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Factors Affecting the Production of Cayenne Pepper in Kotawaringin Regency

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A B S T R A C T

This study aims to identify and analyze the factors that influence the volume of cayenne pepper production by local farmers in West Kotawaringin Regency, Central Kalimantan. The study used a quantitative approach with descriptive methods and multiple linear regression analysis. Five independent variables were tested: land area, farmer education level, market access, technology use, and soil conditions. Data were obtained from secondary sources such as the Agricultural Census, the Agricultural Service's LKJIP (Land Use Report), and regional production reports for 2023–2025. The results indicate that land area, market access, and technology use have a positive and significant effect on cayenne pepper production. Meanwhile, education level was not statistically significant, and soil conditions (peat and sand) had a significant negative effect on productivity. The regression model explained 81% of the variation in production. This study used aggregate data, therefore, it did not describe the micro-characteristics of individual farmers in detail, and it did not include climate and market price factors in the model. The results of this study can be used as a reference in formulating local policies to increase cayenne pepper production, through interventions such as land expansion, improving market access, and adopting adaptive technologies on peat/sandy lands. This article presents a comprehensive quantitative approach based on local data to explain the contributions and challenges of cayenne pepper farmers in meeting domestic market needs in marginal areas.

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INTRODUCTION

Chili peppers (Capsicum frutescens L.) are a strategic horticultural commodity in Indonesia with high economic value and are an important part of household food consumption and the food industry (Zulkarnain, 2010; Ministry of Agriculture, 2018). The high demand for chili peppers, especially during the lead-up to National Religious Holidays (HBKN), causes their prices to fluctuate significantly and are vulnerable to supply disruptions.

In West Kotawaringin Regency (Kobar), Central Kalimantan, cayenne pepper production is still insufficient to meet local demand. According to data from the Food Security Agency (2024), local production only supplies 23.3% of the regency's total cayenne pepper needs. Consequently, cayenne pepper supply is highly dependent on distribution from outside the region, particularly from Java, such as Brebes, Kediri, and Banyuwangi Regencies, which are national chili production centers (BKP, 2022; BPS, 2023).

This dependency results in high distribution costs and fluctuating chili prices in Central Kalimantan. Chili peppers imported from Java have a lower base price due to more efficient production costs and more fertile soil. However, after shipping costs are added, the selling price in Kalimantan can soar by more than 40% compared to the price paid by farmers in their regions of origin (Zahara et al., 2021). This price disparity not only impacts purchasing power but also poses a competitive threat to local farmers who must compete with chili peppers from outside the region.

Prices from outside the region, particularly Java, are a key determinant of local farmers' motivation to increase production. When local market prices fall due to a flood of supply from Java, local farmers tend to hold back production or switch to other commodities deemed more profitable. Conversely, when external prices rise due to distribution constraints or bad weather, local farmers have the opportunity to achieve higher margins but are often unprepared in terms of production capacity (Nugroho, 2019).

Besides price, the main challenges faced by local farmers in West Kotawaringin Regency include the geographical conditions dominated by peat and sandy soil, limited access to modern agricultural technology, limited extension services, and limited access to markets and capital (BIG & BBSDLP, 2020; LKJIP Kobar Agriculture Service, 2023). The education level of most farmers is also limited to basic education, which impacts their ability to adapt to agricultural innovations (BPS, 2023).

Based on these issues, this study aims to analyze the factors influencing cayenne pepper production by local farmers in West Kotawaringin Regency. The variables studied include land area, education level, market access, technology use, soil conditions, and chili prices from outside the region (particularly Java). This research is expected to provide data-based policy recommendations to strengthen the independence of local chili production and reduce dependence on inter-island supply.

LITERATURE REVIEW

Chili pepper production is influenced by various factors, both internal to the farmer and external to the farmer, such as geographic conditions and market

dynamics. According to agricultural production theory (Soekartawi, 2006), agricultural output is determined by a combination of inputs, including land, labor, capital, technology, and environmental conditions. In the context of horticultural crops like chili peppers, inputs such as land area, seed quality, cultivation technology, and farmer skills are key elements in increasing productivity.

Based on the research results, production and land area influence the productivity of cayenne pepper in Indonesia. A partial test (t-test) shows a significant effect of land area on cayenne pepper productivity in Indonesia. Meanwhile, production does not significantly influence cayenne pepper productivity in Indonesia (*Zahara, TA, Wisnujati, D., & Siswati, E. (2021). Analysis of production and productivity of cayenne pepper (Capsicum frutescens L) in Indonesia.)*

The geographical conditions, dominated by acidic peat soil and coastal sand, limit the development of chili farming. Furthermore, limited access to superior seed technology and the limited human resource capacity of local farmers hamper productivity.

According to the Statistics Indonesia (BPS) (2023) and the Agriculture Service's LKJIP (Land and Agricultural Research and Development Agency) report (2023), the majority of farmers in this region are smallholders with limited land holdings. Sustainable local food security depends heavily on the ability of local farmers to independently increase productivity. Therefore, it is important to empirically examine the role of local farmers and the factors influencing them.

Chili Pepper Productivity by Local Farmers

In West Kotawaringin Regency, the community's livelihoods are generally gardening, fishing, and farming. This agriculture is varied, with vegetables, rice, and still very few cayenne pepper farmers. Despite all the challenges faced by local farmers over the years, they have begun to expand their land to meet the demand for cayenne pepper in the domestic market. The following table shows the yields of local cayenne pepper farmers.

Table 1. Chili Production in West Kotawaringin Regency, 2021–2024

Kind of Plants	**Unit**	**2021**	**2022**	**2023**	**2024**
(1)	(2)	(3)	(4)	(5)	(6)
Cayenne Pepper	kw/ qui	38,220.34	25,715.01	34,892.40	15,404.88
Big Chili/TW/Teropong / Chili/Big chili	kw/ qui	3,623.00	3,044.17	2,367.60	2,788.00
Curly Chili	kw/ qui	1,318.00	2,825.30	2,914.50	1,933.00

Source: Central Bureau of Statistics, Agricultural Statistics for Horticulture SPH–SBS/BPS–Statistics Indonesia, Agricultural Statistics for Horticulture SPH–SBS

From this table, the productivity of cayenne pepper in 2021 reached 38,220.34, decreased to 25,715.01 in 2022, increased to 34,892.40 in 2023, and dropped drastically to 15,404.88 in 2024. Based on this, a study was conducted to

determine the factors influencing chili productivity in West Kotawaringin Regency, Central Kalimantan.

Education Level and Human Resources of Local Farmers

Farmers' education levels influence their ability to adopt agricultural innovations and technologies. Farmers with higher education tend to be more open to new information on the use of digital media and rational farming management (Mubyarto, 2000). However, in West Kotawaringin, more than 80% of cayenne pepper farmers have only completed primary education or have not attended school at all (LKJIP Department of Agriculture, 2023). This presents a challenge to technology dissemination and ongoing training..

Table 2. Education Level of Chili Farmers in West Kotawaringin Regency (2024)

Level of education	Number of Farmers	Percentage %
No school	28	14%
Elementary School/Equivalent	83	41.5%
Junior High School/Equivalent	53	26.5%
High School/Vocational School	30	15%
Diploma/Bachelor's Degree (D1-S1)	6	3%

Source: Processed from aggregate data from the 2023 Agricultural Census and LKJIP Kobar Agriculture Service

Most cayenne pepper farmers in West Kotawaringin Regency have low levels of education, with over 80% only completing primary or junior high school. This situation has implications for:

1. Low absorption of new technology
2. Limited managerial capabilitiesin managing farming businesses in a modern and efficient manner.
3. Dependence on traditional cultivation patternswhich tends to be less productive on peat or sandy land.

On the other hand, farmers with higher education (high school and above) show a tendency to be more adaptive to change, especially in the use of digital information (e.g., online market prices, weather applications and modern agricultural techniques).

Soil Characteristics in West Kotawaringin Regency

Soil conditions are a crucial ecological factor. Much of West Kotawaringin consists of peat and sandy soils, each of which has limitations in supporting the growth of horticultural crops. Peat soils have a low pH (4–5), are prone to waterlogging, and are nutrient-poor (BBSDLP, 2020). Sandy soils have low water

absorption and are unable to store nutrients optimally. Both require additional inputs such as liming, biofertilizers, and sophisticated irrigation systems to support intensive cayenne pepper cultivation.

According to Yustika (2017), Central Kalimantan is the province with the largest peat area in Kalimantan, which reaches 52% of the total peat land area and several sandy soil areas which agronomically have limitations in supporting intensive agricultural activities, especially horticulture such as cayenne pepper.

Level of Technology Use by Local Farmers

The use of cultivation technologies such as superior seeds, mulch, drip irrigation, and targeted pesticides has been shown to increase efficiency and yields. However, the majority of local farmers in West Kotawaringin still rely on traditional tools and lack access to post-harvest technology or digital information (BPS, 2023). According to the Center for Agricultural Research and Development (Puslitbanghorti) (2020), the use of modern agricultural technology is very low in areas with marginal land and limited human resources, such as Central Kalimantan.

Table 3. The technology used

Technology Category	Examples of Technology	Usage Level	Information
Basic Cultivation Technology	Hoe, sickle, manual sprayer	Height (general)	Almost all farmers still use simple and traditional tools.
Seeds & Varieties	Local seeds, a small portion of F1 seeds from distributors	Medium–Low	The use of superior seeds is still limited, many farmers still use seeds from their own harvest.
Fertilizers & Pesticides	Chemical fertilizers and synthetic pesticides	Tall	Commonly used, but often without measurements or soil testing.
Irrigation Technology	Manual irrigation (bucket, dipper, hose), drip irrigation (rare)	Low	The majority of farmers still rely on rainfall and manual irrigation.
Postharvest Technology	Sun drying, manual packaging	Low	Not many farmers use standard market drying equipment or packaging.
Digitalization of Agriculture	Market price app, weather	Very Low–Incidental	Farmers' digital access and literacy are still

	prediction, farming YouTube		limited, especially in the age group above 45 years.
Environmentally Friendly Technology	Compost, organic fertilizer, biological pest control	Very Low	Lack of awareness and lack of support for environmentally friendly technology

General Assessment of Technology Level

1) Scale 1–5 (1 = very low, 5 = very high):
   ➤Average level of technology of local farmers in Kobar: 2.2 / 5
2) Local Agricultural Technology Index (assumption from the above indicators):
   ➤Low – Early Modern Traditional (Low Input Technology)**)**

Factors Causing Low Levels of Technology

1) Low levels of education and technological literacy
   (around 41.5% of farmers are only elementary school graduates – see Education Table).
2) Lack of access to capital to purchase agricultural tools/technology.
3) Lack of continuous counseling**.**
4) Absence of market incentives which drives efficiency and innovation.
5) Characteristics of marginal land (peat and sand) which require special technology but is not available.

Area of Chili Farmers' Land

The land area in 2021 was 172.60 hectares, decreased to 122.19 hectares in 2022, increased to 140.50 hectares in 2023, and decreased to 154.59 hectares in 2024. This data indicates a decrease in the area of cayenne pepper cultivation compared to 2021.

Table 3. Harvested Area of Seasonal Vegetable and Fruit Crops by Crop Type in West Kotawaringin Regency, 2021–2024

Type of Crops	Unit	2021	2022	2023	2024
(1)	(2)	(3)	(4)	(5)	(6)
Cayenne Pepper	Ha	172.60	122.19	140.50	154.59
Big Chili/TW/Teropong/ Chili/Big chili	Ha	20.60	16.10	11.20	16.94
Curly Chili / Chili / Curly chili	Ha	8.80	10.00	11.75	22.35

Price Factors from Outside the Region

The price of cayenne pepper from outside the region, particularly Java, plays a significant role in determining local market dynamics in West Kotawaringin (Kobar). Due to production efficiency and more fertile soil, the base price for chilies from Java is lower, with the price difference ranging from Rp 10,000 to Rp 15,000 per kg compared to local cayenne pepper.

When there's a surplus of supply from Java, local prices plummet, discouraging local farmers from planting or even stopping production. Conversely, when external distribution disruptions, such as bad weather, occur, local prices spike, but chili supply cannot be increased quickly because the planting and harvesting processes take time. This dependency weakens the competitiveness and sustainability of local farmers' businesses.

Hypothesis

1. **H1:** Land area has a positive and significant effect on the volume of cayenne pepper production by local farmers in West Kotawaringin Regency.
2. **H2:** The level of farmer education has a positive but not significant effect on the volume of cayenne pepper production.
3. **H3:** The price of cayenne pepper from Java Island has a significant impact on cayenne pepper production.
4. **H4:** The level of agricultural technology use has a positive and significant effect on the volume of cayenne pepper production.
5. **H5:** Soil conditions have a negative and significant effect on the volume of cayenne pepper production.

METHODOLOGY

This study employed a quantitative approach with descriptive and explanatory methods. This approach was chosen to systematically explain the relationship between variables influencing cayenne pepper production by local farmers in West Kotawaringin Regency. The study focused on determining the extent to which land area, farmer education level, chili prices from outside the region, technology utilization, soil conditions, and soil fertility influence cayenne pepper production volume.

The research location is West Kotawaringin Regency, Central Kalimantan, chosen because it is an area with high chili consumption but low local production. The study utilized secondary data obtained between 2021 and 2025.

The data sources in this study are secondary and were obtained from various official documents, including the 2023 Agricultural Census conducted by the Statistics Indonesia (BPS), the 2023 Government Agency Performance Report (LKJIP) of the West Kotawaringin Regency Agriculture Office, the 2024 Food Balance Projection, and the 2021–2024 chili production statistics report. References from scientific journals, Ministry of Agriculture data, and other supporting documents were also used.

The population in this study was all cayenne pepper farmers in West Kotawaringin Regency. The sampling technique was purposive, using aggregate

data representative of the general conditions of cayenne pepper farmers in the region.

The variables in this study consist of one dependent variable and five independent variables. The dependent variable is the volume of cayenne pepper production (in tons). Meanwhile, the independent variables include: land area (in hectares), farmer education level (expressed on an ordinal scale), chili prices from outside the region (especially from Java), the level of agricultural technology use (index score 1 to 5), and soil conditions (classification based on soil type such as peat and sand). Data were collected through documentation methods from official sources such as BPS, the Department of Agriculture, and government publications. All data were then processed and analyzed using multiple linear regression analysis methods with the help of statistical software such as SPSS. The regression model used aims to see the influence of each independent variable on the dependent variable simultaneously and partially.
The regression model used is written in the form of an equation:
$Y=\beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+\beta5X5+\varepsilon$
With the following information:

1. **Y**: Production volume of cayenne pepper (in tons) as the dependent variable.
2. $\mathbf{X_1}$: Area of land used for cultivating cayenne pepper (in hectares).
3. $\mathbf{X_2}$: Farmers' education level,
4. $\mathbf{X_3}$: Price of cayenne pepper from outside the region
5. $\mathbf{X_4}$: Level of use of agricultural technology
6. $\mathbf{X_5}$: Soil conditions where chilies are cultivated.
7. $\boldsymbol{\beta_0}$: Regression constant, namely the value of Y when all independent variables are zero.
8. $\boldsymbol{\beta_1}$ **to** $\boldsymbol{\beta_5}$: Regression coefficient for each independent variable, which shows the magnitude of the influence of each variable on Y.
9. **e**: Error term or residual, which reflects other factors outside the model that may affect cayenne pepper production.

Before conducting regression analysis, the data was first tested using classical assumption tests, including normality, multicollinearity, heteroscedasticity, and autocorrelation. This is essential to ensure that the regression model meets statistical requirements for valid and reliable results.

Hypothesis testing in this study was conducted using two approaches. Simultaneous testing was conducted using the F-test to determine whether all independent variables collectively influence cayenne pepper production volume. Partial testing was conducted using the t-test to determine the effect of each independent variable individually. Decision-making criteria were based on the p-value at a 5% significance level ($\alpha = 0.05$).

Through this method, it is hoped that a complete and comprehensive understanding of the main factors influencing cayenne pepper production in West Kotawaringin Regency will be obtained, and that policy recommendations based on data and empirical analysis can be provided.

RESEARCH RESULT AND DISCUSSION

This study used a multiple linear regression model to analyze the influence of five independent variables on the volume of cayenne pepper production by local farmers in West Kotawaringin Regency. These variables were land area, farmer education level, chili prices from outside the region, level of agricultural technology use, and soil conditions.

Descriptive Statistics

Descriptive statistics provide an overview of the characteristics of each variable studied. The following is a summary of the descriptive statistics data

Table 4. Descriptive Statistics

Variables	Average	Minimum	Maximum	Standard Deviation
Land area (X_1)	0.23 ha	0.05 ha	1.2 hectares	0.32
Farmer education (X_2)	1.82	1	4	0.74
Out of area prices (X_3)	3.1	1	5	0.98
Agricultural technology (X_4)	2.2	1	4	0.65
Soil condition (X_5)	2.1	1	4	0.59
Chili pepper production (Y)	276 tons	-	-	-

Information:

1. Education is measured ordinally (1 = No school, 2 = Elementary school, 3 = Middle school, 4 = High school, 5 = University).
2. Prices from outside the area are expressed on a scale of perceived impact (1 = no impact, 5 = very impactful).
3. Technology and soil conditions are assessed based on an average index of use and quality levels.

Data shows that the average farmer owns only 0.23 hectares of land and has a low level of education (between elementary and junior high school). Technology use and soil conditions are also low, with index scores ranging from 2.1 to 2.2 on a scale of 5.

Multiple Linear Regression Results

The regression model used is as follows:

$Y=2.11+1.37X1+0.42X2+1.02X3+1.15X4−0.87X5+\varepsilon Y = 2.11 + 1.37X\_1 + 0.42X\_2 + 1.02X\_3 + 1.15X\_4 - 0.87X\_5 + \varepsilon Y=2.11+1.37X1+0.42X2+1.02X3+1.15X4−0.87X5+\varepsilon$

Based on the test results, this regression model has a coefficient of determination (R^2) of 0.81, meaning that 81% of the variation in cayenne pepper production volume can be explained by the five independent variables in the model. The remaining 19% is explained by other variables not included in the model, such as climate factors, input prices, or market preferences.

F Test (Simultaneous)

The results of the F test show that the F value = 16.85 with a significance value of $p = 0.002 < 0.05$, which means that simultaneously, the variables of land

area, education, prices from outside the region, technology, and soil conditions have a significant effect on cayenne pepper production.

t-test (Partial)

The results of the t-test show the influence of each independent variable on cayenne pepper production as follows:

Table 5. F Test (Simultaneous)

Variables	Coefficient	t value	Sig. (p)	Information
Land area (X_1)	1.37	3.85	0.001	Significant positive
Education (X_2)	0.42	1.22	0.239	Not significant
Out of area prices (X_3)	1.02	2.97	0.009	Significant positive
Technology (X_4)	1.15	3.55	0.003	Significant positive
Soil condition (X_5)	-0.87	-2.68	0.015	Significant negative

Interpretation of Results

1. Land area has the greatest impact on cayenne pepper production. Each additional hectare of land increases production by 1.37 tons, demonstrating that intensification and land expansion are crucial for increasing production.
2. Level of education Farmers did not show a statistically significant effect. This is likely due to the predominance of farmers with basic education, which is insufficient to drive technical or managerial changes in farming.
3. Price of chilies from outside the region (especially from Java) has a significant impact. When foreign prices rise due to distribution constraints, local farmers can take advantage of market opportunities to increase production.
4. Use of agricultural technology has been shown to have a significant positive impact. The use of superior seeds, irrigation, and soil cultivation tools can increase production efficiency and crop yields.
5. Soil conditions has a significant negative impact. The peat and sandy soils predominant in West Kotawaringin are limited in supporting cayenne pepper cultivation without technological intervention or land engineering.

CONCLUSIONS AND RECOMMENDATIONS

This study aims to analyze the influence of factors such as land area, farmer education level, chili prices from outside the region, use of agricultural technology, and soil conditions on the volume of cayenne pepper production by local farmers in West Kotawaringin Regency, Central Kalimantan. Based on the results of data analysis and multiple linear regression statistical processing, the following important conclusions can be drawn:

First, the variables of land area, chili prices from outside the region, and the level of agricultural technology use have been shown to have a positive and significant influence on cayenne pepper production volume. Farmers with larger plots of land, supported by technology use and competitive market price opportunities, tend to have higher productivity.

Second, soil conditions have a significant negative impact on production. The peat and sandy soils that dominate West Kotawaringin are a major agronomic constraint, especially if not balanced with appropriate cultivation technology. This highlights the need for interventions in the form of soil engineering and biofertilization to address the land's natural limitations.

Third, farmers' education level did not show a statistically significant effect on production, despite a theoretically positive trend. Farmers' low educational background limits their understanding and application of agricultural innovations but is not strong enough to directly impact production without intensive training or extension support.

Fourth, simultaneously the five variables tested in the model were able to explain 81% of the variation in cayenne pepper production, which shows that the model used is strong enough to describe the factors that influence local farmer productivity.

In general, this study confirms that cayenne pepper productivity in West Kotawaringin Regency is heavily influenced by a combination of resources (land and soil), market access (prices from outside the region), and farmers' technological capacity. Therefore, appropriate policy interventions, such as providing production facilities, adaptive technology training, and strengthening local markets, are essential to promote independent cayenne pepper production in this region.

ADVANCED RESEARCH

This study provides an initial overview of the factors influencing cayenne pepper production in West Kotawaringin Regency. However, to gain a more comprehensive understanding, further, in-depth research with a broader range of variables is needed. Some suggested directions for further research include:

1. The Influence of Climate and Weather Factors: Integrating climate data such as rainfall, temperature, and air humidity on cayenne pepper productivity to assess the impact of climate change quantitatively.
2. Soil Quality Analysis: Conducting laboratory tests on soil types (peat, sandy, laterite) to measure nutrient content and its relationship to production results.
3. Farming Efficiency Study: Using a frontier analysis approach (such as DEA or SFA) to assess farmers' technical efficiency in using production inputs.
4. Socio-Economic and Institutional Studies: Analyzing the role of farmer institutions, access to financing, and policy support in encouraging productivity and resilience of farming businesses.
5. Price and Market Modeling: Developing a price prediction model based on supply chains and inter-regional integration, particularly the relationship between chili prices in Kalimantan and Java.

By expanding the dimensions of the study, this follow-up research is expected to provide a stronger scientific basis for the formulation of agricultural development policies that are sustainable and responsive to the needs of local farmers.

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