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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Projections of Agricultural Product Exports and Their Impacts on Rural Development

Tarımsal Ürün İhracatının Projeksiyonları ve Kırsal Kalkınma Üzerindeki Etkileri

Gökçe Bahar GÜRBÜZER[1*], Fatma ÇİFTCİ[2]

Abstract

Food security and sustainable development are among the critical issues of today. Addressing these challenges requires a focus on sectors that can simultaneously ensure food availability and foster sustainable progress. In this context, the agricultural sector serves as a driving force for both rural development and economic growth by enhancing productivity, promoting export-oriented strategies. This study examines Turkey's agricultural products' foreign trade situation, focusing on export-oriented development strategies. The research analyzes agricultural products' import and export data from the years between 2000 to 2023, obtained from the UN Comtrade database. The data consist of nine product groups within Chapters 06-14 of Section 2 of the Customs Tariff Schedule. Using statistical methods, including the Mann-Kendall and Sen's Slope Trend tests, the study investigates foreign trade trends and makes future projections. The results indicate that there is a general upward trend in exports. Export surpluses are expected in product groups such as live trees and other plants, vegetables, fruits, milling products, oilseeds, and vegetable materials for knitting. However, deficits persist in groups such as tea, coffee, spices, cereals, and lacquers, gums, and resins, where imports exceed exports. The most important export product group with the highest surplus is fruit, whereas the highest deficit ratio is observed in cereals. Based on the result of analysis, increasing Turkey's agricultural export performance holds strategic importance for rural development and economic growth. Therefore, reducing import dependency and promoting domestic production are essential for sustainable development in the agricultural sector. Additionally, supporting product groups with competitive advantages in agricultural exports and expanding their market share are recommended. The adoption of modern agricultural techniques, the training of farmers, and the development of rural infrastructure will also contribute to the sustainable growth of the sector and, in turn, support rural development. Structural transformation policies and improvements in the agricultural sector will contribute significantly to strengthening local economies and ensuring national economic stability by encouraging rural development.

Keywords: Rural development, Agricultural export, Mann-Kendall, Sen's Slope Trend tests, Future projections

[1]***Sorumlu Yazar/Corresponding Author:** Gökçe Bahar Gürbüzer, Department of International Trade and Logistics, Faculty of Economics, Administrative and Social Sciences, KTO Karatay University, Konya, Türkiye. E-mail: gokce.ulug@karatay.edu.tr OrcID: 0000-0003-4996-4137
[2]Fatma Çiftci, Department of Industrial Engineering, Faculty of Engineering and Natural Sciences, KTO Karatay University, Konya, Türkiye. E-mail: fatma.ciftci@karatay.edu.tr OrcID: 0000-0001-6362-1777
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Öz

Gıda güvenliği ve sürdürülebilir kalkınma, günümüzde kritik konular arasında yer almaktadır. Bu zorlukların ele alınması gıda güvenliğini ve sürdürülebilir kalkınmayı sağlayacak sektörlere odaklanmayı gerektirmektedir. Bu bağlamda tarım sektörü, üretkenliğin artırılması ve ihracata yönelik stratejileri teşvik edilmesiyle hem kırsal kalkınmanın hem de ekonomik büyümenin sağlanmasında lokomotif görevi görmektedir. Bu çalışma, ihracata dayalı kalkınma stratejisi benimseyen bir ülke olarak Türkiye'nin tarımsal ürün gruplarına yönelik dış ticaret durumunu incelemektedir. Araştırma, BM Comtrade veri tabanından elde edilen 2000-2023 yıllarına ait tarım ürünleri ihracat ve ithalat verilerini analiz etmektedir. Veriler Gümrük Tarife Cetveli 2. Bölüm 06-14. Fasıllar arasında yer alan 9 ürün grubundan oluşmaktadır. Mann-Kendall ve Sen Trend testi gibi istatistiksel yöntemler kullanılarak yapılan analizlerde dış ticaret trenleri ve gelecekteki eğilimleri incelenmiştir. Sonuçlar, ihracatın genel olarak artış eğiliminde olduğunu göstermiştir. Canlı ağaçlar ve diğer bitkiler, sebzeler, meyveler, değirmencilik ürünleri, yağlı tohumlar ve örülmeye elverişli bitkiler ürün gruplarında ihracat fazlası oluşması beklenmektedir. Bununla birlikte ithalatın ihracatı aştığı; çay, kahve ve baharatlar, hububat ile sakız, reçine hülasalar ürün gruplarında cari açık oluşacağı beklenmektedir. En yüksek ihracat fazlasının oluştuğu ürün grubu meyveler olurken, en yüksek cari açık oranı da tahıllarda gözlenmiştir. Analiz sonuçlarına göre Türkiye'nin tarımsal ihracat performansının artırılması, kırsal kalkınma ve ekonomik büyüme açısından stratejik bir öneme sahiptir. Bu sebeple, tarım sektöründe sürdürülebilir kalkınmanın sağlanabilmesi için ithal bağımlılığın azaltılması ve yerli üretimin teşvik edilmesi gerekmektedir. Ayrıca, tarımsal ürün ihracatında rekabet avantajı bulunan ürün gruplarının desteklenmesi ve bu ürünlerin pazar payının artırılması önerilmektedir. Modern tarım tekniklerinin benimsenmesi, çiftçilerin eğitimi ve kırsal altyapının geliştirilmesi de sektörün sürdürülebilir büyümesine ve bu sayede kırsal kalkınmaya katkı sağlayacaktır. Yapısal dönüşüm politikaları ve tarım sektöründeki iyileştirmeler, kırsal kalkınmayı teşvik ederek yerel ekonomilerin güçlenmesine ve ulusal ekonomik istikrarın sağlanmasına önemli katkılarda bulunacaktır.

Anahtar Kelimeler: Kırsal kalkınma, Tarımsal ihracat, Mann-Kendall, Sen's Slope Trend testi, Gelecek projeksiyonları

1. Introduction

Population growth and global climate change pose various problems in many sectors, especially in agriculture and food sectors. Reports from reputable international organizations indicate that the world may soon face significant challenges in providing sufficient food for its growing population. This potential shortfall could lead to a cascade of economic, social, and political issues. Especially in Türkiye, these challenges are expected to be even more pronounced compared to similar countries due to several factors such as the country has one of the highest population growth rates globally and also hosts the largest refugee population in the world. Moreover, Türkiye's agricultural sector has been struggling with a sharp decline in recent years, leading to an increasing reliance on imported food and agricultural products (Açıkgöz, 2023). This situation can be even more challenging for people in underdeveloped rural areas. In addition to economic concerns, people living in areas where natural resources cannot be used efficiently face many social problems such as poverty and inequality, inadequate health services. Because of with these difficulties hunger being one of the most critical global issues in future that highlights the importance of food security and sustainability (Yıldırım and Kaplan, 2022). Accordingly, the concept of rural development, one of the most critical elements of sustainable development, has become an important topic of discussion in recent years.

While rural development is the subject of academic study in different disciplines, in practice, it is both researched by international organizations such as Organisation for Economic Co-operation and Development (OECD) and Food and Agriculture Organization (FAO), and is also the focus of projects led by international financial institutions like the World Bank (Elibol, 2019; Anonymous, 2021a; Anonymous, 2022a; Anonymous, 2024a; Anonymous, 2024b). Rural development essentially refers to the totality of activities and actions of various actors that lead to progress in rural areas. There are various definitions of the concept in the literature. According to the United Nations (UN) definition of the Second Decade of Development, "rural development refers to the fundamental transformation of social and economic structures, institutions, relationships and processes in any rural area". This implies that rural development aims for not only agricultural and economic growth, but also balanced social and economic progress. Its aim is to transform rural society and provide a better and safer life for the people (Oakley and Garforth, 1985).

The development of rural areas is important not only to increase agricultural productivity, but also to strengthen the social fabric of local communities and diversify economic opportunities. Agriculture, in particular, is the main source of foreign exchange inflows for a country on the road to industrialization. However, many developed countries have completed their development by increasing productivity in agriculture and transferring the funds created in this sector to non-agricultural resources (Seyidoğlu, 2017).

Historically, the concept of development has generally been associated with material progress. In other words, it focuses on increasing income and wealth and reducing poverty. However, over time, the understanding of development has evolved beyond material aspects. This approach is now rooted in a more holistic foundation, incorporating cultural, spiritual, and ethical values. This shift is also evident in the agricultural sector, a key component of rural development, which has been supported by the transition to sustainable agriculture (Shepherd, 1998).

When analyzing agricultural production in Turkey, it is evident that production increased significantly starting in the 1930s, especially after World War II, due to the cultivation of new lands. However, by the late 1960s, the limit of arable land had been reached. Although the country remained self-sufficient in agriculture despite rapid population growth during this period, after the 1960s, agricultural production growth could only be achieved through enhanced soil fertility. In 1963, with the introduction of the first five-year development plan, Turkey implemented planned rural development programs, projects, and support initiatives. This plan emphasized that the country's general exports would heavily rely on agricultural products (Anonymous, 1963). Until the late 1970s, the rate of agricultural production growth exceeded population growth, but this trend could not be sustained in subsequent years (Pamuk, 2018). The 1980s marked a pivotal period in Turkey when export-oriented industrialization took precedence, following the economic reforms of January 24. During this time, policies such as trade liberalization, export incentives, and increased foreign capital inflows were introduced. Unlike import substitution strategies, the focus shifted to supporting industries with the potential to grow and compete internationally (Seyidoğlu, 2017). As a result, this era also initiated an export-oriented transformation in Turkey's

agricultural sector. Export-driven growth has been recognized as a crucial strategy for economic development, particularly in rural areas. Agricultural development in a country is closely linked to the advancement of its rural regions. In recent years, efforts to tackle existing challenges have heightened the emphasis on promoting agricultural development and entrepreneurship in Turkey (Sarı Gedik and Yılmaz, 2023).

Turkey's agricultural sector has also gained significant importance in line with global trends (Anonymous, 2021b). The agricultural sector is crucial for economic growth and food security, and it remains vital for Turkey in terms of both employment and exports. However, an examination of the sector's foreign trade balance reveals ongoing challenges. As of November 2024, agriculture accounted for only 3.6% of Turkey's total exports, and the sector faced a trade deficit of $1.525 billion (Anonymous, 2024c). These issues highlight the sector's foreign trade imbalances and the need for targeted strategies to address them.

When the academic literature is analyzed, it is seen that rural development is addressed in many dimensions in different disciplines. While Amao et al. (2021) investigate the impact of agricultural exports on economic development, Nagy et al. (2022) emphasize that interventions based on research and technologies to increase agricultural productivity have a critical role in ensuring food security and supporting rural development. However, they also stated that sustainable development cannot be achieved unless the improvement in agricultural productivity is supported by foreign trade (Nagy et al., 2022). In addition, the export competitiveness of agricultural products in the perspective of rural development has also been mentioned as a noteworthy issue (Hu and Lin, 2024). These studies demonstrate that rural development and international trade are closely interlinked, particularly through the economic dimension. However, the number of empirical studies that directly examine the effect of agricultural exports on rural development remains limited. In this context, the present study aims to contribute to the literature by focusing on the economic relationship between agricultural exports and rural development in Turkey, a country that has adopted an export-oriented development strategy.

The aim of this study is to analyze Turkey's economic and rural development processes based on agricultural product exports, and to make an assessment for the next 15 years by calculating the trend of the trend between 2000 and 2023 based on the current situation. The study aims to draw attention to the importance of an export-based structural transformation in the agricultural sector and to reveal the potential effects of this transformation on rural development. Thus, the strategic role of Turkey's agricultural export performance in terms of both economic growth and sustainable development in rural areas will be emphasized.

The scope of this study is limited to the economic dimension of rural development, with a particular focus on crop-based product groups. The social, political, and institutional aspects of rural development have been deliberately excluded, as they fall outside the methodological framework of the study. In this context, the export-oriented structural transformation in the agricultural sector and its economic impacts on rural areas are examined within the framework of the international trade discipline.

2. Materials and Methods

The main material of the research consists of secondary data obtained from the UN Comtrade database (Anonymous, 2024d.). In this context, data on Chapters 06-14 of Section 2 of the Customs Tariff Schedule were collected. In the study, non-parametric Mann-Kendall trend test and Sen's Trend Tendency Estimator methods were used to reveal the trends and variations of import, export and foreign trade balance (current account deficit/surplus) data of 9 product groups on a total year basis between 2000-2023. After determining the appropriate models in this process, the annual import, export and foreign trade balance values of 9 product groups between Chapters 06-14 until 2038 were predicted. The time series of the data were meticulously evaluated using software such as RStudio, Minitab and Microsoft Office Excel. Information on the chapters within the scope of plant products is given in *Table 1*.

2.1. Methods used in Trend Analysis

In time series, the change of parameter values in the direction of increase or decrease is called trend. Trend analyses are models that show the change in the increasing or decreasing trends of the variable of interest over time during the period of observation. The main purpose of trend analysis in time series analysis is to predict future trends based on past data. In addition, in recent years, it has become an important tool in forecasting the future.

The only difference from the simple linear regression model is that the independent variable is time. With these analyzes, it is important to understand the future trends and make strategic decisions by determining whether the relevant products have a trend in the specified time interval.

Table 1. Section 2 of the Customs Tariff Schedule, Chapters and Descriptions of Vegetable Products

Chapter No	Product Description
06	Live Trees and Other Plants; Tubers, Roots and the Like; Cut Flowers and Ornamental Foliage
07	Edible Vegetables and Some Roots and Tubers
08	Edible Fruits and Edible Hard-Shelled Fruits; Citrus and Melon and Watermelon Rinds
09	Coffee, Tea, Paraguayan Tea and Spices
10	Grain
11	Milling Products; Malt; Starch; Inulin; Wheat Gluten
12	Oil Seeds and Fruits; Miscellaneous Grains, Seeds and Fruits; Plants Used in Industry and Medicine; Hay and Forage
13	Lacquer; Gum, Resin and Other Vegetable Extracts and Extracts
14	Vegetable Materials Suitable for Knitting; Vegetable Products Not Elsewhere Specified or Included in the Tariff

2.1.1. Least Squares Method (LSM)

The trend of the import and export value of the products included in the scope of the study over the years is calculated by the Least Squares Method (LSM). For the application of the LSM, a time series graph must first be drawn. The most appropriate function type was determined according to the development trend of this graph (Serper, 2004). Some trend models used in LSM are the linear and quadratic models in equations 1 and 2.

- Linear regression model,

$\boldsymbol{Y_i = b_0 + b_1 X_i + \varepsilon_i,\ i = 1, 2, \cdots, n}$ (Gujarati, 2003). (Eq.1)

- Quadratic regression model,

$\boldsymbol{Y_i = b_0 + b_1 X + b_2 X^2 + \varepsilon_i,\ \ i = 1, 2, \cdots, n}$ (Akkaya, 1990). (Eq.2)

2.1.2. Mann Kendal (MK) Test

The test developed by Mann-Kendal is one of the widely used methods for trend analysis in time series. The Mann-Kendall test is widely used because it has many advantages such as not requiring the data to fit a particular distribution and can be applied in case of missing data. It is a particularly effective tool for detecting non-linear trends and helps to identify long-term trends in commercial data with seasonal fluctuations. The Mann-Kendall test is based on the calculation of the correlation coefficient. The n elements in the data set are arranged in $(\boldsymbol{n_1, n_2, \cdots, n_m})$ time order and each $\boldsymbol{X_n}$ value is used as a benchmark. Each $\boldsymbol{n = 1, 2, \cdots, m-1}$ value for $\boldsymbol{X_m}$ from the start of the measurement to the end date is compared with the $\boldsymbol{j = n+1, n+2, \cdots, m}$values in the interval $\boldsymbol{X_j}$. MK test statistic S is as in Equation 3;

$$\boldsymbol{S = \sum_{n=1}^{m-1} \sum_{j=n+1}^{m} Sgn(X_j - X_n)}$$ (Eq.3)

Where X_j and X_n denote the data in years *j* and *n*. If $j > n$, The sign function (Sgn) is expressed in the equation in Equation 4:

$$Sgn = (X_j - X_n) = \begin{cases} (X_j - X_n) > 0 & if \quad +1 \\ (X_j - X_n) = 0 & if \quad 0 \\ (X_j - X_n) < 0 & if \quad -1 \end{cases}$$ (Eq.4)

In the variance calculation of the MK test statistic S, m denotes the number of years in the series. After the variance is calculated, whether the test is significant at the specified significance level is determined by comparing

it with the critical Z value given in the equation below. The Critical Z value in Equation 6 is the standard normal distribution.

$$Var(S) = \frac{m(m-1)(2m+5)}{18} \quad \text{(Eq.5)}$$

$$Z = \begin{Bmatrix} S > 0 & if & S - \frac{1}{\sqrt{Var(S)}} \\ S = 0 & if & 0 \\ S < 0 & if & S + \frac{1}{\sqrt{Var(S)}} \end{Bmatrix} \quad \text{(Eq.6)}$$

If the absolute value of the Z value is less than its value in the normal distribution according to the significance level, the null hypothesis is accepted. In this case, it is concluded that the analyzed time series does not contain a trend. However, if the Z value is high, a trend is considered to be present. If the Z value is positive, this indicates an upward trend; if it is negative, it is said to be a downward trend (Yue et al., 2002).

2.1.3. Sen's Slope Test

This test statistic, defined by Hirsch et al., (1982), is a nonparametric trend test developed by Sen (1968). In the Sen trend test, the amount of change in a slope in the series per unit time is determined. Errors and extreme values of the data used in the test do not affect the results, so the test can be applied even if there are deficiencies in the series (Bacanlı and Çukurluoğlu, 2018). According to this test, the values of times j and k in the data set sorted as$(n_1, n_2, \cdots, n_m)$; X_j and X_n denote the data in years j and n. Thus, If $j > n$ is, $N = n(n+1)/2$, Q_i, the value of $n = (1,2, \cdots, N)$ It is calculated as in Equation 7;

$$Q_i = \frac{X_j - X_k}{j-k} \quad \text{(Eq.7)}$$

is obtained with the formula. The resulting $Q_i$values are ordered from smallest to largest. The median of these N, Q_i values is an appropriate statistic to estimate the linear trend slope parameter. However, here the median value is determined by different calculations, such as in Equations 8 and 9, depending on whether N is odd or even. If N is odd;

$$Q_{median} = Q_{(N+1)/2} \quad \text{(Eq.8)}$$

If N is even;

$$Q_{median} = \left(Q_{N/2} + Q_{(N+1)/2}\right)/2 \quad \text{(Eq.9)}$$

A negative median value indicates a decreasing trend, while a positive median value indicates an increasing trend. The calculated median value of Q is evaluated with a two-way test with a 95% confidence interval using Sen's nonparametric method, and thus a judgment is made about the true slope (Bai et al., 2014).

3. Results and Discussion

The Mann-Kendall and Sen test results of the import and export data of 9 product groups for the period 2000-2023 are given in *Table 2* and *3*. According to the Mann-Kendall test results, Ho (no trend) hypothesis was evaluated at two-way 95% (z=1.96) and 90% (z=1.645) confidence intervals. *Table 2* and *3* show that there is an increasing trend ($p<0.05$) in the exports and imports of product groups for the years 2000-2023, and according to the Sen' Slope test result, the slope is positive.

The export perspectives and projections for 9 different product groups in the plant products group for the period 2000-2038 are given in *(Figure 1).* Accordingly, the most prominent product group in exports is Chapter 8 fruits.

The visualization of import perspectives and projections prepared for 9 different product groups in the crop products group for the period 2000-2038 is given in *(Figure 2).* Accordingly, the most prominent product group in exports is Chapter 10 cereals.

Table 2. Mann-Kendall and Sen Test Results for Annual Export Data

Chapter	MK Test	P value	Sen's Slope
06	6.325,1	0.0000	5.055,107
07	5.481,8	0.0000	6.8530,65
08	6.027,5	0.0000	1.884,448
09	6.077,1	0.0000	1.0438,14
10	2.505,2	0.0122	1.1830,20
11	6.176,3	0.0000	7.5742,24
12	6.176,3	0.0000	2.3511,97
13	5.729,8	0.0000	869.566,7

Table 3. Mann-Kendall and Sen Test Results for Annual Import Data

Chapter	MK Test	P value	Sen's Slope
06	3.050,9	0.0022	2.672,329
07	5.1841	0.0000	3.531,808
08	6.0771	0.0000	4.492,372
09	6.4739	0.0000	1.864,608
10	4.8865	0.0000	1.743,250
11	6.4243	0.0000	8.765,130
12	6.1763	0.0000	1.177,817
13	5.0849	0.0000	2.123,753

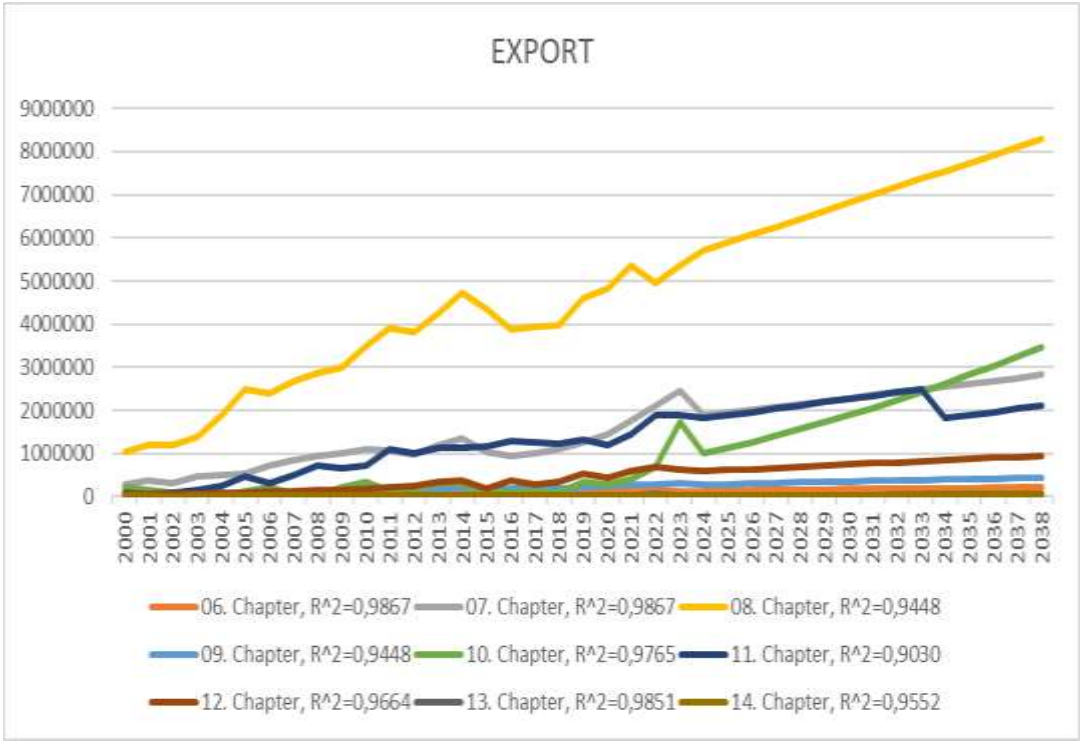

Figure 1: Crop Export Perspectives and Projections between 2000 and 2038

Future projections for the chapters in Turkey's Customs Tariff Schedule, Section 2, Agricultural products group are given in Table 4. According to the results of the analysis; in Chapter 6, it is projected that there will be a current account surplus as a result of an increase in export value by 56.13% to $211.140 and import value by 60.06% to $110.204 in 2038. In Chapter 7, it is projected that there will be a current account surplus as a result of an increase in export value by 15.44% to $2.823.613 and import value by 13.44% to $1.436.392 in 2038. In Chapter 8, it is projected that there will be a current account surplus in 2038 as a result of an increase in the value of exports by 54.43% to $8.290.249 and an increase in the value of imports by 37.83% to $1.740.756. In Chapter 9, a current

account deficit is projected to emerge in 2038 as a result of a 15.44% increase in the value of exports to $2.823.613 and a 21.65% increase in the value of imports to $754.571. In Chapter 10, a current account deficit is projected to emerge as a result of an increase of 100.93% in the value of exports to $3.481.170 and an increase of 33.17% in the value of imports to $6.758.872 in 2038. In Chapter 11, a current account surplus is projected to emerge as a result of an increase in the value of exports by 52.99% to $2.870.258 and an increase in the value of imports by 42.26% to $347.814 in 2038. In Chapter 12, the current account surplus is projected to be realized as a result of an increase of 48.71% in the value of exports to $951.333 and 56.99% in the value of imports to $469.413 in 2038. In Chapter 13, a current account deficit is projected to emerge as a result of an increase of 187.69% in the value of exports to $46.593 and an increase of 23.59% in the value of imports to $100.426 in 2038. In Chapter 14, a current account surplus is projected to emerge as a result of an increase in the value of exports by 63.97% to $55.675 and an increase in the value of imports by 68.62% to $25.195 in 2038.

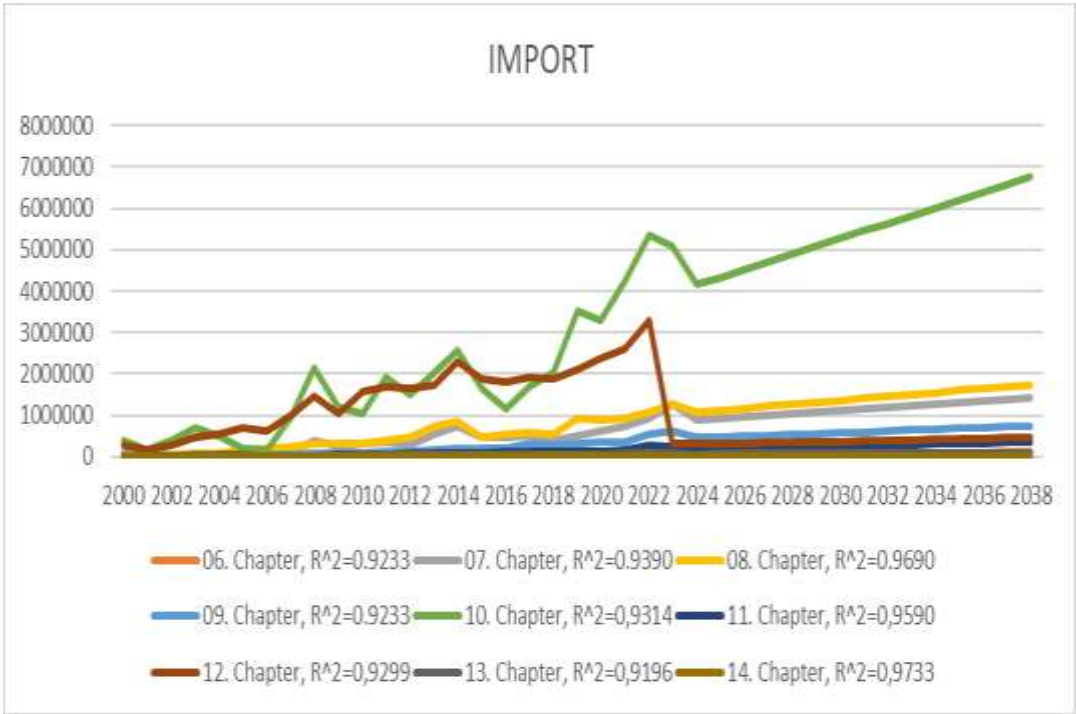

Figure 2: Crop Products Import Perspectives and Projections between 2000 and 2038

These projections reveal how the trade flows of Turkey's agricultural product groups are shaping and indicate the emergence of current account surpluses and deficits in different chapters. It is considered that Turkey's future agricultural trade performance will be influenced not only by trade flows or market conditions but also by structural factors such as rural economic development. Although these issues were already highlighted more than two decades ago, they continue to persist, particularly in key agricultural product groups. Similar concerns about Turkey's long-term dependency on agricultural imports were also identified in the study conducted by Koç et al. (2001) under the Agricultural Economics Research Institute. In their projections Turkey will continue to be a net importer of many products, particularly beef, lamb, cotton, corn, soybean, sunflower, and rice, and by the end of the ten-year period (till 2010), wheat and sugar will also be added to this list. The study highlighted that Turkey would become increasingly dependent on agricultural and food imports, unless structural measures such as the use of high-yield seeds, increasing productivity in meat and dairy production, and reducing feed costs in livestock farming are implemented. When considered together with current projections, these earlier findings underline that the need for rural economic development and structural transformation in agriculture remains critical to ensure sustainable agricultural trade performance.

Moreover, as of 2023, these concerns largely remain valid, and it is evident that Turkey's agricultural sector still faces significant structural problems, particularly in Chapter 9 (Coffee, Tea, and Spices), Chapter 10 (Cereals), and Chapter 13 (Lac; Gums, Resins, and Other Vegetable Saps and Extracts) product groups. Despite some efforts toward production planning and support mechanisms, a high dependency on imports continues, especially in the

cereals group. Along with the current economic conditions and a high inflation environment, the high costs of essential agricultural inputs remain one of the most pressing problems for producers. This situation significantly reduces the competitiveness of domestic producers both in domestic and international markets. Additionally, other major issues in the sector include the insufficient dissemination of high-yield seeds and modern agricultural technologies, fragmented and small-scale agricultural lands that prevent achieving economies of scale, and the negative impacts of climate change such as drought and water scarcity.

Furthermore, another recent scientific study conducted by Çiftci (2024) provides more concrete and data-driven findings regarding the future of Turkey's cereal production, clearly revealing the structural problems faced by the sector. In this context, the study focuses on wheat and barley, which are among the most produced grains worldwide and play a significant role in both human and animal nutrition, thereby forming the foundation for ensuring sustainable food security. By employing Artificial Neural Networks (ANN) and Linear Regression techniques, the study presents projections for Turkey's production, import, export, and population trends between 2023 and 2032. According to ANN-based projections, Turkey's wheat production is expected to reach approximately 22.96 million tons by 2032. Additionally, the production area is projected to increase to 7.55 million decares, wheat exports are expected to reach 1.08 million tons, while imports are anticipated to remain at a high level of approximately 13.7 million tons. Regarding barley, production is expected to rise to 9.19 million tons by 2032, and the production area is projected to expand by 8%, reaching 3.48 million decares. However, barley imports are estimated at around 1.81 million tons, and exports are projected to be 398,489 tons. These findings demonstrate that although there is a moderate increasing trend in production, import dependency for both wheat and barley will persist, which will continue to be a fundamental issue for Turkey's food security and foreign trade balance. It appears unlikely that Turkey will achieve self-sufficiency in the cereal sector without structural reforms and targeted rural development policies.

The research particularly emphasizes the necessity of utilizing data-driven forecasting models, such as Artificial Neural Networks (ANN), in agricultural production planning. By doing so, it is argued that strategic decision-making processes can be improved, supply security risks can be mitigated, and resilience against climate and market fluctuations can be strengthened.

While such long-term, data-driven planning is systematically carried out by developed countries, such as in the United States Department of Agriculture (USDA) Agricultural Projections to 2034, where detailed, data-driven scenarios for agricultural production, trade, and market evolution are used to guide policymaking and ensure food security (Dohlman, et. al., 2025). However, similar long-term strategic planning tools are still limited in Turkey, making it crucial to integrate such forward-looking perspectives into rural development and agricultural transformation policies.

Considering similar studies in the literature and the findings of this research, it is concluded that analyzing trade flows alone is insufficient, and Turkey must implement comprehensive rural development and agricultural transformation policies. These policies should aim to increase agricultural productivity, ensure food security, and reduce import dependency through sustainable and data-based strategies. As Hu and Lin (2024)'s findings confirm that rural economic development significantly enhances the export competitiveness of agricultural products, with this effect being more pronounced in developed regions. Their study highlights that rural economic development has a positive impact on the export competitiveness of agricultural products through rural human capital accumulation. This situation could be a determining factor in sustaining Turkey's agricultural trade balance in the long term and ensuring rural development.

Table 4. Foreign Trade Projections by Chapters

Products / Years		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
06. Chapter x1000$	Export	135.226	136.646	141.967	147.288	152.609	157.930	163.251	168.572	173.893	179.214	184.535	189.856	195.177	200.498	205.819	211.140
	Import	67.581	79.390	81.591	83.792	85.993	88.194	90.395	92.596	94.797	96.998	99.199	101.400	103.601	105.802	108.003	110.204
	Current Account Balance	67.645	57.256	60.376	63.496	66.616	69.736	72.856	75.976	79.096	82.216	85.336	88.456	91.576	94.696	97.816	100.936
07. Chapter x1000$	Export	2.445.822	1.877.031	1.944.644	2.012.257	2.079.870	2.147.483	2.215.096	2.282.709	2.350.322	2.417.935	2.485.548	2.553.161	2.620.774	2.688.387	2.756.000	2.823.613
	Import	1.266.184	884.638	924.049	963.460	1.002.871	1.042.282	1.081.693	1.121.104	1.160.515	1.199.926	1.239.337	1.278.748	1.318.159	1.357.570	1.396.981	1.436.392
	Current Account Balance	1.179.638	992.393	1.020.595	1.048.797	1.076.999	1.105.201	1.133.403	1.161.605	1.189.807	1.218.009	1.246.211	1.274.413	1.302.615	1.330.817	1.359.019	1.387.221
08. Chapter x1000$	Export	5.368.161	5.705.527	5.890.150	6.074.773	6.259.396	6.444.019	6.628.642	6.813.265	6.997.888	7.182.511	7.367.134	7.551.757	7.736.380	7.921.003	8.105.626	8.290.249
	Import	1.263.038	1.075.700	1.123.204	1.170.708	1.218.212	1.265.716	1.313.220	1.360.724	1.408.228	1.455.732	1.503.236	1.550.740	1.598.244	1.645.748	1.693.252	1.740.756
	Current Account Balance	4.105.123	4.629.827	4.766.946	4.904.065	5.041.184	5.178.303	5.315.422	5.452.541	5.589.660	5.726.779	5.863.898	6.001.017	6.138.136	6.275.255	6.412.374	6.549.493
09. Chapter x1000$	Export	318.923	283.318	294.203	305.088	315.973	326.858	337.743	348.628	359.513	370.398	381.283	392.168	403.053	413.938	424.823	435.708
	Import	620.242	451.933	473.550	495.167	516.784	538.401	560.018	581.635	603.252	624.869	646.486	668.103	689720	711.337	732.954	754.571
	Current Account Balance	-301.319	-168.615	-179.347	-190.079	-200.811	-211.543	-222.275	-233.007	-243.739	-254.471	-265.203	-275.935	-286.667	-297.399	-308.131	-318.863

Table 4. Continue

Products / Years		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
	Export	1.732.472	1.012.368	1.138.804	1.272.918	1.414.710	1.564.180	1.721.328	1.886.154	2.058.658	2.238.840	2.426.700	2.622.238	2.825.454	3.036.348	3.254.920	3.481.170
10. Chapter x1000$	**Import**	5.075.074	4.156.076	4.341.990	4.527.904	4.713.818	4.899.732	5.085.646	5.271.560	5.457.474	5.643.388	5.829.302	6.015.216	6.201.130	6.387.044	6.572.958	6.758.872
	Current Account Balance	-3.342.602	-3.143.708	-3.203.186	-3.254.986	-3.299.108	-3.335.552	-3.364.318	-3.385.406	-3.398.816	-3.404.548	-3.402.602	-3.392.978	-3.375.676	-3.350.696	-3.318.038	-3.277.702
	Export	1.876.056	1.817.360	1.892.567	1.967.774	2.042.981	2.118.188	2.193.395	2.268.602	2.343.809	2.419.016	2.494.223	1.817.360	1.892.567	1.967,774	2.042,981	2.118.188
11. Chapter x1000$	**Import**	244.485	208.262	218.230	228.198	238.166	248.134	258.102	268.070	278.038	288.006	297.974	307.942	317.910	327.878	337.846	347.814
	Current Account Balance	1.631.571	1.609.098	1.674.337	1.739.576	1.804.815	1.870.054	1.935.293	2.000.532	2.065.771	2.131.010	2.196.249	1.509.418	1.574.657	1.639.896	1.705.135	1.770.374
	Export	639.716	589.517	615.361	641.205	667.049	692.893	718.737	744.581	770.425	796.269	822.113	847.957	873.801	899.645	925.489	951.333
12. Chapterx1000 $	**Import**	299.001	301.657	313.640	325.622	337.605	349.587	361.570	373.553	385.535	397.518	409.500	421.483	433.466	445.448	457.431	469.413
	Current Account Balance	340.715	287.860	301.721	315.583	329.444	343.306	357.167	371.028	384.890	398.751	412.613	426.474	440.335	454.197	468.058	481.920
	Export	16.184	27.749	29.095	30.441	31.787	33.133	34.479	35.825	37.171	38.517	39.863	41.209	42.555	43.901	45.247	46.593
13. Chapter x1000$	**Import**	81.252	69.654	71.852	74.050	76.248	78.446	80.644	82.842	85.040	87.238	89.436	91.634	93.832	96.030	98.228	100.426
	Current Account Balance	-65.068	-41.905	-42.757	-43.609	-44.461	-45.313	-46.165	-47.017	-47.869	-48.721	-49.573	-50.425	-51.277	-52.129	-52.981	-53.833
	Export	33.953	29.964	31.359	32.823	34.355	35.954	37.621	39.356	41.159	43.029	44.967	46.974	49.047	51.189	53.399	55.675
14. Chapter x1000$	**Import**	14.941	16.199	16.842	17.484	18.127	18.769	19.412	20.055	20.697	21.340	21.982	22.625	23.268	23.910	24.553	25.195
	Current Account Balance	19.012	13.765	14.518	15.339	16.228	17.185	18.209	19.301	20.461	21.689	22.985	24.349	25.780	27.279	28.846	30.480

4. Conclusions

In the shadow of global food crises caused or potentially caused by climate change, wars, and various global disasters, special attention must be given to the agricultural sector. This is essential not only to develop domestic agriculture but also to play a significant role in ensuring the country's rural and economic development. Alongside the industrial sector, Turkey possesses the potential to become a major agricultural power through structural transformations in the agricultural sector. The establishment of a sustainable agricultural system will contribute to rural development as well as to the creation of a sustainable current account balance in foreign trade. Therefore, the foreign trade performance of agricultural products must be meticulously analyzed and evaluated through a holistic approach.

This study aims to uncover the current situation and future potential of the sector by examining Turkey's foreign trade projections for agricultural crop-based product groups. The analyses were carried out for 9 product groups between Chapters 06-14 under Section 2 of the Customs Tariff Schedule.

As a matter of fact, the projection analysis also shows that there are increases by chapters. Accordingly, in line with the future projections for Turkey's plant product group: Chapter 6 live trees and other plants and Chapter 7 vegetables product group may have a current account surplus by 2038. Higher exports compared to imports in these product groups may lead to a favourable trade balance. Chapter 8 fruits product group has the highest current account surplus. In this chapter, exports have a significant advantage over imports. This shows that the agricultural sector is strong in fruit production. Chapter 9 tea, coffee and spices has a current account deficit, but imports are likely to increase in the long run as the growth rate of imports is higher than exports. Chapter 10 cereals has a significant current account deficit. Despite the increase in exports, the value of imports is almost double, which points to a significant problem. In Chapter 11 milling products, exports are expected to significantly exceed imports, leading to a current account surplus. Chapter 12 oilseeds and fruits is expected to post a current account surplus, but the growth rate of imports is higher than the growth rate of exports. Therefore, the values should be monitored carefully as import growth may increase further in the long term. In Chapter 13 lacquers, gums and resins, although the growth rate of exports is high, the value of imports is twice that of exports, leading to a current account deficit. In Chapter 14 vegetable materials for knitting are also expected to post a current account surplus. In line with the results of the analysis or the current foreign trade figures, policies and support programs to encourage domestic production in import-dependent sectors such as cereals and oilseeds are crucial. In addition, training and incentives for exporting both individuals and institutions should also be prioritized to maintain and increase market shares in sectors that are competitive in exports.

In conclusion, Turkey's agricultural foreign trade balance can be restored to a sustainable structure by identifying and protecting existing areas of strength and implementing structural transformation policies in high risk product groups. Thus, by supporting export-oriented agricultural production, important steps can be taken towards both economic development and rural development.

In this direction, some implications can be drawn for Turkey. First of all, policies to support rural development need to be adopted. Enhancing productivity in agricultural production and foreign trade requires training programs for farmers focused on modern agricultural techniques. Infrastructure investments and improved logistics in rural areas will facilitate product access to target markets, increasing export competitiveness. Furthermore, promoting the adoption of innovative technologies in agricultural production processes will improve product quality while reducing costs. According to OECD, providing quality and affordable digital connectivity in rural areas can future-proof rural economies, enabling them to reap the potential benefits from digitalization, climate change and innovation. It also contributes to more efficient and cheaper ways of delivering services (Anonymous, 2022b).

Overall, this study contributes to the literature by providing a product group-based projection analysis of Turkey’s agricultural foreign trade and interpreting its implications for rural development from an economic perspective. One of the limitations of this study is its exclusive focus on the economic dimension of rural development. Social, political, and institutional dimensions have been excluded from the scope. Future research could explore a more integrated model by incorporating multiple dimensions of rural development and conducting comparative country analyses.

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Ethical Statement

There is no need to obtain permission from the ethics committee for this study

Conflicts of Interest

We declare that there is no conflict of interest between us as the article authors.

Authorship Contribution Statement

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