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Measuring export similarity in the ASEAN agricultural sector: Evidence from Indonesia's agrifood and non-agrifood trade

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Abstract. Agricultural trade remains a crucial pillar of ASEAN's economic cooperation, yet the region still faces challenges in aligning its export structures across member countries. Despite ongoing integration efforts, differences in commodity composition may limit collective competitiveness in global markets. This study aims to measure and compare the similarity of Indonesia's agricultural exports with those of other ASEAN members during 2003–2022, using the Export Similarity Index (ESI). The analysis distinguishes between agrifood products (HS 1–24) and non-agrifood commodities (HS 40–44) to capture variations in trade specialization. The results reveal that Indonesia's export similarity is moderate, averaging 0.21 for agrifood and 0.11 for non-agrifood products. Vietnam and Myanmar exhibit higher similarity in agrifood trade, while Malaysia and Thailand show stronger alignment in non-agrifood exports. The overall agricultural similarity index reaches 0.32, indicating gradual convergence amid structural differences. These findings highlight that ASEAN's agricultural trade integration remains uneven, emphasizing the importance of coordinated policies to strengthen value-added trade and enhance regional competitiveness.

1 Introduction

Sustainable improvement in agricultural sector performance has become increasingly critical within the broader context of ASEAN's regional economic integration and trade liberalization agenda [1]. International trade plays a substantial role in national economic growth, contributing significantly to gross domestic product (GDP) across ASEAN member states. However, the contribution of agriculture to GDP varies markedly among countries, reflecting differences in levels of industrialization, economic structure, and production capacity. These disparities underscore the heterogeneous nature of agricultural development

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in ASEAN and highlight the importance of understanding trade dynamics through a structural and comparative lens [2].

Beyond structural economic differences, agricultural trade performance in ASEAN is strongly shaped by geographical and social conditions. Landlocked countries such as Lao PDR face pronounced logistical constraints, resulting in higher transportation costs and longer delivery times that weaken their trade competitiveness [3]. In contrast, countries with direct access to maritime routes and extensive land borders such as Thailand and Vietnam whom the benefit from more efficient trade flows. Social factors, including shared language, cultural proximity, and historical ties, further facilitate cross-border transactions by reducing transaction costs and strengthening sub-regional market integration [3]. Nevertheless, persistent divergences in domestic regulations, sanitary and phytosanitary (SPS) standards, and technical barriers to trade (TBT) continue to impede deeper harmonization of agricultural trade within the region [4].

To address these challenges and enhance regional competitiveness, ASEAN established the ASEAN Free Trade Area (AFTA) in 1992 through the Common Effective Preferential Tariff (CEPT) scheme, which progressively reduced intra-ASEAN tariffs to 0–5 percent. This commitment was further institutionalized with the implementation of the ASEAN Trade in Goods Agreement (ATIGA) in 2010, aimed at eliminating non-tariff barriers and improving trade transparency across member states [2]. The creation of the ASEAN Economic Community (AEC) in 2015 marked a further deepening of regional economic integration, with the objective of forming a single market and a competitive production base that facilitates the free flow of goods, services, and investment.

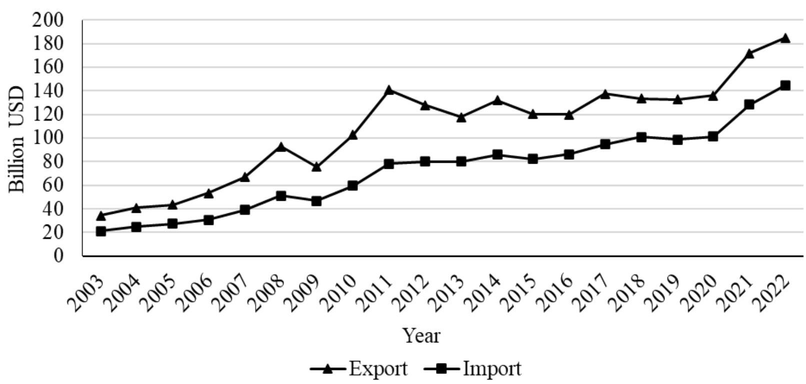

Fig. 1. Agregate export and import value ASEAN agricultural sector

At the aggregate level, from the Figure 1 shows ASEAN's agricultural trade exhibits substantial dynamism. In 2022, total agricultural exports from ASEAN reached USD 185.15 billion, while imports amounted to USD 144.78 billion. Although the region maintains a strong export position in key commodities such as rice, palm oil, rubber, coffee, and horticultural products, structural dependence on external food supplies remains evident [5]. This condition emphasizes the need to strengthen domestic production capacity and intra-regional supply chain integration as long-term strategies to enhance regional food security and reduce agricultural trade imbalances [6].

Despite progress in trade liberalization, intensifying agricultural trade does not necessarily translate into balanced or sustainable trade outcomes. Expanding export volumes and long-distance distribution networks may generate structural pressures, including elevated logistics costs, unequal access to low-emission technologies, and incomplete adoption of sustainability standards in cross-border trade [7]. Moreover, many ASEAN countries export highly similar agricultural commodities particularly palm oil, rice, rubber, coffee, and horticultural products resulting in overlapping export structures and heightened structural competition in regional and global markets [8].

These competitive dynamics are further compounded by wide disparities in productivity levels, policy support mechanisms, and governance effectiveness across ASEAN member states, which translate into uneven export performance and divergent competitive positions. In this context, assessing the degree of similarity in export composition becomes essential for identifying patterns of competition and potential complementarity among countries. The Export Similarity Index (ESI) provides a relevant structural indicator for this purpose, as it quantitatively measures the extent of overlap in export structures between trading partners [9].

For Indonesia, as one of the leading exporters of both agrifood and non-agrifood products in ASEAN, understanding its structural position within the regional export landscape is particularly important. An ESI-based analysis allows for a systematic assessment of how closely Indonesia's agricultural export composition aligns with that of other ASEAN countries, thereby offering empirical insights into competitive intensity and market positioning. Furthermore, empirical studies on export similarity in the ASEAN agricultural sector remain limited, especially those that distinguish between food and non-food products and examine their implications for regional trade dynamics [10]. Addressing this gap, the present study aims to measure and analyze the Export Similarity Index (ESI) of the ASEAN agricultural sector, with a particular focus on Indonesia's agrifood and non-agrifood trade structure.

2 Methods

The data employed in this study consist of secondary data, which panel data (country-year). The time-period started from 2003 to 2022. In terms of the cross-sectional dimension, the sample includes ten ASEAN member countries, namely Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. The analysis distinguishes between agrifood products (HS 1–24) and non-agrifood commodities (HS 40–44) to capture variations in trade specialization.

The Export Similarity Index (ESI) is a quantitative indicator employed to measure the degree of similarity between the export structures of two countries. The index is designed to capture how closely the composition of exports from one country resembles that of another, particularly within the same regional or destination market. The primary function of ESI is to assess the extent of direct export competition by identifying overlaps in product composition, rather than differences in export scale or absolute trade values [11].

Conceptually, ESI measures the shared proportion of export structures by summing the minimum export shares across comparable product categories between two countries. This approach ensures that the index reflects only the overlapping segments of exports, thereby providing a clear representation of structural similarity in trade patterns. As such, ESI serves as an effective tool for evaluating competitive positioning among countries within a regional trading framework. Following [12] the Export Similarity Index is formally defined as:

$$Export\ Similarity_{ij} = \sum \vartheta\, min\left[\left({X_j}/{\text{Xtotal}_j}\right),\ \left({X_i}/{\text{Xtotal}_i}\right)\right] \tag{1}$$

The index ranges from 0 to 1. A value of zero indicates no overlap in export structures, implying that the two countries do not compete directly in terms of export composition. Conversely, a value of one reflects perfect similarity, where the export profiles of both countries are identical. Higher ESI values therefore signal greater similarity in export composition and stronger potential competition in external markets. It is important to note that the ESI framework focuses exclusively on inter-industry structural similarity and does not capture gains derived from intra-industry trade.

3 Results and discussion

The total agricultural commodity category in this study is derived from the aggregation of agrifood and non-agrifood commodity values. Within the agrifood context, the application of the Export Similarity Index (ESI) to Indonesia provides insights into the extent to which the agricultural food export structures of other ASEAN countries resemble that of Indonesia. This degree of similarity reflects the intensity of direct competition in global markets, which in turn shapes trade pressure as one of the sources of trade-related constraints. The higher the agrifood ESI value of a country relative to Indonesia, the greater the potential for competition in similar products across regional and global markets. Table 1 presents the agrifood ESI values of Indonesia within the ASEAN region.

Table 1. ESI value for agrifood commodity of Indonesian agricultural in ASEAN region

Year	BRN	KHM	LAO	MYS	MYR	FLP	SGP	THA	VNM	AVG/Year
2003	0.08	0.14	0.00	0.15	0.00	0.14	0.11	0.22	0.30	**0.13**
2004	0.08	0.20	0.00	0.15	0.00	0.13	0.10	0.20	0.26	**0.13**
2005	0.00	0.15	0.00	0.13	0.00	0.12	0.09	0.18	0.24	**0.10**
2006	0.07	0.14	0.00	0.14	0.00	0.13	0.09	0.18	0.24	**0.11**
2007	0.09	0.17	0.00	0.17	0.00	0.14	0.11	0.19	0.26	**0.12**
2008	0.10	0.15	0.00	0.19	0.00	0.16	0.12	0.21	0.26	**0.13**
2009	0.11	0.15	0.00	0.20	0.00	0.18	0.14	0.24	0.31	**0.15**
2010	0.11	0.14	0.37	0.20	0.22	0.16	0.13	0.23	0.30	**0.21**
2011	0.10	0.15	0.22	0.21	0.33	0.18	0.13	0.24	0.29	**0.21**
2012	0.11	0.20	0.26	0.20	0.44	0.18	0.14	0.25	0.30	**0.23**
2013	0.10	0.23	0.25	0.18	0.38	0.18	0.13	0.23	0.26	**0.22**
2014	0.12	0.25	0.30	0.20	0.34	0.20	0.15	0.26	0.29	**0.24**
2015	0.15	0.24	0.38	0.23	0.40	0.21	0.19	0.30	0.32	**0.27**
2016	0.15	0.24	0.47	0.24	0.49	0.21	0.19	0.30	0.31	**0.29**
2017	0.14	0.25	0.37	0.22	0.45	0.21	0.18	0.29	0.29	**0.27**
2018	0.14	0.26	0.32	0.20	0.44	0.22	0.17	0.28	0.27	**0.26**
2019	0.15	0.27	0.39	0.22	0.41	0.25	0.18	0.31	0.27	**0.27**
2020	0.17	0.25	0.47	0.24	0.48	0.26	0.20	0.34	0.29	**0.30**
2021	0.16	0.32	0.39	0.23	0.51	0.24	0.19	0.33	0.27	**0.29**
2022	0.14	0.29	0.36	0.21	0.44	0.23	0.17	0.32	0.25	**0.27**
Average	**0.11**	**0.21**	**0.23**	**0.20**	**0.27**	**0.19**	**0.15**	**0.25**	**0.28**	**0.21**

Source: Processed Data 2025
Description:

BRN	:	Brunei Darussalam	MYR	:	Myanmar
KHM	:	Cambodia	FLP	:	Philipines
LAO	:	Lao PDR	SGP	:	Singapore
MYS	:	Malaysia	THA	:	Thailand
			VNM	:	Vietnam

The average agrifood ESI of 0.21 indicates a relatively low level of export similarity among ASEAN countries. This suggests that Indonesia's agrifood export structure remains considerably distinct from that of most other ASEAN members, resulting in relatively limited direct competition in the regional agrifood market. However, countries with the highest similarity values relative to Indonesia was Vietnam (0.28) and Thailand (0.25). That value indicate the presence of partial competition in specific commodities such as rice, coffee, and processed tropical food products. This condition provides Indonesia with strategic space to strengthen its market position through the expansion of value-added products and specialization in leading commodities, as the ASEAN agrifood market has not yet reached a saturation point characterized by highly convergent export structures [13].

The relatively low agrifood ESI values compared to Indonesia reflect differences in export structures and higher levels of product diversification across ASEAN countries. Such conditions reduce direct competitive pressure and open opportunities for specialization based on comparative advantages. From a broader trade perspective, agrifood differentiation allows Indonesia to maintain flexibility in responding to market dynamics without being compelled to mirror the export profiles of competing countries [12, 14].

Table 2. ESI value for non-agrifood commodity of Indonesian agricultural in ASEAN region

Year	BRN	KHM	LAO	MYS	MYR	FLP	SGP	THA	VNM	AVG/Year
2003	0.08	0.40	0.00	0.13	0.00	0.09	0.09	0.17	0.14	**0.00**
2004	0.08	0.39	0.00	0.13	0.00	0.09	0.09	0.17	0.13	**0.00**
2005	0.00	0.27	0.00	0.12	0.00	0.08	0.07	0.15	0.12	**0.00**
2006	0.07	0.26	0.00	0.13	0.00	0.11	0.08	0.17	0.15	**0.00**
2007	0.07	0.24	0.00	0.12	0.00	0.11	0.07	0.16	0.14	**0.00**
2008	0.06	0.16	0.00	0.11	0.00	0.11	0.07	0.15	0.14	**0.00**
2009	0.06	0.13	0.00	0.10	0.00	0.12	0.06	0.15	0.14	**0.00**
2010	0.06	0.20	0.09	0.11	0.13	0.11	0.07	0.17	0.18	**0.12**
2011	0.07	0.26	0.12	0.13	0.15	0.14	0.07	0.20	0.18	**0.15**
2012	0.06	0.25	0.11	0.11	0.14	0.14	0.07	0.17	0.16	**0.13**
2013	0.06	0.25	0.13	0.11	0.12	0.17	0.07	0.17	0.17	**0.14**
2014	0.06	0.26	0.14	0.10	0.09	0.16	0.07	0.15	0.16	**0.13**
2015	0.07	0.23	0.12	0.11	0.09	0.17	0.07	0.15	0.17	**0.13**
2016	0.07	0.20	0.10	0.10	0.09	0.17	0.08	0.15	0.16	**0.13**
2017	0.07	0.25	0.11	0.11	0.10	0.12	0.08	0.17	0.15	**0.13**
2018	0.06	0.22	0.09	0.09	0.08	0.08	0.07	0.14	0.13	**0.11**
2019	0.05	0.20	0.10	0.09	0.08	0.08	0.07	0.13	0.14	**0.10**
2020	0.05	0.14	0.10	0.09	0.09	0.08	0.06	0.13	0.13	**0.10**
2021	0.04	0.21	0.09	0.07	0.10	0.07	0.05	0.12	0.12	**0.10**
2022	0.03	0.18	0.08	0.05	0.08	0.06	0.04	0.11	0.11	**0.08**
Average	**0.06**	**0.23**	**0.07**	**0.11**	**0.07**	**0.11**	**0.07**	**0.15**	**0.15**	**0.11**

Source: Processed Data 2025
Description:

BRN	:	Brunei Darussalam	MYR	:	Myanmar
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For the non-agrifood group, the ESI relative to Indonesia serves as an indicator of the extent to which cross-sectoral competition may indirectly influence the performance of the agricultural sector. Although non-agrifood commodities are not directly linked to agricultural production processes, similarities in non-agrifood export structures can affect resource allocation, investment flows, and national trade policy priorities. Table 2 presents the ESI values for agricultural-related commodities within the non-agrifood category.

The average non-agrifood ESI of 0.11 reflects a very low level of export similarity, indicating minimal competition among ASEAN countries in this segment. Indonesia's non-agrifood export structure remains highly specialized and significantly different from that of other ASEAN members. Only Cambodia (0.23) exhibits a modest degree of similarity with Indonesia, potentially due to overlapping exports of processed wood products, textiles, or certain non-food raw materials. These low ESI values suggest substantial scope for complementary trade development, whereby Indonesia can expand its non-agrifood exports without facing significant competitive pressure in ASEAN markets [15].

The persistently low average non-agrifood ESI underscores strong structural differentiation, resulting in limited cross-sectoral competition. Under such conditions, trade interactions in non-agrifood sectors are less likely to crowd out agricultural trade priorities, allowing Indonesia to maintain a clear strategic focus on strengthening its agricultural export positioning within the regional economy.

Table 3. ESI value for total agricultural commodity of Indonesian agricultural in ASEAN region

Year	BRN	KHM	LAO	MYS	MYR	FLP	SGP	THA	VNM	AVG/Year
2003	0.16	0.54	0.00	0.29	0.00	0.23	0.20	0.39	0.44	**0.25**
2004	0.16	0.58	0.00	0.28	0.00	0.22	0.19	0.37	0.39	**0.24**
2005	0.00	0.41	0.00	0.24	0.00	0.20	0.16	0.33	0.36	**0.19**
2006	0.15	0.40	0.00	0.27	0.00	0.24	0.18	0.35	0.39	**0.22**
2007	0.16	0.41	0.00	0.29	0.00	0.25	0.18	0.35	0.40	**0.23**
2008	0.16	0.31	0.00	0.30	0.00	0.27	0.19	0.37	0.40	**0.22**
2009	0.17	0.27	0.00	0.30	0.00	0.29	0.20	0.38	0.45	**0.23**
2010	0.17	0.34	0.46	0.31	0.35	0.26	0.20	0.40	0.47	**0.33**
2011	0.17	0.41	0.35	0.33	0.48	0.32	0.21	0.44	0.47	**0.35**
2012	0.18	0.45	0.38	0.32	0.57	0.32	0.21	0.42	0.45	**0.37**
2013	0.17	0.47	0.38	0.29	0.50	0.35	0.20	0.40	0.43	**0.35**
2014	0.19	0.51	0.44	0.30	0.43	0.36	0.22	0.41	0.44	**0.37**
2015	0.22	0.47	0.50	0.34	0.49	0.37	0.26	0.45	0.49	**0.40**
2016	0.22	0.44	0.58	0.35	0.58	0.38	0.27	0.45	0.48	**0.42**
2017	0.21	0.50	0.48	0.33	0.55	0.33	0.26	0.46	0.44	**0.40**
2018	0.19	0.48	0.41	0.29	0.52	0.31	0.24	0.42	0.40	**0.36**
2019	0.20	0.47	0.49	0.31	0.49	0.33	0.25	0.44	0.41	**0.38**
2020	0.22	0.39	0.57	0.33	0.57	0.34	0.27	0.47	0.42	**0.40**
2021	0.20	0.52	0.48	0.31	0.60	0.31	0.24	0.45	0.40	**0.39**
2022	0.17	0.47	0.44	0.26	0.52	0.28	0.21	0.43	0.36	**0.35**
Average	**0.17**	**0.44**	**0.30**	**0.30**	**0.33**	**0.30**	**0.22**	**0.41**	**0.42**	**0.32**

Source: Processed Data 2025
Description:

BRN	:	Brunei Darussalam	MYR	:	Myanmar
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At the aggregate agricultural level, the ESI relative to Indonesia reflects the overall degree of similarity in agricultural export structures between Indonesia and other ASEAN countries. Table 3 presents Indonesia's ESI values for total agricultural trade within the ASEAN region. Overall, the average total agricultural ESI of 0.32 indicates a moderate level of export similarity. This suggests that while Indonesia's agricultural export structure is not yet highly identical to those of other ASEAN countries, signs of gradual convergence are emerging. The highest similarity values are observed for Cambodia (0.44) and Vietnam (0.42), reflecting structural proximity in exports, particularly in processed food products and tropical commodities. In general, these conditions indicate that Indonesia retains strategic room for export differentiation and enhancement of its competitive positioning, while also needing to anticipate potential increases in long-term competition as agricultural export structures across ASEAN become more homogeneous. Lower total agricultural ESI values signal greater structural diversity and wider scope for specialization. Such differentiation reduces direct competitive overlap and supports trade strategies centered on market positioning rather than volume-based rivalry [9].

Despite regional trade dynamics and ongoing trade liberalization that may intensify competition through converging export structures among ASEAN countries, the results indicate that these conditions do not fundamentally undermine Indonesia's agricultural trade position. This is reflected in Indonesia's ESI value relative to ASEAN of 0.32, which remains relatively low and indicates limited similarity in export profiles as well as restrained levels of direct competition in identical commodities. This structure reflects Indonesia's success in promoting product differentiation and strengthening downstream processing, ensuring that trade pressures are addressed through value enhancement and strategic positioning rather than reactive alignment with competing export structures [6, 10].

Beyond trade structure, developments at the farm level further reinforce Indonesia's agricultural trade orientation through alignment with the ASEAN Good Agricultural Practices (GAP) framework. The implementation of GAP in Indonesia has expanded considerably, encompassing on-farm activities through sustainable cultivation practices, improved post-harvest and after-farm management, strengthened trading systems and downstream integration, as well as the incorporation of environmental considerations into production processes. The synergy between export structure differentiation and GAP implementation explains why, despite the inherent competitive pressures of regional trade, Indonesia has been able to maintain a stable and adaptive agricultural trade profile through policy and structural strategies oriented toward sustainability.

At a strategic level, the Export Similarity Index (ESI) constitutes a vital analytical instrument for assessing Indonesia's position within the evolving landscape of regional and global agricultural trade. By systematically capturing the degree of overlap in export structures, ESI enables policymakers and trade strategists to identify segments where Indonesia faces direct competition and areas where its export profile remains distinct. Such insights are essential for formulating targeted trade policies, negotiating preferential market access, and anticipating shifts in competitive intensity as ASEAN economic integration deepens. In this regard, ESI functions not merely as a descriptive metric, but as a strategic tool that supports evidence-based trade policymaking and informed international economic engagement.

Moreover, the moderate level of Indonesia's aggregate agricultural ESI underscores the importance of preserving structural differentiation in export composition as a cornerstone of long-term trade resilience. Continuous monitoring of ESI trends allows Indonesia to detect early signals of export structure convergence, which may indicate rising competition in specific product categories or destination markets. These insights are particularly valuable for guiding export diversification, strengthening value-chain integration, and aligning trade promotion strategies with emerging global demand patterns. Consequently, ESI serves as a critical benchmark for evaluating Indonesia's competitive posture in agricultural trade and for ensuring that its export strategy remains adaptive, coherent, and responsive to dynamic regional and global market conditions.

4 Conclusion

This study demonstrates that Indonesia's agricultural export structure within ASEAN remains structurally differentiated, as evidenced by consistently low to moderate Export Similarity Index (ESI) values across agrifood, non-agrifood, and aggregate agricultural categories. Such findings indicate limited direct competitive overlap with most ASEAN member states, with only partial similarity observed in comparison with Vietnam and Thailand in selected commodities. In particular, the persistently low similarity levels in the non-agrifood segment underscore a pronounced degree of structural specialization.

At the aggregate level, the presence of moderate ESI values suggests a gradual convergence in export composition. However, this convergence has not reached a magnitude sufficient to materially undermine Indonesia's competitive standing within the regional market. Rather than signalling excessive structural rivalry, the evidence points to a pattern in which regional trade integration coexists with sustained export differentiation. Taken together, these findings contribute to a more nuanced understanding of Indonesia's positioning in the ASEAN agricultural trade landscape. Continuous monitoring of export similarity dynamics therefore remains essential for anticipating potential shifts in competitive structures and for informing future empirical assessments of regional trade integration.

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