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Araştırma Makalesi

Investigation of Olive Production in a Ten-Year Period in 1961-2021

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ABSTRACT

Despite its many nutritional characteristics, the number of countries producing olives is limited owing to the growing conditions. Because the olive is a drought-resistant plant, it is one of the fruits that is least affected by climate change. For this reason, in this study, the production areas and the changes in production among global leading olive producing countries were determined for 1961-2021 years. In addition, the Concentration Ratio (CR) and Herfindahl-Hirschman (HH) indices were used to determine the competitive situation in olive production in this study, while the Revealed Comparative Export Advantage (RXA) index was used in the competition in fruit production areas. According to research, while 32-33 countries produced olives in 1961-1980, the five leading countries were Italy, Spain, Greece, Turkey, and Portugal/Tunisia. In this period, the HH index was over 1.800, and the share of the five countries was approximately 83.55%. During the 1981-2010 periods 32-38 countries produced olives: Spain, Italy, Greece, Turkey, and Tunisia were the leading countries, while Spain was the premier country. According to the HHI, the market is a monopolistic competition, but according to the concentration ratios, it shows the characteristics of an oligopolistic market. Countries with competitive positions in olive production are listed from strong to weak, such as Tunisia, Greece, Morocco, Spain, Portugal, Italy, and Turkey. While the number of countries producing olives has increased slightly in recent years, conspicuous matters worldwide have been climate change and technological developments in the last years. Considering these situations, countries that reduce costs in olive production and develop technologies that increase yield and quality from unit areas will be one step ahead of the competition. In addition, since this market is generally an oligopoly market, each prolific country will not be disadvantaged by closely following the activities of other countries.

Key words: Competition status, olive, production amount, production area

1961-2021 Yılları Arasındaki On Yıllık Dönemde Zeytin Üretiminin Araştırılması

ÖZ

Pek çok besinsel özelliğe sahip olmasına rağmen yetiştirme koşulları nedeniyle zeytin üreten ülke sayısı sınırlıdır. Zeytin kuraklığa dayanıklı bir bitki olduğundan iklim değişikliğinden en az etkilenen meyvelerden biridir. Bu nedenle bu çalışmada, dünyanın önde gelen zeytin üreticisi ülkelerinin 1961-2021 yılları arasındaki üretim alanları ve üretimdeki değişimler tespit edilmiştir. Ayrıca bu çalışmada zeytin üretiminde rekabet durumunu belirlemek için Konsantrasyon Oranı (CR) ve Herfindahl-Hirschman (HH) endeksleri kullanılmış, meyve üretim alanlarındaki rekabette ise Nispi İhracat Avantajı (RXA) endeksi kullanılmıştır. Araştırmalara göre 1961-1980 yıllarında 32-33 ülke zeytin üretirken, önde gelen beş ülke İtalya, İspanya, Yunanistan, Türkiye ve Portekiz/Tunus oldu. Bu dönemde HH endeksi 1.800'ün üzerinde olup, beş ülkenin payı ise %83,55 civarında gerçekleşti. 1981-2010 döneminde 32-38 ülke zeytin üretmiştir: İspanya, İtalya, Yunanistan, Türkiye ve Tunus önde gelirken, İspanya birinci sırada yer almıştır. HHI'ya göre piyasa tekelci bir rekabet yapısına sahip olmakla birlikte, yoğunlaşma oranlarına göre oligopolcü bir piyasanın özelliklerini göstermektedir. Zeytin üretiminde rekabetçi konumda olan ülkeler güçlüden zayıfa doğru Tunus, Yunanistan, Fas, İspanya, Portekiz, İtalya ve

Türkiye olarak sıralanmaktadır. Son yıllarda zeytin üreten ülke sayısı bir miktar artarken, son yıllarda dünya çapında dikkat çeken konular iklim değişikliği ve teknolojik gelişmeler oldu. Bu durumlar dikkate alındığında zeytin üretiminde maliyetleri düşüren, birim alandan verim ve kaliteyi artıran teknolojiler geliştiren ülkeler rekabette bir adım öne geçecektir. Ayrıca bu pazar genel olarak oligopol bir pazar olduğundan her üretken ülke diğer ülkelerin faaliyetlerini yakından takip ederek dezavantajlı duruma düşmeyecektir.

Anahtar Kelimeler: Rekabet durumu, zeytin, üretim miktarı, üretim alanı

INTRODUCTION

The global climate (climate system) has five components: atmosphere, hydrosphere, lithosphere, biosphere, and ice sphere. A complex system interacts with these components. The most prominent module affecting the climate is the atmosphere in this system (Türkeş, 2012). Geological time and atmosphere are changing firmly, which can have a privileged effect on living spaces, such as drought or desertification (Akın, 2019). Aridness is a natural temporary reduction in precipitation and water availability relative to standard conditions over a long period over a large area (Iglesias et al., 2009). Cereal, citrus, vine, and olive products are often grown in the climate zone of the Mediterranean Region because these plants are well adapted to semi-arid climates (Deniz & Ayaydın, 2014). There is no need for a distinctive type of soil for olive production. Even in barren, stony, rocky, high-lime, gravelly, and sandy soils, olives production generates income that exceeds the costs involved (Doğanay & Coşkun, 2012). For this reason, the olive is called a rich tree with poor soil (Çelik & Cin, 2021). However, the soil structure desired for an olive garden is one with a loamy and clayey loam texture, one that is slightly calcareous and gravelly, rich in organic matter and nutrients, one that does not have salinity problems, has a soil depth of 1.5-2 m, has a good water holding capacity, and has a pH of 6–8 (Yılmaz, 2022).

Olive trees are produced in a wide range of countries, with a coast to the Mediterranean as part of the geography where they are grown (Schicchi et al., 2021). This tree, which is valued enormously by Jews, Greeks, & Romans (Kaniewski et al., 2012), is a symbol of peace, health, and longevity (Savran & Demirbaş, 2022). The most important features of this tree are its longevity, slow growth, and fruit production for hundreds of years (Schicchi et al., 2021). Olive (*Olea europaea L.)* plants are divided into two types i.e., cultivated (*Olea europaea var. europaea*), and wild (*Olea europaea var. sylvestris*) (Hannachi et al., 2013). It is believed that olive cultivated when obtained after human contact over time by wild olive tree which grows spontaneously in the Mediterranean basin (Gianguzzi & Bazan, 2019). The main problems in olive production are drought due to climate change, the spread of diseases, product loss (Fraga et al., 2020), and periodicity (Taş et al., 2019). Because of these situations, the fact that the product is too much in some years and less in some years can cause primary marketing problems in both domestic and foreign markets.

The two main products of olive are processed table olive, and olive oil. Olive oil is obtained by processing olives, and olive oil soap and paste are obtained from the remaining pulp. Tea and olive leaf extracts are also obtained, and high-value-added by-products such as wood products are obtained from their timber (Şahin & Bilgin, 2018).

There is a lot of information about the benefits of olives and olive oil from the past to the present, and as consumer awareness of these information increases, more demand is created for this product (Ballco & Gracia, 2020). It is used to treat muscle injuries, calcifications, fractures, wounds, burns, stomach disorders, and for dietary purposes (Şahin & Aydoğdu, 2021). In addition, cholesterol is thought causing to cardiovascular diseases and blood pressure (Storniolo et al., 2017) and cancer may delay by sports life (Farràs et al., 2021). There are also popular beliefs that olive seeds are beneficial for stomach ailments (Kaplan & Karaöz Arıhan 2012).

In today's world, one of the most frightening factors for people is that the world population has increased rapidly, which has fueled migration from rural to urban areas. The world population was 2.54 billion in 1950. It increased by 19-22% in each of the subsequent decades (1960s, 1970s, and 1980s), followed by a growth of 10-15% in each of the decades from 1990 to 2020. Projections suggest a 6% increase in the world population for the years 2030, 2040, and 2050. For this reason, it is stated that the world population will reach 9.77 billion in 2050, and while the rate of urban population was 56.17% in 2020, it is projected to be 68.36% in 2050. Population pressure in urban areas requires efficient increases in food production. In this sense, Ricardo's concept of differential rent has come to mind: as the population increases, decreasing agricultural land is replaced by unsuitable agricultural areas and less profitable areas. Therefore, as the population increases, low-yielding agricultural and less low-return areas are opened to agriculture. Thus, these have been allocated to agriculture, some of the products people need are met, and resources are used efficiently.

The rapid increase in world population and the more contemptuous use of nature by human beings for economic development and growth have revealed climate change. Climate change has caused droughts, forest fires, and widespread disease. Population planning and the correct use of resources are seen as the most serious factors for the continuation of the human race; thus, sustainability can be achieved with better nutrition and less destruction of nature by fewer people. However, there have been studies on ideas that reduce these short-term effects. For this reason, it can be a short-term solution to focus on production that is resistant to drought, which will occur in global climate change, and is extremely important in human nutrition. This study aims to compare the production area, production amount, and per capita production amounts of this product worldwide and in leading countries due to climate change, which is a notable site for human health, over ten years. The production quantities of the countries in the olive market and their competitive situation were determined according to the HH index and concentration ratios, whereas the competitiveness of the leading countries in the olive production area in terms of fruit production areas was determined using the RXA index.

MATERIALS and METHODS

Materials

The first material of the study is Food and Agriculture Statistics (FAOSTAT) data. In addition, studies on the subject were used too. Leader countries in olive production were evaluated in terms of olive production area, production amount, and country population data between 1961-2021 in this context.

Methods

Determining the Competitive Situation

Concentration ratio (CR)

The first four firms are often the shares of the sizes, such as sales or production value, added value, processing, or fixed assets in all industries, although occasionally there are eight, twenty, and fifty companies. This ratio indicates the degree of monopolization in the market structure. As this ratio approaches zero percent, it is perfect competition; if it is less than 50%, it is monopolistic competition; if it is more than 50 percent, it is an oligopoly; and if there is only one firm, it is a monopoly. For example, if the shares of the first four companies in the market are 50%, 25%, 15%, and 10%, then 100% in total is an oligopoly because there are four companies, even though it seems like a monopoly (Uzundumlu et al., 2022).

Herfindahl-Hirschman index (HHI)

This is one of the most reliable industry concentration indices. There is a numerical measurement of whether there is a monopoly that can disrupt the conditions of free competition in the market. It is summed up by squaring the market shares of the firms proportionally and according to the weight of each industry, if this total is above zero value; it means that the conditions of competition are violated. If HHI is less than 1,000, it is perfect competition; if it is 1,000-1,800, monopolistic competition, and oligopoly if it is higher than 1,801; and monopoly if it is 10,000.

For example, if the share of the first five companies in the market is 50%, 25%, 15%, and 10%
HHI = $50^2 + 25^2 + 15^2 + 10^2 + 10^2 = 3{,}550$, thence market is an oligopoly (Uzundumlu et al., 2022).

The calculation of the HHI and CR for the top five producing or exporting countries is as follows (Uzundumlu et al., 2021).

$$\mathbf{HHI} = \mathrm{MS}_1{}^2 + \mathrm{MS}_2{}^2 + \mathrm{MS}_3{}^2 + \mathrm{MS}_4{}^2 + \mathrm{MS}_5{}^2 \quad (1)$$

$$\mathbf{HHI^{-1}} = 1/\mathrm{HHI} \quad (2)$$

$$\mathbf{CR_1} = MS_1 \quad (3)$$

$$\mathbf{CR_2} = MS_1 + MS_2 \quad (4)$$

$$\mathbf{CR_3} = MS_1 + MS_2 + MS_3 \quad (5)$$

$$\mathbf{CR_4} = MS_1 + MS_2 + MS_3 + MS_4 \quad (6)$$

$$\mathbf{CR_5} = MS_1 + MS_2 + MS_3 + MS_4 + MS_5 \quad (7)$$

MS_1= Percentage share of the country that ranks first in the world in production or export
MS_2= Percentage share of the country which ranks second in the world in production or export
MS_3= Percentage share of the country that ranks third in the world in production or export
MS_4= Percentage share of the country which ranks fourth in the world in production or export
MS_5= Percentage share of the country which ranks fifth in the world in production or export
The market situations, according to the HHI and CR are listed in Table 1.

Table 1. Market situations according to HH index and concentration ratios. Reprinted from Krugman & Wells, 2021

Markets	HHI/10.000	CR
Perfect Competition	0-0,0099	<%1
Monopolistic Competition	0,010-0,179	%1-49,9
Oligopoly	0,18-0,99	%50-99,9
Monopoly	1,00	%100

Relative export advantage (RXA) index

The Revealed Comparative Advantage (RCA) index, proposed by Balassa, measures whether a country has a comparative advantage in a product or product group (Demir & Önder, 2023). The difference between the Relative Export Advantage (RXA) index, developed by Vollrath, and the RCA index is that it uses the total export value by subtracting the export of that country from the world total, not the world total covering the same country. The RXA and RCA indices show similar results (Akhuand & Abbas, 2023; Bayav & Şahin, 2023; Uzundumlu et al., 2023). RXA can be defined as the ratio of a country's share of a particular good in the world's production to the margin of all other related products. The most distinctive feature of this index is the exclusion of the area of the product within the group in which the product is included when considering all parts of the product subject to the research, as all countries other than the country counted in the world total are taken into account. This study used olive production and area instead of export values (Stepasyuk & Titenko, 2020). The RXA formulation is as follows:

$$RXA_{ij} = \frac{(X_{ij}/X_{it})}{(X_{nj}/X_{nt})} \quad (8)$$

X_{ij}=Total area of production in product j of country i during the considered period,

X_{it}= Total area of production of the group in which country i does not include that product in the period under consideration,

X_{nj}=Total area of production excluding country i in product j during the considered period, and

X_{nt}= Total world production area excluding country i during the period considered.

In this study, for ij, i denotes the leading countries through the olive production area, j describes the olive production areas of these leading countries, and t indicates the total fruit production areas for those countries. For wj and wt, j denotes the world olive production area, and t is the world fruit production area.

Similar to RCA, the fact that the RXA index is greater than 1 shows its competitive advantage (Yusoff et al., 2022), and the higher these indices, the more advantageous the country competes for that product (Özbaş & Yıldırım, 2022).

RESEARCH and DISCUSSION

Olive Production of Leading Countries

The leading countries in olive production from 1961 to 2021 are given in Table 2.

Table 2. Competitiveness of world olive production over the years. Data provided FAOSTAT, 2023.

Years	HHI	CR1	CR2	CR3	CR4	CR5	Major Producer Countries	Number of Countries
1961-1970	1,836	30.16	55.49	68.58	76.59	83.59	Italy, Spain, Greece, Turkey, Portugal	32
1971-1980	1,802	29.74	54.29	68.37	76.80	83.55	Italy, Spain, Greece, Turkey, Tunisia	32-33
1981-1990	1,802	27.46	54.29	69.58	77.64	83.04	Spain, Italy, Greece, Turkey, Tunisia	32-33
1991-2000	1,660	27.79	50.69	66.88	74.64	81.01	Spain, Italy, Greece, Turkey, Tunisia	32-38
2001-2010	1,783	33.64	53.26	66.96	74.34	79.24	Spain, Italy, Greece, Turkey, Tunisia	39-40
2011-2020	1,476	32.89	45.77	57.61	65.65	72.31	Spain, Greece, Italy, Turkey, Morocco	39-40
2021	1,497	35.81	47.19	57.04	64.58	71.48	Spain, Greece, Italy, Turkey, Morocco	41

While there was an annual production of 7.28 million tons of olives in 32 countries during the 1961-1970 period, the number of producing countries started to increase over time, and with the disintegration of the USSR in the 90s, the number of producing countries reached 38, and the annual production amount was 13.15 million tons. Subsequently, the number of producing countries reached 41, and the sessional production amount reached 23.05 million tons. Considering all the years, the producing countries Italy, Spain, Greece, and Turkey have always been among the first four countries; Portugal in the 1960s, Tunisia until the 2010s, and Morocco after 2010 were among the leading countries as the fifth country. Considering the competitive situation of these countries in terms of production, according to the HH index, the market showed the characteristics of an oligopolistic market until the 90s, as monopolistic competition prevailed in the production

in 1991-2000 and after 2010. However, according to the concentration ratio, the competitive situation in the market appears to be an oligopolistic market in all years, despite the high decreases. According to the concentration ratios, the competitiveness of the first five countries decreased from 83.59% in the first year to 79.24% in the 2001-2010 period and to 72.31% in the 2011-2020 period. This is because Spain replaced Italy as, the 1st country, and increased its share in production from 30% to 36%, and the 2nd country decreased its share from 25% to 12%, and finally, the 3rd country's share was 13%. The share of the 3rd country decreased from 13% to 10% between 2001 with 2021. The share of the 4th and 5th countries did not change much; generally, they had a percentage of 7-8%. One of the most striking features in the table is that Italy, which was the first country with a share of 30% in the first period, ranks 3rd with a production share of 10% after 2010. According to the information given in FAOSTAT (2023), it was stated that in the 1961-1980 period, due to the lack of production area information of Spain, Greece, and Portugal, it was used as olive groves with an annual area of 3.01 and 4.09 million hectares in the world. Owing to the lack of production area information until 1985, this sessional area was approximately 5.99 million hectares in the 1981-1984 period. This area reached 7.84 million ha in the 1991-2000 period, 9.17 million ha in the 2001-2010 period, and 10.61 million ha in 2011-2020 period. Of these, 23.81% were in Spain, 18.04% in Tunisia, 10.78% in Italy, 9.39% in Morocco, 7.94% in Turkey, 7.93% in Greece, and 3.78% in Portugal. This shows that the four countries, Tunisia, Morocco, Italy, and Turkey, that increased their share of production area compared to the previous period. According to EUROSTAT (2023), the use of olives as table olives obtained according to the average of 2012-2021 data is 27% in Turkey, 18% in Greece, 13% in Morocco, 7% in Spain, 3% in Italy, and around 2% in Portugal and Tunisia. It has been determined that one kg of oil can be obtained from 4-7 kg of olives in the last ten years, although this varies according to country, year, and considering the olive and olive oil production data. The quantity of olives (kilograms) required to obtain one kg of olive oil was calculated as follows:

Table olive production = total olive production – (oil olive production) (9)

Oil olive production= (olive oil production * x) (10)

x= Coefficient showing how many kg of olives getting olive oil (4-7 kg)

Olive Production Contributions of Leading Countries by Population in 1961-2021

Production contributions of leading countries in olive production by population from 1961 to 2021 are given in Table 3.

Table 3. Annual olive production by population (kg/person). Data provided FAOSTAT, 2023.

Countries	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2020	2021
Greece	111.62	140.06	150.43	198.08	218.63	250.94	251.20
Spain	57.15	60.50	69.38	91.62	135.29	147.66	173.87
Portugal	57.54	33.94	27.00	27.20	28.69	63.03	133.70
Tunisia	61.91	101.79	69.11	89.87	83.07	87.98	57.08
Morocco	16.83	16.07	17.11	19.76	24.03	40.08	42.90
Italy	42.52	47.70	46.01	52.92	59.48	41.36	38.33
Turkey	18.32	18.57	15.77	17.09	18.90	21.18	20.51
World	2.16	2.15	1.98	2.27	2.68	2.81	2.91

While the annual olive production per capita in the world was 2.16 kg in the 1961-1970 period, it increased 2.91 kg over time, but it decreased to approximately 2 kg in the 1981-1990 period. Greece has the highest per capita olive production, followed by Spain, Tunisia, Portugal, Italy, and Morocco. While the per capita production in Greece was 111.62 kg in the 1961-1970 years, and the olive production per capita showed a continuous increase, increasing to 250.94 kg per year in 2011-2020, and reached 251.20 kg in 2021. While olive production in Spain was 57.15 kg per capita in the 1961-1970 periods, it increased continuously in ten-year periods and reached 147.66 kg in the 2011-2020 periods. Another remarkable result was that the production in 2021 was 173.87 kg. While the olive production per capita in Portugal was 57.54 kg in the 1961-1970 period, it generally decreased until 2011-2020, diminished to 28.69 kg in 2001-2010, and showed a high increase to 63.03 kg in the 2011-2020 period, and reached 133.70 kg in 2021. While the annual olive production per capita was 61.91 kg in Tunisia in the 1961-1970 period, it increased to 101.79 kg in the 1971-1980 period, and after this period, it generally maintained the per capita production level at 80 kg reaching 57.08 kg in 2021. Morocco, which is one of the leading producer countries, produced 16.83 kg per capita in the 1961-1970 period, and there was not much change in production until 2001-2010, but it increased to 40.08 kg in the 2011-2020 period, reaching 42.90 kg in 2021. The olive production per capita in Italy was 42.52 kg during

1961-1970. While Italy maintained almost the same production level until 1981-1990, its per capita production approached approximately 60 kg in 1991-2010 and decreased to 40.08 kg in the 2011-2020 period and to 38.33 kg in 2021. Turkey, which is one of the important countries in olive and olive oil production, had a per capita olive production of 18.32 kg in the 1961- 1970 period. The per capita production decreased to 15.77 kg in the 1981-1990 period, after which it showed a continuous increase and increased to 21.18 kg in 2011-2020 without much increase, and the per capita production was 21.51 kg in 2021. When the table olive and olive oil consumption data obtained from the IOC (2023) are compared to the population data of FAOSTAT (2023), the olive consumption per capita worldwide is 380-430 gr. While the consumption of 5 kg and olive oil consumption was 21-23 kg, it decreased by 50% in both products for 2011-2020 years. Predicting that four kg of olives yield one kg of olives oil, it can be stated that Greece consumed 50% of its production in the domestic market in the 1990s and offered 20-25% of its production in the domestic market after 2010. Between 2011 and 2020, olive production per capita in Spain was approximately 150 kg, while the consumption of table olives was 4 kg and olive oil consumption was 11 kg; that is, nearly 35% of the production was consumed in the domestic market. Per capita consumption of table olives decreased from 1.5 kg to 640 g, while the consumption of olive oil increased from 5.5 kg to 7 kg, on the opposite side of the 60 kg per capita production in Portugal, which achieved a continuous increase in per capita production. Thus, approximately 50% of production is consumed in the surrounding domestic market. Tunisia used the advantage of the width of the production area in production per capita, while 90 kg per capita production was consumed as almost 2 kg table olive and the olive oil consumption decreased from 5.85 kg to 3.02 kg. Thus, approximately 13-16% of the production is consumed in the domestic market. While the per capita production in Morocco is around 40 kg, the consumption of table olives is 1 kg and olive oil consumption is 3.64 kg, and approximately 33-40% of the production is consumed in the domestic market. While the per capita production in Italy is approximately 40 kg, the consumption of table olives is 2 kg, olive oil consumption is 8.93 kg, and almost all the production is consumed in the domestic market. Eventually, while the per capita production in Turkey was approximately 22 kg, the consumption of 4 kg of table olive oil was approximately twice that of olive oil. Thus, almost half of the production is consumed in the domestic market.

Olive Competitiveness of the Countries According to the RXA Index, Considering the Fruit Production Areas tnd Decades of the Leading Countries

The competitive situation of olive production areas according to the total fruit production areas of the leading countries in olive production from 1961 to 2021 is given in Table 4.

Table 4. The competitiveness of leader countries in olives area according to the RXA index in total fruit production areas

Countries	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2020	2021
Tunisia	36.32	45.80	41.28	25.34	27.92	30.65	20.13
Greece	0.00	0.00	11.64	14.60	17.71	19.53	21.38
Morocco	29.71	38.31	10.77	6.78	8.24	10.85	11.56
Spain	0.00	0.42	21.52	6.20	7.29	7.85	8.38
Portugal	0.00	0.00	4.55	6.02	7.34	7.38	6.68
Italy	8.53	10.87	10.02	4.83	5.63	6.24	6.78
Turkey	2.83	2.98	3.28	2.51	2.85	2.84	2.70

The RXA index can be used to compare the competitiveness of leading countries in the olive production area. The competitive power of Tunisia was the highest in the 1961-2020 periods, and it lost its leadership to Greece in 2021. The most conspicuous factor for Tunisia as the leading country was the size of the olive field in the orchards and the low rate of other fruits. In this sense, Tunisia is a country that must prioritize the quality of olives. Larbi et al. (2020) said that olive growing in Tunisia has a cultivated area of 1.88 million hectares, which constitutes about one-third of the total cultivated area, and this fruit has overcome periods of intense drought because it is well adapted to semi-arid and arid Mediterranean regions and is traditionally rain-fed. They stated that a reasonable yield was obtained under these conditions. In addition, they emphasized that the outturn was not at the desired level despite the irrigation opportunities in their new modern orchards, which had a 5% share in Tunisia. They also declared that this situation could be due to the excess undesirable salt content in the irrigation activity of olives. Abdallah et al. (2021) support this situation and state that Tunisia realized olive production in a wide area but with low tree density, and the use of technology fell far behind

other leading countries. They indicate that a low level of olive oil weakens the competitiveness of the olive sector in Tunisia.

In 1981, the production areas of Greece and Portugal started to increase gradually, and the RXA index increased from 11.64 to 19.53 in 2011-2020 in Greece and from 4.55 to 7.38 in Portugal. Russo et al. (2016) stated that there are more than 10 million hectares of olive groves worldwide, of which 95% are in the Mediterranean basin (FAOSTAT, 2023), the EU produces olives in an area of approximately 5 million hectares, accounting for 40-50% of the global production area and 57-63% of olive production. The share of olive production areas of Greece and Portugal in the EU account for 17% and 22%, respectively. On the other hand, the share of production quantity of the two countries in the EU account for 7% and 6%, respectively. Therefore, the olive yield of Greece is higher than the EU average, whereas Portugal's olive yield is lower.

Morocco which had a very high RXA index of 30-40 in the 1961s became one of the countries that experienced a high decline after 1981. This shows that after the 1980s, Morocco increased the amount of other fruit production areas in addition to olive production areas in some periods. As it is known, although the width of the production area makes a high contribution to the production amount, technological development is an efficient factor in quality and competitiveness. Bouhafa (2022) stated that Morocco has an olive production area of 1.17 million hectares, 10% of the world's production area, the production is made generally with traditional methods, contributes 5% to the agricultural gross domestic product (GDP), and gives economic contributes to approximately to 100,000 people. He also stated that it has a significant effect on promoting the economy and employment as it creates permanent jobs. Todde et al. (2019) stated that although technological progress integrated into traditional olive production in recent years has improved product quality and quantity, it has resulted in higher energy input and carbon emissions and has made significant gains in Morocco and Portugal with energy-saving and environmentally friendly irrigation methods. They found that carbon dioxide emissions can be reduced by saving energy.

Although Spain is the first ranking-country in world olive production, it is not at the forefront of competition in the olive area. Spain, which has a variety of broad perspectives on fruit, is a country that uses technology on a significant scale, and it is one of the countries that work on efficiency and yield instead of production area with more trees per unit area and yield per tree. In terms of world olive production areas, Italy is one of the countries that has not shown much change in the RXA index from the past to the present, and there has not been much change in the olive production area. Italy, like Spain, is one of the countries that concentrate on efficiency and effectiveness. When Torrecillas & Martínez (2022) compared the competitive index with the four leading countries in the EU, patent acceptance in five fields related to olives was 218, this patent acceptance accounted for 49.55% in Italy, 38.53% in Spain, 9.17% in Greece and 2.75% in Portugal.

Similar to Italy, Turkey's RXA index did not significantly differ. Despite the expansion of the olive production area in Turkey, which has a large fruit production, there has not been much change. Öztürk & Yalçın (2014) stated that the fact that most of the olive groves in Turkey are in hilly areas limits their irrigation opportunities, so only 8% of the olive production areas have the opportunity to be irrigated in Turkey. Thus, Turkey is disadvantaged in the field of production compared to its competitors, and is likely to face difficulties in competition in terms of production amounts in the coming years.

Table 5. The competitiveness of countries for leader olive producer in the primary fruit areas according to the RXA index in total fruit production areas

Countries	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2020	2021
Italy	0.27	0.22	0.24	0.42	0.40	0.39	0.39
Turkey	0.44	0.40	0.33	0.50	0.45	0.37	0.28
Portugal	1.38	1.36	0.40	0.35	0.31	0.27	0.21
Spain	1.59	0.77	0.14	0.25	0.24	0.22	0.21
Morocco	0.11	0.08	0.12	0.20	0.19	0.17	0.17
Greece	3.07	2.12	0.18	0.15	0.14	0.14	0.14
Tunisia	0.03	0.02	0.03	0.06	0.06	0.05	0.09

Considering that the RXA index of all leading countries is higher than one, it can be concluded that the olive production area can compete with other fruit production areas. In this sense, the competitiveness of olive production is stronger in Tunisia and Greece than in other countries. According to FAOSTAT (2023) statistics, while there were 2.61 million hectares of olive land in the world in 1961, this area increased almost four times reaching10.34 million hectares in 2021. Apart from the countries that are leaders in olive production, there are very few countries that contribute to the increase in olive production area in the world. When the producer

countries in olive production for 1961 and 2021 are compared in terms of olive land, Spain raised from 2.21 million ha to 2.62 million ha in 1985, Greece increased from 0.72 million ha to 0.82 million ha in 1985, Tunisia from 0.54 million ha to 1.28 million ha, Portugal from 0.35 million ha to 0.38 million ha in 1985, Turkey from 0.34 million ha to 0.89 million ha, Morocco increased from 0.16 million ha to 1.10 million ha, while Italy decreased it from 1.23 million ha to 1.13 million ha.

The competitive situation of the fruit production areas based on the total fruit production areas of the leading countries in olive production from 1961 to 2021 is shown in Table 5.

As seen in Table 5, comparing leading olive producing countries in terms of primary fruit production areas reveals that the three countries that lacked olive production area information appeared to be competitive in this period according to the basic fruit production areas, it was revealed that they were not competitive in the basic fruit production areas with the complete processing of the production area data in the 2000s. None of the leading countries is competitive with regard to fruit production areas, and the countries with more competitive power are Italy, Turkey, and Portugal. Also, Tunisia is prominent in olive production and increased its competitiveness for the primary fruit areas in recent years, although it does not look good in terms of competition in this area. According to FAOSTAT (2023) statistics, while there was 27.03 million ha of primary fruit land in the world in 1961, this area increased to 66.48 million ha in 2021. Apart from the countries that are the leaders in olive production, the primary fruit land area has more than doubled since 1961 because many countries have increased their production area. In other words, the leading countries in olive production do not have a very high share of this increase, and there are even significant decreases. Comparing the leading countries in olive production in terms of primary fruit land for 1961 and 2021 reveals that Italy's land under primary fruit production decreased from 2.25 million ha to 1.13 million ha, Spain's decreased from 2.21 million ha to 1.55 million ha, Portugal's decreased from 0.58 to from 0.26 million ha, and Greece's from 0.42 million ha to 0.24 million ha. On the other hand, Turkey's land under primary fruit production increased from 1.28 million ha to 1.34 million ha, Morocco's increased from 0.11 million to 0.48 million ha and Tunisia's increased from 0.11 million ha to 0.26 million ha. This result shows that Tunisia and Morocco allocated less of their olive lands to primary fruit fields.

The competitive situation of the fruit production areas of citrus (Citrus) fruits according to the total fruit production areas of the leading countries in olive production from 1961 to 2021 is given in Table 6.

Table 6. The competitiveness of countries for leader olive producer in citrus fruit areas according to the RXA index in total fruit production areas

Countries	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2020	2021
Morocco	0.00	0.00	0.69	0.77	0.71	0.68	0.64
Spain	0.68	0.77	0.43	0.53	0.58	0.59	0.53
Italy	0.40	0.50	0.55	0.58	0.59	0.55	0.52
Turkey	0.23	0.24	0.29	0.36	0.40	0.41	0.41
Greece	1.16	1.45	0.65	0.49	0.48	0.38	0.32
Portugal	0.38	0.47	0.34	0.31	0.31	0.26	0.22
Tunisia	0.00	0.00	0.08	0.12	0.13	0.15	0.25

As seen in Table 6, when the countries that are leaders in olive production in terms of citrus production areas, Greece seems to be the only competitive country whose olive production area data were not processed until 1981, but after the data were processed, this country is not competitive. Morocco, Spain, and Italy can have competitive power. As can be seen in the table, while the leading countries in olive production generally lost their share in the field of citrus production, Turkey and Tunisia were the two countries that constantly increased their competitiveness. Spain increased its competitiveness in olive production after the 2000s and continued to hike up its competitiveness in the citrus production area after 1980 but started to lose its competitiveness in 2021. According to FAOSTAT (2023) statistics, while there were 2.29 million ha of citrus lands in the world in 1961, this area increased to 10.22 million ha in 2021. Apart from the countries that are the leaders in olive production, many countries have increased their production area. In other words, the leading countries in olive production did not have a significant share in this increase. When the leader countries in olive production are compared in terms of citrus land for 1961 and 2021 increased from 0.11 million ha to 0.48 million ha in Morocco, and from 0.00 million ha to 0.05 million ha in Tunisia, from 0.10 million ha to 0.15 million ha in Italy, from 0.11 million to 0.30 million ha in Spain, from 0.019 million ha to 0.022 million ha in

Portugal, from 0.03 million ha to 0.04 million ha in Greece, and from 0.028 million ha to 0.17 million ha in Turkey.

From 1961 to 2021, the competitive situation of the leading countries in olive production in terms of total fruit production areas in hard-shell fruit production areas is given in Table 7.

Table 7. The competitiveness of countries for leader olive producer in hard-shell fruit production areas according to the RXA index in total fruit production areas

Countries	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2020	2021
Turkey	3.09	2.99	3.22	2.31	2.13	2.67	3.69
Portugal	2.56	2.08	1.25	0.96	0.86	1.19	2.12
Spain	1.82	2.82	1.91	1.61	1.20	1.10	1.27
Morocco	0.00	0.24	2.48	1.68	1.21	0.82	0.86
Tunisia	2.29	2.01	1.71	1.26	0.92	0.73	0.99
Italy	1.96	1.38	1.04	0.76	0.58	0.49	0.49
Greece	0.00	0.00	0.74	0.48	0.31	0.25	0.29

As shown in Table 7, Turkey generally ranks first among these countries in the field of hard-shell fruit production and has increased its competitiveness in recent years. Portugal is one of the countries with high competitiveness in terms of hard-shelled fruits and lost its competitiveness in the 2000s but gained competitiveness again after the 2010s. Spain is a competitive country which decreased after the 1980s but increased its competitiveness again in the 2020s. While Morocco was a competitive country between 1980-2010, it lost its competitiveness between 2011-2020 but started to regain its competitiveness in 2021. Tunisia has lost its competitiveness in recent years, but after the 2020s, it has increased its competitiveness and approached the position of a competitive country, so it is expected to become competitive again in the 2020s. While Italy was a competitive country in hard-shelled fruits until the 1990s, after which it lost its competitiveness. While Greece is a country whose competitiveness has been increasing slightly but decreased in 2021. According to FAOSTAT (2023) statistics, while there was 1.90 million ha of nuts in the world in 1961, this area increased to 13.32 million ha by 2021. Apart from the countries that are leaders in olive production, the production area has reached approximately seven times compared to 1961 because many countries have increased their production area. In other words, the leading countries in olive production did not have a higher share in this increase. When the leading countries in olive production are compared in terms of hard-shell fruit land for the years 1961 and 2021 hard-shell fruit land increased from 0.33 million ha to 1.35 million ha in Turkey, from 0.23 million ha to 0.87 million in Spain, from 0.00 million ha to 0.23 million ha in Morocco, from 0.09 million ha to 0.24 million ha in Tunisia, and from 0.03 million ha to 0.05 million ha in Greece. However, hard-shell fruit land decreased from 0.40 million ha to 0.20 million ha in Italy and from 0.83 million ha to 0.21 million ha in Portugal.

CONCLUSION and RECOMMENDATIONS

Considering the years 1961-2021, while 32 countries produced olives during 1961-1970, the number of producing countries increased to 41 in 2021. Substantially, the number of countries producing this product does not change much because, unlike other agricultural products, olive production is generally grown in countries in the Mediterranean climate zone because of the exclusive climate demand.

During the same period, the share of the first five countries in olive production was 83.59% in 1961-1970, while it showed a continuous decrease in ten-year periods, decreasing to 72.31% in 2011-2020 and 71.48% in 2021. Italy was the leading country in production between 1961 and 1980, Spain took the lead in the last periods, and after 2010, Greece took the 2nd place and pushed Italy to the 3rd place. On the other hand, Turkey drew attention as the 4th country in all periods. Although the 5th country varies between Portugal, Tunisia, and Morocco depending on the periods, it is thought that this place may be taken up by different countries in the coming years.

In addition, as a notable result in production, while the first country always has a share of around 30%, this share of Spain has increased gradually in recent years and currently has a say in the production of close to 36%. While the per capita world production was around 2.15 kg in the 1961-1980 periods, it decreased to nearly 2.00 kg in 1978-1990, and later increased to 2.91 kg in 2021. While the per capita production in 60 years has reached almost 2-3 times in the leading countries, the increase in Turkey has remained at low levels. As of 2021, the per capita production was 251 kg in Greece, 174 kg in Spain, 134 kg in Portugal, 57 kg in Tunisia, 43

kg in Morocco, 38 kg in Italy, and 21 kg in Turkey. When the competitiveness of the countries according to the olive production area is compared using the RXA index Tunisia's competitive power was the highest in 1961-2020 since about 1/3 of the orchards are devoted to olives. However, it lost this leadership to Greece in 2021. Countries with good olive groves in the field of orchards are at the forefront of olive production area competition. All leading countries in olive production are competitive, and the competitiveness ranking after Tunisia and Greece are Morocco, Spain, Portugal, Italy, and Turkey. Considering the orchard areas, although there was no proportional change between 1961 and 2021, the fruiting zones were approximately three times larger in 2021 than in 1961. When the fruit zones were compared proportionally, the primary fruit area accounted for 66.20%, the olive area for 10.56%, citrus fruits for 10.18%, and hard-shelled for 13.06%. When fruiting zones other than olives are considered, the leading countries in olive production have competitive power only in terms of hard-shelled fruit. The countries with this power are Turkey, Portugal, and Spain. Morocco and Spain, which have an RXA index of 0.60-0.70 in citrus, are the countries that can compete among these countries. According to the primary fruit areas, none of the leading countries in olive production have competitive power, though Italy and Turkey are the most competitive. Their index value was between 0.37 and 0.40.

As can be seen from these results, the leading countries in olive production are Spain, Italy, Greece, Turkey, and Tunisia, which are also competitive countries in terms of production area. Countries with significant potential such as Portugal, Morocco, Algeria, and Egypt have drawn attention. The forty countries grow olives, and almost all the production is provided by the first ten countries. This owes to the fact that producer countries in the Mediterranean Region have the climate advantage in olive production. The continuous increase of fruit areas in the worldwide and parallel to this increase in olive fields is important in terms of healthy nutrition. It is thought that the production of olives will increase in the future, especially since olives are a fruit that is resistant to climate change experienced today and makes a higher contribution to human health. Of course, considering only the increase in production, 40 countries are competitive. Among these countries, the first ten producers must use information and technology to reduce costs while increasing efficiency and quality. It is not a coincidence that Spain provides 35% of the world's production because of the significance it attaches to the concepts of technology and information, as it did in previous years. For this reason, countries that give importance to information and technology, take climate change into account, follow their competitors closely, and expand their production and market through advertising and promotional activities rather than price, can become more advantageous in the marketing phase of the product in the coming periods.

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Statement Contribution of the Authors

First writer and second writer had designed the study and collected the data. First writer had executed the study and wrote the article.

Conflicts of Interest

None declared.

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