EXPORT DYNAMICS OF RUBBER FROM LIKE-MINDED COUNTRIES TO EUROPEAN UNION

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Abstract

Background: The European Union is a major importer of natural rubber. However, the rise of global competition and the implementation of the European Union Deforestation Regulation (EUDR) in 2023 has impacted rubber trade dynamics, particularly in Like-Minded Countries (LMC).

Purpose: This study analyzes the competitiveness and efficiency of rubber exports from 17 LMC to the European Union from 2013 to 2022.

Design/methodology/approach: The study uses Revealed Comparative Advantage, Export Product Dynamics, X-Model, and Stochastic Frontier Analysis with data from the UN Comtrade, Trade Map, and World Bank.

Findings/Result: This study shows increased competitiveness in rubber exports to the European Union, while some countries experienced stagnation. The implementation of sustainability policies, particularly the EUDR, significantly influences export competitiveness. Countries that adhere to sustainability standards have demonstrated notable improvements in their export performance.

Conclusion: Although some countries have significant export potential, they have not fully optimized it. The LMC needs to enhance efficiency and meet sustainability standards to improve competitiveness and fully leverage export potential in the European Union market.

Originality/value (state of the art): This research contributes to the limited literature on rubber trade dynamics under the impact of environmental regulations such as the EUDR. It comprehensively analyzes trade patterns and efficiency and offers valuable insights for academic and practical applications in global trade studies.

Keywords: Competitiveness, environmental policy, export efficiency, stochastic frontier, trade potential

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INTRODUCTION

European Union is one of the world's largest rubber importers, with a market share of 18.29%, equivalent to USD 1.90 billion by 2023 (WITS, 2025). Rubber is widely used in various industries in the European Union because of its flexibility, which makes it very useful for various products such as tires, motor vehicle components, household appliances, medical equipment, rubber shoes, cables, insulating materials, conveyor belts, dock fenders, transmission belts, and asphalt mixes (Meliany & Novianti, 2022; Sembiring et al. 2021). Based on data from the Association of Natural Rubber Producing Countries (ANRPC), the global natural rubber market reached 14, 693 million tons in 2023, with a consumption of 14,738 million tons. ANRPC (2024) reports that the number of new vehicles registered in the European Union, the United Kingdom, and the European Free Trade Association (EFTA) grew by 10.7%, reaching 911,064 units. The world's foremost natural-rubber-producing countries have optimally utilized this increase. UN Comtrade (2024) notes that countries such as Thailand (37.40%), Indonesia (25.41%), the Ivory Coast (21.02%), Malaysia (8.35%), and Guatemala (1.80%) dominate global natural rubber production and exports. The dominance of natural rubber exports has impacted the decline in the demand for synthetic rubber in the European Union, which has caused losses in the synthetic rubber raw material industry.

To protect domestic synthetic rubber producers, the European Union has begun to implement various natural rubber import regulations. By 2022, a natural rubber import quota of 562,973 tons of sheet rubber and 752,475 tons of carbon black will be imposed (Global Market Report, 2022). The European Union has also adopted a new regulation on deforestation-free products, known as the European Union Deforestation-free Regulation (EUDR), which aims to ensure that imported products, including rubber, are deforestation-free (Berning & Sotirov, 2024). The EUDR is expected to reduce the rate of global forest loss by requiring products such as rubber to meet sustainability standards before they can enter the European Union market (European Commission, 2024). Of the 12 rubber products affected, three main products–natural rubber (HS 4001), new pneumatic tires of rubber (HS 4011), and accessories for clothing (HS 4015)–account for up to 97% of the value of rubber exports (Permatasari et al. 2024).

In response to this policy, a group of 17 countries known as Like-Minded Countries (LMC), consisting of Indonesia, Argentina, Bolivia, Brazil, Colombia, the Dominican Republic, Ecuador, Ghana, Guatemala, Honduras, Malaysia, Mexico, Nigeria, the Ivory Coast, Paraguay, Peru, and Thailand, responded to the EUDR (Micah et al. 2024; Weber, 2023). According to UN Comtrade data (2024), LMC contributes significantly to rubber exports to 27 EU member states, with a market share of 74.85%. This resistance from the LMC is a response to the significant decline in rubber trade from LMC countries to the EU between 2012 and 2023.

The EUDR affected the performance of the rubber trade between LMC countries in the European Union. Several studies have analyzed the competitiveness of rubber in a country (Amiruddin et al. 2022; Hodijah et al. 2023; Idris et al. 2022; Kamaludin, 2018; Meliany & Novianti, 2022; Mohamad & Zainuddin, 2021; Nugroho et al. 2022; Pinandhita & Agustina, 2019; Prasada & Dhamira, 2022; Ramli & Yusof, 2023; Sembiring et al. 2021; Suparmono et al. 2022; Tiyastuti et al. 2023; Zuhdi & Anggraini, 2020).

This study aims to analyze the competitiveness of rubber and identifies the factors that influence trade flows. This study also aimed to evaluate the difference between actual and potential EU imports to measure the level of efficiency and inefficiency in rubber trade from LMC countries. The results of this study are expected to provide insights for policymakers and related industries to increase the competitiveness and efficiency of rubber exports from LMC countries in response to the strict regulations implemented by the European Union.

METHODS

This study used panel data, which are time-series data from 2013 to 2022, and cross-sectional data covering 17 Like-Minded Countries: Indonesia, Argentina, Brazil, Bolivia, Colombia, Cote D'Ivore, Dominican Republic, Ecuador, Ghana, Guatemala, Honduras, Malaysia, Mexico, Nigeria, Paraguay, Peru, and Thailand. This analysis focused on natural rubber with the four-digit HS code HS 4001. The study is divided into two periods: 2013-2017, when the EU focused on post-crisis economic stabilization and the digital single market, and 2018-2022, when EU policies expanded to include stronger environmental protections, such

as anti-deforestation regulations. This study uses secondary data from the UN Comtrade and the World Bank.

This study used the Revealed Comparative Advantage (RCA) approach, which was designed in 1965 (Balassa, 1965). is the export value of rubber in country i and country j (USD). is the world export value of rubber in country j (USD). is the total export value of country i's commodity in country j (in USD). is the total value of world commodity exports in country j (USD). T is the number of years of analysis, namely, 10 years, while t is the analysis period, namely, 2013-2022. where j represents European Union. i represents 17 LMC countries. RCA is used to assess the rubber export performance of LMC countries by comparing the proportion of total exports of these commodities with their export share in global trade against total exports in the European Union using the following equation:

$$RCA_{ij} = (X_{ij}/W_{ij})_t/(X_{wj}/W_{wj})_t$$

RCA_{ij} index between zero and infinity ($0 \leq RCA_{ij} \leq \infty$). When the RCA index is above one, the share of rubber products in the total exports of LMC countries is greater than the average share of these products in world exports, which means that LMC countries have a comparative advantage and strong competitiveness in the European Union. The opposite was true when the RCA index was < 1.

The Export Product Dynamic (EPD) method analyzes LMC countries' rubber trade performance using the European Union as theory (Estherhuizen, 2006). EPD can estimate whether the performance of rubber is dynamic or static by examining the continuity of its exports (Table 1).

Table 1. EPD market positioning matrix

Share LMC in EU	Share rubber LMC in EU	
	Dynamic (+)	Stagnant (-)
Competitiveness (+)	Rising star	Falling star
Noncompetitiveness (-)	Lost opportunity	Retreat

Source: Estherhuizen (2006)

The four categories of market position in Table 1 are represented in a scatter plot with business strength or export market share growth (x-axis), and market attractiveness or product market share growth (y-axis). Quadrant I (rising star): Dynamic LMC commodities in the competitive EU market. Quadrant II (falling star): Increasing but uncompetitive trade. Quadrant III (lost opportunity): loss of market expansion, and Quadrant IV (retreat): LMC countries' reduced desire to enter the EU with the following EPD formula:

$$\text{Growth share x} = \frac{\sum_{t=1}^{t}\left(\frac{X_{ijk}}{X_{wjk}}\right)_t \times 100\% - \sum_{t=1}^{t}\left(\frac{X_{ijk}}{X_{wjk}}\right)_{t-1} \times 100\%}{T}$$

$$\text{Growth share y} = \frac{\sum_{t=1}^{t}\left(\frac{W_{ij}}{W_{wj}}\right)_t \times 100\% - \sum_{t=1}^{t}\left(\frac{W_{ij}}{W_{wj}}\right)_{t-1} \times 100\%}{T}$$

The X-Model method is used to identify the potential for developing the rubber export market of LMC countries in the European Union by comprehensively assessing comparative and competitive advantages (Meliany & Novianti, 2022; Sembiring et al. 2021). This method combines RCA analysis with EPD analysis to assess the competitiveness of rubber from two perspectives, thus making the study more comprehensive (Table 2).

Table 2. X-Model clustering

RCA	EPD	Market Position
RCA > 1	Rising star	Optimistic
	Lost opportunity	Potential
	Falling star	Potential
	Retreat	Less Potential
RCA < 1	Rising star	Potential
	Lost opportunity	Less Potential
	Falling star	Less Potential
	Retreat	No Potential

Source: Meliany and Novianti (2022)

Based on actual data from natural rubber exports in the European Union, LMC countries are still competitive in the European Union market despite indications of regulations on environmental sustainability. The country could gain significant benefits from natural rubber exports if it succeeds in achieving environmental sustainability. Therefore, this study hypothesizes that LMC is still competitive in rubber exports to the European Union market. The research framework is illustrated in Figure 1.

Empirical model estimation, which focuses on the determinants of EU rubber import demand from LMC, uses the Stochastic Frontier Analysis (SFA) approach with the Maximum Likelihood Estimation (MLE) method. This regression technique addresses the problem of heteroskedasticity and estimates the

efficiency of EU rubber exports and potential for EU rubber imports from the LMC. Rubber import quantity (MRUBB) was used as the dependent variable. The independent variables consist of the union's Gross Domestic Product (GDP), economic distance (DIST), exchange rate (EXCR), rubber import prices (PM), price of substitute products in the form of tea (PY), free trade area (FTA), language similarity (LANG), and landlocked (LL). The constant is symbolised as $\beta0$, and the coefficient of each equation is $\beta1$ to $\beta8$. The SFA model formula for import demand minus Vijt was formulated when SFA was added to the panel data regression model:

$$LnMRUBB_{jt} = \beta_0 + \beta_1 LnPDB_{jt} + \beta_2 LnDIST_{ajt} + \beta_3 LnEXCR_{ajt} + \beta_4 LnPM_{jt} + \beta_5 LnPY_{jt} + \beta_6 FTA_{ajt} + \beta_7 LANG_{aj} + \beta_8 LL_a + \varepsilon_{ajt} - V_{ajt}$$

In the SFA model, ε_{jt} is defined as a two-sided error term, which includes statistics calculated by residual estimation, and N (O–σ2e) represents a one-sided error term, which is assumed to follow a normal distribution. N (μ–σ2u) indicates technical inefficiency. $\phi(.)$ represents the density function and γ indicates the efficiency estimate with a value between 0 and 1. Calculation of technical efficiency by Battese and Coelli (1995).

Efficiency is the ratio of the actual value to the potential. If the difference between the actual and potential export values decreases, then a country has traded in the most efficient way and vice versa. The export efficiency interval is between 0-1, the closer it is to 1, the smaller the difference between actual and potential exports.

$$E[EXP(-V_{ijt})|e_{ijt} + V_{ijt}] =$$
$$\frac{1 - \phi[\sigma_* + \gamma(e_{ijt} + V_{ijt})/\sigma_*]}{1 - \phi\gamma(e_{ijt} + V_{ijt})/\sigma_*} . exp\left[\gamma(e_{ijt} + V_{ijt}) + \frac{\sigma_*^2}{2}\right]$$

In the export efficiency analysis, several variables are involved in their relationship with rubber exports from LMCs countries to the European Union market. The following hypotheses were presented in this study:

Gross Domestic Product (GDP) reflects a country's overall economic condition, purchasing power, and demand capacity for various products. Numerous studies have indicated that GDP has a positive and significant influence on the export performance of commodities (Abdullahi et al. 2021; Anh et al. 2021). H1: GDP has a positive and significant effect on natural rubber exports

Distance also refers to shipment cost, meaning that the distance between the reporter and partner could implicate the amount of exports owing to cost considerations. Many empirical studies have shown that geographical distance tends to have a negative and significant impact on bilateral trade (Atif et al. 2019; Rosyadi et al. 2020). H2: Geographical distance has a negative and significant impact on LMCs Rubber Exports
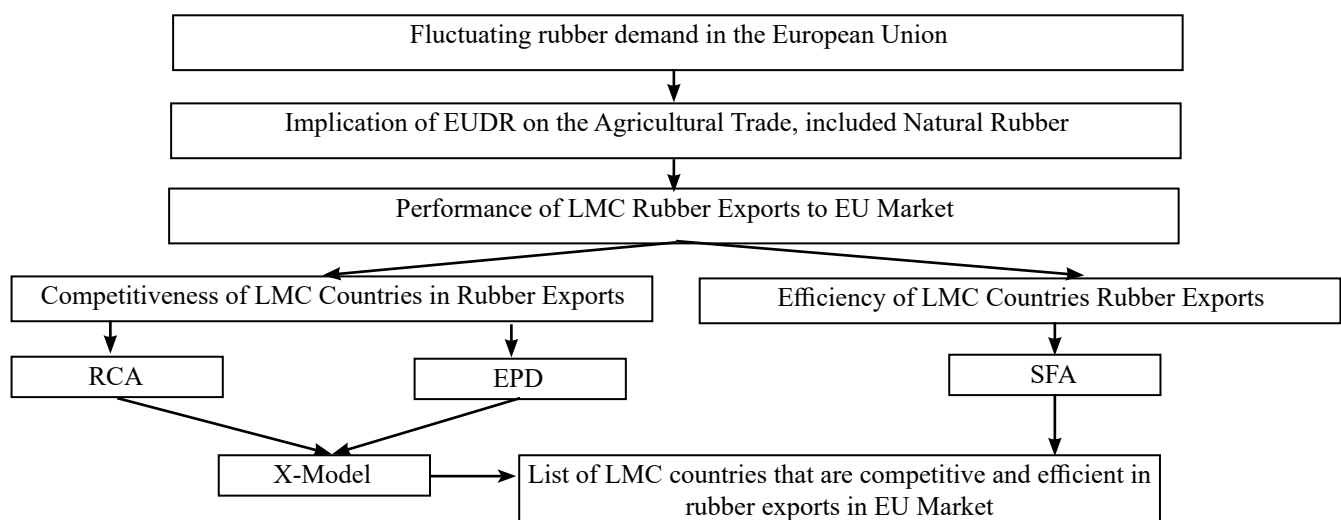

Figure 1. Research framework

The bilateral exchange rate, defined as the value of the local currency unit (LCU) against the US dollar, plays a critical role in trade dynamics and confirms a positive and significant relationship between exchange rates and export performance (Kamal et al. 2021).

H3: Exchange rate has a positive and significant impact on LMCs Rubber Exports

The import price of a specific commodity in the destination country indicates the demand and market absorption of goods, reducing demand when buying costs increase for customers. The import price of the goods can adversely affect exports, based on the several previous findings (Yusiana et al. 2022).

H4: Import Rubber Price has a negative and significant impact on LMCs Rubber Exports

When the prices of substitute goods increase, buyers often shift their demand to alternative products such as natural rubber. Several studies have also found that the prices of substitute products positively and significantly affect trade performance (Mwangi, 2021).

H5: Subsitute Product Price has a positive and significant impact on LMCs Rubber Exports

Free Trade Agreements (FTAs) are designed to lower or remove both tariff and non-tariff barriers between countries, helping exporters access wider and more efficient markets. Previous studies have found a positive and significant relationship between FTAs and export performance (Timsina and Culas, 2022).

H6: FTA has a positive and significant impact on LMCs Rubber Exports

Language differences between exporting and importing countries often create barriers to business communication, contract negotiations, and understanding of regulations and market preferences. Previous studies also found a negative and significant relationship between language and trade (Abdullahi et al. 2021).

H7: Language has a negative and significant impact on LMCs Rubber Exports

A country with landlocked conditions is considered a reporter for trade implementation. The involvement of air freight reduces trade quantity compared to shipments from cargo ships and produces a negative and significant impact from the status of the landlocked country on bilateral trade performance (Abdullahi et al. 2021; Sheikh et al. 2018)

H8: The landlocked country has a negative and significant impact on LMCs

RESULTS

Comparative and competitive advantage analysis

The market share analysis of rubber commodities (HS 4001) between 2018 and 2022 revealed that countries such as Côte d'Ivoire, Ghana, Guatemala, Indonesia, Malaysia, Nigeria, and Thailand were highly competitive, with Indonesia leading at 24.61%, followed by Thailand (18.92%), and Côte d'Ivoire (18.62%). LMC accounted for 74.13% of EU rubber imports. RCA analysis of rubber exports from the LMC to the EU from to 2013-2022 highlights Argentina, Bolivia, Brazil, Colombia, the Dominican Republic, Honduras, Mexico, Paraguay, and Peru, with RCAs of 0.00 in both periods, reflecting limited or no competitiveness in rubber exports. Guatemala's RCA improved from 8.57 to 16.66, whereas that of Cote D'Ivoire substantially increased from 115.69 to 196.31. Indonesia's RCA declined slightly from 77.34 to 77.15, and Ghana's RCA grew from 18.51 22.05. Malaysia's RCA dropped from 24.90 to 19.10, signifying a decline (Figure 2).

Figure 2 shows that increased competitiveness was recorded in countries such as Côte d'Ivoire, Ghana, and Thailand, which was fuelled by increased demand for rubber in the automotive and manufacturing sectors (Ramli & Yusof, 2023), as well as trade agreements that provided competitive advantages (Salehi et al. 2021). Indonesia, Malaysia, and Nigeria have experienced a decline in competitiveness due to competition from new suppliers utilizing preferential trade agreements, and the EU's increased focus on sustainability (Nugroho et al. 2022). The Export Product Dynamic (EPD) analysis from 2013 to 2017 categorized Bolivia, Cote D'Ivoire, the Dominican Republic, Guatemala, Honduras, Paraguay, and Thailand as rising stars because of their expanding rubber trade in the EU (Figure 3).

Figure 3 shows that Argentina, Brazil, Colombia, Ghana, Indonesia, and Peru were classified as falling stars and experienced a decline in rubber exports despite rising trade volumes. Owing to stagnant or declining exports, Ecuador, Malaysia, and Mexico fall into the lost opportunity category. Meanwhile, Only Nigeria was categorized as retreating due to the diminishing rubber trade and overall export performance. From 2018 to 2022, Brazil, Colombia, Ecuador, and Nigeria experienced significant increases in trade, making these countries competitive suppliers in the EU market. This success is driven by a favorable climate and trade agreements that provide preferential EU market

access (Arima et al. 2021). In addition, implementing sustainable production practices that comply with EU standards has increased the competitiveness of rubber products. However, Bolivia, the Dominican Republic, Guatemala, Honduras, and Côte d'Ivoire experienced a decline in rubber trade, turning into a falling star due to intensified competition and supply chain disruptions that worsened their competitiveness in the EU market (Noordwijk et al. 2021). X-Model analysis mapping based on RCA and EPD revealed significant competitiveness shifts between 2013-2017 and 2018-2022 (Table 3).
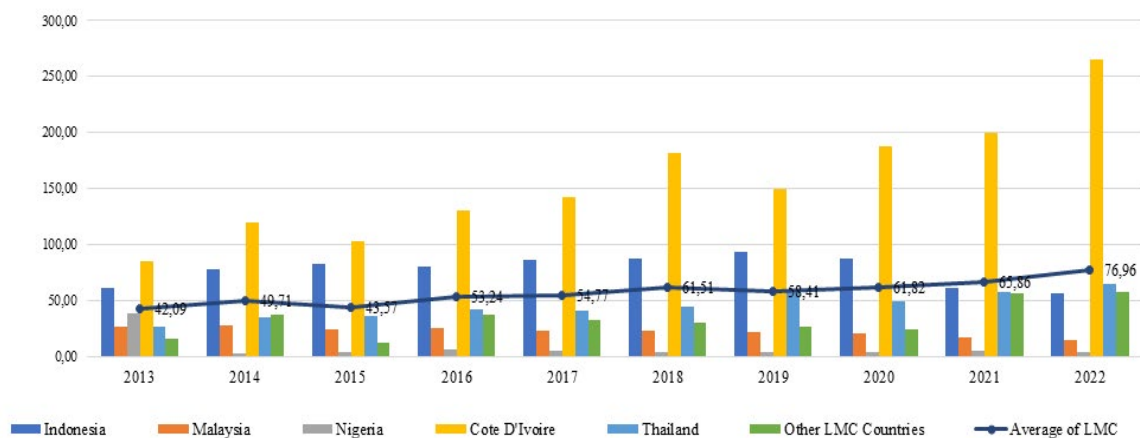

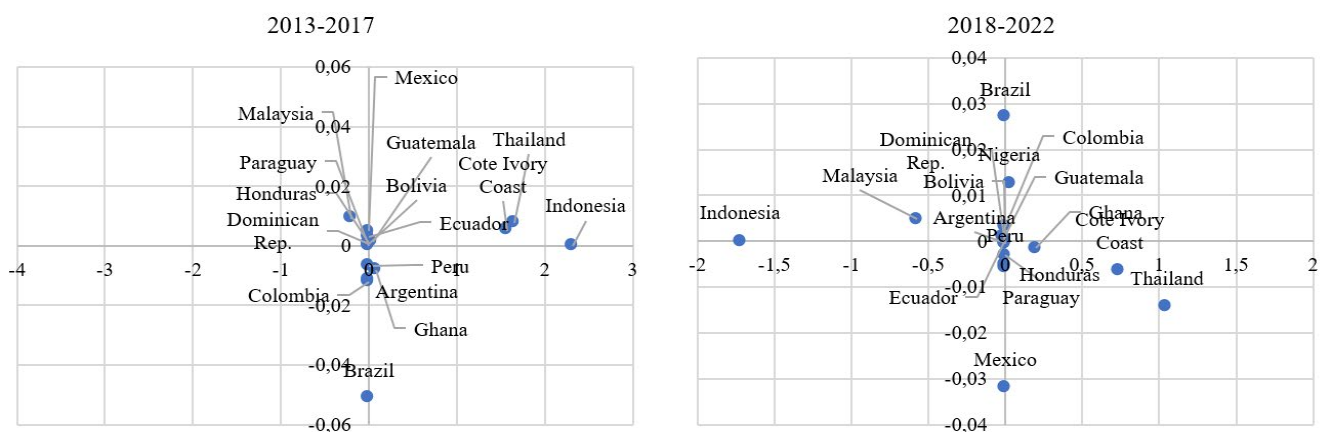Figure 2. Trend in rubber competitiveness (RCA) LMC in EU

Figure 3. Scatter plot (EPD) rubber of LMC in European Union

Table 3 shows that Indonesia, Ghana, Honduras, and Malaysia maintained their competitiveness in the potential category during both periods. Bolivia shifted from potential in 2013-2017 to less potential in 2018-2022, reflecting a decline in competitiveness. Brazil improved from less potential in 2013-2017 to potential in 2018-2022, showing a slight increase in competitiveness. During both periods, Peru remained in the lower potential category, indicating low competitiveness. Thailand moved from optimistic in 2013-2017 to potential in 2018-2022, suggesting a decline in competitiveness. Paraguay also shifted from potential to less potential, signaling a decrease in competitiveness. Colombia and Cote d'Ivoire have improved from less potential to potential, thereby increasing their competitiveness. Guatemala remained optimistic during 2013-2017 and shifted to potential in 2018-2022, indicating a positive change. The Dominican Republic has shifted from potential to no potential, signifying a significant decline. Ecuador maintained less potential in 2013-2017 and improved

its potential in 2018-2022, indicating a recovery in competitiveness. Nigeria has moved from having less potential to optimism, showing a notable improvement in competitiveness.

Determinant of EU rubber imports from LMC

Stochastic Frontier Analysis (SFA) with the Maximum Likelihood Estimation approach addresses heteroscedasticity and estimates export efficiency and potential imports. The SFA estimation used 45 data points for 2013-2017 and 40 data for 2018-2022 from nine countries (Brazil, Cote D'Ivore, Ghana, Guatemala, Indonesia, Malaysia, Meksiko, Nigeria, and Thailand). A gamma value (γ) of one, which is significant at the 1% level, confirms the robustness of the model. The sigma squared coefficient, which is also significant at the 1% level, indicates that the EU's rubber import potential from LMCs varies over time (Table 4).

Table 3. Rubber mapping of LMC countries in the European Union

Country	RCA		EPD		X-Model	
	2013-2017	2018-2022	2013-2017	2018-2022	2013-2017	2018-2022
Argentina	0.00	0.00	Falling Star	Falling Star	Less Potential	Less Potential
Bolivia	0.00	0.00	Rising Star	Falling Star	Potential	Less Potential
Brazil	0.00	0.00	Falling Star	Rising Star	Less Potential	Potential
Colombia	0.00	0.00	Falling Star	Rising Star	Less Potential	Potential
Cote D'Ivoire	115.69	196.31	Rising Star	Falling Star	Optimistic	Potential
Dominican Rep.	0.00	0.00	Rising Star	Retreat	Potential	No Potential
Ecuador	0.07	0.00	Lost opportunity	Rising Star	Less Potential	Potential
Ghana	18.51	22.05	Falling Star	Falling Star	Potential	Potential
Guatemala	8.57	16.66	Rising Star	Lost opportunity	Optimistic	Potential
Honduras	0.00	0.00	Rising Star	Falling Star	Potential	Potential
Indonesia	77.34	77.15	Falling Star	Lost opportunity	Potential	Potential
Malaysia	24.90	19.10	Lost opportunity	Lost opportunity	Potential	Potential
Mexico	0.00	0.00	Lost opportunity	Falling Star	Less Potential	Less Potential
Nigeria	11.26	3.71	Retreat	Rising Star	Less Potential	Optimistic
Paraguay	0.00	0.00	Rising Star	Falling Star	Potential	Less Potential
Peru	0.00	0.00	Falling Star	Falling Star	Less Potential	Less Potential
Thailand	35.71	54.48	Rising Star	Falling Star	Optimistic	Potential

Table 4 shows that the GDP of the European Union (EU) positively and significantly impacts the quantity of rubber imports from Like-Minded Countries (LMC), reflecting a strong link between EU economic growth and increased rubber demand, particularly in automotive and manufacturing sectors (Ramli & Yusof, 2023). Economic growth in developed countries boosts purchasing power and raw material needs, which are often sourced from outside domestic markets (Ansonfino et al. 2021). Major natural rubber producers, such as Indonesia, Malaysia, and Thailand, are key suppliers. The economic distance between EU and LMC countries (Brazil, Côte d'Ivoire, Ghana, Guatemala, Indonesia, Malaysia, Mexico, Nigeria, and Thailand) negatively affects rubber imports because of the higher costs associated with disparities in wealth, infrastructure, and technology (Coppens et al. 2018). Geographically, Antwerp, Belgium, as Europe's primary rubber import hub, plays a vital role in strategic location and efficient logistics (Das et al. 2020). The port's advanced infrastructure and efficient operations make it the preferred entry point for rubber (Meersman and Nazemzadeh, 2017).

Currency exchange rates in LMC countries have little effect on EU rubber imports, because production costs, logistics, and supply chain stability are more significant (Fatahillah et al. 2022). Higher rubber import prices negatively impact EU import quantities as consumers seek cheaper alternatives (Iskandar, 2018; Pasaribu et al. 2021). Conversely, higher prices of synthetic rubber positively influence natural rubber imports from the LMC because higher synthetic rubber prices increase the competitiveness of natural rubber (Laroche et al. 2022). Membership in free trade areas minimizes EU rubber imports, with factors such as quality and logistics being more significant. Linguistic similarities between the EU and LMC countries positively affect rubber imports by easing communication and transactions. Being landlocked does not significantly impact imports, as other factors such as production costs and proximity to the EU are more influential.

Efficiency and potential of rubber from LMC in the European Union

The results of the Stochastic Frontier Analysis show a significant change in the contribution of rubber exports from Like-Minded countries to the European Union, as shown in the efficiency value in Figure 3. As the largest exporter, Thailand has experienced a sharp jump from 27.19% to 91.78%, reflecting its increased dominance in the global rubber market, likely due to more aggressive trade policies and increased production (Hodijah et al. 2023). Indonesia also showed a significant increase, from 25.51% in the period 2013-2017 to 58.34% in 2018-2022, which indicates it is one of the world's leading exporters of natural rubber (Meliany & Novianti, 2022; Nugroho et al. 2022; Tiyastuti et al. 2023). On the other hand, the Ivory Coast experienced tremendous growth, from 8.21% to 78.30%, indicating the country's important role in supplying natural rubber to the European Union.

Table 4. Comparison of estimated SFA demand for rubber imports

Variable	2013-2017		2018-2022	
Constant	470.24 (1.00)	***	-165.95 (6.80)	***
$LnPDB_{jt}$	-14.83 (0.09)	***	5.92 (0.27)	***
$LnDISTRUB_{ijt}$	-0.78 (0.23)	***	0.66 (0.51)	ns
$LnEXCR_{ajt}$	0.16 (0.13)	ns	0.09 (0.13)	ns
$LnPM_{jt}$	-4.02 (0.75)	***	-2.65 (0.02)	***
$LnPY_{jt}$	8.57 (0.97)	***	2.14 (0.25)	***
delta	-0.62 (0.58)	ns	-13.01 (7.15)	*
Dummy FTA_{ajt}	-3.43 (0.41)	***	-3.50 (1.73)	*
Dummy $LANG_{aj}$	8.16 (0.99)	***	15.30 (6.88)	**
Dummy LL_a	0.00 (1.00)	ns	0.00 (1.00)	ns
σ^2	7.56 (0.63)	***	10.42 (3.28)	***
γ	1.00 (0.00)	***	1.00 (0.00)	***
Log-likelihood function	-88.11		-54.63	
Observation (N)	45	40		

Notes: ns (non-significant) ; * (significant 10%) ; ** (significant 5%) ; *** (significant 1%)

Figure 4 shows that Malaysia experienced a slight decline in its market share, from 46.84% to 49.73%, although it remains one of the major players in rubber exports to the EU (Yao & Guo, 2024). Nigeria and Ghana showed an increase in contribution from 1.61% to 9.13% and from 1.32% to 6.56%, respectively. This shows the growing potential of exports, although their contribution is still low compared to that of other countries (Samuel et al. 2021). Brazil and Mexico are still recorded with relatively small and stagnant contributions, with Brazil showing no contribution in 2018-2022 and Mexico declining slightly from 1.23% to 0.71%. This indicates the inability of these two countries to optimally utilize their natural rubber export potential, which may be due to structural issues in their production or trade policies. A comparison between the EU's actual and potential rubber imports from the LMC countries is presented in Table 5.

Based on the data in Table 5, there are significant differences between actual imports, predictions, and potential rubber exports from Like-Minded Countries to the EU. One of the main findings is that some countries, such as Brazil and Mexico, will make no real contribution to rubber exports to the EU in 2013-2017 and 2018-2022. Brazil has neither actual contribution nor measurable export potential, with predicted exports of 546.77 in 2013-2017 and 0 in 2018-2022. This suggests that Brazil does not optimally utilize its rubber export potential. Côte d'Ivoire also showed significant results. In 2013-2017, its actual exports reached 222.22, with a high prediction of 698,784.9, but there was substantial unrealized export potential (698,562.7). In 2018-2022, although actual exports increased to 318.86, there was still a significant difference between potential and actual exports, with a figure of -3,789.72. This shows that although Côte d'Ivoire has excellent potential for rubber exports to the EU, certain constraints hinder the optimization of exports (Zanli et al. 2022). Other countries, such as Ghana and Guatemala, also experienced a similar situation, where despite the high export potential, their actual exports were much lower than the predicted potential. A higher export potential value in SFA means that there is a domestic demand for rubber products, such as inner tubes, footwear, and rubber bands, as a multifunction for daily human activity (Khin et al. 2022). In addition, natural rubber still cannot be substituted in the EU, although the development of technological innovations refers to the synthesis of rubber owing to its practical use in the downstream industry (Umar et al. 2011).

Indonesia and Malaysia show significant differences in their actual and potential exports, respectively. Indonesia had very high actual exports in the 2013-2017 period (472.53), whereas in the 2018-2022 period, its actual exports declined to 380.58, although its potential exports remained high (380.58 in the latest period). This reflects a decline in competitiveness or problems in meeting EU market demand, which may be caused by trade policies or other external factors (Dhamira & Prasada, 2021; Nugroho et al. 2022). On the other hand, Malaysia experienced a significant decline, with actual exports falling from 189.48 in 2013-2017 period to 137.17 in 2018-2022, although its export potential remains (137.17 in the second period). This decline indicates that although Malaysia remains a major player in the rubber market, certain factors, such as competition from other countries or stricter market regulations, may affect its exports (Isnurhadi et al. 2023; Idayu et al. 2017; Isnurhadi et al. 2023).
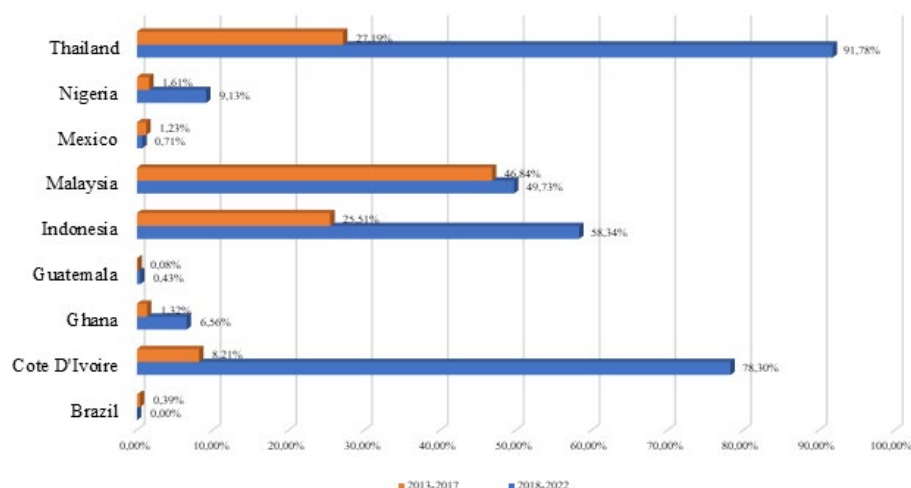

Figure 4. The value of the efficiency of EU rubber imports from LMC

Table 5. Comparison of actual and potential imports of LMC in the EU (thousand tons).

Country	2013-2017			2018-2022		
	Actual	Predicted	Potential	Actual	Predicted	Potential
Brazil	0.00	546.77	-546.77	0.00	0.00	0.00
Cote D'Ivore	222.22	698784.90	-698562.68	318.86	4108.58	-3789.72
Ghana	12.74	277178.70	-277165.95	15.10	2407.72	-2392.62
Guatemala	1.32	3380530.98	-3380529.65	1.80	4829.67	-4827.86
Indonesia	472.53	143.35	329.18	380.58	0.00	380.58
Malaysia	189.48	8.43	181.04	137.17	0.00	137.17
Mexico	0.00	3376.29	-3376.29	0.08	117.12	-117.04
Nigeria	27.60	131178.88	-131151.28	26.72	88.34	-61.62
Thailand	222.78	60.40	162.37	270.65	0.00	270.65

Thailand showed interesting results with a more consistent contribution to rubber exports to the EU. In 2013-2017, its actual exports were 222.78, with much lower predictions and potential. However, during 2018-2022, although Thailand's actual exports increased to 270.65, it still had unrealized export potential. This indicates that Thailand has a greater opportunity to increase rubber exports to the EU despite the uncertainty in predicting more significant exports (Usman et al. 2022; Baroh et al. 2024).

Managerial Implications

The findings of this study emphasize the importance of Like-Minded Countries in formulating efficient and sustainable export strategies to increase their competitiveness in the European Union market, which is increasingly stringent due to regulations such as the European Union Deforestation Regulation (EUDR). Countries such as Thailand, Indonesia, and Côte d'Ivoire, which have met EUDR sustainability standards, can use this policy to strengthen their positions in the global market by investing in technological innovation and environmentally friendly practices. Meanwhile, Brazil and Mexico, which are facing a decline in export contributions, need to adjust their policies to EUDR sustainability regulations and improve supply chain efficiency to maintain competitiveness in the European Union market. Overall, Like-Minded Countries must focus on developing capacities that support sustainability and efficiency in rubber production and exports to meet the EUDR regulatory demands and maintain their positions in the European Union market.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study analyzes rubber exports from Like-Minded Countries (LMC) to the EU, comparing actual and potential exports. This shows that countries such as Thailand, Indonesia, and Côte d'Ivoire have increased competitiveness, whereas Brazil and Mexico face stagnation. Sustainability policies, such as the EUDR, play a crucial role in enhancing export performance. However, some countries struggle to capitalize on their potential. The study is limited to rubber exports and focuses on 27 EU countries and 17 LMCs, which may not represent all developing nations involved in the rubber trade. These findings are also time-bound, which limits their future applicability. Hence, further studies could expand to other countries with a longer span.

Recommendations

Like-Minded Countries must implement an export enhancement strategy that focuses on sustainability and production efficiency to meet the standards set by the European Union. Countries such as Thailand, Indonesia, and Côte d'Ivoire can expand their investments in technological innovation and environmentally friendly practices to increase their competitiveness in the global market. However, countries such as Brazil and Mexico must evaluate and improve their trade policies to meet sustainability demands and improve efficiency in the rubber supply chain. Policies that support the development of production capacity in line with international standards and strengthen trade policies

can help these countries to compete more effectively in the EU market. In addition, rubber-producing countries must adapt to increasingly stringent global regulations to increase their competitiveness and dynamic market changes.

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