Article Type

Factors Affecting White Pepper Production in Puncak Village, South Sinjai District, Sinjai Regency

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OPEN ACCESS

Citation: Nurdin, F., Nurhalyza, N., Nilmalasari, N., Asdar, A., Salsabila, S., & Asma, A. F. (2026). Factors Affecting White Pepper Production in Puncak Village, South Sinjai District, Sinjai Regency. *Sustainable Agribusiness Review*, *2*(1), 25–31. https://doi.org/10.33005/sar.v2i1.36

Editor: Intan Mega Maharani

Submitted: April 20, 2026
Accepted: May 17, 2026
Published: May 31, 2026

Abstract: This study aims to analyze farmer characteristics and the factors affecting white pepper production in Puncak Village, South Sinjai District, Sinjai Regency. This research employed a quantitative approach using a survey method. A total of 30 farmers were selected using a saturated sampling technique. Data were collected through interviews, observations, and documentation, and analyzed using multiple linear regression. The results show that partially, seed quality (X1), land area (X2), and price (X3) have a significant effect on white pepper production with significance values < 0.05. Seed quality and price have a positive effect, while land area has a negative effect on production. Simultaneously, all variables significantly affect production. The coefficient of determination (R^2) is 0.411, indicating that 41.1% of the variation in production is explained by the model, while the rest is influenced by other factors outside the study. In conclusion, Farmers are encouraged to use high-quality seeds and optimize land management to boost white pepper productivity, particularly on large-scale plots, to prevent a decline in production efficiency. The government and agricultural extension officers should provide guidance and training on efficient white pepper cultivation techniques and proper land management to increase farmers' yields.

Keywords: Production, White Pepper, Production Factors, Multiple Linear Regression

1. Introduction

Pepper (Piper nigrum L.) is an important perennial spice crop cultivated mainly by smallholder farmers in tropical regions. In farm-level production systems, yield performance is strongly associated with the quality of planting material, land management, input allocation, labor availability, and farmers' economic incentives (Yulia et al., 2019; Sitorus et al., 2020). Previous studies on agricultural production have also shown that farm size and productivity do not always move in the same direction, particularly when land expansion is not accompanied by sufficient labor, technology, and managerial capacity (Deolalikar, 1981; Barrett et al., 2010; Carletto et al., 2013).

White pepper is produced from mature pepper berries through post-harvest processing that removes the outer skin, while black pepper is produced from berries dried with the skin intact. At the farm level, the use of healthy planting materials and proper crop management is critical because pepper is a perennial crop whose productivity depends on plant establishment, maintenance intensity, disease control, and the efficiency of input use (Yulia et al., 2019; Sitorus et al., 2020).

In Indonesia, white pepper farming remains closely linked to household income and rural agribusiness development. However, smallholder pepper production often faces constraints related to unequal input quality, limited adoption of good agricultural

practices, price uncertainty, and differences in farmers' production capacity. These constraints are relevant because improved agricultural technologies and better farm management have been shown to affect crop income and farm productivity in smallholder systems (Mendola, 2007; Kassie et al., 2011; Shiferaw et al., 2014).

Significant potential to expand agricultural exports, particularly commodities from the plantation sub-sector. The pepper plant produces two types of pepper: white pepper and black pepper. The difference between white pepper and black pepper lies solely in the post-harvest processing method. White pepper is obtained from pepper berries with the outer skin removed, while black pepper is obtained from pepper berries with the outer skin left intact. White pepper is used as a cooking spice, a flavor enhancer, a meat preservative, and can be processed into various food and health products (Karsiningsih et al., 2023).

Although pepper is a high-value commodity, pepper farmers in Puncak Village still face various challenges in their farming activities. These challenges include limited access to high-quality seedlings, suboptimal land management, and price fluctuations that can influence farmers' production decisions. From a production economics perspective, these variables are relevant because seedling quality represents biological input quality, land area reflects the scale and management capacity of farming, and price functions as an economic incentive that may influence production intensity (Chavas & Holt, 1990; Haile et al., 2016).

Previous studies on white pepper and smallholder farming have mostly been conducted in other regions and commodities. Studies on white pepper farming in Bangka Belitung show that production input diversity, farmer participation in good agricultural practices, and cultivation management are important factors influencing productivity (Yulia et al., 2019; Sitorus et al., 2020). Nevertheless, empirical studies specifically examining seedling quality, land area, and price as determinants of white pepper production in Puncak Village remain limited. Therefore, this research is important to provide location-specific evidence for improving white pepper production at the village level.

This research is important because it can provide useful information for farmers to improve farming efficiency, as well as serve as a basis for the government and agricultural extension workers in formulating policies and strategies for the development of white pepper in the region. Based on the above, the objectives of this study are (a) To analyze the characteristics of white pepper farmers in Puncak Village, South Sinjai Subdistrict, Sinjai Regency. (b) To analyze the influence of production factors on white pepper production in Puncak Village, South Sinjai Subdistrict, Sinjai Regency.

2. Methodology

2.1 Research Design and Study Area

This study employed a quantitative research design using a structured survey approach to examine the factors influencing white pepper production. A survey design was considered appropriate because it enables the collection of standardized farm-level data from all respondents and allows statistical testing of relationships among variables (Kelley et al., 2003). The research was conducted in Puncak Village, South Sinjai Subdistrict, Sinjai Regency, Indonesia. The study location was selected purposively because Puncak Village is recognized as one of the main white pepper-producing areas in the region. This condition makes the village a relevant site for analyzing production-related factors at the farm level.

2.2 Data Sources and Data Collection

The study used both primary and secondary data. Primary data were collected through direct interviews with white pepper farmers using a structured questionnaire. The questionnaire was designed to obtain information on farmer characteristics, farm management practices, input use, cultivation activities, and white pepper production. Direct interviews were conducted to ensure that all questions were clearly understood by respondents and to minimize errors in data interpretation.

Secondary data were obtained from relevant institutions, including local agricultural offices, village records, statistical reports, and supporting scientific literature. These data were used to complement the primary data and provide contextual information regarding white pepper farming conditions in the study area.

2.3 Population and Sampling Procedure

The population of this study consisted of all white pepper farmers in Puncak Village. Because the number of white pepper farmers in the study area was relatively small, the study applied a census approach, in which the entire population was included as respondents. A total of 30 white pepper farmers participated in the study.

The use of a census approach was considered appropriate because it allowed the study to capture the complete characteristics of white pepper farmers in the village without selecting only a subset of respondents. However, given the relatively small number of observations, the interpretation of the findings was focused on the study area and should be generalized to broader contexts with caution.

2.4 Variables and Measurement

The dependent variable in this study was white pepper production, measured based on the total production obtained by farmers during the most recent production period. The independent variables consisted of selected farm-level and farmer-level factors assumed to influence white pepper production. These variables included production inputs, farmer characteristics, and cultivation management factors relevant to white pepper farming.

Each variable was operationally defined before analysis to ensure consistency in measurement. Quantitative variables were measured using their actual numerical values, while categorical variables were coded appropriately for statistical analysis. Prior to regression analysis, the data were checked for completeness, consistency, and potential outliers.

2.5 Data Analysis

Data were analyzed using multiple linear regression to determine the influence of independent variables on white pepper production. The general regression model used in this study was formulated as follows:

$$\mathbf{Y = \alpha + ß1X1 + ß2X2 + ß3X3 + \ldots + ßnXn + e}$$

where (Y) represents white pepper production, (α) is the constant, ß1+ ß2+ ß3+ …. + ßn) are the regression coefficients, (X1, X2, X3, Xn) are the independent variables, and (e) is the error term.

The regression coefficients were used to evaluate the direction and magnitude of the influence of each independent variable on white pepper production. The significance of each variable was assessed using the t-test, while the overall fitness of the model was evaluated using the F-test and the coefficient of determination (R^2).

To ensure the reliability of the regression results, several diagnostic tests were conducted. Multicollinearity was examined using the Variance Inflation Factor (VIF), with careful interpretation because fixed rules of thumb may lead to misleading conclusions in small samples (O'Brien, 2007). Normality of residuals was assessed using a residual normality test, while heteroscedasticity was evaluated to determine whether the residual variance was constant. When necessary, heteroscedasticity-consistent standard errors were considered to improve the reliability of statistical inference (White, 1980).

2.6 Ethical Considerations

All respondents were informed about the purpose of the study before data collection. Participation in the survey was voluntary, and the information provided by respondents was used only for research purposes. The identity of respondents was kept confidential throughout the research process.

3. Results and Discussion

3.1. Characteristics of Pepper Farmers in Puncak Village, South Sinjai Subdistrict, Sinjai Regency.

The number of pepper farmers in Puncak Village, South Sinjai Subdistrict, Sinjai Regency, who were selected as respondents in this study was 30. The characteristics of white pepper farmers include age, education, experience in white pepper farming, and the area of white pepper land.

Based on the results of a study of 30 white pepper farmers in Puncak Village, the following characteristics of the farmers were identified: Most farmers are of working age (30–50 years old); the majority have a high school education (60%); they have relatively extensive farming experience, ranging from 5 to 25 years; and the average land area owned by farmers is approximately 1 hectare**.**

Table 1. Characteristics of Pepper Farmers in Puncak Village, South Sinjai Subdistrict, Sinjai Regency

Variable	Criterion	Frequency	%
Age	30 - 35 years	15	50
	35 - 40 years	3	30
	41- 45 years	2	6,67
	46-50 years	4	13,33
	51-56 years	1	3,33
Education	Elementary school	6	20
	Junior High School	5	16,67
	Senior High School	18	60
	Bachelor	1	3,33
Farming experience	5-10 years	7	23,33
	11-15 years	8	26,67
	16-20 years	4	13,33
	21-25 years	11	36,67
Pepper Farm Area	¼ Ha	4	13,33
	½ Ha	11	36,33
	1,00 Ha	12	40
	2,00 Ha	3	10

Source : Primary Data Analysis, (2024)

3.2. Factors Affecting White Pepper Production in Puncak Village, South Sinjai Subdistrict, Sinjai Regency

The production factors influencing white pepper farming are Seedlings (X1), Land Area (X2), and Price (X3). The average white pepper farmer in Puncak Village is 40 years old, has completed high school, and has 20 years of experience in white pepper cultivation. White pepper farmers predominantly use inorganic fertilizers such as urea, ZA, and SP36, accounting for 80% of their fertilizer use.

Table 2. Multiple Linear Regression Results

Variable	Coefficient	Significance
Seedlings (X_1)	0,509	0,002
Land Area (X_2)	-0,362	0,003
Price (X_3)	0,514	0,001
R2	0,411	
F hitung	553,325	

Source : Primary Data Analysis, (2024)

Based on the results of the data analysis using multiple linear regression, the following equation was obtained:

$$\mathbf{Y = a + 0{,}509X1 - 0{,}362X2 + 0{,}514X3}$$

Notes:
Y = White pepper production
X1 = Seedlings
X2 = Land Area
X3 = Price

3.3 Test of the Coefficient of Determination (R^2)

The coefficient of determination (R^2) is 0.411, or 41.1%, which means that 41.1% of the variation in white pepper production can be explained by the variables of seed quality, land area, and price, while the remaining 58.9% is influenced by other factors outside the model, such as labor, fertilizer, and climatic conditions.

3.4 T-Test (Partial)

1) Effect of Seedlings (X1) on Production

The seedling variable has a regression coefficient of 0.509 with a significance level of 0.002 < 0.05. This indicates that seedlings have a significant effect on white pepper production. In other words, improvement in the quality and availability of planting materials can increase white pepper production. This result is theoretically consistent with studies showing that improved agricultural technology and better input quality can increase crop income and productivity among smallholder farmers (Mendola, 2007; Kassie et al., 2011; Shiferaw et al., 2014). In the context of white pepper farming, the quality and diversity of production inputs are also important because they determine plant establishment, field performance, and long-term productivity (Yulia et al., 2019; Sitorus et al., 2020).

2) Effect of Land Area (X2) on Production

The land area variable has a regression coefficient of -0.362 with a significance level of 0.003 ($p < 0.05$), indicating a significant effect on white pepper production. However, the negative coefficient indicates that an increase in land area is followed by a decrease in production. This finding suggests that larger landholdings do not automatically increase production when they are not supported by adequate labor, input allocation, pest and disease management, and effective farm supervision. This pattern is consistent with the broader literature on the inverse relationship between farm size and productivity, which shows that land expansion may reduce output per farm when management intensity and input efficiency decline (Deolalikar, 1981; Assuncao & Braido, 2007; Barrett et al., 2010; Carletto et al., 2013; Desiere & Jolliffe, 2018).

3) The Effect of Price (X3) on Production

The price variable has a regression coefficient of 0.514 with a significance value of 0.001 ($p < 0.05$), indicating a significant effect on white pepper production. This suggests that an increase in pepper prices can encourage farmers to boost production due to greater economic incentives. Farmers tend to increase cultivation intensity, maintain crops more carefully, and allocate more inputs when commodity prices are favorable. This finding is consistent with agricultural supply response studies showing that price expectations and price volatility can influence farmers' acreage, yield, and production decisions (Chavas & Holt, 1990; Haile et al., 2016).

3.5 F-Test (Simultaneous)

The results of the F-test show that the calculated F-value is 553.325 with a significance level of less than 0.05, indicating that the variables of seedling quality, land area, and price jointly have a significant effect on white pepper production. This indicates that these three variables are capable of simultaneously explaining the variation in white pepper production in Puncak Village.

Overall, the results of this study support the argument that production factors such as seedling quality, land area, and price influence white pepper production. Seedling quality reflects the biological potential of the crop, land area

reflects the scale and managerial burden of farming, and price represents the economic incentive that shapes farmers' production decisions. The negative coefficient of land area indicates possible inefficiency in land management, which should be addressed through improved cultivation practices, better labor allocation, and stronger extension support for white pepper farmers (Yulia et al., 2019; Sitorus et al., 2020; Barrett et al., 2010; Desiere & Jolliffe, 2018).

4. Conclusion

Based on the results of the research and analysis conducted, it can be concluded that: (a) The characteristics of white pepper farmers in Puncak Village are dominated by farmers of working age, most of whom have a high school education and considerable farming experience, enabling them to manage white pepper farming more effectively. (b) Partially, the variables of seedling quality, land area, and price have a significant effect on white pepper production. The seedling quality and price variables have a positive effect, while land area has a negative effect on production. (c) Simultaneously, the variables of seedling quality, land area, and price collectively influence white pepper production. (d) The coefficient of determination (R^2) value of 0.411 indicates that 41.1% of the variation in white pepper production can be explained by the variables in the model, while the remainder is influenced by other factors outside the scope of this study.

5. Suggestions

Based on the research findings, the following recommendations are made: (a) Farmers are encouraged to use high-quality seeds and optimize land management to boost white pepper productivity, particularly on large-scale plots, to prevent a decline in production efficiency. (b) The government and agricultural extension officers should provide guidance and training on efficient white pepper cultivation techniques and proper land management to increase farmers' yields.

Author Contributions

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Writing – original draft: Fadilah Nurdin
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