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AGRICULTURAL IRRIGATION AND THE IMPACT OF IRRIGATION ON WATER RESOURCES IN THE EUROPEAN UNION AND TURKEY

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Abstract

Agricultural production and water resources are among the most important issues from the past to the present. The interdependence of these two concepts is quite high. As the world population increases, the needs will undoubtedly increase. Accordingly, while the demand for agricultural production increases, resources remain limited. Water is important for all sectors in the economy. Since it is the main input of agricultural production, it is of vital importance for increasing agricultural production. Excessive water withdrawal for agricultural irrigation, especially in developing countries, has a negative impact on resources. Sustainable use of water resources is getting worse with the addition of pollution problem to excessive water withdrawal. In this study, by being dealt with the impact on the water resources of irrigation in the European Union and Turkey and it will be examined whether it is sustainable or not.

Keywords: *European Union, Water, Irrigation, Agriculture, Sustainability*

AVRUPA BİRLİĞİ'NDE VE TÜRKİYE'DE TARIMSAL SULAMA VE SULAMANIN SU KAYNAKLARI ÜZERİNDEKİ ETKİSİ

Öz

Tarımsal üretim ve su kaynakları geçmişten günümüze en önemli konuların başında gelmektedir. Bu iki kavramın birbirine bağımlılığı oldukça yüksektir. Dünya nüfusu arttıkça ihtiyaçlar da şüphesiz artacaktır. Buna bağlı olarak tarımsal üretime olan talep artarken kaynaklar sınırlı kalmaktadır. Su, ekonomideki tüm sektörler için önemlidir. Tarımsal üretimin ana girdisi olduğundan tarımsal üretimin artırılması için hayati önem taşımaktadır. Tarımsal sulama için aşırı su çekimi, özellikle gelişmekte olan ülkelerde, kaynaklar üzerinde olumsuz bir etkiye sahiptir. Su kaynaklarının sürdürülebilir kullanımı, aşırı su çekilmesine kirlilik sorununun da eklenmesiyle kötüye gitmektedir. Bu çalışmada Avrupa Birliği ve Türkiye'de sulamanın su kaynaklarına etkisi ele alınarak sürdürülebilir olup olmadığı incelenecektir.

Anahtar Kelimeler: *Avrupa Birliği, Su, Sulama, Tarım, Sürdürülebilirlik*

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1. Introduction

Water is a basic requirement for biological life as well as one of the basic components of the economy. It is an input that is used as a raw material for the continuation of the working process as well as participating in the production. Water used as an input in all sectors of the economy is a scarce resource. Especially fresh waters are extremely limited in terms of their presence in the world compared to salty waters, and they are under heavy pressure due to reasons such as climate change, urban and industrial pollution and excessive withdrawal from the source. Due to population growth and global warming, the need for water is gradually increasing, while the amount of water is decreasing. For this reason, issues such as protecting water resources, using it in a sustainable way and developing saving methods in its use are on the agenda. In this context, policies with a different but integrated structure continue to be developed for the use and protection of water in agriculture, industry and public use, which are the three major sectors of water consumption. Among the three sectors mentioned, agriculture is the sector that consumes the largest amount of water in terms of the world average. In order to use water in agriculture, countries have tried to develop policies suitable for their geographical, economic and demographic conditions. It is difficult to say that every country is equally successful in this field. However, it is also worth remembering that the conditions of each country are not the same.

When it comes to agricultural irrigation, there are many different factors that affect irrigation efficiency. These factors may vary from the type of product selected to different types within the same type of product. In addition to the geographical structure of the country, irrigation techniques to be used for production can be added to these factors. In addition to these, it should not be forgotten that there are factors that are not directly related to irrigation but have indirect effects, such as the structure of the market where the product is offered for sale, the pricing of the product, the current competition conditions in the current market and the legal framework in which the conditions are regulated. In connection with the supranational nature of the European Union, certain policies are produced on the use of water within the union. Among these policies, those produced for the agricultural use of water contain various difficulties in terms of their implementation in all member states with different geographical and population structures. For this reason, although it is difficult to examine the agricultural use of water as a whole in the European Union, it is undoubtedly necessary to evaluate the agricultural use of water from the union scale for a Europe that has the ideal of increasing the degree of integration.

In this study, it will be focused on the general structure of agricultural irrigation in the European Union. In the first part, the structure of irrigation in agriculture and the distribution of agricultural irrigated lands in the world will be discussed. In the second part, the water consumption of the member countries and the distribution of irrigated lands will be discussed by giving place to the use of water in the agriculture of the European Union. In the third and last part, a comparison will be made between the structure of the European Union and the structure of Turkey in the context of water used in agriculture. Finally, by

specifying the strengths and weaknesses of Turkey and the European Union in agricultural irrigation, what needs to be done for sustainable irrigation will be tried to be determined.

2. Agricultural Irrigation and Irrigated Lands in the World

Agricultural irrigation is vital for the continuation of food production in the world. Sufficient amount of water is needed for the continuation of plant production and livestock activities. In cases where the appropriate amount of precipitation cannot be obtained, irrigation appears as an inevitable necessity for agricultural production. Agricultural production, which must be continuous for civilized human life, can be sustained in very few parts of the world by relying only on precipitation. Natural factors such as precipitation regime that is not evenly distributed in many parts of the world, excessive evaporation and insufficient precipitation for agriculture necessitate irrigation in agriculture. Irrigation provides a more reliable agricultural production in terms of quantity and quality. Almost all of the cultures that have emerged in many parts of the world have been born in geographies that allow adequate irrigation. It would not be wrong to say that if irrigation did not exist, the birth of civilization would not have been possible. In ancient times, civilizations such as Mesopotamia, Egypt and China leapt forward because they had the opportunity to develop irrigation techniques. Irrigation wells, irrigation canals and river dams are among these techniques. The aqueducts built in the later Roman period enabled water supply not only for irrigation but also for settlements.

In the modern world, many different methods are used to access irrigation water and irrigation skills. Among these methods, closed channels, underground pipes, drip and rain irrigation systems, precipitation water collection units, water wells drilled with deep drilling can be counted. In fact, methods can be added to all these that allow determining the irrigation need suitable for the type of plant to be cultivated. Because with such methods, it is now possible to make the necessary irrigation planning for agricultural irrigation. Under the current conditions we are in and under the assumption that there will be more severe conditions than today in the future, it will be necessary to increase the efficiency of irrigation techniques and develop new techniques in order to continue agricultural activities.

Approximately 70 percent of the world's water withdrawal is for the agricultural sector and it is the sector with the highest water use with 90 percent of the total water consumption in the world (FAO, 2021). In order to continue irrigation activities, water resources must be sufficient in terms of quantity and water quality must be suitable for carrying out irrigated agriculture. Agricultural production causes an increasing physical pressure on water resources due to both the increasing world population and global warming. In addition, as a result of unconscious or excessive chemical fertilization used for agricultural activity, the agricultural sector causes a serious nitrate pollution in the waters, thereby putting water resources under pressure in terms of chemical pollution.

In the reports prepared by the Organization for Economic Cooperation and Development and the Food and Agriculture Organization of the United Nations, it

has been stated that the increase in global food demand will reach 15% until 2028 and it has been underlined that how this demand will be met will determine the impact on water and soil resources in the future. With the addition of global warming to this situation, it is expected that the danger of water scarcity will increase in the future. It can be said that agricultural plans made under the absence of global warming cannot be implemented under future conditions. In the report of the European Environment Agency (EEA) on the state of waters in Europe in 2018, it was stated that agricultural and public water supply is the main source of pressure on renewable water resources. Under the effects of climate change, more water will be needed for agricultural production in the Mediterranean Region and southern Europe in the future. Therefore, if alternative water management approaches are not adopted and food consumption is not changed, water demand is likely to outweigh water supply by 2050. In this context, an effective and sustainable agricultural production is needed to ensure global food supply security and the flow of agricultural-based raw materials required in the industry. In order to create an effective and sustainable agriculture, it is clear that irrigation methods are needed in agriculture that are efficient and will not put pressure on the resources by not overloading them. In addition to advanced irrigation methods, water resources management should be done well in order to ensure supply security for irrigation water. Otherwise, even in areas where water is accessible, water supply may remain below water demand due to water losses because of weak infrastructure capacity and poor management approach (Rossi, 2019: 2).

The production of food and non-food products based on agricultural activities is possible by carrying out agricultural activities in which irrigation technique is used to a large extent. For example, the water used for agricultural irrigation in 2013, with approximately 252 billion m^3, corresponds to 6.5% of the world's renewable fresh water flow, while it also corresponds to 70% of the fresh water withdrawn from the source globally. The irrigation water used varies from country to country. Especially in developing countries, the share of water used for agriculture in total water withdrawal is large. In developing countries, the ratio of water withdrawn from the source for agricultural irrigation to total water withdrawal reaches up to 90%. In developed countries, this rate drops to 43%(Pinstrup-Andersen, 2015: 40). Likewise, the distribution of irrigated land for agricultural activity in the world is larger in developing countries.

Table 1: Irrigated Areas in the World

Region	**Irrigated Area (Million Hectares)**	**Percentage of Irrigated Areas**
Developed countries	51 761	16.808
Developing countries	245 873	79.871
Underdeveloped countries	10 321	3.351
Total	**307 955**	**100**

Source: The International Commission on Irrigation and Drainage (ICID), Annual Report 2018, p.96.

When we look at the world in terms of irrigated areas, it is seen that the majority of irrigated areas are in developing countries. Irrigated areas in developing countries, with an area of more than 245 million hectares, constitute almost 80% of all irrigated areas in the world. This rate is not surprising in that it parallels the use of agricultural water used for food and non-food production. Irrigable lands in developed countries, on the other hand, constitute only 16.8% of the global whole, with approximately 52 million hectares. Although the distribution of irrigable lands is shown in this way, it has not yet been possible to determine the irrigated land in the world in terms of scope and distribution (FAO, 2021). However, under the assumption that the determined numbers indicate a sample, the proportional inferences made above are still not considered wrong.

Although only one sixth of the agricultural lands in the world is irrigated, the food produced in the irrigated lands corresponds to 40% of the total food produced in the world. In the twentieth century, the world population has more than tripled. Global water use has increased sixfold and most of this water has been used for irrigation (Zinnbauer and Dobson, 2008: 67-68). Considering the continuing population growth trend in the world and the existence of global warming, it is predicted that the pressure on water resources in the twentieth century will also continue in the twenty-first century. In the light of this foresight, industrialized countries will be relatively less affected by water scarcity in the future in terms of production pattern. It is possible to say that developing countries with large populations and population growth trends, dependent on agricultural production, with low irrigation techniques and poor water sector management will be heavily affected by water scarcity.

3. Agricultural Irrigation in the European Union

In the years following the Second World War, it was aimed to create an integrated Europe. To achieve this goal, a spillover effect was needed. Economy has been chosen as the point where this effect will be initiated. Transferring the management of the coal and steel which were necessary for the production of war materials to a joint commission and the creation of an economic community was the first step. However, food production had to be secured in order for the integration process to continue more effectively and to mitigate the destruction caused by the war. In this direction, a common policy in agriculture was established in 1962 in order to secure food supply and structure agriculture. The current European Union's Common Agricultural Policy (CAP) aims to support farmers, increase agricultural productivity and create a stable food supply at an affordable price for over 500 million citizens. In addition, it has objectives such as helping to combat climate change and sustainable management of natural resources, protecting rural areas throughout the European Union, keeping the rural economy alive by promoting jobs in the agriculture and agri-food industries and related sectors (EC The Common Agricultural Policy, 2021).

The Common Agricultural Policy referred to the sustainable use of resources used in the agricultural production phase. Considering that the most important agricultural resource is soil and water, it would not be wrong to expect the Common Agricultural Policy to include regulations for the protection of soil and

water in terms of quantity and quality. The relevant regulations on the principles of the Common Agricultural Policy can be seen in the first and second columns of the relevant regulation (EUR-LEX, 2021). After the Common Agricultural Policy, the European Union has developed a new and specific framework for the management and protection of transboundary water bodies within and shared by the union. In this context, the Water Framework Directive adopted in 2000 was prepared with the aim of protecting and improving the water policies of the European Union in terms of quantity and quality. The Water Framework Directive has a number of regulatory effects on the union's agricultural activity, with directives such as the Nitrate Directive (91/676/EEC) contained in it (Rossi, 2019: 7-8).

In this framework, the regulation and implementation of agricultural irrigation in the European Union is also legally and administratively based on the dual basis of the Common Agricultural Policy and the Water Framework Directive. The Common Agricultural Policy is compulsory for all member states, just like other common policies. In addition, all members are obliged to transfer the Water Framework Directive into domestic law. For this reason, although there is no common agricultural irrigation regime in the European Union, it can be said that a common legal and administrative ground has been established in this regard.

3.1. Agricultural Water Use in the European Union

The majority of the lands suitable for agricultural activity in the world, which do not need irrigation, are located in the European continent (Roberts, 2017: 7-8). Despite this, irrigation is used in the agricultural sector in order to ensure the food supply for the people living in the continent (over half a billion in the European Union). It is also necessary to increase the product quality and to carry out agricultural activity in geographies that are not suitable for agriculture without water. In addition, it is desired to guarantee the production in the agricultural sector through irrigation for various purposes such as providing additional income with food exports and providing the agricultural-based raw materials needed for the non-food industry. The terrain of the European continent does not exhibit a geographically homogeneous structure. For this reason, irrigation needs of agricultural activities carried out in regions with high rainfall such as Germany or with high quality soils such as France are not the same as in countries with relatively hilly terrain such as Italy or more arid geographical structures such as Spain.

Annual total freshwater withdrawal in Europe is 182 billion m^3. In general, the energy sector has a share of 39%, the agricultural sector 22.5%, the urban water supply 26.5% and the industrial sector 12% from the total water withdrawal. However, these rates vary considerably from region to region. The largest water withdrawals are for electricity generation in Eastern countries (more than 50%), while water supply for urban use is second in water withdrawal with a share of 22%. The irrigation has a small percentage share. In Western countries, water extraction is mainly done for electricity generation and accounts for more than 45% of total consumption. This is followed by urban water supply with a share of 28%. Industry, on the other hand, ranks third with a share of 23%. In this region,

agriculture takes the last place in terms of water withdrawal with a small share (EUROSTAT, 2021). 44% of the used part of the total withdrawn water in Europe is used for agriculture. This amount is generally used for irrigation to increase product quantity and quality. Southern European countries use most of the water withdrawn from the source for agricultural activities. This rate corresponds to more than two-thirds of the total water withdrawal. In some southern river basins, this rate can reach 80%. In countries located in the northern part of the European Union, the rate of water used in agriculture is much lower. Although most of the water withdrawn from the source is used in the industrial sector, in some regions the water drawn for agricultural use can exceed 30% of the total withdrawal (EC Safe Water, 2021).

Table 2: Amount of Water Used for Ag riculture in European Union Countries

Country	**Year / m³**
Bulgaria	355 609 760
Czech Republic	11 146 900
Denmark	219 246 000
Germany	293 373 760
Estonia	60 210
Ireland	0
Greece	3 896 682 810
Spain	16 658 537 500
France	2 711 480 650
Croatia	30 281 170
Italy	11 570 290 300
Cyprus	91 509 600
Latvia	72 970
Lithuania	1 214 670
Hungary	48 907 370
Malta	28 176 060
Netherlands	64 856 650
Austria	18 316 230
Poland	12 854 860
Portugal	3 437 365 770
Romania	203 667 430
Slovenia	2 643 850
Slovakia	5 579 130
Finland	4 369 230
Sweden	111 052 560
United Kingdom	86 647 250

Source: Eurostat.

In Table 2, the amount of water used for agricultural activities in European Union countries is given annually in cubic meters based on Eurostat data. Spain used more than 16.6 billion m^3 of water annually to sustain agricultural activity. This amount is the highest value among the European Union countries as the annual water volume used by a single country for agriculture. Italy comes second with an annual agricultural water consumption of approximately 11.6 billion m^3. Greece has an annual agricultural water use of approximately 3.9 billion m^3, Portugal 3.4 and France 2.7 billion m^3. The water used by the five counted countries in agriculture corresponds to almost all of the irrigation water use in the European Union, with a ratio of 96%. 1.6 billion m^3, constituting the remaining 4%, is shared by the other member states (Rossi, 2019:6). When these sharing rates are examined in terms of the five largest agricultural water users, the remaining four countries except for France, are located in Southern Europe and display similar geographical and climatic structures. In addition, Italy, Greece and Spain are also Mediterranean countries. In addition, Italy, Greece and Spain are Mediterranean countries. As seen in the table, Germany, Bulgaria and Denmark are the countries that use the majority of the remaining 4%. However, unlike the countries with high agricultural water users, these countries do not show similarity between each other in terms of geographical or climatic structure. The distribution is not evenly proportional, and population structures are not similar too.

The agricultural sector is one of the water user sectors that puts water resources under serious pressure. For this reason, it is useful to examine the data of the European Environment Agency, which has evaluated the pressure on water resources for Europe. According to this, it is seen that the water resources of the European Union countries, which use the largest amount of agricultural water, have been under serious and moderate pressure for the year 2000. But in this distribution, France is an exception again. While there is no serious pressure on the water resources in its geography, but only moderate water pressure is observed in some of its resources. In Germany, there is moderate water pressure. In the same study, a prediction was made for water pressure in Europe for 2030. While the situation in Germany has improved for the coming years, the current pressure on water resources for France, Italy and Greece has remained virtually unchanged. However, it has been estimated that water resources will come under serious pressure in some parts of Spain and Portugal that are under moderate water pressure (EEA, Water Stress in Europe, 2021). According to these data, it would be necessary to take a series of measures for the use of irrigation water in agricultural activities carried out especially in Spain and Portugal. Examples of these measures include changing the crop pattern, improving plant species, developing more efficient irrigation systems and transferring water between basins. Increasing productivity in agricultural irrigation can also be achieved by reducing water losses in the system. However, the agricultural irrigation efficiency rate in Europe could not be determined precisely. Although the European agricultural sector has increased its added value by 20% in the last twenty-five years, there are some studies indicating that the irrigation efficiency is still in the range of 50% to 70% (EEA, Use of Freshwater, 2021). Compared to 1990, the amount of irrigation water used in European Union agriculture was reduced by

22%(European Commision, 2017: 23). However, based on all the data, it can be said that irrigation efficiency in European agriculture should be increased. In this direction, the European Green Deal, designed as a holistic production approach in the European Union, includes objectives that will increase efficiency in water use too.

3.2. Irrigable Lands in the European Union

Agricultural lands constitute almost half of the entire surface area of the European Union with 179 million hectares in 2016. About two-thirds of farmland is used for arable crops, one-third for permanent pastures and meadows, and the remainder for permanent crops. In addition to the agricultural area, forests cover 37.5% of the territory of the European Union. The largest share in agricultural lands belongs to France with 29 million hectares. This share constitutes 16% of all European Union agricultural lands. Spain follows France with 24 million hectares. Within these areas, irrigable lands have a specific share. By definition, irrigated land refers to the area that is irrigated at least once a year. While the irrigable area (currently equipped for irrigation) does not vary much from year to year, the irrigated area can actually change significantly due to meteorological conditions or crop selection (EC, Food, Farming and Fisheries, 2021).

Table 3: Irrigated and Irrigable Areas in the European Union (2016)

Member State	Irrigated Area	Irrigable Area
Malta	% 31.4	% 32.9
Greece	% 23.6	% 29.7
Cyprus	% 21.0	% 34.1
Italy	% 20.2	% 32.6
Spain	% 13.2	% 15.7
Portugal	% 13.0	% 15.1
Netherlands	% 11.2	% 29.1
EU - 26	% 6.5	% 9.7
Denmark	% 5.6	% 8.3
France	% 4.9	% 9.7
Germany	% 2.7	% 4.0
Hungary	% 2.6	% 4.9
Bulgaria	% 2.1	% 3.0
Romania	% 1.9	% 2.7
Sweden	% 1.7	% 5.2
Slovakia	% 1.5	% 3.9
Austria	% 1.4	% 3.7
Croatia	% 1.0	% 1.9
Poland	% 0.9	% 1.9
Belgium	% 0.8	% 1.8
Slovenia	% 0.7	% 1.3
Czech Republic	% 0.7	% 1.1
Finland	% 0.4	% 2.4
Estonia	% 0.2	% 0.3
Lithuania	% 0.1	% 0.2
Latvia	% 0.0	% 0.0
Ireland	% 0.0	% 0.0

Source: European Court of Auditors, Sustainable Use of Water in Agriculture, 2020, p.5

Malta has the highest percentage in the European Union in terms of the share of irrigated and irrigable lands. However, Malta is a very small country in terms of surface area and the water which it consumes. For agricultural production, it is necessary to establish a parallelism between the size of the amount of water withdrawn from the source and the irrigated and irrigable areas. In this context, Spain, which uses the highest amount of water for agricultural purposes, ranks fifth in the EU in terms of irrigated lands. 13.2% of Spain's total agricultural land is irrigated actively. The ratio of lands that are currently equipped for irrigation is 15.7%. Italy, the highest agricultural water abstractor, ranks fourth in terms of irrigated land. While 20.2% of Italian agricultural lands are irrigated, the share of lands ready for irrigation is 32.6%. Portugal, which is the third largest agricultural water abstractor, ranks sixth in terms of irrigated areas. The shares of her irrigated and irrigable areas are 13% and 15.1%, respectively. These three largest agricultural water users are also in the top three in terms of the share of irrigated lands, if Cyprus is neglected for the same reason as Malta. Considering that the European Union average is 6.5% in point of the ratio of irrigated agricultural lands to the entire agricultural area, it will be noticed how serious agricultural water consumers are Greece, Italy and Portugal on the Union scale. France, which is in the top five in agricultural water use, remains below the European Union average with a 4.9% share in terms of irrigated lands. It is the only country among the water abstractor with a high rate, which is below the European Union average in terms of the ratio of irrigated lands to all agricultural lands. Although Denmark and Germany are not in the top five water users, they are the countries closest to the top five in point of irrigated lands. Although the Netherlands does not use large amounts of water in agriculture, it is the only member above the European Union average in terms of irrigated lands. Although the ratio of irrigated agricultural lands to all lands used for agricultural purposes in the European Union is 6.5%, currently 9.7% of all agricultural lands can be irrigated. In other words, if the European Union needs it in the future, it is in a position to include some of the lands that it does not currently irrigate into irrigated agriculture without almost any preparation. On the basis of the above, it can be concluded that the European Union is partially prepared for the declines in agricultural production that may occur due to climate change or the demographic shocks that may arise from a sudden population increase.

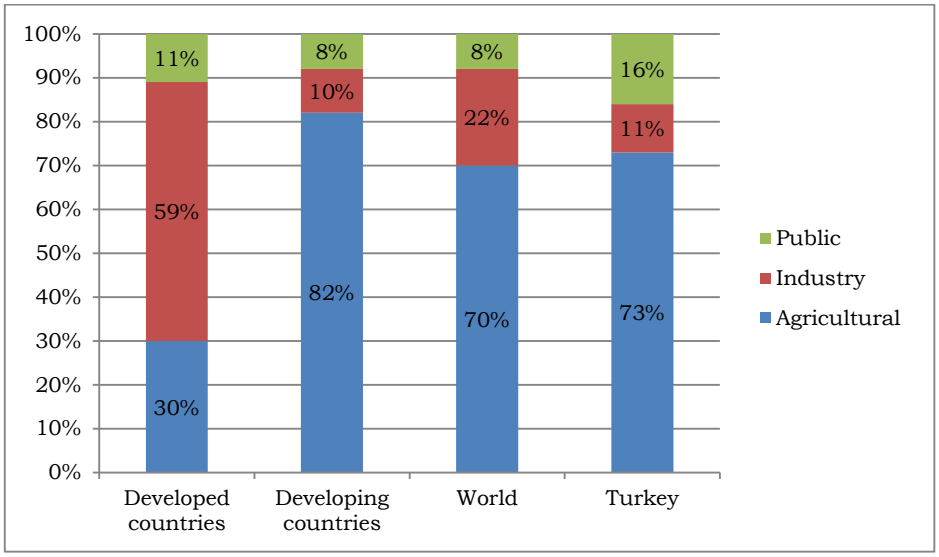
4. Agricultural Water Use and Irrigated Lands in Turkey

Agricultural activity in Turkey varies depending on product preference, irrigation structure and variable geography. Turkey's climate has a mixed climate structure due to its geographical features. The general location of the country is in the Mediterranean region. Turkey's Mediterranean Region and Aegean Region have a Mediterranean climate in accordance with its position in the world. However, the inner parts, where the marine influence cannot reach, show a harsh continental climate type. The Black Sea Region is located in the north of the country, and the coastline is sharply separated from the interior by a mountain range rising abruptly. This situation causes the precipitation to remain intensely in the coastal area and exhibits a very temperate climate structure. Regardless of soil type, the climate structure seems to be sufficient to determine the type of

agricultural activity. It can also be said that this situation affects the form of agricultural irrigation. While there is no need for agricultural irrigation for tea production on the eastern coast of the Black Sea Region, there is a need for intense water withdrawal from the source for rice production in the Thrace Region. This situation can be an example of the diversity in Turkey's irrigation regime.

To address the agricultural sector in more detail, Turkey surpassed France in terms of total agricultural production gross value in 2013, with fixed prices for the years 2004-2006, and ranked eighth in the world, right behind Argentina. Most of the agricultural products it produces consist of high-value herbal products and it is among the top ten producers in the world in this field. Accordingly, Turkish industry has been directed to the production of food products. Food products sector is currently the largest manufacturing industry sector in Turkey, accounting for approximately 15 percent of the country's production value. From the perspective of international trade relations, Turkey has an important place in the food import of the European Union with its high quality agricultural products. In addition, it is one of the most important food suppliers for the Middle East and North African countries, which are net food importers. With the advantage of its geographical location, it has a strategic importance in terms of food supply security and international trade (Santos, et al., 2016: 1-2). Turkey's total usable water asset is 112 billion m^3 and total annual water use is equivalent to 44 billion m^3. When the use of water obtained from this amount of resources is analyzed by sectors for 2008, it is detectable that 7 billion m^3 of total water use was allocated to public use, 5 billion m^3 of which was 11% to industrial use, and 32 billion m^3 of which was 73% to agricultural use. By 2023, it is planned to use the entire water potential of Turkey by changing the public water use to 18 billion m^3 with a 16% share, the industrial use to 22 billion m^3 with a 20% share, and the agricultural use to 72 billion m^3 with a 64% share (T.C. Kalkınma Bakanlığı, 2018: 24-27). Turkey's water usage rates show a very different structure from the distribution of the European Union in terms of distribution by sectors. By allocating most of the amount of water it uses to the agricultural sector, Turkey is closer to the world average with 70% and the average of developing countries with 82%.

Figure 1: Sectoral Water Use by Level of Development



Source: UNESCO

In Turkey, the water withdrawal from groundwater sources for irrigation purposes increased regularly between 1995-2019. However, the same regular increase trend in terms of volume is not valid for surface waters used for agricultural purposes. There is an unsteady fluctuation in this area. Most of the withdrawals for irrigation water in Turkey are made from surface water sources. Therefore, irrigation water withdrawal from groundwater is too small to affect the general upward trend in the same direction. In general, Turkey is an irrigation water user that cannot be compared with any other country in the European Union in terms of its withdrawal from its sources for irrigation water. Considering the data for the year 2015 and after, Turkey draws more water from the source for the same purpose than the sum of the first five countries of the European Union that withdraw the highest amount of irrigation water.

Table 4: Amounts of Irrigation Water According to the Withdrawal Source in Turkey

	1995	2000	2004	2010	2014	2019
Amount of surface water withdrawn for agriculture (km^3/year)	-	27.237	31.030	30.949	26.688	35.363
Amount of groundwater withdrawn for agriculture (km^3/year)	4.63	5.67	6.24	7.20	9.18	11.21
Total	-	32.904	37.270	38.146	35.868	46.573

Source: DSİ

When Turkey is examined in terms of the agricultural products it produces, wheat is the number one agricultural product in terms of quantity. Sugar beet comes next. Cotton, sunflower, maize, barley, tomato and potato are among the most produced products in terms of quantity. In Table 5, the amounts of agricultural products produced in Turkey and the amount of water they need during growing are given. In the light of these data, cotton, sugar beet, sunflower and maize are the products with high water consumption within the pattern of agricultural products produced in Turkey (Kırılgan Döngü, 2021). In addition, citrus fruits, peppers and tomatoes are also products that consume high water but have a relatively high unit price.

Table 5: Amounts of Some Agricultural Products Produced in Turkey and Water Requirement Range of Products

Crops Type	Production Amount in 2018 (tons)	Water Requirement (mm/total growing time)
Cereal	20 000 000	400-480
Maize	5 700 000	500-800
Cotton	2 570 000	700-1300
Sunflower	1 949 229	600-1000
Sugar Beet	18 900 000	550-750
Peppers	2 557 974	600-900
Tomatoes	12 150 000	400-800
Citrus	4 902 052	900-1200
Barley	7 000 000	450-650
Banana	498 888	1200-2200

Source: TUIK, FAO

Table 6 shows how agricultural productivity has increased in Turkey thanks to irrigation. The table has been prepared by the Devlet Su İşleri (DSI) for a productivity project involving irrigated lands of 1 000 ha and above in 2019. The increase in yield provided by irrigation has increased similarly for the time period between 2013-2018. As it can be understood from here, the agricultural activity carried out in the country is dependent on irrigation in point of value increase in the field of crops production. Efficiency in terms of quantity is at least one hundred percent for almost every product within the scope of the project. The yield increase provided by irrigation is significantly high in crops such as cotton and maize, which are relatively high in terms of the amount of product produced and water consumption. Based on these data, it seems almost impossible from an agricultural and economic point of view to continue the production of these products without irrigation. Continuing the production under the current conditions will continue to be a serious pressure factor in terms of water resources. If their production is continued under the current conditions, it will remain as a serious pressure factor on the water resources of the country.

Table 6: Average Yield and Production Value Increases Provided by Irrigation (2019)

Corps Type	Unit Price (TL/kg)	Yield			Production Values (TL/da)		
		Before The Project (kg/da)	Current Situation After the Project (kg/da)	Increase Rate (%)	Before the Project (1)	Current Situation After the Project (2)	The raise (TL/da) (2-1)
Cotton	2.34	125	535	328	292.50	1251.90	959.4
Maize	0.60	205	1634	699	123.00	982.20	859.20
Sugar Beet	0.19	3110	6120	97	590.9	1162.80	571.90
Forage Crops	0.58	479	1361	184	277.80	789.40	511.60
Cereal	0.86	177	510	188	152.20	438.60	286.40
All Kinds of Fruit	1.26	1127	2429	116	1420.00	3060.50	1640.50
All Kinds of Vegetables	0.65	1507	4375	190	979.50	2843.80	186420

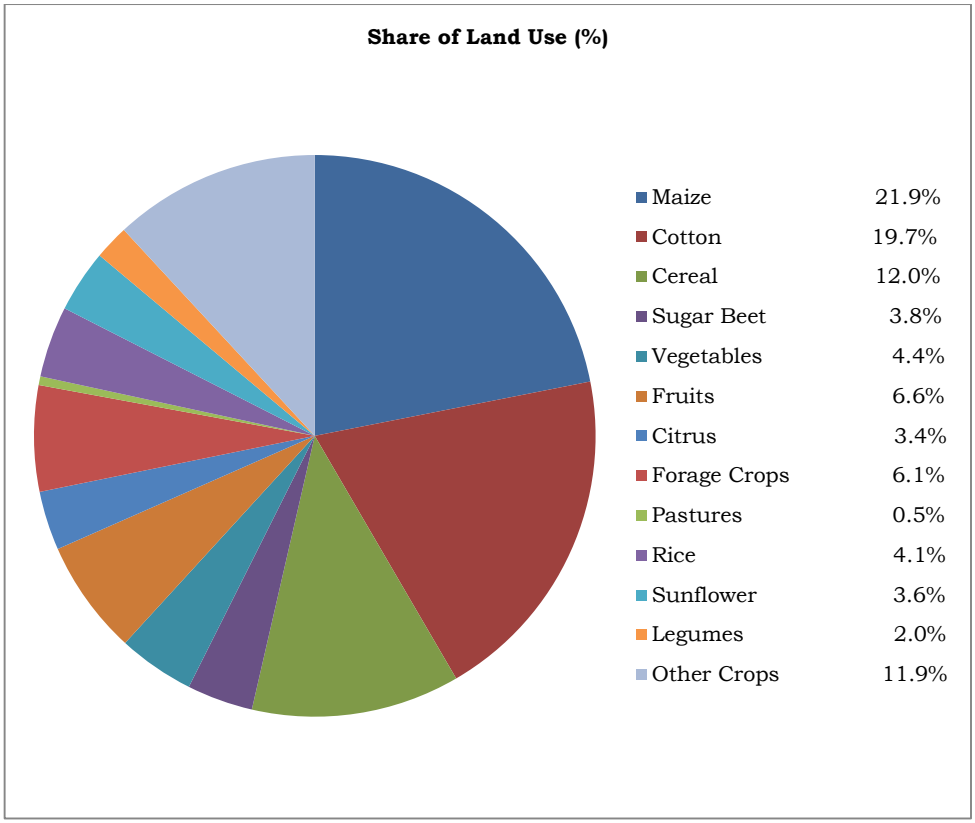
Source: DSI

The area of lands used for agricultural purposes in Turkey corresponds to 28 million hectares. This land size is almost one third of the total area of the country. When Turkey is examined in terms of irrigated agricultural lands, 5.5 million hectares of existing agricultural lands are irrigated agricultural lands. It seems possible to increase the surface area of the lands where irrigated agriculture is carried out to 8.5 million hectares in terms of current water availability and economic conditions. In other words, the size of the irrigable area is 8.5 million hectares. If shared as a percentage, irrigated areas correspond to approximately 19.6% of all agricultural lands, which is three times the European Union average. Potentially irrigable areas correspond to approximately 30.3% of all agricultural land. The surface area of the lands where dryland farming activities are carried out in Turkey is 7.5 million hectares. Apart from these areas, all the remaining agricultural lands of Turkey are suitable for irrigated agriculture activities in terms of structure, if economic conditions and water resources allow (Muluk, et al. 2013: 26).

Figure 2, which was prepared by Republic of Turkey Ministry of Agriculture and Forestry by using DSI data, shows how the irrigated agricultural lands in Turkey are distributed by product type. Accordingly, it is seen that approximately 65% of Turkey's total irrigated agricultural land in 2018 was divided into four products consisting of cotton, cereal, sugar beet and maize. The largest share in this distribution is maize with 21.9%. This rate constitutes almost a quarter of Turkey's irrigated land surface. This is followed by cotton with 19.7%, while cereal comes in third place with 12%. According to these ratios, in the light of DSI data, it can be calculated that maize, which is the product of the largest agricultural land irrigated by Turkey, provided a monetary value increase of approximately 8.2 billion TL for 2013 thanks to irrigation. For the same year, this increase was approximately 4.9 billion TL for cotton, the crop of the second largest irrigated area. For the cereals planted in the third largest irrigated area, this increase corresponded to approximately 1.4 billion TL. The total monetary value increase achieved through irrigation in the products grown on more than half of the lands on which Turkey irrigated reaches 14.5 billion TL. According to DSI data, it can

be said that if these three products are produced without irrigation, the amount value will decrease to at least one third.

Figure 2: Usage Shares of Irrigated Lands by Product Type (2018)



Source: Republic of Turkey Ministry of Agriculture and Forestry.

Approximately one-tenth of Turkey's GDP comes from the agricultural sector. The share of the three crops (cotton, maize and cereal) cultivated in more than half of the irrigated part of the area where all agricultural products are produced, in the total agricultural income is quite small. Especially in cotton, Turkey is among the largest producers in the world and this product has an important share among agricultural export items. However, the amount of water needed to produce one kilogram of cotton in Turkey, where most of the irrigation activities are carried out by the flood irrigation method, is 3 100 liters. In this case, a large amount of irrigation for cotton production puts pressure on water resources. In addition, illegal drilling for agricultural irrigation suppresses groundwater in terms of quantity and quality both (WWF, unknown date: 24-25). From the perspective of the legal framework related to water, it is clear that there is an extremely scattered legislative structure and confusion of authority in Turkey. Turkey lacks a comprehensive single water act that would form a framework for the entire acquis on water. Turkey, which is obliged to transpose the Water Framework Directive to national law due to its candidacy to the European Union, has not made sufficient progress in implementing the regulations on the protection and management of water resources, which are addressed in this directive.

4. Conclusion

When considering agricultural irrigation in the light of all these data, European Union countries do not exhibit the same structure. For example, in countries such as Austria and Denmark, which have a similar structure to Germany, the need for irrigation for agricultural production is very low. In addition, when compared with the high level of industrialization, agriculture has a smaller share as a sector. On the other hand, countries such as Spain, Greece and Italy, which are in the union and have a relatively arid climate in the south of Europe, have high need for irrigation in agriculture. The volume of water used for agriculture in the European Union is close to 1.5 million m^3 annually. While Spain has an irrigation water usage volume that is more than ten times this average, this rate is fifteen times lower in Cyprus. It would be wrong to attribute this change only to the low need for irrigation in agricultural activities. The difference in the volume of water use also depends on the size of the irrigated lands. The ratio of irrigated agricultural lands to all agricultural lands in the European Union corresponds to an average of 6.5%. While this rate exceeds three times in Greece, it decreases by half in Germany. 9.7% of all agricultural lands in the European Union provide the necessary conditions for irrigation. This means that the union is prepared for a sudden increase in demand for agricultural products, even if not completely. In the study conducted by the European Environment Agency on water pressure in Europe in 2000 and renewed in 2017, it seems that there is a moderate pressure on water resources in general in the southern regions of the union. The pressure in question becomes serious in some places. This situation will turn into severe water pressure in parts of Spain, Portugal, Greece and Bulgaria where moderate water pressure is present in the forecast of change in pressure on water resources for 2030, which was made in the same study. Contrary to this, there is an expectation that the moderate water pressure in Germany and Poland will disappear for the date in question. In Spain, approximately 45% of agricultural irrigation is still carried out as flood irrigation. There are other member states where flood irrigation is widely practiced. Under these conditions, the more widespread use of high-efficiency methods such as drip or sprinkler irrigation systems can save significant water and reduce pressure on water resources. In addition, by controlling of illegal well drilling activities the uncontrolled pressure on water resources due to excessive and unregistered water withdrawal can be reduced. Such illegal well drilling activities also violate the principle of passing all costs on to the consumer, which is emphasized in the European Union's common environment policy and in the Water Framework Directive. It is also necessary to ensure the implementation and supervision of other articles regulated in detail in the Water Framework Directive for the protection of water resources in terms of quantity and quality.

Turkey uses most of its water withdrawal for agricultural production and draws a profile in line with the profile of developing countries in point of the ratio of agricultural water use to other sectors. In this context, Turkey's average water use for agricultural purposes is much higher than Europe's average for agricultural water use. Although Turkey is similar to southern European countries such as Spain and Greece in terms of agricultural conditions, it is quite behind in

point of irrigation efficiency. In all irrigation activities, the flood irrigation method has a share of nearly 90%. This rate is almost double that of Spain, the member country with which it is most similar to her in terms of agricultural conditions. Therefore, it is essential for Turkey to develop irrigation technologies and increase irrigation efficiency. In this way, it is necessary to save a large amount of water. Agriculture and processed food products have a significant share among the income items of the country. This reveals that Turkey is economically dependent on the agricultural sector, which is a high water user. High yield increase is provided by irrigation. However, when evaluated from the price scale, the income obtained from the increase in efficiency is significantly low. This is due to the low added value form of the unprocessed agricultural crop. Turkish authorities have a target to use the country's full water potential by 2023. In addition, it is foreseen that the rate of agricultural water use would decrease to 64% for the same year. Even this rate is more than twice the level of developed countries. Considering all these, it is understood that agricultural products and products of agricultural origin would continue to be the main source of income for Turkey in the future, as in the past. Likewise, this situation indicates that irrigation strategies would maintain their importance in Turkey in the future.

Turkey produces a large amount of cotton, fruit and vegetables and exports them to European Union countries. However, the preferential agricultural products trade practice between Turkey and the European Union has put Turkey at a disadvantage in terms of processed agricultural products. This situation creates negative effects for Turkey, which relies heavily on the trade of processed and unprocessed agricultural products. Due to its high agricultural export volume, Turkey is also a water exporting country. Although the virtual water budget of the country seems balanced, it is possible to reach a more profitable position in virtual water trade by processing and selling agricultural products. However, in order for this to happen, the preferential trade practice of the European Union for agricultural products must be made profitable for both parties. The Turkish water acquis has not yet been fully aligned with the Water Framework Directive, and the basin management and protection plans have not been completed. Illegal drilling of wells for irrigation purposes cannot be prevented and there is also not sufficient legal regulation on this issue.

In addition to all of these, in the study prepared by the European Environment Agency on the water pressure in Europe for the years between 2000 and 2030, it is predicted that heavy water pressure would occur in Turkey in 2030. Accordingly, while the pressure on medium water resources experienced in two-thirds of Turkey would be replaced by severe water pressure, regions that are not under water pressure would be exposed to moderate water pressure in 2030. Under these conditions, Turkey's target to use all of its water resources in 2023 does not comply with the predictions of the European Environment Agency. Turkey's water resources are already under pressure due to inefficient and unsustainable farming methods. When the relevant study of the European Environment Agency and Turkey's 2023 water use target are brought together, it can be said that there would be an extremely serious water problem in Turkey in the future unless the necessary precautions are taken.

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