

Export Competitiveness Dynamics of Indonesian Black and White Pepper in the ASEAN Market: Evidence from RCA and ECI Analysis, 2014–2023

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Abstract. Indonesia is one of the world's major pepper producers, and ASEAN remains an important export market for Indonesian black and white pepper. However, export performance has fluctuated over the last decade due to production instability, price volatility, competition from Vietnam, and changing market requirements. This study analyzes export dynamics and evaluates the comparative and dynamic competitive advantages of Indonesian black and white pepper in the ASEAN market during 2014–2023. The study contributes to the literature by separately examining black and white pepper in major ASEAN destination markets using Revealed Comparative Advantage (RCA) and Export Competitiveness Index (ECI) analyses. Secondary time-series data on export volume and value were obtained from UN Comtrade, ITC Trade Map, FAOSTAT, Statistics Indonesia, and the Ministry of Agriculture, using HS codes 090411 for black pepper and 090412 for white pepper. Results show that Indonesian pepper exports to ASEAN were highly volatile. Black pepper exports to Vietnam declined after peaking in 2015, while white pepper exports displayed unstable performance across destination markets. RCA results indicate strong comparative advantages for black pepper exports to Vietnam and Singapore and for white pepper exports to Malaysia. However, ECI findings reveal fluctuating dynamic competitiveness, particularly for white pepper exports. Strengthening Indonesia's pepper export competitiveness requires improvements in post-harvest handling, standardization of quality standards, value-added processing, logistics efficiency, and compliance with export and sanitary standards. Stronger farmer–exporter linkages and value-chain upgrading are also needed to enhance the long-term competitiveness of Indonesia's smallholder-based pepper agribusiness in the ASEAN market.

Keywords: Export Competitiveness; Black Pepper; White Pepper; RCA; ECI

INTRODUCTION

Pepper (*Piper nigrum*) is one of Indonesia's important spices and plantation commodities, with a strategic role in food, agro-industry, and export-oriented agricultural trade (Ministry of Agriculture of the Republic of Indonesia, 2022). As one of the world's leading pepper-producing countries, Indonesia holds a strategic position in the global pepper trade. This commodity is vital not only for earning foreign exchange but also for supporting farmers' livelihoods and driving local economic activity in major pepper-producing regions. In this context, pepper plays a significant role in both agriculture and the country's export performance. Indonesia's participation in international trade further emphasizes the importance of pepper, as the commodity competes with other producing countries in meeting global and regional demand, including demand from ASEAN markets (International Trade Centre, 2025). More

broadly, export competitiveness is increasingly shaped by integration into global value chains and by industries' ability to strengthen their export positions over time (Jangam et al., 2024). To strengthen the competitiveness of Indonesian pepper exports, improvements are needed not only in production capacity but also in quality management, Good Agricultural Practices, and compliance with international market standards (Azahari et al., 2021). However, Indonesia's position in the international pepper market remains sensitive to fluctuations in global prices, shifts in demand from importing countries, and competition from other major producers. These factors highlight the need for ongoing assessment of Indonesia's export performance and competitiveness.

From the production perspective, Indonesia's pepper sector has shown signs of pressure in recent years. Data from FAO (2025) indicate that pepper production in Indonesia has fluctuated over the last decade, with a downward overall trend. In 2023, national pepper production was recorded at only around 70,169 tons, suggesting constraints on Indonesia's supply capacity. Such production instability may affect the country's ability to meet export demand, including demand from ASEAN markets consistently. At the same time, ASEAN remains a promising market due to geographical proximity, intensive trade relations, and the presence of regional trade agreements. The ASEAN region is also relevant to competitiveness analysis because agri-food export competitiveness among ASEAN countries varies across commodities and markets, reflecting differences in trade structures, production capacities, and market specialization (Mizik, 2020). Vietnam, Singapore, and Malaysia are among the main ASEAN destinations for Indonesian pepper exports during the study period, as reflected in annual export data from Trade Map (International Trade Centre, 2025).

Pepper cultivation in Indonesia is predominantly managed by smallholder farmers, making export competitiveness closely linked to farmer productivity, post-harvest practices, market access, and supply-chain efficiency. Consequently, fluctuations in export performance not only affect national foreign exchange earnings but also influence the sustainability of rural livelihoods and regional agribusiness development in major pepper-producing areas. In this context, strengthening pepper export competitiveness requires improvements not only in production but also in value addition, quality upgrading, logistics, and integration within regional agricultural value chains (Abidin et al., 2021; Beghin et al., 2023).

Despite these opportunities, Indonesian pepper exports still face several structural challenges. These include price volatility, inconsistent product quality, supply chain inefficiencies, and intense competition from major producing countries such as Vietnam (Azahari et al., 2021). Recent studies also show that export competitiveness in agricultural

commodities is increasingly determined by the efficiency of global value chains, compliance with sanitary and phytosanitary (SPS) standards, and the ability to meet non-tariff requirements imposed by importing countries (Beghin et al., 2023; Peng, 2023). In ASEAN agricultural trade, differences in food safety standards, pesticide residue limits, quality certification systems, and supply chain coordination can significantly affect the export performance of spice commodities, including pepper. Weak market integration and inefficient marketing systems may also lower export responsiveness and competitiveness in regional markets (Hanani et al., 2020; Haryati et al., 2021). Additionally, poor coordination among farmers, traders, processors, and exporters can reduce exporting countries' ability to maintain a stable supply and consistent product quality in international markets (Abidin et al., 2021).

Although previous studies have examined the competitiveness of Indonesian pepper exports, most have analyzed pepper as a single aggregated commodity, focused primarily on global markets, or relied mainly on static competitiveness indicators. Limited empirical attention has been given to the different competitiveness patterns of black pepper and white pepper in specific ASEAN destination markets, even though these two products may face different demand structures, quality requirements, and market dynamics. In addition, studies that combine Revealed Comparative Advantage (RCA) and Export Competitiveness Index (ECI) remain limited, particularly in capturing both structural comparative advantage and dynamic export competitiveness over time. Therefore, the novelty of this study lies in separately analyzing Indonesian black pepper and white pepper exports in major ASEAN destination markets, namely Vietnam, Singapore, and Malaysia, by integrating RCA and ECI approaches. Therefore, this study aims to analyze export developments and measure the comparative and dynamic competitive advantages of Indonesian black and white pepper exports in the ASEAN market during the period 2014–2023.

METHODS

This study employed a descriptive, quantitative approach to analyze the dynamics of export competitiveness for Indonesian black and white pepper in the ASEAN market during 2014–2023. This approach was used to examine changes in export volume and export value and to evaluate Indonesia's competitive position across selected ASEAN destination markets. The analysis focused on export performance, comparative advantage, and dynamic export competitiveness of Indonesian pepper in Vietnam, Singapore, and Malaysia.

The study used annual secondary time-series data on Indonesian black and white pepper export volume (kg) and export value (US\$), world pepper exports, and Indonesian pepper exports to three major ASEAN destination countries: Vietnam, Singapore, and Malaysia. These

countries were selected because they represent important ASEAN markets for Indonesian pepper exports during the observation period. Vietnam was selected due to its dominant role as both a major pepper importer and a global re-exporter; Singapore, because of its strategic position as a regional trade and logistics hub; and Malaysia, due to its relatively stable white pepper import demand and food-processing industries. These countries also accounted for a substantial share of Indonesia's pepper exports and provided relatively consistent trade data during 2014–2023.

Black pepper was classified under HS code 090411, while white pepper was classified under HS code 090412. Export volume and export value data were primarily obtained from UN Comtrade and ITC Trade Map, while production data were sourced from FAOSTAT and Statistics Indonesia. Supporting information on national pepper development and export policies was obtained from publications of the Ministry of Agriculture. Data consistency was ensured by cross-checking export values, measurement units, and HS classifications across data sources.

To provide a comprehensive assessment of export performance and competitiveness, the analysis consisted of three stages: export growth analysis, Revealed Comparative Advantage (RCA), and Export Competitiveness Index (ECI). All analyses were conducted separately for black pepper and white pepper and for each selected ASEAN destination country.

Export Growth Analysis

Export growth analysis was used to describe changes in Indonesia's pepper exports to the ASEAN market during 2014–2023. The analysis was conducted by calculating the annual growth rate of export volume and export value for black and white pepper exports to Vietnam, Singapore, and Malaysia. The export growth rate, expressed as the Growth Ratio (GR), was calculated using Equation (1):

$$Grow Ratio = \frac{Present - Past}{Past} \times 100\% \dots\dots\dots (1)$$

where GR represents the annual growth ratio of export volume or export value, Present refers to export volume or export value in the current year, and Past refers to export volume or export value in the previous year. A positive GR indicates an increase in export performance compared with the previous year, while a negative GR indicates a decline. This analysis enables the identification of periods of expansion and contraction in pepper exports by commodity type and destination country. In several years, export values or volumes were recorded as zero or extremely small, particularly for white pepper exports. Therefore, growth rates involving zero

values in the previous year were not interpreted as normal percentage changes and were marked as unavailable where necessary to avoid misleading results.

Revealed Comparative Advantage (RCA)

The Revealed Comparative Advantage (RCA) index was used to measure the comparative advantage of Indonesian pepper exports in the ASEAN market. RCA compares the share of a particular commodity in a country's total exports with the share of the same commodity in world exports. In this study, RCA values were calculated separately for black pepper (HS 090411) and white pepper (HS 090412) exported by Indonesia. The RCA index was calculated using Equation (2):

$$RCA = \frac{X_{ik}/X_{it}}{X_{wk}/X_{wt}} \dots\dots\dots (2)$$

In Equation 2, (X_{ik}) represents the export value of commodity (k) from country (i), (X_{it}) represents the total export value of all commodities from country (i), (X_{wk}) represents the world export value of commodity (k), and (X_{wt}) represents the total world export value of all commodities. In this study, country (i) refers to Indonesia, while commodity (k) refers to black pepper under HS code 090411 and white pepper under HS code 090412. The RCA values were calculated separately for each pepper type and ASEAN destination market to identify differences in Indonesia's comparative advantage across Vietnam, Singapore, and Malaysia. An RCA value greater than 1 indicates that Indonesia has a revealed comparative advantage in the corresponding pepper commodity. In contrast, an RCA value less than 1 indicates the absence of a comparative advantage. In the agribusiness trade context, RCA helps explain whether Indonesia's pepper exports exhibit stronger specialization than the world average.

Export Competitiveness Index (ECI)

The Export Competitiveness Index (ECI) was used to evaluate changes in export competitiveness over time. While RCA reflects structural comparative advantage, ECI captures the dynamics of export share between two consecutive periods. In this study, ECI was calculated separately for black pepper and white pepper exports from Indonesia to Vietnam, Singapore, and Malaysia during 2014–2023. The ECI was calculated using Equation (3):

$$ECI = \frac{(X_{ik}/X_{wk})^t}{(X_{ik}/X_{wk})^{t-1}} \dots\dots\dots (3)$$

In Equation 3, (X_{ik}) represents the export value of pepper commodity (k) from country (i), (X_{wk}) represents the world export value of pepper commodity (k), (t) represents the current year, and (t-1) represents the previous year. In this study, country (i) refers to Indonesia, while commodity (k) refers to black pepper under HS code 090411 and white pepper under HS code

090412. The ECI values were calculated separately for each pepper type and ASEAN destination market to assess changes in Indonesia's export share over time. An ECI value greater than 1 indicates an increase in Indonesia's export share and reflects improving dynamic export competitiveness. In contrast, an ECI value below 1 indicates a decline in export share and a weakening of dynamic competitiveness. Because ECI is sensitive to very small base-year export values, unusually high ECI values were interpreted carefully, particularly for white pepper exports with small or zero export bases in certain years.

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RESULT AND DISCUSSION

Development of Indonesian Pepper Exports in the ASEAN Market

This study shows that Indonesia's pepper exports to ASEAN (Vietnam, Singapore, and Malaysia) during 2014–2023 experienced strong fluctuations both in volume and value for black and white pepper. Overall, Indonesian pepper exports to ASEAN during 2014–2023 were characterized by strong volatility and declining performance in several markets rather than a consistent upward trend. These fluctuations in global pepper prices were influenced by volatile domestic production, competition from Vietnam, and regional differences in market demand.

Export Volume of Black Pepper

Vietnam and Singapore are the main destinations for Indonesian black pepper exports in the ASEAN market (International Trade Centre, 2025). Table 1 reports the development of Indonesia's black pepper export volume and its annual growth rate to both countries over the period 2014–2023. Overall, exports to these destinations exhibit a highly fluctuating pattern, with sharp increases in some years followed by substantial declines in subsequent years (International Trade Centre, 2025). The decline in export values reflects not only lower export volumes but also structural weaknesses along the pepper value chain. Limited post-harvest innovation, inconsistent quality control, low product differentiation, and dependence on bulk commodity exports reduce Indonesia's ability to obtain higher export prices in regional and international markets. Previous studies also suggest that weak coordination among actors within

agricultural value chains may reduce supply-chain efficiency and increase export vulnerability to market shocks (Abidin et al., 2021; Beghin et al., 2023).

Table 1. Development of Indonesian Black Pepper Export Volume in the ASEAN Market

Year	Vietnam – Export volume (kg)	Growth (%)	Singapore – Export volume (kg)	Growth (%)
2014	5,914,520	-49.22	8,069,992	35.95
2015	22,644,753	282.87	6,631,086	-17.83
2016	19,102,912	-15.64	3,224,178	-51.38
2017	16,336,430	-14.48	2,688,001	-16.63
2018	23,277,857	42.49	1,593,199	-40.73
2019	21,371,702	-8.19	419,536	-73.67
2020	21,064,933	-1.44	871,754	107.79
2021	8,147,611	-61.32	962,084	10.36
2022	5,734,996	-29.61	627,046	-34.82
2023	3,410,616	-40.53	676,743	7.93
Average	14,700,633	10.49	2,576,362	-7.30

Source: UN Comtrade (processed), 2025.

As shown in Table 1, the export volume of Indonesian black pepper to Vietnam reached its highest level in 2015 at 22.64 million kg, then gradually declined to 3.41 million kg in 2023. Over the past ten years, the average export volume to Vietnam was 14.70 million kg per year, indicating that although Vietnam remains a major market, Indonesia's position has weakened in recent years (International Trade Centre, 2025). In contrast, exports to Singapore were much smaller and more volatile. The highest export volume to Singapore was recorded in 2014 at 8.07 million kg, after which it declined, with several years of negative growth or fluctuation, ultimately dropping to 0.68 million kg in 2023. The average export volume to Singapore during the studied period was only 2.58 million kg per year. This pattern reflects Singapore's role more as a trade and re-export hub than as a large final consumer market, making its import demand highly sensitive to global trade trends, logistics connectivity, and re-export requirements (Jones et al., 2020).

The sharp contraction in black pepper exports to both Vietnam and Singapore after the mid-2010s suggests that Indonesia is facing increasing competitive pressure, particularly from Vietnam, which has strengthened its position as a major producer, exporter, and trader in the global pepper market (Azahari et al., 2021). In addition, external factors such as changes in importing countries' demand, export prices, market competition, and trade policy dynamics may contribute to the volatility of Indonesia's black pepper exports in regional and global markets. This volatility is also closely related to the extent to which export-oriented industries are integrated into global value chains and able to respond to changing market conditions (Jangam et al., 2024; United Nations Conference on Trade and Development, 2021).

Export Volume of White Pepper

Table 2 reports the development of Indonesia's white pepper export volume and its annual growth rate to Vietnam, Singapore, and Malaysia over the period 2014–2023. In general, the export volume of white pepper shows significant fluctuations across years and destination countries, with several extreme increases followed by sharp declines (International Trade Centre, 2025).

Table 2. Development of Indonesian White Pepper Export Volume in the ASEAN Market

Year	Vietnam – Export volume (kg)	Growth (%)	Singapore – Export volume (kg)	Growth (%)	Malaysia – Export volume (kg)	Growth (%)
2014	66,743	33.31	65	58.54	2,801	–
2015	49,855	-25.30	742	1,041.54	5,628	100.93
2016	191,823	284.76	4,059	447.04	935	-83.39
2017	28,051	-85.38	5,418	33.48	1,125	20.32
2018	28,000	-0.18	870	-83.94	3,414	203.47
2019	79,850	185.18	328	-62.30	14,357	320.53
2020	41	-99.95	234	-28.66	5,242	-63.49
2021	137,600	335,509.76	37,479	15,916.67	33,426	537.66
2022	0	-100.00	3,413	-90.89	5,202	-84.44
2023	15,000	–	1,072	-68.59	6,486	24.68
Average	59,696	37,300.24	5,368	1,716.29	7,862	108.48

Source: UN Comtrade (processed), 2025.

Note: Extremely high growth values should be interpreted with caution because very small export volumes may strongly influence them in the preceding year. Growth rates calculated from zero or near-zero base values do not necessarily reflect a sustained improvement in export performance.

White pepper export volumes to Vietnam, Singapore, and Malaysia showed significantly different patterns during the study period. Exports to Vietnam were highly volatile, with sharp increases in certain years, including 191.82 thousand kg in 2016 and 137.60 thousand kg in 2021, before dropping to zero in 2022 and recovering only slightly in 2023. A similar unstable pattern was observed in Singapore, where export volumes remained very low overall, despite a temporary spike to 37.48 thousand kg in 2021. These fluctuations indicate that Indonesia's white pepper exports to Vietnam and Singapore are highly sensitive to short-term market conditions, re-export dynamics, and changes in regional trade flows (Safitri et al., 2025).

In contrast, white pepper exports to Malaysia showed a relatively more positive and consistent trend. Although export volumes were generally lower than those to Vietnam in peak years, they increased substantially in several periods and remained positive at 6.49 thousand kg in 2023, suggesting relatively more stable demand in the Malaysian market than in Vietnam and Singapore (International Trade Centre, 2025). Overall, these patterns suggest that

agricultural export performance is shaped not only by export volume but also by product quality, distribution efficiency, and bilateral trade linkages. Markets with stronger institutional and logistical relationships, such as Malaysia, tend to exhibit more stable import patterns, whereas re-export-oriented markets such as Singapore and, to some extent, Vietnam are more volatile (Ernah et al., 2024).

Export Value of Black Pepper

Table 3 presents the development of Indonesia's black pepper export value and its annual growth rate to Vietnam and Singapore during the period 2014–2023. In value terms, the pattern of black pepper exports mirrors the volume trend, but with even sharper peaks and troughs, indicating high volatility across destination markets (International Trade Centre, 2025).

Table 3. Development of Indonesian Black Pepper Export Value in the ASEAN Market

Year	Vietnam – Export value (US\$)	Growth (%)	Singapore – Export value (US\$)	Growth (%)
2014	47,217,983	-39.00	83,288,091	81.71
2015	179,638,731	280.45	78,168,481	-6.15
2016	121,026,891	-32.63	34,579,583	-55.76
2017	67,971,817	-43.84	18,325,855	-47.00
2018	56,431,304	-16.98	7,232,552	-60.53
2019	46,518,820	-17.57	1,620,887	-77.59
2020	47,229,052	1.53	3,353,604	106.90
2021	31,688,914	-32.90	4,954,696	47.74
2022	28,684,822	-9.48	3,520,353	-28.95
2023	14,623,545	-49.02	3,628,793	3.08
Average	64,103,188	4.06	23,867,290	-3.66

Source: UN Comtrade (processed), 2025.

Note: Extremely high ECI values, particularly for white pepper exports in 2021, should be interpreted carefully, as they may reflect very small base-year export volumes or temporary market shocks rather than stable improvements in dynamic export competitiveness.

As shown in Table 3, the export value of Indonesian black pepper to Vietnam reached its highest level in 2015 at 179.64 million US\$, an increase of more than 280% compared to the previous year. After this peak, export values declined almost continuously, reaching 14.62 million US\$ in 2023. Over the past ten years, the average export value to Vietnam was 64.10 million US\$ per year, suggesting that although Vietnam remains a key market, Indonesia's export performance in value terms has weakened in recent years (International Trade Centre, 2025).

Exports of black pepper to Singapore also show a declining long-term trend. The highest export value to Singapore was recorded in 2014 at 83.29 million US\$, after which it decreased sharply and stabilized at around 3–5 million US\$ in the final years of the observation period, with 3.63 million US\$ in 2023. The average export value to Singapore during 2014–2023 was

23.87 million US\$ per year, significantly lower than that to Vietnam, indicating that Indonesia's black pepper exports to both markets have experienced a substantial erosion in value over time (International Trade Centre, 2025)

The decline in export values reflects not only lower export volumes but also potential issues with prices and limited value addition along the pepper value chain. Previous studies indicate that weak coordination within agricultural value chains, inefficiencies in distribution systems, and limited downstream processing reduce exporting countries' ability to capture higher added value in international markets (Abidin et al., 2021; Beghin et al., 2023). These findings align with previous studies emphasizing that improving product quality, value-chain efficiency, and compliance with international standards is essential for maintaining agricultural export competitiveness, including Indonesian pepper exports (Azahari et al., 2021; Beghin et al., 2023). The decline in export value should be understood not only as a consequence of lower export volume but also as a reflection of potential price changes, differences in product quality, and limited value addition. In the agribusiness trade, export value is influenced by both quantity and the ability to meet market requirements, including quality consistency, processing standards, and buyer specifications.

Table 4. Development of Indonesian White Pepper Export Value in the ASEAN Market

Year	Vietnam – Export value (US\$)	Growth (%)	Singapore – Export value (US\$)	Growth (%)	Malaysia – Export value (US\$)	Growth (%)
2014	117,855	-67.84	660	114.98	63,108	–
2015	271,588	130.44	6,856	938.79	28,766	-54.42
2016	1,233,342	354.12	12,483	82.07	23,786	-17.31
2017	14,024	-98.86	56,316	351.14	14,512	-38.99
2018	12,622	-10.00	6,329	-88.76	36,302	150.15
2019	54,102	328.63	2,128	-66.38	115,892	219.24
2020	366	-99.32	812	-61.84	79,164	-31.69
2021	540,539	147,588.25	216,443	26,555.54	172,023	117.30
2022	0	-100.00	26,589	-87.72	56,980	-66.88
2023	9,875	–	5,336	-79.93	70,675	24.03
Average	225,431	...	33,395	2,765.79	66,121	33.49

Source: UN Comtrade (processed), 2025.

Export Value of White Pepper

Table 4 shows the development of Indonesia's white pepper export value and its annual growth rate to Vietnam, Singapore, and Malaysia from 2014 to 2023. Overall, the export value of white pepper exhibits significant fluctuations over the years and across destination countries, with several sharp increases followed by steep declines (International Trade Centre, 2025). The export value of Indonesian white pepper to Vietnam, Singapore, and Malaysia from 2014 to

2023 was highly variable, though the extent of fluctuation varied across markets (International Trademap, 2025). Vietnam experienced the highest volatility, with export values rising from \$117,855 in 2014 to \$540,539 in 2021, then dropping to \$0 in 2022 and only slightly recovering in 2023. Singapore showed a similarly unstable pattern, increasing from \$660 in 2014 to \$216,443 in 2021, followed by a steep decline in the subsequent years. These patterns imply that exports to both Vietnam and Singapore are highly sensitive to short-term changes in demand, supply conditions, and regional trade flows, as reflected in annual export fluctuations recorded in Trade Map data (International Trade Centre, 2025). Malaysia showed relatively more stable demand compared with Vietnam and Singapore, although annual fluctuations remained evident. The export value increased from \$63,108 in 2014 to \$70,675 in 2023, with an average annual value of \$66,121. This indicates a relatively more consistent demand structure in Malaysia than in Vietnam and Singapore, although further industry-level data would be needed to confirm whether this stability is associated with direct consumption or food-processing demand (International Trade Centre, 2025).

Overall, these findings show that global price volatility, supply disruptions, and re-export dynamics heavily influence Indonesia's white pepper exports. They also highlight the importance of supply chain resilience and value addition in maintaining export performance (International Pepper Community, 2025; United Nations Conference on Trade and Development, 2021; Gustrinazul et al., 2023; Ernah et al., 2021). In this context, limited post-harvest innovation, weak product diversification, and strong competition from Vietnam may hinder Indonesia's ability to stabilize and increase the export value of pepper in regional and global markets (Safitri et al., 2025; Tarigan et al., 2024). Additionally, stricter sanitary and phytosanitary standards, pesticide residue limits, and export quality requirements could also impact the competitiveness of Indonesian pepper exports, especially given the uneven quality grading and traceability systems among exporters (Peng, 2023).

Overall, this pattern suggests that white pepper exports are more sensitive to market-specific demand, quality requirements, and trade relationships than black pepper exports. The different performance across Vietnam, Singapore, and Malaysia indicates that white pepper competitiveness depends not only on export volume but also on the ability to maintain consistent quality and meet specific market preferences. Therefore, improving export value requires not only increasing export volume but also strengthening product grading, processing, packaging, and compliance with destination-market standards.

Comparative Advantage (RCA) of Indonesian Pepper in ASEAN

The Revealed Comparative Advantage (RCA) index measures the extent to which a country is relatively specialized in exporting a particular commodity compared with the rest of the world. An RCA value greater than 1 indicates that the commodity has a revealed comparative advantage, while a value below 1 reflects the absence of such an advantage (Harniati & Jamil, 2020; Wuri, 2024). Table 5 summarises the RCA values of Indonesian black and white pepper exports to Vietnam, Singapore, and Malaysia during the period 2014–2023, based on international trade data (International Trade Centre, 2025).

Table 5. RCA Values of Indonesian Pepper in the ASEAN Market, 2014–2023

Year	RCA Value				
	Black Pepper		White Pepper		
	Vietnam	Singapore	Vietnam	Singapore	Malaysia
2014	41.28	8.41	23.75	0.00	214.10
2015	52.73	9.27	14.02	0.04	92.65
2016	62.49	19.27	50.96	0.08	60.10
2017	60.71	15.21	0.66	0.44	49.04
2018	59.94	10.77	0.99	0.06	195.46
2019	35.14	6.93	3.68	0.02	731.45
2020	33.66	12.67	0.01	0.01	498.15
2021	20.14	18.01	13.80	2.02	757.53
2022	7.90	13.61	0.00	0.22	240.90
2023	7.17	15.73	0.26	0.04	261.61
Average	38.12	12.99	10.81	0.29	310.10

Source: UN Comtrade (processed), 2025.

Indonesia has a strong comparative advantage in black pepper exports to Vietnam and Singapore. For exports to Vietnam, RCA values remained well above 1 throughout the study period, averaging 38.12 and reaching a peak of 62.49 in 2016, confirming Indonesia’s strong export specialization and its key role in that market (Gustrinazul et al., 2023; International Trade Centre, 2025). Black pepper exports to Singapore also maintained RCA values above 1 each year, averaging 12.99, indicating that Indonesia holds a significant comparative advantage in Singapore’s re-export-oriented pepper trade. This finding is consistent with previous evidence that Indonesian black pepper has comparative and competitive potential, although its export position remains challenged by competition from other major suppliers such as Vietnam (Tarigan et al., 2024).

For white pepper, the strongest comparative advantage was found in the Malaysian market. RCA values for white pepper exports to Malaysia consistently remained well above 1, averaging 310.10 and reaching 757.53 in 2021, indicating Indonesia’s dominant position in this

segment (International Trade Centre, 2025). In contrast, white pepper exports to Singapore showed RCA values consistently below 1, averaging only 0.29, suggesting a lack of a revealed comparative advantage. Meanwhile, white pepper exports to Vietnam showed a less stable pattern, with high RCA values in some years but sharp declines in others, suggesting a fragile comparative advantage in that market (International Trade Centre, 2025).

Overall, the RCA analysis indicates that Indonesia's comparative advantage in the ASEAN pepper market is concentrated mainly in black pepper exports to Vietnam and Singapore and white pepper exports to Malaysia. These product–market combinations exhibit stronger export specialization than the world average. However, other combinations, particularly white pepper exports to Singapore and, to a lesser extent, to Vietnam, remain weaker and more volatile. This variation suggests that Indonesia's comparative advantage differs not only by commodity type, but also by destination market.

The relatively strong RCA values in certain markets should be interpreted as evidence of export specialization rather than as automatic proof of stable competitiveness. In agricultural commodity studies, competitiveness is commonly assessed by examining whether a commodity has comparative and competitive advantages within a particular market or production system (Rum et al., 2020). Maintaining comparative advantage in agricultural exports requires continuous improvements in product quality, post-harvest handling, certification, logistics, and supply-chain integration. This is particularly important for pepper, as ASEAN markets may have different requirements for quality standards, food safety, processing levels, supply reliability, and sanitary and phytosanitary compliance (Beghin et al., 2023). Therefore, the RCA results highlight the need for market-specific strategies to strengthen Indonesia's position in black pepper and white pepper exports.

Export Competitiveness (ECI) of Indonesian Pepper in ASEAN

While the RCA index shows the structural or comparative advantage of a commodity in international trade, the ECI measures changes in export performance over time. An RCA value greater than 1 indicates that the commodity has a revealed comparative advantage, while a value below 1 reflects the absence of such an advantage (Harniati & Jamil, 2020; Wuri, 2024). Table 6 displays the ECI values for Indonesian black and white pepper exports to Vietnam, Singapore, and Malaysia from 2014 to 2023. Overall, the ECI values indicate that Indonesia's export competitiveness is quite volatile across years, pepper types, and destination countries (International Trade Centre, 2025).

Table 6 demonstrates that Indonesian pepper's fluctuating export competitiveness in the ASEAN market from 2014 to 2023 varied significantly across different product types, destination countries, and years. Among all product–market combinations, white pepper showed the greatest variation. The ECI values for white pepper exports to Vietnam and Singapore surged sharply in 2021, reaching 1,004.65 and 580.67, respectively. However, these exceptionally high figures should be viewed with caution, as very low export volumes are likely to have influenced them in the previous year rather than a sustained improvement in competitiveness. Consequently, the high average ECI values for white pepper exports to Vietnam (101.76) and Singapore (61.64) were mainly driven by outliers and do not necessarily reflect stable competitive performance throughout the study period (International Trade Centre, 2025).

Table 6. ECI Values of Indonesian Pepper in the ASEAN Market, 2014–2023

Year	ECI Value				
	Black Pepper		White Pepper		
	Vietnam	Singapore	Vietnam	Singapore	Malaysia
2014	0.46	1.02	0.22	1.49	7.51
2015	3.57	1.04	2.42	19.40	0.44
2016	0.59	2.14	3.96	2.58	0.57
2017	0.76	0.88	0.01	3.50	0.85
2018	1.26	0.59	1.16	0.11	3.03
2019	0.88	0.55	5.17	8.03	4.29
2020	1.13	2.58	0.01	0.21	0.90
2021	0.47	1.04	1,004.65	580.67	1.56
2022	0.93	0.84	0.00	0.21	0.28
2023	0.53	0.95	0.00.	0.16	1.42
Average	1.06	1.16	101.76	61.64	2.09

Source: UN Comtrade (processed), 2025.

Black pepper exhibited a more moderate, yet still fluctuating, competitiveness pattern by contrast. The average ECI for black pepper exports to Singapore was 1.16, indicating a slightly positive trend in dynamic competitiveness. However, several annual values remained below 1, reflecting periodic declines in export share. A similar pattern was observed for black pepper exports to Vietnam, where the average ECI reached 1.06 but fluctuated substantially over time, declining to 0.53 in 2023. This suggests that Indonesian black pepper maintained some market presence in Vietnam and Singapore, but its position was not consistently strengthening. This condition may be related to strong competitive pressure from Vietnam, which plays a major role in the global pepper trade and affects Indonesia's export position in several destination markets (International Trade Centre, 2025; Safitri et al., 2025).

White pepper exports to Malaysia showed a different pattern. The previous RCA analysis indicated that Indonesia had a strong structural comparative advantage in this market. However, the ECI values for white pepper exports to Malaysia were frequently below 1, averaging 2.09 during the study period. Although relatively high values were recorded in certain years, such as 7.51 in 2014 and 3.03 in 2018, the index declined sharply thereafter, reaching 0.28 in 2022. This pattern suggests that a strong comparative advantage does not automatically translate into sustained dynamic export competitiveness. In other words, Indonesia may have strong export specialization in white pepper for the Malaysian market. However, its export share may still decline when supply continuity, product quality, logistics efficiency, and responsiveness to market demand are not consistently maintained (International Trade Centre, 2025).

Overall, these findings confirm that comparative advantage and dynamic competitiveness do not necessarily move in parallel. RCA reflects Indonesia's structural export specialization, while ECI captures changes in export share over time. The sharp increase in ECI for white pepper exports to Vietnam and Singapore in 2021 appears to reflect temporary market opportunities rather than a stable strengthening of competitiveness. Therefore, sustaining Indonesia's pepper export competitiveness requires not only maintaining market presence but also improving post-harvest handling, standardizing quality, enhancing logistics efficiency, improving traceability, ensuring export reliability, and coordinating the value chain among farmers, traders, processors, and exporters. Recent studies also emphasize that agricultural export competitiveness increasingly depends on value-chain upgrading, quality certification, compliance with SPS standards, and stronger integration into regional trade networks (Ernah et al., 2021; Safitri et al., 2025; Beghin et al., 2023; Peng, 2023).

Limitations and Future Directions

This study has several limitations that should be considered when interpreting the findings. First, the analysis relies on secondary time-series data for 2014–2023 and is limited to three ASEAN destination countries, namely Vietnam, Singapore, and Malaysia. Therefore, the results cannot fully represent Indonesia's pepper competitiveness in the entire ASEAN region or in other global markets. Second, this study examines black and white pepper in aggregate, without distinguishing quality grades, processing levels, branding, or value-added products. As a result, the role of product differentiation in shaping export competitiveness cannot be fully captured.

Third, the analytical tools used in this study, namely export growth analysis, RCA, and ECI, are descriptive indicators. These indicators are useful for identifying export performance, comparative advantage, and dynamic competitiveness. However, they do not directly explain

the determinants of competitiveness, such as production costs, exchange rates, trade policies, non-tariff barriers, logistics performance, and global price movements. In addition, extreme growth and ECI values in some years may reflect temporary market shocks or very small base-year export values. Fourth, this study adopts a macro-level perspective and does not include primary information from farmers, traders, processors, or exporters, even though these actors directly influence supply continuity, quality consistency, and export readiness.

Future research should expand the analysis to include more ASEAN and non-ASEAN markets and integrate RCA and ECI with other methods, such as gravity models, Constant Market Share analysis, or panel data regression, to more clearly identify the factors that drive export competitiveness. Additionally, future studies should consider product differentiation, quality improvements, compliance with sanitary and phytosanitary standards, and value-chain analysis based on primary data from farmers, processors, and exporters. These strategies would offer a more complete understanding of how Indonesia can enhance the long-term competitiveness of black and white pepper in regional and global markets.

CONCLUSION

This study examined the export competitiveness of Indonesian black and white pepper in the ASEAN market during 2014–2023 using export growth analysis, Revealed Comparative Advantage (RCA), and Export Competitiveness Index (ECI). The findings indicate that Indonesia's pepper exports to Vietnam, Singapore, and Malaysia were highly volatile in both volume and value, reflecting the influence of global price fluctuations, supply conditions, international trade dynamics, and domestic production trends (FAOSTAT, 2025; International Trade Centre, 2025).

The main contribution of this study lies in demonstrating that the export competitiveness dynamics of Indonesian pepper differ significantly between black pepper and white pepper and across ASEAN destination markets. By combining RCA and ECI approaches, this study provides a more comprehensive understanding of both structural comparative advantage and dynamic competitiveness over time. The findings also show that a strong comparative advantage does not necessarily guarantee stable export competitiveness, particularly when export performance is highly vulnerable to fluctuations in quality, supply consistency, and regional market conditions.

The RCA results show that Indonesia maintains a strong comparative advantage in several important product market combinations, particularly black pepper exports to Vietnam and Singapore, and white pepper exports to Malaysia. However, the comparative advantage of white pepper in Singapore and, to some extent, Vietnam remains weak or unstable (International

Trade Centre, 2025). Meanwhile, the ECI analysis demonstrates that dynamic export competitiveness is more unstable than comparative advantage. The unusually high ECI values for white pepper exports to Vietnam and Singapore in 2021 appear to reflect temporary opportunities rather than sustained competitiveness, while repeated ECI values below 1 indicate weakening market share in several cases (Harniati & Jamil, 2020; Ernah et al., 2021; Trademap, 2025).

Overall, the findings suggest that a strong comparative advantage does not automatically guarantee sustained export competitiveness. Therefore, strengthening Indonesia's pepper competitiveness requires more targeted agribusiness strategies. Priority policies should include improving post-harvest handling and standardizing quality; strengthening traceability and export certification systems; expanding the production of value-added and processed pepper products; improving logistics and supply-chain efficiency; and strengthening partnerships among smallholder farmers, cooperatives, processors, and exporters. In addition, stronger regional trade cooperation and market intelligence systems are necessary to enhance Indonesia's capacity to respond to evolving ASEAN market requirements and non-tariff measures.

Author Contribution

The study design and conceptual framework of this research were developed by Henny and Endang. The processes of data collection and data curation were carried out by Balqis, Yetty and Windi, who ensured the accuracy and completeness of the dataset used in the analysis. Furthermore, the analysis and interpretation of the data were collaboratively conducted by Henny, Endang and Yetty, integrating their expertise to provide comprehensive insights. The writing process, including the preparation of the initial draft and subsequent revisions, was undertaken by Putri. Finally, Henny and Endang were responsible for the final approval of the manuscript and assumed full accountability for the overall integrity and quality of the research.

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