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Farmers' Behavior in Facing Risks in Ginger Farming

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Abstract

Ginger is a medicinal plant with numerous uses across traditional industries, food sectors, and as an export commodity. Although ginger production in West Kalimantan reached 3,805.89 tons in 2022, this figure remains below the national average of 7,278.10 tons. Ginger farmers face various risks, including beetle pest attacks and rhizome rot diseases, leading to production fluctuations. This study aims to analyze the impact of farmers' behavior in facing production risks on the level of ginger production. The analysis was conducted using a production function regression with dummy variables representing farmers' behaviors, categorized into three groups: risk takers, risk neutral, and risk averters. The results indicate that farmers categorized as risk takers have 142.1% higher ginger production compared to risk averters, while risk-neutral farmers have 73.6% higher production. These findings demonstrate that farmers' behavior in managing production risks significantly influences ginger production levels.

Introduction

The majority of Indonesian people's income is dominated by the agricultural sector, making it a crucial area for ongoing development to ensure the population's welfare. Agriculture in Indonesia faces the dynamics of strategic environmental changes, both domestically and internationally, which demand the production of competitive agricultural products in the global market. To support increased competitiveness and added value, Indonesian agricultural products require efficiency in production systems, processing, quality control, and sustainability, backed by production and marketing efforts. The agricultural sub sectors include plantations, livestock, fisheries, horticulture, and food crops (Deptan, 2012; Temu & Temu, 2005; Tanjung et al., 2021; Khairina & Syahputra, 2023; Paulus et al., 2020).

In connection with the horticulture sector, one of the current agricultural issues is the "Back to Nature" movement. This trend significantly influences the demand for medicinal plants. Many modern medicines made with chemicals have various adverse effects on human health, prompting consumers to shift towards horticultural plants as remedies for health issues. Horticultural plants play a crucial role in daily human life, particularly as sources of food and beverages, such as vegetables, fruits, ornamental plants, and medicinal plants (biopharmaceuticals). Post-pandemic, the public's awareness of healthy food that can boost immunity has led to increased interest in horticultural plants, especially biopharmaceutical plants. Biopharmaceutical plants are used for medicinal, cosmetic, and health purposes, derived from parts of the plants like leaves, stems, fruits, rhizomes, or roots (Warra, 2022; Pereira et al., 2024). Examples include temulawak, ginger, kencur, keji beling, sambiloto, garlic, and others.

Ginger is one of the four most widely used medicinal plants, found in traditional herbal medicine, small traditional medicine industries, food and beverage industries, spices, and as an export commodity (Lubbe & Verpoorte, 2011; Ozdal et al., 2021; Alam, 2008; Riaz et al.,

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2021). Ginger is a medicinal plant that plays an important role in health because it can enhance the immune system. This plant originates from the Asia-Pacific region, specifically from India and China, where it was discovered hundreds of years ago (Suharman, 2020; Okemo et al., 2024). Between 2006 and 2020, Asia dominated global ginger production, averaging 79.3% of the total. According to the Food and Agriculture Organization (FAO), in 2020, Indonesia ranked fifth in global ginger production, following India, Nigeria, China, and Nepal. Over the past four years, ginger production in Indonesia has been unstable, with fluctuating increases and decreases in productivity from 2019 to 2022.

Table 1. Total Production & Harvest Area of Ginger in Indonesia 2019-2022

	2019	**2020**	**2021**	**2022**
Total Ginger Production in Indonesia (Tons)	174.380,12	183517,78	307.241,51	247.455,49
Ginger Harvest Area in Indonesia (m^2)	80.765.542	74.511.965	106.095.168	104.055.735

As shown in Table 1, total ginger production and harvest area in Indonesia have experienced unpredictable fluctuations. However, despite these uncertainties, the domestic ginger balance remains positive. According to the Director of Vegetables and Medicinal Plants, Tommy Nugraha, the ginger balance from 2019 to 2021 was positive, indicating that domestic ginger availability is still sufficient to meet the needs for direct consumption, industry, export, and seeds. To support domestic ginger production and productivity, starting in 2021, the Ministry of Agriculture will develop integrated upstream and downstream ginger areas through the Medicinal Plants Village program. This village is part of the overall Horticulture Village program. The target for the Ginger Village in 2021 is 305 hectares spread across 53 villages in 47 regencies/cities in 22 provinces, one of which is West Kalimantan.

In 2022, ginger production in West Kalimantan reached 3,805.89 tons, but this figure remains below the national average of 7,278.10 tons. The potential for ginger in West Kalimantan is actually quite large, as the region has its own ginger variety, the Menanjak Ginger. Menanjak Ginger is an indigenous variety developed in Teluk Empening Village, West Kalimantan. The low production of ginger in West Kalimantan is influenced by the conversion of land use from agriculture to buildings and from ginger farming to other commodities. Additionally, pests and diseases affecting ginger plants, along with climate and weather conditions, influence the development of these pests and diseases, leading to reduced ginger production. Ginger farming is fraught with various risks, such as beetle pest attacks on leaves and rhizome rot disease caused by fungi, leading to fluctuating production. Fluctuating production and prices result in unstable income, with high farming costs often not covered by harvest revenue, leading to losses. This indicates that ginger farming is risky, potentially reducing farmers' income due to unstable production and selling prices. Farmers, as individuals, greatly influence their decisions in managing the risks associated with farming. Farmers' decisions in combining input factors of production and other factors are closely related to their attitudes and behavior in facing these risks. Farmers who are bold, neutral, or risk-averse have different approaches to increasing their ginger production (Zeweld et al., 2019; Edwards-Jones, 2006; Ahmad et al., 2020).

Research on production risks in ginger farming has been conducted before, but these studies did not analyze farmers' behavior in facing these risks. While studies on farmers' behavior in managing farming risks have also been conducted, none have focused on ginger as a commodity. Based on the above explanation, this study, titled "Farmers' Behavior in Facing Risks in Ginger Farming in Teluk Empening Village, Terentang District, KuburayaRegency,"

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was conducted to provide insights on how to improve ginger production in Teluk Empening Village by encouraging farmers to be more daring in facing production risks.

Based on the above explanation, this research is formulated to answer the following key questions: First, what is the level of ginger production risk in Teluk Empening Village, Terentang District, KuburayaRegency? Second, how do farmers behave in facing ginger production risks in this village? Third, how does farmers' behavior in managing production risks affect the level of ginger production in Teluk Empening Village? In line with these problem formulations, this research aims to: (1) determine the level of ginger production risk in Teluk Empening Village, Terentang District, KuburayaRegency, (2) understand farmers' behavior in facing ginger production risks in this village, and (3) analyze the impact of farmers' behavior on the level of ginger production in Teluk Empening Village, Terentang District, KuburayaRegency.

Literature Review

Farmer Behavior in Facing Risks

According to (Smith, 1996), decision-making is part of a plan, so making a decision is considered an implementation of a plan. This explains that before making a decision, a person has designed a plan to achieve their desired goal, and they will realize their plan through various strategies they have set. Farmer behavior in facing risks is divided into three types according to (Debertin, 1986):

Risk Taker

This refers to a person who behaves boldly in facing risks. Graphically, this can be illustrated as shown in the following image.

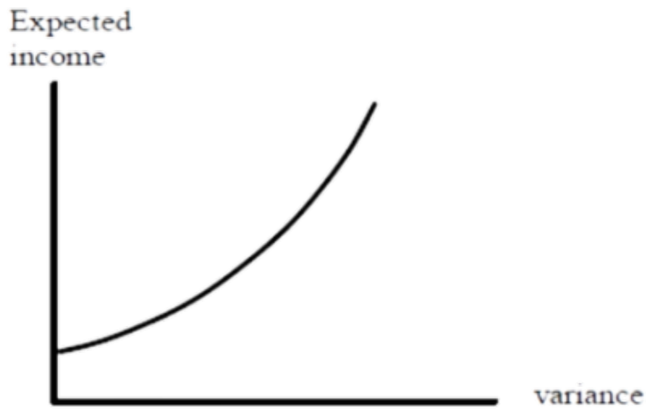

Figure 1. Risk Taker Curve

Source: Debertin (1986)

Description**:** Variance = level of risk; Expected income = expected income

Figure 1 shows that as the level of farming risk increases, the expected income for the farmer also increases. This indicates that farmers who behave boldly in facing farming risks will expect high income even though the risk they face is also high.

Risk Neutral

This refers to a person who behaves somewhere between a risk taker and a risk averter. This can be graphically illustrated as in Figure 2.

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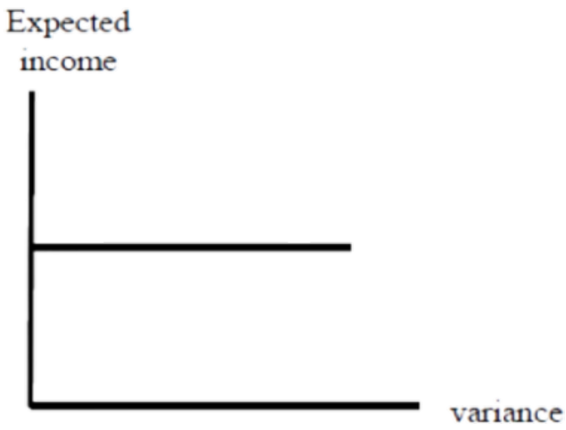

Figure 2. Risk Neutral Curve

Source: Debertin (1986)

Description**:** Variance = level of risk; Expected income = expected income

In Figure 2, it is explained that even though the level of farming risk increases, the expected income for the farmer remains unchanged (constant). This indicates that farmers who behave somewhere between a risk taker and a risk averter also consider the risks in their farming activities but still expect income similar to that of the previous harvest season, even though the farming risk increases.

Risk Averter

This refers to farmers who behave in ways to avoid risk. Graphically, this is illustrated in Figure 3.

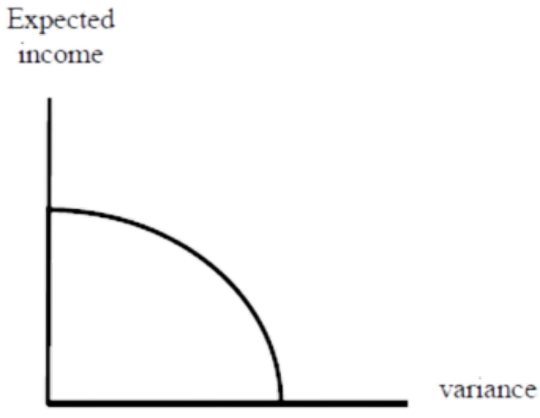

Figure 3. Risk Averter Curve

Source: Debertin (1986)

Description: Variance = level of risk; Expected income = expected income

Figure 3 shows that as the level of farming risk increases, the expected income for the farmer decreases. This indicates that farmers who behave in ways to avoid risks will expect lower income as their farming risk increases. Risk-averse farmers tend to be slow or hesitant to adopt innovations. In contrast, risk-taking farmers will boldly adopt innovations even if they may fail. According to (Doll, 1978), risk-averse farmers allocate fewer production inputs than risk-

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taking farmers. The allocation of production inputs by farmers will affect the amount of production yielded (Kumbhakar, 2002; Russo et al., 2022).

Farming Risks

Risk is the likelihood of failure that may occur within one growing season, which is the possibility of earning less than the expected income. This explains that for each use of production factors in farming activities, farmers have predicted the expected income they want to achieve. Therefore, in carrying out farming activities, farmers need to consider internal conditions (use of production factors) as well as external conditions (weather, prices) beforehand to ensure that the results are as expected.

Natural factors such as rainfall, pest and disease disturbances can create risks and uncertainties for farming performance. Market factors such as price fluctuations also cause uncertainty in farming (Kwakye et al., 2024). Activities in the agricultural sector related to the production process are always faced with risk and uncertainty. In risk situations, the likelihood of potential losses can be known beforehand, while uncertainty is something that cannot be predicted because the likelihood of loss is unknown. Key sources of uncertainty in agriculture include fluctuations in agricultural yields and price fluctuations. Yield uncertainty is caused by natural factors such as climate, pests, diseases, and drought. Therefore, production failures can affect farmers' decisions to continue farming (Sukartawi & Damaijati, 1993; Javadinejad et al., 2021).

Knowledge of the relationship between risk and income is an important part of farm management. According to (Elton et al., 2009), risk measurement metrics consist of variance, standard deviation, and coefficient of variation. The standard deviation describes the average difference in deviations. The higher the coefficient of variation, the higher the risk that must be borne (Kadarsan, 1995; Just & Pope, 1979) state that in farming activities, the level of risk influences farmers' decisions in using production inputs, and the allocation of these inputs affects production yields. Production risk can be systematically formulated as follows:

$$CV = \frac{\sigma}{\bar{Q}}$$

Production Risk

Explanation

CV	: Coefficient of Variation
Σ	: Standard Deviation
Q	: Average Production (Kg)

According to (Hernanto, 1993), this shows that if CV > 0.5, the production risk in farming borne by the farmer is greater, while a CV ≤ 0.5 indicates that the farmer will always profit or break even. The coefficient of variation is a measure of variance that can be used to compare data distributions with different units.

Ginger

The ginger plant (Zingiber officinale rosc) belongs to the class Monocotyledon (single-seeded plants) and the family Zingiberaceae (ginger family). This plant is one of the types of spices that have long grown in Indonesia. Ginger originates from India and China, which are known as countries that use ginger for medicinal purposes. The Greeks and Romans obtained ginger from Arab traders who sourced it from India. Ginger is a spice used as a drink or food ingredient. It is often used in food, the food or beverage industry, and as a medicinal ingredient. The name "Zingiber" is the Latin name derived from the Sanskrit word "singibera," meaning "horn-shaped," because it's rhizome branches resemble deer antlers. The ginger rhizome can also be shaped like fingers, with bulbous joints in the middle.

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The height of the ginger plant is about 0.3 – 0.75 m. Ginger has a pseudo-stem that is round, upright, and unbranched (Setyaningrum & Saparinto, 2013). In general, there are three types of ginger plants that can be distinguished by aroma, color, shape, and size of the rhizome. These three types are large white ginger, small white ginger, and red ginger. The structure of the ginger plant consists of the stem, leaves, flowers, fruits, and rhizome. Each type of ginger has different uses according to the characteristics of each variety. Large ginger is more commonly used for cooking, drinks, candy, and pickles. Small ginger is often used as a flavor enhancer in food and beverages. Red ginger, which has superior chemical content, is more often used as a raw material for medicine (Herlina et al., 2002).

The ginger variety in Teluk Empening Village, Terentang Subdistrict, is a new variety in Indonesia, called "Jahe Menanjak." Jahe Menanjak has been registered as a horticultural plant variety under the Decree of the Minister of Agriculture of the Republic of Indonesia Number: 110/Kpts/PV.240/D/III/2023. This variety is native to Teluk Empening Village.

Previous Research

Previous research is one of the reference sources for the author in conducting this study. Previous research is used as a reference to add theory in examining the research being conducted. Additionally, previous research provides various important information related to common problems on a particular topic, as well as the methods and analytical tools used. Therefore, it can be said that previous research plays an important role in providing an overview for the author in conducting similar studies. In this study, the author includes several results of previous research on the topic being studied as follows:

Analysis of Farmers' Behavior Towards Risk in Red Onion Farming in Mampu Village, Anggeraja District, Enrekang Regency (Hasriani & Zulfan, 2022). This study explores independent variables such as land area, seeds, labor, fertilizers, and pesticides, and the dependent variable being farmers' behavior towards risk. The data analysis techniques used include risk analysis, multiple linear regression, and farmers' risk behavior analysis. The study finds that the risk level of red onion farming is 2.70% for production risk, 3.14% for cost risk, and 2.58% for income risk. Factors affecting production simultaneously include land area, seeds, labor, fertilizers, and pesticides, while farmers' behavior is categorized as risk-loving.

Analysis of Risk in Oil Palm Farming in Limbur Lubuk Mengkuang District, Bungo Regency (Asminar et al., 2021). This research focuses on production risk, income risk, and risk mitigation efforts. The data analysis methods used are coefficient of variation and descriptive analysis. The study shows that a coefficient of variation (CV) value of 0.0024 indicates low farming risk, as $CV < 0.5$. Similarly, income risk is also low, with a coefficient of variation (CV) of 0.00062, which is below 0.5.

Risk of Production in Spinach Farming in Siantan Hilir Village, North Pontianak District. This study assesses independent variables related to production factors and productivity as the dependent variable. The analysis techniques used are coefficient of variation (CV) and multiple linear regression analysis. The findings reveal that the CV for production risk in spinach farming is 15% for land ≥ 0.5 Ha and 70% for land < 0.5 Ha. The significant risk factor affecting spinach production is the use of urea fertilizer.

Analysis of Risk in Ginger Farming in Laiya Village, Cenrana District, Maros Regency (Nila Sari, 2021). This study analyzes production risk, income risk, and price risk. The data analysis techniques used include income analysis and Coefficient of Variation (CV). The average annual income of farmers in Laiya Village is Rp 6,394,034. The Coefficient of Variation (CV) for production risk is 0.8073, for price risk is 0.3440, and for income risk is 1.6901.

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Methods

The selection of the research location was done purposively, which means the area was chosen based on specific considerations closely related to this study. The research was conducted in Teluk Empening, Terentang District, because the village is known for its superior agricultural product, ginger. According to the statistical data on biofarmaka plant production in KuburayaRegency, Terentang District is one of the three districts with the highest production and productivity in Kuburaya, as shown in Table 2 below.

Table 2. Production, Harvest Area, and Productivity of Ginger in Kuburaya Regency in 2021

Sub-district	Production	Harvest Area	Productivity
Batu Ampar	128	132	0,97
Terentang	51.740	25.500	2,03
Kubu	12.500	12.500	1,00
Teluk Pakedai	2.288	408	5,6
Sungai Kakap	1.706	2.409	0,7
Rasau Jaya	6.272	6.544	0,96
Sungai Raya	68.400	66.000	1,03
Sungai Ambawan	14.532	10.800	1,35
Kuala Mandor B	223.500	68.500	3,26

In addition to having a significant ginger production, Terentang District has its own local variety of ginger called "Jahe Menanjak," which has been officially registered with Certificate Number 110/Kpts/PV.240/D/III/2023. The issuance of this registration certificate also serves as a formal legal basis for distributing Jahe Menanjak seeds and recognizing this local ginger as a superior national variety. This research was conducted from August to December 2023 in Teluk Empening Village. The research stages included the preparation of the research proposal, the proposal seminar, interviews, data compilation, data analysis, preparation of research findings, and the final research seminar.

Population and Sample

Population

he population is a generalization area consisting of subjects or objects with certain quantities or characteristics determined by the researcher, which are then studied to obtain a conclusion. The population can also be defined as the total number of items whose characteristics are being studied. In this research, the population comprises all members of the ginger farmer groups in Teluk Empening Village, Terentang District, totaling 265 individuals.

Sample

The sampling method used in this research is non probability sampling with purposive sampling technique. According to Sugiyono (2016), purposive sampling is a sampling technique based on certain considerations or criteria. The sample criteria in this study are ginger farmers who have harvested at least twice and are members of farmer groups. Farmers who have harvested at least twice are expected to have sufficient knowledge and experience regarding the ginger farming process, so they can provide deeper and consistent insights, thus strengthening the reliability of the data collected. These criteria were set to ensure that the study achieved the desired objectives.

Data collection in this study was conducted through interviews involving ginger farmers in Teluk Empening Village, Terentang District. The interview method was chosen to obtain in-

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depth information about ginger farming practices and farmers' experiences in the production process. Interviews were conducted in a semi-structured manner, allowing the researcher to ask questions that had been prepared in advance while still providing space for respondents to provide more open-ended responses. The questionnaire used contained a series of questions related to various aspects, such as the area of land used for ginger planting, the number of seeds planted, labor inputs, and the types of fertilizers and pesticides used.

After the data was collected, it was analyzed using a quantitative approach. In the quantitative analysis, production function regression was used to evaluate the relationship between production inputs (such as land area, number of seeds, amount of fertilizer, amount of pesticide, and labor input) and ginger production yield. The selection of independent variables in this regression model is based on production theory in agriculture as well as relevant previous studies.

Results and Discussion

Analysis of Ginger Production Risk Level

This objective was analyzed by calculating the coefficient of variation in ginger production in Teluk Empening Village, Terentang District, Kuburaya Regency. The coefficient of variation was obtained by dividing the standard deviation of production by the average production. A higher coefficient of variation indicates a higher level of risk faced by farmers. The results of the ginger production risk analysis in Teluk Empening Village are presented in Table 9. Based on Table 9, the coefficient of variation obtained is 0.72, which is greater than 0.5 (0.72 > 0.5), indicating that the ginger production risk in Teluk Empening Village, Terentang District, Kuburaya Regency is classified as high. This high production risk is due to various challenges in ginger farming, such as pest and disease attacks on the plants and seeds that fail to grow, leading to low ginger production. The pests attacking ginger plants in Teluk Empening Village include the leaf beetle, which damages the ginger leaves. Additionally, a common disease that affects ginger plants is rhizome rot, caused by the fungus *Rhizoctonia solani*. To avoid water shortages for the ginger plants, farmers generally avoid planting during the dry season and prefer to plant during the rainy season, usually between March and August each year, to coincide with the rainy season. Although rain is essential for irrigating ginger plants, prolonged rainfall can cause waterlogging, as most ginger farms lack proper terracing or irrigation channels, leading to water accumulation in certain areas. During the rainy season, when water quantity is abundant, poor soil drainage can result in water stagnation, hampering ginger plant growth and making them more susceptible to diseases, sometimes leading to failed seed growth.

Farmers' Behavior in Facing Ginger Production Risks

The second objective of the study was to analyze farmers' behavior towards ginger farming production risks in Teluk Empening Village, Terentang District, Kuburaya Regency. This objective was analyzed by calculating the risk aversion parameter (K(S)) using the econometric model of Moscardi and de Janvry. However, prior to this, a regression analysis of ginger farming production was conducted to identify the most significant production inputs for the K(S) formula.

Ginger Production Function Regression Analysis

Classical Assumption Test

The classical assumption test was conducted to determine whether the model is free from multicollinearity, has normally distributed residuals, and is free from heteroscedasticity. If

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these three assumptions are met, the model is considered the best. In this study, autocorrelation testing was not performed because the data used were cross-sectional, making the possibility of autocorrelation very rare. The following is a discussion of the classical assumption tests in this study.

Normality Test

The normality test aims to determine whether the residuals of the data used in this study are normally distributed. Based on the Kolmogorov-Smirnov test, the residuals are normally distributed for the ginger production function. This is indicated by the Kolmogorov-Smirnov significance value being greater than the 5% significance level (0.05), with a significance value of 0.200 for the ginger production function.

Multicollinearity Test

The multicollinearity test aims to examine and determine whether there is high or perfect correlation between independent variables in a regression model. Multicollinearity in the model causes uncertainty in predicting the influence of all parameters on the dependent variable. To determine whether the model is free from multicollinearity, the Variance Inflation Factor (VIF) value is used. If the VIF value is less than ten, multicollinearity does not occur. Additionally, the tolerance value is also considered; if the tolerance value is greater than 0.10, the model is free from multicollinearity. Based on the VIF and tolerance values in the ginger production function, it can be concluded that all independent variables in the model are free from multicollinearity, as all VIF values are less than ten and all tolerance values are greater than 0.10.

Table 3. Multicollinearity Test Results of Ginger Farming Production Function in Teluk Empening Village

Variable	Nilai VIF	Nilai *Tolerance*	Description
Land Area	6,814	0,147	Multicollinearity not detected
Amount of Seeds	7,083	0,141	Multicollinearity not detected
Amount of Fertilizer	1,930	0,518	Multicollinearity not detected
Amount of Pesticide	1,730	0,578	Multicollinearity not detected
Labor	5,870	0,170	Multicollinearity not detected

Heteroscedasticity Test

The heteroscedasticity test is one part of the classical assumption tests in multiple linear regression, which aims to determine whether there is an inequality in the regression model in terms of the variation of residual values between two or more observations. In this case, homoscedasticity occurs when the residual variance between two observations remains the same, while heteroscedasticity occurs when the residual variance between two observations differs. Heteroscedasticity should not appear in a good regression model. The Glejser test is one way to detect heteroscedasticity in a regression model. The decision rule for the Glejser test is that if the significance value (Sig.) from the Glejser test is smaller than the specified significance level (usually 0.05), the null hypothesis is rejected, indicating heteroscedasticity in the model. Conversely, if the significance value is greater than the specified significance level, the null hypothesis is accepted, indicating that the assumption of homoscedasticity is met. The following are the results of the heteroscedasticity test using the Glejser test for the ginger production function regression model in Teluk Empening Village.

Table 4. Results of the Heteroscedasticity Test for the Ginger Farming Production Function in Teluk Empening Village

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Variable	Significance Values	Description
Land Area	0,740	Free from heteroscedasticity
Amount of Seeds	0,874	Free from heteroscedasticity
Amount of Fertilizer	0,914	Free from heteroscedasticity
Amount of Pesticide	0,421	Free from heteroscedasticity
Labor	0,549	Free from heteroscedasticity

Based on the output above, the significance values (Sig.) for all independent variables are greater than 0.05 (>0.05), indicating that there is no heteroscedasticity in the ginger farming production function model in Teluk Empening Village.

Ginger Production Function Regression Analysis

The most significant production input in the K(s) formula was obtained through the ginger production function regression analysis by using the largest standardized coefficient beta values of the independent variables. The results of the ginger production function regression analysis are presented in the following table.

Table 5. Ginger Production Function Regression Analysis Results

Variable	Regression Coefficient	t Statistic	*Sig.*	*standardized coefficient*
Constant	3,439	1,965	0,058	-
Ln Land Area	0,260	1,023	0,314	0,225
Ln Amount of Seeds	0,585	4,238	0,000*	0,529
Ln Amount of Fertilizer	0,377	2,164	0,038**	0,311
Ln Amount of Pesticide	0,032	0,218	0,828	0,022
Ln Labor	-0,146	-0,553	0,584	-0,100
F Results = 32,056 R^2 = 0,834 *) = significantly affecting α = 0.01 (level of trust 99%) **) = significantly affecting α = 0.05 (level of trust 95%)				

The calculated F value of 46.150 is greater than the F table value of 13.804 (significant at α = 0.01). This means that land area, seed quantity, fertilizer amount, pesticide amount, and labor as independent variables can collectively explain ginger production as the dependent variable. The R^2 value of 0.834 indicates that land area, seed quantity, fertilizer amount, pesticide amount, and labor as independent variables explain 83% of the variation in ginger production as the dependent variable, while the remaining 17% is explained by other factors not included in the model.

The most significant input in the regression analysis in Table 12 is seed quantity, indicated by the highest beta coefficient of 0.585. This is because seed quantity is the most influential input on the level of ginger production in the study area. High-quality and certified seeds lead to better production, while low-quality seeds result in poor quality and higher susceptibility to pests and diseases (Soekartawi et al., 1986; Olisa et al., 2022). In the study area, farmers use high-quality certified seeds, specifically Menanjak Ginger, which adapts well to the study area's conditions as it is native to Teluk Empening Village and produced by local farmers. This explains why seed quantity is the most significant production input for ginger production. The more seeds used in farming, the higher the ginger production.

Analysis of Farmers' Behavior in Facing Risk

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The distribution of ginger farmers according to their behavior in facing production risks in Teluk Empening Village, Kuburaya Regency, based on risk aversion calculations (K(s)), is presented in Table 6.

Table 6. Distribution of Farmers According to Their Behavior in Facing Ginger Production Risks in the Study Area

Farmers' Behavior in Facing Ginger Production Risks	Amount (People)	Percentage
Risk Taker	1	3
Risk Neutral	34	89
Risk Averter	3	8
Total	**38**	**100**

Table 6 shows that most ginger farmers in Teluk Empening Village, Terentang District, Kuburaya Regency, exhibit a neutral risk behavior (89% or 34 people). Risk-neutral farmers are willing to take risks but are not comfortable taking significant risks. Despite fluctuations in results, these farmers remain neutral in their decisions and do not let productivity changes or fluctuations in input prices affect their willingness to farm. This is because ginger farming is a long-standing practice for them, and they believe it is profitable. This finding aligns with (Kurniati, 2015) research on soybean farming, where 15 out of 31 farmers were risk-neutral. Risk-neutral farmers are rational in their risk perception, understanding that every endeavor carries a chance of profit or loss.

The analysis also shows that risk averter and risk taker behaviors have the smallest percentages. Based on field observations and interviews, there is only one risk-taker among the ginger farmers. This risk-taker uses a larger amount of production inputs compared to other respondents, including seeds, fertilizers, pesticides, labor, and land area. According to the interview data, this farmer is confident in using large quantities of inputs due to their experience and expertise in large-scale ginger farming. Additionally, this farmer is the head of GAPOKTAN Empening Mandiri in Teluk Empening Village and is involved in the development and registration of Menanjak Ginger seeds. The farmer's willingness to use a large amount of seeds is partly due to the availability of seeds and the ability to produce seeds independently. This risk-taker behavior aligns with (Hidayati, 2016) study, where farmers with a preference for risk tend to favor risk-taking.

The analysis shows that there are three risk-averse respondents. These risk-averse farmers use the smallest amount of seed input compared to other respondents because they aim to minimize production costs. They are content with their income as long as it meets their basic needs and family requirements. Additionally, risk-averse behavior is influenced by limited land area and capital. These farmers assume that even with low earnings, ginger farming can continue as long as family needs are met.

The Impact of Farmers' Risk Behavior on Ginger Production Levels

This objective was analyzed through the ginger production function regression analysis by adding dummy variables for farmers' risk behavior. The results of the regression analysis of farmers' risk behavior on ginger production levels are presented in Table 7.

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Table 7. Regression Analysis of Farmers' Risk Behavior on Ginger Production Levels

Variable	Regression Coefficient	t Statistic	*Sig.*
Constant	5,807	2,889	0,007
Ln Land Area	0,479	1,802	0,082***
Ln Seed Quantity	0,162	0,679	0,502
Ln Fertilizer Quantity	0,412	2,135	0,041**
Ln Pesticide Quantity	0,002	0,012	0,990
Ln Labor	-0,252	-0,841	0,407
Farmer Behavior Dummy (*risk taker*/D1)	1,421	2,063	0,048**
Farmer Behavior Dummy (*risk neutral*/D2)	0,736	2,022	0,052***
F hitung = 25,490 R^2 = 0,856			
Keterangan : Dependent Variable : Ln Ginger Production Level (Kg) * = Significant at α = 0,01 (99% confidence level) ** = Significant at α = 0,05 (95% confidence level) *** = Significant at α = 0,1 (90% confidence level) F table (0,01) dfN1:6, dfN2:30 = 3,473 F table (0,05) dfN1:6, dfN2:30 = 2,421 F table (0,1) dfN1:6, dfN2:30 = 1,980 t table (0,01) df: 30 = 2,457 t table (0,05) df: 30 = 1,697 t table (0,1) df:30 = 1,310			

Results of Classic Assumption Testing for Regression Data

Multicollinearity Test

The Multicollinearity Test aims to check whether there is a high or perfect correlation between independent variables in a regression model. The presence of multicollinearity in a model causes uncertainty in predicting the effect of all parameters on the dependent variable. To determine whether the model is free from multicollinearity, one can look at the Variance Inflation Factor (VIF) values. If the VIF value is less than ten, multicollinearity is not present. Additionally, tolerance values can be examined; if the tolerance value is greater than 0.10, the model is free from multicollinearity. Based on the VIF and tolerance values for the ginger production function, it is evident that all independent variables in the model are free from multicollinearity, as all VIF values are less than ten and tolerance values are greater than 0.10.

Table 8. Multicollinearity Test Results for Regression Analysis of Farmer Behavior in Facing Ginger Production Risk

Variable	VIF Value	*Tolerance Value*	Notes
Land Area	9,966	0,101	No multicollinearity detected
Amount of Seeds	9,701	0,103	No multicollinearity detected
Amount of Fertilizer	5,291	0,189	No multicollinearity detected
Amount of Pesticide	2,145	0,466	No multicollinearity detected
Labor	8,748	0,114	No multicollinearity detected
Dummy 1	4,899	0,204	No multicollinearity detected

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Dummy 2	5,024	0,199	No multicollinearity detected

Heteroskedasticity Test

The following are the results of the heteroskedasticity test using the Glejser test for the ginger production function model in Teluk Empening Village.

Table 9. Heteroskedasticity Test Results for Regression Analysis of Farmer Behavior in Facing Ginger Production Risk

Variable	Significance Value	Notes
Land Area	0,313	Free from heteroscedasticity
Amount of Seeds	0,923	Free from heteroscedasticity
Amount of Fertilizer	0,717	Free from heteroscedasticity
Amount of Pesticide	0,234	Free from heteroscedasticity
Labor	0,897	Free from heteroscedasticity
Dummy 1	0,723	Free from heteroscedasticity
Dummy 2	0,364	Free from heteroscedasticity

Source: Processed Primary Data, 2023

Based on the output above, it is known that the significance (Sig.) values for all independent variables are greater than 0.05 (>0.05), so it can be concluded that there are no symptoms of heteroskedasticity in the Regression Analysis Model of Farmer Behavior in Facing Ginger Production Risk in Teluk Empening Village. Next, the regression data was tested for model fit, consisting of variance test (F test) and coefficient of determination test (R^2) as follows:

Variance Test (F Test)

Table 9 shows that the F calculated value of 25.490 is greater than the F table value of 7.218 (significant at $\alpha = 0.01$). This means that land area, seed amount, fertilizer amount, pesticide amount, labor, dummy for risk-taking behavior (D1), and dummy for risk-neutral behavior (D2) as independent variables together can explain the level of ginger production as the dependent variable.

Coefficient of Determination Test (R^2)

The R^2 value of 0.856 means that land area, seed amount, fertilizer amount, herbicide amount, labor, dummy for risk-taking behavior (D1), and dummy for risk-neutral behavior (D2) as independent variables can explain 85% of the variation in ginger production as the dependent variable, while the remaining 15% is explained by other factors outside the model.

To determine the partial effects of each production factor on ginger production, the results of the t-test and significance values listed in the table can be observed. The estimation results based on the t-test (partial) show that some production inputs do not have a significant effect on ginger production. According to Table 14, the inputs that have a partial effect on ginger production are seeds, fertilizer, pesticides, labor, dummy for risk-taking behavior (D1), and dummy for risk-neutral behavior (D2). While land area and pesticides do not have a significant partial effect on ginger production. The detailed effect of each independent variable on ginger production is explained as follows:

Land Area

Table 9 shows that the significance (Sig.) value for the land area variable is 0.082. This means that the land area variable has a significant effect on ginger production at $\alpha = 0.1$ (90% confidence level). Based on the test results, the land area variable has a coefficient of 0.479

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with a t-calculated value of 1.802, which is greater than the t-table value of 1.310. The coefficient value of 0.479 indicates that an increase in land area input by 1% (with other inputs held constant) will increase ginger production by 0.479%. The coefficient of 0.479 indicates that a 1% increase in land area (assuming other inputs remain constant) will increase ginger production by 0.479%. That is, an increase in land area is directly linked to an increase in production. In practice, this means that farmers who want to increase ginger production should consider expanding the land used or implementing a monoculture pattern in ginger cultivation. This monoculture pattern allows for a more intensive focus on ginger, thereby reducing competition with other crops.

In the field, some farmers also cultivate other crops such as turmeric and banana on the same land. However, too many crops in one plot can cause problems, such as an increased risk of rhizome rot disease due to high humidity. To avoid this, the ideal spacing recommended by the Research Institute for Medicinal and Aromatic Plants is 30x60 cm, which allows the plants enough space to grow without increasing excessive humidity.

Seed Amount

Based on Table 9, the significance (Sig.) value for the seed amount variable is 0.502. This means that the seed amount variable does not have a significant effect on ginger production at $\alpha = 0.1$ (90% confidence level). The test results indicate that the seed amount variable has a coefficient of 0.162 with a t-calculated value of 0.679, which is less than the t-table value of 1.310. The change in significance between the analysis before and after the addition of dummy variables is influenced by several factors, such as additional resources and technology. Risk-taker farmers often invest more in better agricultural technology and practices, such as more efficient fertilizers, appropriate irrigation, or more effective pesticides. This can lead to increased production that may not be directly related to seed amount but rather to the technology and resources used. Risk-neutral farmers may rely on proven techniques and technologies but do not always maximize the potential of new technologies, leading to stable but potentially less dramatic production increases compared to risk-takers. Therefore, ginger production increases might be more attributable to stable practices than the amount of seeds used. Additionally, the dummy variables for farmer behavior might capture some unmeasured factors affecting ginger production, such as managerial skills, access to information and training, and social networks, which are often better among risk-taker farmers, indirectly boosting ginger production. Consequently, when dummy variables for risk-neutral or risk-taker behavior are included in the model, they capture variations in ginger production that were previously explained by seed amount, indicating that farmer behavior (both risk-taker and risk-neutral) has a significant impact on production, making the seed amount less significant in a more comprehensive model.

Fertilizer Amount

The analysis conducted using SPSS shows that the significance value for the fertilizer amount variable is 0.041. This means that the fertilizer amount variable has a significant effect on ginger production at $\alpha = 0.05$ (95% confidence level). The test results indicate that the fertilizer amount variable has a coefficient of 0.412 with a t-calculated value of 2.135, which is greater than the t-table value of 1.697. The coefficient value of 0.412 indicates that an increase in fertilizer input by 1% (with other inputs held constant) will increase ginger production by 0.412%. This finding is consistent with Risqie's (2008) study, which explains that the addition of manure has a positive and significant effect at a 90% confidence level. This is because the average use of manure by respondent farmers is still below the standard usage of 15-20 tons/ha, so additional manure can still be applied up to the optimum limit. In addition to manure, farmers

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also use chemical fertilizers. Chemical fertilizers are often used by farmers to make plants fertile, and various types of chemical fertilizers are used according to needs, meaning that different chemical fertilizers have different functions, such as enriching the soil, making plants lush, accelerating fruiting, and more.

Amount of Pesticides

The pesticide variable shows a positive but not significant correlation with a coefficient of 0.1. The partial test results for pesticides at a 90% confidence level show a t-value of 0.012, which is less than the t-table value of 1.310, and a significance value of 0.990 (> 0.1). This indicates that the use of pesticides does not have a significant effect on ginger production. The lack of a significant impact is because the amount of pesticides used by respondent farmers varies according to the pests and diseases affecting their crops. However, this study did not differentiate in its calculations. Therefore, the effect of the amount of pesticides on ginger production cannot be concluded from this analysis.

Labor

The labor variable has a coefficient of -0.252 with a t-value of -0.841. The t-value is smaller than the t-table value at the 10% level (1.310), indicating that the labor variable does not significantly impact production. This implies that if ginger farmers want to increase ginger production, they need to enhance labor input, particularly for plant maintenance like weeding and irrigation system upkeep to avoid waterlogging and ensure proper water flow. The condition of ginger plants is affected by pests and diseases, possibly due to waterlogging, especially during prolonged rainy seasons.

Dummy Variable for Risk-Taking Behavior (D1)

The dummy variable for risk-taking behavior (D1) shows a statistically significant effect at $\alpha = 0.05$ (99% confidence level), with a t-value of 2.063 greater than the t-table value of 1.697. The coefficient for the risk-taker dummy variable is 1.421, meaning risk-taking farmers have ginger production 142.1% higher compared to risk-averse farmers (excluded group), assuming other independent variables remain constant (ceteris paribus). The substantial production difference between risk-takers and risk-averse farmers is due to only one out of 38 respondent farmers being willing to take risks. This risk-taker has the largest input usage, land area, and knowledge of ginger cultivation, particularly ginger Menanjak. Risk-taker farmers also exhibit a higher production level due to their willingness to engage in riskier practices compared to risk-averse farmers who follow the Safety First principle to avoid failures.

Dummy Variable for Risk-Neutral Behavior (D2)

The The dummy variable for risk-taking behavior (D1) shows a statistically significant effect at $\alpha = 0.05$ (99% confidence level), with a calculated t value of 2.063 greater than the t table value of 1.697. The coefficient for the risk-taking dummy variable is 1.421, which means that risk-taking farmers have 142.1% higher ginger production compared to risk-averse farmers (the excluded group), assuming other independent variables remain constant (ceteris paribus). The considerable difference in production between risk-taking and risk-averse farmers is due to the fact that only one of the 38 respondent farmers was willing to take the risk.

The 142.1% higher production also reflects a substantial practical impact. In the real world, an increase in production of this magnitude can translate into a significant increase in income for farmers. For example, if the average ginger production per risk-averse farmer is 500 kg per season, risk-taking farmers can expect to produce about 1,210.5 kg. But assuming the selling price of ginger is fixed, the additional income generated from this increased production could

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far exceed the risk borne, providing a financial incentive for other farmers to consider adopting riskier practices.

These risk-taking farmers have the greatest input use, land area and knowledge in ginger cultivation, particularly ginger uphill. Risk-taking farmers also exhibit higher production levels due to their willingness to engage in riskier practices compared to risk-averse farmers who follow the Safety First principle to avoid failure. This increase in production has the potential to have a positive impact on the local economy. With higher yields, farmers can create more jobs by hiring additional labor to help manage larger plots of land or increase harvest volumes. In addition, higher yields can open up wider market opportunities, both locally and nationally, which in turn can increase farmers' income. A change in behavior from risk-aversion to more risk-taking could affect ginger production in the region. If more farmers are willing to adopt more productive practices despite the risks, ginger production in the area could increase significantly. The impact could strengthen the local economy and improve food security.

For farmers who are neutral or risk-averse, appropriate training programs can help them become more confident in taking calculated risks. Agricultural extension services can serve in providing training related to modern farming techniques, technology use, and risk management (Irawan, 2023). In addition, access to financial resources such as microloans or agricultural insurance can reduce the uncertainty experienced by farmers, allowing them to take more innovative steps (Gunawan & Muzayanah, 2023). Finally, collaboration between the government, private sector, and NGOs in developing training and mentoring programs for farmers can also be a solution to increase productivity and efficiency in the agricultural sector.

Furthermore, if risk-averse farmers have significantly lower production levels, local or national governments can intervene to reduce the risks faced by farmers. Policies such as subsidies for agricultural inputs, financial support for the adoption of modern agricultural technologies, or educational programs on agricultural risk management can provide encouragement for farmers to take more calculated risks. These policy interventions are expected to help farmers increase production yields and will also contribute to improving the competitiveness of the agricultural sector more broadly.

Conclusion

Based on the discussion, several conclusions can be drawn: The production risk level of ginger farming in Teluk Empening Village, Terentang District, Kuburaya Regency is classified as high, with a risk value of 0.81. The majority of ginger farmers in the research area exhibit risk-neutral behavior, with 89% (34 people) being risk-neutral, 8% (3 people) risk-averse, and 3% (1 person) risk-takers. This is attributed to the ongoing nature of ginger farming, leading farmers to perceive it as consistently profitable, regardless of yield fluctuations or input price changes. Land size and fertilizer usage positively affect ginger production, while the effects of seeds, labor, and pesticides remain inconclusive, as farmer behavior (risk-taker or risk-neutral) significantly influences production. When the dummy variables for risk behaviors were included in the model, they captured variations in ginger production previously explained by seed quantity, indicating that risk behavior impacts production. The analysis also shows that risk-taker farmers have a ginger production Ln that is 142.1% higher, and risk-neutral farmers have a production Ln that is 73.6% higher, compared to risk-averse farmers. However, the results of this study have some limitations that need to be noted. The relatively small sample size of 38 ginger farmers, as well as the cross-sectional nature of the data collected, limits the ability to generalize these findings to a wider population of ginger farmers. In addition, the situation in Teluk Empening village may not reflect the situation in other ginger producing areas. Therefore, future research is expected to expand the scope by involving a larger sample

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size and include other regions to provide more representative results. This will strengthen the validity and generalizability of these findings and provide greater insight into the factors that influence ginger production in different regions.

Acknowledgment

The analysis shows that most farmers are risk-neutral due to a lack of enthusiasm and courage to pursue greater profits. Therefore, there is a need for initiatives and outreach programs on agricultural insurance for biofarmaka crop farmers, especially ginger farmers. This would encourage farmers to allocate production inputs more optimally, with the expectation that recommended input allocation will increase ginger production. The analysis shows that the effect of pesticides on ginger production cannot be conclusively determined due to the variety of pesticides used by farmers, which were not differentiated in this study. Therefore, further research is needed to analyze the impact of pesticide use by distinguishing between the types of pesticides used by farmers on ginger production. For future researchers, it is recommended to conduct further studies that analyze the influence of farmer behavior in facing production risks on ginger production across different types and sizes of land.

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