

Original article

An Analysis of Türkiye's Competitiveness in the Sunflower Seed Foreign Trade and the Transformation of Export Markets

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Abstract

The aim of this study is to examine Türkiye's competitive strength in the foreign trade of sunflower seeds and the long-term transformation of its export markets. The study utilised foreign trade data for sunflower seeds (HS code 120600) for the period 2010–2025. Türkiye's foreign trade performance was assessed using indicators such as exports, imports, the trade balance, the export-to-import coverage ratio and unit value. The Revealed Comparative Advantage (RCA) and Symmetric Revealed Comparative Advantage (RSCA) indices were utilised to determine international competitiveness. The concentration and diversification structure of export markets was analysed using the Herfindahl-Hirschman Index (HHI), the concentration ratio of the top four countries (CR4) and the number of partner countries. The long-term transformation of markets was analysed by comparing country shares during the 2010–2012 and 2023–2025 periods. The findings indicate that Türkiye possessed a revealed comparative advantage in sunflower seed exports throughout the entire period under review. The RCA value stood at 3.07 in 2010 and reached 5.83 in 2025. RSCA values followed a positive trend throughout all analysis periods. In contrast, Türkiye consistently recorded a trade deficit in sunflower seed trade, except in 2024. Analyses of the structure of export markets revealed that the HHI fell from 0.229 to 0.098, the CR4 declined from 70.06 per cent to 50.27 per cent, and the number of export partners rose from 49 to 93, indicating a significant expansion of the market. Country-by-country comparisons revealed that the weight of traditional markets has shifted and new export markets have gained importance. The findings of this study indicate that Türkiye's growing export capacity and comparative advantage in the sunflower seed trade coexist with a dependence on imports and a trade deficit; however, export markets have evolved into a geographically more diversified structure.

Keywords: Sunflower Seeds, International Competitiveness, Revealed Comparative Advantage, RCA, Export Market Diversification, Market Concentration

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INTRODUCTION

In addition to being one of the fundamental raw materials of food systems, oilseeds constitute a strategic product group in international agricultural trade due to their role in the production of vegetable oil, animal feed and various industrial products. Within this product group, sunflower stands out in terms of its production and trade volume, its strong links to the vegetable oil industry, and its ability to be cultivated in diverse geographical regions. Sunflower (*Helianthus annuus* L.) is a strategic agricultural commodity that holds a significant position in the global oilseed and vegetable oil markets; it is utilised in the production of food, animal feed and various industrial products, primarily vegetable oil for human consumption (Ates & Bukowski, 2022; Aydın Can, et al., 2021; Murphy, 2025; Pilorge, 2021). From Türkiye's perspective, sunflower holds a strategic position as an agricultural product in terms of food security, self-sufficiency and the balance of trade, owing to its significant share in vegetable oil consumption, the inadequacy of domestic production to meet demand, and the resulting shortfall being met through imports (Gül et al., 2016). In recent years, global oilseed markets have been significantly influenced not only by production and demand conditions but also by trade policies, supply chain issues, price fluctuations and geopolitical developments. These conditions necessitate that countries' positions in international markets be assessed not only in terms of export volumes but also in terms of their competitive strength and changes in the structure of their export markets.

In the literature on international trade, one of the most common approaches to assessing a country's relative specialisation and competitive position in a particular product is the concept of revealed comparative advantage. Developed by Balassa (1965), the Revealed Comparative Advantage [RCA] approach assesses a country's specialisation in foreign trade for a given product by comparing the relative weight of that product in the country's exports with its relative weight in global exports of the same product. An RCA index value above 1 indicates the presence of revealed comparative advantage, whilst values below 1 are interpreted as comparative disadvantage. For this reason, the RCA approach is widely used, particularly in the analysis of the international competitive positions of agricultural products.

Studies on agricultural products, and in particular oilseeds, demonstrate that the revealed comparative advantage approach is effective in determining the international competitive positions of these products. Matkovski, Jeremic, Dokić and Jurjević (2020) examined Serbia's export potential for oilseeds and products derived from them, and determined that sunflower products, in particular, possess significant comparative advantages in international markets. In a more recent study, Matkovski, Dokić, Zekic and Jurjevic (2025) examined Serbia's oilseed production and foreign trade competitiveness, revealing that sunflower seeds and sunflower oil possess high revealed comparative advantage values amongst the oilseed products analysed. Similarly, Titin, Popovic and Matkovski (2025), by assessing Serbia's international market position in sunflower and sunflower derivatives using the RCA approach, highlighted the importance of the competitiveness of sunflower products within the country's

agricultural foreign trade. These studies demonstrate that sunflower is a strategic product that warrants investigation not only in terms of production but also in terms of foreign trade specialisation.

In the literature on exports, geographical diversification and market concentration are regarded as key dimensions of foreign trade performance (Cieslik et al., 2012). The Herfindahl-Hirschman Index (HHI) is one of the most widely used indicators for measuring the concentration of export markets. The HHI is based on the sum of the squares of each target country's share of total exports. A rise in the index indicates that exports are concentrated in a more limited number of markets, whilst a fall indicates a more diversified market structure. This approach makes it possible to assess not only the existence of a competitive advantage but also the extent to which that advantage is sustained within a diversified market structure.

For Türkiye, sunflowers hold a special position in terms of production, the food industry and foreign trade. Although Türkiye possesses favourable production conditions and significant sunflower production capacity, imports have long played a key role in meeting domestic demand and the raw material requirements of the vegetable oil industry (Aydın Can et al., 2021; Çatuk, 2025; Semerci & Durmuş, 2021). This situation makes sunflower one of the products where domestic production capacity and external dependence are observed simultaneously. A significant proportion of research conducted on sunflowers in Türkiye focuses on the economics of production, farmer behaviour, seed usage, production costs and the effects of agricultural policy. Güngör, Saraçoğlu and Güngör (2018) examined the sunflower seed sector and producers' seed purchasing behaviour in the Thrace Region. Badem and Hurma (2025), on the other hand, assessed the profitability and competitiveness of sunflower production in Tekirdağ using the Policy Analysis Matrix and efficiency indicators, and presented findings regarding the comparative advantage of sunflower production.

There are also studies on the competitiveness of Türkiye's agricultural foreign trade. Şahinli (2014) examined Türkiye's competitive strength in the agricultural sector across a broad range of products using the RCA approach, demonstrating that there are significant differences in competitiveness between agricultural products. Duru (2024) analysed Türkiye's vegetable oil foreign trade using RCA, symmetric comparative advantage and trade balance indicators, and determined that, despite high imports of oilseeds and crude oil, positive indicators of competitive strength could emerge, particularly in processed vegetable oils. This finding indicates that the structure of Türkiye's foreign trade in oilseeds and their processed products is too multidimensional to be explained solely by the concepts of net exports or net imports.

However, a review of the existing literature reveals that there are few studies which examine Türkiye's foreign trade in HS 120600 sunflower seeds within a long-term and product-specific framework, analysing both its international competitiveness and the geographical concentration and transformation of its export markets. Whilst some studies on agricultural competitiveness in Türkiye

focus on broad agricultural product groups (Şahinli, 2014), other studies have examined the foreign trade competitiveness of oilseeds using indicators such as RCA, RXA and RSCA (Kadakoğlu et al., 2023). In the international literature, studies examining the foreign trade competitiveness of sunflower seeds and their derivatives on a product-by-product basis have focused particularly on major producing countries such as Serbia (Matkovski et al., 2025; Titin et al., 2025). These studies demonstrate that strong comparative advantages can be identified in sunflower seeds and sunflower oil. In contrast, there appears to be a limited number of studies that simultaneously examine Türkiye's competitive strength in sunflower seed exports under HS code 120600 alongside the long-term transformation in the concentration, diversification and country composition of its export markets. However, when assessing a product's position in international markets, it is not sufficient to merely identify its stated comparative advantage; it is also important to determine in which export markets this advantage exists, to what extent exports are concentrated in specific countries, and how market diversification has changed over time. Accordingly, this study aims to provide a comprehensive perspective to the existing literature by evaluating the evolution of Türkiye's competitive strength in sunflower seed foreign trade over time, taking into account the concentration and diversification of export markets as well as changes in country shares.

The aim of this study is to examine Türkiye's competitive strength in the sunflower seed foreign trade sector and the long-term transformation of its export markets on a country-by-country basis for the period 2010–2025. Within the scope of the study, the development of Türkiye's sunflower seed exports and imports (HS code 120600) was assessed in terms of the foreign trade balance, the export-to-import coverage ratio, and export and import unit values. Furthermore, Türkiye's international competitiveness was determined using the RCA and RSCA indices, whilst the concentration and diversification structure of export markets was analysed using the HHI, the four-country concentration ratio (CR4) and the number of partner countries to which exports are made. To examine country-specific trends, country-specific export shares for the periods 2010–2012 and 2023–2025 were compared, thereby identifying the strengthening, declining and emerging markets in Türkiye's sunflower seed exports.

METHOD

This study is a quantitative, descriptive and comparative analysis aimed at examining Türkiye's competitive strength in the sunflower seed foreign trade sector and the long-term transformation of its export markets. The study utilises the six-digit Harmonised System (HS) code 120600 – 'Oil Seeds: Sunflower seeds, whether or not broken' – as the basis for product definition for the period 2010–2025. By conducting the analysis at the six-digit HS level, the study aimed to minimise product heterogeneity that might arise from broader groups of oilseeds or agricultural products and to examine Türkiye's sunflower seed foreign trade on a product-specific basis. The following questions were examined within the scope of the research:

- **RQ1.** How has Türkiye's foreign trade performance in sunflower seeds changed over the period 2010–2025?
- **RQ2.** What trend has Türkiye's comparative advantage in sunflower seed exports followed?
- **RQ3.** How have market concentration and diversification in Türkiye's sunflower seed exports changed?
- **RQ4.** How has the country composition of Türkiye's sunflower seed export markets changed?

Data Source and Data Set Construction

The data analysed as part of this study were obtained from the UN Comtrade Database published by the United Nations Statistics Division. The data covers the period 2010–2025 on an annual basis; export and import figures were obtained separately by selecting HS 120600 as the product and Türkiye as the reporting country. The 'Trade Value' (US\$) variable was used to measure the value of foreign trade, whilst the 'Net Weight' (kg) variable was used to measure the volume of trade (United Nations, 2026).

Export data has been compiled at partner-country level for the purpose of analysing Türkiye's export market structure. The distribution of Türkiye's total exports under HS code 120600 amongst target countries has been determined on an annual basis. 'World' observations, which represent total trade, have been used to determine the annual totals. In the revealed comparative advantage calculations, four key export time series have been analysed. These are: Türkiye's exports under HS 120600, Türkiye's total goods exports, world exports under HS 120600, and world total goods exports.

In the study, exports, imports, the balance of trade, the export-to-import coverage ratio and unit values of exports and imports were analysed to determine foreign trade performance. Revealed Comparative Advantage (RCA) and Symmetric Revealed Comparative Advantage (RSCA) analyses were applied to measure international competitiveness. To assess the concentration and diversification of export markets, the Herfindahl-Hirschman Index (HHI), the concentration ratio of the top four countries (CR4) and the number of partner countries were utilised.

The indicators used in the study were evaluated together to highlight the different, complementary dimensions of Türkiye's foreign trade performance in sunflower seeds. While RCA determines Türkiye's revealed comparative advantage in this product, RSCA allows for an assessment of this advantage on a symmetric scale. In contrast, HHI and CR4 indicate the level of concentration of exports in specific target markets, while the number of countries to which exports are made reflects the breadth of market diversification. Country shares and changes in market share, meanwhile, make it possible to identify shifts in the geographic distribution of exports over time. The combined use of all these indicators makes it possible to assess not only whether Türkiye possesses a competitive advantage in

sunflower seed exports but also the nature of the market structure within which this advantage is realized.

Measuring Foreign Trade Performance

In order to determine Türkiye's overall position in the foreign trade of sunflower seeds, annual export and import values were compared and the foreign trade balance was calculated as follows:

$$TB_t = X_t - M_t$$

TB_t represents the trade balance in year t, X_t represents the export value under HS 120600, and M_t represents the import value under HS 120600. A positive value indicates a trade surplus, whilst a negative value indicates a trade deficit.

The export-to-import coverage ratio was calculated as follows:

$$K_t = \frac{X_t}{M_t} \times 100$$

If the coverage ratio is above 100 per cent, this indicates that the value of exports exceeds the value of imports; if it is below 100 per cent, this indicates that the value of imports is higher than the value of exports.

In order to compare the value-volume structure of trade flows, the unit values of exports and imports have been calculated as follows:

Unit Value of Exports:

$$UV_t^X = \frac{X_t}{Q_t^X}$$

Unit Value of Imports:

$$UV_t^M = \frac{M_t}{Q_t^M}$$

Unit values are expressed in US dollars per kilogram. Furthermore, these indicators are not interpreted as direct product prices. As a product group at the six-digit HS level may vary within itself in terms of quality, variety, intended use and other product characteristics, the unit values have been assessed as descriptive indicators showing the ratio of the average monetary value of the relevant trade flow to its physical quantity.

Revealed Comparative Advantage (RCA)

The Revealed Comparative Advantage (RCA) index, developed by Balassa (1965), was used to assess Türkiye's international specialisation in sunflower seed exports. The Balassa approach compares the relative weight of a specific product within a country's total exports with the relative weight of that same product within total world exports. Thus, comparative advantage is determined on the basis of the actual structure of foreign trade (Balassa, 1965).

RCA was calculated as follows:

$$RCA_t = \frac{\frac{X_{TR,120600,t}}{X_{TR,t}}}{\frac{X_{W,120600,t}}{X_{W,t}}}$$

If the RCA value is greater than 1, this indicates that Türkiye has a revealed comparative advantage in sunflower seed exports; if it is less than 1, it indicates a revealed comparative disadvantage. An RCA value equal to 1 indicates a neutral situation (Balassa, 1965).

Symmetric Revealed Comparative Advantage (RSCA)

The fact that the RCA index takes values between 0 and infinity means that the comparative advantage and disadvantage values are not symmetrical about the neutral value. For this reason, it may present a methodological limitation, particularly when making comparisons between different periods or products. To address this asymmetric characteristic of the RCA, the use of a symmetric transformation is recommended. To this end, the study utilised the Revealed Symmetric Comparative Advantage (RSCA) index as a complementary indicator to the RCA (Laursen, 2015).

The RSCA value was calculated as follows:

$$RSCA_t = \frac{RCA_t - 1}{RCA_t + 1}$$

An $RSCA > 0$ indicates a documented comparative advantage, an $RSCA < 0$ indicates a documented comparative disadvantage, and an $RSCA = 0$ indicates a neutral situation. The combined use of RCA and RSCA aims both to preserve the traditional Balassa index and to reduce the interpretative limitations arising from the asymmetric nature of the RCA (Laursen, 2015).

Measuring Export Market Concentration: HHI

The Herfindahl-Hirschman Index (HHI) was used to assess the distribution of Türkiye's sunflower seed exports amongst target countries. The HHI is one of the indicators used in international trade analysis to assess the concentration of exports across products or target markets. (Cadot et al.,

2011; World Bank, 2026). In calculating the index, the share of each partner country in Türkiye's total sunflower seed exports was first calculated:

$$s_{it} = \frac{X_{it}}{X_t}$$

Secondly, the squares of all partner countries' export shares were summed:

$$HHI_t = \sum_{i=1}^n s_{it}^2$$

The index is calculated on a scale of 0–1; an increase in its value indicates that exports are concentrated in a more limited number of target markets, whilst a decrease indicates that exports are more diversified across partner countries (World Bank, 2026).

Four-Country Concentration Ratio (CR4)

To complement the HHI indicator, **the four-country concentration ratio (CR4)** has been analysed. Concentration ratios indicate the cumulative share of the largest units within the total. In this study, the CR4 was calculated as the sum of the shares of the four partner countries to which Türkiye exported the most HS 120600 goods each year within the total exports.

$$CR4_t = \sum_{i=1}^4 s_{it}$$

A rise in the CR4 value indicates that Türkiye's sunflower seed exports are becoming increasingly dependent on its four largest target markets, whilst a fall indicates that the share of these markets in total exports is decreasing.

Number of Partner Countries and Geographical Diversification

The number of partner countries has also been calculated in order to assess changes in the geographical spread of export markets. The number of partner countries to which exports are made is one of the key indicators used to assess the breadth and geographical diversification of exports (Brenton & Newfarmer, 2007; Hummels & Klenow, 2005). In the World Bank's WITS methodology, the number of export markets is also included amongst the indicators used to assess foreign trade diversification (World Bank, 2026).

Analysis of the Long-Term Transformation of Export Markets

Although the HHI, CR4 and the number of partner countries indicate the overall level of concentration and diversification in export markets, these indicators do not directly reveal which

countries are responsible for changes in market composition. For this reason, in the final stage of the study, long-term changes in the export shares of partner countries were examined separately.

As the use of a single start and end year could be unduly influenced by the effects of annual production, price, demand or foreign trade shocks, three-year period averages have been preferred for the comparison. To this end, the 2010–2012 period was compared with the 2023–2025 period. For each partner country, the average export value and average market share for the initial and final periods were calculated. The change in the country's market share was then determined as follows:

$$\Delta S_i = \bar{S}_{i,2023-2025} - \bar{S}_{i,2010-2012}$$

Positive values indicate that the relative share of the country in question in Türkiye's sunflower seed exports has increased, whilst negative values indicate that it has decreased. Countries to which no exports were made in the initial period but to which exports were made in the most recent period represent new markets, whilst countries to which exports were made in the initial period but not in the most recent period represent lost markets.

FINDINGS

The findings obtained within the scope of this study have been analysed and reported under four subheadings in accordance with the research questions.

RQ1. How has Türkiye's sunflower seed foreign trade performance changed over the period 2010–2025?

The development of Türkiye's foreign trade indicators for sunflower seeds (HS code 120600) over the period 2010–2025 is presented in Table 1.

Table 1. Türkiye's sunflower seed foreign trade performance, 2010–2025

Year	Exports (million \$)	Imports (million \$)	Trade Balance (million \$)	Coverage (%)	Export Unit Value (\$/kg)	Import Unit Value (\$/kg)
2010	58.9	349.7	-290.8	16.84	2.72	0.54
2011	81.1	589.6	-508.5	13.75	2.51	0.65
2012	101.1	444	-342.9	22.77	2.52	0.59
2013	119.2	477.1	-357.9	24.98	2.32	0.67
2014	136.4	404.8	-268.4	33.7	2.5	0.72
2015	101.1	248.5	-147.4	40.68	1.67	0.69
2016	164.4	319.2	-154.8	51.5	1.43	0.63
2017	190.1	367.7	-177.6	51.7	1.22	0.55
2018	156.7	395.6	-238.9	39.61	1.3	0.51
2019	172.4	568.3	-395.9	30.33	1.49	0.46
2020	193.6	628.4	-434.8	30.81	1.68	0.52
2021	226.6	542.1	-315.5	41.8	2	0.74
2022	228	647.7	-419.6	35.21	1.99	0.78
2023	276.2	480.5	-204.3	57.48	2.96	0.64
2024	345.7	208	137.7	166.19	2.39	0.72
2025	360.4	886.1	-525.7	40.67	2.46	0.67

An examination of Table 1 shows that sunflower seed exports, which stood at 58.9 million US dollars in 2010, reached 360.4 million dollars in 2025. When comparing the start and end of the analysis period, exports increased by approximately 6.1 times in nominal terms. Although declines were observed in 2015 and 2018 compared with the previous year, it can be seen that, following 2020, the value of exports generally reached higher levels and peaked in 2025, marking the highest value within the period.

On the import side, however, there has been greater volatility than on the export side. Imports, which stood at 349.7 million dollars in 2010, fell to 208.0 million dollars in 2024, before rising to 886.1 million dollars in 2025, reaching the highest level of the period under review. This pattern is also directly reflected in the foreign trade balance. It can be seen that Türkiye recorded a trade deficit in sunflower seeds in 15 out of the 16-year period. A trade surplus of \$137.7 million was recorded only in 2024. In contrast, in 2025, the trade deficit reached \$525.7 million, marking the highest level of the period under review.

Data on the coverage ratio also supports this finding. Whilst exports accounted for just 16.84 per cent of imports in 2010, this ratio has risen over time, reaching 166.19 per cent by 2024. However, due to a sharp rise in imports in 2025, the ratio fell back to 40.67 per cent. Consequently, despite the marked expansion in export capacity, it is evident that the need for imports in the sunflower seed trade persists.

Analyses of unit values also reveal a striking result. It was observed that, throughout the years under review, the unit value of exports was higher than that of imports. For example, in 2025, the unit value of exports was \$2.46/kg, whilst the unit value of imports stood at \$0.67/kg. This disparity was largely maintained throughout the period. This finding suggests that the trade composition of products exported and imported by Türkiye under HS code 120600 may differ.

RQ2. What trend has Türkiye’s comparative advantage in sunflower seed exports followed?

Türkiye’s international competitive position in sunflower seed exports has been analysed using RCA and RSCA indicators. The results of the RCA and RSCA analyses are presented in Table 2.

Table 2. RCA and RSCA values for Türkiye’s sunflower seed exports

Year	RCA	RSCA
2010	3.073	0.509
2011	2.86	0.482
2012	3.375	0.543
2013	3.259	0.53
2014	4.403	0.63
2015	3.495	0.555
2016	5.065	0.67
2017	5.427	0.689
2018	4.045	0.604
2019	3.961	0.597
2020	4.177	0.614
2021	4.665	0.647
2022	3.153	0.518
2023	4.768	0.653
2024	6.425	0.731
2025	5.832	0.707

An examination of Table 2 reveals that the RCA values were above 1 in all years. This result indicates that Türkiye possessed a revealed comparative advantage in the export of HS 120600 sunflower seeds throughout the entire 2010–2025 period. The RCA stood at 3.07 in 2010 and reached 5.83 in 2025. The lowest value for the period was recorded in 2011 at 2.86, whilst the highest was recorded in 2024 at 6.42.

The results of the RSCA analysis also corroborate the RCA findings. The fact that the RSCA remained above zero in all years indicates that Türkiye’s comparative advantage in sunflower seed exports was maintained throughout the period. The RSCA value rose from 0.509 in 2010 to 0.707 in 2025, with the highest value recorded at 0.731 in 2024.

The key finding here is the distinction between comparative advantage and the net foreign trade position. Although Türkiye exhibits strong relative specialisation in sunflower seed exports according to RCA and RSCA indicators, it has been a net importer within this product group in all years except 2024. Consequently, the identified comparative advantage does not imply a trade surplus in this product group. The high share of sunflower seeds in Türkiye's total exports, compared to the world average, is observed alongside a domestic import requirement.

RQ3. How have market concentration and diversification in Türkiye's sunflower seed exports changed?

Changes in the structure of Türkiye's sunflower seed export markets have been assessed using HHI and CR4 analyses, as well as the number of partner countries. The results of the analysis are presented in Table 3.

Table 3. Concentration and diversification of export markets

Year	HHI	CR4 (%)	Number of Partners
2010	0.229	70.06	49
2011	0.186	66.61	52
2012	0.135	59.39	51
2013	0.142	61.48	52
2014	0.129	60.62	54
2015	0.085	48.7	58
2016	0.089	48.66	62
2017	0.097	53.42	64
2018	0.092	52.43	59
2019	0.086	50.43	61
2020	0.082	48.24	75
2021	0.085	49.72	93
2022	0.085	44.25	86
2023	0.115	53.04	72
2024	0.076	47.53	88
2025	0.098	50.27	93

An examination of Table 3 reveals a marked long-term diversification in Türkiye's export market structure. The HHI stood at 0.229 in 2010 but fell to 0.098 in 2025. The lowest HHI value during this period was recorded in 2024 at 0.076. This change indicates that export value is now distributed across a broader group of partner countries compared with the beginning of the period.

The CR4 results support this shift from another perspective. The share of Türkiye's four largest export markets in total exports fell from 70.06 per cent in 2010 to 50.27 per cent in 2025. In other words, whilst at the start of the period approximately seven-tenths of sunflower seed exports were directed to

just four countries, by the end of the period this proportion had fallen to approximately half. The lowest CR4 value during the period was recorded in 2022 at 44.25 per cent.

The change in the number of partner countries, meanwhile, indicates an increase in market diversification. Whilst Türkiye exported to 49 partner markets in 2010, this figure rose to 93 by 2025. Consequently, the number of partner markets to which exports were made increased by approximately 90 per cent between the start and end of the period.

The fact that the decline in the HHI and CR4 has coincided with an increase in the number of partner countries is a significant indicator. An increase in the number of partner countries alone may not be sufficient to demonstrate diversification of exports. However, in this case, not only is the number of markets increasing, but concentration indicators are also falling compared to the previous period. These results indicate that Türkiye's sunflower seed exports have expanded geographically and that concentration in major target markets has decreased.

However, the transformation observed is not linear in nature. For example, whilst the HHI stood at 0.085 in 2022, it rose to 0.115 in 2023, fell to 0.076 in 2024, and rose again to 0.098 in 2025. Similar fluctuations are also observed in the CR4 value. Consequently, the findings point to a distinct long-term transformation between the initial and final structures of the 2010–2025 period, rather than a continuous annual variation. The fact that the increase in the number of markets occurred alongside a decline in the HHI and CR4 values indicates that exports are spreading to a broader and more balanced group of countries. Conversely, the fact that concentration indicators have remained at high levels despite the increase in the number of markets suggests that, even with entry into new markets, exports remain fundamentally dependent on a limited number of large markets. Therefore, the sustainability of competitive strength is linked not only to improving export performance but also to distributing that performance evenly across different target markets.

RQ4. How has the country composition of Türkiye's sunflower seed export markets changed?

The change in country composition has been analysed and reported by comparing the average for the first three years of the analysis period with the average for the last three years. The transformation of the export market is presented in Table 4.

Table 4. Changes in Türkiye's main markets for sunflower seed exports

Country	2010–12 Share	2023–25 Share	Change in Share	Direction
Romania	5.20%	11.64%	6.43%	Strengthening
Bulgaria	0.78%	5.54%	4.76%	Strengthening
Algeria	0.00%	3.97%	3.97%	Strengthening
Iraq	3.94%	6.97%	3.03%	Strengthening
Syria	2.78%	5.43%	2.64%	Strengthening
Ukraine	13.30%	15.47%	2.17%	Strengthening
Kazakhstan	0.92%	2.73%	1.81%	Strengthening
Poland	0.68%	2.21%	1.53%	Strengthening
Tunisia	0.12%	1.45%	1.33%	Strengthening
USA	0.10%	1.29%	1.19%	Strengthening
Russian Federation	37.00%	15.55%	-21.45%	Declining
Hungary	7.19%	3.74%	-3.45%	Declining
Austria	5.84%	3.64%	-2.20%	Declining
Spain	3.88%	1.71%	-2.17%	Declining
France	5.49%	3.39%	-2.10%	Declining
Netherlands	1.06%	0.09%	-0.97%	Declining
Belarus	0.83%	0.04%	-0.79%	Declining
Azerbaijan	1.94%	1.48%	-0.46%	Declining
Germany	3.56%	3.13%	-0.43%	Declining
Slovakia	0.41%	0.03%	-0.38%	Declining

The analysis results show that market diversification stems not only from an increase in the number of countries to which exports are made, but also from a redistribution of the shares of the main export markets. The most pronounced change has occurred in the Russian market. Russia's average share of Türkiye's sunflower seed exports stood at approximately 37.0 per cent during the 2010–2012 period, but fell to approximately 15.6 per cent during the 2023–2025 period, representing a decline of approximately 21.5 percentage points.

However, there have recently been significant increases in the relative weight of certain markets. Some of the most notable increases in the growing markets have been observed in Romania (+6.4 per cent), Bulgaria (+4.76 per cent), Algeria (+3.97 per cent), Iraq (+3.03 per cent), Syria (+2.64 per cent) and Ukraine (+2.17 per cent). These changes indicate that the high proportion of exports to Russia at the start of the period has, over time, given way to an export structure that is more widely spread across different geographical regions.

These results also explain the mechanism behind the decline in the HHI and CR4 observed in Table 3. The transformation of Türkiye's export markets has not merely taken the form of new countries being added alongside existing ones. The share of major markets within total exports has also changed significantly. Whilst the structure was more concentrated in certain major markets during the initial

period, it is evident that the export composition has shifted towards a more balanced structure in recent years, driven by the increasing weight of markets such as Romania, Bulgaria, Algeria, Iraq, Syria and Ukraine.

DISCUSSION AND CONCLUSION

This study examines Türkiye's sunflower seed foreign trade over the period 2010–2025 across three interrelated dimensions: foreign trade performance, revealed comparative advantage and the geographical structure of export markets. The findings indicate that Türkiye maintained its revealed comparative advantage in sunflower seed exports throughout the period, that its export markets became more diversified over time, but that, despite these developments, the country remained largely a net importer in its sunflower seed foreign trade. When these three findings are assessed together, they reveal that Türkiye's position in sunflower seed foreign trade is too multifaceted to be explained solely in terms of the volumes of exports or imports.

Although Türkiye's sunflower seed exports are set to rise from US\$58.9 million in 2010 to US\$360.4 million in 2025, the foreign trade balance has been in deficit in 15 of the 16 years under review. The high and volatile trend in imports over the period indicates that the expansion in exports has not eliminated Türkiye's need to import sunflower seeds. This finding is generally consistent with previous studies on Türkiye's oilseed and vegetable oil sector. Duru (2024) demonstrated that the shortfall in Türkiye's oilseed production led to significant imports of oilseeds and crude oil, whilst competitiveness in processed vegetable oils was maintained. Consequently, the simultaneous occurrence of high imports and international competitiveness in specific products or product stages can be regarded as a more general characteristic of Türkiye's oilseed sector.

Findings regarding the economic competitiveness of sunflower production in Türkiye also support this assessment. A study conducted by Badem and Hurma (2025) demonstrated that, in the case of Tekirdağ, sunflower production showed positive profitability under both private and social prices, and that this crop possesses a greater competitive advantage compared to wheat. However, competitiveness at the production level does not equate to domestic supply meeting total demand. Indeed, studies examining the production and input structure of the sunflower and seed sector in Türkiye indicate that the sector's international linkages are significant in terms of both production inputs and trade (Güngör et al., 2018). In the present study, the persistence of the foreign trade deficit throughout the period is significant in that it demonstrates that competitiveness in production or export capacity does not, on its own, eliminate high domestic demand and raw material requirements.

Another finding of the study is that Türkiye possesses a strong revealed comparative advantage in exports of sunflower seeds under HS code 120600. The fact that the RCA value was well above 1 in all the years examined, whilst the RSCA value remained consistently positive, indicates that this advantage is not specific to any particular year. Şahinli (2014), who examined Türkiye's international

competitive strength in agricultural products across a broader product group, demonstrated that there are significant variations in comparative advantages amongst agricultural products. The present study, however, narrows the product level down to HS 120600 and demonstrates, through a more specific trade classification, that sunflower seeds are one of the products in which Türkiye holds a comparative advantage.

This finding is also noteworthy when compared with the international literature on sunflowers. Matkovski et al. (2025) examined Serbia's international competitiveness in oilseeds and determined that the strongest comparative advantages were found in sunflower seeds and sunflower oil. Similarly, Titin et al. (2025), by analysing Serbia's international position in sunflower seeds and their derivatives using RCA and self-sufficiency indicators, demonstrated that sunflower products hold a strong competitive position. Consequently, the RCA results obtained for Türkiye in the present study are consistent with international findings indicating that sunflower is a product capable of generating strong foreign trade specialisation in major producing countries. A key point distinguishing Türkiye from these examples is that revealed comparative advantage and the foreign trade balance can move in different directions. Although Türkiye's RCA value remained above 1 throughout the entire period, its foreign trade balance was consistently negative, except in 2024. Whilst this may appear contradictory at first glance, it is consistent with the conceptual framework of RCA. RCA does not compare a country's status as a net exporter or net importer of a given product, but rather compares the relative weight of that product within the country's exports with its relative weight in global exports of the same product. Consequently, a country possessing revealed comparative advantage in a specific product does not necessarily imply that it will run a trade surplus in that product. The example of Türkiye clearly illustrates this distinction empirically.

At this point, unit values for exports and imports provide an important additional insight. The fact that the unit value of exports exceeded that of imports in all the years examined suggests that Türkiye may have trade flows of different characteristics within the same HS 6 classification. For example, in 2025, the unit value of exports was \$2.46/kg, whilst the unit value of imports was \$0.67/kg. However, it is not possible to interpret this difference directly as an indicator of quality or value added. The HS 120600 classification may encompass sunflower seeds with different uses, varieties and commercial characteristics within the same six-digit category. Consequently, the results also suggest the possibility that Türkiye imports products with relatively low unit values whilst exporting those with higher unit values.

The long-term geographical shift in export markets is another parameter examined within the scope of the research. The decline in the HHI from 0.229 in 2010 to 0.098 in 2025, and in the CR4 from 70.06 per cent to 50.27 per cent, indicates that Türkiye's sunflower seed exports have a less concentrated market structure compared to the previous period. This result is further supported by the increase in the number of partner countries from 49 to 93 over the same period. Thus, this diversification stems not

only from the rise in the number of countries to which exports are made, but also from a more balanced distribution of total exports amongst the major markets.

Geographical diversification is regarded in the international export literature as one of the key dimensions of the positioning of firms and economies in foreign markets. Cieřlik et al. (2012) demonstrate that geographical diversification and concentration in core markets are alternative export strategies, and that the geographical distribution of markets must be taken into account when assessing export performance. In the present study, the combined assessment of the HHI, CR4 and the number of partner countries is significant in this regard. An increase in the number of partner countries alone is not a sufficient indicator of genuine diversification. The majority of exports may continue to be concentrated in a few traditional markets. In the case of Türkiye, however, the increase in the number of partner countries, accompanied by a long-term decline in the HHI and CR4, points to a more comprehensive market diversification.

Country-specific results illustrate the nature of this shift more clearly. When comparing the periods 2010–2012 and 2023–2025, Russia’s average share of Türkiye’s sunflower seed exports has fallen from approximately 37 per cent to 15.6 per cent. Conversely, there has been an increase in the weight of markets such as Romania, Bulgaria, Algeria, Iraq, Syria and Ukraine. This finding is particularly significant for agricultural products such as sunflower seeds, where production and trade are concentrated in specific regions. Matkovski et al. (2025) demonstrate that Serbia’s oilseed trade is largely integrated with the European Union and CEFTA markets. This finding demonstrates that a strong comparative advantage can coexist with a trade structure concentrated on specific regional markets. Türkiye’s results, however, show a different pattern of development. Whilst comparative advantage has been maintained, the number of export destinations has increased and the combined weight of the largest markets has decreased. From this perspective, the development of Türkiye’s sunflower seed exports should be assessed not only in terms of the preservation of competitive strength but also as a geographical restructuring of the export network. Consequently, the development of Türkiye’s sunflower seed foreign trade cannot be explained by a simple classification as an ‘exporter’ or ‘importer’ country. Türkiye is a country with a strong revealed comparative advantage in HS 120600 exports, which is expanding its export volume and significantly diversifying its target markets. Furthermore, it has a foreign trade structure characterised by substantial imports of the same product due to high domestic demand.

Türkiye’s sunflower seed export policy must take into account not only the preservation of competitive strength but also the sustainability of the market structure. In this context, it is of the utmost importance to support access to new markets with stable demand potential while maintaining Türkiye’s position in existing major export markets. Preventing excessive dependence on a limited number of countries for exports can enhance resilience against country-specific shocks that may arise in foreign

demand or trade policies. At the same time, export policies must not be considered in isolation from domestic production and the supply of raw materials.

Additional Declaration

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Ethics Approval: This study does not require ethics committee approval as it does not involve any direct application to human or animal subjects.

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