

Evaluation of the Occupancy Rates of Some Dam Lakes in Sivas Province

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Abstract— *In this study, it is aimed to evaluate the water occupancy rate of some Dam Lakes in Sivas Province (Gazibey, 4 Eylül, Pusat-Özen) between 2010 and 2019 by using the DSI data. The occupancy rate of Gazibey dam lake between 2010 and 2019 was calculated average as 28.58%. The 4 Eylül dam lake between 2012 and 2019 years, the occupancy rate was calculated average as 31.86%, and the occupancy rate of the Pusat Özen dam lake was calculated average as 69.93% between 2012 and 2019. For this purpose, information on the sustainable use of waters in different dam lakes has been provided. Dams should be considered as a separate ecosystem and a water management plan should be prepared against water scarcity.*

Keywords— *Dam Lake, Global climate change, occupancy rate.*

I. INTRODUCTION

Dam Lakes are structures created for drinking and potable water, irrigation water, flood prevention, hydroelectric power generation, aquaculture production and promenade creation purposes. Dams store water and provide it when there is little or no water. They increase the water level by collecting surface water in their bodies, especially during the rainy season. Dams are also used to effectively regulate the level of water flowing in the river by temporarily storing and then releasing the flood volume. Hydroelectric power generation, from dams is recognized as the cleanest and largest source of renewable electric energy. Today's modern dams are of strategic importance for developing countries due to their role in energy production. If suitable dam lakes are fished, both the development of aquaculture resources and the economic benefits of dam lakes are provided. In addition to these, they are also very important in terms of creating areas such as boat trips, skiing, camping, picnic areas. In addition to these considered goals of dam lakes, they also create a social, economic and cultural natural heritage for humans.

Global climate change, which affects the whole world and the effects it creates have been observed especially in Turkey in recent years. Global warming and climate

change are expected to affect both the quantity and quality of water resources. It has been reported that increases in temperature and decreases in precipitation and currents will increase pollution concentrations and cause water quality problems (Fistikoğlu & Biberoglu, 2008; Kucukklavuz, 2009). Especially in rainy seasons, it will increase the occupancy rates of dams, and the increase in temperature in summer will cause the occupancy level to decrease with evaporation from the dam lakes. Drought and rainy seasons will creating a pressure on water resources. As water decreases, excessive fertilizers and pesticides used to obtain yields that will increase salinization, wasteland in agricultural areas will also cause both water and soil contamination (Kadioglu, 2001; Öztürk, 2002). The observed effects of drought in the field of agriculture are much greater than in other areas. But this effect will also shift over time to other areas where water is used. For example, if we consider it as a dam lake, it will have a size that will affect even the fish farming done in that lake.

Turkey is one of the countries that will be the most affected by the effects of global warming due to its geographical location. It has been reported that distinct regions of Turkey will be affected by climate change in

different ways and at diverse sizes (Öztürk, 2002). Arid and semi-arid regions under threat of desertification and semi-humid regions that do not have enough water (South east, Central Anatolia, Aegean and Mediterranean regions) will be more affected by the temperature increase (Türkeş, 1998). The Sivas province and the dam lakes that make up our study area are located in the Central Anatolia Region.

In this study, the occupancy rates of some dam lakes in Sivas province will be evaluated by using the DSI data between 2010 and 2019. I will try to provide both information about some technical characteristics of dam lakes and information about sustainable use of dam waters. Data on how global climate change is affecting dam lakes will also be presented in the study.

II. MATERIALS AND METHODS

Gazibey Dam, which is established on Üsküp Stream in Sivas, was built for irrigation and flood control purposes. The dam created between 1987 and 1992 is of the lake rock body fill type. The height of the dam body volume, which is 900,000 m³, from the streambed is 58 m., the lake volume is 18.53 km³ at normal water elevation and the lake area is 0.45 km² at normal water elevation. This dam serves to irrigate the lake on an area of 2,386 hectares.

The Sivas 4 Eylül Dam, located 10 km northeast of Sivas in the Upper Kizilirmak basin, was built to meet the drinking water needs of the province. The dam provides 33 hm³ of drinking water annually. The dam is located on the Mısmıl river and has a drainage area of 236.8 km², which is fed by other streams. There are no industrial enterprises in the vicinity of the dam lake and the tributaries that feed it (Yıldız & Değirmenci, 2012). The dam, which is a soil body fill type, was built between 1996 and 2002. Dam lake has a body volume of 4,200,000 m³. The height of the dam lake from the stream bed is 65 m, the lake volume is 85.05 hm³ at normal water elevation, and the lake area is 5.60 km² at normal water elevation.

Hafik is a town in the west of the provincial center of Sivas and 37 km away. With an area of 1,765 km², Hafik has an altitude of 1,275 meters above the sea. Pusat-Özen dam lake was built on Pusat stream at Hafik district between 1996 and 2002. The dam provides irrigation services for an area of 10,924 hectares. The body volume of the dam, which is a rock body fill type, is 2,820,000 m³. Its height from the streambed is 86 m., the lake volume is 95.20 km³ at normal water elevation and the lake area is 4.20 km² at normal water elevation.

Table 1. Technical characteristics of some dam lakes in Sivas province

The name of the dam	Gazibey Dam Lake	4 Eylül Dam Lake	Pusat-Özen Dam Lake
Location	Sivas	Sivas	Sivas, Hafik
The beginning of the dam	1987	1996	1996
Completion of the dam	1992	2002	2002
Purpose	Irrigation-Flood control	Drinking water	Irrigation
River	Üskülüp Stream	Mısmıl River	Pusat Stream
Body filler type	Rock	Stone	Rock
Height	58 m	65 m	86 m
Lake volume	18.53 hm ³	85.05 hm ³	95.20 hm ³
Lake area	0.45 km ²	5.60 km ²	4.20 km ²
Irrigation area	2.386 ha	-	10.924 ha
Coordinates	39.3301°N 36.6661°E	39°50'26"N 37° 3' 43"E	40° 0' 47"N 37° 24' 43" E

Sivas is the coldest province of the Central Anatolia Region and has a unique continental climate character compared to the surrounding provinces. The summer season is very hot, dry and rather short. The winter months are freezing cold, long and snowy. The average temperature in this season is about 0 °C.

As the most important source of income among the vegetable crops grown in the province of Sivas, field crops cereals are in the first place. This is followed by forage crops, industrial crops and edible legumes, respectively. Cereals take the first place both in terms of production quantities and in terms of cultivation area (İl gıda, 2013). Oats, rye, alfalfa, sainfoin, vetch, corn, burchak, triticale are grown as cereals in Sivas province and districts. Sugar beet is grown as industrial crops. Dried beans, chickpeas, yesil lentils and dried lentils are grown as edible legumes. Potatoes and onions are also grown as tuber plants (İl gıda, 2013).

In this study, it was evaluated the occupancy rates of some dam lakes in Sivas province (Gazibey, 4 Eylül and Pusat-Özen) between 2010 and 2019 by using DSI data.

III. RESULTS AND DISCUSSION

The occupancy rates of the Gazibey dam lake, which constitutes our study area, between 2010 and 2019 are presented in Figure 1. The dam occupancy rates between 2012 and 2019 is presented in figure 2 for 4 Eylül dam lake and in figure 3 for Pusat Özen Dam Lake.

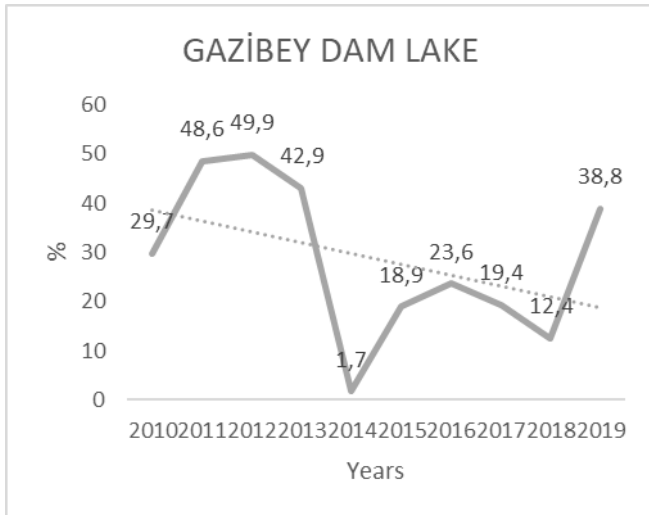


Fig. 1: Gazibey Dam Lake occupancy rates between 2010-2019

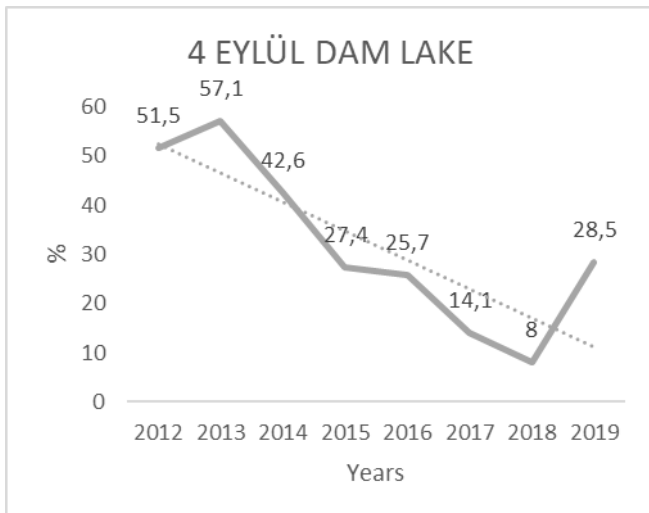


Fig. 2: 4 Eylül Dam Lake occupancy rates between 2012-2019

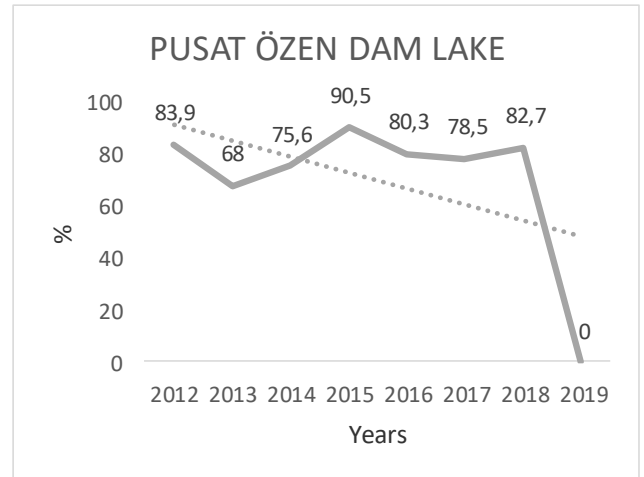


Fig. 3: Pusat- Özen Dam Lake occupancy rates between 2012-2019

There is an increase in water levels in dams during rainy seasons. In summer, the amount of water decreases even more with the evaporation of water as the air warms up and the withdrawal of water for agricultural irrigation purposes.

The highest occupancy rate of Gazibey dam lake was reported as 49.90% in 2012 and the lowest was reported as 1.70% in 2014. In 2015, it increased by 17.20% and reached a rate of 18.90%. Between 2010 and 2013, the dam occupancy rates showed an occupancy rate between 29.66% and 49.90% (Figure 1). In a study conducted by DSI (2005) zebra mussels were found in Gazibey dam lake in 2001 and 2005, but they reported that there was no problem caused by this (Aksu & Yıldız, 2017).

In 4 Eylül dam lake, the highest occupancy rate in the dam lake was reported as 57.10% in 2013, and the lowest was reported as 8% in 2018 (Figure 2).

Yıldız & Değirmenci (2012) examined the water quality of the 4 Eylül Dam lake and the streams feeding the dam. It performed some chemical and bacteriological analyses by taking water samples during dry and rainy periods. Bacteriological pollution has in the dam lake, however, any heavy metals are no present in the sources. The rainy and dry seasons of the samples showed differences in the amount of organic matter. It has been reported that there is a low flow rate and a higher hardness water inlet to the dam during the dry period, but there is a lower hardness water inlet to the dam during the rainy period because the flow rate is high and it is fed by precipitation.

In a study conducted by Yıldız & Karakuş (2018) reported that the manganese value increased when the lake area was deep below the surface in the dam lake, where the drinking water needs of Sivas province were met, and there was no

change in the iron value. The pH and oxygen value did not change depending on the depth were reported. It was found that the value of NO₃-N of lake water varies between 0.1-0.3 mg/L. It was reported that the turbidity value in the lake increased towards the bottom of the lake, and the electrical conductivity value was measured at higher values near the lake towards the middle parts of the lake.

Pusat-Özen dam reached its highest occupancy rate with 90.50% in 2015. Between 2012 and 2018, it was reported that the dam had occupancy rates between 68% and 90.50% respectively. In 2019, there was no water in the dam lake (Figure 3). In this year, due to the decrease in the water level, water was supplemented to Hafik lake, where fish deaths occurred from time to time, by closed-circuit method with pipes underground from the irrigation line of Pusat-Özen dam. This, in turn, may have led to reductions in the water level of the dam lake.

As can be seen from the tables where the annual occupancy rates of dam lakes are given, there is an increase in some years and a decrease in some years. The increase may be as a result of rainy seasons (rain, snow), as well as the decrease may be due to a decrease in water levels due to evaporation of water as a result of hot seasons and due to the withdrawal of excess water for agricultural purposes.

In studies conducted in the Gölova, Maksutlu and Karacalar dam lakes located in Sivas province, water occupancy rates showing a decreasing trend were determined, as in the Gazibey, 4 Eylül and Pusat-Özen dam lakes (Dirican, 2021 a; Dirican 2021 b; Dirican 2022).

Türkeş (1998) reported that our country will also be negatively affected by climate changes due to global warming, especially by the reduction of water resources, drought and desertification, and the ecological changes associated with them. In terms of the potential effects of global warming, Turkey is also among the risky countries. If the necessary measures are not taken for climate changes, the water resources in the arid and semi-arid areas of our country, especially the state of water resources in cities, will add new ones to the problems and it is expected that the need for water in all areas will increase even more.

Drought has been shown to be one of the most important effects of global climate change. Also, drought is caused by many factors below normal precipitation, low soil moisture, hot dry air. The decrease in the amount of precipitation and the degree of influence of precipitation are also related to this. Variables such as high temperature, high wind and low humidity are effective in drought in many regions. In addition, drought also has various effects on society due to the dependence of human activities on

water resources (Türkeş, 1998). It is observed that deviations in the amount and distribution of precipitation observed throughout Turkey lead to negative results in both underground and above-ground water reserves. It has also been determined by the general Directorate of Meteorology that these deviations in the climate are continuous (Türkeş, 2001).

IV. CONCLUSION

Humans not must ignore the effects of global climate change, which has been global problem of recent years and is increasing its impact every day, on water resources. Global climate change will affect each water source to different degrees. For this effect to impact the dams at the minimum level, each dam should be evaluated separately. A water management plan should be prepared to ensure sustainable use of the water of each dam lake.

As a result, the water quality of each dam lake should be evaluated as a separate ecosystem for the purpose of living creatures and use in it. Farmers should be aware of agricultural irrigation. It should be encouraged to use technological irrigation systems that can provide more effective irrigation with less water. For each dam lake, the water sources entering and leaving the lake should be evaluated well. Sources of pollution should be identified and strictly controlled around the dam lake. It is necessary to check the compliance of the water quality of the dams with the intended use. It is recommended that the dam lakes be periodically examined both for the quality of the water and for the creatures it harbors.

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