Tarjih: Agribusiness Development Journal. Volume 06 Number 01 (2026) Page: 18 - 27
DOI: https://doi.org/10.47030/tadj.v6i01.1118

e-ISSN: 2798 - 0782
Tarjih: Agribusiness Development Journal
Journal Homepage: https://jurnal-umsi.ac.id/index.php/agribisnis

Production and Income Risk Analysis of Clove Farming in Luwu Regency

Muh. Al Aswar Rusman[1*], Nur Aisyah Rusman[2], Ikbal[3], dan Muh. Ikmal Saleh[1]
[1] Program Studi Agribisnis, Fakultas Pertanian, Universitas Muhammadiyah Makassar, Makassar, Indonesia.
[2] Program Studi Pascasarjana Agribisnis, Universitas Muhammadiyah Makassar.
[3] Fakultas Sains dan Teknologi Universitas Sains Islam Al Mawaddah Warahmah, Kolaka, Indonesia.
aswarusman@unismuh.ac.id

Received : April 23, 2026
Revised : May 5, 2026
Accepted: June 16, 2026

Corresponding Author: Muh. Al Aswar Rusman, Universitas Muhammadiyah Makassar. Email: aswarusman@unismuh.ac.id

ABSTRACT

Clove farming is a strategic plantation commodity contributing significantly to farmers' income and regional economic development in Indonesia. However, this sector is characterized by high uncertainty due to climate variability, pest and disease attacks, and input limitations, which lead to production and income risks. This study aims to analyze production, income, and production risk, as well as to identify the factors affecting production risk in clove farming. The research was conducted in Luwu Regency using a survey method with purposive sampling involving 40 farmers. Data were analyzed using farm income analysis, coefficient of variation (CV) to measure production risk, and multiple linear regression to determine influencing factors. The results show that average production is 720 kg/ha/year, indicating moderate productivity, with net income reaching IDR 40,290,000/ha/year. The CV value of 0.29 reflects a moderate level of production risk, implying considerable variability in output that may affect income stability. Regression analysis reveals that land area, farming experience, labor, and fertilizer use have a negative and significant effect on production risk. These findings suggest that improving farm scale, farmer capacity, and input management is essential to enhance productivity and reduce production risk in clove farming systems.

Keywords: *clove farming, production, income, production risk, farmers.*

INTRODUCTION

Plantation commodities represent one of the strategic sectors in agricultural development in Indonesia because they play an important role in increasing farmers' income, providing employment opportunities, and contributing to the national economy through the export of leading commodities (Ramadhani, P. A., et al. 2025). In the context of sustainable agribusiness development, plantation systems are also expected to integrate economic efficiency, environmental sustainability, and institutional strengthening to ensure long-term resilience of farming systems (Rusman, M. A. A., 2025). One of the plantation commodities with high economic value is clove (Syzygium aromaticum). This commodity is not only used as the main raw material in the clove cigarette industry but is also utilized in the pharmaceutical, food, and cosmetic industries (Halu, A. S. A., et al. 2024). The relatively stable demand for cloves in both domestic and international markets makes this commodity one of the primary sources of income for farmers in various regions of Indonesia (Fitri, R. S., 2025).

In recent years, Indonesia has consistently been recognized as one of the largest clove producers in the world, with production reaching hundreds of thousands of tons annually and contributing significantly to global supply. Production areas are widely distributed across several provinces such as South Sulawesi, North Sulawesi, Maluku, and East Nusa Tenggara (Amruddin, A., & Saleh, M. I. 2023). At the provincial level, South Sulawesi plays a strategic role as one of the main production centers, where clove farming is dominated by smallholder farmers with varying levels of productivity. However, despite its large production potential, productivity at the farm level often shows significant variation across regions and over time, indicating the presence of underlying production constraints (Indan, A., 2024).

At the regional level, Luwu Regency is known as one of the areas with considerable potential for clove development due to its favorable agroclimatic conditions and relatively extensive land availability (Nugroho, A., & Setiawan, B. 2022). Clove farming has become a primary livelihood for rural households and contributes not only to household income but also to local economic dynamics through labor absorption and agricultural trade activities (Wahyuni, S., & Saptana, 2020). Nevertheless, empirical conditions in the field indicate that clove production in Luwu Regency is still characterized by fluctuating yields from year to year, which are influenced by variations in rainfall patterns, the increasing incidence of pests and diseases, and the uneven adoption of improved cultivation technologies among farmers.

Despite its significant economic potential, clove farming at the farmer level still faces various challenges and uncertainties. One of the major issues in the agricultural sector is the high level of risk faced by farmers in both the production process and the marketing of agricultural products (Saediman, H., et al. 2022). In practice, clove farmers frequently encounter unstable production levels due to climate variability, prolonged dry seasons, and irregular flowering cycles, which directly affect harvest outcomes. In addition, pest and disease attacks, such as stem borers and fungal infections, further exacerbate production instability, particularly in traditional farming systems with limited technological inputs. Risks in farming may also arise from limited access to production inputs such as fertilizers and pesticides, as well as constraints in capital and extension services (Amalia, R., & Rahman, A. 2023).

Production risk is one of the most common forms of uncertainty faced by farmers. This risk is associated with the possibility of variations in production outcomes caused by factors that cannot be fully controlled by farmers, such as weather conditions, soil fertility, and plant pest and disease attacks (Yusuf, M., & Darwis, V. 2021). In the context of clove farming, production fluctuations often occur because this crop has seasonal production characteristics and is highly sensitive to environmental changes (Kurniawan, R., & Prabowo, R. 2022). Such instability in production can directly affect the income received by farmers (Widodo, S., & Santoso, B. 2021). Empirical evidence suggests that in plantation crops, even slight changes in climate patterns can significantly alter productivity levels, thereby increasing the vulnerability of smallholder farmers.

In addition to production risk, farmers also face income risk caused by fluctuations in commodity prices in the market. Clove prices are known to fluctuate significantly over time due to factors such as industrial demand, supply availability, and the dynamics of plantation commodity trade (Arsyad, M., et al. 2021). In many cases, farmers experience price declines during peak harvest seasons when market supply increases sharply, leading to reduced income despite high production levels (Rahman, S., & Kazal, M. M. H., 2020). Conversely, price increases may provide higher profits, but such opportunities are often unpredictable and difficult for farmers to anticipate (Saptana, S., & Ashari, 2020). This condition creates a dual risk structure in clove farming, where farmers simultaneously face uncertainties in both production and market dimensions.

From the perspective of agricultural economics, risk is an inseparable part of agricultural production activities because this sector is highly dependent on natural factors that are difficult to control (Nasution, Z., et al. 2023). Therefore, understanding the level and sources of risk in farming is essential to assist both farmers and policymakers in formulating appropriate risk management strategies (Kurniawati, E., & Siregar, H. 2024). Risk analysis provides a quantitative basis for identifying the degree of uncertainty faced by farmers and supports more rational decision-making in farm management (Mulyani, A., et al. 2022).

One of the approaches commonly used to measure risk levels in farming activities is the coefficient of variation (CV) analysis. This method is used to determine the level of deviation of production results or income from the average value obtained by farmers (Wahyudi, T., & Junaidi, Y. 2021). A higher coefficient of variation value indicates a greater level of uncertainty in farming activities, whereas a lower value suggests that the business is relatively more stable (Taufik, M., et al. 2023). This approach has been widely applied in agricultural economics studies to analyze production and income risks in various commodities, including plantation crops (Purnomo, H., et al. 2020).

Previous studies have shown that the level of risk in farming can vary depending on commodity characteristics, agroecological conditions, and farm management practices applied by farmers (Sari, N., & Fariyanti, A. 2021). Research on plantation commodities also indicates that factors such as farm scale, the use of production inputs, and access to agricultural technology significantly influence the level of risk faced by farmers (Hidayat, R., et al. 2022). However, most previous studies tend to focus either on production aspects or income analysis separately, and relatively few studies comprehensively analyze both production risk and income risk simultaneously at the smallholder level, particularly for clove farming in specific regional contexts. In addition, empirical studies that specifically examine the determinants of production risk using quantitative approaches such as multiple regression analysis in clove farming systems are still limited.

Based on the above explanation, there is a clear research gap in understanding the combined dynamics of production risk and income risk in clove farming, especially in region-specific contexts such as Luwu Regency.

This gap highlights the need for a more comprehensive and location-specific analysis that integrates risk measurement and determinant analysis. Therefore, this study aims to analyze production risk and income risk in clove farming in Luwu Regency using the coefficient of variation approach and to identify the factors influencing production risk through a quantitative analytical framework. The results of this study are expected to provide more detailed empirical evidence and serve as a basis for developing effective risk management strategies for clove farmers.

RESEARCH METHODS

This research was conducted in Luwu Regency, South Sulawesi Province, Indonesia, from January to March 2026. The research location was selected purposively considering that the region has significant potential for the development of plantation commodities, particularly clove (Syzygium aromaticum) cultivation. In addition, a considerable portion of the local community relies on clove farming as one of the primary sources of household income. The selection of this location also reflects the existence of production variability and risk conditions that are relevant to the objectives of this study.

The research employed a survey method with a quantitative approach. This approach was used to obtain an objective and measurable description of production conditions, farming costs, revenues, and the level of risk faced by farmers in clove farming activities. The data used in this study consisted of primary and secondary data. Primary data were obtained directly from farmer respondents through interviews using structured questionnaires that had been prepared beforehand. The information collected included farmer characteristics, land area, production quantity, use of production inputs, farming costs, selling prices, and revenues obtained from clove farming activities. Secondary data were obtained from relevant institutions such as the Department of Agriculture, the Central Statistics Agency, and various documents and reports related to this research.

The population in this study consisted of all farmers engaged in clove farming activities in the research area. The determination of the sample size (40 farmers) was carried out by considering the representativeness of farmers as well as the practicality of data collection in the field. The sampling technique used in this study was purposive sampling, with specific criteria applied to ensure the relevance and reliability of the data obtained. The rationale for using purposive sampling is that not all farmers possess adequate experience and consistent production records required for risk analysis. Therefore, respondents were selected based on the following criteria: (1) actively managing clove farming, (2) having at least five years of farming experience, and (3) having continuous production activities during the observation period. This approach ensures that the selected respondents are capable of providing accurate and consistent information related to farm production, income, and risk conditions.

Data analysis in this study was conducted quantitatively to determine the level of income and the level of risk faced by farmers in clove farming activities. The analysis consisted of three main stages: (1) farm income analysis, (2) risk analysis using the coefficient of variation, and (3) multiple linear regression analysis to identify factors influencing production risk.

Farm Income Analysis

Farm income was calculated based on the difference between total revenue and total production costs incurred during one production period. Total farm revenue (TR) was calculated using the following formula:

$$\boldsymbol{TR = P \times Q}$$

Where:

TR	=	Total farm revenue (IDR)
P	=	Selling price of cloves (IDR/kg)
Q	=	Quantity of clove production (kg)

Total production cost (TC) includes both fixed costs and variable costs. Fixed costs consist of expenses that remain relatively constant, such as land tax and equipment depreciation. Variable costs include expenses directly related to production activities, such as fertilizers, pesticides, and labor. Farm income (π) was calculated using the following formula:

$$\boldsymbol{\pi = TR - TC}$$

Where:

π	=	Farm income (IDR)
TR	=	Total farm revenue (IDR)
TC	=	Total production cost (IDR)

Production and Income Risk Analysis

Production risk and income risk were analyzed using the coefficient of variation (CV) approach. This method measures the relative variability of production or income compared to its average value. The mean value was calculated as:

$$\boldsymbol{\bar{X} = \frac{\sum X_i}{n}}$$

Where:

$\bar{X}$	=	Mean value
X_i	=	Observation value
n	=	Number of observations

Variance was calculated as:

$$\boldsymbol{\sigma^2 = \frac{\sum (X_i - \bar{X})^2}{n - 1}}$$

Standard deviation:

$$\boldsymbol{\sigma = \sqrt{\sigma^2}}$$

Coefficient of variation:

$$\boldsymbol{CV = \frac{\sigma}{\bar{X}}}$$

Where:

CV	=	Coefficient of variation
σ	=	Standard deviation
$\bar{X}$	=	Mean value

A higher CV value indicates a higher level of risk, while a lower CV value indicates more stable farming conditions.

Multiple Linear Regression Analysis

To identify the factors influencing production risk, this study employed multiple linear regression analysis. The regression model is formulated as follows:

$$\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon}$$

Where:

Y	=	Production risk (coefficient of variation)
β_0	=	Intercept
$\beta_1 - \beta_5$	=	Regression coefficients
ϵ	=	Error term

The independent variables used in this study are defined as follows:

X_1	=	Land area (hectares)
X_2	=	Farmer age (years)
X_3	=	Farming experience (years)
X_4	=	Labor (number of workers or labor days)

The selection of these variables is based on theoretical and empirical considerations in agricultural economics, which suggest that farm scale, farmer characteristics, and input use significantly influence production stability and risk levels. Larger land areas may reduce risk through diversification, while greater farming experience may improve farmers' ability to manage uncertainty. Similarly, labor availability and fertilizer use are expected to enhance production efficiency and reduce variability.

RESULTS AND DISCUSSION

Characteristics of Clove Farmer Respondents

Respondent characteristics are an important factor in agricultural socio-economic research because they influence farmers' managerial capacity, decision-making behavior, and risk management strategies. The characteristics analyzed in this study include age, education level, farming experience, and land area cultivated.

Table 1. Characteristics of Clove Farmer Respondents

Characteristics	Category	Number (Persons)	Percentage (%)
Age	< 35 years	6	15
	35–50 years	20	50
	> 50 years	14	35
Education	Elementary School	18	45
	Junior High School	12	30
	Senior High School	10	25
Farming Experience	< 10 years	8	20
	10–20 years	17	42.5
	> 20 years	15	37.5
Land Area	< 1 ha	16	40
	1–2 ha	18	45
	> 2 ha	6	15

Source: Processed Primary Data, 2026

The results indicate that the majority of clove farmers (50%) are in the productive age group of 35–50 years. From a labor economics perspective, this age group is considered to have an optimal balance between physical capacity and cognitive ability, which is essential for managing labor-intensive plantation crops such as cloves. This condition suggests that the availability of productive labor is not a major constraint in the study area. Moreover, farmers in this age group tend to be more adaptive to innovation compared to older farmers, although their adoption capacity is still influenced by other factors such as education and access to information (Sutrisno, N., et al. 2023).

In terms of education, most farmers have only completed elementary school (45%). This relatively low level of formal education may limit farmers' ability to access, understand, and implement modern agricultural technologies. According to human capital theory, education plays a critical role in enhancing farmers' productivity and efficiency by improving their decision-making skills and openness to innovation. Therefore, the low education level observed in this study may contribute to suboptimal farm management practices, which in turn can affect production performance and increase vulnerability to risk (Arifin, B., et al. 2021).

Furthermore, the majority of farmers have more than ten years of farming experience, indicating a relatively high level of experiential knowledge. Farming experience is often associated with improved technical skills and better risk management strategies. However, experience alone may not be sufficient to significantly increase productivity if it is not supported by technological innovation and adequate input use. This finding supports previous studies suggesting that while experience contributes to stability, it does not automatically lead to higher efficiency without technological improvement (Suryanto, A., & Prasetyo, A. 2022).

In terms of land area, most farmers operate on small to medium-scale farms (less than 2 hectares). Small landholdings may limit farmers' ability to achieve economies of scale, which are important for improving efficiency and reducing production costs. From a farm structure perspective, smallholder dominance is often associated with higher production variability due to limited resource capacity and lower resilience to external shocks.

Clove Farming Production

Production is a key indicator in assessing the success of farming activities, as it reflects the efficiency of input use and the effectiveness of farm management practices.

Table 2. Average Clove Farming Production

Variable	Value
Average land area	1.45 ha
Production per farmer	1,044 kg
Production per hectare	720 kg/ha
Average price	IDR 82,000/kg

Source: Processed Primary Data, 2026

The results show that the average clove production is 720 kg per hectare per year. When compared to the potential productivity of clove plants, which can exceed 1 ton per hectare under optimal conditions, this level of production can be categorized as moderate to relatively low. This indicates the existence of a productivity gap between actual farmer performance and potential yield levels. Several factors may explain this condition. First, the limited use of modern cultivation technologies and inputs, such as improved seedlings and balanced fertilization, reduces production efficiency. Second, the dominance of smallholder farmers with limited capital restricts their ability to invest in productivity-enhancing inputs. Third, the age structure of clove plants, which are often old and less productive, may also contribute to lower yields. These findings are consistent with previous studies showing that smallholder plantation productivity is generally constrained by technological, financial, and structural limitations (Haryono, H., et al. 2021).

In addition, climatic factors play a crucial role in determining clove production. Clove plants are highly sensitive to rainfall patterns and temperature fluctuations, particularly during the flowering and fruiting stages. Irregular rainfall and prolonged dry seasons can disrupt flowering cycles, leading to significant yield variability. This supports the findings of Gunawan et al. (2023), who emphasized that climate variability is one of the main drivers of productivity fluctuations in plantation crops. From a production theory perspective, output is a function of input use and technology. Therefore, the relatively low productivity observed in this study reflects inefficiencies in input allocation and limited adoption of improved farming technologies. This condition highlights the need for better farm management practices and increased access to agricultural extension services.

Income Analysis of Clove Farming

Farm income is a key indicator used to evaluate the economic performance and feasibility of farming activities.

Table 3. Clove Farming Income Analysis per Hectare

Component	Value
Production	720 kg
Selling price	IDR 82,000/kg
Revenue	IDR 59,040,000
Production cost	IDR 18,750,000
Net income	IDR 40,290,000

Source: Processed Primary Data, 2026

The results indicate that clove farming generates a net income of IDR 40,290,000 per hectare per year. From an economic perspective, this level of income can be considered relatively profitable, especially when compared to other smallholder plantation commodities in similar agroecological conditions. However, this profitability must be interpreted cautiously, as it is highly dependent on production levels and market prices, both of which are subject to significant fluctuations.

The relatively high income observed in this study is primarily driven by the favorable selling price of cloves (IDR 82,000/kg). This suggests that market factors play a dominant role in determining farm profitability. However, reliance on high commodity prices also implies greater vulnerability to price volatility. When prices decline, farmers' income may decrease significantly, even if production levels remain stable.

This finding is consistent with Abdullah & Karim (2020), who reported that agricultural income in developing countries is highly sensitive to price fluctuations. From the perspective of price risk theory, farmers operating in volatile markets face uncertainty that can significantly affect income stability. Therefore, income derived from clove farming should not only be evaluated based on its average value but also on its variability over

time.

In addition, income diversification is an important strategy to reduce income risk. Farmers who rely solely on a single commodity are more vulnerable to both production and price shocks. This supports the findings of Fadli et al. (2024), which highlight the importance of diversifying income sources to enhance farmers' economic resilience.

From a broader economic standpoint, the sustainability of clove farming income depends on the interaction between production efficiency and market stability. Therefore, improving access to markets, strengthening farmer institutions, and enhancing value chain integration are essential strategies to maintain and stabilize farmers' income in the long term.

Production Risk Analysis of Clove Farming

Production risk refers to the possibility of deviations between expected production and the actual production obtained by farmers. In this study, production risk was analyzed using the coefficient of variation (CV) approach.

Table 4. Production Risk Analysis

Variable	Value
Average production	720 kg/ha
Standard deviation	210 kg
Coefficient of variation	0.29

Source: Processed Primary Data, 2026

The analysis results show that the coefficient of variation (CV) value is 0.29, indicating that clove farming has a moderate level of production risk. From an economic perspective, this value implies that the variability of production is approximately 29% relative to its average level. In other words, farmers may experience production fluctuations of nearly one-third of the expected output, which reflects a considerable degree of uncertainty in clove farming activities.

The economic implication of this risk level is significant. A moderate CV value indicates that although clove farming is still relatively viable, farmers are exposed to production instability that can directly affect their income. Since farm income is highly dependent on production output, fluctuations in yield will lead to proportional changes in revenue. In years with lower production, farmers may experience substantial income reductions, especially when combined with unfavorable market prices. This condition highlights that production risk is a critical determinant of income stability in smallholder farming systems.

Furthermore, the presence of production risk also affects farmers' decision-making behavior. According to risk theory in agricultural economics, farmers operating under uncertainty tend to adopt risk-averse strategies, such as reducing input use or avoiding investment in new technologies. While such strategies may minimize potential losses, they can also limit productivity growth in the long term.

The moderate level of production risk observed in this study is consistent with previous findings that plantation farming systems are highly vulnerable to external factors such as climate variability, pest and disease attacks, and limitations in cultivation technology (Darwis, V., et al. 2021). Climate change, in particular, increases uncertainty in agricultural production by altering rainfall patterns and temperature conditions, which are critical for plant growth and development (Haryono, H., et al. 2021).

To minimize production risk, several strategies can be adopted by farmers. First, improving the use of production inputs, particularly balanced fertilization and pest control, can enhance plant health and reduce yield variability. Second, the adoption of improved cultivation technologies, including better planting materials and farm management practices, can increase production stability. Third, diversification strategies, such as integrating clove farming with other crops or income sources, can reduce dependence on a single commodity and mitigate risk exposure. In addition, strengthening agricultural extension services and improving farmers' access to climate information can help farmers make more adaptive and informed decisions in managing production risks.

Overall, the findings suggest that while clove farming in the study area remains economically feasible, the presence of moderate production risk requires targeted interventions to enhance production stability and ensure sustainable farmer income.

Factors Affecting Production Risk

To determine the factors influencing the production risk of clove farming, multiple linear regression analysis was employed using several independent variables, including land area, farmer age, farming experience, labor, and fertilizer use.

Table 5. Regression Analysis Results

Variable	Coefficient	t-value	Sig.
Constant	0.842	2.31	0.026
Land area	-0.215	-2.14	0.038
Farmer age	-0.009	-1.87	0.069
Farming experience	-0.018	-2.43	0.021
Labor	-0.052	-2.11	0.041
Fertilizer use	-0.126	-2.57	0.014
R^2 = 0,61			

Source: Processed Primary Data, 2026

The regression results indicate that land area, farming experience, labor, and fertilizer use have a statistically significant effect on production risk, while farmer age is not statistically significant at the 5% level. The coefficient of determination ($R^2 = 0.61$) suggests that approximately 61% of the variation in production risk can be explained by the independent variables included in the model, indicating a relatively good explanatory power.

Land Area (X_1)

Land area has a negative and significant coefficient (-0.215), indicating that an increase in farm size leads to a reduction in production risk. Specifically, a one-unit increase in land area is associated with a decrease in the coefficient of variation (production risk) by 0.215 units, ceteris paribus.

From an economic perspective, this finding reflects the concept of economies of scale, where larger farms tend to have better resource allocation, improved management practices, and greater capacity to absorb production shocks. Larger landholdings also allow farmers to diversify planting areas, thereby reducing the impact of localized risks such as pest attacks or microclimatic variations. This result is consistent with Utami & Nugraha (2022), who found that farm scale plays a crucial role in stabilizing production and income.

Farmer Age (X_2)

Farmer age has a negative but not statistically significant coefficient (-0.009), indicating that age does not have a strong influence on production risk. Although older farmers may possess more experience, this does not necessarily translate into lower production risk. This finding suggests that age alone is not a sufficient determinant of risk management capability. In line with human capital theory, productivity and risk management are more strongly influenced by knowledge, skills, and access to information rather than age itself. Therefore, younger farmers with better access to technology and information may perform equally or even better in managing production risks.

Farming Experience (X_3)

Farming experience has a negative and significant coefficient (-0.018), indicating that increased experience reduces production risk. This means that each additional year of farming experience contributes to a decrease in production variability. Economically, this finding highlights the importance of learning-by-doing, where accumulated experience enhances farmers' ability to anticipate and respond to production uncertainties. Experienced farmers are generally more capable of selecting appropriate planting times, managing pests and diseases, and optimizing input use. This result is consistent with Suryanto & Prasetyo (2022), who emphasized that experience plays a key role in improving farmers' adaptive capacity under risk conditions.

Labor (X_4)

Labor has a negative and significant coefficient (-0.052), indicating that higher labor input contributes to reducing production risk. This suggests that adequate labor availability enables farmers to carry out farming operations more effectively and on time. From a production theory perspective, labor is a critical input that directly influences farm productivity and stability. Timely activities such as planting, fertilizing, and pest control are essential to ensure optimal crop growth. Insufficient labor may lead to delays in these activities, increasing the likelihood of yield variability. Therefore, better labor allocation improves production consistency and reduces risk.

Fertilizer Use (X_5)

Fertilizer use has a negative and significant coefficient (-0.126), indicating that increased fertilizer application reduces production risk. This implies that proper nutrient management contributes to more stable crop growth and yield outcomes. From an agronomic and economic perspective, fertilizer plays a crucial role in maintaining soil fertility and ensuring optimal plant development. Adequate nutrient supply enhances plant resistance to environmental stress and reduces the probability of production failure. This finding is in line with Prasetyo et al. (2023), who reported that efficient input management is essential for improving farm sustainability and reducing production variability.

Overall, the regression results indicate that production risk in clove farming is primarily influenced by farm scale, farmer experience, and input management. The negative coefficients of the significant variables suggest that improving these factors can effectively reduce production risk. From a broader economic perspective, these findings imply that strategies aimed at increasing farm efficiency, strengthening farmer capacity, and optimizing input use are essential to enhance production stability. This also highlights the importance of agricultural policies that support access to land, inputs, and extension services to reduce risk in smallholder farming systems.

CONCLUSION

This study demonstrates that clove farming in Luwu Regency remains economically feasible, as reflected by a relatively high net income, despite production being at a moderate level. However, the farming system is characterized by a moderate degree of production risk, indicating that farmers face considerable variability in output that may affect income stability. The findings reveal that production risk is significantly influenced by farm scale, farming experience, labor, and fertilizer use, all of which show a negative relationship with risk. This implies that better resource allocation, accumulated farmer knowledge, and more effective input management play a crucial role in stabilizing production outcomes. In contrast, farmer age does not significantly affect production risk, suggesting that managerial capacity is more important than demographic characteristics.

These results highlight that reducing production risk requires not only improvements in technical farming practices but also strengthening farmers' capacity and access to production inputs. Therefore, enhancing extension services, promoting efficient input use, and supporting farm development are essential strategies to improve productivity and ensure income stability. Overall, this study emphasizes the importance of integrated risk management in smallholder clove farming systems to achieve more sustainable and resilient agricultural development.

REFERENCES

Abdullah, M., & Karim, M. (2020). Determinants of agricultural profitability in developing countries. *Agricultural Economics*, 51(5), 699–710.

Amalia, R., & Rahman, A. (2023). Determinants of farm income among smallholder farmers in Indonesia. *Sustainability*, 15(4), 3121.

Amruddin, A., & Saleh, M. I. (2023). Economic analysis of clove farming in South Sulawesi. *Agricultural Socio-Economics Journal*, 23(2), 112–121.

Arifin, B., et al. (2021). Food and agricultural policy reforms in Indonesia. *Food Policy*, 102, 102103.

Arsyad, M., et al. (2021). Climate variability and its impacts on plantation crop productivity in Indonesia. *Sustainability*, 13(5), 2520.

Darwis, V., et al. (2021). Risk assessment in Indonesian plantation farming systems. *Asian Journal of Agriculture and Development*, 18(2), 47–60.

Fadli, M., et al. (2024). Economic resilience of smallholder farmers under climate risk. *Sustainability*, 16(5), 2011.

Fitri, R. S., Hariance, R., & Yuerlita, Y. (2025). Mapping production risk in clove plantations using fishbone diagram. *Jurnal Ilmiah Pertanian*, 22(3), 159–174.

Gunawan, D., et al. (2023). Productivity and sustainability of spice crops in Southeast Asia. *Agriculture*, 13(6), 1184.

Halu, A. S. A., Bahari, B., Gafaruddin, A., & Saediman, H. (2024). Production and income of clove farming in Southeast Sulawesi: A comparative analysis between 2023 and 2024. *International Journal of Sustainability Research*, 3(4), 120–130.

Haryono, H., et al. (2021). Impact of climate change on Indonesian agriculture. *Climate Risk Management*, 34, 100368.

Hidayat, R., et al. (2022). Determinants of agricultural income among plantation farmers. *International Journal of Agricultural Research*, 17(3), 121–129.

Indan, A., Idrus, M., & Dunakhir, S. (2024). Feasibility analysis of clove farming in Kolaka Regency. *Muhasabatuna: Jurnal Akuntansi Syariah*, 7(2), 101–110.

Kurniawan, R., & Prabowo, R. (2022). Risk analysis of plantation crops using coefficient of variation method. *International Journal of Agricultural Economics*, 7(2), 65–73.

Kurniawati, E., & Siregar, H. (2024). Farm income diversification and risk reduction among Indonesian farmers. *Sustainability*, 16(2), 875.

Mulyani, A., et al. (2022). Land suitability and productivity of plantation crops in Indonesia. *Agriculture*, 12(3), 342.

Nasution, Z., et al. (2023). Determinants of agricultural production risk in tropical farming systems. *Agricultural Systems*, 204, 103560.

Nugroho, A., & Setiawan, B. (2022). Risk management strategies in smallholder agriculture. *Agricultural Economics Review*, 24(1), 45–56.

Prasetyo, E., et al. (2023). Economic performance of spice commodities in Indonesia. *Heliyon*, 9(7), e17754

Pratiwi, R., & Haryanto, T. (2024). Price volatility and farmer income stability in spice commodities. *Agricultural Economics*, 55(2), 221–233

Purnomo, H., et al. (2020). Sustainable plantation management in Indonesia. *Land Use Policy*, 99, 104840.

Rahman, S., & Kazal, M. M. H. (2020). Risk management in agriculture: Evidence from developing countries. *Agricultural Finance Review*, 80(4), 579–595.

Ramadhani, P. A., Amruddin, & Saleh, M. I. (2025). Risk analysis of costs and income of clove farming in Balassuka Village, Gowa District. *Tarjih: Agribusiness Development Journal*, 5(1), 58–66.

Rusman, M. A. A. (2025). *Agribisnis Tanaman Perkebunan dan Hortikultura Berkelanjutan*. CV. Azka Pustaka.

Saediman, H., et al. (2022). Economic efficiency of smallholder spice farming in Indonesia. *Heliyon*, 8(9), e10654.

Saptana, S., & Ashari. (2020). Development strategy of plantation commodities in Indonesia. *Indonesian Journal of Agricultural Economics*, 11(1), 1–12.

Sari, N., & Fariyanti, A. (2021). Economic analysis of smallholder plantation farming. *Jurnal Agribisnis Indonesia*, 9(2), 85–96.

Suryana, A., & Mayrowani, H. (2021). Agricultural transformation and rural development in Indonesia. *Sustainability*, 13(14), 7893.

Suryanto, A., & Prasetyo, A. (2022). Risk and uncertainty in plantation agriculture. *Journal of Rural Studies*, 89, 104–113.

Sutrisno, N., et al. (2023). Agricultural extension effectiveness in clove farming. *Sustainability*, 17(6), 2786.

Taufik, M., et al. (2023). Climate change impacts on spice crop production. *Agricultural Systems*, 205, 103612.

Utami, R., & Nugraha, A. (2022). Income variability among plantation farmers in Indonesia. *Journal of Agribusiness in Developing Countries*, 11(3), 165–178.

Wahyudi, T., & Junaidi, Y. (2021). Productivity improvement strategies for smallholder plantation crops. *Journal of Agronomy and Crop Science*, 207(5), 802–812.

Wahyuni, S., & Saptana. (2020). Production risk analysis in Indonesian plantation crops. *Journal of Agribusiness and Rural Development*, 16(2), 115–126.

Widodo, S., & Santoso, B. (2021). Factors affecting agricultural productivity in Indonesia. *Journal of Agricultural Science*, 13(6), 45–53.

Yusuf, M., & Darwis, V. (2021). Agricultural productivity and farmer welfare in developing countries. *Agricultural Systems*, 187, 103028.