IJSSR
International Journal of Social Service and Research

Vol. 4, No. 10, October 2024
e-ISSN: 2807-8691 | *p*-ISSN: 2807-839X

ANALYZING THE IMPACT OF INDONESIAN SUSTAINABLE PALM OIL (ISPO) CERTIFICATION AND THE FACTORS THAT INFLUENCE CRUDE PALM OIL (CPO) EXPORTS VOLUME

Rizqa Siti Hajar, Byung-Wook Yun, Hwa-Seok Hwang
Kyungpook National University, South Korea
*e-mail: rizqash@gmail.com bwyun@knu.ac.kr hhs2129@knu.ac.kr

Keywords

Indonesian Sustainable Palm Oil (ISPO), Crude Palm Oil (CPO), Multiple Linear Regression (MLR) Analysis, Difference-in-Differences (DID) Analysis

ABSTRACT

This study examines the impact of Indonesian Sustainable Palm Oil (ISPO) certification on Indonesian Crude Palm Oil exports and other factors, such as commodity production and prices, exchange rates, and production levels. The data covers total CPO volume (HS codes 15111000 and 15119000) from January 2006 to December 2022, focusing on ISPO certification for large State-owned and Private Enterprises in palm oil cultivation and processing. The analysis employs the Difference-in-Differences (DID) method and multiple linear regression (MLR) to identify the linear relationship between the dependent and independent variables. The DID analysis revealed that Indonesian CPO production and global CPO prices significantly affected CPO export volumes, while soybean oil prices and effective exchange rates were not statistically significant in the regression model. The results provide valuable insights for policymakers and industry stakeholders in developing strategies that support sustainable growth, enhance competitiveness, and maintain Indonesia's leading position in the global palm oil market. Policymakers should focus on encouraging broader adoption of ISPO among palm oil producers through incentives, training, and technical support, especially for smaller producers.

INTRODUCTION

The plantation (a large-scale agricultural estate typically cultivating a specific crop, such as oil palm, for commercial purposes) subsector is crucial to Indonesia's agricultural landscape, contributing approximately 2.76% or IDR 206,721.4 billion to the GDP in 2022 (Statistics Indonesia (BPS), 2022) and employing over 6 million people, thus playing a key role in labor absorption, regional development, and government revenues. Palm oil is Indonesia's flagship plantation commodity, strategically prioritized for revitalization due to its significant impact on local income and strong domestic and international market prospects (Ministry of Industry, 2021). Since 2006, Indonesia has been the leading global exporter of palm oil, meeting a significant share of the world's vegetable oil demand. Major private players, such as Wilmar Group and Sinar Mas Group, dominate the sector, accounting for over 50% of the nation's palm oil production (Rifin, 2017).

In 2022, Indonesia exported around 24.99 million tons of palm oil, representing 59% of global exports and a 57% market share. Major importing countries include India, Italy, Malaysia, Kenya, the Netherlands, and Spain (International Trade Centre, 2014). Palm oil, extensively used in cooking and food products, constitutes approximately 85% of production due to its neutral taste, stability, and affordability, representing 35% of global consumption. The global market is projected to grow to 111 million tonnes by 2026 (U.S. Department of Agriculture (USDA) Foreign Agricultural Service, 2022).

However, increased demand has led to expanded palm oil plantations in Indonesia, raising concerns about long-term sustainability and ecological impacts such as deforestation, carbon emissions, and biodiversity loss. Critics argue that the industry's expansion threatens endangered species like orangutans (Anwar et al., 2016). Specifically, palm oil stands out as a crucial component, anticipating an average yearly expansion rate of 2.72% between 2018 and 2022 (Ministry of Agriculture, 2022).

Indonesia has faced significant pressure from the European Union (EU), which introduced the Renewable Energy Directive (RED) (a regulatory framework established by the European Union (EU) to promote renewable energy sources and reduce greenhouse gas emissions in the energy sector) to phase out palm oil-based biofuels due to environmental concerns. This policy negatively affected Indonesia's CPO exports to the EU, with a decline observed shortly after its implementation (Nasution & Wulansari, 2019). Additionally, multinational companies like Unilever have adopted the "Responsible Sourcing Policy" to reduce environmental impact (Kehati, 2023). Environmental advocates, including Greenpeace, have also actively protested against the palm oil industry (Greenpeace Indonesia, 2018).

The Indonesian Sustainable Palm Oil (ISPO) certification was created to improve transparency and accountability in the palm oil industry, responding to global concerns over environmental and social issues (Dauvergne, 2018). While most research has focused on voluntary schemes like the RSPO, ISPO, a mandatory initiative by the Indonesian government, requires all oil palm growers, mills, and smallholders to comply with sustainable practices as outlined in Law No. 39/2014 and Ministry of Agriculture Regulation No. 38/2020. The ISPO framework consists of seven principles, 56 criteria, and 141 indicators covering environmental management, social responsibility, and community empowerment (Indonesia Palm Oil, 2024). Its primary goals are to enforce Indonesian plantation standards, improve global competitiveness, and reduce greenhouse gas emissions (Presidential Regulation No. 44/2020).

To obtain ISPO certification, companies must follow procedures mandated by the Indonesian government, including securing permits and passing assessments (Mutu International, 2022). These companies must meet criteria in areas like land ownership, environmental compliance, and production practices, with regular evaluations conducted by accredited institutions. If successful, the ISPO certificate is issued for five years. Although meeting these bureaucratic requirements can be burdensome, companies benefit from improved operational efficiency, reduced risks like fires and accidents, and overall better management of plantations, which enhances the quality and productivity of crude palm oil (CPO) (Panjaitan, 2013; Rodhiah et al., 2019).

The implementation of ISPO certification offers direct benefits, such as improved CPO quality, better waste management, and emissions reduction, alongside indirect benefits like enhanced community relations and improved ties with the government and labor (Rodhiah et al., 2019). However, ISPO's financial advantages remain limited as ISPO-certified products are not yet labeled for sale, which restricts opportunities to market these products at higher prices internationally (David, 2022). While some research indicates a positive impact on palm oil exports to the EU, other studies suggest ISPO has not significantly increased CPO exports to markets like the Netherlands and Italy (Solihin et al., 2020). This highlights the need for further analysis of ISPO's global economic impact.

Despite its potential to improve Indonesia's palm oil competitiveness, ISPO faces several challenges in its implementation. Legal complexities, fragmented governance, and slow enforcement hinder progress, especially in protecting High Conservation Value (HCV) areas (Fahamsyah & Pramudya, 2018; Hidayat et al., 2018). Moreover, major markets like the EU, UK, and USA do not recognize ISPO as a credible sustainability standard, undermining its global competitiveness (Jong, 2016). These issues, combined with ongoing regulatory revisions (Presidential Regulation No. 44/2022), continue to affect ISPO's role in the global palm oil trade, making it crucial to explore its interaction with factors like global CPO prices, exchange rates, and substitutes such as soybean oil (Sukirno, 2011; Widyastutik & Ashiqin, 2011; Wulansari et al., 2016).

In response, Indonesia introduced Presidential Regulation No. 44 of 2020 concerning the Indonesian Sustainable Palm Oil (ISPO) certification system. This initiative aims to promote sustainable practices within the sector. By 2025, ISPO certification will be mandatory for all palm oil businesses and smallholders, emphasizing compliance with Indonesian laws and international quality standards (Hidayat et al., 2018). ISPO strives to be economically sustainable for producers while maintaining independence from external influences.

This research examines the impact of ISPO certification on CPO export volumes and other factors, such as commodity production and prices, exchange rates, and production levels. The findings provide

policy recommendations to boost Indonesia's CPO exports, enhance global competitiveness, and address sustainability challenges.

METHODS

The study employs Multiple Regression Analysis (MLR) and Difference-in-Differences (DID) Analysis using secondary data from credible sources such as the Directorate General of Plantations, Ministry of Agriculture, and the World Bank. The data covers Total CPO Volume (HS codes 15111000 and 15119000) from January 2006 to December 2022, focusing on ISPO certification for large State-owned and Private Enterprises in palm oil cultivation and processing. Building on Akbar & Dahlan (2023), it examines the Real Effective Exchange Rate (REER) and incorporates Soybean Global Price due to its impact on CPO exports, reflecting government efforts to promote palm oil sustainability. Detailed variable information is in Table 1.

Table 1. Variables of Multiple Linear Regression Analysis

Variable	Unit	Description	Source	Code
Indonesian CPO Export Volume	Tons	The total quantity of crude palm oil (CPO) that Indonesia exports to other countries within a period.	The Ministry of Agriculture and the UN Comtrade	VEXCPO
Indonesian CPO Production	Tons	Total crude palm oil (CPO) production was produced within Indonesia over a specified period.	The Ministry of Agriculture and the Statistics Indonesia	PRCPO
CPO Global Price	$/mt	Prevailing price of crude palm oil (CPO) in the international market.	The World Bank, commodity price data (the pink sheet)	GPCPO
Soybean Oil Global Price	$/mt	The current market price of soybean oil traded internationally.	The World Bank, (the pink sheet)	PSOY
Real Effective Exchange Rate	RP/LCU	Currency value compared to a group of other currencies, considering variations in inflation.	Bank for International Settlements (BIS)	REER
ISPO	Companies	The number of plantation companies or processing industries with ISPO certification.	Directorate General of Estates, The Ministry of Agriculture	ISPO
Interaction (DID Effect)	Difference-in-Differences (DID) variable representing the impact of ISPO certification. This variable is created by interacting the time variable (Post: 1 for years after ISPO implementation and 0 for years before ISPO) with the group variable (Treatment: 1 for companies with ISPO certification and 0 for those without). It measures the differential effect of ISPO on certified companies compared to non-certified companies over time.			

Multiple Linear Regression (MLR) Analysis

Multiple regression analysis uses independent variables to predict a dependent variable. This study assesses the impact of independent variables (X1, X2, X3, ..., Xi) on the dependent variable (Y), examining the relationship between one outcome and several predictors.

$$\mathbf{VEXCPO} = \beta_0 + \beta_1 \mathbf{PRCPO}_t + \beta_2 \mathbf{GPCPO}_t + \beta_3 \mathbf{PSOY}_t + \beta_4 \mathbf{REER}_t + \beta_5 \mathbf{ISPO}t + e \quad [1]$$

Description:

VEXCPO t : Export Volume of Crude Palm Oil in Indonesia (Tons) at t
PRCPOt : Indonesian CPO Production (Tons) at t
GPCPOt : CPO Global Price ($/mt) at t
PSOYt : Soybean Oil Global Price ($/mt) at t
REERt : Real Effective Exchange Rate (RP/LCU) at t

ISPOt : Indonesia Sustainable Palm Oil (ISPO) Certification (Companies) at t
β_0 : Intercept at t
$\beta 1, \beta 2 .. \beta 5$: The regression Coefficient to (i = 1,2,3,4,5)
e : Standard error

This study used Multiple Linear Regression Analysis with the Ordinary Least Square (OLS) technique, supported by IBM SPSS 24.0, to test model assumptions and hypotheses. The analysis includes Normality, Autocorrelation, Multicollinearity, and Homoscedasticity tests. The t-test evaluates the impact of individual independent variables, while the F-test assesses the combined effect. The coefficient of determination (R^2), F-test, and t-test measure the model's effectiveness for hypothesis testing and evaluation.

Hypotheses

This study posits the following hypotheses: PRCPO t (Indonesian CPO Production at t) positively affects VEXCPO t; GPCPO t (CPO Global Price at t) negatively affects VEXCPO t; PSOY t (Soybean Oil Global Price at t) positively affects VEXCPO t; REER t (Real Effective Exchange Rate at t) negatively affects VEXCPO t; and ISPO t (Indonesian Sustainable Palm Oil Certification at t) positively affects VEXCPO t. The study rigorously examines these variables, focusing on the impact of ISPO certification on CPO exports and its role in promoting sustainable practices. It ultimately provides insights into factors influencing CPO exports and the significance of sustainable certification for the industry.

Difference-in-Differences (DID) Analysis

This study employs a quantitative descriptive approach, using time-series cross-sectional data to evaluate the impact of ISPO certification. The dependent variable is Crude Palm Oil (CPO) export volume, while the independent variables include CPO production volume, global CPO price, global soybean oil price, Real Effective Exchange Rate (REER), and ISPO implementation. The analysis utilizes the Difference-in-Differences (DID) method and Ordinary Least Squares (OLS). The impact of the policy is determined by comparing changes between certified and non-certified groups over time in relation to the dependent variable.

$$\mathbf{VEXCPOt = \alpha_0 + \alpha_1(Post) + \alpha_2(Treatment) + \alpha_3(Post\ x\ Treatment) + \gamma X\mathit{it} + e\mathit{i}} \quad \mathbf{[2]}$$

Description:
$VEXCPO_t$: Export Volume of Crude Palm Oil in Indonesia (Tons) at t
$Post_t$: Dummy variable for the period after the intervention
$Treatment_t$: Dummy variable for the group that received the intervention
Post x : Interaction between the Post period and the Treatment group,
Treatment : indicating the policy's effect (impact of the intervention)
X*it* : Matrix of control variables (e.g., CPO production, Global CPO price, etc.)
ϵit : Error term
The hypotheses used in this research are as follows:
H_0 : The implementation of ISPO has no significant effect on CPO export
H_a : The implementation of ISPO significantly affects the CPO export.

The Difference-in-Differences (DID) method tracks changes over time in treatment and control groups, identifying causal effects before and after an intervention. This approach is useful for analyzing economic policies, helping policymakers understand the impact of interventions, and improving decision-making (Lauradina & Murwiati, 2023).

Classical Assumption Test

The Classical Assumption Test consists of four key tests to ensure the validity of a regression model. The Normality Test evaluates if the regression errors are normally distributed by observing data alignment with a diagonal line on a probability plot. The Multicollinearity Test assesses whether independent variables influence each other, using the Variance Inflation Factor (VIF), where values below 10 indicate no multicollinearity. The Autocorrelation Test, applying the Durbin-Watson (D-W) test, checks for correlations between residuals, with values between -2 and +2 suggesting no autocorrelation. Lastly, the Heteroskedasticity Test checks for unequal variances of residuals; a random scatter plot pattern indicates no heteroskedasticity, while a discernible pattern suggests its presence.

RESULTS

Indonesian Sustainable Palm Oil (ISPO) Certification Implementation

By the end of 2022, 687 palm oil plantation companies in Indonesia had received Indonesian Sustainable Palm Oil (ISPO) certification, covering 6.7 million hectares. The government aims for all palm oil plantations to be ISPO-certified by 2025. 830 out of 2,074 plantation companies (40%) hold ISPO certificates, reflecting a growing interest in sustainability standards.

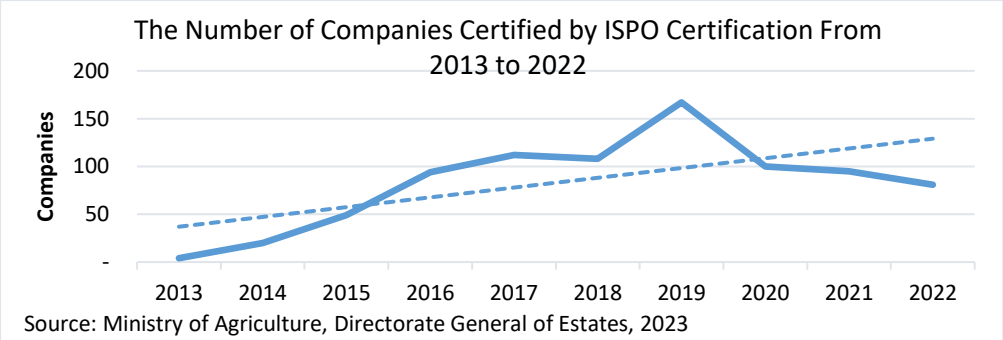

Figure 1. The Number of Companies Certified by ISPO Certification in Indonesia

ISPO certification has been mandatory since 2011 and will become compulsory for smallholders in November 2025. Despite this, some companies lack certification due to unmet requirements, the lengthy process, and a lack of understanding of its benefits (Nasution & Wulansari, 2019). The Indonesian government promotes ISPO certification by updating regulations, providing incentives, and increasing outreach to ensure sustainable and competitive palm oil production.

Descriptive Statistics

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Volume Export CPO	204	182797	3589411	1761960.07	623909.927
CPO Price	204	459.05	1776.96	855.0180	251.68234
Soybean Price	204	533.27	1962.88	994.9934	295.11672
CPO Production	204	694316	3335972	1685770.79	620562.018
REER	204	87.95	113.38	101.8109	5.01643
ISPO	204	0	63	4.07	10.491
Valid N (Listwise)	204				

Sources: SPSS Output, 2024

The analysis covers 204 observations from January 2006 to December 2022. Indonesian CPO Export Volume varied from 182,797 to 3,589,411 tons, with a mean of 1,761,960.07 tons and a standard deviation of 623,909.927 tons. CPO Production ranged from 694,316 to 3,335,972 tons, averaging 1,685,770.79 tons. CPO Global Price fluctuated between $459.05 and $1,776.96 per metric ton, with an average of $825.018. Soybean Oil's Global Price ranged from $533.27 to $1,962.88 per metric ton, averaging $994.9934. The Real Effective Exchange Rate (REER) ranged from 87.95 to 113.38 RP/LCU, with a mean of 101.8109. ISPO certification adoption varied from 0 to 63 companies, averaging 63. These statistics provide a comprehensive view of Indonesia's dynamic CPO industry, covering production, pricing, exchange rates, and sustainability efforts.

Classical Assumption Testing

A multiple linear regression model, adhering to classical assumptions, relies on unbiased, linear, and Best Linear Unbiased Estimators (BLUE) estimators. Classical assumption testing ensures model validity by assessing normality, multicollinearity, autocorrelation, and heteroskedasticity.

Normality test

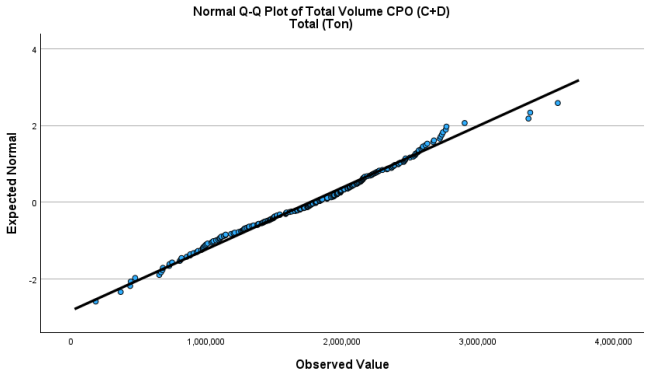

Figure 2. Normal Probability Plot Graph, SPSS Output 2024

The Kolmogorov-Smirnov test assessed normality by comparing the cumulative distribution of residuals to the expected normal distribution. The test statistic indicates normality if it is insignificant ($p > 0.05$). The test results for the unstandardized residuals are presented in Table 2.

Table 3. One-Sample Kolmogorov-Smirnov Test for Normality

Statistic	Value
N	203
Test Statistic	0.052
Asymp. Sig. (2-tailed)	0.200

Sources: SPSS Output, 2024

The test statistic is 0.200, with a p-value of 0.151 ($p > 0.05$), indicating that we cannot reject the null hypothesis (H_0) of normality. This implies insufficient evidence to assert that the residuals significantly deviate from a normal distribution.

Multicollinearity Test

Table 4. Multicollinearity Test

Independent Variables	Collinearity Statistics	
	Tolerance	VIF
CPO Global Price (GPCPO)	0.129	7.781
Soybean Price (PSOY)	0.126	7.925
CPO Production (PRCPO)	0.692	1.446
Real Effective Exchange Rate (REER)	0.887	1.127
ISPO Certification (ISPO)	0.848	1.179

Sources: SPSS Output, 2024

CPO Production, REER, and ISPO have VIF values well below ten and Tolerance values above 0.1, indicating no multicollinearity concerns. CPO Global Price (GPCPO) and Soybean Price (PSOY) have higher VIF values (7.781 and 7.925) and lower Tolerance values (0.129 and 0.126), suggesting a moderate correlation. Thus, our model has no severe multicollinearity, though CPO Global Price and Soybean Price show a moderate correlation due to their nature as global commodity prices.

Autocorrelation Test

Based on Table 5, the Durbin-Watson (DW) value is 1.526. This value ranges between 0 and 4. There is no autocorrelation if the DW value is close to 2. Thus, the regression model does not have significant autocorrelation issues at the 5% significance level ($\alpha = 0.05$).

Table 5. Durbin – Watson Test

Durbin-Watson
1.526

Sources: SPSS Output, 2024

The Durbin-Watson statistic for our model is 1.526, within the range of 1.5 to 2.5, indicating no significant autocorrelation. Thus, our model meets the autocorrelation assumption, supporting the validity of our coefficients and inferential statistics.

Heteroscedasticity Test

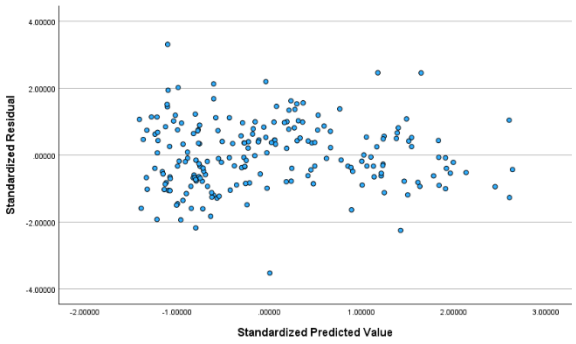

Figure 3. Scatter Plot Heteroscedasticity
Sources: SPSS Output, 2024

Heteroscedasticity and unequal variability across predictor values lead to inefficient estimates and unreliable standard errors in regression.

The Impact of Indonesian Sustainable Palm Oil (ISPO) and The Factors Influencing on CPO Export Volume

To address the objective of this research, which is to analyze the factors affecting the export volume of Indonesian Crude Palm Oil (CPO) and the influence of ISPO certification on the export volume of Indonesian CPO, the analytical model employed in this study is the Difference-in-Differences (DID) method—used to evaluate the impact of policies or interventions by comparing two groups (treatment and control) before and after the intervention—and multiple linear regression (MLR) to identify the linear relationship between the dependent and independent variables. The method used to estimate the model's parameters is the Ordinary Least Squares (OLS) method. Furthermore, the model is assessed through classical assumption testing and parameter examination. The MLR results help formulate regression equation [3] with estimated values for α, β1, β2, β3, β4, and β5.

VEXCPOt = 1103305.452 + 0.636PRCPOt - 620.655GPCPOt + 207.255PSOYt - 1046.118REERt + 4498.161ISPOt + e [3]

Table 6 summarizes the Multiple Linear Regression analysis of factors influencing Indonesia's CPO export volume (2006-2022), including six independent variables: Indonesian CPO Production, CPO Global Price, Soybean Oil Global Price, REER, and ISPO Certification. It details each variable's relationship direction, estimated coefficient, standard error, t-value, significance level, and collinearity statistics. The model explains 49.4% of the variation in CPO export volume, with an R-value of 0.703 and an R Square of 0.494.

Table 6. Statistical Summary of Multiple Linear Regression Analysis

Variable	Anticipated direction	Coefficient	t-value	t-table	p-value
Constant		1,103,305.452	1.601	1.972	0.111
CPO Production (PRCPO)	+	0.636	10.395	1.972	0.000
CPO Global Price (GPCPO)	-	-620.655	-1.775	1.972	0.077

Soybean Oil Global Price (PSOY)	+	207.255	0.689	1.972	0.492
Real Effective Exchange Rate (REER)	-	-1,046.118	-0.157	1.972	0.876
Indonesian Sustainable Palm Oil (ISPO)	+	4,498.161	1.377	1.972	0.170
R	0.703	F-value	38.605	Prob. F	0.000
R Square	0.494	F-table	2.257	α	0.05
Adjusted R Square	0.481				

Source: SPSS Output, 2024

Table 6 shows that current CPO Production and CPO Global Price significantly impact export volume ($p < 0.05$), while Soybean Oil Price, REER, and ISPO certification do not. Past export volume and current production positively influence exports, whereas global CPO price negatively affects them. The model's F-value is 38.605 ($p = 0.000$), indicating significance, and the Durbin-Watson statistic of 1.526 suggests no autocorrelation. Collinearity statistics reveal a moderate correlation between CPO and Soybean prices, highlighting key economic dynamics affecting Indonesia's CPO export volume.

Indonesian CPO Production (PRCPO)

Indonesian CPO Production (PRCPO) is a key variable representing total CPO output in Indonesia. Regression analysis reveals a significant positive relationship between CPO Production and export volume, with a coefficient of 0.227, indicating that a one-unit increase in production corresponds to a 0.636-ton increase in exports. The t-value of 10.395 ($p = 0.000$) confirms this significance. This finding highlights the critical role of domestic production in driving Indonesia's CPO exports, reinforcing its status as the world's largest palm oil producer. The PRCPOt variable reflects domestic supply, considering factors like plantation area, yield, and processing capacity. Its significance underscores the impact of supply-side factors on export performance, suggesting that policies promoting sustainable practices, productivity improvements, and investment in the palm oil sector are vital for maintaining Indonesia's competitive advantage in the global market.

CPO Global Price (GPCPO)

The CPO Global Price (GPCPO) reflects the international price of Crude Palm Oil and shows a significant negative relationship with Indonesia's CPO export volume, with a coefficient of -620.655. This indicates that a $1/mt increase in global CPO price reduces exports by 620.655 tons, with a t-value of -1.775 ($p = 0.077$). Higher global CPO prices negatively affect export volume as buyers may switch to substitutes like soybean oil or reduce overall vegetable oil consumption. Additionally, increased output from other producers may intensify competition, decreasing Indonesia's market share. This highlights the importance for Indonesian producers and policymakers to monitor international markets and implement strategies to enhance efficiency, lower costs, and diversify markets to mitigate the impact of price fluctuations on CPO exports.

Soybean Global Price (PSOY)

The Soybean Oil Global Price (PSOY) reflects the international price of soybean oil, a substitute for CPO. Regression analysis shows a positive but statistically insignificant relationship between PSOY and Indonesia's CPO export volume, with a coefficient of 207.255, indicating that a $1/mt increase in PSOY results in a 207.255-ton increase in CPO exports. However, the t-value of 0.689 ($p = 0.492$) is below the 5% significance level, indicating that soybean oil prices do not significantly impact CPO export volume. While the positive relationship suggests a substitution effect where consumers may switch to CPO as soybean oil prices rise, the lack of significance implies that other factors, such as price differences, the availability of substitutes, and consumer preferences, also play a role.

Real Effective Rate (REER)

The Real Effective Exchange Rate (REER) measures Indonesia's currency value against others, adjusted for inflation, indicating international competitiveness. Regression analysis shows a negative but statistically insignificant relationship between REER and Indonesia's CPO export volume, with a coefficient of -1,046.118. This suggests that a one-unit increase in REER reduces CPO exports by 1,046.118 tons, but the t-value of -0.157 ($p = 0.876$) indicates no significant effect. While a higher REER may make Indonesian CPO more expensive for foreign buyers, the lack of significance suggests that

other factors, such as global demand, production levels, and trade policies, may influence CPO export volume more than REER.

Indonesian Sustainable Palm Oil (ISPO)

The Indonesian Sustainable Palm Oil (ISPO) variable measures the number of ISPO-certified companies, promoting sustainability and competitiveness. The analysis shows a positive but statistically insignificant relationship between ISPO certification and Indonesia's CPO export volume, with a coefficient of 4,498.161. This implies that an additional ISPO-certified company could increase CPO exports by 4,498.161 tons. However, the t-value of 1.377 ($p = 0.170$) indicates no significant effect. While ISPO certification could enhance market access and reputation, its lack of statistical significance suggests that factors like global market conditions and price competitiveness may more significantly influence CPO exports than ISPO certification.

Regression Analysis with Difference in Differences (DID) Method

Analysis using the Difference in Differences (DID) method was conducted to evaluate the impact of the implementation of Indonesian Sustainable Palm Oil (ISPO) certification on the volume of Indonesian Crude Palm Oil (CPO) exports. DID allows researchers to measure significant changes between the periods before and after ISPO implementation and the differences between the treatment group (companies with ISPO certification) and the control group (companies without ISPO certification).

Table 7. Difference in Differences (DID) analysis

Variable	Coefficient	Std. Error	t-value	p-value	Collinearity Statistics (VIF)
Constant	1,519,622.740	661,433.118	2.297	0.023	-
CPO Global Price (GPCPO)	-977.556	341.269	-2.864	0.005	8.195
Soybean Oil Global Price (PSOY)	444.745	290.844	1.529	0.128	8.184
Total production	0.425	0.074	5.743	<0.001	2.337
Real Effective Exchange Rate (REER)	-3,834.874	6,378.283	-0.601	0.548	1.137
Interaction (DID Effect)	439,820.534	91,622.964	4.800	<0.001	1.945

Source: SPSS Output, 2024

The results of the Difference in Differences (DID) analysis in Table 7 show that the implementation of Indonesian Sustainable Palm Oil (ISPO) certification has a significant impact on increasing the export volume of Indonesian Crude Palm Oil (CPO). The interaction variable (Interaction) used in the DID regression model has a coefficient of 439,820,534 with a p-value <0.001. This result means that after the implementation of ISPO, there was an average increase of around 439,820,534 tons in the volume of CPO exports for companies with ISPO certification compared to companies without ISPO certification. This finding indicates that the ISPO certification policy effectively increases the competitiveness and volume of Indonesian CPO exports in the international market.

Implication

These results confirm previous studies indicating that sustainability certification, like ISPO, enhances product competitiveness in the international market (Limaho et al., 2022). ISPO improves the reputation of Indonesian CPO products, increases market access, and reduces environmental trade barriers, positively impacting CPO export volumes. Additionally, the analysis shows that rising CPO prices significantly decrease export volume, as higher commodity prices typically reduce demand. In contrast, increased total production positively affects export volume (Ha et al., 2020). The Soybean Price and REER variables are insignificant in this model, indicating they do not significantly impact CPO export volume during this period, aligning with Gultom et al. (2024), which found that fluctuations in soybean oil prices and exchange rates also had limited short-term effects on CPO exports.

CONCLUSION

The analysis of Indonesia's Crude Palm Oil (CPO) export volume from 2006 to 2022, using the Difference in Differences (DID) method, revealed that the implementation of the Indonesian Sustainable Palm Oil (ISPO) certification had a significant positive impact, with companies adopting ISPO experiencing an average export increase of 439,820.534 tons. Additionally, multiple linear regression showed that CPO production positively influenced exports, while global CPO prices had a negative impact, highlighting the need for Indonesia to enhance competitiveness and market diversification. Although some factors like soybean oil prices and exchange rates were not significant in the regression, ISPO's role in promoting sustainable practices was confirmed. The findings emphasize the importance of strategies to encourage ISPO adoption, improve production efficiency, and stabilize exports through market diversification. Future research should focus on supporting smaller producers, increasing ISPO's global recognition, and leveraging technology and sustainable farming to ensure long-term export growth.

REFERENCES

Akbar, M., & Dahlan, M. (2023). pengaruh produksi cpo, harga internasional cpo, dan nilai tukar terhadap volume ekspor cpo (crude palm oil) indonesia (studi tahun 2001-2020). *JISIP (Jurnal Ilmu Sosial Dan Pendidikan)*, *7*(3), 1836. https://doi.org/10.58258/jisip.v7i2.5042

Anwar, R., Sitorus, S. R., Fauzi, A. M., Widiatmaka, N., & Machfud, N. (2016). Achievement of Indonesian Sustainable Palm Oil Standards of Palm Oil Plantation Management in East Borneo Indonesia. *Jurnal Penelitian Tanaman Industri*, *22*(1).

Dauvergne, P. (2018). The global politics of the business of "sustainable" palm oil. *Global Environmental Politics*, *18*(2). https://doi.org/10.1162/glep_a_00455

David, C. (2022). *Kewajiban Sertifikasi ISPO bagi Pengusaha Perkebunan Kelapa Sawit*. Hukum Online.

Fahamsyah, E., & Pramudya, E. P. (2018). *The ISPO system addresses the challenges in the sustainable development of Indonesian palm oil*. Universitas Jember.

Greenpeace Indonesia. (2018). *Terobosan Baru Wilmar Agar Para Perusak Hutan Tidak Dapat Bersembunyi*. Greenpeace Indonesia.

Gultom, G. A., Harianto, H., Saragih, B., & Suharno, S. (2024). Estimating Factors That Affect Domestic CPO Prices in The Short And Long Run Using The ECM Approach. *IOP Conference Series: Earth and Environmental Science*, *1359*(1), 012057. https://doi.org/10.1088/1755-1315/1359/1/012057

Ha, V. T. C., Holmes, M. J., & Le, T. M. (2020). Firms and export performance: does size matter? *Journal of Economic Studies*, *47*(5). https://doi.org/10.1108/JES-12-2018-0451

Hidayat, N. K., Offermans, A., & Glasbergen, P. (2018). Sustainable palm oil as a public responsibility? On the governance capacity of Indonesian Standard for Sustainable Palm Oil (ISPO). *Agriculture and Human Values*, *35*(1). https://doi.org/10.1007/s10460-017-9816-6

Indonesia Palm Oil. (2024). *ISPO Indonesia is Palm Oil*. Indonesia Palm Oil.

International Trade Centre. (2014). *Bilateral trade between Indonesia and World*.

Jong, H. N. (2016). *Govt to boost palm oil sustainability as result of foreign pressure*. The Jakarta Post.

Kehati. (2023). *Ispo dan Tantangan Bagi Petani Sawit*. Kehati.

Lauradina, D., & Murwiati, A. (2023). Dampak Kompensasi Kenaikan Harga Bahan Bakar Minyak (BBM) Terhadap Pengeluaran Rumah Tangga Miskin Dengan Metode Difference in Difference (Studi Kasus: Kecamatan Panjang Kota Bandar Lampung). *Innovative: Journal of Social Science Research*, *3*(3).

Limaho, H., Sugiarto, Pramono, R., & Christiawan, R. (2022). The Need for Global Green Marketing for the Palm Oil Industry in Indonesia. *Sustainability (Switzerland)*, *14*(14). https://doi.org/10.3390/su14148621

Ministry of Agriculture. (2022). *Analysis of GDP in the Agricultural Sector in 2022*.

Ministry of Industry. (2021). *Challenges and Prospects of National Palm Oil Downstreaming*.

Mutu International. (2022). *Mengenal ISPO serta Manfaat, Tujuan, dan Cara Sertifikasi*. Mutu International.

Nasution, A. S., & Wulansari, I. Y. (2019). Analyzing Impacts of Renewable Energy Directive (RED) on Crude Palm Oil (CPO) Export and Forecasting CPO Export from Indonesia to European Union (EU) for 2019-2020 Using ARIMA Intervention Analysis. *Proceedings of the International Conference on Trade 2019 (ICOT 2019)*. https://doi.org/10.2991/icot-19.2019.28

Panjaitan, M. (2013). *Legal Analysis of ISPO Certification Obligations in Relation to Investment Growth in Oil Palm Plantations in Indonesia (Study at PT. REA KALTIM PLANTATION-Jakarta)* [Master Thesis].

Rifin, A. (2017). Determinants of Exporting Firm in Indonesian Food Processing Sector. *International Research Journal of Business Studies*, *10*(1).

Rodhiah, Ifdal, I., Syarfi, I. W., & Hasnah, H. (2019). The impact of ISPO certification on economic, social and environmental aspect in the palm oil plantation. *IOP Conference Series: Earth and Environmental Science*, *336*(1). https://doi.org/10.1088/1755-1315/336/1/012013

Solihin, I., Putra, R. T., Salamah, N. S., Fidya, E. S., & Khairunnisaa, L. A. (2020). The effect of the implementation of Indonesian Sustainable Palm Oil (ISPO) on the average export value of Indonesian crude palm oil (CPO) to the Netherlands and Italy during the 2012-2017 period. *Solid State Technology*, *63*(4).

Statistics Indonesia (BPS). (2022). *Indonesian Oil Palm Statistics (Statistik Kelapa Sawit Indonesia)*.

Sukirno, S. (2011). *Pengantar Makroekonomi*. Rajawali Press.

U.S. Department of Agriculture (USDA) Foreign Agricultural Service. (2022). *Palm Oil Explorer*.

Widyastutik, & Ashiqin, A. Z. (2011). Analisis daya saing dan faktor-faktor yang mempengaruhi ekspor CPO Indonesia ke China, Malaysia, dan Singapura dalam skema ASEAN-China Free Trade Agreement. *Jurnal Manajemen & Agribisnis*, *8*(2).

Wulansari, E., Yulianto, E., & Pangestuti, E. (2016). PENGARUH JUMLAH PRODUKSI, HARGA INTERNASIONAL, NILAI TUKAR DAN TINGKAT SUKU BUNGA TERHADAP TINGKAT DAYA SAING EKSPOR KELAPA SAWIT INDONESIA (Studi pada Tahun 2009-2013) Eka. *Jurnal Administrasi Bisnis*, *39*(2).