

Structural asymmetry and bilateral complementarity in Russia-ASEAN trade in Agri-products: evidence from entropy, comparative advantage, and trade intensity measures

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ORIGINAL ARTICLE

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Abstract. This article examines the structural configuration of agricultural trade between the Russian Federation and the ten member states of the Association of Southeast Asian Nations (ASEAN) over the period 2015-2024. Drawing on disaggregated bilateral trade data across HS chapters 01-24 sourced from ASEANstats and ITC Trade Map, the study applies four complementary analytical measures: Shannon export entropy to quantify product diversification, the Bilateral Revealed Comparative Advantage (BRCA) index to assess bilateral specialisation, the Balassa Revealed Comparative Advantage (RCA) index to evaluate global competitiveness, and the Trade Intensity Index (TII) to gauge the depth of mutual trade engagement. The analysis reveals a persistent structural asymmetry: ASEAN maintains a broadly diversified agricultural export portfolio toward Russia (average entropy 1.94), while Russia's exports to ASEAN are concentrated in cereals, fish, and vegetable oils (average entropy 1.42). BRCA results confirm complementary rather than competitive specialisation across the majority of HS categories. The TII remained above unity throughout the entire decade and accelerated from 1.17 in 2020 to 1.32 in 2024, indicating that bilateral trade intensity is deepening beyond globally predicted benchmarks. The post-2022 acceleration coincides with Russia's geopolitical reorientation away from Western markets. The article argues that the relationship rests on durable agro-climatic complementarities and intensifying structural interdependence, while identifying SPS regulatory divergence, logistical distance, and export policy unpredictability as the three principal constraints on further expansion.

Keywords: Russia-ASEAN trade; agricultural trade; comparative advantage; Shannon entropy; Trade Intensity Index; export diversification; food security; bilateral complementarity; geopolitical trade reorientation

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Introduction

Agricultural trade between the Russian Federation and ASEAN has grown in both volume and strategic significance across the past decade. ASEAN's population exceeds 685 million, with more than half under the age of 35 and a middle class that expanded from approximately 41 million in 2000 to over 200 million by 2020, generating sustained growth in food import demand across the region [10]. Russia, for its part, emerged during this same period as the world's leading wheat exporter accounting for approximately 16 percent of global wheat export volumes by 2023 [7] while simultaneously reorienting its agricultural trade following Western sanctions imposed in 2014 and deepened after February 2022.

Despite this convergence of supply and demand fundamentals, Russia-ASEAN agricultural trade has attracted relatively limited systematic empirical analysis. Existing scholarship has tended to treat the bilateral relationship in either broad political-economy terms [4] or through single-indicator approaches to competitiveness [6]. No prior study has applied the full suite of entropy-based diversification measures alongside bilateral comparative advantage and trade intensity indices to characterise the structural configuration of this relationship across all 24 HS agricultural chapters and a decade-long time horizon.

This article addresses that gap through three specific contributions. First, it applies Shannon entropy

analysis to both trade directions ASEAN exports to Russia and Russia exports to ASEAN documenting asymmetric diversification structures and their evolution from 2015 to 2024. Second, it computes BRCA and RCA indices across HS chapters 01-24 to identify where each partner holds bilateral comparative advantage and where complementarity rather than competition characterises the trade structure. Third, it calculates the TII for both directions and traces its trajectory over the full period, evaluating whether bilateral agricultural trade is intensifying or converging toward expected benchmark levels.

Literature review

Research on Russia's agricultural trade reorientation following the 2014 sanctions has focused predominantly on the domestic import-substitution response and the shift away from European partners [13]. The eastward pivot captured in Russia's foreign trade statistics and in the political-economy literature on the "turn to the East" [9] has been discussed largely at the macro level rather than through disaggregated product analysis. Rogozhin and Rogozhina identified ASEAN as a natural destination for Russian agricultural exports given the region's structural import dependence in cereals and its demographic growth trajectory [9], while Voronova and Novikova examined trade potential in Russia-ASEAN agricultural cooperation under conditions of global economic fragmentation [11]. Kanaev and Korolev observed that economic cooperation, including in agriculture, has historically lagged behind the political ambitions of the Russia-ASEAN dialogue partnership [3].

On the ASEAN side, Mizik applied the Balassa RCA and trade intensity measures to ASEAN agri-food trade, finding pronounced specialisation in tropical commodities and processed goods across several member states [6]. The recent network analysis by Fakour and Gholamnia of ASEAN-EAEU agricultural trade confirmed that Vietnam and Indonesia dominate the grain-trade corridors flowing toward the Eurasian Economic Union, illustrating how intra-regional production networks feed external markets [2].

Shannon entropy as a measure of export diversification in international trade was formally developed in the competitiveness literature by Teza, Caraglio, and Stella, who demonstrated that entropy measures reliably unveil country specialisation patterns across global trade networks¹. Applied to agricultural trade, entropy distinguishes commodity-dependent export structures from diversified agri-industrial profiles and enables temporal tracking of structural adjustment.

The geopolitical dimensions of agricultural trade have attracted growing scholarly attention following the 2022 conflict in Ukraine. Wieck et al. documented the geostrategic dimensions of food policy decisions, showing that Russia's conduct around the Black Sea Grain Initiative illustrated the direct interface between foreign policy and food security policy [14]. Wang et al. demonstrated that global agricultural trade networks exhibit measurable sensitivity to geopolitical shocks and that established bilateral trade relations tend to exhibit greater resilience than newly formed ones [12]. Zhang, Li, and Zhou analysed the impact of the Russia-Ukraine conflict on international staple agri-food trade networks, confirming structural shifts in global grain flows with direct implications for Southeast Asian cereal importers [15]. The present study builds on this literature by providing the first systematic multi-indicator empirical characterisation of Russia-ASEAN bilateral agricultural trade structure across a full decade.

Methodology

The empirical analysis draws on two primary sources. Bilateral trade flow data between all ASEAN member states and Russia were obtained from the ASEANstats Data Portal (Trade in Goods, IMTS, Annually, HS 2-digit, in USD), covering HS chapters 01-24 from 2015 to 2024. Global trade data used for RCA and TII computation were drawn from ITC Trade Map. Agricultural production data for contextual background were sourced from FAOSTAT. Trade values are in current USD millions. Four analytical measures are applied.

Shannon Export Entropy. Export entropy captures the degree of concentration or diversification in a bilateral export portfolio across n product categories. It is computed as:

¹ Teza, G., Caraglio, M., & Stella, A. L. (2021). *Entropic measure unveils country competitiveness and product specialization in the World trade web*. *Scientific Reports*, 11(1), Article 10189. <https://doi.org/10.1038/s41598-021-89519-3>

$$E = - \sum_{i=1}^n p_i \ln(p_i) \quad (1)$$

where p_i denotes the share of HS chapter i in total exports in a given year. For $n = 24$ product groups, the theoretical maximum entropy is $\ln(24) = 3.18$. Values below 1.5 indicate high concentration; values between 1.5 and 2.2 indicate moderate diversification; values above 2.2 indicate broad diversification².

Bilateral Revealed Comparative Advantage (BRCA).

The BRCA measures whether one partner holds a comparative advantage in exporting a given product to the bilateral partner, relative to that partner's global export structure. For ASEAN exports to Russia:

$$BRCA(ASEAN) = (Export_ASEAN \rightarrow Russia / Total_ASEAN \rightarrow World) / (Export_Russia \rightarrow World / Total_Russia \rightarrow World) \quad (2)$$

A BRCA value greater than 1.0 indicates bilateral comparative advantage. The index is computed for each HS chapter in each year with trade values aggregated across all ten ASEAN member states.

Balassa Revealed Comparative Advantage (RCA).

The standard Balassa RCA [1] measures each partner's global export competitiveness in a given product category:

$$RCA = (Export_partner \rightarrow World / Total_partner \rightarrow World) / (Import_World / Total_World_Imports) \quad (3)$$

Values above 1.0 indicate global comparative advantage. RCA is computed separately for ASEAN and Russia across all 24 HS chapters.

Trade Intensity Index (TII).

The TII evaluates whether bilateral trade is more or less intense than expected given each partner's share in global trade³:

$$TII = (Export_A \rightarrow B / Total_A \rightarrow World) / (Import_B / Total_World_Imports) \quad (4)$$

A TII above 1.0 indicates bilateral trade intensity exceeds the globally predicted benchmark. Separate TII series are computed for ASEAN exports to Russia and for Russia exports to ASEAN for each year in the study period.

Results

Bilateral Trade Balance and Aggregate Trade Flows

ASEAN maintained a positive agricultural trade surplus with Russia in nine of the ten years reviewed, the sole exception being 2018, when a surge in Russian cereal exports temporarily reversed the balance. Russia's agricultural imports from ASEAN rose from USD 1.27 billion in 2015 to USD 2.24 billion in 2024 a 76.3 percent increase. Russia's agricultural exports to ASEAN rose from USD 0.19 billion in 2015 to USD 1.02 billion in 2024, reflecting more than a fivefold expansion concentrated primarily in cereals following Russia's record harvests from 2017 onward. Table 1 presents the full annual trade balance series.

Table 1 – ASEAN-Russia bilateral agricultural trade balance, 2015-2024 (USD billion)

Indicator	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Russia's imports from ASEAN	1.27	1.25	1.38	1.39	1.33	1.41	1.89	1.98	1.55	2.24
Russia's exports to ASEAN	0.19	0.22	0.79	1.43	0.71	0.93	0.63	0.61	0.87	1.02
ASEAN trade surplus	1.08	1.03	0.59	-0.04	0.62	0.48	1.26	1.37	0.68	1.22

Source: ASEANstats⁴

² Ibidem.

³ World Integrated Trade Solution (WITS). (2025). Trade indicators. Source: <https://wits.worldbank.org> (accessed on 20.11.2025)

⁴ ASEANStats. Source: <https://data.aseanstats.org/trade-annually> (accessed on 18.03.2025)

ASEAN's surplus is concentrated in vegetable oils and fats (HS 15, average annual surplus of USD 710.7 million), coffee, tea, and spices (HS 09, USD 258.9 million), and cocoa preparations (HS 18, USD 115.9 million). Russia's export surpluses with ASEAN are anchored in cereals (HS 10, average annual ASEAN deficit of USD 409.4 million), meat and offal (HS 02, USD 66.6 million), and fish and crustaceans (HS 03), where the balance shifted from a USD 49 million ASEAN surplus in 2015 to a deficit exceeding USD 134 million by 2022. Cereals, meat, and fish together account for approximately 85 percent of ASEAN's cumulative agricultural import expenditure from Russia over the decade, reflecting the concentration of Russian exports in a limited set of primary commodity groups.

Export Diversification: Shannon Entropy

Table 2 reports annual Shannon entropy values for both bilateral export directions. Two structurally distinct patterns are visible.

Table 2 – Shannon entropy of bilateral agricultural exports across HS chapters 01-24, 2015-2024

Export series	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Avg.
ASEAN → Russia	1.88	1.91	1.93	1.97	2.04	2.02	1.84	1.73	2.01	2.04	1.94
Russia → ASEAN	1.73	1.82	0.95	0.63	1.20	1.41	1.83	1.74	1.51	1.34	1.42

Source: ASEANstats⁵

ASEAN's export entropy fluctuated within a narrow band of 1.73-2.04, averaging 1.94 comfortably within the moderate-to-broad diversification range. The gradual upward trajectory from 1.88 in 2015 to 2.04 in 2024 indicates that ASEAN progressively widened the range of agricultural categories supplied to Russia, consistent with the production heterogeneity of its ten member states and with the expansion of regional agro-processing industries. Stability through the COVID-19 period (2020-2021) suggests that the diversified structure provided resilience against external disruption.

Russia's export entropy averaged only 1.42, exhibiting substantially greater volatility. The sharp decline to 0.95 in 2017 and 0.63 in 2018 reflects the surge in wheat exports following Russia's record harvests and the concurrent concentration of cereal deliveries to ASEAN markets. Partial recovery to 1.83 in 2021 gave way to renewed decline to 1.34 by 2024. The persistent gap between ASEAN's average entropy (1.94) and Russia's (1.42) documents a structural asymmetry in product composition: while ASEAN's exports to Russia are distributed across a broad range of categories, Russia's exports to ASEAN are anchored in a small number of primary commodity groups principally cereals, fish, and vegetable oils. This asymmetry describes differentiated modes of specialisation rather than a commercial imbalance: Russia holds a strong, concentrated comparative advantage in temperate-zone primary commodities, while ASEAN's exports span a wider spectrum from tropical raw materials to processed agri-industrial goods.

Bilateral Comparative Advantage: BRCA Analysis

Table 3 presents BRCA values for ASEAN exports to Russia across selected HS chapters, averaged over two sub-periods. ASEAN sustained bilateral comparative advantage (BRCA > 1.0) in approximately two-thirds of HS chapters throughout the period. The highest and most persistent values are observed in tropical and processed categories: HS 15 (vegetable oils), HS 09 (coffee, tea, spices), HS 18 (cocoa), HS 20 (prepared fruit and vegetables), and HS 08 (fresh and dried fruit). These categories align directly with ASEAN's agro-climatic production strengths.

Table 3 – BRCA values for ASEAN exports to Russia, selected HS chapters (five-year sub-period averages)

HS	Product description	Avg. BRCA 2015-2019	Avg. BRCA 2020-2024	Direction
15	Vegetable fats and oils	3.42	3.81	↑
09	Coffee, tea, spices	2.87	3.14	↑

⁵ ASEANStats. Source: <https://data.aseanstats.org/trade-annually> (accessed on 18.03.2025)

HS	Product description	Avg. BRCA 2015-2019	Avg. BRCA 2020-2024	Direction
18	Cocoa and cocoa preparations	2.53	2.71	↑
20	Prepared vegetables/fruit	2.14	2.44	↑
08	Edible fruit and nuts	1.89	2.12	↑
03	Fish and crustaceans	1.62	0.91	↓
10	Cereals	0.38	0.24	↓
02	Meat and edible offal	0.22	0.19	→
04	Dairy products and eggs	0.41	0.38	→

Source: ASEANstats⁶

Note: BRCA > 1.0 = bilateral comparative advantage

Russia's BRCA profile is the structural inverse of ASEAN's. Russia sustained clear bilateral comparative advantage in cereals (HS 10, BRCA values exceeding 4.0 in peak years), meat (HS 02), and fish (HS 03). Russian BRCA values in tropical categories (HS 09, HS 15, HS 18) remain well below unity throughout the period. This inverse structure confirms that the two partners are not competing for the same bilateral markets in the same product categories. Rather, each side supplies the other with commodities it cannot efficiently produce domestically the empirical hallmark of complementary rather than competitive trade.

Global Competitiveness: RCA Analysis

RCA analysis contextualises bilateral patterns within global competitive positions. ASEAN's collective RCA exceeds unity across the majority of its bilateral export categories to Russia, confirming that the products ASEAN supplies to Russia are those in which ASEAN holds strong global positions. Vegetable oils (HS 15) present the clearest case: Indonesia and Malaysia together account for approximately 84 percent of global palm oil output, and ASEAN's RCA in this category exceeds 8.0 across most years. Coffee and spices (HS 09) and cocoa (HS 18) similarly exhibit RCA values well above unity.

Russia's RCA profile reflects its well-documented role as a global primary commodity exporter. Cereals (HS 10) show RCA values consistently above 3.0 from 2017 onward, coinciding with Russia's position as the world's largest wheat exporter. Fish and seafood (HS 03) carry RCA above 1.5 throughout the period. The alignment between Russia's global RCA and its bilateral BRCA profile toward ASEAN confirms that Russia's exports to ASEAN reflect genuine productive specialisation rather than trade diversion. Taken together, the BRCA and RCA evidence indicates that bilateral trade is the intersection of two globally competitive export profiles in products where each partner faces structural domestic scarcity.

Trade Intensity Index

Table 4 presents the annual TII series for ASEAN agricultural exports to Russia. The TII remained above unity in every year of the study period, confirming that ASEAN's agricultural exports to Russia are consistently more intense than global trade shares alone would predict.

Table 4 – Trade Intensity Index: ASEAN agricultural exports to Russia, 2015-2024

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
TII (ASEAN → Russia)	1.21	1.19	1.15	1.09	1.14	1.17	1.24	1.29	1.31	1.32

Source: ASEANstats⁷

Note: TII > 1.0 = bilateral trade intensity exceeds the globally predicted benchmark

Three temporal phases are distinguishable. In the first phase (2015-2018), the TII declined modestly from 1.21 to 1.09, reflecting the surge in Russian cereal exports that temporarily shifted the bilateral balance

⁶ ASEANStats. Source: <https://data.aseanstats.org/trade-annually> (accessed on 18.03.2025)

⁷ ASEANStats. Source: <https://data.aseanstats.org/trade-annually> (accessed on 18.03.2025)

and compressed ASEAN's relative export intensity. In the second phase (2019-2021), the TII stabilised and began recovering as ASEAN tropical commodity exports to Russia resumed growth and the post-sanctions market reorientation consolidated. In the third phase (2022-2024), the TII accelerated markedly, reaching 1.32 the highest value recorded over the decade. This acceleration coincides with Russia's deepened geopolitical pivot toward Asian markets following the full-scale intensification of Western sanctions in 2022, which further concentrated Russian external trade toward non-Western partners and reinforced ASEAN's relative importance as an agricultural supplier.

The post-2022 TII trajectory is analytically significant because it occurred precisely when global trade fragmentation was disrupting many established bilateral relationships. The fact that Russia-ASEAN agricultural trade intensity increased during this period provides quantitative confirmation that the bilateral relationship was reinforced rather than weakened by the geopolitical shock.

Discussion

The four empirical measures converge on a coherent structural picture. Russia-ASEAN agricultural trade is characterised by complementary rather than competitive specialisation, is deepening in intensity beyond what global trade benchmarks predict, and rests on production profiles that are well-grounded in each partner's global export strengths. The structural asymmetry in diversification ASEAN's broader export basket versus Russia's concentrated commodity profile reflects not a commercial weakness but a difference in comparative advantage modes that creates the conditions for mutually beneficial and durable trade.

This complementarity is rooted in agro-climatic endowments that cannot be altered by policy decisions in the near term. Russia's temperate continental climate enables large-scale cereal, oilseed, and livestock production but excludes tropical commodities entirely. ASEAN's equatorial and subtropical climates produce palm oil, coconut, coffee, cocoa, and tropical fruits in quantities far exceeding regional consumption and for which Russia represents a major import market. This structural basis distinguishes the Russia-ASEAN agricultural relationship from trade partnerships that are primarily policy-driven and therefore vulnerable to policy reversal [3].

The post-2022 acceleration of the TII is consistent with the broader literature on geopolitical trade reorientation. As Western sanctions constrained Russia's access to traditional partners [8], ASEAN emerged as a more prominent agricultural destination. This is consistent with aggregate evidence showing that the share of "friendly" states in Russian agri-food exports rose to approximately 90 percent by 2023⁸. The quantitative TII evidence adds bilateral precision to this aggregate picture: the shift toward ASEAN was not merely a political declaration but a measurable intensification of actual trade flows relative to global benchmarks.

Three structural constraints qualify an otherwise favourable reading of these trends. First, Russia's export policy architecture creates an inherent tension with ASEAN's food security interests. Russia's 2020 Food Security Doctrine authorises export restrictions whenever domestic supply thresholds are at risk⁹, meaning ASEAN's dependence on Russian cereals is structurally unguaranteed. ASEAN wheat importers face sensitivity in the sense of Keohane and Nye's interdependence framework without the institutional mechanisms that would convert this sensitivity into structured vulnerability capable of generating cooperative obligations.

Second, SPS regulatory divergence constitutes a persistent non-tariff barrier. Heterogeneous SPS measures increase transaction costs substantially, particularly for exporters from developing countries [5], and no bilateral or multilateral SPS harmonisation framework currently governs Russia-ASEAN agricultural trade. The ASEAN-Russia Work Programme for Cooperation on Agriculture and Food Security 2021-2025 identifies food safety standards and veterinary controls as priority domains¹⁰, but this identification has not

⁸ OSW Centre for Eastern Studies. (2024). *An increase in Russia's agri-food exports*. Source: <https://www.osw.waw.pl/en/publikacje/analyses/2024-03-01/increase-russias-agri-food-exports> (accessed on 26.03.2026)

⁹ USDA, Foreign Agricultural Service. (2020). *New food security doctrine adopted* (GAIN Report No. RS2020-0003). Source: https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=New+Food+Security+Doctrine+Adopted_Moscow_Russian+Federation_02-03-2020 (accessed on 26.03.2026)

¹⁰ ASEAN Secretariat. (2020). *Work programme for the ASEAN-Russia cooperation on agriculture and food security 2021-2025*.

yet translated into binding regulatory alignment.

Third, geographical distance imposes transport cost disadvantages relative to Australia, the United States, and Canada as wheat suppliers to Southeast Asia. These disadvantages are partially offset by Russia's competitive export pricing, but their structural persistence means that competitiveness is sensitive to global freight and energy market conditions¹¹.

These constraints indicate that the deepening interdependence documented by the TII and BRCA analyses remains fragile unless accompanied by institutional developments that provide greater predictability, lower transaction costs, and formal linkages between bilateral trade flows and each partner's food security frameworks.

Conclusion

This article has provided the first systematic multi-indicator characterisation of Russia-ASEAN agricultural trade structure across the 2015-2024 period, applying Shannon entropy, BRCA, RCA, and TII measures to disaggregated HS chapter data. Four principal findings emerge.

ASEAN's agricultural export portfolio to Russia is moderately to broadly diversified (average entropy 1.94), while Russia's exports to ASEAN are substantially more concentrated (average entropy 1.42), reflecting differentiated specialisation rooted in agro-climatic endowments. BRCA analysis confirms that the two partners are overwhelmingly complementary: ASEAN holds bilateral comparative advantage in tropical and processed categories where Russia has negligible production, while Russia holds advantage in cereals, meat, and fish where ASEAN faces structural import dependence. RCA analysis confirms that bilateral comparative advantage profiles mirror global competitiveness positions, indicating that bilateral trade is structurally embedded within each partner's broader international trade network. The TII remained above unity throughout the full decade and accelerated to 1.32 in 2024, with the post-2022 intensification providing quantitative evidence of deepening bilateral engagement under conditions of global trade fragmentation.

These findings carry clear practical implications. For Russia, diversifying agricultural export destinations toward ASEAN aligns with the strategic logic of its eastward reorientation but requires investment in logistics and SPS harmonisation to convert structural complementarity into durable commercial relationships. For ASEAN food importers, Russia represents a strategically meaningful supplementary cereal supplier whose export reliability is subject to domestic policy constraints not yet addressed through formal bilateral arrangements. For both parties, the gap between the institutional ambitions of the 2021-2025 Work Programme on Agriculture and Food Security and the actual depth of institutional integration represents the principal development priority for the relationship.

Future research should address several limitations of the present analysis. The HS 2-digit aggregation level conceals product heterogeneity that determines actual price competitiveness and market access conditions. Data gaps for Russia-to-ASEAN TII after 2021 reflecting Russia's cessation of detailed customs data publication limit post-conflict bilateral analysis to the ASEAN-to-Russia direction. Extension to HS 4-digit and 6-digit classifications, integration of unit-value data, and analysis of intra-ASEAN heterogeneity in bilateral trade relations with Russia would substantially deepen the empirical picture.

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Source: <https://asean.org/wp-content/uploads/22.-WP-2021-2025-29-as-of-21-August-Supported-by-Russia-20201002.pdf> (accessed on 26.03.2026)

¹¹ Hossen, M.D. (2023). *Tariff and non-tariff barriers affect U.S. agricultural exports to the ASEAN market*. Southern Ag Today. Source: <https://southernagtoday.org/2023/12/01/tariff-and-non-tariff-barriers-affect-u-s-agricultural-exports-to-the-asean-market/> (accessed on 26.03.2026)

CONFLICT OF INTEREST

The author declares no conflict of interest.

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