

## Analysis of Recent Trends in Pistachio (*Pistacia vera* L.) Production in Turkey

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**ABSTRACT:** One of the homelands of the Pistachio (*Pistacia vera* L.) is Anatolia (Turkey) which has 10 or more varieties. Pistachio is an agricultural product that has commercial value and is widely used but is generally consumed as dried nuts. As it is not very selective in terms of soil, it is of great importance as an income-generating species in lands that are not suitable for many agricultural products. On the other hand, pistachio is an important food in terms of human nutrition due to its fatty acids, protein, carbohydrate, vitamins, minerals, dietary fiber and herbal sterols. Pistachio production stands out with its features such as the assessment of arid areas, the need for intense labor, it's being storable, and being the raw material for the food and pharmaceutical industries. The aim of this research is making a trend analysis of pistachio production, production areas, and an assessment of the amount of the foreign trade balance between 2004 and 2018 in Turkey and make predictions for until the years of 2023. In the research, the statistical data of the Ministry of Agriculture and Forestry, FAO, Turkish Statistical Institute (TUIK), international and national level study findings related to the subject were used. According to the results obtained, while the pistachio planting areas, the number of fruiting trees, prices and exports will increase in the future, no significant increase is expected in the average yield and foreign trade balance in Turkey. Additional public support policies are needed in terms of agricultural supports, incentives and extension services in order to maintain Turkey's competitive advantage in pistachio production. This research provides useful data to decision-makers and agricultural policymakers.

**KEYWORDS:** Foreign trade balance, Pistachio, Production amount, Sales price, Trend analysis, Turkey.

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Date of Submission: 25-02-2020

Date of Acceptance: 11-03-2020

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### I. INTRODUCTION

Anatolia is one of the oldest settlements that started to be cultivated in parallel with the developments in other parts of the world in the Neolithic Age (8,000-5,500 BC), which started following the gathering and hunting period of human history. It is known that Pistachio (*Pistacia vera* L.) was first cultured in South Anatolia by ancient civilizations and the fact that it is a product served to important guests in the palaces shows that the pistachio was cultured from the ancient period [1]. Pistachio (*Pistacia vera* L.) is a fruit that is commercially available and sold as nuts, covering 10 or more species in the *Pistacia* genus. The homeland of pistachio is the Near East gene and Central Asia gene centers, which include the high parts of Anatolia, the Caucasus, Iran, and Turkmenistan. The gene center of pistachio culture forms is Anatolia, Iran, Syria, Afghanistan and Palestine [2]. It is estimated that the pistachio cultivated in Anatolia, Northern Syria and Iran since ancient times brought the Roman King Vitallis from Syria to Italy in the first century. From there, it was taken to Spain, the Mediterranean islands, Southern France and North Africa [3].

Although pistachio can be grown in poor soils and non-irrigated, calcareous, rocky and stony areas by nutrients where other fruit types are difficult to grow, winter conditions are relatively cold, and summer months require special climate conditions that are hot, dry and long. The pistachio tree is a contentious species in terms of soil demand. Pistachio trees can grow on rocky, stony, very shallow, low organic matter, poor nutrients and calcareous soils. As it is not very selective in terms of soil, it is of great importance as an income-generating species in lands that are not suitable for many agricultural products [3–5]. Pistachio is a very important food in terms of human nutrition and health due to its fat and unsaturated fatty acids, protein, carbohydrate, vitamins, minerals, dietary fiber and herbal sterols. Pistachios are rich in vitamins B and C as well as vitamin E, which has antioxidant properties. Pistachio contains cholesterol and lipoproteins with their monounsaturated fatty acids and non-lipid components. Pistachio fruit ranks first with 15.6% carbohydrate, 22.6% protein and 3.250 calories compared to fatty fruits such as nuts, almonds and peanuts. In terms of fat content, it takes second place after the

hazelnut. In this sense, pistachio with high nutritional value can be consumed as a snack, and it is also used as a raw material in the food and pharmaceutical industry such as sugar, chocolate, bakery products [1,6–10].

Pistachio production stands out with its features such as assessment of dry areas, intense labor requirement, storability, and raw material for the food and pharmaceutical industries. Pistachio is a product that is not only sold immediately after harvesting, and also can be stored for a long time after drying. The marketing period of pistachio is longer than many other fruit types, in this case, it also offers its producer the opportunity to sell it at an attractive price in a wide period of time [11]. The aim of this study is making a trend analysis of pistachio production, production areas, and an assessment of the amount of the foreign trade situation between 2004 and 2018 in Turkey and make predictions for until the years of 2023.

## II. MATERIAL AND METHOD

The main material of the research is composed of secondary data about pistachio tree planting area, fruit-bearing tree numbers, pistachio production amount, sales price, pistachio export value and foreign trade balance between 2004-2018 period as in Turkey. In the research, the statistical data of the Ministry of Agriculture and Forestry, FAO, Turkish Statistical Institute (TUIK), international and national level study findings related to the subject were used. In this research, as the method, the number of pistachio trees giving fruit in Turkey, productivity, sales price, the value of exports, trade balance data for the index, percentage values are calculated and used. Graphs were used to show the slope of the general situation by making trend analysis with related data. The slope shows the general trend that the time variable will take in the long run. The main purpose of the trend analysis using the time series is to accurately predict the future values of the variables or variables in the time series. In other words, time series analysis can be summarized as the process of discovering the probabilistic structure of a time series and predicting its future situation or determining the relationships between more than one-time series. However, it is known that time series may also have a tendency in the form of steady descent or ascent in the long term [12–17].

## III. RESEARCH FINDINGS AND DISCUSSION

Pistachios can be produced in a limited number of countries in the world. The planting area is respectively the most cultivated countries of Iran, Turkey and the United States [18,19]. These top three countries have 77.7% of world pistachio production areas. Pistachio cultivation areas are becoming more and more common in the world. According to FAO data, while pistachio cultivation areas were 498,412 hectares in 2004, it is increased by 35.4%, to 770,863 hectares in 2017 [19]. The change is positive and the regression coefficient is 64.6% (Figure 1). This situation shows that pistachio cultivation areas will increase in the world in the coming years.

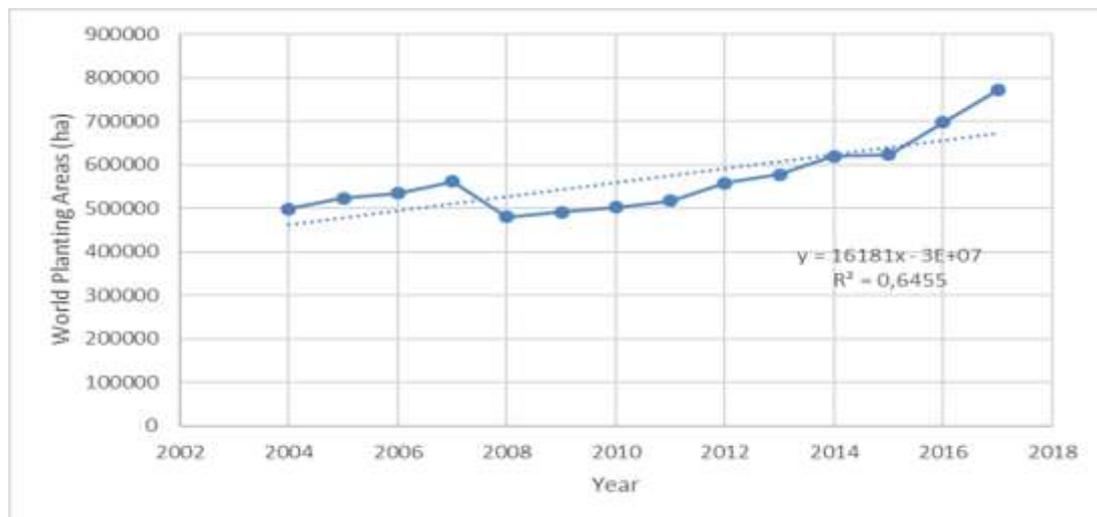


Figure 1: Changes in pistachio cultivation areas in the world between 2004-2017

According to the FAO data of 2017, the top 21 countries that produce the most pistachio are shown in Figure 2. Accordingly, the maximum production that Iran is the country with 574.987 tons, 272.291 tons of it with the United States, followed by 95.294 tons and 78,000 tons in China and Turkey [19] (Figure 2). The fact that the USA is a world leader candidate in pistachio production in recent years ensures that its production volume is constantly increased depending on the development of production and irrigation techniques. With these practices, the USA has become a competitor under the leadership of pistachio production against Iran

[20,21]. US and Iranian pistachio trees being grown almost entirely in the irrigation conditions, while only 5% of pistachio trees in Turkey are irrigated.

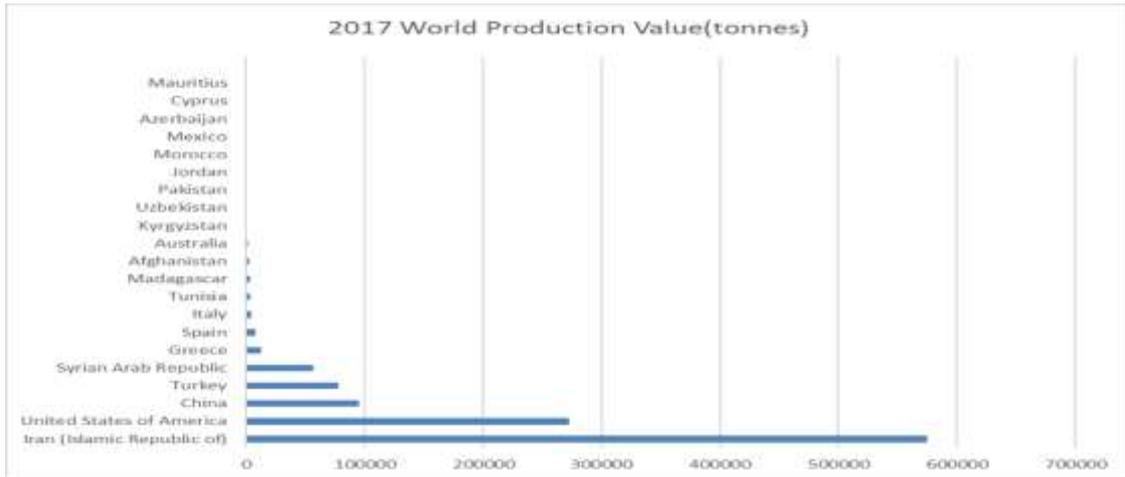


Figure 2: The top 21 countries producing peanuts in the world in 2017

### Pistachio Production in Turkey

Turkey is one of the homelands of the pistachio. In Turkey, for more than a thousand years it has been cultivating pistachio. Generally, pistachio planting is to be done in the areas which are not very convenient for cultivation in Turkey. Therefore, the amount of product per unit area in Turkey is lower than in other countries [22]. Pistachio plantations are established in two different ways in Turkey. The first one is the inoculation of the wilds that grow naturally in Anatolia. A pistachio orchard in arid and non-irrigated areas starts to yield fruit in economic terms only in 20-25 years. This long period can be shortened to 5-7 years by the inoculation of wilds. The second way to set up a garden is by planting seeds [23]. Pistachio orchards, which were formed as a result of the inoculation made in meningic and buttum species that grow naturally in mountainous areas in the past, have started to multiply with those established in plain areas [4]. Professionally in Turkey for the first time in pistachio production began in Şanlıurfa Ceylanpınar State Farm in 1948 by 1.14 hectares (ha). Today, this state farm has an important place in pistachio researches and has allocated 4,300 hectares for these surveys [21]. Pistachio production is cultivating in more than 40 provinces in Turkey. Especially the Southeastern Anatolia Region (GAP) meets the climate demands of the pistachio to a large extent. Therefore, peanuts are grown intensively in the provinces of GAP, mainly in Şanlıurfa, Gaziantep, Adıyaman and Siirt. These four provinces of the GAP Region provide approximately 95% of the total production of Turkey [4,23,24].

### Trend Analysis

In Turkey, pistachio acreage was 37.572 ha in 2004 and is increased by 44.94% during the researched period, reached to 68.237 ha is in 2017 [24]. The change of slope is positive and the regression coefficient is 89.9% (Figure 3). This positive slope shows that pistachio planting areas will increase in the future in Turkey.

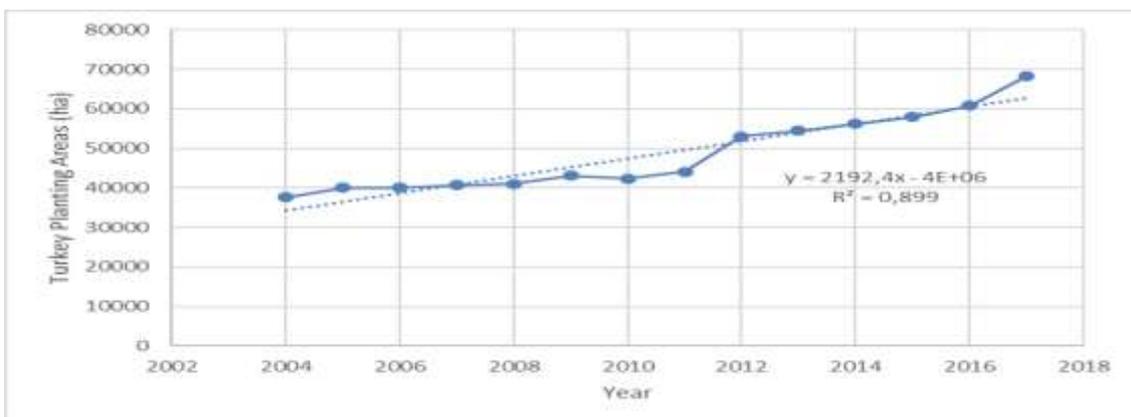


Figure 3: Changes in pistachio acreage in Turkey between 2004-2017 years

The number of pistachio trees which were 42.5 million (fruiting and not fruiting trees) in 2004, increased by 65% in the researched period and reached 70.1 million in 2018 in Turkey. 30 thousand tons of pistachio production in 2004, is increased to 240 thousand tons in 2018 with an increase of 8 times in this period. The average number of fruiting trees is 37.5 million between the years 2004-2018 in Turkey [24,25]. According to TUIK 2018 data, pistachio productions were 100,107 tons in Şanlıurfa, 90,183 tons in Gaziantep, 24,015 tons in Adıyaman and 11,301 tons in Siirt which are the provinces of GAP, where Şanlıurfa is the biggest one in terms of production amounts [25]. Turkey, the GAP region and in Şanlıurfa province, 2004 and subsequent changes in the number of fruit-bearing trees are given in Figure 4 where depending on the change between 2004-2018, projections were made until 2023. The number of fruiting pistachio trees is 26.5 million in 2004 and was 49.5 million in 2018 with an increase of 86.7% in Turkey. The change of slope until 2023 is positive and the regression coefficient is 96.03%. This positive slope shows that fruiting pistachio trees will increase in the future.

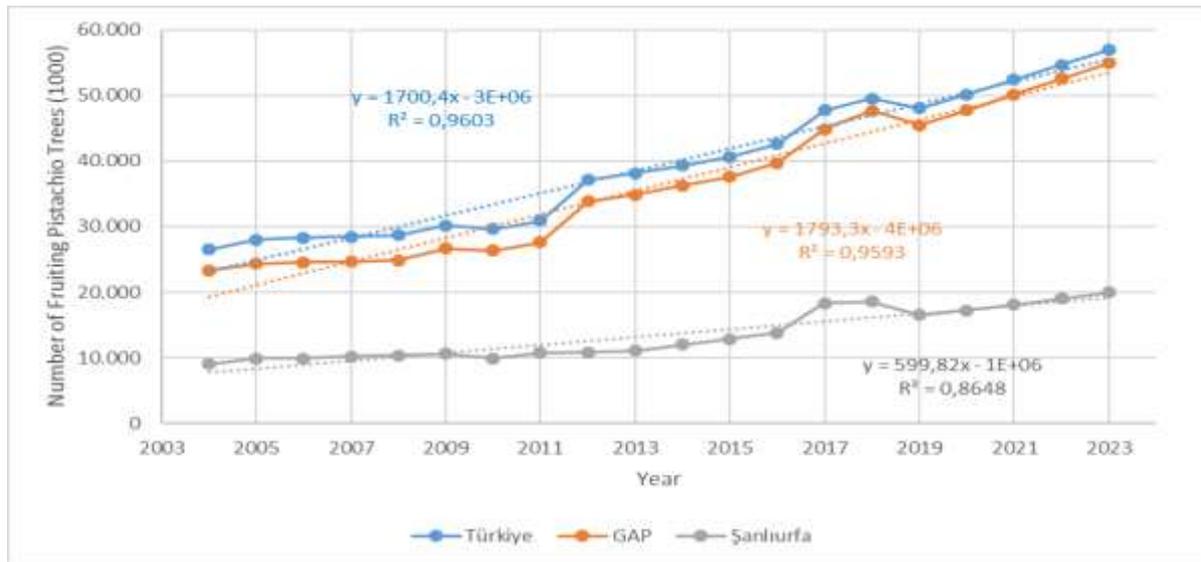


Figure 4: The number of changes in fruiting pistachio trees between 2004 and onwards in Turkey, GAP and Şanlıurfa

The number of pistachio trees that produced fruit in the provinces of the GAP region in 2004 was 23.2 million, increasing by 105% and reached to 47.6 million in 2018. The change of slope until 2023 is positive and the regression coefficient is 95.93%. This positive slope shows that fruiting pistachio trees will increase in the future in GAP Region. The number of fruiting pistachio trees in Şanlıurfa province in 2004 was 9.01 million and increased by 105%, and reached to 18.5 million in 2018 [24]. The change of slope until 2023 is positive and the regression coefficient is 86.48%. This positive slope shows that fruiting pistachio trees will increase in the future in Şanlıurfa, too. Although the same slope of change between 2004 and 2011 both in the GAP region and in Turkey and then is followed by an increasing trend from 2012 onwards. Between the 2004-2011 year, while there was an increase in the number of fruiting trees in Turkey and GAP, there was no change in the number of fruiting trees in Şanlıurfa. The most important reason for the absence of changes in the number of trees that bear fruit in 2004-2011 in Şanlıurfa is that the annual average temperature level in Şanlıurfa was 2.1-2.2 °C higher than normal rate. In the same period, Turkey has the highest temperature occurred on July 24, 2012, Ceylanpınar district of Şanlıurfa with 47.0 °C [26].

Turkey, GAP and Şanlıurfa have increased at a parallel level by a growth rate between the years 2012-2017 in the number of fruit-bearing pistachio trees, but there is a tendency to decline in 2018. According to the data of TUIK, the reduction will be the number of trees fruiting in 2019 in Turkey, GAP and Şanlıurfa but after 2019 up to 2023 there will be increasing again has been determined by the trend analysis (Fig. 4). As of the beginning and end of the period, the pistachio production amount increased 8 times in Turkey. Between 2004 and 2018, the pistachio production amount was approximately 119 thousand tons per year. In the trend analysis made according to TUIK data, the yield change graph of the pistachio kilogram (kg) per year is given in Figure 5. While the yield per fruiting tree was 1.13 kg in 2004, this amount was 4.84 kg in 2018. Pistachio yield was calculated as 3.36 kg per fruiting tree between 2004-2018 and yield trend analysis for 2004-2023 is given in Figure 5. Increasing and decreasing annual yields in the period investigated relate to the periodicity of the pistachio tree. Pistachio tree has the feature of increasing one year and decreasing yield in the following year,

vice versa is true, too. It comes from the nature of pistachio trees in Turkey. This feature is more evident in the changes in figure 5. That is, it shows an increasing and decreasing wavy slope annually.

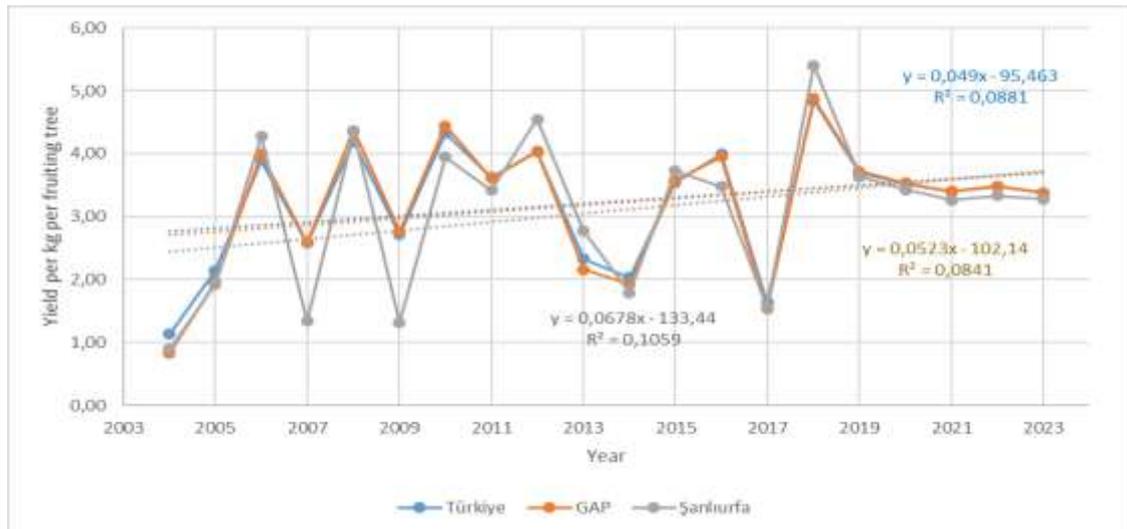


Figure 5: The fruit yield trend analysis for pistachio trees for the year 2004 and thereafter in Turkey, GAP and Şanlıurfa

The trend of prices in pistachios is directly related to production amount, supply and demand. If the amount of production decreases due to both periodicity and climatic conditions, the prices increase, as the supply amount will decrease. Since pistachios are a product that can be dried and stored and marketed, there is no big fluctuation in prices if there is enough stock to meet the demand. If this is not the case, that is, if there is not enough stock, then big fluctuating prices may occur between years. The price of pistachios, which was 6.03 TL/kg in 2004, (Turkish liras= TL), increased by 491% and reached to 29.62 TL/kg in 2018. The average price of pistachios between 2004-2018 was calculated as 13.30 TL/kg. The trend of the change in prices is given in Figure 6.

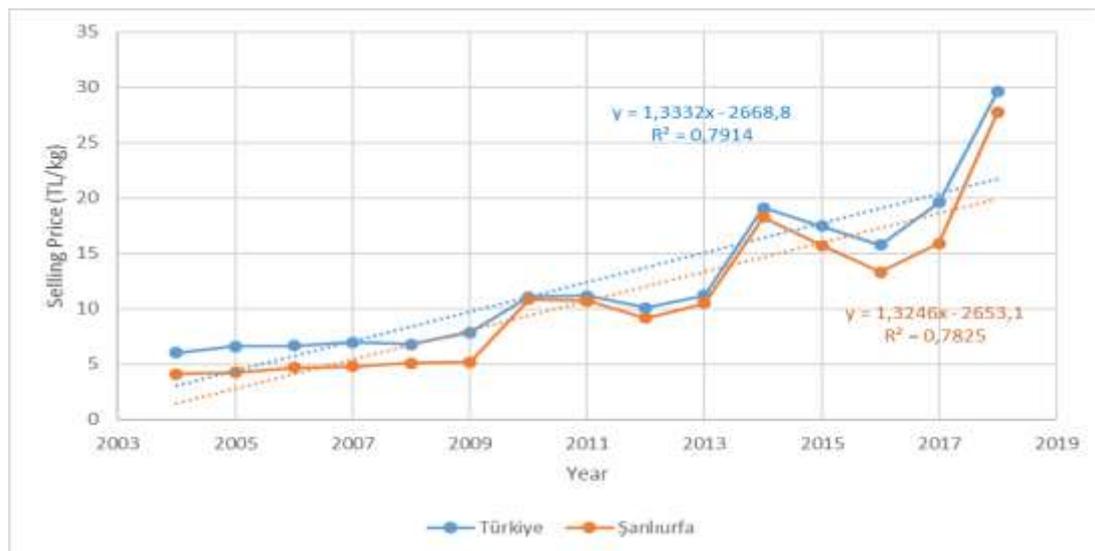


Figure 6: Trend analysis of pistachio sales price between the years of 2004-2018 in Turkey and Şanlıurfa

There was no significant change in the prices of pistachio between 2004 and 2009. This situation is explained by the fact that the stock and production amounts remaining from the previous year meet the demand. Significant changes occurred in sales prices between the years 2009 and 2018. This change is explained by production amount, stock, supply, and demand. It shows that the prices in the research period increased significantly after 2009 and fluctuated significantly both in Turkey and Şanlıurfa. The regression coefficient is 79.14% for Turkey and 78.25% for Şanlıurfa. These positive slope regression coefficients show that price increases will continue in the coming periods.

The pistachio export value was calculated with trend analysis which is expected to occur in Turkey until 2023 by using TUIK data for the years of 2000-2017. The obtained trend analysis is given in Figure 7. The annual average export amount of the researched period was over 6,325 thousand tons.

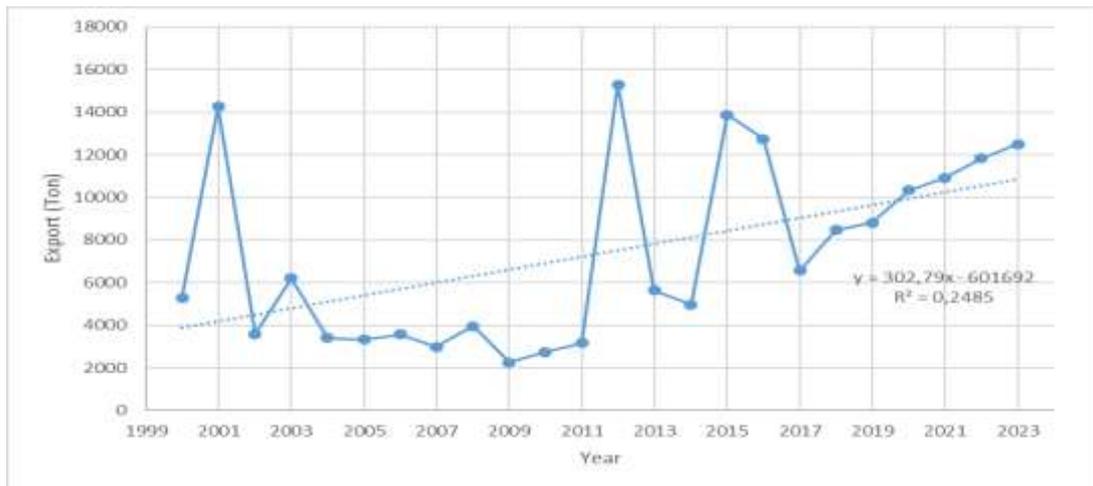


Figure 7: Pistachio export amounts from 2000-2023-year by trend analysis in Turkey

Turkey is a net exporter in the researched period between the years of 2000-2018 and based on these years, it is expected that Turkey will be the next exporter according to the projection analysis made until 2023. Turkey's average annual net imports in the period surveyed were 143 tons, while the export of 6,557 tons. Based on the data of TUIK from the years of 2000-2017, the foreign trade balance that is expected to occur until 2023 in Turkey has been calculated by the trend analysis. The trend of the change in the foreign trade balance is given in Figure 8.

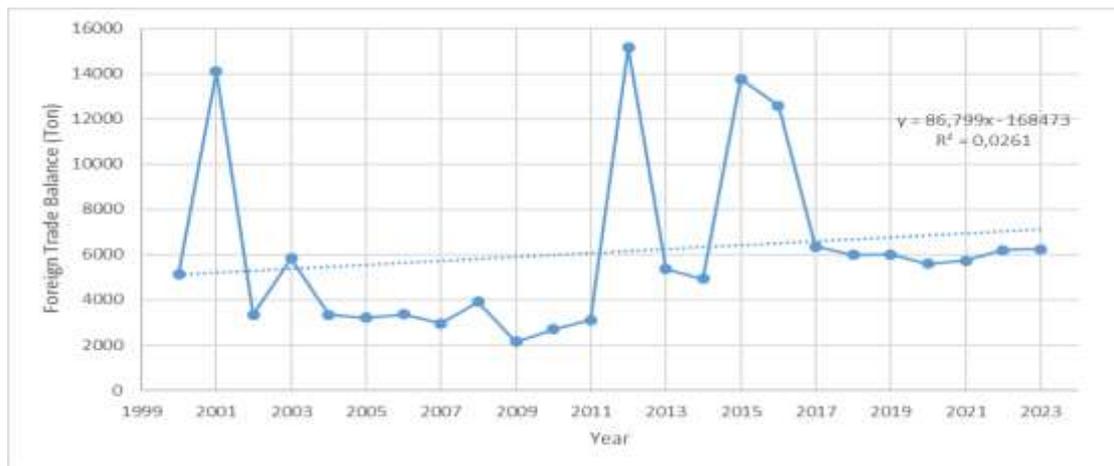


Figure 8: Turkey's foreign trade balance analysis based on the years 2000-2017 until 2023

Both Turkey's exports and imports are increased by 24% and 33% respectively between the years 2000-2017. In terms of foreign trade of pistachios in Turkey between 2000 and 2017, depending on the year, imports and exports show an undulating slope ascending and descending rate. In addition, the pistachio foreign trade balance is expected to show a more stable trend slope in the period after 2017 to 2023.

#### IV. CONCLUSION

Pistachio is an activity that requires a lot of labor due to the way of agricultural production in Turkey. Due to this feature, it is the source of livelihood and employment areas for many people. Accordingly, pistachio farming is important in preventing unemployment, strengthening the economy and combating welfare issues [27]. Pistachio is important for the GAP Region in which 95% of the total production of Turkey's supplied and has a special significance for Şanlıurfa where approximately 50% of the GAP Region's supplied. Besides all of this importance of pistachio production, it is seen as significant variations by years in the production amounts in Turkey. The main reasons that reveal this difference are the problems in the garden facility, cultural practices

(irrigation, fertilization, pruning, tillage), cultivation technique, pollination and fertilization biology. [21,28]. It is possible to contribute to the reduction of low yield agricultural lands and fallow lands with additional public supports and incentives. This will contribute positively to individual and social welfare. In addition, it is possible to increase both the yield and the quality of the fruits of pistachio cultivation, by making the necessary technical applications and maintenance, and these applications can also reduce the sharp periodicity in pistachio production. In this, agricultural extension services should be increased. With respect to the trend analysis, it is predicted to further increase in the number of fruit-bearing pistachio trees both in the GAP Region and Turkey as compared to Şanlıurfa. Increases in pistachio sales prices are expected to continue. It will be expected that a continuation of the increase in pistachio exports and the trade balance is not expected to be a big change in Turkey in the near future. Additional public policies, support and extension services are needed to expand the pistachio planting areas will lead to an increase in employment in the agricultural areas. This research provides useful data to decision-makers and agricultural policymakers.

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Mustafa H. Aydogdu. “Analysis of Recent Trends in Pistachio (Pistacia vera L.) Production in Turkey” *International Journal of Humanities and Social Science Invention (IJHSSI)*, vol. 09(3), 2020, pp 40-46..