuring lost profit potential rises and efficiency decreases as risk aversion increases. Consequently, farming risks have an impact on how production elements are used [13].

This study seeks to examine (1) Analyze how farmers act in response to the risks of growing shallots, and (2) the efficient use of shallot production factors by considering production risks.

2 Research Method

The research used descriptive analysis methods [14, 15, 16] and was carried in Nawungan Village, Imogiri District, Bantul Regency, Yogyakarta Special Region's center of shallot production. The research was carried out in a straightforward random manner and involved 100 farmers out of a total of 315 farmers. An interview guide and observational methods were used to conduct the research. Using facts, occurrences, and conclusions based on empirical evidence gathered at the study site, the data were processed using inductive methods, were then analyzed using qualitative and quantitative descriptive methods. Farmers' behavior toward risks was investigated using a quadratic utility function model with the following formula.

$$U = b_0 + b_1 M + b_2 M^2 \tag{1}$$

Description:
U= utility value
M= acceptance obtained at the equilibrium point of the proposed alternative choices
b_0= intercept
b_1 = regression coefficient
b_2= risk preference coefficient

The profit maximization model is used to identify the productive factor that is most effective. The first step is to calculate the regression coefficient of the production function.

$$E[Y] = \alpha_0 \prod_{i=1}^{k} X_i^{\alpha_i} \tag{2}$$

$$E[Y] = \alpha_0 X_1^{\alpha_1} X_2^{\alpha_2} X_3^{\alpha_3} X_4^{\alpha_4} X_5^{\alpha_5} X_6^{\alpha_6} X_7^{\alpha_7} X_8^{\alpha_8} X_9^{\alpha_9} X_{10}^{\alpha_{10}} X_{11}^{\alpha_{11}} X_{12}^{\alpha_{12}} \tag{3}$$

The second step is to calculate the regression coefficient of the variance function using the exponential function model as follows:

$$V[Y] = \beta_0 \prod_{i=1}^{k} X_i^{\beta_i} \quad (4)$$

$$V[Y] = \beta_0 X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} X_5^{\beta_5} X_6^{\beta_6} X_7^{\beta_7} X_8^{\beta_8} X_9^{\beta_9} X_{10}^{\beta_{10}} X_{11}^{\beta_{11}} X_{12}^{\beta_{12}} \quad (5)$$

Description:

Y = Production (kg)
$V[Y]$ = Variance (residual E[Y])
X_1 = Land area (ha)
X_2 = Seeds (kg)
X_3 = Labor (hko)
X_4 = Organic fertilizer (kg)
X_5 = Urea fertilizer (kg)
X_6 = TSP fertilizer (kg)
X_7 = NPK fertilizer (kg)
X_8 = POSKA fertilizer (kg)
X_9 = Curracron EC pesticide (lt)
X_{10} = Score pesticide (lt)
X_{11} = Sellestol pesticide (lt)
X_{12} = Dithane M-45 pesticide (kg)
α_0 = Intercept
α_i = Regression coefficient

The third step is calculating the use of efficient factors of production by considering production risks using the profit maximization model as follows:

$$X_i = ((\alpha_i - \phi\beta_i)/(\sum_i \alpha_i - \phi\sum_i \beta_i))(C/Px_i) \quad (6)$$

Description:

X_i = Production factors
α_i = The regression coefficient of the production function
$\sum_i \alpha_i$ = The sum of the regression coefficients of the production function
β_i = The regression coefficient of the variance function
$\sum_i \beta_i$ = The sum of the regression coefficients of the variance function
ϕ = Average risk level
C = Variable costs
Px_i = Factor prices of production
i = 1, …, 12

3 Results and Discussion

3.1 Farmers' Behavior Toward Risks

A quadratic utility function was used to analyze how farmers acted in response to the risks associated with shallot farming. The coefficient of determination (R^2) ranged from 0.975 to 0.997. As a result, income fluctuations account for 97.50% of the variation in the utility value of shallot farming, while other factors not included in the model account for 2.50% of the variation (lowest R^2). The variation in utility value is caused by variations in revenue that account for 99.70% of the variation and variations in other factors that are not part of the model that account for 0.30 percent, according to the coefficient of determination (highest R^2).

Table 1 reveals that 93% of farmers have a significant negative risk coefficient (b2), indicating that they are hesitant to take chances. The remaining 4% of farmers have a negative risk coefficient (b2) and 3% have a positive but negligible risk coefficient (b2), indicating that they are risk averse. Further analysis shows that 4% of farmers have a negative risk coefficient (b2) and 3% have a positive but insignificant risk coefficient (b2), indicating that farmers are risk averse. Research entitled Risks of Shallot Farming in Bantul Regency [9]; Farmers' Attitudes Toward the Dangers of Shallot Farming in Central Sulawesi's Palu Valley [11]; and Shallot Farming Production in Batu City Risk Analysis [7], most farmers avoid risks..

Table 1. Distribution of Shallot Farmers' Behavior Toward Risks, 2022

Behavior	Total	Percentage (%)
Averse	93	93
Neutral	7	7
Lover	0	0
Lowest R^2		0.975
Highest R^2		0.997
Lowest F-count		77.661
Highest F-count		955.500

A high number of farmers were risk-averse since the majority of farming families confronted a basic economic issue [17, 18, 19, 20, 21]. Farmers were near the subsistence limit and often faced weather unpredictability, preventing them from using the maximum profit estimate in farming. How farmers attempt to prevent failure is referred to as safety first or putting safety first, typical of most farmers.

Shallot farmers have been motivated to obtain a large income since they produce rapidly, and the price is relatively high. However, most farmers have not ventured into large-scale farming due to the substantial risk involved. A few farmers have ventured to run farming on a huge scale, but they were speculative farmers with substantial cash. When harvest time arrived, small farmers were forced to sell their produce at both somewhat high and cheap prices because they lacked the funds to meet their daily necessities.

3.2 Analysis of the Efficiency of Using Production Factors

Table 2. Shallot farming's average use of production factors and effective production factors per garden and per hectare 2022

Production Factor	Per Farm		Per Hectare	
	Average	Efficiency	Average	Efficiency
Land area, X_1 (ha)	0.1835	0.1875		
Seeds, X_2 (kg)	229	206	1,250	1,100
Labor, X_3 (hkp)	71	89	385	425
Organic fertilizer, X_4 (kg)	3,762	4,875	20,500	26,000
Urea fertilizer, X_5(kg)	64	56	350	300
TSP fertilizer, X_6 (kg)	51	42	275	225
NPK fertilizer, X_7 (kg)	18	7	95	38
POSKA fertilizer, X_8(kg)	23	-6	126	-35
Curacron EC pesticide, X_9 (lt)	0.4853	0.1002	2.6449	0.5344
Score pesticide, X_{10} (lt)	0.8787	0.1237	4.7885	0.6595
Sellestol pesticide, X_{11} (lt)	0.9359	-0.6204	5.1000	-3.3086

Dithane M-45 pesticide, X^{12}(kg)	1.0195	0.4695	5.5560	2.5039

Land area, seeds, labor, organic fertilizer, urea, TSP, NPK, POSKA, and pesticides Curacron EC, Score, Sellestol, and Dithane M-45 are production factors that affect shallot production. Using the profit maximization model, the effectiveness of using production factors was examined [22] is employed, with the outcomes shown in table 2.

An analysis of how well production factors are utilized while taking production risks into account in shallot farming leads to the following conclusions :

3.2.1 Land Area

Table 2 shows that the use of land area in the shallot production process is not yet efficient so its utilization needs to be increased. This is also supported by the regression coefficient of land area in the shallot production function, which is positive and significant and indicates that, ceteris paribus, shallot production will be significantly increased by the addition of land area [23]. In other words, the addition of land area will cause a large amount of shallot production to be produced.

Farmers' land holdings have an impact on the number of production factors they use. The wider the farming land owned by the farmer, the more factors of production used. The total use of production factors, such as seeds, labor, organic fertilizer, urea, TSP, NPK, POSKA, pesticides Curacron EC, Skor, Sellestol, and Dithane M-45, increases with the amount of land that farmers cultivate, but on average it is less, making it more cost-effective. On the other hand, as the area of arable land becomes smaller, production factors such as seeds, labor, urea, TSP, NPK, POSKA, organic fertilizers, and pesticides such as Curacron EC, Score, Sellestol, and Dithane M-45 are used less overall but more wasteful on average.

The analysis's findings also indicate that 0.1875 hectares of land are effectively being used for shallot farming. This is in line with the reality on the ground, according to farmers, who claim that managing narrow land will result in time, energy, and other production factors being sacrificed. However, if it is too large, they are also unable to manage it, because it takes a lot of time, effort and capital.

3.2.2 Seeds

Seeds are a production factor that contributes significantly to the production process. The analysis' findings indicate that using seed is inefficient, so less seed needs to be used [24, 26, 27, 28]. This is further supported by the fact that the regression coefficient of the shallot production function per farm is negative and insignificant, indicating a tendency for adding seeds to lower shallot production under the same conditions. This also occurs in the function of shallot production per hectare, each additional seed has a tendency to reduce shallot production ceteris paribus. In other words, the addition of seeds will cause a reduction in the production of shallots that will be produced. This can happen because in shallot cultivation the seeds used are large in size with a planting distance of 15 cm x 15 cm.. Meanwhile, according to recommendations, if the spacing is 15 cm x 15 cm, good seed size is medium size with an amount of around 1,050 kilograms per hectare.

3.2.3 Labor

The role of humans in agriculture is a major factor. Humans are not only the workforce to work on shallot farming, but they also have to think about how to farm so that high and satisfying production results can be obtained. The analysis' findings indicate that more labor needs to be used because the efficiency of the shallot production process is low [25, 27, 28, 30]. This can also be seen from the regression coefficient of labor on the shallot production function per farm which is positive and significant, meaning that additional labor will increase shallot production ceteris paribus. This also occurs in the shallot production function per hectare, each additional workforce will significantly increase shallot production ceteris paribus. In other words, the addition of labor will cause the amount of shallot production to be produced.

The use of labor in shallot farming between one farmer and another is not necessarily the same amount even though in the same unit area. The difference in the use of labor is caused by a number of things, firstly location and topography, secondly farming management. Location and topography, for sloping land the management of farming is rather difficult, this can be seen from the preparation of the land, irrigation and fertilization so that a lot of manpower is needed. In contrast to flat land, which is relatively easier to manage, so that not so much labor is needed

There are farmers in managing shallot farming who manage it intensively so that all procedures and sequences of activities are carried out, but there are also farmers who manage their farming business not intensively, there are several procedures or activities not carried out. For example, if it is intensive, tillage is done well by carrying out all activities, weeding is done 3 times, of course the results will be optimal even though more labor is needed. In contrast to those that are not intensive, not all tillage activities are carried out, weeding is carried out 2 times or even only 1 time, of course, the results are not optimal even though the labor required is less.

3.2.4 Organic Fertilizer

The organic fertilizers used by farmers are manure produced from manure which is mixed with leftover food from goats, cattle and horses that have been stored. This organic fertilizer is given as a basic fertilizer which is given together with tillage. The analysis's findings indicate that more organic fertilizer needs to be used because its current use is ineffective [25, 26, 27, 29]. This is also evident from the positive and significant regression coefficient for the use of organic fertilizer per farm, which indicates that, ceteris paribus, the addition of organic fertilizer will increase shallot production. This also occurs in the shallot production function per hectare, each addition of organic fertilizer will significantly increase shallot production ceteris paribus. In other words, adding organic fertilizer will significantly increase shallot production.

This situation can arise because the majority of farmers in the study area need a lot of organic fertilizers when planting shallots, and there are only a limited number of organic fertilizers that are appropriate for use and accessible in the neighborhood. The analysis results show the efficient use of organic fertilizer amounting to 26 tons per hectare, while the average use of organic fertilizer by new farmers is 20.50 tons per hectare

3.2.5 Inorganic Fertilizer

The inorganic fertilizers used by farmers are Urea, TSP, NPK and POSKA fertilizers. TSP fertilizer is given as basic fertilizer and supplementary fertilizer, basic fertilizer is given simultaneously with soil processing while as supplementary fertilizer is given in the second fertilizer around 35 days old shallots, given simultaneously with Urea fertilizer. For Urea, NPK and POSKA fertilizers as follow-up fertilizer given when the plants are 15 days old, and the plants are 35 days old.

The analysis's findings indicate that using Urea, TSP, NPK, and POSKA fertilizers per farm in the shallot production process is inefficient, and their use must be decreased. This also holds true for using these fertilizers per hectare [24, 25, 26, 27, 28, 29, 30]. Table 2 reveals that the use Urea, TSP and NPK fertilizers per farm or per hectare far exceeds the efficient or optimal use, so the use needs to be reduced, while for POSKA fertilizer if the use is increased it will actually reduce shallot production, the regression coefficient of the use of POSKA fertilizer on the shallot production function per farm is negative but not statistically significant, meaning that with the addition of POSKA fertilizer there is a tendency to reduce shallot production ceteris paribus. This also occurs in the function of shallot production per hectare, each addition of POSKA fertilizer tends to reduce shallot production ceteris paribus.

This can all happen because most farmers use inorganic fertilizers that exceed the recommendations, for example the recommended urea fertilizer of 300 kg per hectare and TSP fertilizer of 225 kg per hectare. Farmers use 350 kg of Urea fertilizer per hectare and 275 kg of TSP fertilizer per hectare. Conditions like this cause the soil to become infertile, the soil has started to be poisoned by chemical substances.

3.2.6. Pesticide

The pesticides used by farmers are Curacron EC, Score, Recotd, Dusban, Sellestol, Supergro, Dithane M-45 and Padan, but the pesticides most widely used by farmers are Curacron EC, Score, Sellestol and Dithane M-45, while Recotd Pesticides , Dusban, Supergro and Padan are only used by a small number of farmers. Most farmers spray by mixing between the four pesticides, either Curacron EC, Sellestol and Dithane M-45 pesticides or between Score, Sellestol and Dithane M-45 pesticides. Pesticides Curacron EC and Score function to eradicate pests that attack shallot plants. The Dithane M-45 pesticide functions to control fungus on the shallot plants, especially if there is a lot of rain or fungus, while the Sellestol pesticide functions as an adhesive so that the spraying can stick to the shallot plants and the spraying is not in vain.

The analysis's findings indicate that it is inefficient to use the pesticides Curacron EC, Score, Sellestol, and Dithane M-45 per hectare in the shallot production process, and that their use should be decreased [26, 27, 28]. Table 2 shows that the average use of the pesticides Curacron EC, Score, Sellestol and Dithane M-45 far exceeds efficient or optimal use, so their use needs to be reduced, whereas for the pesticide Sellestol, if it is added it will actually reduce shallot production, seen from the usage regression coefficient. Sellestol pesticide on the function of shallot production per farm is negative and not significant, meaning that with the addition of Sellestol pesticide there is a tendency to decrease shallot production ceteris paribus.The same thing happened to the function of shallot production per hectare, each time the addition of Sellestol pesticide tends to reduce shallot production ceteris paribus.

All of this can happen because firstly, most farmers do not pay attention to the dosage when using pesticides, some use below the recommended dose, but also not a few farmers use more than the recommended dose. 08.00 WIB to 10.00 WIB for the morning and 14.00 WIB until 17.00 WIB for the afternoon but not a few farmers spray during the day, the three spraying are very good if there is no wind but also not a few farmers spray when there is wind , and fourthly, when spraying, the farmer does not see whether or not spraying is necessary, but the farmer sprays routinely, namely once a week, if according to the recommendations, spraying is done when it is really needed.

4 Conclusion and Policy Implication

4.1 Conclusion

Conclusions can be made in light of the research and discussion's findings (a). 93 percent of farmers have a reluctance attitude toward the risks of shallot farming, 7 percent have a neutral attitude, and not a single farmer has a brave attitude toward the risks of shallot farming. (b). The use of land, labor and organic fertilizer production factors in the shallot production function is not yet efficient so their use needs to be increased. Meanwhile, the use of seeds, Urea, TSP, NPK and POSKA fertilizers, Curacron EC, Score, Sellestol and Dithane M-45 pesticides is inefficient so it needs to be reduced, even for POSKA fertilizer and Sellestol pesticides. if added it will actually reduce shallot production.

4.2 Policy Implications

It's time to encourage farmers to use organic fertilizers and pesticides in place of inorganic fertilizers and chemical pesticides, or at the very least, some of the inorganic fertilizers and chemical pesticides currently used.

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