

Paradox Of Indonesia's Natural Rubber Export Competitiveness And The Improvement Of Farmers' Welfare

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ABSTRACT

Natural rubber is a strategic commodity for Indonesia with a strong comparative advantage in the global market; however, this advantage is not reflected in the welfare of smallholder farmers. This study aims to analyze the paradox between Indonesia's natural rubber export competitiveness and farmer welfare. A descriptive-comparative quantitative approach was employed using secondary data from 2010-2024 covering five major natural rubber exporting countries: Indonesia, Thailand, Vietnam, Côte d'Ivoire, and Malaysia. Export competitiveness was assessed using Revealed Comparative Advantage (RCA) and Revealed Symmetric Comparative Advantage (RSCA), while farmer welfare was evaluated through income, farm-gate rubber prices, and Farmer Exchange Rate (NTP) indicators. The results show that Indonesia consistently maintained a comparative advantage ($RCA > 1$; $RSCA > 0$), but competitiveness declined over time, with RCA decreasing from 32.47 in 2017 to 16.34 in 2024 and RSCA declining from 0.9321 in 2010 to 0.8847 in 2024. Meanwhile, farmer welfare remained vulnerable due to price volatility, low productivity, and weak bargaining power. These findings reveal a persistent paradox between strong export competitiveness and fragile farmer welfare. Therefore, integrated policies are needed to improve productivity, strengthen farmer institutions, stabilize prices, and promote downstream industrial development.

Keywords: export competitiveness, farmer welfare, natural rubber, RCA, RSCA.

INTRODUCTION

Natural rubber is a strategic commodity for the automotive, healthcare, and manufacturing industries. Indonesia is the second-largest producer and exporter in the world after Thailand, with an area of 3.15 million hectares and a production of 2.26 million tons in 2024 [1]. Indonesia competes with Thailand, Vietnam, Côte d'Ivoire, and Malaysia in the global market [2]. However, this

considerable potential contrasts with the paradoxical conditions faced by the national rubber sector, which warrant further investigation [3], [4], [5]

Behind Indonesia's position as the world's second-largest natural rubber producer lies a serious competitiveness paradox. National productivity remains only 700-900 kg/ha/year, far

below Thailand (1,500 kg/ha) and Vietnam (1,700 kg/ha), resulting in lower production efficiency [6]. Export value has also declined from USD 11.77 billion in 2011 to USD 2.90 billion in 2024, while Vietnam has shown a rapid increase in export performance [2]. Although RCA analysis indicates that Indonesia still possesses a comparative advantage, its competitive position has weakened and tends to decline, accompanied by the emergence of new competitors such as Côte d'Ivoire [7], [8]. This condition reflects a widening gap between production potential and export performance.

The paradox becomes more apparent when viewed from the welfare conditions of rubber farmers. Smallholder farmers earn only Rp300,000-Rp500,000 per month when rubber prices decline, compared with Rp800,000-Rp1,200,000 during more favorable market conditions [9]. Rubber prices are highly volatile, fluctuating between Rp5,000 and Rp15,000/kg and even falling to Rp5,000/kg, reducing farmer income by up to 44% [10], [11]. Globally, rubber prices tend to decrease by an average of 10.44% per year, while farmers remain price takers with limited bargaining power [12]. The dominance of intermediary traders in an oligopolistic market further reduces the share of value received by farmers, causing high export performance to coexist with stagnant welfare conditions [4], [13].

Various previous studies have examined rubber export competitiveness and farmer welfare separately. Low competitiveness in the rubber sector has been associated with weak plantation management and limited downstream industrial development, [3] while improvements in farmer welfare continue to be constrained by ecological and technological weaknesses despite relatively strong socio-economic conditions [5]. Indonesia's competitive position has been analyzed using RCA and ISP approaches [14], [15] and the establishment of a Rubber BPDP has been proposed as a structural solution to strengthen the sector [16]. However, most previous studies remain partial, focusing either on export competitiveness or farmer welfare without comprehensively integrating both dimensions and examining the causal mechanisms underlying the

paradox. This research gap is important because a comprehensive understanding of the relationship between national rubber export performance and farmer welfare at the micro level is essential for formulating effective and equitable policies.

This research aims to analyze the paradox between the competitiveness of Indonesia's natural rubber exports and the welfare of smallholder rubber farmers as the main producers. By integrating macro analysis of international trade and the micro perspective of farmers, this research identifies the root of the problem and formulates strategic policies. Theoretically, this study enriches the literature on agricultural economics and international trade related to the dissonance between export performance and producer welfare. Practically, the results are expected to serve as a policy basis for rubber downstreaming, strengthening farmer institutions, and stabilizing prices more fairly so that the benefits of exports are directly felt by farmers.

The primary novelty of this study lies in its integrative analytical framework, which simultaneously examines macro-level export competitiveness (RCA and RSCA) and micro-level farmer welfare (income, farm-gate prices, and the Farmer Exchange Rate) within a single, unified analysis. While previous studies have tended to treat these two dimensions separately, focusing either on trade performance [3], [7], [14], [15] or on farmers' socio-economic conditions [5], [9], [21], this study explicitly links both perspectives to reveal the causal disconnect between national export success and producer-level welfare. This integrative approach distinguishes the present study from prior partial analyses and offers a more holistic, policy-relevant understanding of the rubber sector paradox. These welfare-related conditions are further corroborated by recent household-level evidence, which reports similarly declining income, weakened bargaining power, and

growing dependence on non-farm income sources among rubber-farming households, reinforcing the empirical basis of the

arguments developed in this study [11], [21], [22].

RESEARCH METHOD

Data Collection Techniques

This study uses a descriptive-comparative quantitative approach with a longitudinal design based on secondary data. This study was conducted from January to March 2026, covering an analysis of the five main natural rubber exporting countries in the world, namely Indonesia, Thailand, Vietnam, Ivory Coast, and Malaysia, during the period 2010-2024. The five countries were purposively selected based on two inclusion criteria: (1) being among the top five global exporters of natural rubber according to data from the International Trade Center (ITC); and (2) the availability of complete and consistent export data throughout the observation period.

In accordance with the two dimensions of the problem in the research title, the collected data is divided into two groups. First, data to measure the competitiveness of natural rubber exports: the export value of natural rubber HS code 4001 and the total export value of all commodities from each sample country as well as global data, sourced from ITC Trade Map in USD (75 observations; 15 years $\times$ 5 countries). Second, data to analyze the conditions and opportunities for improving the welfare of Indonesian rubber farmers, operationalized thru three indicators: (a) average income of smallholder rubber farmers (Rp/month), (b) rubber prices at the farmer level (Rp/kg), and (c) the Farmer's Exchange Rate (NTP) in the plantation subsector. Data on farmer welfare indicators are sourced from the Central Statistics Agency (BPS), the Directorate General of Estates of the Ministry of Agriculture, and empirical studies from verified peer-reviewed scientific literature.

Data Analysis

Data analysis was conducted in three integrated stages. First, the competitiveness of natural rubber exports was measured and compared using RCA and RSCA, supported by trend analysis and descriptive statistics (mean, standard

deviation, minimum, and maximum). Second, farmer welfare was analyzed using indicators of Farmer Exchange Rate (NTP), income, and rubber prices, and then compared with competitiveness results to identify the paradox between export performance and farmer welfare. Third, strategic policy implications were formulated based on the synthesis of the findings and the best practices of comparator countries. All calculations were performed using Microsoft Excel 2021. The Revealed Comparative Advantage (RCA) method [17] was used to measure comparative advantage based on a commodity's export share in the world market. The formula is:

$$RCA = \frac{\left(\frac{X_{ij}}{X_{it}}\right)}{\left(\frac{X_{wj}}{X_{wt}}\right)}$$

where X_{ij} is the value of natural rubber exports from country i ; X_{it} is the total export of all commodities from country i ; X_{wj} is the total export of natural rubber worldwide; and X_{wt} is the total export of all commodities worldwide. Interpretation criteria: $RCA > 1$ indicates the presence of comparative advantage (competitiveness), while $RCA < 1$ indicates the absence of comparative advantage. To overcome the right-skewed distribution of RCA values, the Revealed Symmetric Comparative Advantage (RSCA) method [18] was employed. The formula is:

$$RSCA = \frac{RCA - 1}{RCA + 1}$$

RSCA values range from -1 to $+1$, where positive values indicate comparative advantage and negative values indicate comparative disadvantage. RCA and RSCA were used complementarily to provide more robust

competitiveness assessments. Data validity was ensured through source triangulation by comparing export data from ITC Trade Map with production data from BPS and the Directorate General of Estates, as well as verifying the analytical approach against previous studies [3], [14], [15]. Policy

It should be noted that RCA and RSCA, although widely used and robust as indicators of comparative advantage, capture only the trade-based dimension of competitiveness and do not fully represent a country's overall competitive position, which is also shaped by production efficiency, cost structure, product quality, and non-price factors such as certification and sustainability compliance [3], [19]. Accordingly, the RCA and RSCA results in this study are interpreted as measures of relative export specialization rather than as a comprehensive assessment of industry competitiveness, and they are complemented by an analysis of underlying structural factors in the Results and Discussion

recommendations were formulated through comparative analysis of rubber-sector strategies implemented in comparator countries that have successfully improved both export competitiveness and farmer welfare.

section. In addition, because the three farmer welfare indicators used in this study, namely income (Rp/month), farm-gate rubber prices (Rp/kg), and the Farmer Exchange Rate (NTP, an index number), originate from different sources and are expressed in different units and measurement periods, each indicator was analyzed descriptively within its own metric and interpreted according to its respective trend rather than combined into a single composite score. This approach avoids the measurement bias that could arise from forcing heterogeneous indicators onto one scale while still allowing triangulated conclusions to be drawn regarding the overall welfare condition of rubber farmers.

RESULTS AND DISCUSSION

Revealed Comparative Advantage (RCA) Analysis of Natural Rubber in Five Major Exporting Countries from 2010-2024

Based on RCA calculations, all five sample countries recorded RCA values greater than 1 throughout 2010-2024, indicating that natural

rubber (HS 4001) maintained a strong comparative advantage among the world's major exporters [17] However, substantial differences were observed in the magnitude and trends of RCA values across countries, as presented in Table 1.

Table 1. RCA Value of Natural Rubber (HS-4001) of the Top Five World Exporting Countries 2010-2024

Year	Indonesia	Thailand	Vietnam	Côte d'Ivoire	Malaysia
2010	28,44	24,75	17,71	40,51	8,82
2011	22,80	22,71	12,16	40,56	7,54
2012	20,95	19,29	11,04	37,70	5,67
2013	27,58	26,25	13,13	40,27	7,11
2014	29,97	29,42	12,35	52,99	6,64
2015	30,65	29,37	8,19	49,67	6,43
2016	31,40	27,81	6,71	69,71	6,19
2017	32,47	27,50	4,71	71,14	5,43
2018	32,08	26,71	5,73	93,50	5,53
2019	31,56	25,32	5,70	105,13	5,74
2020	29,06	23,93	4,40	131,47	5,28
2021	23,17	27,52	4,80	133,92	4,92

Year	Indonesia	Thailand	Vietnam	Côte d'Ivoire	Malaysia
2022	18,94	27,95	4,78	177,16	4,62
2023	18,15	24,50	4,55	211,76	4,94
2024	16,34	24,74	4,80	178,11	4,45
Average	26,24	25,85	8,05	95,57	5,95
Std. Deviation	5,62	2,68	4,18	58,23	1,20
Min	16,34	19,29	4,40	37,70	4,45
MaX	32,47	29,42	17,71	211,76	8,82

Source: Processed from ITC Trade Map (<https://www.intracen.org/resources/data-and-analysis/trade-statistics>), 2026.

Indonesia recorded an average RCA of 26.24 (SD = 5.62), peaking at 32.47 in 2017 before declining to 16.34 in 2024. Although still slightly higher than Thailand (25.85; SD = 2.68), Indonesia's RCA decreased by 49.7% during 2017–2024, indicating a substantial decline in competitiveness. This condition suggests that competitiveness is influenced not only by production scale but also by plantation management, industrial innovation, policy support, and productivity performance [3], [14]

Thailand maintained a relatively stable RCA (average 25.85; SD = 2.68), reflecting stronger export resilience than Indonesia. Its lower standard deviation and productivity of approximately 1,500 kg/ha, compared with Indonesia's 700–900 kg/ha, indicate a more efficient production system [1]. Previous studies also show that Indonesia's position in several rubber commodity segments remains relatively weak despite its strong RCA performance, highlighting inconsistencies between comparative and competitive advantages [15].

A striking phenomenon can be observed in Côte d'Ivoire, where RCA increased from 40.51 in 2010 to 211.76 in 2023 before slightly declining to 178.11 in 2024, with an average value of 95.57 (SD = 58.23). Although Indonesia still dominates 71.96% of the United States market, its competitiveness has shifted from a lost opportunity position toward retreat, while Côte d'Ivoire has strengthened its position [7]. Indonesia's competitive advantage also remains concentrated in the United States market, whereas its position

has weakened in Japan, China, India, and South Korea, reflecting a mismatch between high comparative advantage and broader market competitiveness [8].

Vietnam experienced the largest RCA decline among the five countries, falling from 17.71 in 2010 to 4.80 in 2024, a decrease of 72.9%. This trend reflects successful export diversification toward higher value-added manufacturing products, reducing the relative share of natural rubber in total exports despite stable export values. Malaysia consistently recorded the lowest RCA (average 5.95; SD = 1.20), confirming its long-term decline as a major rubber exporter. Although Malaysia's downstream rubber supply chain is relatively efficient, declining production capacity has limited the utilization of comparative advantages in processed rubber products [19].

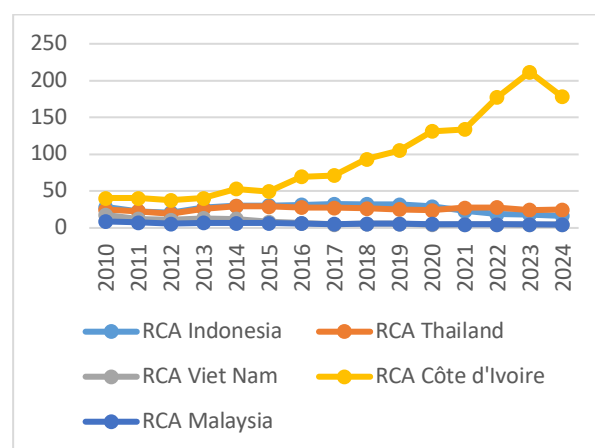


Figure 1. Development of RCA Value of Natural Rubber (HS-4001) of the Five Main Exporting Countries in the World from 2010–2024

Source: Processed from ITC Trade Map, 2026

Figure 1 illustrates the widening divergence in RCA performance among the sample countries. Indonesia's RCA increased until

reaching its peak in 2017, then declined sharply and consistently through 2024, indicating a reversal in competitiveness trends. Previous

evidence suggests that production factors and land area positively influence rubber exports, whereas exchange rates and export prices tend to have negative effects, implying that rupiah depreciation does not automatically improve competitiveness when production declines [20]. The reduction in production from 3.07 million tons in 2019 to 2.26 million tons in 2024, accompanied by a decline in plantation area from 3.72 million hectares in 2020 to 3.15 million hectares in 2024, has likely contributed to the downward trend in Indonesia's RCA [1], [6].

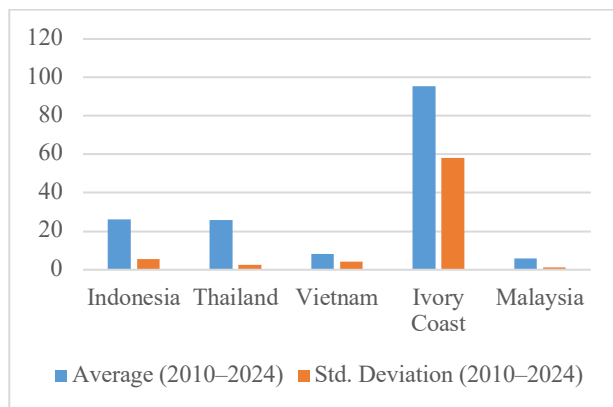


Figure 2. Average and Standard Deviation of RCA Value of Natural Rubber from the Five Main Exporting Countries 2010-2024

Source: Processed from ITC Trade Map, 2026.

Figure 2 further illustrates differences in export competitiveness among the five major natural rubber exporting countries by presenting both the average RCA values and their standard deviations during 2010–2024. Côte d'Ivoire recorded the highest average RCA (95.57), indicating the strongest comparative advantage among all countries, although it was accompanied by the largest variability (SD = 58.23), reflecting

rapid but unstable growth. Indonesia and Thailand showed relatively similar average RCA values of 26.24 and 25.85, respectively, confirming their strong comparative advantages in the global natural rubber market. However, Thailand exhibited the most stable competitiveness performance, as indicated by its lower standard deviation (SD = 2.68) compared with Indonesia (SD = 5.62). Vietnam and Malaysia recorded substantially lower average RCA values of 8.05 and 5.95, respectively, indicating weaker comparative advantages relative to the other exporting countries. Overall, the figure suggests that competitiveness should be assessed not only by the magnitude of average RCA but also by its stability over time, as reflected in the standard deviation values.

Previous studies indicate that Indonesia's competitiveness is concentrated primarily in the TSNR (Technically Specified Natural Rubber) segment, where RCA values exceed 1 and market shares remain dominant in the United States and Japan [20]. However, Indonesia ranks below Thailand in RSS (Ribbed Smoked Sheet) exports and remains unable to compete with Malaysia in the rubber glove industry, indicating that its comparative advantage is concentrated in a limited range of rubber products [20].

Analysis of Revealed Symmetric Comparative Advantage (RSCA) and Confirmation of Competitive Position

To confirm and adjust for the right-skewed distribution of RCA values, the RSCA method was applied as a complementary measure of comparative advantage [18] formula. The complete results are presented in Table 2.

Table 2. RSCA Value of Natural Rubber (HS-4001) of the Top Five World Exporting Countries 2010-202

Year	Indonesia	Thailand	Vietnam	Côte d'Ivoire	Malaysia
2010	0,9321	0,9223	0,8931	0,9518	0,7963
2011	0,9160	0,9156	0,8481	0,9519	0,7658
2012	0,9089	0,9014	0,8338	0,9483	0,7000
2013	0,9300	0,9266	0,8584	0,9515	0,7534
2014	0,9354	0,9343	0,8502	0,9630	0,7382
2015	0,9368	0,9341	0,7823	0,9605	0,7307

Year	Indonesia	Thailand	Vietnam	Côte d'Ivoire	Malaysia
2016	0,9383	0,9306	0,7407	0,9717	0,7217
2017	0,9403	0,9298	0,6495	0,9723	0,6887
2018	0,9395	0,9278	0,7027	0,9788	0,6939
2019	0,9386	0,9240	0,7014	0,9812	0,7032
2020	0,9335	0,9198	0,6295	0,9849	0,6814
2021	0,9173	0,9299	0,6549	0,9852	0,6623
2022	0,8997	0,9309	0,6539	0,9888	0,6444
2023	0,8955	0,9216	0,6397	0,9906	0,6631
2024	0,8847	0,9223	0,6554	0,9888	0,6329
Average	0,9231	0,9247	0,7396	0,9713	0,7051
Std. Deviation	0,0183	0,0084	0,0953	0,0155	0,0462

Source: Processed from ITC Trade Map, 2026.

The RSCA values of all five countries remained above 0 throughout 2010–2024, confirming the existence of comparative advantages in natural rubber exports. Côte d'Ivoire recorded the highest average RSCA (0.9713; SD = 0.0155) with a consistently increasing trend, while Thailand exhibited the greatest stability (average 0.9247; SD = 0.0084). Indonesia ranked third with an average RSCA of 0.9231 (SD = 0.0183), but its RSCA declined from 0.9321 in 2010 to 0.8847 in 2024, indicating a reduction of 0.0474 points over the study period.

Previous evidence suggests that ecological factors significantly constrain the sustainability of smallholder rubber agribusiness (coefficient = -0.376; $p < 0.001$), implying that land degradation and conversion to other commodities not only reduce production but also weaken Indonesia's long-term export competitiveness [5].

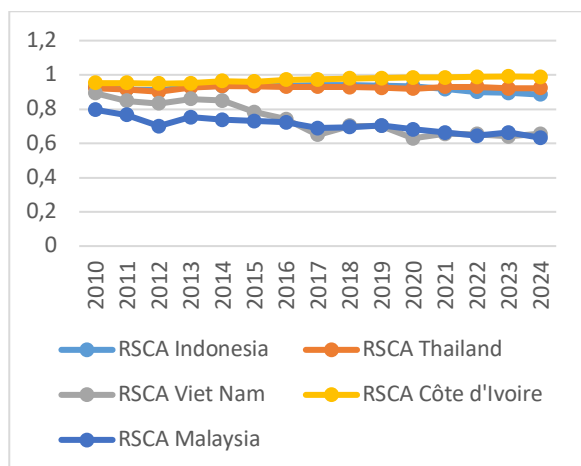


Figure 3. Development of RSCA Value of Natural Rubber (HS-4001) in the Five Main Exporting Countries Worldwide from 2010-2024

Source: Research data, processed by the author (2026)

Figure 3 illustrates RSCA trends from 2010 to 2024, facilitating cross-country comparisons. Indonesia's RSCA declined consistently, accelerating from 0.9173 in 2021 to 0.8847 in 2024. Vietnam experienced an even steeper decline, from 0.8931 to 0.6554, reflecting structural changes in its export composition. Indonesia's 2024 RSCA level is approaching Vietnam's 2010 position, suggesting the risk of a similar long-term decline without effective intervention.

The decline in competitiveness is also associated with weaknesses in upstream production. Despite a relatively efficient downstream supply chain (76-78%), processed rubber production at PT Industri Karet Nusantara decreased from 326 tons in 2009 to 297 tons in 2018, indicating that downstream efficiency alone is insufficient to offset stagnating upstream production capacity [19].

Table 3. Recapitulation of the Competitive Position of Natural Rubber Exports in 2024 and the Trend from 2010-2024

No.	Country	RCA 2024	RSCA 2024	Average RCA	Trend 2010-2024
1	Côte d'Ivoire	178,11	0,9888	95,57	Increased (+422.7%)
2	Thailand	24,74	0,9223	25,85	Relatively stable
3	Indonesia	16,34	0,8847	26,24	Declining (-49,7%)
4	Vietnam	4,80	0,6554	8,05	Declining (-72,9%)
5	Malaysia	4,45	0,6329	5,95	Gradually declining

Source: Processed from ITC Trade Map, 2026.

Table 3 summarizes the dramatic shift in the hierarchy of competitiveness. Côte d'Ivoire, which was in third place in 2010, now dominates the first position with an RCA of 178.11 and an RSCA of 0.9888. Indonesia, which was once in the leading position (2013-2019), has now been pushed to the third position. This shift is not just about the numbers; it is a warning signal that Indonesia's remaining comparative advantage (RCA = 16.34; RSCA = 0.8847) is in the process of erosion, which could lead to the loss of a strategic position in the global natural rubber market if not addressed promptly.

The Paradox between Export Competitiveness and the Welfare Condition of Indonesian Rubber Farmers

The RCA and RSCA results reveal the central paradox of this study: although Indonesia still maintains a comparative advantage in natural rubber exports (RCA = 16.34; RSCA = 0.8847 in 2024), the welfare of smallholder rubber farmers, who form the backbone of production, remains under pressure. This disparity becomes evident when export competitiveness indicators are compared with farmer welfare conditions.

On the income side, average farmer income declined from Rp800,000-Rp1,200,000 to only Rp300,000-Rp500,000 per month when rubber prices weakened, indicating that export competitiveness does not automatically translate into farmer welfare [9]. Farmers with 1–2 hectares of land may still meet basic needs (Rp455,000-Rp490,000 per week), but their welfare remains highly vulnerable to fluctuations in global rubber prices [21].

Price volatility represents a major structural challenge. Rubber prices fell from Rp8,000/kg in 2017 to Rp5,500/kg in 2018, reducing farmer income by 44% in Epil Village amid high production costs (Rp36,800,000/ha) and unequal land ownership [10]. In Surulangun, farmer income declined from Rp3-5 million to Rp1.5-2 million per month, accompanied by reductions in food consumption (37.5%), education expenditure (58.3%), and health expenditure (66.7%) [11]. Price instability and dependence on weather conditions further increase farmers' economic vulnerability [22].

The transmission of international prices has also failed to fully benefit farmers. The elasticity of SICOM price transmission was estimated at 1.0980, suggesting that increases in global prices should be transmitted proportionally to farm-gate prices [12]. However, farmers continue to act as price takers due to adjustment costs and the dominance of intermediary traders. Asymmetric value-chain governance in Jambi allows farmers to receive only 40–60% of auction prices, causing a larger share of value added to be captured by traders, exporters, and industries [23].

Although the Farmer Exchange Rate (NTP) reached 116.79 in April and 120.70 in October 2024 [24], these figures do not necessarily indicate real welfare improvements because living and production costs have also increased. This condition has been described as “illusory welfare,” where rubber-producing regions remain associated with poverty due to dependence on global markets and weak local institutions [4]. Furthermore, the agribusiness model explained only 9.9% ($R^2 = 9.9\%$) of welfare variation, indicating that many

determinants of farmer welfare remain unaddressed [5].

Structural Factors Underlying the Decline in Indonesia's Rubber Export Competitiveness

Beyond the descriptive RCA and RSCA trends presented above, the declining trajectory of Indonesia's competitiveness can be explained by at least five interrelated structural factors. First, productivity remains the most fundamental constraint: at 700-900 kg/ha/year, Indonesia's yield is roughly half that of Thailand (1,500 kg/ha) and considerably below Vietnam (1,700 kg/ha) [6], so that even with a larger planted area, Indonesia's export volume growth cannot keep pace with more efficient competitors. Second, rising production costs relative to farm-gate prices erode farmers' incentive to maintain and rejuvenate their plantations; in Epil Village, for example, production costs reached Rp36,800,000/ha while farm-gate prices fell sharply, discouraging reinvestment and accelerating the aging of rubber trees [10]. Third, weak plantation management, including the continued use of unimproved planting materials and limited adoption of good agricultural practices, has constrained yield improvement despite Indonesia's large cultivated area [3], [6]. Fourth, market structure plays a decisive role: the oligopolistic dominance of intermediary traders and asymmetric value-chain governance allow farmers to capture only 40-60% of auction prices [23], weakening the price signal that would otherwise incentivize productivity investment, while Indonesia's export concentration in a narrow set of destination markets, primarily the United States, leaves it more exposed to demand shocks than more diversified competitors such as Côte d'Ivoire [7], [8]. Fifth, government policy support, particularly the absence of a dedicated funding and coordination institution comparable to a Rubber BPDP, has limited the scale and consistency of replanting programs, research investment, and compliance with emerging international sustainability requirements such as the EUDR [16]. Taken together, these five factors, namely productivity, production costs, plantation management, market structure, and policy support, reinforce one another in a self-perpetuating

manner: low productivity raises unit costs, which discourages reinvestment and in turn perpetuates low productivity, while weak policy coordination and an unfavorable market structure prevent this cycle from being broken. This structural interpretation moves beyond the purely descriptive RCA/RSCA trends reported earlier and provides the analytical basis for the policy directions discussed in the following section.

Implications of Strategic Policies for Improving Farmers' Welfare

The synthesis of competitiveness and farmer welfare analyses reveals a negative feedback loop in the natural rubber sector. Low farm-gate prices reduce investment and plantation maintenance, leading to lower productivity, declining export performance, reduced RCA values, and a weaker bargaining position in the global market. Breaking this cycle requires integrated interventions across the entire rubber value chain.

Price stabilization and institutional strengthening are essential to enable farmers to participate in higher value-added activities rather than merely supplying raw materials. Strengthening Farmer-Owned Enterprises, UPPB, and cooperatives can improve value-chain governance, create a fairer distribution of benefits, and enhance farmers' bargaining power [4], [12], [23].

Low productivity relative to competing countries highlights the urgency of replanting programs and the adoption of superior planting materials. Significant productivity gaps remain between Indonesia and major competitors such as Thailand and Vietnam [6]. Improving plantation management, technological adoption, and farmer capacity is therefore critical for strengthening competitiveness [3]. In addition, the establishment of a Rubber BPDP funded through export cess revenues has been proposed to support replanting, downstream development, research, and compliance with international standards such as the EUDR [16].

Market diversification and stronger domestic consumption are also important policy priorities. Increased domestic rubber consumption

has been shown to improve prices and farmer welfare [25]. Given that approximately 85% of production is export-oriented, the Demand Promotion Scheme is considered a relevant instrument for price stabilization. Expanding exports to emerging markets such as China, India, and South Korea, while maintaining access to established markets such as the United States, may further strengthen competitiveness [8].

Value-added downstream development offers additional opportunities to enhance competitiveness. Although the downstream rubber supply chain is relatively simple and efficient, declining production capacity has limited the utilization of comparative advantages in processed rubber products [19]. Furthermore, the use of local raw-material innovations such as Antiox-TMQ has the potential to reduce production costs by up to 75%, decrease import dependence, and improve industrial efficiency [26].

CONCLUSION

This study confirms a persistent paradox between Indonesia's strong natural rubber export competitiveness and the fragile welfare of smallholder farmers. Although RCA and RSCA values remained above the comparative advantage threshold throughout 2010–2024, both indicators showed a declining trend, while farmer welfare continued to be constrained by price volatility, low productivity, and weak bargaining power. These findings imply that macro-level export success does not automatically translate into producer-level welfare. However, this study is limited by its

Income diversification and social protection also play important roles in reducing farmer vulnerability. Many farmers rely on non-farm activities to cope with price fluctuations, highlighting the importance of training programs, access to capital, and targeted subsidies [11], [22]. Farmer welfare is influenced not only by income levels but also by price stability, household basic needs, and broader socio-economic conditions [9], [21].

Overall, these policy measures are mutually reinforcing. Higher productivity strengthens export competitiveness, institutional improvements ensure a fairer distribution of benefits, downstream development increases value added, and market and income diversification reduce exposure to price volatility. Because downstream efficiency cannot be sustained without strong upstream production, policy implementation should be conducted simultaneously and in a coordinated manner [19].

exclusive reliance on secondary data and the absence of primary farmer-level observations. Therefore, future research should incorporate household surveys and advanced econometric approaches, such as panel data regression or structural equation modeling, to empirically test the causal pathways linking trade competitiveness, market structure, and farmer welfare, as well as conduct comparative policy studies with countries like Thailand and Malaysia that have achieved more stable farmer welfare outcomes.

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