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A Look at the Change in Water Occupancy Rates of Gölova Dam Lake, Turkey

Seher Dirican[1*]

[1]*Department of Crop and Animal Production, Sivas Technical Sciences Vocational School, Sivas Cumhuriyet University, Sivas, Turkey.*

ABSTRACT

Climate change stands out as the biggest threat to agriculture and food production. The study aimed to examine the water occupancy rates of the Gölova Dam Lake from 2010 to 2019. The data regarding the water occupancy rate of the Gölova Dam Lake was obtained from the General Directorate of State Hydraulic Works of the Republic of Turkey. The results showed that the water occupancy rate was lowest (2.70%) in 2014, while the highest water occupancy rate (38.90%) was in 2016. The average water occupancy rate of Gölova Dam Lake for the period between 2010-2019 remained at 23.81±12.05. The evaluation revealed that the water occupancy rates of Gölova Dam Lake, decreased up to 75% on average between the period of 2010-2019. If this situation continues, the Gölova Dam Lake will become short and it will cause a decrease in the amount of water discharge that can accentuate due to climate change.

Keywords: *Gölova dam lake, Water occupancy rates, Sivas, Turkey*

Corresponding author: Seher Dirican
e-mail ✉ sdirican@cumhuriyet.edu.tr
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INTRODUCTION

Water is the most important element necessary for the continuation of life. Although three-quarters of the earth is covered with water, however, the amount of freshwater suitable for human use is quite limited. Less than one percent of the available water consists of freshwater resources suitable for ecosystem and human use. About 70% of the available water resources are used for agricultural purposes. This is followed by industry and domestic use with 19% and 11% respectively (Muluk *et al*., 2013). Climate change will, directly and indirectly, affect ecological systems, which will increase the frequency and intensity of disasters such as floods and droughts (Özdemir, 2021). In recent years, scientists aimed to increase agricultural production to meet the nutritional needs of the ever-increasing population. Although this one-sided approach increased production, however, it is being done by the brutal use of natural resources. The increasing pressure on natural resources is causing lands to become barren due to decreasing water resources together with faulty agricultural practices. Moreover, the risk of climate change, which is becoming more evident every day, is adding to the problem. Water scarcity is one of the most important problems the modern world is facing. All activities in life are more or less affected by the quantity and quality of water. The increasing demand for clean water resources calls for a careful examination and evaluation of resources that can be used as water resources (Taş & Yıldırım, 2020). Turkey is a country on the border of water scarcity. The annual average precipitation in Turkey is 643 mm, which is below the world average of 800 mm. This amount corresponds to an average of 501 cubic kilometers of water per year. Between 1990 and 2010, the amount of water consumed in Turkey increased by 40.5%. It is estimated that the amount of water that Turkey will need in the next 25 years will increase 3 times. Therefore, pressure on water resources is increasing to meet Turkey's growing demand for water (Muluk *et al*., 2013). In addition, climate change will adversely affect this situation. In this regard, analyzing the water storage capacities of dams that store water for later use, can be very important. These dams ensure the availability of water during the dry season. Therefore, dams increase the usability of water resources. In this study, we evaluated the change in water occupancy rates of an important reservoir, Gölova Dam Lake, for the period of 2010-2019.

MATERIALS AND METHODS

Gölova Dam Lake is located in Sivas province and South of the Gölova district center. It is situated between 40º 2' 42'' N and 38º 37' 21'' E. It is approximately 190 kilometers away from Sivas city center. Gölova is adjacent to Refahiye in the east, İmranlı in the south, Akıncılar in the west and Çamoluk in the north. Gölova Dam is located on the Çobanlı Creek which is a branch of Kelkit Stream. Gölova Dam was built between 1981 and 1990 **(Table 1)**. The Gölova Dam Lake area is about 5 square kilometers. The maximum water depth of the dam lake is 13 meters. The water of the Gölova Dam Lake is used for power generation, trout farming, commercial fishing, sport fishing, and agricultural irrigation (Yüngül *et al*., 2019). In addition, Gölova Dam Lake is frequented by nature lovers and bird watchers.

Gölova Dam Lake is approximately 3 km from the Gölova district. Gölova district is located at the junction of the Black Sea, Central, and Eastern Anatolia regions and has the characteristics of these three regions. It is located in the inner

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parts of the Central Black Sea region in the northeast of Sivas province. Gölova has a mixed climate with the characteristics of the continental climate of Central Anatolia and the Black Sea climate. It is warmer than the snowy winters of Central and Eastern Anatolia and receives less precipitation than that of the Black Sea. The 20 percent of Gölova district is forest-covered and healthy land and the remainder is the steppe. The fact that the district is in the transition zone of the Black Sea climate enriches the vegetation. The main livelihood of the Gölova district is agriculture and animal husbandry (URL-1, 2021). Cattle breeding is common in the district. However, these agricultural and animal rearing activities are not very profitable; they are in the form of small family businesses and products that remain in the domestic market.

Table 1. Characteristics of Gölova Dam Lake

Year of Construction	1981
Year of Operation	1990
Purpose of the Dam	Energy, Irrigation
Creek	Çobanlı Creek
Body Fill Type	Soil
Height	26 m
Lake Volume	65 hm^3
Lake Area	4.85 km^2
Irrigation Area Gross	6616 ha

To reveal the changes in the water occupancy rates of Gölova Dam Lake during different periods, the data shared by the General Directorate of State Hydraulic Works of Turkey were used (URL-2, 2021) and a comparison of 2010-2019 with the current water occupancy rate was done.

RESULTS AND DISCUSSION

Gölova Dam Lake is fed by Çobanlı Stream that joins Kelkit Stream. Gölova Dam's occupancy rate varied between 2.70-38.90 percent **(Figure 1)**. The highest occupancy rate was found in 2016. The lowest occupancy rate was observed in 2014. The average occupancy rate was 23.81±12.05 for the period (2010-2019). Gölova Dam has an occupancy rate of 28.00% in 2013.

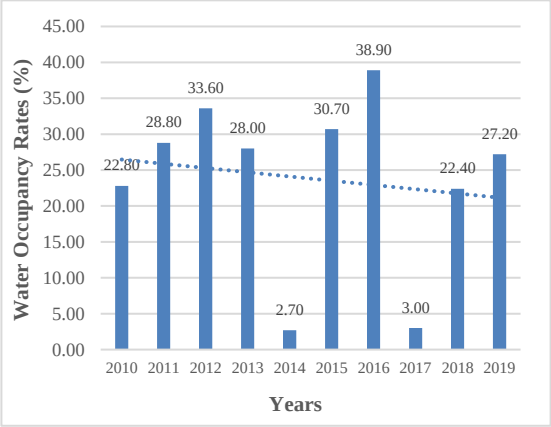

Figure 1. Changes in the water occupancy rates of Gölova Dam Lake in the period 2010-2019.

Compared to 2014, the occupancy rate in Gölova Dam decreased by 25.3%. Similarly, while the water fill rate of Gölova Dam was 38.90% in 2016, it was observed that the water fill rate decreased by 35.9% in 2017 to 3.00%. Looking at the trend line of 2010-2019 in **Figure 1**, it has been observed that it has a continuous decreasing trend.

Gölova Dam Lake and its surroundings are some of the points that are considered important in Sivas province and the region in terms of wildlife. Among the features that make Gölova one of the internationally important natural beauty are; *Verbascum trichostylum* is an endemic plant species found in the area. In addition, *Oxyura leucocephala* (Ruddy Duck), which breeds in the reeds, is an important bird species of the area. In the past, *Grus Grus* (Crane Bird) is known to breed here as well. *Grus* is now seen here only during the migration period (Eken *et al*., 2006). Six fish species (*Barbus lacerta*, *Capoeta sieboldii*, *Capoeta tinca*, *Chondrostoma nasus*, *Cyprinus carpio*, *Squalius cephalus*) are also found in Gölova Dam Lake (Yüngül *et al*., 2019). With the formation of Gölova Dam Lake, commercial fishing has emerged as a new line of business. The fish farm in Gölova Dam Lake produces rainbow trout. This fish farm has a production capacity of 50 tons/year.

Gölova Dam Lake is also used for irrigation purposes. To irrigate agricultural lands from the Gölova Dam Lake, the project prepared by the General Directorate of State Hydraulic Works of Turkey has been put into practice. The net irrigation area of Gölova Dam Lake is 6616 hectares and the irrigation rate is 71% (SPESR, 2020). Grain farming and forage crops constitute the basis of agricultural activities in Gölova. The main agricultural products are onions, potatoes, beans, cabbage, plums, sugar beets, sunflowers, wheat, and barley. If modern irrigation methods are used to irrigate these crops, a great deal of water savings and contribution to climate change can be made. Today, with the effect of climate change, the correct use of water resources is gaining more and more importance. Therefore, farmers should be encouraged to use modern irrigation methods. Modern irrigation methods used in agricultural production create a positive change in the amount of production, the yield of the product, and water-saving. Applications known as modern irrigation methods are drip irrigation and sprinkler irrigation methods. On the other hand, the wild irrigation method is not recommended, as it does not save water. Today, with the effect of climate change, it is becoming more and more important to use water resources correctly. For this reason, it is very important to inform, raise awareness and encourage the farmers who use the Gölova Dam Lake for irrigation purposes to use modern irrigation methods.

Gölova Dam Lake, which is a source of life for living things from humans to migratory birds and fish species in Sivas province, has been particularly affected by the drought caused by climate change in 2014 and 2017. It was observed that the water occupancy rates in Gölova Dam Lake decreased to 2.70 percent in 2014 and 3.00 percent in 2017 **(Figure 1)**. The drought in the Gölova Dam Lake, which is an important food and spawning area for migratory birds, is used for fishing and irrigation, has also adversely affected the living things. In the Gölova Dam Lake, it was observed that the water occupancy rates were around 23.81 percent on average in the 2010-2019 period due to the drought and incorrect irrigation techniques. This indicates that approximately 75 percent of the Gölova Dam Lake is empty.

With the decrease in water occupancy rates, the habitat of many living species in the Gölova Dam Lake has narrowed.

According to the drought assessment study of Turkey based on provinces, conducted by Cebeci *et al*. (2019), Sivas province was defined as arid with a drought index value of 82.6. Accordingly, Sivas province has a drought risk on a global scale. Gölova Dam Lake, located in the northeast of Sivas province, suffered from a drought of 2010-2019. This situation has been caused by reasons such as climate change, evaporation, wrong irrigation techniques. Due to the decrease in the water occupancy rates in Gölova Dam Lake, the farmers waiting for irrigation were also adversely affected. Climate change affects the agriculture sector both directly and indirectly in various ways (Akalın, 2014). Agriculture is one of the most affected sectors during drought periods. The most important input in agricultural production is water. Drought poses a great risk in agricultural production, especially in Turkey, where the dry farming system is common. As a result of the standard precipitation index and drought, determination analyzes in Turkey, when the vegetative productivity in the drought years and regions were examined, it was determined that there were losses of up to 30 percent in agricultural production in the drought-experienced regions of Turkey in 2004, 2007, 2008 and 2013 (Oguz *et al*., 2017). The emergence of drought in the Gölova Dam Lake causes difficulties in meeting the water demand.

The climate change experienced all over the world increases the need for water day by day. As a result of this, the groundwater and surface water used is decreasing and droughts can be experienced as a result of this decrease. When we evaluate the water occupancy rates in Gölova Dam Lake from 2010 through 2019, it has been observed that there is a significant water shortage and drought. Gölova Dam Lake, where the water occupancy rate decreases, is an important habitat for many living species. The decrease in water occupancy rates causes an imbalance in the Gölova Dam Lake ecosystem. There is an ecological relationship between living things that have formed a certain habitat in the Gölova Dam Lake. With the decrease in the water level in the Gölova Dam Lake, the habitat of many species has been adversely affected by this situation.

Drought can be seen everywhere. However, arid climates are more susceptible to drought due to lack of moisture and high variability of precipitation. Drought usually develops slowly, is often long-lasting, and is the least estimated of all atmospheric hazards, but its effects are very broad (Kapluhan, 2013; Oğuz *et al*., 2017). In the Gölova Dam Lake, the drought effect was felt more in 2014 and 2017. Since the drought develops slowly and insidiously in the Gölova Dam Lake, it should be closely monitored.

CONCLUSION

In this study, the water occupancy rates of Gölova Dam Lake were analyzed. The drought that occurred in the Gölova Dam Lake between 2010 and 2019 poses a serious threat to all living things. Droughts can lead to food and water shortages. Therefore, effective use of Gölova Dam Lake waters and minimizing the possible drought impact of agricultural production activities should be ensured.

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