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The Situation of Water Resources in the Closed Basin of Konya

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Abstract— Undoubtedly, water is the most important material after air for life. It has not been proved yet that there is life outside earth in still-continuing space studies. The greatest evidence in explorations and examinations that life can be found outside earth is whether or not water exists. In this study, an investigation has been launched into the water resources and the future of Central Anatolia and Karaman region, which is considered as the grain warehouse of Turkey.

Keywords—water resources; Konya closed basin; Turkey

I. INTRODUCTION

Water is the most typical substance which is found in solid, liquid and gas form. Oceans, seas, lakes and land waters evaporate into the atmosphere. The water vapor which is mixed with the atmospheric air moves to the highest points of the world with the wind and it goes down to the earth as pure water in the form of snow, rain and hail depending on the decrease of the ambient temperature. These rains reach to small rivers, lakes, seas and oceans with the effect of gravity. This loop is called the water cycle [1].

Any area on the earth surface receives precipitation with different amounts according to its altitude and geographical location. The continuity and balance of the environment's life is directly affected by the annual amount of precipitation that the region receives. The total amount of water in the world is 1.4 billion km^3. 97.5% of these waters are in the oceans and in the sea as salt water, 2.5% are in rivers and lakes and poles as fresh water. Moreover, 90% of these freshwater resources are found in poles and underground. Clearly the amount of available fresh water that human beings can easily benefit from it are limited. After the industrial revolution, some people consume too much water, while the rest have water shortage. Water demand increases as proportional with increased population. This situation leads the deterioration of the natural balance over long term [2].

II. WATER MANAGEMENT IN TURKEY

The General Directorate of State Hydraulic Works is responsible for the planning, management, development and operation of water resources in Turkey. The water precipitation varies greatly from region to region and from year to year. The minimum annual precipitation was determined as 63.3 mm in Himmetdede, Kayseri (1933) and the maximum was determined 4043.3 mm in Rize (1931). The annual average of precipitation by region is as follows.

- Turkey precipitation average (arithmetic): 642,6 mm

- 750,7mm in the Mediterranean, 611,2 mm in the Eastern Anatolia,

- 388,8 mm in the Central Anatolia, 816,5 mm in the Black Sea,

- 640,6 mm in Marmara, 672,2 mm in Aegean,

- It is 609,8 mm in South East Anatolia [3]

In Turkey, the rains during the cultivation seasons of culture plants are irregular. Therefore, the plants do not meet their water requirements. Irrigation is indispensable for the agricultural production except the Eastern Black Sea coastline [4]. The water requirements in agricultural irrigation for different cities that closest the irrigation projects, including farm and channel losses, is shown by Table 1. In case of more than one irrigation project exist, the water requirements are emphasized in the largest and smallest values on the table.

III. TURKEY'S WATER RESOURCES POTENTIAL AND RELATED ISSUES

In order to investigate the problems of water resources, Turkey has been divided into twenty-six basins depends on the drainage area. The water potential calculated in each of these basins and the obtained values are given in Table 2. The total water space is 501 km^3 and the part of its that converted to the flow is 186.05 km^3. The annual usable water potential is 112 billion m^3, 74% of annual water use is in agriculture, 15% is in drinking water and 11% in industry [5]. The amount of safe groundwater reserves determined by the end of 2015 is 18 billion m^3. With 4.4 billion m^3 of this reserve used in underground for irrigation, the total area irrigated are approximately 685 000 hectares [2].

Table-1 Precipitation and Irrigation Water Requirement in Turkey [4].

PLACES	Altitude (m)	Annual Average Precipitation (mm)	Rise Time (Day)	Precipitation on Critical Period (mm)	Irrigation Water Requirement (mm)
Edirne	48	585,6	229	102,5	400-1100
İstanbul-	39	676,1	274	69,2	
Aydın	57	546,4	326	20,7	750-1320
Antalya	42	1061,3	355	14,3	660-1150
Adana	20	653,9	327	23,3	535-850
Ankara	891	379	190	56,3	470-920
Konya	1028	325,8	180	36,3	360-810
Eskişehir	801	371,5	195	54,2	440-680
Samsun	4	711,8	335	107,6	395-630
Erzurum	1869	440,2	178	99,8	330-600
Rize	4	2312,3	308	473,6	
Kars	1775	497	175	175,4	175-415
Şanlıurfa	547	466,9	275	3,9	1000-1520

Table 2. Water Potential and Basins in Turkey [2]

	Name of Basin	Water Potential (billion m^3)
1	Meriç- Ergene	1,33
2	Marmara	8,33
3	Susurluk	5,43
4	Kuzey Ege	2,09
5	Gediz	1,95
6	Küçük Menderes	1,19
7	Büyük Menderes	3,03
8	Batı Akdeniz	8,93
9	Antalya (Orta Akdeniz)	11,06
10	Burdur Gölü	0,50
11	Akarçay (Afyon)	0,49
12	Sakarya	6,40
13	Batı Karadeniz	9,93
14	Yeşilırmak	5,80
15	Kızılırmak	6,48
16	Konya (Orta Anadolu)	4,52
17	Doğu Akdeniz	11,07
18	Seyhan	8,01
19	Asi (Hatay)	1,17
20	Ceyhan	7,18
21	Fırat	31,61
22	Doğu Karadeniz	14,90
23	Çoruh	6,30
24	Aras	4,63
25	Van	2,39
26	Dicle	21,33
	TOTAL	**186,05**

Figure 1. Turkey water basin map

IV. KONYA CLOSED BASIN AND WATER SITUATION

Konya closed basin is formed by the air movements of an old riverbed rising in the middle of Anatolia. A flat plain located at an altitude of 900-1050 meters covers a large part of the basin [5]. The mountains surrounding the plain also prevent the water from being drained from the basin into the sea. It means the Konya Basin has an important closed basin character that does not drain its water into the sea [6, 7]. Within the boundaries of the basin, there are states of Konya, Niğde, Aksaray, Karaman, Ankara, Isparta, Nevsehir, İçel and Antalya. Besides, more than 90% of the basin belongs to the four main provinces of Konya, Aksaray, Niğde and Karaman [2].

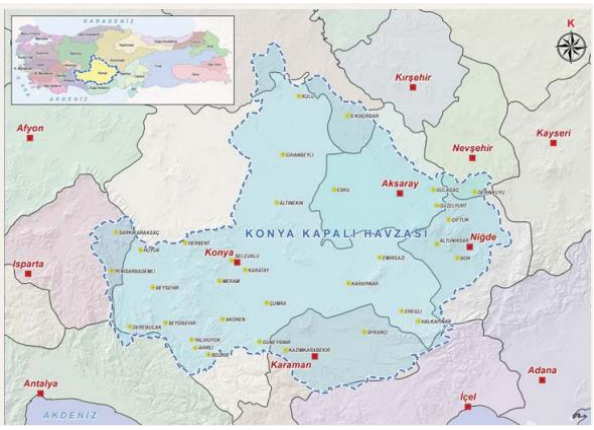

Figure 2. Konya closed basin map.

Over the past 50 years, rivers and underground waters that feed natural water resources have been directed to artificial wetlands such as dams, ponds and storage that serve human use for agriculture or agricultural irrigation. As a result of these interventions, all natural wetlands outside the regulated Beysehir Lake, Kozanlı - Gökgöl and Ilgın-Çavuşçu Lake are completely dried or shrunk to a great extent [6]. Although the insufficient surface water resources, the basin has a significant underground water potential, and the underground waters of the basin used today are formed in cool and humid climatic conditions in the geological past [12].

The Taurus Mountains are majorly the sources of underground waters in the basin [13]. Other sources for groundwater are rainfall, surface flows, runoff and leaks in irrigation waters and dams [14]. The use of groundwater in the basin began in the 1960s and has increasingly continued [6]. As a result of increasing water demand for agricultural production and increasing urbanization and industrial activities, more and more groundwater is being used in response to the inadequacy of surface water resources in the basin. Konya Closed Basin is known as the most used basin of groundwater in Turkey.

The average amount of rainfall in a large part of the basin is 300-350 mm. And this is almost half of the total average rainfall of Turkey, which is 740 mm [2]. The total annual usable water supply in the basin is 4,365 billion m^3 and annual water consumption is 6.5 billion m^3 [8]. It is seen obviously that the basin's water has a deficit of 2 billion m^3 per year [9]. Most of the deficit of water budget is met by the underground water's static reserves, so the underground water reserves are rapidly consumed [8].

Reduced precipitation is one of the reasons for the decrease in water resources in the basin. It is estimated that after the 2030s a decrease of 20-30% will be observed in the rains falling to the basin [10]. There is a significant increase in the planting areas of clover, corn, potatoes and sunflower plantations, which are high water consumption products, despite the deficit of water budget [11]. By the combination of these two factors, it is estimated that there will a decrease by more than 50% in the total water budget of the basin [10]. This rapidly removes the basin from environmental and agricultural sustainability. Unfortunately, approximately 90% of the water is used for agricultural irrigation [8]

DSİ 4 Regional Directorate stated that there has been a decrease of 28 meters in underground water levels throughout the basin since 1980 [6]. According to the information obtained from KOSKİ, it is observed that water wells supplied to Konya show a decrease of 40-100 meters at the water level, and The Chamber of Geological Engineers states that a forecast period of up to 20-30 years is foreseen [6].

Since there is not enough nutrition in some parts of the basin, the bottom parts of groundwater (fossil water) are started to be used.

This suggests that if possible climate scenarios are taken into consideration, there will be a decrease in future reserves that cannot be recovered in the basin water reserves [15]. Many of the internationally significant wetlands in the basin are facing the threat of drying, and serious drops are observed every year in groundwater levels. For example, the decrease of underground water level is seen in Figure 3.

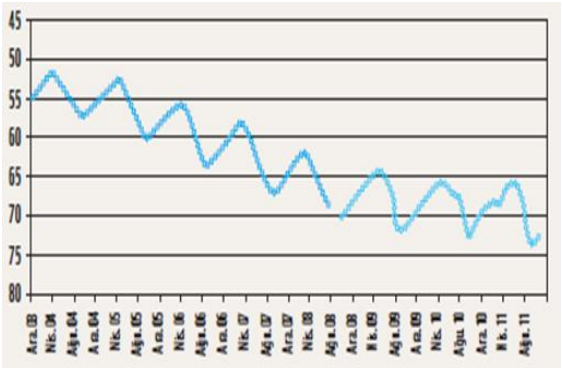

Figure 3. Static level reduction example in wells[8].

The KOP (Konya Basin Project) region, with the availability of approx. 2.9 million hectares of agricultural land; constitutes 12% of the total agricultural areas in Turkey and 16% of the irrigated areas. It is known that with 50 county town and more than 50% of the residents of Karaman, Aksaray and Niğde city centers and at least 30% of those living in Konya city center are directly or indirectly dependent on the agricultural production revenues [17]. According to Konya Governorship and Mevlana Development Agency, 62.4% of the population employed in Konya is in agriculture sector and the number of agricultural holdings is around 109 thousand. 30% (865,059 hectares) of cultivated land in the KOP (Konya Basin Project) region are irrigated farming and 70% (1,995,417 hectares) are dry land farming [8].

According to the KOP Administration, around 15 billion m^3 of irrigation water is needed to irrigate all of the existing agricultural areas (3 billion hectares), even when applying suitable plant design and modern irrigation systems in the region. In this scenario it will be necessary to provide four times as much water as the Basin's annual water budget. This figure corresponds to 1/3 of the current annual water use in Turkey (44 billion m^3) [6]. Such a scenario is not possible.

The Konya-Çumra II was developed to meet the rapidly rising water demand and to solve the salting problems. And III. Stage Project aims to transfer 414 million cubic meters of water per year to the Konya Plain from Göksu Basin basically [10].

V. Future of Konya Closed Basin

Many plans and projects are being designed and actualized by various institutions for the water problem in the basin. Some of those;

- To carry out various studies for the closed irrigation system in order to use the water resources in basin more efficiently and to prevent missing leakages,

- Determination of the water allocation on the quota system and the principles on how to make this allocation,

- Restriction of the use of groundwater in licensed wells, closure of illegal wells,

- Reorganization of small, fragmented and scattered agricultural land as land consolidation according to modern agriculture.

It is aimed to increase the productivity of agricultural production and raise the standard of living in the rural areas. But to decrease the consumption of water.

VI. Scenarios on Water Supply for Kop

The solutions underlined by the stakeholders in the basin are to overcome this difference between the basin's water presence (4.365 billion m^3) and irrigation needs (15 billion m^3):

1-Improving existing irrigation infrastructure,

2-Bringing water from outside the basin.

VII. Conclusion

KOP Administration put forward ideas about water supply from Ermenek Creek and Kızılırmak. Konya Governorship states that water can be transferred from the Euphrates River to Kızılırmak and from Kızılırmak to the Konya Plain. In addition to these, with new dams and regulators to be constructed on the Gevne Stream which constitutes the source of Ermenek Creek, new alternatives such as water transfer to the basin can be carried out. Since Mamasın Dam is inadequate for irrigation during dry seasons, Aksaray Directorate of Provincial Food, Agriculture and Livestock recommends bringing water from Kızılırmak River.

Karaman Directorate of Provincial Food, Agriculture and Livestock says that water must be transferred from the Göksu River and Ermenek region to Karaman and Ayrancı plains.

TMMOB (UCTEA Chamber of Mechanical Engineers) Chamber of Agriculture Konya Branch also states that it is imperative to bring water from outside the basin, and claims that water can be transferred from Hirfanlı, Sakaryabaşı and Erzincan Karasu to the north of the basin; from Adana Seyhan Dam to the southern basin, from Aksu to the Hotathan storage

Niğde Special Provincial Administration, Provincial Directorate of Food, Agriculture and Livestock and Chamber of Commerce and Industry share their opinion on the transfer of Ecemiş Stream water, especially for the use of Niğde Center, to the basin.

Konya Chamber of Industry and Konya Chamber of Commerce suggest that water can be transferred from Çatalan Dam on Seyhan River and Hirfanlı Dam on Kızılırmak to basin.

Konya Sugar points out the Manavgat River and Erzincan Karasu River as water sources from outside basins.

The process has been initiated for the DSİ (General Directorate of State Hydraulic Works) Master Plan tender to investigate the possibilities of transferring water from outside basins. Before actualizing the projects of water transfer between basins, it is important to research the alternatives and enable the following steps in an integrated plan covering the entire river basin: to reduce water demand, to meet water supply primarily from local sources, to recycle wastewater, to think water transfer between basins as the last option.

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