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Determinants Of Cabbage Export Value From North Sumatra To Taiwan: Evidence From Time Series Data

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Abstract

This study investigates the determinants of cabbage export value from North Sumatra to Taiwan using time-series data from 2021 to 2023. Employing a quantitative approach with multiple linear regression analysis, the research utilizes secondary data sourced from the Central Bureau of Statistics (BPS) and the Indonesian Quarantine Information System (IQFAST). The analysis evaluates the influence of the independent variables examined, including exchange rate, export volume, and export price, while the dependent variable is total export value. Empirical results demonstrate that all three independent variables exert a positive and statistically significant impact on export performance. These findings highlight the critical role of macroeconomic stability and market dynamics in shaping agricultural trade. This research contributes to the literature on horticultural economics by providing regional empirical evidence and offering strategic policy insights to bolster Indonesia's export competitiveness.

Keywords: Export Value, Exchange Rate, Export Volume, Price, Time Series Analysis.

INTRODUCTION

Competitiveness in exports constitutes a significant determinant of a nation's performance within the global value chain. The efficacy of export performance is not solely contingent upon production capacity; it is also shaped by international trading regulations and global standards that exporting countries must adhere to (Otsuki et al., 2006; Karbalei et al., 2014).

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The volatility of export values is often driven by a heavy dependence on supply-side standards, which are susceptible to seasonal fluctuations and climatic shifts. Beyond environmental factors, global market dynamics—characterized by economic instability, evolving trade policies, and shifting demand in importing nations—further complicate export performance (Handley & Limão, 2017; Rustina et al., 2023; Da Silva et al., 2023). In light of these challenges, developing a robust predictive model that incorporates diverse influencing factors is essential to ensure sustainable export growth, particularly for strategic commodities such as North Sumatran cabbage.

North Sumatra is a primary hub for horticultural production in Indonesia, with cabbage emerging as a leading contributor among 147 agricultural export products (Pinem et al., 2022; Hasibuan et al., 2023). Aside from its socio-economic significance to the local community, North Sumatran cabbage has maintained strong demand in international markets, most notably Taiwan. Data from the Central Bureau of Statistics (BPS) indicates that Indonesia's average cabbage exports reached approximately 4,500 tons per year during the 2013–2017 period. Furthermore, between 2018 and 2020, production volume and export value exhibited a fluctuating yet generally upward trend. This growth trajectory is reflected in records from both BPS and the Indonesian Quarantine Information System (IQFAST), with a notable increase observed in 2019 and 2020 compared to 2018 levels, as detailed in Table 1 below

Table 1. Cabbage Exports from North Sumatra Province 2016 – 2020

No	Information	Year				
				2018	2019	2020
	Volume (Tons)			29.970.361,15	31.946.919,00	42.753.419,33
	Value of Goods (Rp)			97.023.649.920,98	98.757.823.743,14	124.599.898.513,00

Source: BPS North Sumatra Province and IQFAST, 2020

Previous studies by Komalasari (2009) and Reza & Hermawan (2024) emphasize that export volume is inherently driven by production capacity; an increase in domestic production typically facilitates a higher volume of exports. Furthermore, the exchange rate serves as a pivotal determinant of export performance (Soekartawi, 2005; Karbalei et al., 2014). From a macroeconomic perspective, currency fluctuations play a crucial role in correcting trade deficits. A depreciation of the Rupiah against the US Dollar generally enhances export competitiveness by making Indonesian commodities more affordable in

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the global market, thereby stimulating export volume. Conversely, an appreciation of the Rupiah may lead to a decline in exports as domestic products become relatively more expensive for international buyers (Bahmani-Oskooee & Kara, 2005; Thorbecke, 2011; Reza & Hermawan, 2024).

In addition to currency dynamics, export volume is closely linked to international price disparities. As noted by Soekartawi (2005), Pinem et al. (2022), and Hasibuan et al. (2023), when global market prices exceed domestic prices, producers are incentivized to increase the quantity of goods allocated for export. Given that high export values significantly bolster the Indonesian economy, understanding the regional export development in North Sumatra is essential for driving broader economic progress.

This research addresses the existing literature gap regarding commodity-specific trade by focusing on North Sumatran cabbage exports to Taiwan. Utilizing time-series data from the Indonesian Quarantine Agency (Barantin) and the Central Bureau of Statistics (BPS), this study investigates how exchange rate fluctuations and price dynamics influence export value. By bridging the gap between aggregate economic theories and micro-level empirical evidence, this study provides practical insights for horticultural trade policy. Consequently, the primary objective of this research is to evaluate the impact of the Rupiah-USD exchange rate, export volume, and export price as critical determinants of cabbage export performance from North Sumatra to Taiwan

LITERATURE REVIEW

International Trade Theory

International trade involves the cross-border exchange of goods and services, facilitated by bilateral, regional, or multilateral agreements ratified under global organizational frameworks. At its core, international trade stems from the demand of economic agents (individuals, corporations, and governments) to engage in the procurement and sale of products manufactured in foreign markets. The decision making process regarding product selection and definition is fundamentally shaped by global availability and competitive pricing strategies (Bahmani-Oskooee & Kara, 2005; Karbalei et al., 2014).

In the context of the global economy, international trade theory and policy serve as vital extensions of microeconomic analysis, particularly concerning the behavior of individual nations as distinct economic units and the determination of relative commodity prices. In contrast, the study of the balance of payments, which tracks total national receipts and expenditures, highlights the macroeconomic dimensions of international

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economics. This perspective emphasizes how temporary policy adjustments can influence national income levels and overall price indices (Salvatore, 1997; Karbalei et al., 2014; Suryanto & Kusniati, 2022)

Exporting is defined as the commercial activity of selling or delivering goods, services, or capital from a domestic customs territory to a foreign jurisdiction, regardless of whether a formal agreement is in place. These activities are conducted by individuals, legal entities, or sovereign states in compliance with prevailing statutory regulations. Fundamentally, an export system involves the outward flow of domestic commodities to international markets while adhering to established trade protocols (Indriani & Purwito, 2018; Utami et al., 2018).

Theoretically, the export of goods is governed by the principles of supply and demand within the global trade framework. From the demand perspective, export performance is influenced by international export prices, currency exchange rates, global income levels, and devaluation policies. Conversely, from the supply side, exports are shaped by domestic price levels, real exchange rates, production capacity (often driven by investment) input material standards, and deregulation initiatives (Krugman & Obstfeld, 2000).

According to Amir (2004), exports serve as a primary catalyst for economic activity by stimulating foreign consumption of domestic products. Direct export transactions contribute significantly to the economic growth of participating nations, positioning the export sector as a vital pillar of national development. Consequently, promoting export growth is essential for countries seeking to enhance their per capita income and overall economic prosperity

Regulatory Framework and Procedures for Cabbage Exports

All vegetable commodities destined for international markets must undergo mandatory quarantine procedures to ensure compliance with biosecurity standards. In Indonesia, these activities are regulated by the Indonesian Quarantine Agency (Barantin), specifically governed by Decrees No. 2471/Kpts/KR.020/K/11/2018 and No. 2523/Kpts/KR.020/K/11/2018.

Export Documentation Requirements, to facilitate the export of cabbage, the following documentation must be fulfilled:

- Phytosanitary Certificate (PC): An official document issued by the Indonesian Quarantine Agency certifying that the shipment meets the plant health requirements of the destination country.

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- Export Permits: Regulatory licenses required for the legal outflow of goods.
- Fumigation Certification: Specific certificates as requested by the importing country's authorities.
- Logistics and Administrative Documents: Including the Cargo Manifest, Bill of Lading (B/L) or Air Waybill (AWB), and Commercial Invoice.

The procedural flow for agricultural quarantine inspection during export is conducted through the following stages:

Standardized Export Quarantine Procedures

a. Reporting and Application: Electronic Declaration System. The service user (commodity owner or authorized agent) submits an export declaration to the Regional Quarantine Office via the Electronic Phytosanitary Certification System.
b. Administrative Audit: Verification Phase Quarantine officials conduct an administrative review to verify the completeness and validity of the submitted documentation. Incomplete applications are returned to the owner for rectification.
c. Physical and Health Inspection: Identity Verification Upon successful administrative verification, officials perform physical identity checks and laboratory health examinations to ensure the commodity is free from Regulated Quarantine Pests.
d. Treatment and Mitigation: Pest Management. If Regulated Pests are detected, the commodity undergoes specific phytosanitary treatments (such as fumigation or heat treatment). If the treatment successfully eliminates the biosecurity risk, the process continues; otherwise, an Official Rejection Notice is issued.
e. Payment and Certification: Final Release. Following a successful inspection, the owner fulfills the Mandatory Statutory Fees (Non-Tax Revenue). The Quarantine Agency then issues the final Phytosanitary Certificate or relevant health certificates required for international dispatch.

Note on Compliance:

The issuance of the Phytosanitary Certificate is the final prerequisite for the legal release of commodities, ensuring that the exported cabbage aligns with both domestic regulations and International Standards for Phytosanitary Measures (ISPM).

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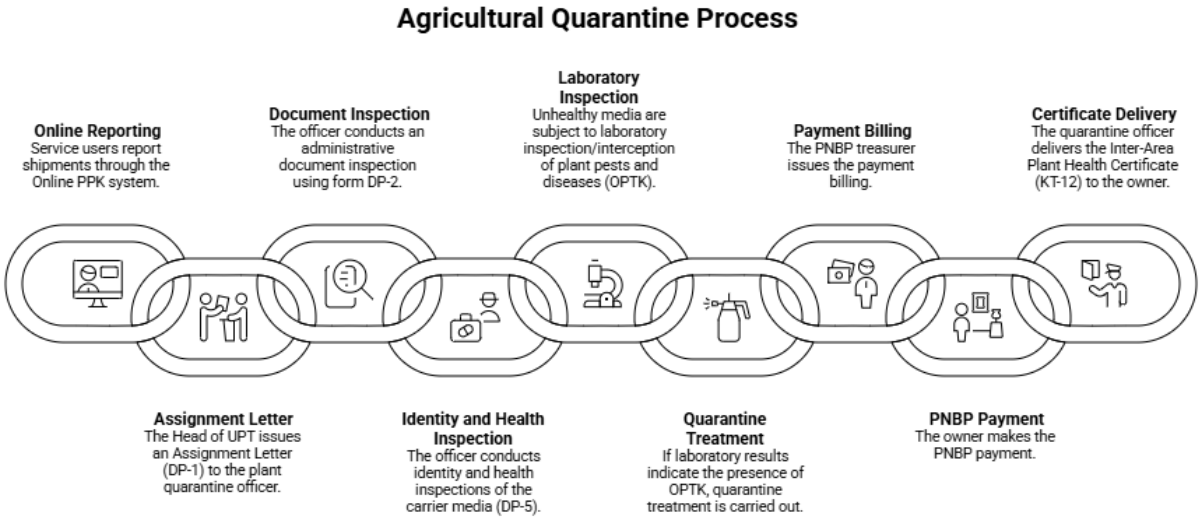


Figure 1. Quarantine Service Requirements and Procedures Agriculture in Inter-Area Expenditure and Exports (Illustration by author,2026)

Operational Variables

Exchange Rate Theory

Fluctuations in the exchange rate significantly impact the domestic pricing of goods and services, dictating the pace of currency appreciation or depreciation. Fundamentally, the exchange rate is determined by the equilibrium between the supply and demand of a specific currency (Mankiw, 2021). It represents the agreed price at which two nations conduct international trade (Bulut & Yasar, 2023). Rose et al. (2000) and Salvatore (2014) conceptualize the exchange rate as a comparative metric between the prices of exported commodities and imported raw materials. This relative value serves as a reciprocal trade indicator, reflecting the economic positioning of one country against its global trading partners.

Domestic and International Prices

Price is a critical determinant of consumer demand; according to the law of demand, higher prices typically result in a decrease in the quantity demanded (Faini, 1994). Economically, price is defined as the monetary value required to acquire a product

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or service, which must align with the perceived utility of that offering (Kristanto, 2011). In a strategic context, price fulfills three primary functions: regulating sales volume, determining profit margins, and shaping product branding. Gilarso (2004) further explains the inverse relationship between price and quantity; an increase in price leads to a contraction in purchase volume, and vice versa. Price shifts are generally driven by the macroeconomic conditions of exporting nations and broader international market trends, both of which directly influence export performance (Deaton & Laroque, 1992; Krugman, 1999).

World Price and Export Dynamics

The international price (world price) represents the prevailing market value for a commodity globally. When the world price exceeds the domestic price, a nation is incentivized to become an exporter, as producers seek higher profit margins in international markets. Conversely, if the domestic price is higher than the world price, the nation tends to become an importer, as consumers favor cheaper foreign alternatives (Salvatore, 1997). This equilibrium in international trade is formed through a continuous process of aligning global supply and demand (Sugiharti et al., 2019; Firmansyah et al., 2017).

The relative price (the ratio between world and domestic prices) serves as a primary driver of trade orientation. A higher relative price (where international prices outperform domestic ones) has a positive correlation with export volume; the greater the price disparity in favor of the global market, the larger the incentive for domestic producers to export (Feenstra, 2015; Mankiw, 2021).

Export Volume

Export volume serves as a critical determinant that positively and significantly influences the total export value of North Sumatran cabbage. Empirical research utilizing multiple linear regression analysis for the 2016–2020 period demonstrates that higher export volumes directly correlate with an increase in total export value, driven by the accumulation of commodity wealth sent to destination countries (Mejaya et al., 2016; Pinem et al., 2022).

A substantial export volume facilitates greater foreign exchange earnings, particularly when supported by stable prices and robust international demand. Conversely, studies have identified that declining land availability, post-harvest constraints, and limited value-added processing have contributed to a year-on-year

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decrease in cabbage exports (Kusuma & Firdaus, 2015; Arsanti et al., 2017). Consequently, augmenting export volume requires a strategic focus on supply chain strengthening, agricultural technology adoption, and export facilitation to ensure quality and continuity of supply. Enhancing export volume not only raises the economic value of the sector but also bolsters the global competitiveness of North Sumatran cabbage (Bukit, 2013; Novita et al., 2022).

RESEARCH METHODS

Data collection was carried out with method observing/observing company data that is carried out export cabbage that does registration to the Quarantine Office. The population used in the study. This is all export data of cabbage from North Sumatra to Taiwan using time series data in the range of 2021–2023. The total data is 36 months. The data used is quantitative data secondary from government agencies related to the study, such as the Department of Agriculture, Food Crops and Horticulture, and the data obtained from the Central Statistics Agency (BPS) and the System Information Quarantine (IQFAST)

Data used is the value of export cabbage as variables bound/dependent, whereas variables free/independent consist of the value of Rupiah-USD exchange rate (ER), export volume cabbage (VOL), and price export cabbage (PRC). From the variables free the will see how big its influence on the value of export cabbage (EX). The export value of cabbage to Taiwan is the total value of export commodities exported from North Sumatra to Taiwan and declared in Rupiah units. The value of the Rupiah-USD exchange rate, namely the average nominal exchange rate of Rupiah against the United States Dollar, is stated every month in Rp/US$ units. Export volume of cabbage is the total export volume of cabbage from North Sumatra to Taiwan and is declared in kilogram units. The export price of cabbage is results distribution between the value of the export price of cabbage and the export volume of cabbage from North Sumatra to Taiwan every month, and stated in Rupiah/Kg.

The analysis method used is multiple linear regression. The equation model used is as follows:

$$EX = \alpha + \beta_1 ER + \beta_2 VOL + \beta_3 PRC + \varepsilon$$

Information :

EX = Export value of cabbage (Rp)

α = Coefficient intercept

$\beta_1 - \beta_3$ = Coefficient variables regression

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ER = Rupiah-USD exchange rate(Rp/US$)
VOL = Export volume of cabbage (Kg)
PRC = Export price cabbage (Rp/Kg)
ε = Error term
As for the hypothesis in the research, this is :

1. Rupiah-USD exchange rate, export volume, and export prices have a partial positive and significant to export value of vegetable cabbage from North Sumatra to Taiwan.
2. Rupiah-USD exchange rate, export volume, and export prices simultaneously influence significant to export value of vegetable cabbage from North Sumatra to Taiwan.

RESULTS AND DISCUSSION

Analysis Descriptive

Descriptive analysis was conducted to evaluate the trends and distribution of the variables examined in this study. The independent variables include the Rupiah-USD exchange rate (ER), export volume of cabbage (VOL), and the price export cabbage (PRC). The dependent variable in the study is the value of export of cabbage in North Sumatra (EX) during the period 2021 to 2023, as shown in Table 2 below:

Table 2. Descriptive Statistical Analysis of Each Variable

Descriptive Statistics			
	Mean	Standard Deviation	N
Export Value of Cabbage (EX)	5185517251,89	3784838495,620	36
Rupiah-USD Exchange Rate(ER)	14826,81	511,525	36
Export Volume of Cabbage(VOL)	1507596,75	996990,217	36
Export Price of Cabbage (PRC)	3309,25	527,913	36

Source: Secondary data from BPS and IQFAST (processed), 2024

Based on the statistical processing results shown in Table 2, all variables, which are the Rupiah-USD exchange rate (ER), export volume (VOL), and export price (PRC), exhibit mean values significantly higher than their respective standard deviations. This indicates a relatively low level of data dispersion, suggesting that the data points are clustered closely around the mean. Such a distribution implies that the observations are

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consistent and minimizes the potential for extreme outliers or significant bias during the subsequent econometric analysis.

Assumption Test Results Classic

Before done analysis influence value Rupiah-US Dollar exchange rate (ER), volume of cabbage (VOL), price of cabbage (PRC), against value of export cabbage (EX) first formerly assumption testing was carried out classic or normal known with Best Linear Unbiased Estimate (BLUE) is data that is normally distributed (normality test), not occurrence heteroscedasticity, no occurrence multicollinearity, and no occurrence autocorrelation so that known that no there is disturbances in the regression model that will used and fulfilled requirements on analysis multiple linear regression based on ordinary least squares (OLS).

Analysis Multiple Linear Regression

Analyze multiple linear regression to determine the influence of three independent variables, that is, the value of the Rupiah-USD exchange rate (ER), export volume of cabbage (VOL), and price export of cabbage (PRC), against the value of export of North Sumatra cabbage to Taiwan, can be seen as follows:

Table 3. Analysis Results, Multiple Linear Regression

Coefficients [a]								
Model	Unstandardized Coefficients		Standardized Coefficients		Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-15262611153.897	5073277259.944		-3,008	005		
Rupiah-USD Exchange Rate (ER)	844251.025	382129.243	.114	2,209	034	.639	1,565
Volume Export of Cabbage (VOL)	3528.186	169,856	.929	20,772	000	.851	1,174
Price Export of Cabbage (PRC)	789151.675	384619.332	.110	2,052	048	.592	1,688

a. Dependent Variable: Export Value of North Sumatran Cabbage (Y)

Source: Secondary data from BPS and IQFAST (processed), 2024

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

EX = -15.262.611.153,897+ 844.251,025 ER + 3.528,186 VOL +789.151,675 PRC + e

In this study, all independent variables have positive coefficients. A positive coefficient indicates that the independent variables are positively correlated with the value of North Sumatran cabbage exports to Taiwan.

From the equation on can explain as follows :

Constant Value

Constant of -15.262.611.153,897 indicates that if all independent variables, namely ER, VOL, and PRC, do not change or are zero, then the export value decreases by -15.262.611.153,897. The negative constant value is not a problem as long as the independent variable is not equal to 0, because it is impossible to do so; what needs to be considered is finding the lowest value of ER, VOL, and PRC. In the regression equation, it can be seen that Rupiah-USD exchange rate (ER), cabbage export volume (VOL), and cabbage export price (PRC) are not equal to zero, so the negative value of the export value in the regression equation is not considered. This means that if ER, VOL, and PRC are zero, it will affect the export value by -15.262.611.153,897.

Influence The Rupiah-USD Exchange Rate Against The Value of Exporting North Sumatra Cabbage to Taiwan

Variables of Rupiah-USD exchange rate (ER) have a positive coefficient in the regression, with a positive with assumptions other variables are constant, meaning every increase in the Rupiah-USD exchange rate of 1 unit will increase the value of export of vegetables such as cabbage, by 844.251,025 units and vice versa. The results of the t-test on the variable of the Rupiah-USD exchange rate (ER) show a significance 0,034 < 0,05 and t count > t table (2,209 > 2,037), so that the value of the Rupiah-USD exchange rate has a significant value compared to the export of North Sumatra cabbage. This result, in accordance with the theory of Sukirno (2013), stated that the strengthening of the US Dollar and the weakening of the Rupiah can increase the value of exports. Ibrahim (2018) also mentioned that value swap is important in exports. When the Rupiah weakens against the US Dollar, the price of domestic commodities domestic become more cheap for importers, so that exports increase, while the Rupiah tends to strengthen lower exports. This result is also in line with the study by Hasibuan et al (2023) stated that the

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value of the Rupiah-USD exchange rate has a significant to value of export of North Sumatra cabbage to Taiwan

Influence Cabbage Export Volume Against The Value of Export of North Sumatra Cabbage to Taiwan

The cabbage export volume variable (VOL) has a regression coefficient with a positive direction of 3.538,186. Assuming other independent variables are constant, every increase in export volume by 1 unit will increase the value of cabbage exports by 3.538,186 units and vice versa. The results of the t-test on the export volume variable cabbage (VOL) show a significance value 0,000 < 0,05 and t count > t table (20,772 > 2,037), so H_0 is rejected, and H_1 is accepted. This shows that the export volume of cabbage is positively influential and significant to the value of the export of cabbage from North Sumatra. This result is in line with the study by Mejaya et al. (2016) and Hasibuan et al. (2023), who stated that the export volume is an influential real value and price of export commodities.

Influence The Export Price of Cabbage Against The Value of The Export Price of North Sumatra Cabbage to Taiwan

The export price variable (PRC) has a regression coefficient with a positive direction of 789.151,675. Assuming other independent variables are constant, every increase in export price by 1 unit will increase the value of cabbage exports by 789.151,675 units and vice versa. The results of the t-test on the variable price export cabbage (PRC) show a significance value 0,048 < 0,05 and t count > t table (2,052 > 2,037), so H_0 is rejected, and H_1 is accepted. This is proof that the price export cabbage influential positive and significant to value of the export of North Sumatra cabbage. This result is in line with the study by Pinem et al. (2022), Syafiruddin (2013), and Kusuma and Firdaus (2015), consistent with Ibrahim (2018), and elevated export prices drive growth in both volume and total value. This dynamic fosters broader market access and strengthens the profitability of international trade operations.

Rupiah-USD Exchange Rate, Price, and Volume Serve As Simultaneous Determinants of North Sumatra's Cabbage Export Value to Taiwan

Based on the table above, the results of the simultaneous test calculation show that the calculated F value is 163,999. Meanwhile, seen from the significance level of 0,000, which is smaller than 0,05, it can be concluded that the value of the Rupiah-USD

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exchange rate, export volume, and price export cabbage in a way simultaneous influential significant to value of export of North Sumatra cabbage to Taiwan. In addition, the external factors, like non-tariff and regulatory barriers internationally, also influence the performance of Indonesian exports.

CONCLUSION

The Rupiah-USD exchange rate, export volume, and export price, both partially and simultaneously, exert a positive and significant influence on the export value of cabbage from North Sumatra to Taiwan for the 2021–2023 period. Among these three variables, export volume emerged as the most dominant factor influencing the export value. These results underscore the critical importance of maintaining macroeconomic stability, optimizing agricultural technology to sustain supply volume, and complying with international quarantine regulatory standards to enhance the global competitiveness of Indonesian horticulture..

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