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WHEN PRICES BEAT PRODUCTION: THE DYNAMICS OF INDONESIA'S PLANTATION COMMODITY EXPORTS

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Abstract

Plantation commodities are a strategic sector that contributes significantly to foreign exchange earnings and the stability of Indonesia's trade balance. This study aims to analyze the influence of commodity prices, total production, and land area on the export value of seven Indonesian plantation commodities, namely CPO, cocoa, coffee, rubber, tobacco, coconut, and tea in the 2015–2023 period. This study uses secondary data from BPS and UNCTAD and uses a panel data regression approach with the Fixed Effects Model (FEM) as the selected model based on the results of the Chow Test and the Hausman Test. The estimation results show that commodity prices and plantation land area have a positive and significant effect on export value, indicating that increases in international prices and land capacity expansion are the main determinants of long-term export growth. In contrast, total production does not show a significant effect, which is explained by the dominance of the price effect over the quantity effect amid global price volatility. These findings emphasize the importance of commodity downstreaming policies and sustainable plantation land management to strengthen the export performance of the Indonesian plantation sector.

Keywords: Export Value, Total Production, Land Area, Plantation Commodities, Fixed Effect Models

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INTRODUCTION

Trade is a key driver of Indonesia's economic growth. Indonesia is known as one of the world's largest producers and exporters of plantation commodities. This sector plays a significant role in the national economy, particularly through the contribution of four leading commodities: Crude Palm Oil (CPO), cocoa, coffee, and rubber. These commodities not only provide a primary source of income for millions of rural farmers but also contribute substantially to the country's foreign exchange earnings, maintain a stable trade balance, and drive the growth of downstream industries. (Darmanto et al., 2021; Maulana et al., 2023).The strong and stable export performance of these commodities directly impacts the stability of the trade balance and the country's macroeconomic resilience. Therefore, the sustainability and competitiveness of plantation sector exports are a top priority in the national economic development agenda.

These four commodities are strategic plantation commodities and highly sensitive to external and environmental factors. CPO is a key focus because Indonesia is one of the world's largest producers. (Dermoredjo et al., 2025).Changes in temperature, rainfall, and climate pressures can impact the productivity and export patterns of these commodities. (Wulandari et al., 2025). Furthermore, these commodities are leading exports, dominating the majority of Indonesia's plantation sector export value and are highly competitive in the international market.

Coffee and cocoa were also chosen because they are highly sensitive to climate change (Ge et al., 2025). Although their contribution to exports is smaller than CPO, they have historically remained an important part of the plantation export structure due to stable global demand. (Nisa et al., 2023).Rubber was also chosen because it is a plantation commodity that plays a significant role in the economy of a major tropical export-producing country in Indonesia. Other research on rubber complements this study because this commodity is connected to global manufacturing production and is also affected by changes in the environment and international markets. Studies from Srisawasdi and Cortes (2024)state that global trade volatility and instability of rubber exports are caused by changes in climate and land productivity.

The export performance of Indonesia's four plantation commodities during the period 2015 to 2023 is faced with a high level of global volatility and is multidimensional. Empirical evidence shows that export volumes tend to fluctuate between years influenced by various policies and market conditions both domestically and globally (Kusuma et al., 2023).Export volatility is also further exacerbated by a series of significant external shocks. During this research

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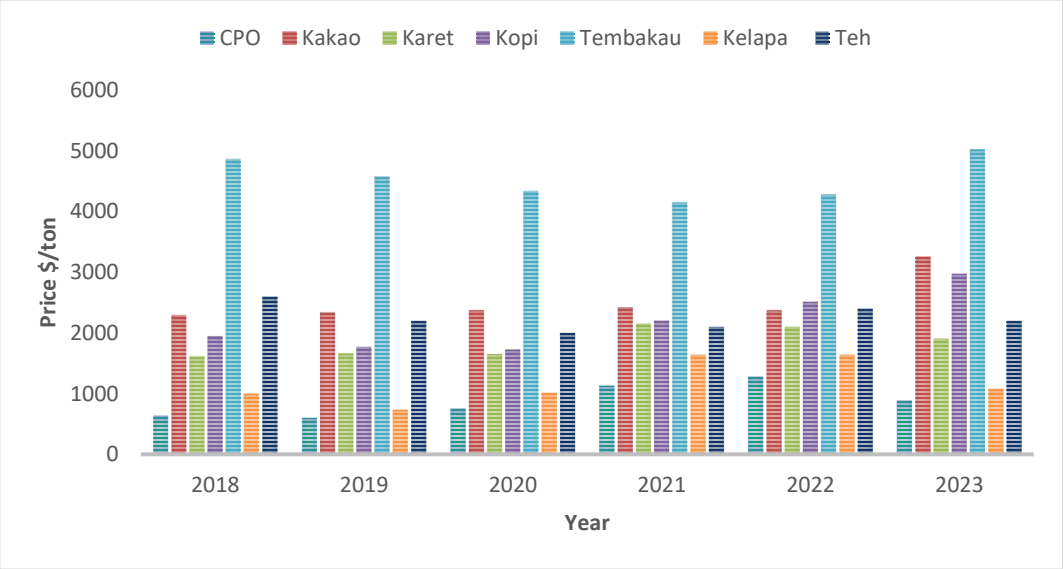
period, a major shock occurred, namely the Covid -19 pandemic, which caused disruption to logistics and supply chains. Lockdown policies implemented by various countries also worsened the state of international trade (Kusuma et al., 2023). In addition, this situation was also exacerbated by the presence of a global energy and food crisis after the Russia-Ukraine war conflict which further pushed up fluctuations in plantation commodity prices (Fang & Shao, 2022;Urak et al., 2024).

Image 1
Commodity Price Fluctuation Graph 2020-2023.



Source: UNCTAD

In Image 1, cocoa prices tended to be stable despite being hit by the Covid -19 crisis. Olarte-Libreros et al. (2025)They stated that cocoa prices tended to be more stable because global supply was better maintained compared to the pre-pandemic period. This condition suggests that cocoa prices were less prone to sharp declines despite global economic disruptions. Chart 1 also illustrates the decline in coffee prices from 2018 to 2020. This occurred due to excess supply Coffee commodities. Massive production in Brazil has resulted in a global oversupply and driven down prices. The International Coffee Organization (ICO) also notes that increased global production has put downward pressure on global market prices. This decline was further exacerbated by the presence of Covid-19 in 2019-2020. The . Vo et al. (2024)report stated that the decline in coffee exports in Vietnam was due to the Covid- 19 pandemic, which disrupted the supply chain, coffee demand, and employment.

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After experiencing a decline in the 2019–2020 period, coffee commodity prices began to show a gradual recovery in 2021–2023. This increase was influenced by the recovery of global coffee demand along with the improvement in economic activity after the Covid-19 pandemic, especially with the resumption of operations of the hotel, restaurant, and cafe sectors. In addition, a report from the Food and Agriculture Organization of the United States (FAO) stated that production disruptions in major producing countries such as Brazil due to extreme weather conditions also reduced global coffee supply, thus driving up prices in the international market. The combination of increased demand and limited supply caused coffee prices to increase again during that period (Aduteye et al., 2023; Massrie, 2025). In addition, the volatility of other commodities such as CPO tended to be at a stable level despite being under global uncertainty. (Jeong et al., 2023).However, this was different from rubber, which fluctuated in 2015–2023 due to other external influences such as climate, global uncertainty, and other production factor issues (Ghosh & Paparas, 2023).

Tobacco and tea commodities experienced similar fluctuation patterns between 2018 and 2023. The decline in tobacco and tea prices between 2018 and 2021 was due to the Covid-19 pandemic. (Shiferaw, 2023).Studies Qin and Zhou (2024)show that the global tea industry is experiencing an imbalance between production and consumption, with production increasing faster than demand, thus depressing prices in the international market. In addition to Covid-19, increases in tobacco taxes/excise significantly reduced cigarette consumption, thereby suppressing demand for tobacco raw materials and impacting prices at the farm level (Wardani & Khoirunurrofik, 2022). Tobacco prices are heavily influenced by weather changes and market uncertainty, leading to price fluctuations in the market.(Nargis et al., 2021)

Coconut price fluctuations in the 2018–2023 period were influenced by several factors, such as climate change, production, and the dynamics of supply and demand in the global market. Studies Silva and Matsui (2026)show that changes in rainfall, drought, and other production disruptions cause supply instability, which directly impacts prices. Furthermore, increased global demand and substitution with other commodities, such as palm oil, have exacerbated coconut price volatility. During the Covid-19 pandemic (2019–2021), coconut prices increased due to disruptions in the global supply chain and weakened production capacity, while market demand remained high (Dilrukshi et al., 2022). This imbalance between contracted supply and relatively stable demand ultimately created inflationary pressure on coconut prices, both in the international and domestic markets.

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In addition to external factors, the volatility of Indonesian plantation commodity exports is also significantly influenced by internal dynamics, particularly variability caused by total production and planted area. Changes in land area and declining productivity per hectare trigger supply inconsistencies that directly increase fluctuations in export volume. Policy studies and landscape models Zhao et al. (2023)show that systemic replanting and yield improvement strategies can mitigate CPO supply volatility and lower medium-term export volatility. Literature on cocoa supply chains and processing confirms that limited processing capacity and production concentration in climate-vulnerable regions like Indonesia make cocoa export volumes highly sensitive to local supply shocks (Ge et al., 2025).

Empirical evidence shows that coffee production is concentrated in certain regions, making coffee supplies susceptible to disruptions during climate change. Consequently, production is vulnerable to shocks, which can fluctuate coffee prices and export volumes. (Valérie et al., 2024).Limitations in rubber plantation production and management make rubber exports vulnerable to short- and long-term fluctuations (Sitepu et al., 2016). Indonesia needs an integrated policy to identify and mitigate export volatility that goes beyond international market volatility. Attention to domestic supply stability through improved land management and strengthening downstream facilities will also help reduce the volatility of plantation commodity exports (Sugiharti et al., 2020).

Based on the background review above, this study aims to analyze the determinants of Indonesian plantation commodity exports, particularly crude palm oil (CPO), coffee, cocoa, and rubber, during the 2015-2023 period amidst global volatility. This study aims to fill a gap in the literature by providing comprehensive empirical evidence regarding the dynamics of plantation commodity exports in Indonesia.

LITERATURE REVIEW

Research conducted by Amoro and Shen (2012)shows that commodity production and prices have a positive influence on cocoa and rubber export volumes in Côte d'Ivoire, while domestic consumption negatively affects exports because increased domestic demand can reduce the production surplus for the international market. These research findings are supported by findings Feni and Efendi (2019) analyzing Indonesian cocoa bean exports using the Ordinary Least Squares (OLS) method. The study found that domestic prices have a significant

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positive influence on cocoa exports, thus indicating that price factors are an important determinant in increasing agricultural commodity exports.

Furthermore, Adelina et al. (2020)a gravity model with panel data was used to analyze Indonesian cocoa exports to trading partner countries. The results showed that domestic production capacity positively impacted cocoa exports, while economic distance negatively impacted trade. These findings align with research Nisa and Antriyandarti (2023)using a panel gravity model to analyze Indonesian cocoa exports to several major destination countries. The study found that domestic production and the economic size of destination countries positively impacted Indonesian cocoa exports.

The study Putri and Hasmarini (2025)used a multiple linear regression (OLS) approach with time series data to analyze the influence of macroeconomic factors such as exchange rates, interest rates, and international prices of plantation commodities (coffee, cocoa, and rubber) on Indonesia's export value. The results showed that the exchange rate, coffee prices, and rubber prices had a significant positive effect on export value, while cocoa prices had no significant effect. Meanwhile, the study Solarin et al. (2025)used a fractional integration approach to analyze the long-term persistence of international prices of various agricultural commodities. The results showed that plantation commodity prices tend to exhibit persistence and mean reversion, and price volatility is influenced by various global factors such as exchange rates and international economic conditions.

Purbantoro et al. (2024) used panel data regression to analyze the influence of production factors on the export of plantation commodities such as coffee, cocoa, and palm oil in Indonesia. The results showed that plantation land area and commodity production had a positive effect on increasing export volume. These results align with research Ramdhani and Dewi (2024)that found that production and plantation land area also influence cocoa export volume in Indonesia, thus indicating that land area is a significant determinant in increasing plantation commodity exports.

Ismail et al. (2022)used the Autoregressive Distributed Lag (ARDL) method to analyze Malaysian CPO export demand using export price, partner country income, and exchange rate variables. The results showed that CPO prices and destination country income had a positive effect on CPO exports in the long run. Meanwhile, Oginni et al. (2024) the Nonlinear Autoregressive Distributed Lag (NARDL) approach was used to analyze the influence of price and production on cocoa exports in Nigeria. The results showed that world cocoa prices and production had a positive effect on cocoa exports.

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The difference between this study and previous studies lies in the object and combination of variables used. This study specifically analyzes four main Indonesian plantation commodities: cocoa, coffee, rubber, and crude palm oil (CPO) for the period 2015–2023, using price, land area, and total production as independent variables, and export volume as the dependent variable. Furthermore, this study emphasizes the influence of domestic production factors on the export performance of Indonesian plantation commodities, thus providing a more comprehensive picture of the determinants of plantation commodity exports in the most recent period.

RESEARCH METHOD

This research is a quantitative study with secondary data obtained through the Plantation Statistics Book released by the Central Statistics Agency (BPS) for 2015-2023 and using data from the UN Trade and Development (UNCTAD). The data used in this study is a combination of cross-section and time series data . In this study, the cross-section data are seven commodities with high export volumes, while the time series data are from 2015-2023. The econometric equations to estimate the average price of commodities, total production volume, and plantation area against export volume are as follows:

$$\text{VALUE}_{it} = \beta_0 + \beta_1 \text{LogPRICE}_{it} + \beta_2 \text{PROD}_{it} + \beta_3 \text{TOTALAREA}_{it} + \varepsilon_{it}$$

Where:

VALUE	:	Export Value (US$)
β_0	:	Constanta
$\beta_1, \beta_2, \beta_3$	:	Independent Variable Coefficient
PRICE	:	Commodity Prices (US$)
PROD	:	Total Productions (ton)
TOTALAREA	:	Plantation Land Area (hectares)
e	:	Error term

Panel data regression uses three estimation methods: Common Effects Model (CEM), Fixed Effects Model (FEM), and Random Effects Model (REM). The best model is selected using the Chow and Hausman tests. The best model will be used to estimate the effect of the independent variables on the dependent variable.

The model existence test or F test is conducted to determine whether the independent variables jointly influence the dependent variable. H0 in the $_F$ test states that $\beta 1 = \beta_2 = \beta_3 = 0$, which means that commodity prices, total production, and plantation area together have no effect on export value. H_0 rejected if the probability F -statistic < α.

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Then, a t-test is conducted to determine whether the individual independent variables significantly influence the dependent variable. H_0 states that $\beta i = 0$ (i = 1-3), which means the i-th independent variable has no effect on export value. H0 states that $\beta i > 0$, which means that commodity prices, total production, and plantation area each have a positive effect on export value. H_0 is rejected if the t-statistic probability is less than α.

RESULTS AND DISCUSSION

Estimated using three approaches: the Common Effects Model (CEM), the Fixed Effects Model (FEM), and the Random Effects Model (REM). The panel data estimation results are shown in Table 1.

Table 1
CEM, FEM, and REM Regression Results

Variables	Regression Coefficient		
	CEM	FEM	BRAKE
C	-12156676	-33753639	-23932345
LOG(PRICE)	1541743	3796127	2948469
PROD	0.433943	-0.521555	0.239019
TOTALAREA	-0.222254	3.499225	0.949531
R^2	0.942509	0.967753	0.857331
F-statistic prob	0.000000	0.000000	0.000000
1) Chow Test Cross-section F (6, 53) = 6.915150; Prob. F = 0.0000 2) Hausman test Random cross-section $\chi^2(3)$ = 19.113593; Prob χ^2= 0.0003			

Source: BPS; UNCTAD, processed

Based on the CEM, FEM, and REM regression results obtained, two tests are needed to determine which model best estimates panel data. First, a Chow test is conducted to determine the best model between CEM and FEM. Second, a Hausman test is conducted to determine the best model between REM and FEM.

In the Chow Test, decisions are made by looking at the F -statistic probability value. If the F -statistic probability < α , then H0 is rejected, which means FEM is the better model to use than CEM. Meanwhile, the provision in the Hausman Test is that if the probability $\chi^2 < \alpha$, then H0 is rejected, so FEM is a more appropriate model to use than REM.

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The results of the Chow Test and Hausman Test in Table 1 show that the probability of Cross-section F is 0.0000 < α (0.01) and the probability $\chi^2$is 0.0003 < α (0.01), so H $_0$ is rejected because both have probabilities less than α. Thus, FEM is a more appropriate model to use to estimate panel data.

Table 2
FEM Regression Results

$\text{VALUE}_{it} = -33753639 + 3796127\ \text{logPRICE}_{it} - 0{,}521555\text{PROD}_{it} +$ (0.0004)* (0.0532) $3{,}499225\text{TOTALAREA}_{it}$ (0.0015)*
R^2 = 0.967753; F-stat = 176.7299; Prob F-stat = 0.0000

Note: *significant coefficient at α 0.05

Table 2 shows that the probability value of the F -statistic is 0.0000 < α (0.01) so that H $_0$ is rejected, and it can be concluded that commodity prices, total production, **and** plantation land area jointly influence the export value. In addition, the coefficient of determination (R^2) of 0.967753 indicates that 96.77% of the change in export value is caused by changes in commodity prices, total production, and plantation area, while the remaining 3.23% is caused by changes in variables outside the model.

t -test was conducted to determine whether the independent variables partially or individually influenced the dependent variable. Based on Table 3, it can be concluded that commodity prices and total plantation area have a positive effect on export value. However, the total production variable was detected to have no effect on export value. A summary of the t -test results is summarized in Table 3.

Table 3
T -test results

Variables	Coefficient	Prob. t	Conclusion
LogPRICE	3796127	0.0004	$\beta_1$significant at α 0.05
PROD	-0.521555	0.0532	$\beta_2$insignificant
TOTALAREA	3.499225	0.0015	$\beta_3$significant at α 0.05

PRICE coefficient is 3796127 with a linear-log relationship pattern, which means a one percent increase in commodity prices will increase export value by 0.0379 million dollars or 37961.27 dollars. The TOTALAREA coefficient of 3.499 means an increase in plantation land area by one hectare will increase export value by 3.499 million dollars. The PROD variable is not significant at α 0.05; so

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it can be concluded that the increase in total production has no effect on export value.

Based on the regression results, it was found that commodity prices have a positive effect on the value of plantation commodity exports. This finding aligns with findings Putri & Hasmarini (2025) that price increases directly drive export value increases by increasing exporters' income and competitiveness in the global market. Furthermore, Solarin et al. (2025)research on the resilience of plantation commodity prices also found that international commodity price volatility directly impacts the export earnings of developing countries. It was also found that prices have a positive and significant effect on the value of exports by Ismail et al. (2022)and Oginni et al. (2024).

The export value of plantation commodities is a function of the product of price and volume, so that price increases in the world market directly drive an increase in export value even without significant changes in quantity. Theoretically, this mechanism works through the terms of trade (ToT) channel, where increases in export prices relative to import prices improve a country's trade position. In this context, Doojav et al. (2023) it is emphasized that for exporting countries, increases in commodity prices channel improvements in export revenues which in turn drive overall economic growth. Astari et al. (2025) emphasizes that agricultural commodities such as coffee, cocoa, palm oil, and rubber play a crucial role for the economies of developing countries, generating more than USD 50 billion per year in global trade. Thus, it can be concluded that the positive relationship between plantation commodity prices and export value is not merely a statistical phenomenon, but rather an economic transmission mechanism rooted in the accounting identity of international trade.

This study found that plantation land area has a significant positive effect on export value. This finding aligns with Purbantoro et al. (2024) the statement that land area has a positive effect on export value. This finding is also supported by Ramdhani and Dewi (2024) the statement found that the area of plantation land has a positive effect on the value of cocoa exports in Indonesia, thus indicating that land area is an important determinant in increasing plantation commodity exports.

The positive and significant influence of land area on the export value of Indonesian plantation commodities indicates that expansion of land capacity in the plantation sector is a key determinant of export performance. Plantation land area not only reflects the physical area planted but also signals long-term supply capacity, which is responded to by the international market (Roelfsema & Findlay, 2026). Furthermore, the commodities studied, such as palm oil, rubber,

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cocoa, and coffee, are perennial crops that require decades of investment. This makes the decision to expand land area a reflection of a commitment to providing supply certainty to exporters. Furthermore, land expansion allows producers to achieve a more efficient production scale, thereby increasing commodity price competitiveness in the export market and increasing export value (Wen & Chatalova, 2021).

The regression results showed that total production had no effect on export value, even though it is theoretically known that increased production leads to increased export value. This finding contradicts Amoro and Shen (2012)the findings that production has a positive effect on cocoa export value in Ivory Coast. Furthermore, the findings Adelina et al. (2020)also indicate that production capacity has a positive effect on export value. This difference from previous research indicates an unexplained empirical gap, thus providing added value and worthy of consideration in further research.

The estimation results showing a negative and insignificant impact of production on the value of Indonesian plantation commodity exports in the 2015–2023 period can be explained by the dominance of the price effect over the quantity effect. Conceptually, export value is a function of the product of price and volume, so that when the decline in international prices is deeper than the increase in production volume, the resulting export value actually decreases in aggregate. This phenomenon is known to have an empirical impact on Indonesia's main plantation commodities. The price of CPO fell from 751 dollars in 2017 to 639 dollars in 2018, which caused its export value to decline even though its volume increased.

Latifah and Novianti (2022) noted that Indonesia's rubber export volume reached 8.38 million tons in 2021, but its export value contracted from US$11.10 billion in 2013 to just US$7.86 billion in 2020, a condition in which volume expansion was not accompanied by an increase in foreign exchange earnings. A similar condition occurred for CPO, where Windirah and Novanda (2023)it found that 2018 was the lowest point in the last six years with a decline in CPO prices reaching 15%, triggered by a 14% increase in Indian import tariffs and the European Union's rejection of CPO as a biofuel, so that the simultaneous increase in production failed to boost export value. High production output not accompanied by increasing demand caused the value of Indonesian exports to stagnate. The large supply generated by Indonesian commodity products was not accompanied by an increase in world prices, so the value of exports did not increase in line with the increasing production (Suprianto et al., 2026).

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CONCLUSION

Fixed Effects Model (FEM) estimation with a coefficient of determination of 96.77%, this study empirically proves that commodity prices and plantation land area are determinants that have a positive and significant effect on the value of Indonesian plantation commodity exports in the 2015–2023 period. On the other hand, the total production variable does not show a significant effect on export value, which can be explained through the mechanism of price effect dominance over quantity effect; namely a condition where the pressure of decreasing international prices due to global volatility is able to offset or even eliminate the positive impact of increasing production volume on export value.

Based on this research, the recommended policy implications include strengthening the downstreaming strategy for plantation commodities to increase added value and bargaining power in international markets, as well as optimizing plantation land expansion governance, oriented toward productivity and environmental sustainability. Furthermore, innovation in processing these commodities is also needed to reduce reliance on export profits. Academically, further research is recommended to integrate macroeconomic variables such as the real exchange rate, trade tariff policies, and the climate change index as additional explanatory variables, so that the model can provide a more comprehensive estimate of the dynamics of Indonesian plantation commodity exports.

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