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# INCOME AND RISK DETERMINATION OF SHALLOT FARMING BUSINESS IN WANASARI DISTRICT, BREBES REGENCY, INDONESIA

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## ABSTRACT

In every agricultural business, farmers face the phenomenon of farming risk. Climate-related production risk, market risk, financial risk, and institutional risk are some of the dangers faced. This study aims to analyze the level of risk and risk mapping faced by farmers and its impact on shallot farming income. This study was conducted in the shallot center area in Wanasari District, Brebes Regency, Central Java, Indonesia from April to May 2023. The survey was conducted using semi-structured interviews and questionnaires on the level of shallot farming risk and factors that influence farmers' income. The analysis was carried out using risk mapping and multiple regression techniques. The results of the study showed that the production risk, market risk, and financial risk of shallot farmers in the study area were included in the high category, while institutional risk was included in the moderate group. The shallots produced per hectare reached 12.76 tons. The factors that influence shallot farming income are land area, productivity, total costs and shallot farmers' risk awareness. Meanwhile, the price of shallots and the level of risk did not significantly affect shallot farming income.

**Keywords**: *farm income, risks, shallots, technology*

## BACKGROUND

Shallots (*Allium ascalonicum L.*) are a strategic horticultural commodity, because this type of vegetable is used in almost all food menus in Indonesia. Shallot provides a significant contribution to regional economic growth, provides employment, and as a source of income (Susanawati et al., 2018). Brebes Regency is an area in Central Java Province that has the largest contribution to the supply of shallots in Indonesia. Wanasari District is the center of shallot production in Brebes Regency. In 2022, around 29.93% of the national shallot supply came from this area. However, this supply decreased by 14.04% in 2023. On average, Agricultural Data and Information System Center reported that the productivity of shallots in Indonesia is 10.05 tons per hectare (Pusat Data dan Sistem Informasi Pertanian, 2023). The Bima Brebes variety is the most preferred variety (71.43%) in this location. The productivity of Bima Brebes in the lowlands reaches 13.89 tons per hectare, while in the highlands it reaches 14.13 tons per ha ( Basuki et al., 2014; Citra & Firmansyah, 2020).

Many smallholder farmers in Indonesia depend on agriculture for their livelihoods. but this sector is at high risk from climate change. Smallholder farmers must adjust and reduce their vulnerability by determining the cost-effectiveness of climate adaptation. Appropriate planning and managerial actions can improve their agricultural productivity (Williams et al., 2020). In addition to

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climate risk, shallot farmers also need good business management due to the influence of various risks faced such as market risk, financial risk, and human resource risk. Market risk refers to fluctuations in market prices for production factors that result in high production costs. or a decrease in selling prices that result in a decrease in farmer income. Market risk makes it difficult for farmers to obtain consistent profits. Financial risk is related to the ability to pay back borrowed funds along with interest to have enough finance to continue farming. and to avoid bankruptcy (Akhtar et al., 2019).

There are various risks faced by farmers. Therefore, shallot farmers must manage these risks with the right strategies such as the use of agricultural technology, crop diversification, and access to wider markets to minimize losses (Jaroenwanit et al., 2023). The application of management skills in agricultural businesses and the adoption of technology are very important in efforts to achieve high production. Agricultural management must be carried out according to technical provisions so that agribusiness efforts can achieve success (Mariyono et al., 2022 ; Rahvita et al., 2024).

Various strategies have been suggested to address risks in agricultural businesses. Such as through diversification, insurance, credit or off-farm income (Nazir et al., 2018 ; Saqib et al., 2016; Akhtar et al., 2019). According to Nin-Pratt & McBride (2014), income diversification is considered as a method for households to overcome the problem of diminishing marginal returns from labor. According to Senevirathna & Dharmadasa (2021), income diversification is often regarded as a successful strategy for lowering income risks and promoting better household wellbeing in emerging nations. Especially in rural areas that have high seasonal unemployment rates. In addition, income diversification can be used to reduce risk or to meet increasing basic household demands (Wan et al., 2016). The impacts of climate variability and change also drive sustainable livelihoods. However, efforts to adapt to existing climate impacts are hampered by economic constraints that require farmers to prioritize options in terms of cost effectiveness (Cartwright et al., 2013).

Shallots are one of the high-value horticultural commodities that are the mainstay of farmers' income in many regions. In conditions of uncertainty, such as changes in subsidy policies or the impact of climate change, price fluctuations, business capital, institutional performance of input providers and shallot marketing, make it difficult for agricultural businesses to achieve efficiency (Nurjati et al., 2018 ; Wulandari et al., 2017). For farmers, good risk awareness is needed in order to achieve the expected business goals, and managerial skills can help farmers adapt and maintain profit stability while maintaining business sustainability. So far, risk awareness has not received much attention, especially for shallots in Indonesia. This study aims to analyzed the risk level of shallot faarmingand factors that influence the income of shallot farmers.

## RESEARCH METHODS

The research was conducted in Wanasari District, Brebes Regency, Central Java, based on several considerations. First, it is the largest shallot production center in Brebes Regency, contributing approximately 29.23% of the production across 14 villages, with a total shallot harvest area of 32,990 hectares in 2021 (BPS Brebes, 2022). Additionally, the area has shallot farmers with diverse social and economic backgrounds as well as variations in land ownership. Furthermore, it includes farmers actively participating in farmer groups. The selected research locations were three villages based on their proximity to the Pemali River water source: Glonggong (near), Lengkong Village (medium), and Tanjung Sari (far). Primary data collection for this study was carried out from April to May 2023.

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The data collected consists of data from the previous year's planting season and data from the current year's planting season. The population of shallot farmers in the research area was 395 people. The sample size was established using Yamane's formula, which is a modification of Cochran's formula. In quantitative research, this method is frequently used to determine the necessary sample size (Sugiyono, 2019). The equation is as follows:

$$n = \frac{\frac{t^2\ P.Q}{d^2}}{1 + \frac{1}{N}\left[\frac{t^2\ P.Q}{d^2} - 1\right]}$$

The sample size was determined using the Cochran formula, where nnn represents the minimum sample size, N is the population, t is the confidence level (set at 0.95, resulting in t=1.96), d is the margin of error (set at 0.05), P is the proportion of a specific characteristic, Q=1−P, and 1 is a constant. Based on the calculation, the required sample size was 61.61, which was rounded up to 63 farmers. These farmers were evenly distributed among the villages, with 21 farmers selected randomly from each village.

**Estimation of Risk Shallot Farming**

When analyzing the risk of revenue in shallot farming. Both profit and loss are possible outcomes. The amount of risk is established prior to action taking. Taking into account the expectations and estimations of farmers who function as decision makers. Using risk analysis, the sources of production risk that shallot growers confront are identified through structured questionnaire-based interviews. The coefficient of variation. which is derived from the ratio of the standard deviation to the expected value or expected return is used to assess the degree of production risk (Walpole et al., 2011). The formula: $CV = \frac{\sigma_i}{\mu}$ .100%

Information:
CV : Coefficient variation
$\sigma_i$ : Standard deviation
μ : Productivity on average (ton/ha)

**Risk Map**

If the risk level is known, then the risk map of shallot farming production can be determined. To determine the risk level (R), the Likelihood value (L) and risk consequence value (Q) techniques were used. With this approach, risk grouping, risk mapping, and risk handling can be carried out to assess the level of risk that arises. The resulting equation is L × Q = R (Godfrey & Halcrow, 1996; Ristic, 2013)

Information:
R : The risk level
L : Risk likelihood
Q : Risk consequence.

The estimated risk likelihood and risk probability level of shallot farming use a range of values 1 to 5. The parameters for assessing risk likelihood and consequence can be seen in the following Table 1.

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**Table 1**. Risk Assessment Matrix in Shallot Farming

| Category | Severity/Consequence | Guidance |
|---|---|---|
| I | Catastropic | The losses are very large, such as crop failure. the consequences of the losses are very significant |
| II | Critical | The losses are large, such as crop failure. the consequences of the losses are significant |
| III | Serious | The damage is quite large, the consequences of the losses are quite large |
| IV | Marginal | Low damage, the consequences of losses are moderate |
| V | Negligible | Damage is very low, the consequences of losses are low |
| **Level** | **Probability** | **Guidance** |
| A | Frequent | It is likely to occur frequently. Many times during the period of concern (p=0.8) |
| B | Probable | Several times in the period of concern (p=0.6-0.79) |
| C | Occasional | Some time in the period of concern (p=0.4-0.59) |
| D | Remote | Unlikely but possible in the period of concern (0.2-0.39) |
| E | Improbable | It is unlikely that it can be assumed that it will not occur, or it cannot occur (p=0-0.19) |

Source: Ristic (2013)

The next stage is to evaluate the risk of shallot farming based on the risk level value based on the shallot production risk evaluation criteria in Table 2.

**Table 2**. Risk Evaluation Criteria for Shallot Farming Production

| Risk Level | Risk Category | Risk Decision |
|---|---|---|
| 16 – 25 | Extreme risk (E) | Reject |
| 10 – 15 | High risk (H) | Reject |
| 5 – 9 | Medium risk (M) | Reject |
| 1 – 4 | Low risk (L) | Accepted |

Source: Ristic (2013)

The final stage is to describe the risk map of shallot farming obtained from the analysis of the likelihood value and risk consequences and the results of the analysis of the risk evaluation of shallot farming. The risk map in Figure 1 shows the situation or possible risks faced by shallot farmers.

| Category | | | Insignificant | Minor | Moderate | Major | Catastrophic |
|---|---|---|---|---|---|---|---|
| Score | | | 1 | 2 | 3 | 4 | 5 |
| LIKELIHOOD | 5 | Almost certain | M | H | H | E | E |
| | 4 | Likely | M | M | H | H | E |
| | 3 | Possible | L | M | M | H | E |
| | 2 | Unlikely | L | M | M | H | H |
| | 1 | Rare | L | L | M | H | H |
| | | | Potential Consequences | | | | |
| Financial (% of budget) | | | 1 | 2.5 | >5 | >10 | >25 |

Information: E = Extreme; H = High; M=Medium; L=Low

**Figure 1**. Risk Map for Shallot Farming
Source: Ristic (2013)

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The risk map of shallot farming related to financial losses, namely insignificant, minor, moderate, large, and catastrophic criteria. This risk map shows the classification of losses amounting to 1%. 2.5%, more than 5%, more than 10%, and more than 25% of the budget respectively (Ristic. 2013).

**Analysis of Shallot Farming Income**

The method of analysis of shallot farming includes costs, revenues and income. Income analysis to determine the amount of shallot farming income is calculated using the formula: $\pi$ = TR - TC and TR = Q.Pq; TC = FC + VC (Suratiyah, 2015).

Information:

| | |
|---|---|
| $\pi$ | : Net farm income |
| TR | : Gross farm income or production value is the total product value of the farm within a certain time both sold and unsold. |
| Q and Pq | : The amount of production and price of shallots |
| TC | : Total cost |
| FC | : Fixed cost |
| VC | : Variable cost. |

**Analysis of factors influencing shallot farming income**

Factors affecting income were analyzed using multiple linear regression with the estimated variables namely: land area, total production costs, productivity, price of shallots, risk awareness, and risk level. The regression model for the influence of estimated variables on shallot farming income is written in the following equation:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_6 X_6 + \varepsilon$$

Information:

| | |
|---|---|
| Y | : Income of shallot farming (Rp $ha^{-1}$) |
| $X_1$ | : Land area (ha) |
| $X_2$ | : Total cost |
| $X_3$ | : Productivity (ton $Ha^{-1}$) |
| $X_4$ | : Shallot price (Rp) |
| $X_5$ | : Risk awareness (score) |
| $X_6$ | : Risk level (score) |
| $\alpha$ | : Constant |
| $\beta_1$- $\beta_6$ | : Regression coefficient |
| $\varepsilon$ | : Error term |

The assessment of the risk awareness variable uses a score of 1 to 5 from the worst to the very best. Risk awareness in this study shows managerial ability includes the ability of farmers to manage production risks (climate, pests and diseases), scheduling planting times and implementing integrated pest control, managing production factors with the use of technical recommendations in terms of quantity and quality, the ability to determine market prices and negotiate with marketing institutions.

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## RESULT AND DISCUSSION

### Characteristics of Farmers

About 79.6% of respondents are married, and men make up many shallot growers (77.5%). The growing proportion of married people in the population suggests that there is a good chance that family labor will be available to engage in shallot farming in the study area. The study's findings additionally demonstrated that 52.1% of farmers had five to eight people living in their households. Bigger households will provide more labor for tasks both on and off the farm, which will increase the diversity of income sources. These outcomes are consistent with earlier studies (Abdullah et al., 2022). The amount of labor that a family can put into the farm depends on its size. In addition, the study's findings revealed that 47.1% of shallot growers had finished their junior high school education. About 7.9% of those surveyed have completed secondary school or above. A higher level of education will enable them to more efficiently handle the resources in their businesses. Educators also positively influence farmers' adoption of new technologies and their access to crucial information that can enhance their yields. Most farmers (70%) have been cultivating shallots for more than 20 years. The implication of this finding suggests that long experience generally provides lessons and technical skills in overcoming.

Most farmers (40.4%) are aged between 31 to 50 years. with an average age of 47 years. This age range shows they are still quite young and active. They are included in the FAO definition of economically active population, which is defined as people aged 25 to 59 years. The land controlled by shallot farmers is around 0,2 to 1 Ha the majority (73.3%) with an average area of 0.25 ha. These results indicate that the respondent farmers are small-scale farmers. Managerial ability in managing shallot farming in the high category.

### Risk Level of Shallot Farming

The level of risk for shallot production in Wanasari District, Brebes Regency is shown in Table 3.

**Table 3**. Risk Level, Production and Probability Faced by Farmers in Shallot Farming.

| Category | Production (ton/season) | Probability |
|---|---|---|
| Low | 3.25 | 0.67 |
| Medium | 5.52 | 0.30 |
| High | 10.70 | 0.03 |

Source: Primary Data (2023)

Table 3 shows that there is a 3% chance for farmers to achieve high production with an average of 10.7 tons. Farmers have a 30% chance of achieving medium category production of 5.52 tons and a 67% chance of achieving low production of 2.25 tons. Measurement of the risk level of shallot farming production is done by measuring the variance value, standard deviation, and coefficient of variation. The average calculation of shallot production is 12.76 tons per ha, the standard deviation is 784.95 and the coefficient of variation is 61.48%. Wanasari District shallot farmers experience very high production risk, this shows that the distribution of shallot farmer production data is very diverse. It is suspected that the factors that cause differences are managerial capabilities such as access to resources, cultivation techniques, or weather conditions.

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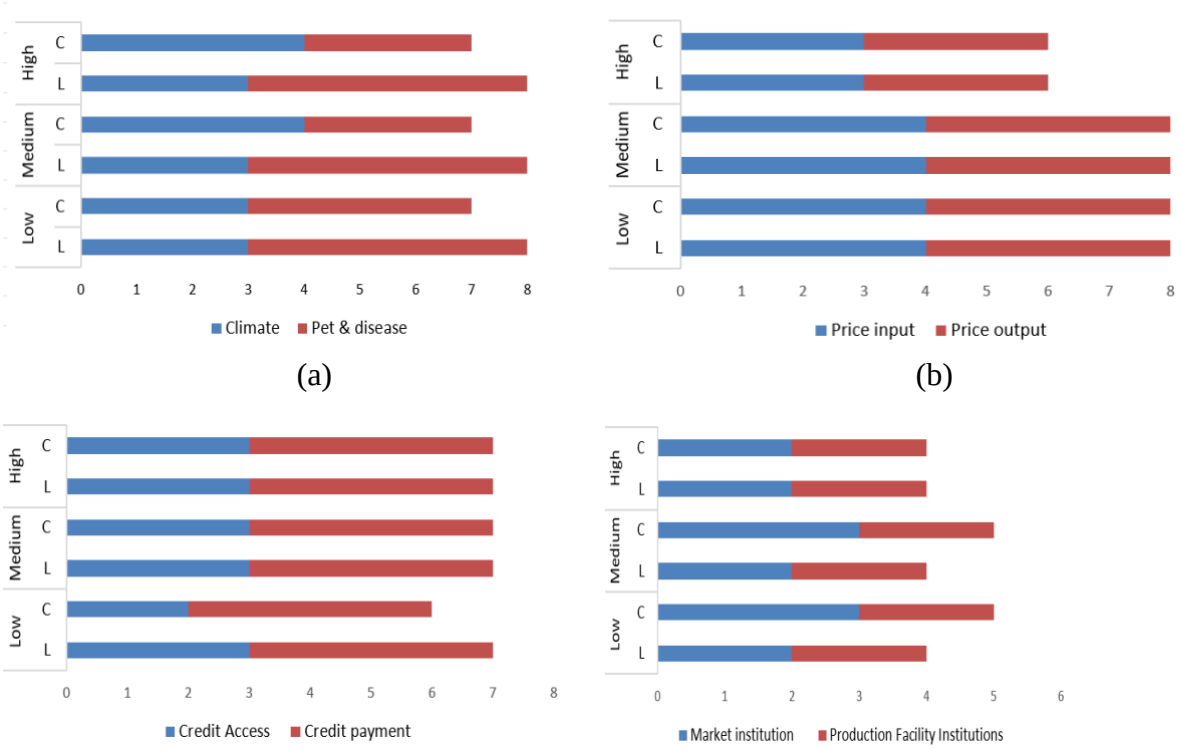
**Risk Maps of Shallot Farming**

The risk map of shallot farming is explained in Figure 2. consisting of: (1) production risks related to climate, pests, and diseases; (2) market risks related to input and output prices; (3) financial risks related to credit availability and payments; and (4) institutional risks related to marketing organizations and organizations that provide production facilities forming the likelihood or probability value and consequences of shallot farming risks.




a. Production Risk; b. Market Risk; c. Financial Risk; d. Institutional Risk

**Figure 2**. Likelihood (L) and Consequences (C) Value of Shallot Farming Risk in Wanasari District Brebes Regency

A complete map of the risks of shallot farming in Wanasari District. Brebes Regency is presented in the matrix of Figure 3.

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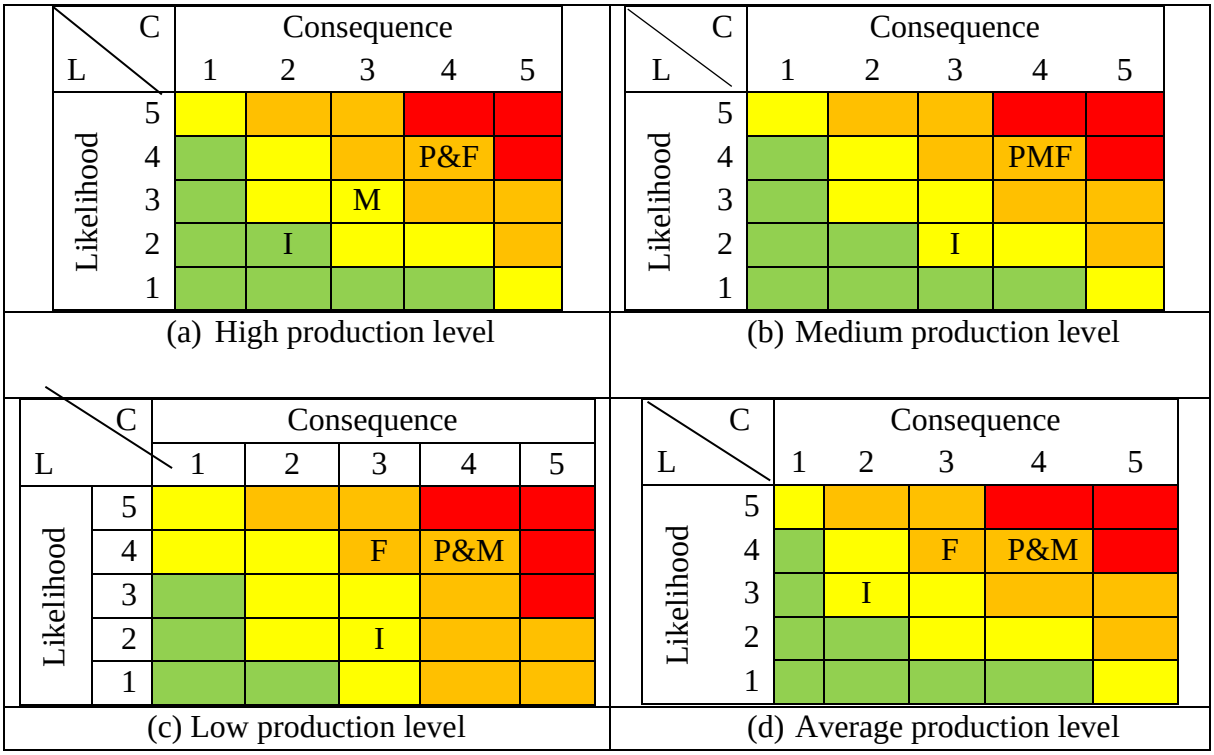


Information: P=Production Risk; M=Market Risk; F=Financial Risk; I=Institution Risk

**Figure 3**. Map of Shallot Farming Risks in Wanasari District, Brebes Regency

Figure 3 shows the risk map in shallot farming at high production levels (a) production risk and financial risk are in the high category, market risk is in the medium risk category. While institutional risk is in the low-risk category. In farmers with medium production levels (b) production. market and financial risks are in the high category and institutional risk is in the medium risk category. In shallot farming with low production levels (c). Production risk, market risk, and financial risk are in the high-risk category, while institutional risk is in the medium category (d). Overall, the risk map of shallot farming at the research location shows that production risk, market risk, and financial risk are in the high category. While institutional risk is in the medium category. Likelihood and consequence (L.C) of production risk (4.4), market risk (4.4), financial risk (4.3), and institutions (3.2) show overall moderate category (3.3). Production risk is considered almost certain to occur in shallot farming and the impact of risk is also high. This condition is also in line with the report (Ghozali & Wibowo, 2019) and (Astuti et al., 2019). Market risk was found to be in the high category, which arises from input and output price fluctuations that have an impact on reducing the income of shallot farmers. According to Asmara & Ardhiani (2010) reported that the dynamics of the shallot price adjustment process both in the long term and in the short term are weak. This proves that the flow of price information is slow between markets also at the producer level.

**Shallot Farming Income**

Shallot farming in the research location is carried out on a land area of 0.25 hectares. Production in one planting season is 3190 kg or around 12.76 tons/ Ha, with a range of 8.9 to 17.71 tons/ Ha. The results achieved in this location are higher than shallot farming in several other locations (Utami et al., 2023; Purwanti et al., 2024; Erny et al., 2022). Based on this data, it can be concluded

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that the productivity of shallot farmers in Wanasari District is above the national average of only 8 tons/ Ha (BPS Brebes, 2022).

**Net Farm Income**

Net farm income is the difference between gross farm income and total costs. The average costs incurred per area of 0.25 Ha in one planting season are shown in Table 4.

**Table 4.** Income Analysis in Shallot Farming in Wanasari District. Brebes Regency

| | Rp/season | Rp/Ha | Percentage (%) |
|---|---|---|---|
| Revenue | 67,771,550 | 271,086,200 | |
| Variable cost | | | |
| a. Seed Cost | 16,850,505 | 67,402,020 | 44.42 |
| b. Fertilizer Cost | 8,026,517 | 32,106,068 | 21.16 |
| c. Pesticide cost | 1,108,315 | 4,433,260 | 2.92 |
| d. Labor cost | 9,719,387 | 38,877,548 | 25.62 |
| e. Water fee | 1,296,717 | 5,186,868 | 3.42 |
| f. Capital interest | 386,242 | 1,544,968 | 1.02 |
| Fixed cost | 547,415 | 2,189,660 | 1.44 |
| Total cost | 37,935,098 | 151,740,392 | |
| Net farm income | 29,836,452 | 119,345,808 | |
| R/C | 1.79 | | 100 |

Source: Primary Data (2023)

The average revenue, production costs and income of farmers from shallot farming are explained in Table 4. The results of the analysis showed that the average income of farmers from shallot farming in Wanasari District on an area of 0.25 Ha per planting season is Rp 37,935,098. The largest component in shallot farming is seed costs, which is the largest percentage (44.42%) followed by labor costs of 25.62%. The research results of Erny et al. (2022) also found that seed costs took the largest portion of costs reaching 81.8% and Susanawati et al. (2018) about 42.08%, while Zulkarnain et al. (2018) reported that labor costs are the largest component reaching 48.59%. Most farmers in this location plant twice a year. The seeds used were mostly (78.8%) using a variety known as Bima Brebes, the rest using the Bima Sawo and Bima Curut varieties. The Bima Brebes variety is known to have superior tuber size, spiciness, tuber color, number of shoots, and high tuber yield/production (Basuki et al., 2017).

**Factors Affecting Shallot Farming Income**

The five variables used for the analysis of factors that influence the income of shallot farming businesses are land area. total farming costs, productivity, shallot price, management and risk level (Table 5).

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**Table 5**. The Factors Analysis Result of Shallot Farming Income

| Variable | Coeficient | Std. Error | t | Sig. |
|---|---|---|---|---|
| (Constant) | 2357.970 | 485.836 | -4.853 | 0.000 |
| Land | 1.183** | 0.161 | 7.358 | 0.000 |
| Total Cost | -0.110** | 0.021 | -5.251 | 0.000 |
| Productivity | 2.031** | 0.161 | 12.644 | 0.000 |
| Shallot Price | -0.013 | 0.033 | -0.392 | 0.696 |
| Risk Awareness | 68.525* | 28.017 | 2.446 | 0.018 |
| Risk Level | 4.075 | 28.969 | 0.141 | 0.889 |
| F | 69.444** | | | 0.000 |
| Adjsted R square | 0.869 | | | |

Information: **Significant at 1%; *Significant at 5%

The results of the analysis shown in Table 5, the variables that influenced the income of shallot farming are land area, total cost of shallot farming, productivity, and risk awareness, while the price of shallots and the level of risk do not have a significant effect. The results of the analysis can be interpreted that an increase in land area of 1 square meter significantly increases income by 1,183 rupiah, assuming other variables do not change. This condition is as reported by previous researcher that land area significantly effects farming income (Suswadi & Prasetyo, 2022). The land at the research location varies in distance from the water source. There are 30% of the research samples that are far from the water source. Whereas water is an important factor in shallot farming (Patel & Rajput, 2013; Arifin & Saeri, 2020)

Production costs showed a significant effect on increasing the income of shallot farming businesses. The results of the analysis showed that increasing production costs will significantly reduce income. Seeds, fertilizers, and labor were costs that accounted for a large percentage of the total expenses, and at the research location, their application in shallot farming showed variation. The same result was reported by Lestari & Winahyu (2021) that production costs have a real effect on the income of shallot farming businesses. Furthermore, managerial variables had a real effect on the income of shallot farming businesses. According to Baruah et al. (2023) good manager is able to allocate resources optimally to increase productivity. Efficient application of inputs such as seeds, fertilizers, water, and labor can reduce production costs. Managerial ability to identify and manage risks, such as pest attacks, weather changes, or market price fluctuations, plays a major role in maintaining income stability. The results of the managerial assessment of the research sample showed that shallot farmers have high category abilities. The assessment includes the ability of farmers to manage production risks related to pest and disease management, scheduling planting times and implementing integrated pest control, but still varies in financial planning, the ability to determine market prices and negotiate with marketing institutions. These results are in line with Wilson (2014) who stated that successful farm enterprises will rely on technical, business, and environmental information from a variety of sources.

The risk awareness factor is also a variable that affected production. The main components of the risk awareness factor include understanding of risk, early signal recognition, attitude towards risk, access to information and previous experience. Shallot farmers at the research location have a moderate risk awareness. Only a small portion are able to recognize early signals and are able to take action on the risks faced at the right time. This condition is due to low access to information. The same thing was also reported by Li et al. (2021) and Ricart et al. (2023). The level of risk in the

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analysis showed a positive effect, meaning the higher the level of risk, the increase in income is also higher, but in this study it did not have a significant effect.

## CONCLUSION AND SUGGESTION

The research findings indicate that shallot farmers in the study area face high-risk levels in terms of production, market, and financial risks, while institutional risks are categorized as medium. The average yield per hectare is 12.76 tons. Key factors influencing shallot farming revenue include land area, total farming costs, productivity, and risk awareness. However, the price of shallots and overall risk levels do not show a significant impact on revenue. Based on the results of this study, it can be suggested that to improve risk management, farmers should receive training on effective risk management practices, particularly in production and market risks, to reduce potential losses. Increasing Productivity by introducing modern farming techniques, improved seed varieties, and improved irrigation systems can help increase yields and optimize land use. For cost efficiency: farmers should focus on optimizing costs by adopting efficient resource utilization practices to reduce unnecessary costs. Strengthening Institutions, to provide better access to market information, credit facilities, and agricultural inputs, enabling farmers to operate more effectively. Promoting risk awareness, as awareness programs on agricultural risks and mitigation strategies should be intensified, empowering farmers to make informed decisions and increasing resilience to uncertainty.

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