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A Quantitative and Qualitative Assessment of Turkey's Water Resources Potential

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ABSTRACT

One of the most basic human needs is water, which is also needed to create all the nutrients required for nutrition. For this reason, water is the basic element of life. While the presence of underground mines and oil is an indicator of the wealth of a country, the existence of water resources is now considered a part of this group.

A hundred years ago, the existing water availability in a country was a direct indicator of the water wealth of that country. However, as a result of the increase in industrialization and the rapid pollution of water resources, it has become a necessity to evaluate water not only in terms of quantity but also in terms of quality. Because the unit water value of a source is related to the number of different purposes that source can be used for, the more varied a water resource's application, the more valuable it is. Sometimes one unit of very clean water is more valuable than a hundred units of dirty water. For this reason, the value of a country's water resources should be evaluated not only in terms of quantity but also in terms of quality.

In this study, the total surface water as rivers and lakes and groundwater of Turkey were examined in terms of quantity and quality on a basin basis, and assessments were made about the basin water potentials.

While the amount of water in 25 water basins in Turkey does not show a significant change over time, a serious changing draws attention in terms of quality, especially in the last 50 years. The change in the amount of water in the basin primarily manifests itself in the form of a decrease in the water levels of rivers, lakes and groundwater. This process arises due to the effects of global warming and climate change, which is a global problem that concerns the whole world. However, pollution in water resources and making the water resource unusable are all related to the fact that the regulations on the protection of water are not adequately implemented and people do not act consciously. In other words, although quantitative reduction is a global problem, the quality problem is related to the polluting factors in the region of that resource.

In a country with a very high population growth rate, the decrease in the per capita water potential and the rapid increase in the pollution in the existing resources leads to a steady decline in the availability of usable water resources. In this study, attention was drawn to point and diffuse pollution on the basis of water presence and water source on the basis of basin, and an evaluation of Turkey's water resources in terms of quantity and quality was made.

Keywords: Water resources, Irrigation water quality, Watershed, Turkey

1. Introduction

The greatest absolute needs of people are drinking water and nutrition. Nearly 1 billion people in the world suffer from drinking water shortages while 2 billion people live with insufficient access to quality water. In addition, half of the world's population is struggling with water scarcity. Water is a vital resource not only for drinking but also in the production of nutrients (Öztürk & Çolak 2021).

While water is an absolute necessity in the lives of all living things, it is also t used wastefully and carelessly. Water, which has not only an economic aspect, is also a natural resource that should be considered as a social asset, political and strategic power related to the right to life of humans and nature (Sevindi 2005).

Meeting the ever growing demands for the world growing population in terms of food and water continues to be a global concern. A large part of the efforts to feed the world is made through agricultural production. There are three main inputs of agricultural production. These are soil, water and sunlight. Although there may be enough agricultural land, a lack of water and sunlight in many areas are the main issues that limit production. While there is usually sufficient water at high latitudes, temperature and sunlight are the limiting factors for agriculture. At lower latitudes, which are typically semi-arid and arid, water is usually the main factor limiting agricultural production. The amount of evaporation from the earth has increased due to climate change and related global warming. Excessive evaporation causes a decrease in the water on the earth and an increase in the water in the atmosphere. With excessive evaporation, there is not only a decrease in the water on the earth, but also a deterioration in water quality. Because evaporation takes place as pure water, the salt concentration of the remaining water rises even more and the water becomes of increasingly poor quality. The quality of most water sources in summer is often lower than in winter. One reason for this is evaporation with the other being the increase in microbial activities in hot conditions.

Although the total amount of water on earth shows no change, the distribution of this water is disordered and shows significant variation. More than half of the world's fresh water is found in Canada. The potential of water resources is evaluated in two different ways. While one of them is the total fresh water availability, the other is the per capita water potential. Since the population of the countries interact in terms of these two parameters, the ranking can vary significantly in the population-based assessment. For example, Iceland, with a population of 357 thousand, is 5 times better than Canada, which has half of the world's fresh water in terms of water potential per capita. Therefore, the total water potential and the per capita potential lead to different conclusions.

36% of the water used in the world is distributed in Asia, 25% in South America, 15% in North America, 11% in Africa, 8% in Europe and 5% in Oceania. An examination of this distribution shows that the water potential per capita is insufficient since Asia has 60% of the world's population. There is 5 000–6 000 m^3 of water per person per year in the world (UN 2007). Falkenmark et al. (1989) developed an indicator called the "Falkenmark water stress indicator" to define the water scarcity threshold. According to this indicator, if the annual water potential per capita in a country is below 1700 m^3, then that country suffers from water scarcity. A water-scarce country faces seasonal or continuous water stress. If the water potential falls below 1 000 m^3, problems arise in human living conditions and water stress is experienced. If the water potential falls below 500 m^3, serious problems emerge in basic human life, which is defined as absolute water scarcity. This classification is common in many studies due to the ease of its calculations (UNDP 2006).

If the world population continues to increase in this way, the proportion of people experiencing water shortages will increase to 36% in 2025 and 42% in 2050. Today, 700 million people in 43 countries suffer from water stress and water scarcity. In the Middle East, which is one of the regions where water stress is most apparent in the world, the annual water potential per person is 1200 m^3 on average. The only countries in the region where the per capita water availability exceeds this value are Iran, Iraq, Lebanon and Turkey. Palestine, especially Gaza, suffers from thee most severe water shortage in the Middle East with 320 m^3 per capita per year (UNDP 2006).

The quality of the water is also important as well as the amount of water available, since the quality of water is the most important feature that limits its use. The existence of a water source that cannot be used for any purpose can be taken as the equivalent of not having that water source at all. In many regions, a small amount of good quality water is preferred over a large amount of poor quality water. Today, if there is water of different qualities in the same area, a quality-based water pricing is applied. For example, when it comes to using poor quality groundwater cheaply in an agricultural area, the farmer may prefer to use higher quality but more expensive surface water. In fact, in the near future, considering the reaction of the crops to the water quality, it is possible to implement planned agricultural practices such as using quality water in sensitive periods and using low-quality water in non-sensitive periods.

In arid and semi-arid areas, irrigation has become even more dependent on poorer quality and deficit quantity water. Moreover, differences in resistance to drought and salinity between varieties, which were not covered extensively before, have become more important than before (Semiz et al. 2023). Both irrigation water pollution and increasing soil salinity in agricultural lands are the most important limiting factors for cultivation of culture crops. To meet increasing needs, marginal waters should be used and agricultural lands should be used for production. Saline lands could also be used in production through the use of salt-resistant plants (Taş et al. 2022).

While there is vast quantities of water in the seas and oceans what makes water scarce is its quality. The problem is not one of water scarcity in the world, but a problem of quality water scarcity. It is still not considered economical to treat sea water into good quality water. The cheapening of treatment technologies will significantly affect the availability of quality water. Transferring water to where it is needed is not an economical solution at present due to the high energy cost. The development of inexpensive methods of conveying water is vital in wider efforts towards eliminating water scarcity.

In low latitudes where arid and semi-arid climatic zones are located, it is almost impossible to carry out crop production without irrigation. The presence of water resources required for plant production in these latitudes, including Turkey, directly affects the agricultural production potential. The significant increase in the yield of some products with irrigation, or the fact that many products cannot be grown in dry farming is an indicator of how important irrigated agriculture is.

In this study, Turkey's water resources potential was examined in terms of its quantity and quality and evaluated on a basin basis. The evaluation on the basis of basin was made quantitatively and qualitatively in the form of rivers, lakes and groundwater.

2. Turkey's Water Availability

Turkey consists of 25 river basins (Figure 1). Most of the rivers in the country originate within the borders of the country and reach the sea. The most important rivers in the country are the Kızılırmak (1 355 km), Sakarya (824 km), Meander (548 km), Seyhan (560 km), Yeşilırmak (519 km), Ceyhan (509 km), Gediz (401 km), and Little Meander (114 km) rivers. The rivers that originate within the country borders and flow into the sea from the shores of other countries are the Euphrates (1 263 km in Turkey), Tigris (512 km in Turkey), Chorokhi (354 km in Turkey), Kura (189 km in Turkey) and Aras (548 km in Turkey) rivers. The Orontes (98 km in Turkey) and Meriç (187 km in Turkey) rivers originate in the lands of other countries and flow into the sea on the shores of Turkey (SHW 2022).

Figure 1- Turkish water basins

As a result of the topography of Turkey, which is quite young in terms of geological age and due to the high slope of the land, the regimes of the rivers are generally irregular and wild stream. Therefore, it is often not possible to use water directly without taking the necessary regulations and precautions. While it may appear that Turkey has vast quantities of water, the needs cannot always be met due to different levels of precipitation in the basins and precipitation at different times of the year (Burak et al. 1997).

The water availability of a country is directly related to the levels of rainfall that occur in that country. Precipitation varies depending on the country's precipitation regime, geographical location, topography, climatic conditions and season. In Turkey, which has continental and semi-arid climate characteristics, although there are regional differences depending on these characteristics, the annual average precipitation amount is 574 mm, which corresponds to an average precipitation volume of 450 billion m^3 per year. According to the basin master plans, it is calculated that 185 billion m^3 of this water flows into the seas and lakes through streams of various sizes. The groundwater reserve determined through Turkey's hydrogeological studies has been calculated as 23 billion m^3, and the safe usable groundwater reserve has been calculated as 18 billion m^3. Within the framework of today's technical and economic conditions, the surface water potential that can be used for various purposes is 94 billion m^3 annually, and the groundwater potential that can be safely used is 18 billion m^3 annually. Thus, the total consumable surface and groundwater potential of Turkey can be calculated as 112 billion m^3 per year (Anonymous 2018).

According to the 2021 realization values of Turkey's total water potential, it was determined that 58.41 billion m^3 of water was used for various purposes (45.05 billion m^3 (77%) for irrigation water, 13.36 billion m^3 (23%) for drinking, domestic and industrial water) (Figure 2) (SHW 2022).

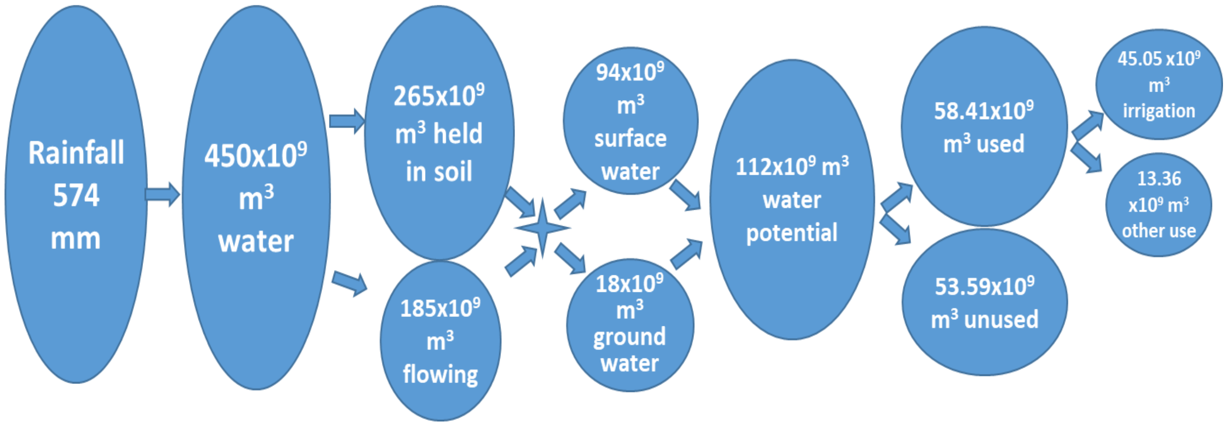

Figure 2- Turkey's water availability and use

According to the data of the Turkish Statistical Institute, the population of Turkey is 84 680 273 as of 2021. The annual amount of usable water per capita in the country is 1 323 m^3 in 2021. Considering the usable water potential per capita, Turkey is among a wider group of countries experiencing water stress. The population of Turkey in 2050 is predicted to be 96 498 000, which means that even if the amount of water in the country does not decrease, the water potential per capita will decrease to 1 161 m^3/year and Turkey will become a water-poor country (SHW 2019, TUIK 2019). Due to the drought in Turkey, especially in recent years, significant problems have been experienced in both the agriculture and domestic use of water and economic losses have occurred. It is estimated that the social and economic problems in the country will grow exponentially, as climate instabilities to be experienced due to global climate change will cause water shortage. For this reason, an accurate monitoring of Turkey's water potential and appropriate use of water will be vital in planning the future.

In Turkey, it is important to use water economically and in an optimum way, and studies have been carried out to evaluate the potential of water resources and to use it in a multi-purpose way through the construction of storage facilities. The use of water in a multi purpose way is aimed to prevent water losses in the irrigation projects under operation and to use water more effectively and efficiently. In addition, it is aimed to give importance to renovation works in order to prevent drainage problems affecting soil quality and to expand the use of closed irrigation systems instead of classical open system irrigation networks (SHW 2021).

3. Water Resources Status in Quantitative and Qualitative Aspects in Turkey's Water Basins

The flow regimes of the rivers in Turkey vary throughout the year due to variables in precipitation levels according to the regions and seasons as well as differences in the bed slopes of the rivers. The high slopes of the rivers does provide the potential to generate hydroelectric energy from the rivers. However, the fact that the rivers have different bed morphology and high bed slopes does create certain obstacles for transportation (SHW 2019).

13 of the 25 basins (the Euphrates and Tigris, Seyhan, Ceyhan, Kızılırmak, Sakarya, Chorokhi, Yeşilırmak, Susurluk, Aras, Orontes, Meander, Gediz and Little Meander) can be considered as individual river basins. The other 12 basins (the Eastern Mediterranean, Eastern Black Sea, Antalya, Western Black Sea, Western mediterranean, Marmara, Konya Closed, Van Lake, North Egean, Meriç-Ergene, Burdur Closed and Akarçay) cover large and small discrete streams and lakes. Of these 12 basins, 4 (Konya Closed, Van Lake, Burdur Closed and Akarçay) are closed basins that are not in contact with the seas (SHW 2022).

Lakes; It has attracted the attention of human beings for centuries, both in terms of supply of fresh water, which is inevitable for living life, and with its unique resources. From the perspective of the historical process of humanity, many important civilizations were established and rooted in areas where fresh water resources were found.

As a result of the studies carried out by the General Directorate of Nature Conservation and National Parks, there are 320 natural lakes in Turkey. Some of these lakes are seasonal and are filled through winter precipitation and then dry up due to a lack of precipitation in the summer. Of the lakes in Turkey, Lake Van (3 713 km^2), Salt Lake (1 300 km^2), Beyşehir Lake (656 km^2), Eğirdir Lake (482 km^2) are the largest lakes in size (SHW 2022).

There are 861 dams in operation in Turkey. Of the dams in Turkey, the Atatürk Dam has a surface area of 817 km^2, Keban Dam 675 km^2, Ilısu Dam 313 km^2, Karakaya Dam 268 km^2, Hirfanlı Dam 263 km^2 (SHW 2022).

Groundwater sources are water reserves that have been formed by accumulating underground for many years, show small changes with annual consumption and re-feeding, and constitute a country's safe water resources. It is important to protect groundwater both quantitatively and qualitatively. Groundwater polluting factors are restricted by law. Excessive use of groundwater may cause the source to dry out completely through these sources inability to renew themselves. Overuse can also cause seawater to enter the freshwater aquifer at seaside. For this reason, in terms of resource conservation, the annual use of underground reserves should never exceed the average recharge rate. The water reserve in underground aquifers should not be allowed to decrease over time. Groundwater sources protected in terms of quantity and quality by regulations. On the other hand, in many areas monitored by observation wells, excessive water use occurs during dry periods.

In this study, the rivers, lakes and groundwater resources of Turkey's basins have been analyzed on a basin basis in terms of both quantity and quality and evaluated according to the basin numbers provided below.

3.1. Meriç-ergene basin

The precipitation area of the Meriç-Ergene Basin, which is one of the smaller basins, is 14 486 km². The basin has an annual precipitation average of 665 mm. The estimated total water potential of the basin is approximately 2 billion m^3 per year. A total of $1.235x10^9$ m^3 of water is consumed in the basin, $970x10^6$ m^3 for irrigation, $112x10^6$ m^3 for domestic use and $153x10^6$ m^3 for industrial use. This figure constitutes 61.8% of the total water potential of the basin (Anonymous 2018a).

The main rivers in the Meriç-Ergene Basin are the Ergene River and its tributaries. The Ergene River originates from the Ergene springs in the Istranca Mountains in the northeast of Thrace and flows in a northeast-southwest direction under the name of Ergene Creek. Later on, it merges with the Çorlu Stream coming from the east near the village of İnanlı and takes the name of the Ergene River. The Ergene River flows in an east-west direction, taking the Ana Stream, Soğucak Stream, Lüleburgaz Stream, Şeytan Stream, Çimenli Stream and Süloğlu Stream from the north, and the Çengelli Stream, Beşiktepe Stream, Hayrabolu Stream and Bayramlı Stream tributaries from the south. It then joins with the Meriç River in the south of Adasarhanlı village (Anonymous 2018a).

Water pollution is the biggest problem facing the Meriç-Ergene Basin. The waters of the Ergene River are in the low irrigation water quality class due to uncontrolled industrialization, failures in waste water management and incorrect agricultural practices. Due to the of the overflow of the stream, particularly after rainfall, the plain is polluted with flood waters and soil pollution arises from the polluted waters. In recent years in particular, through excessive industrialization in the Tekirdağ region, an excessive pollution load has been observed in the Çorlu Stream owing to waste discharge from industrial facilities.

The electrical conductivity (EC) values of the basin waters show significant regional differences. With the exception of the Çorlu Stream, the tributaries of the Ergene River and the Meriç River are in the 2nd class in terms of EC values. The Ergene River has 3rd class water quality, excluding the source area and its tributaries, and Çorlu Stream has 4th class water quality (WPCR 2015).

The lakes found in the basin are the Çeltik (Gala) and the Pamuklu Lakes. The Gala Lake has a total area of 601 hectares and is divided into the Grand Gala (Çeltik) and Small Gala (Pamuklu). The Grand Gala has a large water area. Some parts of the lakes are in the form of reed beds (Small Gala), seasonal marshes and wetlands consisting of salty lakes containing salt water. Rice is cultivated extensively in the region. The lakes in this basin are under the threat of pollution coming from the Meriç River, agricultural activity wastes and the sediment created by the floods. Especially in dry periods, the salinity value of the lake water tends to increase (Anonymous 2015). The Gala Lake has an EC 2.5 dS/m salinity in terms of irrigation water quality and an irrigation water class of 4 (Tokatlı et al. 2014).

Along the river route, which is 283 km in total from its source to the point where it reaches the sea, the stream flow gradually increases as a result of the industrial and domestic wastes absorbed by the river.

When the basin is evaluated in terms of groundwater. The groundwater recharge quantity is $507.7x10^6$ m^3/year with an operating reserve is $498.2x10^6$ m^3/year. Three-quarters of the total annual operating reserve of the groundwater potential of the basin is allocated to domestic and industrial water. In addition, an area of 15 585 ha is irrigated from 347 wells belonging to 46 irrigation cooperatives. The effect of the climate on groundwater is most apparent through precipitation levels. While the amount of water in the aquifers increases with the effect of precipitation, precipitation does not affect the deep wells. In recent years, it has been observed that there has been a decrease in groundwater levels and a decrease in groundwater quality (Anonymous 2015).

3.2. Marmara basin

The precipitation area of the Marmara Basin is 23 074 km². The Marmara Basin is the most populated basin in Turkey, and İstanbul, the most populated city of Turkey, is located in this basin. The average annual precipitation of the basin is 685 mm. The annual average flow value of the Marmara Basin is $5.08x10^9$ m^3 (6.69 L/s/km^2) and constitutes 2.77% of Turkey's surface water potential. Considering the $5.08x10^9$ m^3/year surface and $396x10^6$ m^3/year groundwater potential in the basin, the total water potential is $5.476x10^9$ m^3/year. Of the total water potential, the usable water potential of the basin is stated as $2.54x10^9$ m^3/year surface water and $297x10^6$ m^3/year groundwater, totalling $2.837x10^9$ m^3/year. 11% of the total water potential of the Marmara Basin is used for irrigation and 89% for domestic water (drinking, using, industry, etc.) activities (Anonymous 2010).

Since the Marmara Basin is not a large river basin, it has many large and small streams. The streams in the basin demonstrate very different water quality characteristics from each other as they are exposed to domestic and industrial wastewater discharges (Anonymous 2010).

Natural lakes in the basin are İznik, Küçükçekmece and Dalyan lakes. The main water source in the basin is Lake İznik, which is predominantly used for drinking water and irrigation water. A total of 7036 ha of agricultural land is irrigated by the irrigation facilities built by DSI in İznik, Boyalıca and Orhangazi (Anonymous 2015). Lake İznik is the largest and deepest natural lake in the Marmara and the fifth largest natural lake in Turkey (Anonymous 2022). In terms of the irrigation water quality of the lake, the electrical conductivity values vary between 0.68-1.10 dS/m (Anonymous 2022a).

The surface area of Lake Küçükçekmece is 1956 ha, its length in the north-south direction is 10 km and its widest part is approximately 6 km. Although Küçükçekmece Lake is not very deep, its depth reaches up to 20 m near the southern shore. The lake contains brackish water and has a lagoon type character (Anonymous 2015). The water of the lake is salty because of the transfer of seawater from the Marmara Sea into the lake when it swells (Okumuş 2007).

The other lake in the Marmara Basin is Dalyan Lake with an approximate size of 400 ha. The depth, which is about 10-20 cm on the shores of the lake, increases up to 1.5 meters towards the centre of the lake. The lake waters are not used because they are alkaline and salty. Since the lake surroundings are sandy, it lacks any natural vegetation. The groundwater recharge quantity of the Marmara Basin is 241.7x10^6 m^3/year, and the operating reserve is 210.7x10^6 m^3/year (Anonymous 2015).

3.3. Susurluk basin

The precipitation area of the Susurluk Basin is 24 319 km² while the population numbers 3 139 112. The average annual precipitation in the Susurluk River Basin is approximately 662 mm/year. The total water potential of the Basin, including surface and groundwater, is approximately 5.81x10^9 m^3/year. Within the basin potential, it is estimated that 1.18x10^9 m^3/year for irrigation, 200x10^6 m^3/year for domestic use and 234x10^6 m^3/year for industrial use, a total of 1.614x10^9 m^3/year water is used (Anonymous 2018b).

Many small and large rivers discharge the rainfall of the Susurluk Basin into the Marmara Sea and Lakes Uluabat and Manyas. There are many large and small rivers in the basin flowing continuously throughout the year or for a short time.

• The Simav Stream (Susurluk Stream): The most important stream of the Susurluk Basin, the Simav Stream originates in Kütahya. The length of the Simav Stream, which enters Balıkesir from the Sındırgı district and disembogues into the Marmara Sea, is 175 km. It is also fed by many streams in the basin. High boron concentration waters discharged from Bigadiç Borax plants to Simav Stream, which adversely affect the irrigations in Balıkesir, Susurluk, Kemalpaşa, Karacabey plains located in the Susurluk Basin.

• The Dursunbey Stream (Balat Stream): The Dursunbey Stream, which originates in the Alaçam Mountains and merges with the Simav Stream and disembogues into the Marmara Sea, has a length of 65 km.

• The Kille Stream: The length of the Kille Stream, which originates from the Dursunbey district and joins with the Simav Stream and disembogues into Marmara Sea is 97 km.

• Yağcılar Creek: It originates in the Bigadiç district and merges with Simav Creek in Kepsut and disembogues into the Marmara Sea. The length of the stream is 30 km.

• The Atnos Stream: The river originates in Kütahya, joins with the Simav Stream in Sındırgı and disembogues into the Marmara Sea.

• The Üzümcü Stream: Originating in the İvrindi district of Balıkesir, the stream merges with the Simav Stream and disembogues into the Marmara Sea. The Üzümcü Stream is approximately 56 km long.

• The Dombay Stream: The stream originating from Bigadiç district merges with the Simav Stream and disembogues into the Marmara Sea.

• The Kocaçay: The Kocaçay, one of the important rivers of the basin, arises from the foothills of the Madra Mountain and flows 140 km from south to north and disembogues into Lake Manyas. It is the most important river source feeding the lake.

• The Nilüfer Stream: It is the most important stream of Bursa province and one of the characteristics of Bursa city. The stream originates around Keles and merges with the Susurluk Stream and disembogues into the Marmara Sea around Karacabey Boğaz district.

• The Deliçay: It arises from the northern slopes of Uludağ and brings vast quantities of sediment as a result of the melting of snow in spring due to the very steep slope. The Deliçay joins the Nilüfer Stream and disembogues into the Marmara Sea.

• Aksu Creek: This streams descends from the northern slopes of Uludağ. It reaches to Gölbaşı Pond.
• The Kaplıkaya Stream: It arises from the northern slopes of Uludağ, after entering the Bursa Plain, it merges with the Deliçay and joins the Nilüfer Stream.

• The Ayvalı Stream: It joins the Nilüfer Stream by passing through the Çayırköy Plain.

• The Hasanağa Stream: It joins with the Nilüfer Stream about 7 km west of the Ayvalı Stream.

• The Orhaneli Stream (Kocasu Stream): The Orhaneli Stream, which is 104 km long within the provincial borders, arises in the Gediz district of Kütahya Province. 20 km from Mustafakemalpaşa district, in Çamandar Village, it merges with the Emet Stream, which is the branch of the Mustafakemalpaşa Stream coming from the west, and takes the name Mustafakemalpaşa Stream and disembogues into Lake Uluabat.

• The Emet Stream: It originates at 1100 meters on the Şaphane Mountain in the Gediz region and merges with the Orhaneli Stream in the north and forms the Mustafakemalpaşa Stream. Its length within the provincial borders is 44 km.

• The Mustafakemalpaşa Stream: The Mustafakemalpaşa Stream, which is 134 km long within the provincial borders and formed by the merging of Orhaneli and Emet Streams in Çamandar Village, flows into Uluabat Lake 40 km from here.

• The Sultaniye: The length of this stream, which is a branch of the Nilüfer Stream, within the provincial borders is 11 km.

• The Kurtkaya Stream: The length of the Kurtkaya Stream, which is a branch of the Nilüfer Stream, within the provincial borders is 20 km.

• The Değirmendere: The length of this stream, which is a branch of the Nilüfer Stream, within the provincial borders is 16 km.

• The Yaylacıkdere: The length of this stream, which is a branch of the Nilüfer Stream, within the provincial borders is 22 km.

• TheEmet Stream: The 90 km long brook consists of springs near the Saruhanlar and Aşıkpaşa villages, and merges first with the Kocadere, then the Doğanyakası Stream and the Kayaköy, and takes the name of the Emet Stream.

• The Bedir Stream: Flowing in the southwest-northeast direction, the stream passes through Çavdarhisar and merges with the Barağı Stream, İmam Stream and Çat Stream. Its average flow is 0.178 m^3/s.

• The Tavşanlı Stream: The brook, which is 65 km long within the provincial borders, originates in Esatlar Village. It merges with the Bedir Creek, and flows northward from here to the Tavşanlı Plain.

• The Simav Stream: The length of the brook, which starts from the point where Kalkan Stream ends and leaves the provincial borders after Beciler Village, is 40 km.

• The Hamzabey Stream (Kocaçay): The length of the stream, which originates from the town of Naşa and then reaches the Emet Stream, is 45 km (Anonymous 2018c).

There are 2 natural lakes in the Susurluk Basin, which is located in the west of the country and has a population density of more than 100 people per km^2.

Lake Manyas is located within the borders of the Manyas district of Balıkesir province and covers an area of approximately 16 069 ha. Since Lake Manyas has shallow waters, the water temperature varies depending on the atmospheric conditions. Lake Manyas, which hosts a bird paradise and is a RAMSAR area, is one of the important of Turkey's wetlands. With the water of the lake having high turbidity, it almost exclusively used for irrigation purposes and the area around the lake has a high number of agricultural fields and factories (Anonymous 2017). The increase in the regions in the region's population as well as growing industrial use and domestic waste has led to a deterioration in the water quality Lake Manyas (Gürlük & Rehber 2009).

Lake Uluabat, located within the borders of the Karacabey and Mustafakemalpaşa districts of Bursa province, covers an area of approximately 15 409 ha and has been included in the List of Ramsar Wetlands as of 1998. The lake, with a maximum depth of 6 m is a shallow, turbid, eutrophic freshwater lake. The most important water source feeding the lake is the Mustafakemalpaşa Stream. In addition, the drainage waters of the surrounding agricultural areas are also discharged into the lake. The quantity of water entering the lake varies greatly according to the seasons and years. The excess water of the lake flow into the Uluabat Stream and the Susurluk Stream to the west of the lake and then into the Marmara Sea. However, when the water level of the lake falls below that of the Uluabat Stream, the stream flows towards the lake and feeds the lake. With the water pumped from the lake, 6 350 ha of land around the lake is irrigated (Anonymous 2017).

A high number of settlements, factories, workplaces, agricultural lands and mines can be found around Lake Uluabat, which is located in the Marmara Region, where the population and industry are dense. This leads to the deterioration of the water quality and an increase in the lake's pollution levels (Akdeniz 2005).

There are over 30 lakes in the Living Lakes network. Lake Uluabat is among these globally important lakes and is recognized and supported internationally (Karaer et al. 2009) Lake Uluabat is in the 4th class according to the irrigation water criteria (Katip & Karaer 2011). The groundwater operation reserve of the Susurluk Basin varies in the range of 503x10^6-671x10^6 m^3/year (Anonymous 2015).

3.4. North Aegean basin

The precipitation area of this basin is 9 861 km^2 while the population living within the borders of the basin is approximately 800 000 people. Many rivers of different sizes in the North Aegean Basin that disembogues their waters into the Aegean Sea including the Bakırçay River, Karamenderes Stream, Madra Stream, Güzelhisar Stream, Tuzla Stream, Havran Stream and Black Stream. The flow rates of the rivers in the basin vary most of the year depending on precipitation and discharges (Anonymous 2019).

In the North Aegean Basin, the annual average precipitation value is around 672 mm. The annual average flow amount is 1.39x10^9 m^3 (4.86 L/s/km^2) and constitutes 0.75% of Turkey's surface water potential. The usable part of this water is estimated to be 695x10^6 m^3/year. The groundwater operating reserve of the North Aegean Basin is 187x10^6 m^3/year and the groundwater potential is estimated to be around 249x10^6 m^3/year. Considering the 1.39x10^9 m^3/year surface and 249x10^6 m^3/year groundwater potential in the basin, the total water potential is calculated as 1.639x10^9 m^3/year. The usable water potential of the basin is stated as 882x10^6 m^3/year in total, of which 695x10^6 m^3/year is surface water and 187x10^6 m^3/year is groundwater operating reserves (Anonymous 2015).

While there is no significant lake in the North Aegean Basin, there are still many dams in operation, under construction and planned. The important dams in the basin and their features are given in Table 1.

Table 1- Important dams in the North Aegean Basin (Anonymous 2019)

Dam name	*Surface area km^2*	*Storage volume x10^6 m^3*
Güzelhisar Dam	5.80	158.0
Sevişler Dam	6.05	127.0
Bayramiç Dam	5.85	86.5
Madra Dam	2.68	79.4
Yortanlı Dam	4.25	67.3
Havran Dam	3.15	66.5
Çaltıkoru Dam	1.90	46.0
Kestel Dam	2.40	37.4
Ayvacık Dam	3.42	30.0
Sarıbeyler Dam	1.37	15.6
Akçin Pond	0.70	9.0

Within the scope of the North Aegean River Basin Management Plan, monitoring was carried out at 101 points in the basin according to the Surface Water Quality Regulation. According to the monitoring results, the water quality status of the basin has been determined.

As a result of surface water quality evaluation; 2 water sources "bad" (3%), 11 water sources "poor" (16%), 34 water sources "moderate" (49%), 4 water sources "good" (6%), 2 water sources "very good" (3%), and there is no monitoring in the remaining 16 water bodies (23%) (Anonymous 2019)

When the Bakırçay River is evaluated in terms of all parameters in general, it is reported to be in class 4 water quality. Olives, vegetables and fruit cultivation is widely practiced in the basin. There are stone quarries and tomato paste factories in Bergama. There is a Thermal Power Plant in Manisa Soma and it is important in terms of environmental pollution (Anonymous 2014).

The potential for groundwater in the basin to be affected by climate changes will not be as high as other basins in the region (eg Gediz, Meander and Little Meander). According to the results of the examinations made in terms of groundwater quality, 11 aquifers were determined as "good" and 20 aquifers were determined as "poor" in groundwater.

The main problems identified in the North Aegean Basin include domestic and industrial wastewater discharged without treatment, septic tank water from rural areas, leakages from irregular solid waste landfills to water resources, fertilizers and pesticides used in agricultural activities, pollutants originating from livestock activities, mining and hydro morphological changes. In addition, in the olive growing facilities located in the basin the coal mining enterprises located around Manisa Soma cause significant environmental pressures (Anonymous 2019).

3.5. Gediz basin

The precipitation area of the Gediz Basin is 17 145 km² with an annual average rainfall of 585 mm. The basin receives a significant amount of precipitation, and most of this precipitation disembogues into the sea (Anonymous 2018d). The population of the basin is just over 2 million.

The annual average flow amount of the Gediz Basin is 1.09x10^{9} m^{3} (2.01 L/s/km^{2}) and covers 0.59% of Turkey's surface water potential. The usable water potential of the basin is determined as 545x10^{6} m^{3}/year; the groundwater potential of the Gediz Basin is 555x10^{6} m^{3}/year, and the groundwater operating reserve is 248x10^{6} m^{3}/year. Considering the 1.09x10^{9} m^{3}/year surface and 555x10^{6} m^{3}/year groundwater potential in the basin, the total water potential is 1.645x10^{9} m^{3}/year. The total usable water potential of the basin has been determined as 793x10^{6} m^{3}/year considering the groundwater operation reserve (Anonymous 2015).

The main water source of the Gediz Basin is the Gediz River. In addition, the Alaşehir Stream, Gürduk Stream, Kemalpaşa (Nif) Stream, Kum (Gördes) Stream, Kurşunlu Stream, Kokarazmak Stream, Gümüş Stream, Irlamaz Stream, Ağlı Stream, Doğucan Stream, Karacalı Stream, Zeytin Stream, Sart Stream, Ahmetli Stream, Tabakçayı Stream, Şahyar Stream, Kısık Stream, Medet Stream, Üçgöz Stream, Merdiven Stream, Aşağıkoçak Stream, Göbekli Stream, Gökçay, Değirmendere and Derbent Stream are the other most important water resources of this basin (Anonymous 2019a).

The flow values measured in the basin are quite high. It has been stated that the long-term annual total flow in the Muradiye Bridge of the Gediz River is 1.228x10^{9} m^{3}, and the annual average flow is 39.134 m^{3}/s. The annual flow of the Alaşehir Stream, which is one of the tributaries feeding the Gediz River, is 106x10^{6} m^{3}, and the annual average flow is 3.379 m^{3}/s. The annual total flow of the Gördes Stream, one of the rivers feeding the Gördes Dam, is 113x10^{6} m^{3} and its annual average flow is 3.61 m^{3}/s. When the Nif Stream, which is the most important stream of the Kemalpaşa sub-basin, is examined, the annual average total flow is recorded as 73.5x10^{6} m^{3} with an annual average flow of 2.749 m^{3}/s (Anonymous 2019a).

The Gediz river faces a growing pollution threat resulting from industrial waste, domestic waste and also pesticides and artificial fertilizers from agricultural areas in the region. It is in the 4th class in terms of irrigation water quality (Öner & Çelik 2011).

The number of natural lakes in the Gediz Basin is almost non-existent. The most important natural lake in the basin is the Marmara, near the Marmara town of Akhisar. The storage volume of Lake Marmara is 320x10^{6} m^{3}. Apart from Marmara Lake, there are Gölcük and Sazlı Lakes as natural lakes in the basin (Anonymous 2019a).

The surface area of Lake Marmara varies between 3400-6800 hectares (Girgin 2000). Pollution found in the lake originates from the sewage in the Gölmarmara district. Fertilizers and pesticides used in agricultural areas around the lake are transported to the area by surface runoff and drainage waters (Anonymous 2017). The lake water is recorded as medium salty, and of a low sodium irrigation water class with a pH value of 8 (Ünlü 2013).

Lake Gölcük, one of the natural lakes of the Gediz Basin, is located in the middle of Bozdağlar, 22 km southwest of Salihli. The deepest area of the lake is 8.5 meters. Its surface area is 0.8 km^{2} and its volume is approximately 4x10^{6} m^{3} (Ünlü 2013). Agricultural activities are carried out on the lands on the shores of the streams feeding the lake, and as a result of these activities, both the lake water level decreases and fertilizers and pesticides used for agricultural purposes pollute the lake (Anonymous 2017).

Demir (2020) in his study; By taking groundwater samples from 392 points in the Gediz Basin, irrigation water classification was made according to the Technical Principles of the Water Pollution Control Regulation (1999). The SAR (Sodium Adsorption Ratio) parameter value was found between 0-10 in 383 of the total 392 points in the basin. According to the SAR parameter, the groundwater in the basin are largely suitable for agricultural irrigation. The SO_4 parameter recorded a value between 0-192 mg/L at 364 points and was included in the 1st class waters, 15 points in the 2nd class waters, and 7 points in the 3rd class waters. It has been determined that it is within the scope of 4th class waters at 5 points and cannot be used as 5th class waters at 1 point. In terms of Cl parameter; Waters are classified as 1st class waters at 378 points, 2nd class waters at 4 points, 3rd class waters at 4 points,

4^{th} class waters at 3 points, and 5^{th} class waters at 3 points. According to these results, it has been stated that the groundwaters of Gediz Basin are in the appropriate class in terms of agricultural irrigation, except for a few regions.

3.6. Little meander basin

The Little Meander Basin is the smallest basin in Turkey with a surface area of 6 963 km². The population of the basin is 3 793 321 (Anonymous 2018e).

The annual average flow in the Little Meander Basin is 540x10^6 m^3 (2.40 L/s/km^2), constituting 0.29% of Turkey's surface water potential. The usable part of this water is estimated to be 270x10^6 m^3/year. The groundwater operating reserve of the Little Meander Basin is 185x10^6 m^3/year and the groundwater potential is estimated to be 247x10^6 m^3/year. Considering the 540x10^6 m^3/year surface and 247x10^6 m^3/year groundwater potential in the basin, the total water potential was to be calculated as 787x10^6 m^3/year. The usable water potential of the basin has been determined as 455x10^6 m^3/year, taking into account 270x10^6 m^3/year usable surface water and 185x10^6 m^3 year groundwater operating reserves (Anonymous 2015).

The most important stream of the Little Meander Basin, the Little Meander River, is 129.1 km long. Other important rivers include the Çevlik Stream (12 km), Deveçukuru Stream (10.7 km), Keleş Stream (11.6 km), Kemer Stream (6.7 km), Kervan Stream (4.2 km), Kocaçay Stream (5.4 km), Manda Stream (7.7 km), Rahmanlar Menderes Stream (13.3 km), Tahtalı Stream (12.7 km), Udi Stream (4.7 km), Yassı Stream (11.9 km), Boğaz Stream (16.6 km), Çay Stream (Değirmen Stream) (10.8 km), Değirmen Stream (10.3 km), Döşeme Stream (11.3 km), Gök Stream (22.9 km), Ilıca Stream (14.2 km), Kızılkaya Stream (10.3 km), Koca Stream (11.7 km), Fetrek (Vişneli) Stream (13.8 km) and Aktaş Stream (8.9 km). The average annual precipitation in the basin is 622 mm with an average annual flow of 11.45 m^3/s (Anonymous 2018e).

The basin is home to both large and small lakes. The main lakes include Lake Gölcük in the west of Bozdağ, Karagöl, which is a typical crater lake on Yamanlar Mountain, Lake Belevi, a shallow lake between Torbalı and Selçuk, and Lake Çakal and Lake Gebekirse, which are made up of alluvium brought by the Little Meander River. The most important lakes in the basin and their characteristics are given in Table 2 (Anonymous 2017).

Table 2- The important lakes of the Little Meander Basin and some of their characteristics

Lake name	*Surface area (ha)*	*Maximum depth (m)*	*Storage volume (10^6 m^3)*
Gölcük Lake	94.1	7	1.81
Karagöl Lake	3.1	23	0.70
Belevi Lake	192.0	3	1.50
Çakal Lake	78.0	4	0.90
Gebekirse Lake	96.0	5	1.50

Among the lakes of the Little Meander Basin, Lake Karagöl is is a popular natural park and recreation area, while other lakes are used specifically for providing irrigation water. It is known that the Çakal and Gebekirse lakes are considered to be second quality water (slightly contaminated water) in terms of ortho phosphate phosphorus and nitrite parameters. In terms of the electrical conductivity parameter, it has been determined that Lake Çakal is deemed to be of the second quality (slightly contaminated) water class, and Lake Gebekirse third quality (contaminated) water class. In addition, Lake Gebekirse is of the second quality (slightly contaminated) water class in terms of its anionic detergent parameter. According to the irrigation water criteria, the average concentrations of temperature, pH, boron, nitrate and ammonium are below the limit values and both lake waters can be used for irrigation water. The electrical conductivity of the water of Lake Çakal are recorded as 925 µS/cm, and that of the water of Lake Gebekirse as 1 025 µS/cm (Minareci & Sungur 2019).

The waters of the (Vişneli) Stream and Gelinbözü Stream, which feed the Little Meander River, are in the 4^{th} class according to the chemical oxygen demand (COD) and ammonium nitrogen (NH4–N) parameters. In terms of COD, the Ilıca Stream waters is class 3, whereas other streams are typically classes 1-2. It is stated that all the rivers in the basin are in the 4^{th} class in terms of nitrite nitrogen (NO_2-N) and in the 1^{st} class in terms of nitrate nitrogen (NO_3-N). According to group A (physical and inorganic pollutants) parameters, the water quality was found to be in the 4^{th} class due to nitrite nitrogen (NO_2-N). In the evaluation made in terms of Biochemical Oxygen Demand (BOD) for group B (organic) parameters, the Little Meander River, Fetrek Stream, Gelinbözü Stream were in the 4^{th} class, and the other creeks (with the exception of the Aktaş Stream, which was in the 2^{nd} class) were in the 3^{rd} class. In the evaluation of group C (inorganic pollution) parameters of all streams and creeks in the basin, it was observed that the waters were generally in the 3^{rd} and 4^{th} classes. There is very important organic and inorganic pollution in the Little Meander River after Beydağ district. For COD, BOD, NH_4-N, dissolved oxygen, color and boron parameters, the river is in the 4^{th} class, that is, very polluted category. In addition, it is recorded as in the 3^{rd} class in terms of iron, manganese and fluoride. In summary, in the evaluation made in terms of water quality in the rivers in the basin, the Little Meander River can be described as in the very polluted water category in terms of its organic matter, nitrogen, color, dissolved oxygen and salinity values. This situation is one of the most serious problems seen in the basin. In the Fetrek (Vişneli) Stream, after the Torbalı district, there are extreme values in terms of many parameters such as organic matter, nitrogen, color, dissolved oxygen, salinity, fluoride, manganese and boron. The Fetrek Stream is in the category of highly polluted water and is the most problematic stream in the basin, thus increasing the pollution in the Little Meander River. The Gelinbözü Stream is in the very polluted water category in terms of organic matter, nitrogen and color parameters, and in the polluted or very polluted category in terms of dissolved oxygen, total coliform, color and iron parameters (Anonymous 2015).

Since the surface water potential is insufficient in the Little Meander Basin, the sustainability of agricultural production depends entirely on the use of groundwater. Reducing this dependence on groundwater in agricultural production may be possible by expanding the use of pressurized irrigation systems in agriculture.

In the Little Meander Basin, groundwater is widely used for drinking, irrigation and industrial purposes. The distribution of total groundwater use in the basin by sectors is 78% irrigation, 20% drinking and utilization and 2% industry (Tol 2021).

The wastes of surface and groundwaters used for irrigation, urban and industrial purposes in the basin are returned to the environment as wastewater. In particular, in this basin, which suffers from water shortage, the possibility of reusing the wastewater for certain purposes after treatment is of great importance in terms of the sustainability of the basin's water resources.

The groundwater resources of the Little Meander Basin face not only the problem of overexploitation but also pollution. Urban and industrial wastewater discharged to surface water resources without treatment, drainage waters containing fertilizer and pesticide residues returning from agricultural activities, animal wastes from livestock facilities, irregular dumping sites, wastes from olive processing and mining facilities, waste geothermal fluid discharge in geothermal fields, are sources of pollution which impact groundwater.

3.7. Meander basin

The precipitation area of the Meander Basin is 25 960 km². The average annual precipitation in the Meander Basin is about 637 mm. Estimated total runoff of the Meander Basin, including surface and groundwater bodies, is 2.673×10^9 m^3 per year. Almost all of this amount is used. On average, 2.414×10^9 m^3 is used for irrigation, 184×10^6 m^3 for residential use and 72×10^6 m^3 for industrial purposes per year (Anonymous 2018f). The population living in the basin is recorded as 2 283 812 people.

The groundwater operating reserve of the Meander Basin is 700×10^6 m^3/year and the groundwater potential is estimated to be around 933×10^6 m^3/year. Considering the 2×10^9 m^3/year surface and 933×10^6 m^3/year groundwater potential in the basin, the total basin water potential was calculated as 2.933×10^9 m^3/year (Anonymous 2015).

The Meander River is both the main river in the basin and the longest river in the Aegean Region. This river originates from springs flowing from the plains between Sandıklı, Dinar, Çivril and Honaz in Western Anatolia. The Meander River is fed by the waters that fill Lake Işıklı. The river is fed by many tributaries (Anonymous 2018f). It takes the Banaz Stream from Uşak and the Çine Stream from Muğla and flows into the Aegean Sea. The average flow of the river is approximately 110 m^3/s. Since the river is mostly fed by winter precipitation, the highest flow rate is determined in January and February (average 164 m^3/s). In summer, the quantity of water that makes up the natural flow of the stream is very low (Yenici 2010).

The Banaz, Akçay, Kufi, Dokuzsele, Geyre (Dandalaz), Dipsiz, Çine and Hamam rivers can be listed as the most important rivers of the basin (Anonymous 2018f).

The natural lakes in the basin are Lake Bafa, Lake Işıklı and Lake Azap (Anonymous 2017).

Lake Bafa is a lagoon lake and is located in the southeast of the Meander Delta. The total area of the lake is 7 088 ha, its altitude is 10 m from the sea level, its circumference is 50 km and its distance to the sea is 17 km. The lake is characterised by its large and small island found within the waters of the lake. The main source feeding the lake is the Meander River (Anonymous 2017).

Lake Işıklı (Çivril Lake) is a 4 976 ha lake located in the south of Akdağ within the borders of the Çivril district of Denizli. In 1968, the western, southern and eastern shores of the lake were surrounded by a set; later, the lake became a dam lake. Lake Çivril is today used as a reservoir for large-scale irrigation in the surrounding plains (Anonymous 2017).

Lake Azap is popular destination for many domestic and foreign bird watchers, especially in the winter months, as it has a rich ecosystem where aquatic creatures such as the reed rat and the whitetail eagle inhabit. Although the total area covered by the lake is 166 ha, almost all of the lake had dried up by 2007; however, in 2008 the lake began to slowly fill up again (Anonymous 2017).

Yenici (2010) evaluated the measurement results at State Hydraulic Works (SHW) stations between 2003 and 2008 and determined the water quality of the basin according to the classes defined in the Water Pollution Control Regulation. When the analysis results of the samples taken from the stations in the Meander River Basin are evaluated; It has been stated that there is no class 1, that is, high quality water in the basin. It has been determined that the water quality in the basin is generally class 4.

One of the most significant problems faced in terms of water quality in the basin's rivers is the excessive organic matter, nitrogen, pH and heavy metal pollution and oxygen deficiency in the Gökpınar Stream originating from Denizli. An additional problem is the salinity added to the organic matter and nitrogen pollution in the Çürüksu Stream and the Meander River on the Denizli-Sarayköy-Kuyucak line. In addition, excessive organic matter and nitrogen pollution, salinity and oxygen deficiency originating from Uşak in the Dokuzsele Creek (before Banaz Stream) and significant salinity, organic matter and boron pollution in Gümüşçay (around Ortaklar-Söke) can be listed as significant issues faced (Anonymous 2015).

3.8. Western Mediterranean basin

The precipitation area of this basin is 20 956 km². The surface water resources of the Western Mediterranean Basin are largely composed of rivers including the Alakır Stream, Akçay, Demre Stream, Eşen Stream, Kargıcak Stream, Dalaman Stream, Yuvarlakçay Stream, Namnam Stream, Kazandere Stream, Kocaalan Stream, Değirmendere Stream, Kocaçay Stream, Gerin Stream, Batış Stream, Koca Stream, Sarıçay Stream, Hamzabey Stream, Kurbanlı Stream, Kandak Stream and Derince Stream (Anonymous 2018g). The population living in the basin is around 1.25 million.

Natural lakes in the Western Mediterranean Basin include Lake Köyceğiz, Lake Gölhisar, Lake Avlan, Lake Girdev, Kocagöl and Lake Yazır (Anonymous 2017).

Lake Köyceğiz is Turkey's 16th largest lake with an area of 52 km². It is situated 8 meters above sea level. The sulphur content of the lake water is high. The lake water, which is polluted by mixing with domestic wastewater, is also polluted by agricultural pollutants from the agricultural areas found around the lake. The salinity in the lake, which is connected to the sea, is very high in places, and the electrical conductivity varies between 4 dS/m and 65 dS/m (Ceviz 2020).

Lake Avlan, which serves as an important station on bird migration routes and has international importance, was completely dried in the 1970s in order to expand on the region's agricultural land. Agricultural activities were carried out in the lake area for a while, but as of 2001, water was started to be kept in the lake again in order to re-create the lake. Around 2004, the lake started to dry up again. It may even become impossible for fish to survive in the lake, which tends to dry out especially in summer. The area of the lake, which is one of the few reclaimed wetlands in the world, is currently 797 ha (Anonymous 2018h).

Lake Gölhisar has an area of 459 ha and is located in the Gölhisar District of Burdur Province. There is plenty of catfish fishing in the lake. The lake is situated 1000 meters above sea level and has a maximum depth of 10 meters and is surrounded by reeds. The lake is eutrophic and under the threat of drought (Anonymous 2017). The lake waters have C_2S_1 quality class and can be used for the irrigation of all cultivated plants with the exception of salinity sensitive plants (Anonymous 2018h).

Mumcular Dam is a dam built between 1986 and 1989 on Kocadere in Muğla for irrigation and drinking water purposes. The body volume of the earthfill dam is 986 000 m³, its height from the river bed is 32 m, the lake volume at a normal water level is 19.04x10^6 m³, and the lake area at a normal water level is 1.42 km². While the dam provides irrigation water to an area of 1 365 hectares, it also provides drinking water at 10x10^6 m³ per year.

Alakır Dam is a dam built between 1967 and 1971 for irrigation and flood control purposes on the Alakır Stream in Antalya. The body volume of the dam, which is a rock body fill type, is 1.6x10^6 m³, its height from the river bed is 44.5 m, the lake volume at a normal water level is 91.75x10^6 m^3, and the lake surface area at a normal water level is 4.28 km². It provides irrigation water to an area of 3 262 hectares.

Çayboğazı Dam is a dam built between 1996 and 2000 for irrigation purposes on the Çayboğazı Stream in Antalya. The body volume of the dam, which is an earth body fill type, is 10.7x10^6 m³, its height from the river bed is 79 m, the lake volume at a normal water level is 56x10^6 m³, and the lake area at a normal water level is 2.25 km². The dam provides irrigation water to an area of 13 848 hectares.

Yapraklı Dam is a dam built between 1985 and 1991 for irrigation purposes on Horzum Stream in Burdur. The body volume of the dam, which is an earth body fill type, is 1.6x10^6 m³, its height from the river bed is 70 m, the lake volume at a normal water level is 113x10^6 m³, and the lake area at a normal water level is 6.5 km². The dam provides irrigation water to an area of 19 576 hectares.

Çavdır Dam is a dam built between 1993 and 1996 for irrigation purposes on the Bayır Stream in Burdur. The body volume of the dam, which is a rock body fill type, is 2.6x10^6 m³, its height from the river bed is 60 m, the lake volume at a normal water level is 36.42x10^6 m³, and the lake area at a normal water level is 1.94 km². The dam provides irrigation water to an area of 4 254 hectares.

Belkaya Dam is a dam built between 1993 and 2003 for irrigation purposes on the Aksu Stream in Burdur. The body volume of the dam, which is an earth body fill type, is $1.4x10^6$ m³, its height from the river bed is 68 m, the lake volume at a normal water level is $56x10^6$ m³, and the lake area at normal water level is 5.2 km². The dam provides irrigation water to an area of 4 545 hectares. The dam water is in the C_2S_1 class in terms of quality.

Geyik Dam in the same basin is a dam built for the purposes of drinking water between 1986 and 1988 the Sarıçay in Milas district of Muğla. The body volume of the dam, which is a rock body fill type, is 260 000 m³, its height from the river bed is 41 m, the lake volume at a normal water level is $40.8x10^6$ m³, and the lake area at a normal water level is 3.74 km². The dam provides $38x10^6$ m³ of drinking water per year and serves the Yeniköy Thermal Power Plant between Milas and Ören.

Akgedik Dam is a dam constructed for irrigation purposes on the Sarıçay in Muğla. The dam has a rock body filling type with a height of 51 m above the river bed and a lake volume of 31 hm³ at a normal water level. The drainage area is approximately 93 km^2 (Aydın & Aydın 2006).

The annual average flow amount in the Western Mediterranean Basin is $7.11x10^9$ m^3 (9.97 L/s/km^2), constituting 3.87% of Turkey's surface water potential. The usable part of this water is estimated to be $3.555x10^9$ m^3/year. The groundwater operating reserve of the Western Mediterranean Basin is $317x10^6$ m^3/year, and the groundwater potential is $473x10^6$ m^3/year. Considering the $7.11x10^9$ m^3/year surface and $473x10^6$ m^3/year groundwater potential in the basin, the total water potential was calculated as $7.583x10^9$ m^3/year. The usable water potential of the basin is calculated as $3.872x10^9$ m^3/year, considering $3.555x10^9$ m^3/year usable surface water and $317x10^6$ m^3/year groundwater operating reserves (Anonymous 2015).

The waters of the Western Mediterranean Basin are in the 1st and 2nd classes in terms of COD and BOD. However, it is designated as class 3 in terms of COD and BOD at the Mumcular and Geyik Dam outlets, and class 3 in terms of BOD at the Akgedik Dam outlet. In terms of ammonium nitrogen (NH_4-N), the waters in the basin are in the 1st and 2nd class quality, while in terms of nitrate nitrogen (NO_3-N), the waters in the basin are in the 1st class. In terms of nitrite nitrogen (NO_2-N), although most station values are in the 1st or 2nd class, this parameter is in the 3rd and 4th class levels in the Çavdır Stream, Dalaman Stream, Namnam Stream, Sarıçay Stream, Kocadere Stream, Esen Stream and Hamzabey Stream. The total phosphorus (TP) parameter is not measured at most stations, but is at the 2nd class level in the Çavdır and Dalaman Streams and Başpınar springs (Anonymous 2015).

3.9. Antalya basin

The precipitation area of the Antalya Basin is 20 249 km² with an average precipitation value of the basin is 973.7 mm. The total annual average water potential of the Antalya Basin is over $10x10^9$ m^3. This potential is approximately 30% higher than the water potential of the Seyhan Basin, which is approximately 22 000 km², and the Yeşilırmak Basin, which is approximately 38 000 km². These data are indicative of the high water yield of the Antalya Basin (Anonymous 2016). The population of the basin area is recorded to be more than 2 million.

The annual average flow for Antalya Basin is $13x10^9$ m^3 (27.96 L/s/km^2), constituting 6.97% of the total runoff in the basins. The usable quantity of this water is estimated as $6.5x10^9$ m^3/year. The groundwater potential of Antalya Basin is $1.1x10^9$ m^3/year, and the groundwater operating reserve is $526x10^6$ m^3/year. Considering the $13x10^9$ m^3/year surface and $1.1x10^9$ m^3/year groundwater potential in the basin, the total water potential is calculated as $14.1x10^9$ m^3/year. The usable water potential of the basin is expressed as $7.03x10^9$ m^3/year, taking into account $6.5x10^9$ m^3/year usable surface water and $526x10^6$ m^3/year groundwater operating reserves (Anonymous 2015).

The most important rivers of the region are the Köprüçay River, Manavgat River, Aksu Stream, Alara Stream, Kargı Stream, Dim Stream, Karpuz Stream, Acısu Stream, Sarısu Stream, Kömürcüler and Ilıca streams.

The largest and most important lake of the basin is Lake Eğirdir, followed by Lakes Kovada, İlvat and Dipsiz.

Lake Eğirdir is in the Western Mediterranean part of Turkey, within the borders of the province of Isparta, surrounded by the districts of Eğirdir, Senirkent, Yalvaç and Gelendost. Lake Eğirdir has an area of 45 633 ha of tectonic origin extending in the north-south direction, in the north of the Eğirdir district. Lake Egirdir is considered as a hot spot because it is used as a drinking water source.

The surface area of Kovada Lake is 929 hectares. The water entering Lake Kovada through a channel is taken through a bypass channel and given to the hydroelectric power plant channel. For this reason, when the water input to the lake decreased, the lake level decreased.

Oruçoğlu & Beyhan (2019) evaluated the water samples taken monthly in 2016 in the Lakes Region of Turkey and located within the borders of the 18th Regional Directorate of State Hydraulic Works, in accordance with the Water Pollution Control

Regulation in force. In the results of working, it has been reported that Lakes Eğirdir and Kovada have 1st class water quality in terms of their freshwater characteristics.

When the Antalya Basin is evaluated in terms of its water quality in general, the quality of the water resources in the basin is predominantly less polluted water quality (Anonymous 2015).

The most important factor in the decrease in the water quality of the basin is the wastewater discharged without domestic treatment. Activities such as nitrogen and phosphorus fertilizer applications used for agricultural activities and cage fishing in the lakes negatively affect the water quality in the basin (Anonymous 2018i).

Within the scope of the Antalya Basin Drought Management Plan, 1 of the 46 stations evaluated in the basin in terms of irrigation water quality is 1st class, 4 of them are 3rd class, and the remaining 41 stations have been designated 2nd class. Since two of the four stations designated as 3rd class irrigation water are found to be effluent downstream of the wastewater treatment plant, the other two stations are of low quality because of their high electrical conductivity values due to their being fed from karstic sources and coastal water intrusion.

Half of the Antalya Basin groundwater reserve has been determined as the safe groundwater reserve for the entire basin. Groundwater use in the basin is produced through wells. In places where there is no surface water source, agricultural irrigation is completely dependent on groundwater (SHW 2016).

The groundwater recharge of basins occurs in three basic ways: by direct infiltration from the surface during and after precipitation, by infiltration from water transmission and distribution lines, and by groundwater from neighboring basins. In this case, the total groundwater reserve in the Antalya Basin can reach $4.3x10^9$ m³/year, which is higher than the known the operable amount (SHW 2016).

3.10. Burdur closed basin

The Burdur Closed Basin is the second smallest basin in Turkey comprising 6 294 km². The annual precipitation of the basin is 508.7 mm (Anonymous 2019b). In terms of population, it is the lowest recorded population area with 214 715 inhabitants.

The annual average flow for the Burdur Closed Basin is $250x10^6$ m^3 (0.91 L/s/km^2), constituting 0.14% of Turkey's surface water potential. The usable part of this water is $125x10^6$ m^3/year. The groundwater operating reserve of Burdur Closed Basin is $43x10^6$ m^3/year and its groundwater potential is $57x10^6$ m^3/year. Considering the $250x10^6$ m^3/year surface and $57x10^6$ m^3/year groundwater potential in the basin, the total water potential was calculated as $307x10^6$ m^3/year. The usable water potential of the basin is determined as $168x10^6$ m^3/year considering $125x10^6$ m^3/year usable surface water and $43x10^6$ m^3/year groundwater operating reserves (Anonymous 2015).

The regimes of the streams in the basin are quite irregular; streams in the basin include the Bozçay (Eren) Stream, Değirmen Stream, Sarı Stream, Yayla Stream, Domuz (Elmacık) Stream, Menevşeli (Kent) Stream, Özdere Stream, Karapınar Stream, Ulupınar Stream, and Çolakboğazı Stream (Anonymous 2019b).

The lakes in the Burdur Closed Basin include Lake Burdur, Lake Salda, Lake Acıgöl, Lake Sıralı and Lake Karataş.

Lake Burdur is one of the important lakes of the basin and is located between the provinces of Burdur and Isparta. The average lake area is 20 311 ha with an altitude of 857 meters. Lake Burdur is structurally tectonic and mesotrophic - eutrophic in terms of eutrophication. The water of Lake Burdur is insuitable for drinking, domestic, industrial and agricultural use. Due to the high sodium, sulfate and chloride content in its water, plant species diversity is low and only a few species of fish inhabit the lakes waters. The salinity rate is high and the Burdur toothed carp has adapted to it.

Lake Salda is a slightly salty tectonic lake surrounded by forest-covered hills, rocky lands and small alluvial plains, with a surface area of 4 451 ha. The waters of the streams feeding the lake are used for the irrigation of agricultural lands in the basin.

Acıgöl, located in the Çardak district of Denizli province. Acıgöl is the second saltiest lake in Turkey after Lake Salt. Intensive agriculture is conducted on the plain in the Başmakçı region. The lands around the lake, especially the eastern and northeastern shores, are used as pasture.

Lake Yarışlı is a shallow lake with high sodium phosphate, sodium chloride and sodium sulfate concentrations. The lake is surrounded by agricultural areas where cereals and poppies are cultivated in the west and north. The natural vegetation around the lake has been removed by converting it into agricultural land. Wind and water erosion have become a significant problem in the agricultural lands around the lake, and have been caused by inappropriate agricultural practices. Fresh water resources feeding the lake are used in agricultural irrigation.

Lake Karataş is located in the south of Burdur province and northeast of Tefenni Plain. The lake is a shallow freshwater lake with a surface area of 526 ha. In addition to agriculture, commercial fishing is practiced on the lake. The most significant problem of the lake is its insufficient water level due to the lack of precipitation and the drying up of the sources feeding the lake (Anonymous 2017).

3.11. Akarçay basin

The Akarçay Basin is the 4th smallest basin constituting 7 995 km², and the 3rd least populated basin with a population of 725 568 (Tüik 2019).

The average precipitation value of the Akarçay Basin is 436.1 mm/year. The Akarçay Basin is a very poor basin in terms of surface and groundwater resources. It is important to know the characteristics of the sub-basins for both water management and land use. The Akarçay Basin is studied as two sub-basins. The area where the Akarçay river starts from the point where it originates and flows into the Eber Lake is defined as the Upper Akarçay (Eber) Sub-Basin. This upper basin (Lake Eber Basin) covers an area of 5 660.5 km^2. The second sub-basin located further down is the Lower Akarçay (Akşehir) Basin, which can be defined as the branches feeding Lake Akşehir and the area surrounded by these branches. This sub-basin area is approximately 2 334.5 km^2 (Anonymous 2019c).

The annual average flow in the Akarçay Basin is $260x10^6$ m^3 (0.97 L/s/km^2), constituting 0.14% of Turkey's surface water potential. The usable part of this water is estimated as $130x10^6$ m^3/year. The groundwater potential of the Akarçay Basin is $188x10^6$ m^3/year, and the groundwater operating reserve is $182x10^6$ m^3/year. Considering the $260x10^6$ m^3/year surface and $188x10^6$ m^3/year groundwater potential in the basin, the total water potential is calculated as $448x10^6$ m^3/year. Considering the $130x10^6$ m^3/year usable surface water and $182x10^6$ m^3/year groundwater operating reserves, it has been recorded that the usable water potential of the basin is $312x10^6$ m^3/year (Anonymous 2015).

The important streams of the basin are the Akarçay River, Aksu (Araplı) Stream, Seydiler (Kuruçay) Stream, Çayözü Stream and Kali Stream (Anonymous 2019c).

The main source of the Akarçay River is the Aksu (Arablı) Stream. The waters of the Seyitler (Kuruçay) Stream originating from the north, the Çayözü Stream waters originating from the north and the Kali Stream waters originating from the south join the Akarçay River and disembogues into Lake Eber (Anonymous 2019c).

Kıvrak et al. (2012) took water samples every month from March to December 2008 at four different stations to determine the water quality of the Akarçay. Their analyses of the water samples found that the pH of the river was between 7.4 and 8.7. They stated that this fluctuation in pH values was caused by the effect of pollution rather than the geological structure. The electrical conductivity values of the samples were found to be generally high in all stations during the summer months. In particular, the electrical conductivity and water temperature were recorded at a record level at the 2nd station. In this station, their research found that the thermal facilities' discharge of waste water to the Akarçay River had a significant effect on the increase in the electrical conductivity and temperature of the river water at this station. They found that the high EC values at other stations were closely related to the levels of pollution in the river by domestic and industrial waste.

The natural lakes in the basin are Lakes Eber and Akşehir. Lake Eber is an important source of irrigation and drinking water in the southwest of Turkey and is also a 1st Degree Natural Protected Area. It is a tectonic lake with an altitude of 966 m, located 65 km from the city center of Afyonkarahisar. The most important source feeding Lake Eber is the Akarçay River. Gümüş et al. (2020), determined the average conductivity value of the lake to be 1.740 (0.697-2.590 dS/m).

While Lake Eber used to be a single large lake that included the waters of Lake Akşehir; with the decrease of water resources over time, Lake Akşehir was separated from Lake Eber and formed a separate lake. It still transfers water from Lake Eber to Akşehir Lake through a channel. Today, with the effect of global warming and especially the unconscious use of water resources, the lake has begun to shrink in size. For this reason, the water flowing into Lake Akşehir was stopped, which caused the waters of Lake Akşehir to be withdrawn. For this reason, the lake, which is one of the most beautiful lakes in Turkey, is in danger of drying out.

Lake Akşehir, like Lake Eber, is located in the depression area between the Sultan Mountains and Mount Emir. It is located 10.2 km away from the Akşehir District and is the fifth largest lake in Turkey. Administratively, it is located within the borders of Konya and Afyonkarahisar provinces. Since it is in a closed basin, it has no outflow (Elmacı & Obalı 1998).

Lakes Eber and Akşehir, which form the downstream of the Afyonkarahisar-Akarçay Basin, which is a bowl basin, are not suitable for drinking and domestic use of water quality. COD and BOD values, which are important parameters indicating organic pollution in the Akarçay Basin, are predominantly of class 4 quality. When the basin is evaluated in terms of water quality in general, it is deemed to be dirty or very polluted (Anonymous 2015).

3.12. Sakarya basin

The Sakarya Basin is the third largest basin constituting 6 3303 km². Ankara, the second most populous city of Turkey, is located in this basin, and the total municipal population in the basin is 7 034 906. The annual average precipitation value of the basin is 850.2 mm (Anonymous 2019d).

The average annual flow value of the Sakarya Basin is $5.02x10^9$ m^3 (2.82 $L/s/km^2$), which corresponds to 2.73% of Turkey's surface water potential. The usable part of this water is estimated to be $2.51x10^9$ m^3/year. The groundwater potential of the Sakarya Basin is recorded as $2.192x10^9$ m^3/year, with a groundwater operating reserve of $1.519x10^9$ m^3/year. Considering the $5.02x10^9$ m^3/year surface and $2.192x10^9$ m^3/year groundwater potential in the basin, the total water potential has been calculated as $7.21x10^9$ m^3/year. The usable water potential of the basin has been determined to be $4.03x10^9$ m^3/year considering $2.51x10^9$ m^3/year usable surface water and $1.519x10^9$ m^3/year groundwater operating reserves (Anonymous 2015).

There are many streams in the Sakarya Basin. The waters of these streams flow into the Black Sea via the Sakarya River. Important streams feeding the Sakarya River include the Porsuk Stream, Kirmir Stream, Ankara Stream, Mudurnu Stream, Seydi Stream, Göksu Stream, Gökpınar Stream, Aladağ Stream, Karasu Stream, Göynük Stream, Çark Stream, Bardakçı Stream, Ilıcaözü Stream, Nallıdere Stream, Çatak Stream and Değirmendere Stream (Anonymous 2019d).

Lakes in the Sakarya Basin include Lake Mogan, Lake Poyrazlar, Lake Ilgın, Lake Eymir, Lake Taşkısığı, Lake Balıkdamı, Lake Çubuk, Lake Sünnet, Lake Uyuz, Lake Sapanca, Lake Akgöl, Lake Küçük Akgöl and Lake Acarlar (Anonymous 2017).

Lake Mogan is situated 17 km south of Ankara. The altitude of the lake is 972 m above sea level, the lake area at a normal water level is 6.64 km^2, the average depth of the lake is 3-5 m, and the lake volume at a normal water level is $13.34x10^6$ m^3. The groundwater recharge of Lake Mogan is quite low, and the water inflow is through streams with an irregular regime, which typically dry up in the summer months. Lake Mogan is situated within the Gölbaşı Special Environmental Protection Area and is also one of the important bird areas in the country nominated for Ramsar (Anonymous 2017).

Lake Sapanca takes its name from Sapanca, the town of Sakarya in the south. Lake Sapanca, one of the few lakes in the world with high quality drinkable features, is the only source of drinking and domestic water for Sakarya Province and an important source for Kocaeli Province. The surface area of the lake is 4 771 ha, the surface altitude is 31 m above sea level, and the deepest point is 61 m. Lake Sapanca, which has a precipitation area of 252 km^2, has an average of 75 cm level change per year. During the rainy months of the year, the covers of the Çark Creek are opened and the level of the lake is kept in balance. Sapanca Lake is an important wetland where tens of thousands of migratory birds stay migrate to every year, as well as being a source of drinking and utility water (Anonymous 2017).

In terms of COD and BOD, which are important parameters that show organic pollution in the Sakarya Basin, the waters of the Porsuk Stream, Karasu Stream and Çarksuyu Stream and Kalburt Göksu Stream are predominantly of the 4^{th} class (highly polluted water), while the waters of the Sakarya River and its other branches are deemed 2^{nd} class (less polluted water) or 3^{rd} class (dirty water). In terms of NH_4-N, which is one of the important nitrogen parameters, the waters of the Porsuk Stream, Karasu Stream and Çarksuyu Stream are in the 4^{th} class, and the water of the Kalburt Göksu Stream and the creeks feeding it varies between 2^{nd} and 4^{th} class. In the Sakarya River and its other branches, the pollution level is predominantly at a 2^{nd} class level. In terms of NO_3-N parameter, the basin in general is predominantly class 1 (clean water) quality. However, nitrate pollution at the 3^{rd} and 4^{th} class levels was determined at the stations in the Çubuk Stream, Sukesen Stream, Kadıköy Stream and Bayındır Stream. In terms of total phosphorus parameter, while the waters in the Sakarya River were 1^{st} and 2^{nd} class before the addition of the Porsuk Stream, it turns becomes 3^{rd} class water after the addition of the Porsuk Stream. After the addition of the Ankara Stream, the waters become more polluted and take the 4^{th} class feature. After the addition of Karasu and Kalburt Göksu Streams, it was determined that the water quality improved slightly and turned could be deemed to be of a 3^{rd} class level.

In terms of total phosphorus, the Porsuk Stream shows grades ranging from 2 to 4, but before the Porsuk Dam and before the Sakarya River, the quality completely turns into 4^{th} class pollution. The total phosphorus was determined to be class 4 in the Ankara Stream, Karasu Stream, Kalburt Göksu Stream and Çarksuyu Stream. In other branches, it is typically at the 1^{st} and 2^{nd} class levels. When the basin is evaluated in terms of water quality in general, it can be said that the Sakarya River and the important streams that feed it, the Porsuk Stream, Karasu Stream, Çarksuyu Stream, Kalburt Göksu Stream, Ankara Stream and Çubuk Stream have polluted or very polluted water quality in terms of different parameters. The Sakarya River, especially after the addition of the Porsuk and Ankara Streams, shows dirty or very polluted features in terms of organic matter, ammonium nitrogen, total phosphorus as well as conductivity, inorganic parameters, boron and certain metals (Anonymous 2015).

3.13. Western black sea basin

The Western Black Sea Basin has a precipitation area of 28 855 km² and an annual precipitation level of 774.05 mm (Anonymous 2019e). The basin is the 5^{th} most populated basin in Turkey with a population of approximately 3.8 million.

The annual average flow value of the Western Black Sea Basin is 9.36x109 m3 (9.99 L/s/km2), constituting 5.09% of Turkey's surface water potential. The usable part of this water is estimated to be 4.68x109 m3/year. The groundwater operating reserve of the Western Black Sea Basin is recorded as 412x106 m3/year, with a groundwater potential of 416x106 m3/year. Considering the 9.36x109 m3/year surface and 416x106 m3/year groundwater potential in the basin, the total water potential is 9.78x109 m3/year. Considering the 4.68x109 m3/year usable surface water and 412x106 m3/year groundwater operating reserves, usable water was determined as 5.09x109 m3/year (Anonymous 2015).

The streams in the Western Black Sea Basin include the Filyos Stream, Bartın River, Ovaçayı and İnönü Streams, Küçük Melen Stream, Asar Stream, Uğur Stream, Aksu Stream, Büyük Melen Stream, Gülüç Stream, Devrek River, Alaplı River, Üzülmez Stream and Kozlu Stream (Anonymous 2019e).

The natural lakes in the basin include Lake Abant, Lake Sarıkum, Lake Yeniçağa and Lake Efteni.

Lake Abant, located 30 km southwest of Bolu in the Western Black Sea region, is a landslide set lake in terms of formation. The lake is located at an altitude of 1 345 m above sea level, its maximum depth is 18 m and its surface area is 125 ha. Lake Abant was taken under protection on October 21, 1988 by the National Parks Law No. 2873 dated 9 August 1983 and declared a "Nature Park" (Atıcı & Obalı 2002; Müderrisoğlu et al. 2005).

Lake Sarıkum is located between Sinop and Ayancık. The lake is a lagoon lake and its depth varies between 0.5-1 m. The entire area of the lake comprises 785 ha, and the lake surface area, which is especially important as a habitat for waterbirds, is 102 ha, as well as a swamp area of 82 ha. The lake was declared a 1st Degree Natural Protected Area in 1991 (Yılmaz 2005). The Black Sea climate effect is observed in the region (Özkoç et al. 2019).

Hasançavuşoğlu & Gündoğdu (2021) reported that the physico-chemical structure of Lake Sarıkum deteriorated due to the discharge of domestic wastewater into the lake and the natural and artificial fertilizers used in the agricultural areas around the lake entering the lake. In addition, they stated that there was an increase in the level of salinity due to the mixing of sea water with lake water from the connection channel of the lake and the sea.

Lake Yeniçağa is located in the Yeniçağa district of Bolu. The lake is of great economic importance because of fishery. Tunca et al. (2012) measured the EC value of the lake as 0.439 dS/m in their study.

Lake Efteni, located in the southwest of Düzce city center and 14 km away from the center, is located at 40º45' N latitude – 31º 03' E longitude. Lake Efteni wetland is within the drainage area of the Düzce plain formed by the Melen Stream and many surface waters of the Melen Sub-basin within the Western Black Sea Basin. The elevation of the area above sea level is approximately 115 m. The lake area decreases to 5 km^2 when the waters recedes, and it can reach up to 25 km^2 in times of flooding. The lakes water is recorded as being in the "medium saline waters" class and can be used for irrigation puposes, and are of the "C2S1" class (Şener & Kırlangıç 2014).

Many water sources in the Western Black Sea Basin are classified as either 1st (clean) or 2nd (less polluted) in terms of COD and BOD, which are important parameters indicating organic pollution. In terms of COD parameter, the Gerede Stream is in the 3rd class (dirty water) in the Bahçedere region. However, in terms of BOD parameter, the Gerede Stream, Büyüksu Stream, Devrek Stream, Markusa Stream, Mudurnu Stream, Ulusu Stream and Zonguldak Acılık Stream are in the 3rd or 4th Class, that is, in the polluted or highly polluted water class. When the basin is evaluated in terms of water quality in general the water resources in the basin consist of 4th class, 3rd class and 2nd class waters. However, due to parameters such as iron, ammonium nitrogen, nitrite, total phosphorus, dissolved oxygen, sodium, chloride and sulfate, the water quality in some of the above-mentioned streams is classified as contaminated or very polluted (Anonymous 2015).

3.14. Yeşilırmak basin

The Yeşilırmak catchment area is 39 595 km² with a population of around 3 million. The rivers in the region include the Yeşilırmak River, Çekerek River, Tersakan Stream, Kelkit Stream, Abdal River, Kürtün River, Engiz Stream and Derinöz Stream (Anonymous 2015a).

According to the data from the General Directorate of Meteorology, the Yeşilırmak Basin has an annual precipitation value of 646 mm (Kale 2018). The annual average flow in the Yeşilırmak Basin is 5.28x10^9 m^3 (4.63 L/s/km^2), constituting 2.87% of Turkey's surface water potential. The usable part of this water is 2.64x10^9 m^3/year. The groundwater potential of the Yeşilırmak Basin is 609x10^6 m^3/year and the groundwater operating reserve is 456x10^6 m^3/year. Considering the 5.28x10^9 m^3/year surface and 609x10^6 m^3/year groundwater potential in the basin, the total water potential is 5.9x10^9 m^3/year. The usable water potential of the basin is calculated as 3.1x10^9 m^3/year considering the 2.64x10^9 m^3/year usable surface water and 456x10^6 m^3/year groundwater operating reserves (Anonymous 2015).

The number of dam lakes in the Yeşilırmak Basin is high. The most important of these are the Hasan Uğurlu, Almus, Çakmak, Kılıçkaya, Süreyyabey and Koçhisar dam lakes. These dam lakes meet the demand for irrigation, drinking, industrial and utility water in addition to hydroelectric power generation.

The natural lakes in the basin are Lakes Ladik and Simenli. Winter precipitation waters stored in lake Ladik are left to the Tersakan River from the regulator on the outlet side in summer and used in Amasya-Suluova irrigation project area. The water altitude of the lake varies between 861 m and 867 m. The lake waters are fed by waters flowing from Akdağ, which is located at an elevation of 2 050 m, and by side streams.

One of the most significant problems in terms of surface water pollution in the Yeşilırmak Basin is that the Tersakan and Çorum Streams are highly polluted in terms of organic matter and ammonium nitrogen due to the wastewater discharges they are exposed to. There is significant organic matter pollution in the Boğazköy area, which is close to the downstream of Tersakan Stream, especially before it confluence with Yeşilırmak. Pollution load concentration becomes even more evident during dry periods. In addition, dissolved oxygen, sulfate, total dissolved matter, sodium, chloride, nitrate and phosphate pollutants are also present in the Çorum Stream (Anonymous 2015).

3.15. Kızılırmak basin

The Kızılırmak Basin is the second largest basin with an area of 82 181 km². With a population of 4 million inhabitants, it is the 4th most populated basin in Turkey (Anonymous 2010a).

More than one climate is effective in the basin due to its coverage and location over a wide area. The average annual precipitation of the basin is 435.6 mm with an average annual flow of 6.12 km^3. The circumference of the basin is 3 546 km and the length recorded as 293 km (Anonymous 2019f).

The annual average flow value of the Kızılırmak Basin is 5.18x10^9 m^3 (2.09 L/s/km2) and constitutes 2.82% of Turkey's surface water potential. The usable part of this water is 2.59x10^9 m^3/year. The groundwater operating reserve of the Kızılırmak Basin is 1.02x10^9 m^3/year and the groundwater potential is 1.36x10^9 m^3/year. Considering the 5.18x10^9 m^3/year surface and 1.36x10^9 m^3/year groundwater potential in the basin, the total water potential becomes 6.54x10^9 m^3/year. The usable water potential of the basin is 3.61x10^9 m^3/year considering the 2.59x10^9 m^3/year usable surface water and 1.02x10^9 m^3/year groundwater operating reserves (Anonymous 2015).

The longest of the Turkey's rivers, the Kızılırmak River has a length of 1 151 km and discharges the waters of an area of 78 180 km² into the Black Sea (Anonymous 2010a). There is no known issues with the chemical properties of the waters from the İmranlı district, where the Kızılırmak originates, to the borders of Zara district. However, after Hafik, due to the presence of gypsum and salt minerals and the addition of its southern branches (Tuzlasuyu Stream, Yavşanlı Stream, İslim Stream and Fadlum River), the chemical structure of the water changes and becomes quite salty. The waters of the Kızılırmak River is generally in the 3rd and 4th classes in terms of irrigation water quality (Koç et al. 2018).

The most important streams of the Kızılırmak Basin are the Delice River, Gökırmak Stream and Devres Stream, which collects the waters of the mountainous northern part (Anonymous 2010a).

There are a large number of rivers and streams in the Kızılırmak Basin: those with a than 20 km in the basin include the Gökırmak River, Kanak Stream, Karasu Stream, Acısu Stream, Delice Stream, Devrez Stream, Mısmıl Stream and Tecer Stream.

Important lakes in the Kızılırmak Basin include the Sultansazlığı Marshes and Lake Tuzla (Palas). Sultansazlığı is one of the 14 wetlands of the country; in 1994 it was declared a Ramsar Site and later registered as a National Park on 17/03/2006 and taken under protection (Anonymous 2017).

Lake Tuzla (Palas) is covers an area of 2 387 ha in the Palas Plain, 40 km northeast of Kayseri. The important water resources of this lake include the Değirmen, Yertaşpınar, Körpınar, Başpınar and Soğukpınar streams. The lake was declared a first degree natural protected area in 1993 and has also been registered as a wetland of national importance (Anonymous 2017).

The most important source of pollution in the Kızılırmak Basin are natural resources. Due to the geological factors arising from the source of the river and the land it passes through, there is a high amount of salt and sulfate in the Kızılırmak River water. The Kızılırmak River water is unsuitable for use as drinking and irrigation water or for industrial use, with the exception of the upstream section, which does not have a gypsum area. In addition, arsenic found in the territory of the region where the river passes through is also carried into the river, negatively affecting the water quality. In addition to Kızılırmak, the water sources of Seyfe and Göydün in the Sivas region and Lakes Hafik, Tödürge and Lota are also exposed to salt and sulfate pollution by natural means (Anonymous 2017).

The Kızılırmak River is in the 1st or 2nd class in terms of COD, which is one of the organic parameters. The waters along the main river are in the 2nd and 4th class for nitrogen parameters (NH_4–N), 3rd and 4th classes in terms of NO_2-N, and 1st and 2nd classes in terms of NO_3-N. The river waters are between 2nd and 4th classes in terms of total phosphorus parameter. In terms of sodium, chloride, nitrite and sulfate, which are salinity factors, it ranks 3rd 4th class and is in the 2nd or 3rd class in terms of total dissolved matter (Anonymous 2015).

3.16. Konya closed basin

The Konya Closed Basin is the fifth largest basin with an area of 49 930 km². The annual precipitation average in Konya Closed Basin is recorded as 454 mm. The estimated total surface flow of Konya Closed Basin is $4.9x10^9$ m^3 per year, including surface and groundwater bodies. A very large part of this water ($4.7x10^9$ m^3) is used in the basin. Of the used part, $4.43x10^9$ m^3 is used for irrigation, $0.2x10^9$ m^3 for residential use and $0.07x10^9$ m^3 for industry (Anonymous 2018j). As can be seen, the amount of irrigation water used in the basin corresponds to 94% of the total usable water. The population of the Konya Closed Basin is about 2.6 million people.

Located in the southwest of the Konya Closed Basin, in the province of Konya, the Çarşamba Stream is one of the most important streams in the basin. The Çarşamba Stream joins the Beyşehir Canal near Pınarcık village on the east side and flows into Lake Beyşehir. The Melendiz Stream, originating from the Melendiz Mountains in Aksaray, is another important stream of the Konya Closed Basin. After merging with the Belisırma and Ilısu streams, it pours into Lake Salt. The Mamasın Dam Lake, which is the most important water source of Aksaray and meets the drinking water and irrigation water needs of the province, was built on the Melendiz Stream (Anonymous 2018j).

Lakes in the Konya Closed Basin include Lake Salt, Lake Beyşehir, Lake Hotamış, Lake Uyuz, Lake Tersakan, Lake Kozanlı, Lake Samsam, Lake Meke, Lake Akgöl, Lake Bolluk and Lake Düden (Anonymous 2017).

Lake Salt, which is the second largest lake in Turkey, is 940 m above sea level, 80-100 km long, 20-25 km wide, and covers an area of 193 946 ha. The waters that feed the lake are streams whose waters decrease or completely dry up in the summer months. Lake Salt, which is a class A wetland according to international criteria, is fed by the Peçeneksuyu Stream passing through Şereflikoçhisar in the east, the Bağlıca and Kırkdelik streams entering the lake from Eskil in the south, the Tersakan Stream in the southwest and the İnsuyu Stream coming from Cihanbeyli in the west. The growing population in Konya and its vicinity, industrial facilities established without wider considerations of the environmental impact, direct discharge of sewage wastes into Lake Salt and pollution from agricultural lands are the main factors threatening the future of the lake (Anonymous 2017).

Lake Beyşehir is the third largest lake in Turkey. It is the largest natural lake in terms of fresh water reserve and is 69 086 hectares wide. In addition, it is a tectonic depression lake and was formed in the northern part of the Beyşehir, Seydişehir and Bozkır depression basin. The lake, which was formed between two fault breaks of the Taurus Mountains, is located in the depression area of the earth's crust in the third geological time. Its average altitude above sea level is around 1 124 m. This height rises to a maximum of 1 126 m in a periodic time frame, and decreases to a minimum of 1 121 m, resulting in a level difference of 5 m in the lake. The 88 750 ha area in and around Beyşehir Lake has been taken under protection as a National Park with the decision of the Council of Ministers dated 11/01/1993. It was also approved as a wetland protection zone in 2007 and entered into force. The water level of the lake has been gradually decreasing due to insufficient rainfall and excessive water withdrawal from the lake. As a freshwater lake, Lake Beyşehir is used as a source of drinking and irrigation water. Agricultural water is drawn from the lake through the Çarşamba Canal, which was built to irrigate the Konya Plain, and other irrigation canals and wells. The drinking water needs of 19.6% of the basin's population are met by the lake (Anonymous 2017). Şener and Taştekin, in their 2019 study, stated that the electrical conductivity (EC) values of Lake Beyşehir varied between 0.388-0.868 dS/m, and the SAR values calculated using the results of the analysis of the waters in the study area were generally between 0.04-0.29 and % Na values between 1.14-9.09.

While Lake Hotamış was a 13 615 ha wide and dense reed-covered lake located between Karapınar and Çumra counties in Konya Province, it started to dry up in the early 2000s when the water channels coming to the lake were directed to Lake Salt. Today, the lake has completely dried up and the lake area has been opened to agriculture. During the rainy seasons, only a small area between Adakale and Sürgüç villages accumulates water, and this place dries up during the summer months (Anonymous 2017).

Lake Meke is another lake that has since dried up. Lake Acı, on the other hand, is a lake with a significant decrease in water level, although it is a very deep lake. The lake waters contain high levels of magnesium and sulfate and the salinity is considered to be very high. No fish inhabit the lake water, but the lake is a wetland for birds.

The Peçenek Stream one of the streams feeding the Konya Closed Basin and Lake Salt subbasin, carries domestic pollution originating from the district of Şereflikoçhisar. The Peçenek dam lake waters are in the 2nd Class in terms of NH_4-N and NO_3-N. According to group A parameters (physical and inorganic pollutants), the lake waters are in the 4th class in terms of NO_2-N, in the 3rd class in terms of group B parameters (organic) and in the 2nd class in terms of group C parameters (inorganic pollution). The Pınarbaşıözü (İnsuyu) Stream waters passing through the Cihanbeyli district are in the 3rd class in terms of NH_4-N and in the 2nd class in terms of NO_3-N. Stream waters are in the 4th class in terms of A parameters (NO_2-N), 4th class in terms of B parameters (COD-BOD), and 4th class in terms of C parameters (Boron class determining parameter) (Anonymous 2015).

3.17. Eastern mediterranean basin

The Eastern Mediterranean Basin covers the area between the Antalya, Seyhan and Closed Konya Basins in the south of Turkey, which disembogues its waters into the Mediterranean along with the Göksu River and some other streams. The Eastern Mediterranean Basin consists of the area between the Sedir Stream in the east of Alanya and the Tarsus River in the East (Anonymous 2017).

The Eastern Mediterranean Basin has an area of 21 150 km². The annual average flow in the Eastern Mediterranean Basin is $9.46x10^9$ m^3 (13.34 $L/s/km^2$) and covers 5.15% of Turkey's surface runoff potential. The usable part of this water is estimated to be $4.73x10^9$ m^3/year. The groundwater operating reserve of the Eastern Mediterranean Basin is $70.5x10^6$ m^3/year, and the groundwater potential is $96.5x10^6$ m^3/year. Considering the $9.46x10^9$ m^3/year surface and $96.5x10^6$ m^3/year groundwater potential in the basin, the total water potential is $9.56x10^9$ m^3/year. The usable water potential of the basin is $4.8x10^9$ m^3/year considering the $4.73x10^9$ m^3/year usable surface water and $70.5x10^6$ m^3/year groundwater operating reserves (Anonymous 2015). The population of the basin is recorded as around 1.5 million people (Anonymous 2016a).

The Göksu River is the main stream of the Eastern Mediterranean Basin. The Eastern Mediterranean Basin includes the sub-basins that discharge their waters into the Mediterranean via the Göksu River and its tributaries, the Berdan Stream, Anamur Stream, Limonlu Stream, Efrenk Stream, Alata Stream, Çubuk Stream, Kirmir Stream, Ova Stream and Seydi Stream (Anonymous 2016a). Kılıç conducted a study in 2020 to determine the water quality of the Göksu River and to examine the flow change over the years. In the study, some seasonal measurements made by the State Hydraulic Works in the downstream of the Göksu River between 1992 and 2017 were evaluated. The study evaluated the temperature (ºC), nitrite (NO_2^-), nitrate (NO_3^-), ammonium (NH_4^+), biological oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO), pH, sulfate (SO_4^{-2}), sodium (Na^+), total dissolved solids (TDS) parameters. When the annual average concentration values of the parameters were compared with the Water Pollution Control Regulation, the water quality was deemed to be 1st class in terms of pH, DO, COD, SO_4^{-2}, Na^+, TDS, NO_3 parameters. It has been determined that the waters vary between 1st class and 2nd class in terms of BOD parameter and between 1st class and 4th class in terms of NO_2, NH_4 parameters. Kilic found that there are changes in water quality depending on the seasons, and that there is a significant decrease in water quality as a result of increased evaporation in summer (Kılıç 2020).

The natural lakes in the Eastern Mediterranean Basin are Lakes Akgöl and Eğrigöl (Anonymous 2017).

Lake Akgöl covers an area of 1 200 hectares. Since Lake Akgöl is fed by the water coming from the drainage channels in the delta, the salt rate is around 1 g/l. The water level in Lake Akgöl is at its highest level and quite stable during the peak irrigation period (June-October). During the winter, the water level changes by 0.4 m depending on the precipitation (Anonymous 2013).

The Eastern Mediterranean Basin waters are in the first class, that is, clean water category, in terms of COD and BOD, which are important parameters indicating quality class organic pollution. When the nitrogen parameters are evaluated, the quality class is 1st or 2nd in terms of NH_4-N parameter, and 1st 2nd or 3rd class in terms of NO_2-N. In terms of NO_3-N, it was determined that the waters were 1st class throughout the basin. When the basin is evaluated in terms of water quality in general, it can be said that the water quality is at the 2nd class level, in other words, it has the characteristic of less polluted water quality (Anonymous 2015).

3.18. Seyhan basin

The Seyhan Basin area is 22 035 km² with a population of around 2 million people (Anonymous 2016b).

When the precipitation data of the meteorological stations in the Seyhan Basin are examined, winter and spring months are rainy, summer months and the beginning of autumn are dry months. The driest month is August (7.8 mm), while the wettest month is December (77.4 mm). Considering the average of the annual total precipitation of the stations, the highest precipitation was seen at the Karaisalı station with an average of 860.3 mm, while the lowest precipitation was seen at the Ulukışla station with 317.1 mm. The long-term annual total precipitation average of the stations in the basin is 531.4 mm (Anonymous 2019g).

The annual average flow for the Seyhan Basin is $6.66x10^9$ m^3 (10.18 $L/s/km^2$), corresponding to 3.62% of Turkey's surface water potential. The usable part of this water is estimated to be around $3.3x10^9$ m^3/year. The total groundwater potential in the Seyhan Basin is around $300x10^6$ m^3/year, and the associated operating reserve is $200x10^6$ m^3/year. Considering the $6.66x10^9$ m^3/year surface and $300x10^6$ m^3/year groundwater potential in the basin, the total water potential is $6.96x10^9$ m^3/year. The usable water potential of the basin is found as $3.5x10^9$ m^3/year considering the $3.3x10^9$ m^3/year usable surface water and $200x10^6$ m^3/year groundwater operating reserves (Anonymous 2015).

The longest of the two important tributaries of the Seyhan River is the Zamantı River, which originates from the Long Plateau at an altitude of 1 500 m in the Kayseri-Pınarbaşı district and passes through the Pınarbaşı, Tomarza, Develi and Yahyalı districts of Kayseri. Before descending to Çukurova, the Zamantı branch passes through Adana, merging with another important branch, Göksu, on the slopes of Mount Akinek of the Aladağ district, 80 km north of Adana, and disembogues into the Mediterranean Sea from the Deli Burnu point on the Adana-Mersin border, at the westernmost part of Çukurova. The length of the main tributary of the Seyhan River with its tributaries is 560 km, and the length from the junction point of the Zamantı and Göksu tributaries to the Mediterranean Sea is 137 km (Anonymous 2016b).

The Seyhan Basin is not rich in natural lakes, but is richer in terms of its dam lakes. The only natural lakes in the basin are Lakes Akyatan and Tuzla.

Lake Akyatan is Turkey's largest lagoon lake. Demir and Selek, in their study in 2009, defined the electrical conductivity value of the Akyatan Lagoon as 0.65-105.7 dS/m, and defined the lagoon as extremely salty because it has values of 1.5-2 times higher than sea water (Demir & Selek 2009). The main reason why the salinity is so variable in the lagoon is because the lagoon is fed by both waters returning from irrigation and by the waters originating from the sea. Salinity is lower in the regions where the drainage channels are discharged into the lagoon, and quite high in parts in close proximity to the sea.

Lake Tuzla, with its 808 ha area, forms a part of the Çukurova Delta wetlands system (Gençoğlu 2019). Tuzla Lagoon has a channel connected to the sea and the water quality of the lagoon is characterized as slightly salty throughout the year. The water quality improves due to winter precipitation but salinity of water increases due to excessive evaporation in summer. The lagoon is also used for irrigation purposes from time to time, from the regions of the lagoon where the water quality is good.

When the Seyhan Basin was evaluated in terms of surface water quality, it was determined that it was of 3rd class water quality in the Zamantı sub-basin, 3rd class water quality in the Göksu sub-basin, and 4th class water quality in the Seyhan sub-basin. In terms of groundwater quality, the Seyhan Basin was found unsuitable for domestic use in accordance with the relevant regulation.

3.19. Orontes basin

The precipitation area of the Orontes Basin is 7 886 km² and the basin has a population of just over 3 million inhabitants (Anonymous 2019h).

The annual average rainfall of the basin is 816 mm, the annual total flow is 1.17 km³/year, and the average basin yield is 2.60 L/s/km². Of the annual $2.8x10^9$ m^3 water potential of the basin, $300x10^6$ m^3 originates in Lebanon, $1.2x10^9$ m^3 originates in Syria, while $1.3x10^9$ m^3 originates in Turkey. The important tributaries of the Orontes River are the Karasu Stream, which comes from the Kahramanmaraş direction and is used as a flood protection channel, the Afrin Stream coming from the Gaziantep direction, and the Little Orontes, which is the part after the junction of the Karasu and Afrin Streams. In addition, in the downstream, Defne Stream, Big Karaçay and some other streams flow into the Orontes River (Anonymous 2015).

The Orontes River, the most important river of the Orontes Basin, was formed by the merging of the rivers originating in the Bekaa Valley between the Lebanon Mountains and the Anti-Lebanon Mountains. The total length of the Orontes River is 386 km, and most of the river is situated in Syrian territory. Its length in the territory of Turkey is 88 km. Many floods occur in the winter and spring seasons. The Orontes River forms wide valleys in the form of plains and bowls along its bed, and sometimes narrow and deep gorges. A large delta was formed where the river disembogues into the sea. The Orontes River is the only river whose source is not in Turkey but where it spills out. The flow of the river, which has a precipitation area of 1 800 km^2 in Turkey, is very irregular. This current overflows in winter and spring, crossing the river bed and causing damage to its surroundings. The annual average flow of the river, which is 8 m^3/s, approaches 20-40 m^3/s in winter and spring, and may even rise to 100 m^3/s from time to time. The Orontes River is also important in that its most important tributaries including the Karasu Stream, Afrin Stream, Little Orontes and Karadere Stream are located in Turkish territory. Since the river disembogues into the sea by crossing three different countries, it is necessary to determine the annual average water volume, but there are very different measurements of the average water volume. In some sources published in Turkey, the annual water volume of the Orontes River is given as $1.2x10^9$ m^3 (Anonymous 2019h). The quality of the Orontes River water has been determined as C_3S_1 (Ağca & Doğan 2020).

The only natural lake in the basin is Gölbaşı (Fish). Lake Fish, which does not have a natural wetland protection status, is actually the remnant of the dried up Lake Amik. The lake serves as an important stop for migratory birds, especially during the migration season, and has a rich aquatic life. The area of the lake is 55 ha. Gölbaşı Lake, below the Kurt Mountains, in the northeast of the Amik Plain, is 11 km from Kırıkhan. It is fed by spring waters arising from the base of the Kurt Mountains. The lake is very similar to Lake Amik in terms of its flora and fauna features and richness (Anonymous 2017).

The Orontes Basin is in the 1st or 2nd class in terms of COD and BOD, which are important parameters that show organic pollution, that is, clean and less polluted water. However, in the Orontes River, Afrin Stream and Muratpaşa Stream, the BOD parameter is in the 3rd class, that is, the polluted water level. Among the important nitrogen parameters, NH_4-N is at the 4th class, that is, very polluted water, in the Orontes River, Afrin Stream, Belen Stream, Beyazçay (Bohşin Stream) and Muratpaşa Stream, and at the 3rd class, that is, polluted water level, in the Karasu Stream, Büyük Karaçay Stream and Tahtaköprü Dam Lake. Throughout the basin, the NO_2-N parameter was determined as 4th class and NO_3-N as 1st class. When the water quality is evaluated in general, the water quality in the stations in the basin is at the 4th class level, in other words, it has the characteristics of highly polluted water quality (Anonymous 2015).

3.20. Ceyhan basin

The Ceyhan Basin area is 21 391 km² with approximately 2 million people living in this area (Anonymous 2010b).

The average annual total precipitation in the Ceyhan Basin is 727.3 mm (Anonymous 2019i) while the annual average flow value of the is $6.5x10^9$ m^3 (9.72 L/s/km^2), corresponding to 3.54% of Turkey's surface water potential. The usable part of this flow is $3.25x10^9$ m^3/year. The groundwater operating reserve of the Ceyhan Basin is $559x10^6$ m^3/year and the groundwater potential is $745x10^6$ m^3/year. Considering the $6.5x10^9$ m^3/year surface and $745x10^6$ m^3/year groundwater potential in the basin, the total water potential becomes $7.25x10^9$ m^3/year. The usable water potential of the basin has been determined as $3.81x10^9$ m^3/year considering the $3.25x10^9$ m^3/year usable surface water and $559x10^6$ m^3/year groundwater operating reserves (Anonymous 2015). 38% of the total water potential of the Ceyhan Basin is used for irrigation, and 62% is used for non-irrigation (drinking, using, industry, etc.) activities (Anonymous 2010b).

The important streams in the Ceyhan Basin include the Ceyhan River, Aksu Stream, Göksun Stream, Söğütlü Stream, Hurman Stream, Körsulu Stream, Savrun Stream, Deli Stream, Karanlık Stream, Ördeközü Stream and Bertiz Stream (Anonymous 2010b).

Streams and dams in the Ceyhan Basin are generally classified as 1st class in terms of COD parameter indicating organic matter pollution. The water quality of the Ceyhan River, which is the main stream of the basin, and the large streams feeding it and the dams on it, is generally classified as high quality water or less polluted water in terms of organic substances, nitrate nitrogen and inorganic parameters. However, in terms of ammonium nitrogen, the Ceyhan River water is in the polluted water class after Kahramanmaraş. Dissolved matter, chloride, sulfate and sodium values are high in terms of surface water pollution (Anonymous 2015).

When the Ceyhan Basin is evaluated in terms of water quality in general; As a result of the discharge of industrial wastewater into streams in Kahramanmaraş, the water quality in the region is reduced to the 4th class. It is known that the water quality is better around Adana due to the added clean water. While the Ceyhan River is in the 4th class in terms of pollution in Kahramanmaraş, the water quality in Adana improves and rises to the 2nd class (Anonymous 2016c).

3.21. Euphrates and Tigris basin

In the "International River Basins" list published by the UN, the water catchment basin of the Euphrates and Tigris (Turkey, Syria, Iraq, Iran, Saudi Arabia) is given as 895 628 km^2. The population of the Euphrates-Tigris Basin, which is the second most populated basin in terms of population, is approximately 7.7 million people. The Euphrates and Tigris Basin is largely fed by snow falling on the mountainous areas of northern and eastern Turkey, Iran and Iraq. The basin has the largest drainage area of Western Asia and Turkey. The Euphrates, the longest of the rivers in Western Asia, flows in this basin (Yıldırım 2006).

The total precipitation area of the Euphrates-Tigris Basin is 182 614 km^2 (Al-Ansari et al. 2019) and the annual average flow rate of the basin is 52.94 km^3 (8.29 L/s/km^2 in the Euphrates part and 14.44 L/s/km^2 in the Tigris part). The annual average precipitation level is 540 mm for the Euphrates section and 807 mm for the Tigris section, while the annual average flow rate is 1002 m^3/s in the Euphrates section and 744 m^3/s in the Tigris section (Anonymous 2015).

The Euphrates Basin consists of basins and low hills. The basin extending to the Persian Gulf has the appearance of a high plateau (Atuk 2005). The distribution of the Euphrates River basin area and long-term average water potential by countries is summarized below. In Table 3, catchment areas (Al-Ansari et al. 2019) and flow amounts (Onüçyıldız et al. 2016) are given on a country basis.

Table 3- The area and flow rate of the Euphrates Basin

Country	*Catchment area (km^2)*	*Catchment area (%)*	*Annual Flow km^3/year*	*Flow Rate %*
Turkey	125000	28.1	33.1	98.5
Syria	76000	17.1	0.5	1.5
Iraq	177000	39.9	0	0
Saudi Arabia	66000	14.9	0	0
Total	444000	100	33.6	100

Considering the water potential of the Euphrates in Turkey, it is at a level that can easily meet the water needs of the region. With the waters of the Euphrates, 1.6 million hectares of agricultural land in Turkey and 800 thousand hectares in Syria can be irrigated. If Turkey and Syria irrigate in this level, it is estimated that there will not be much irrigation water left for Iraq. For this reason, it will be necessary to meet the irrigation water needs of the agricultural lands on the Euphrates river route, with the waters to be transferred from the Tigris River, which has a lot of water in Iraq (Özdemir et al. 2002).

The distribution of the Tigris River basin area and long-term average water potential by countries is summarized below. In Table 4, catchment areas (Al-Ansari et al. 2019) and flow amounts (Onüçyıldız et al. 2016) are given on a country basis.

Table 4- The area and flow rate of the Tigris Basin

Country	*Catchment area (km^2)*	*Catchment area (%)*	*Annual Flow km^3/year*	*Flow Rate %*
Turkey	57 614	12.2	27.2	53.4
Syria	834	0.2	0	0
Iraq	253 000	58	3	5.9
Iran	140 180	29.6	20.7	40.7
Total	451 628	100	50.9	100

Considering the water potential of the Tigris, it is predicted that 650 thousand hectares of agricultural land in Turkey and 3.5 million hectares in Iraq (partly along the Euphrates) could be irrigated beyond the water needs of the settlements and industry in the region.

Turkey has initiated the Southeastern Anatolia Project (GAP), a multi-sectoral regional development project located in the Southeastern Anatolia Region around the Euphrates and Tigris rivers. The project area covers 45% of the Euphrates-Tigris Basins within the borders of Turkey (Onüçyıldız et al. 2016).

The Murat River, which is the most important first-degree tributary of the Euphrates, arises from the skirts of Mount Ararat and flows approximately 500 km to the southwest, and joins the Karasu River coming from the north (Erzurum) 10 km north of the Keban Dam. The river, named the Euphrates River after this confluence point, reaches a length of approximately 3 000 km, 1 230 km in Turkey, 710 km in Syria, 1 060 km in Iraq, from this point until it merges with the Tigris River (Kaya 2007).

Lakes in the Euphrates-Tigris Basin include Lake Hazar, Lake Akdoğan, Lake Haçlı, Lake Ekşisu and Lake Gaz.

Lake Hazar is situated 22 km away from Elazığ, on the Elazığ-Diyarbakır highway route, and is a tectonic lake between the Hazarbaba and Mastar Mountains. It has a length of 22 km and width of 5-6 km. The lake basin constitutes 8 166 ha with a water surface of 78.8 km^2. It was registered as a wetland of national importance in 2015.

The COD of Euphrates-Tigris Basin is predominantly at the level of 1st class (clean water) or 2nd class (less polluted water). In terms of this parameter, the Nizip Stream, Samözü Stream, Şehir Stream, Eğriçay Stream, Haringet Stream and Lülük Stream are 4th class, while Sacır Stream, Akdere Stream and Sitilce Stream are 3rd class quality. NH_4-N, one of the important nitrogen parameters, is largely in the 1st and 2nd class quality throughout the basin. In the Euphrates River basin, the Haringet Stream, Lülük Stream, Karakoyun Stream, Habur Stream, Çatak Stream, Nizip Stream, Sacır Stream, Sitilce Stream, Şehir Stream, Eğriçay Stream, Samözü Stream and Hancağız Dam water were evaluated as 4th class. When the Tigris River basin is examined in terms of NH_4-N, at some points in the Tigris River, it is classed 3 to 4. While Kulp Stream, Batman Stream, Çavuşbayırı Station of Garzan Stream and before the Tigris River joint in Devegeçidi Stream and Beyhan Stream in 3rd class quality, and it is 4th class in Sarge Stream after Ergani (Anonymous 2015).

3.22. Eastern black sea basin

The area of the Eastern Black Sea Basin is 22 846 km² with an average precipitation value of just over 1 000 mm (Anonymous 2016d). Its population is recorded as more than 2 million.

The annual average flow amount of the Eastern Black Sea Basin is $17.85x10^9$ m^3 (23.57 $L/s/km^2$) and covers 9.72% of Turkey's surface water potential. The usable part of this water is 8.9x109 m^3/year. The groundwater potential of the Eastern Black Sea Basin is $0.44x10^9$ m^3/year and all of them constitute the operational reserve. Considering the $17.85x10^9$ m^3/year surface and $0.44x10^9$ m^3/year groundwater potential in the basin, the total water potential becomes $18.29x10^9$ m^3/year. The usable water potential of the basin has been determined as $9.34x10^9$ m^3/year considering the $8.9x10^9$ m^3/year usable surface water and $0.44x10^9$ m^3/year groundwater operating reserves (Anonymous 2015).

Almost all the rivers of the Eastern Black Sea Basin obtain their sources from the peaks of the mountains that run parallel to the coast. Streams descending rapidly from the slopes are short rivers and overflow frequently after heavy rains; the most important stream being the 160 km long Harşit Stream. Other water sources include the Gelevera, Yağlıdere, Aksu, Batlama, Pazar, Turnasuyu, Melet, Civil, Akçaova, Bolaman, Elekçi, Cevizdere, Lahna, Curi and Akçay rivers. Since these waters overflow from their beds following heavy precipitation, they show an irregular flood regime (Anonymous 2016d).

The physical structure of the basin, especially the topography, prevents the formation of a large lake. There are small crater lakes of touristic importance in the İkizdere and Çamlıhemşin districts of the Kaçkars in Rize. In Trabzon, are are found Lakes Uzungöl and Sera.

COD, which is one of the important parameters showing organic pollution in the Eastern Black Sea Basin, is in the 1st class (clean water) in all water quality monitoring stations. In the evaluation made in terms of BOD, the majority of the water is in the 1st class and less in the 2nd class (less polluted water). In terms of NH_4-N and NO_3-N, which are important nitrogen parameters, most of the waters are in the 1st class. When the basin is evaluated in terms of water quality in general, many streams can be considered as clean or less polluted in terms of organic substances, ammonium, nitrate and microbiology (Anonymous 2015).

3.23. Chorokhi basin

The area of the Chorokhi Basin amounts to 20 248 km² with an average annual precipitation of approximately 560 mm. The annual average of the basin water potential is 6.5 billion m³ (Anonymous 2020) while the annual average flow of the Chorokhi Basin is 201.81 m^3/s (9.97 $L/s/km^2$). The contribution of the Chorokhi Basin to the total water potential of Turkey is approximately 3.47% (Anonymous 2015). The population of the basin is around 300 thousand people (Fakıoğlu ve Kağnıcıoğlu 2009).

The Chorokhi River is one of the largest rivers in the Northeast Anatolia. The three largest tributaries joining the Chorokhi River include Oltu Stream, Berta Stream and Barhal Stream, respectively. Of these, the Oltu Stream, which originates in Erzurum province, has a precipitation area of approximately 4 900 km^2 and 25% of the Chorokhi Basin. The Chorokhi River is fed from many tributaries in Erzurum and Artvin, especially after it enters Erzurum province; the most important of these are the Aralık Stream, Deviskel Stream, Murgul Stream, Hatila Stream, Çamlıkaya Stream, Aksu Stream, Cala Stream, Karataş (Engücek) Stream, Çapan Stream, Anuri Stream, Sırakonaklar Stream and Cihala Stream (Fakıoğlu & Kağnıcıoğlu 2009).

The Deriner Dam, which was started to be built in 1998 in order to generate energy on the Chorokhi River, is the second highest dam in Turkey in terms of body height and the 13th tallest dam in the world. At the average water level of the dam, which is a concrete arch body fill type, the lake volume is recorded as 1.97x109 m^3, and the lake area as 26.4 km^2.

The Yusufeli Dam, which is located in the basin, started to be built in 2013 and water was started to be retained in 2022, is in the 1st place in Turkey and 3rd in the world in terms of body height. The body height of Yusufeli dam is 275 m and the lake volume will be $2.2x10^9$ m^3 at normal water level. When Yusufeli Dam is full, it will be one of the most important water resources of the basin.

The lakes in the Chorokhi Basin include Lakes Tortum and Karagöl. Lake Tortum, located within the borders of Erzurum Province, covers an area of 615 ha. The lake has a maximum water level elevation of 1014 m, and a minimum water level elevation of 1 005 m. Lake Tortum is a risk of drying up due to the sediment problem. In their 2018 study, Fakıoğlu and Nuhoğlu determined that Lake Tortum is in the 2nd class according to the dissolved oxygen value and in the hard water class according to the total hardness, Ca hardness and Mg hardness values (Fakıoğlu & Nuhoğlu 2018).

Karagöl-Sahara National Park, located within the boundaries of the district of Şavşat, consists of two separate parts. The Sahara is located 25 km north of the town of Şavşat. Lake Karagöl is a landslide lake formed by water accumulating in the basin behind the rationally sliding mass (Anonymous 2020). Şener & Kibar in their study in 2017; by examining the geological and hydrogeological features of Karagöl Lake and its surroundings, they evaluated the hydrogeochemical properties, use cases and pollution of the water resources in the region. At the end of the study; they determined that all of the waters in the study area are in the 1st class in terms of water quality, are in the C1S1 class according to SAR and EC values, and are suitable for use as drinking and irrigation water. When the Chorokhi Basin is evaluated in general, it is less polluted in terms of water quality (Anonymous 2015).

3.24. Aras basin

The area of the Aras Basin, which has a population of around 800 thousand, is 27 775 km². The Aras Basin has a semi-arid and arid climate type. Iğdır, one of the provinces with the least rainfall in Turkey, is located in this basin. The average annual precipitation in Ardahan is recorded as 550.8 mm, in Kars 486.9 mm, in Iğdır 258.8 mm, and in Erzurum 405.3 mm. The level of snowfall is one of the factors affecting the occurrence of floods. Heavy snowfall occurs in the upper basins. The highest recorded snowfall is 110 cm in Ardahan, 88 cm in Kars, 38 cm in Iğdır and 110 cm in Erzurum (Anonymous 2019j).

The annual average flow of the Aras Basin is 4.63x109 m^3. In terms of runoff levels, the share of Aras Basin water potential in Turkey's wider water potential is 2.5% (Anonymous 2015).

The Aras River is the main stream of the Aras Basin. Originating from the northwestern piedmonts of the Bingöl Mountains, the Aras River flows to the north and enters the Erzurum-Pasinler Plain, and after receives the Zivin Stream from the north and the Velibaba Stream from the south. In Kağızman, it passes through deep valleys between the mountains and flows in the plain formed at the bottom of the 10 km wide valley. After leaving this narrow valley, known as Buğum Boğazı, The Aras River takes the Arpaçay Stream coming from the north in Aşağı Çıyrıklı. After crossing the Iğdır Plain, it leaves from Turkey to Nakhchivan. The total length of the river is 920 km, and its length within the borders of Turkey is 411 km. The average flow rate at the junction of the Aras River with the Arpaçay branch is 56.7 m^3/s.

The most important water resources of the Aras Basin can be listed as the Aras River, Kura River, Kars Stream, Arpaçay Stream, Lake Balık, Lake Çıldır, Lake Aktaş and the Arpaçay Dam Lake. The largesst lake in the Aras Basin is Lake Çıldır in Ardahan. There are many HEPPs in operation and under construction in the basin. In addition, there are four ponds built by SHW (Anonymous 2015).

Lake Çıldır is located at an altitude of 1 959 m above sea level and amounts to a surface area of 126 km^2 (Anonymous 2015). In their study, conducted between 1991-93, Yerli et al. (1996) recorded the EC value of the lake as ranging between 60-155 µS/cm.

Lake Aktaş, shared by Turkey and Georgia, is a tectonic lake located in the Aras Basin. The water of the lake, which has a surface area of 27 km^2, is soda (Yerli & Zengin 2019) BOD and nitrogen measurements are made at some stations in the Aras Basin, and the waters are classified as 1st and 2nd in this respect. When the basin is evaluated in general, it shows less polluted or clean water characteristics in terms of water quality (Anonymous 2015).

3.25. Van lake basin

The Van Lake Basin has an area of 17 861 km² and is home to 730 000 people. The annual average rainfall of the basin is 474 mm with an annual water potential of approximately $3.5x10^9$ m^3 (annual average flow is 95.32 m^3/s) (Anonymous 2019k).

The groundwater potential of the Van Lake Basin is $180x10^6$ m^3/year, and the groundwater operating reserve is $148x10^6$ m^3/year. Considering the $3x10^9$ m^3/year surface and $180x10^6$ m^3/year groundwater potential in the basin, the total water potential is $3.18x10^9$ m^3/year (Anonymous 2015).

Most of the rivers in the basin flow into Lake Van. The rivers, which are considered relatively large in terms of the water they carry and the distance they cover, are located in the east of Lake Van. The main streams in the Van Lake Basin include the Zilan and Deliçay Streams in the north, the Bendimahi Stream in the northeast, the Karasu Stream in the east, Engil Stream in the southeast, the Gevaş Stream in the south, the Kotum Stream in the southwest and the Sufresor-Ahlat creeks in the west. The Özalp and Büyükçaylak Streams, which flow from east to west, are located within the closed basin Lake of Erçek.

Natural lakes in the basin include Lakes Van, Nemrut, Erçek, Nazik, Turna and Gövelek (Ermenis).

Lake Van is Turkey's largest lake with an area of 357 269 ha. It is ranked 15th among the largest closed lakes in the world and is the largest soda lake on earth. The waters of Lake Van are brackish and salty. The salt concentration of water is 0.224%. Chemical composition of the salts in water is 42% NaCl, 34% $NaCO_3$, 16% Na_2SO_4, 3% KSO_4 and 2.5% $MgCO_3$. As a result of this feature, the lake has a large reserve as a soda production source. The water level of the Lake Van fluctuates by 50-60 cm between the summer and winter months. However, in recent years, these fluctuations have reached several meters (Anonymous 2017).

Nemrut is a crater lake located on the lands belonging to Tatvan, Ahlat and Güroymak districts to the west of Lake Van, spread over an area of 1 266 ha. The average depth of the half-moon shaped Lake Nemrut is around 100 m. The water of the lake is colorless, odorless and tastes like drinking water (Anonymous 2017).

Lake Erçek is located 30 km east of Lake Van, in a collapse of basin. The water of the lake, which has an area of 9904 ha, is salty and soda (Anonymous 2017).

Lake Nazik is a freshwater lake with an area of 46 km^2 located on The Van Lake Basin. (Bozaoğlu & Akkuş 2019). The lake waters are used for the irrigation of Adabağ and Sarıkum villages lands (Anonymous 2017).

Lake Van is highly polluted in terms of pH, salinity and total phosphorus parameters, and in the polluted water class in terms of organic matter and ammonium nitrogen. In particular, the fact that the total phosphorus parameter is at the level of dirty or highly polluted water in many stations indicates diffuse phosphorus pollution caused by fertilizers. In the streams flowing into Lake Van, the BOD parameter value varies between 3^{rd} class and the NH_4-N parameter value varies between 2^{nd} and 3^{rd} class. In many water sources flowing into Lake Van, the NO_2-N parameter is at the 4^{th} class level (Anonymous 2017).

4. Conclusions and Recommendations

Although there are still thoughts that reject global warming today; the claim that the consumption of fossil fuels would cause global warming existed even 100 years ago. However, the measures taken on this issue were so delayed that although global warming was known, it took more than 45 years to reveal its causes. Average global temperatures today are estimated to have risen by about 1.1 °C in 2021 compared to pre-industrialization. It is stated that as the temperature rises above 1.5 °C, climate-related disasters will become increasingly more common (Anonymous 2022b). With the effect of global warming, significant climate changes have already been seen in many parts of the world. The most important effect of climate change is the decrease in water resources and the change of habitats of many species. For many creatures living in extreme conditions, these effects have reached critical points. It has become almost impossible for polar bears, especially those living in the Arctic, to sustain their generation. If the polar bears that reach the continents cannot adapt to a terrestrial life, it seems unlikely that they can continue their generation. Moreover, the fact that sea creatures living in the equatorial region have started to be seen in more northern and more southerly seas due to the warming of the seas reveals the importance of climate change.

The effects of climate change are particularly apparent in the decrease in water resources on a global scale, the threat of desertification over large areas, the shrinking of forest areas, the decrease in stream flows, the decrease in water levels in lakes and the drying up of some lakes.

The effects of climate change are also seen in Turkey to a great extent and manifests itself in the form of the deterioration in the distribution of precipitation levels throughout the year. Instead of raining at a constant rate over a regular period of time, rapid precipitation in intense form causes a decrease in the amount of water held by the soil and an increase in the amount of surface runoff. This leads to a significant deterioration in the balance between retained water and flowing water.

The total annual average flow of the basins in Turkey is 185.37 billion m^3. Since the annual precipitation is not the same in each of the hydrological water basins, their yields and water potentials also differ from one another. While the Euphrates-Tigris Basin has the highest water yield with 56.3 km^3, the Burdur Closed Basin has the lowest water potential with 0.2 km^3, while the Akarçay Basin has 0.4 km^3. In addition, the Euphrates-Tigris Basin constitutes approximately 30.3% of the total country's water potential. Annual average runoff and water potential values by basins are given in Table 5 for 2019.

About half of the total annual water flow in the country is located in four of the 25 basins (Euphrates and Tigris, Eastern Black Sea, Eastern Mediterranean and Antalya). Apart from these four basins, the remaining 21 share the remaining half of the total water flow. This shows the imbalance in the distribution of waters according to the basins. On the other hand, there are also imbalances between the flow rates of the basins and the population they serve. For example, the Marmara Basin, where 28% of the total population lives, has only 4% of the total flow. Similarly, in basins such as Sakarya, Little Meander, Meander, Kızılırmak and Konya Closed Basin, significant differences exist in the proportion between the flow amounts and the population served. This further affects the water use in the basins and causes water shortages (Aküzüm et al. 2010).

Turkey is a country with a high probability of encountering serious water problems in the near future. For this reason, Turkey needs to protect its resources and use them more effectively in order to maintain sufficient quality water for future generations (Aküzüm et al. 2010).

Table 5- Annual Average Surface Water Potential by Basins, 2019 (SHW 2019)

Basin No	*Name of the Basin*	*2019* *Basin Precipitation area (km^2)*	*Average Annual Flow (km^3)(*)*	*Potential Affiliate Rate (%)*
01	Meriç-Ergene Basin	14486	1.7	0.9
02	Marmara Basin	23074	7.4	4.0
03	Susurluk Basin	24319	5.0	2.7
04	North Egean Basin	9861	2.0	1.1
05	Gediz Basin	17145	1.8	1.0
06	Little Meander Basin	6963	0.6	0.3
07	Meander Basin	25960	3.0	1.6
08	Western Mediterranean Basin	20956	6.5	3.5
09	Antalya Basin	20249	12.9	7.0
10	Burdur Closed Basin	6294	0.2	0.1
11	Akarçay Basin	7995	0.4	0.2
12	Sakarya Basin	63303	6.5	3.5
13	Western Black Sea Basin	28855	10.8	5.8
14	Yeşilırmak Basin	39595	7.0	3.8
15	Kızılırmak Basin	82181	7.0	3.8
16	Konya Closed Basin	49930	2.4	1.3
17	Eastern Mediterranean Basin	21150	7.6	4.1
18	Seyhan Basin	22035	6.2	3.3
19	Orontes Basin	7886	1.8	1.0
20	Ceyhan Basin	21391	7.7	4.2
21	Euphrates and Tigris Basin	181204	56.3	30.3
22	Eastern Black Sea Basin	22846	16.4	8.9
23	Chorokhi Basin	20248	7.0	3.8
24	Aras Basin	27775	4.5	2.4
25	Van Lake Basin	17861	2.6	1.4
Total		**783562**	**185.37**	**100**

*: These values were obtained from the base station flows at the most downstream of the basins in the country

About 54 billion m^3 of Turkey's annual potential of 112 billion m^3 is in use. Of this 54 billion, 40 billion m^3 (74%) is used in irrigation (Table 7), 7 billion m^3 (13%) in domestic use and 7 billion m^3 (13%) in industry (SHW 2017). These rates are respectively 70%, 22%, 8% in the world, and 33%, 51% and 16% in Europe (Anonymous 2018). The fact that the irrigation water for agricultural use is so high in Turkey makes the agricultural sector the focal point in terms of water saving. Because a 10% savings to be made in domestic use or industry corresponds to a small rate of only 1.75% in agriculture. In other words, saving that can be made by forcing people for domestic use is a goal that can be achieved very easily in agriculture. So that; It is possible to save at least 25% of water in a certain area, even by switching from the surface irrigation method to the pressurized irrigation methods. The water obtained with a 25% savings in agricultural irrigation corresponds to more water than all domestic use at the whole country level. It can be clearly observed how important water conservation is in agriculture. The water savings that can be achieved by the use of advanced technologies in agriculture are far more than the total use of the domestic and industrial sectors, and it is enough to irrigate more areas than the existing irrigated areas.

The amount of surface water used in irrigation throughout Turkey between 2000 and 2019 is given in Table 6.

Table 6- Amount of Surface Water Used in Irrigation in Turkey, 2000-2019 (SHW 2019)

Year	*Amount of Irrigation Water Used in SHW Irrigation (km³/year)*	*Estimated Amount of Irrigation Water Used in Other Irrigations (km³/year)*	*Total Amount of Surface Water Used in Irrigation (km³/year)*
2000	12839	14398	**27237**
2001	10964	12477	**23441**
2002	12214	14707	**26921**
2003	13442	14029	**27471**
2004	14487	16543	**31030**
2005	13231	17491	**30722**
2006	13847	15567	**29414**
2007	11756	13420	**25176**
2008	12182	14814	**26996**
2009	13566	16306	**29872**
2010	14396	16553	**30949**
2011	14764	18335	**33099**
2012	15831	18172	**34003**
2013	15373	19326	**34699**
2014	14285	12383	**26668**
2015	16727	14699	**31426**
2016	17694	15530	**33224**
2017	17425	14771	**32197**
2018	18693	14796	**33490**
2019	20450	14912	**35363**

In Turkey, there are serious imbalances between the water needed for irrigation according to the regions and the amount of water in that region. For this reason, in many regions of the country, groundwater is used as a supplement to irrigation, since the available surface waters are not sufficient for irrigation. Almost all of the existing groundwater reserves in almost every basin are drawn through wells and used for irrigation purposes. In some regions, groundwater is used for domestic and industrial purposes due to a regional lack of water. The groundwater reserve status according to the basins in Turkey is shown in Figure 3.

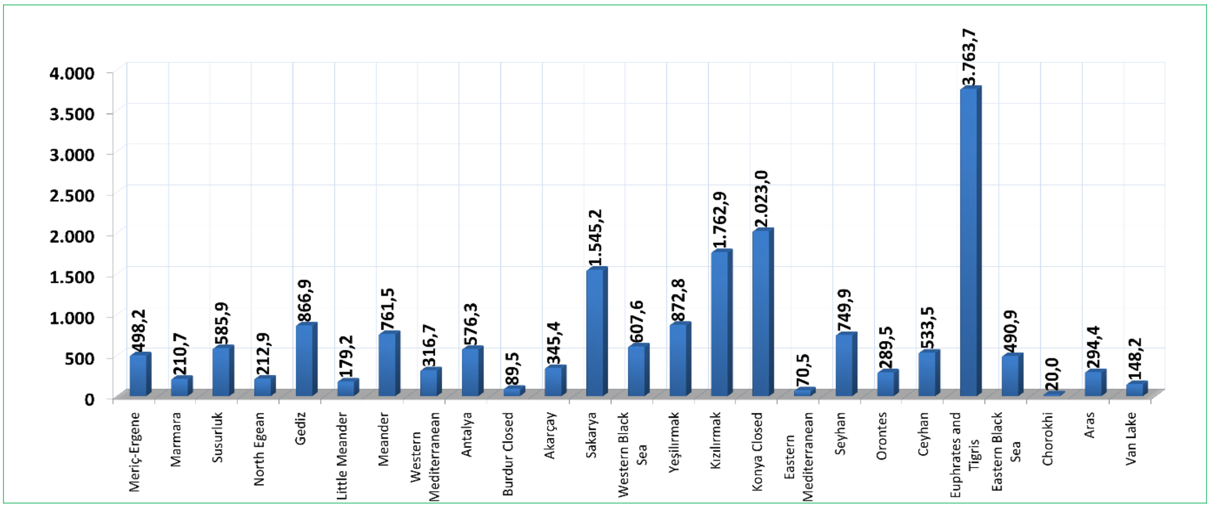

Figure 3- Annual Groundwater Reserve by Basin (10^6 m^3/year, SHW 2019)

Freshwater lakes in Turkey are mostly used intensively for irrigation purposes. However, the withdrawal of water for different purposes from many lakes, whose levels are already decreasing under the influence of global warming, jeopardizes the future of the lake. In particular, Lakes Eğirdir and Burdur are used intensively for irrigation and utility water, and face the risk of drying up in the near future. Unfortunately, regulations regarding the use of lakes in Turkey are insufficient and only one third of Turkey's lakes and wetlands have water management plans. The unauthorized use of lakes for different purposes is in question without a water management plan. For this reason, it is crucial to prepare water management plans for all water resources as soon as possible to better existing water sources.

Meeting the water needs of the growing world population is becoming more difficult not only due to the gradual decrease in water resources, but also because of the pollution of existing water resources. Even the supply of drinking water is a critical problem for many countries of the world. Today, the presence of water in countries has begun to be perceived as an indicator of the wealth of that country. However, it should not be forgotten that the most important parameter besides the presence of water is the presence of uncontaminated water. The real wealth is to have water that can be used for a specific purpose without undergoing any procedure or treatment. There is enough water in the seas and oceans for all humanity in the world for all purposes. However, seawater can be used directly in a few processes such as cooling without purification. Very high treatment costs may limit the evaluation of many waters even as water assets. Many countries have taken serious measures through legislation to protect their existing water resources not only in quantity but also against quality deterioration. The loss of a water source does not mean its disappearance, but it becoming unusable. In this respect the pollution of water resources is equivalent to the destruction of that resource.

An awareness of water quality is now growing in Turkey and monitoring of the quality of water sources is being carried out in many locations. In addition, studies for the preparation of quality maps of water resources are being conducted. All water resources are threatened by point and diffuse pollutants. Even the causes of pollution in water resources can sometimes be revealed as a result of analyses made on the waters. For this reason, periodic analyses must be made in both surface and groundwater sources and pollution must be kept under control.

Even if there is no pollutant discharge, it should not be ignored that the quality of the remaining water source will decrease slightly, even with evaporation due to extreme temperatures, so a quality difference will occur between early spring and early autumn in the same source. Since water quality is a parameter that directly affects the purpose of use, it is as important as the quantity of water today.

In the near future, water used for different purposes may be priced according to its quality, and the cost of obtaining better quality water will continue to grow. In terms of water quality, Turkey's basins show different values from each other. Generally, the effect of industrial pollutants in places where industrial activities are intense and the effects of agricultural pollutants in agricultural regions are observable in water resources.

Since there are intense industrial areas in the Meriç-Ergene Basin, the waters of the basin show industrial pollution, and many sources used in irrigation are of the 2^{nd} and 3^{rd} classes.

Since the Marmara Basin has the densest population of the country, the pollution caused by domestic wastes is observable in the water resources. At the same time, industrial waste is evident in the waters as the region is industry intense.

The Susurluk Basin is also a densely populated region, domestic waste load in water resources is quite high and this pollution is seen especially in the lakes in the basin. In Lake Uluabat, the lake waters are in the class of very polluted waters (4^{th} class) due to intense domestic and industrial waste.

The waters of the North Aegean Basin are relatively high quality waters, and ¾ of the basin waters consist of waters that can be called clean. Since agriculture is intensive in the basin, 1/3 of the groundwater is clean and the rest is of medium quality.

The Gediz Basin contains intensive agricultural regions, agricultural pollution is the leading cause of water pollution. Fertilizer and pesticide pollution can be found in the surface water resources and a diffuse pollution problem in the area that is difficult to control. However, groundwater is in a slightly better condition than surface waters.

Since The Little Meander Basin contains both industrial and residential areas, domestic wastes and industrial wastes are also polluting factors in the waters. Most of the basin waters consist of polluted and very polluted waters (3^{rd} and 4^{th} class).

The Meander Basin is a basin that hosts important industrial facilities. The waste from industrial facilities in the Denizli and Uşak provinces, in particular, adversely affect the water resources of the basin. Most of the basin waters consist of very polluted waters.

Agricultural contamination is common in surface waters as there are intensive agricultural areas in the Western Mediterranean Basin. Industrial waste in the region also pollutes rivers. For this reason, rivers generally consist of polluted and very polluted

(3rd and 4th class) waters. However, the lakes in the basin are cleaner and generally consist of clean or less polluted (1st and 2nd class) waters.

Although there are intensive agricultural regions in the Antalya Basin, the region receives a lot of orographic precipitation due to the Taurus Mountains. For this reason, many streams flowing from the mountains to the sea have very clean waters. However, depending on the heavy use of fertilizers, there is pollution in groundwater coming from to agricultural pollutants.

The main water sources in the Burdur Closed Basin are Lake Burdur and Lake Acı Göl. However, both sources are extremely salty and have high values of sodium, sulfate, and chlorine.

The Akarçay Basin is a basin exposed to multi-directional pollution and agricultural, domestic and industrial pollution is found in the waters. Salinity is high in the Akarçay River, which is the main stream of the basin, due to pollutant discharges.

Lake Sapanca has remained relatively clean within the waters of the Sakarya Basin. However, rivers in the basin, especially the Sakarya, Porsuk, Ankara Brook, and Çark Brook, are in the category of very polluted waters (4th class) due to the discharge of intense industrial and domestic wastes.

The lakes in the Western Black Sea Basin remained relatively clean, while the streams have been polluted by industrial wastes, particularly by iron, ammonium, nitrite, phosphorus, sodium and chlorine.

While only partial agricultural pollution is observed in the groundwaters of the Yeşilırmak Basin, there is intense biological pollution in the surface waters due to the wastewater discharges to the surface waters, especially to the Tersakan and Çorum streams. The pollution of these streams is more evident in dry periods.

A feature that distinguishes the Kızılırmak Basin from other basins is related to the rock structure in the river bed. In some regions along the bed where the Kızılırmak River flows, there are salt minerals in the mineral structure of the soil, referred to as primary salinity. During the flow of the river and its tributaries, salt mixes with the stream from the eroded soils, thus increasing the sodium, chlorine and sulfate salts in the water content. Especially the waters of Hirfanlı dam and afterwards are in the 3rd and 4th class values in terms of irrigation water quality.

Since the Konya Closed Basin has the characteristics of a closed basin, the pollution of the rivers in the region directly affects the lakes where those rivers flow. Therefore, besides Lake Beyşehir, there are significant lake pollutions in the basin. In addition, groundwater is saltier than other basins due to the intense use of groundwater in the region.

Although the streams in the Eastern Mediterranean Basin are relatively less polluted, both high salinity and agricultural pollution are observed, especially in streams where drainage waters are discharged. During the dry summer seasons, a significant decrease in quality is observed in the streams.

The salinity in the sea-connected lagoons in the Seyhan Basin is very high and the surface water quality is quite low throughout the basin. Generally, irrigation water consists of 3rd or 4th class waters.

The water resources in the Orontes Basin are generally clean or slightly polluted waters and are in the 1st and 2nd classes in terms of COD and BOD. However, due to the high level of agricultural pollution, nitrogen-based pollutants rank first among the parameters that cause the main pollution. Most of the basin waters are in the 4th class in this respect.

Ceyhan Basin also shows a different situation compared to other basins. Although the water quality in the part of the Ceyhan River up to Kahramanmaraş is quite good and is first class in most places, the wastes of Kahramanmaraş province pollute the river to such an extent that from that point on, the Ceyhan River quickly becomes 4th class water in its quality.

Most of the Euphrates and Tigris Basin is clean in terms of BOD and COD and has 1st and 2nd class waters. Although the higher parts of the basin contain relatively clean waters, the wastes from the cities pollute the waters significantly. Industrial wastes are mixed into the Euphrates River near Gaziantep and the water quality becomes 3rd and 4th class. Similarly, when the Tigris River passes through Diyarbakır, it turns into 3rd and 4th class water with a significant amount of domestic waste discharge.

The Eastern Black Sea Basin is one of the country's cleanest watersheds. In terms of most parameters, the waters are first class. Only a significant part of it is in the 2nd class in terms of the COD parameter.

The waters of the Chorokhi Basin contain Class 1 waters for all parameters at almost every point. In the basin, which has clean waters enough to be called the basin where the cleanest waters in Turkey are found, the waters have remained cleaner because of a lack of industrial development and a geographical structure that prevents crowded settlements.

The Aras Basin has both rivers and lakes and is a basin where all water resources are clean. Only in terms of BOD, some sources show 2nd class characteristics.

The largest water source of the Lake Van Basin is Lake Van, the soda water of which limits its potential uses. The lake waters are considered polluted in terms of salinity, phosphorus, organic matter and ammonium nitrogen. The lake is exposed to diffuse pollution and is classified as 2nd class water in terms of ammonium nitrogen, 3rd class in terms of BOD, and 4th class water in terms of salinity.

In Turkey, adequate control is not provided for water use and allocations. In particular, groundwater is used far above the operable reserves through illegal wells. Therefore, laws and sanctions regarding the protection of water resources must be determined and introduced. In addition, basin-based water management should be institutionalized and the relevant structures be established as soon as possible. Since the characteristics of basins are different from each other, management plans to be implemented for each basin should be put into effect. In many basins, it is not possible to meet the allocations due to insufficient water. Therefore, the usage habits of users in such basins should be changed and water should be used sparingly.

Care should be taken to ensure that any water management plans to be carried out on a basin basis in Turkey are carried out in the form of real evaluations in the field. The management organizations to be established on basin basis should be in a manner that can carry out all kinds of inspections regarding the use of water in the field. It is of great importance to implement the prepared basin water management plans and basin water allocation plans in the field in accordance with the reality and to minimize water loss.

It is necessary to give the authority to influence both the plant pattern and the irrigation method to be applied in the relevant region to the organizations that have undertaken the management of water. In addition, activities that raise awareness should be carried out to ensure that water is used in the most efficient and responsible way at this stage.

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