Beşerî Faktörlerin Kapalı Havza Göllerine Etkisi: Van Gölü Örneği*¹

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Abstract

Although many factors are effective in the formation of closed basin lakes in the world, landforms, land structure and climate factor are the the leading effective factors. Particularly, the semi-arid closed basin areas located in the inner parts of the middle beltlands are lower than their close surroundings, so their winter temperature averages are higher. The places in question have been sheltered places against cold air masses in the winter months due to both of the lakes in these areas and the surrounding mountains. For these reasons, those areas have been the most preferred areas throughout history. Closed basin areas in Turkey have been places where population is higher than their immediate surroundings since ancient historical times. Van Lake basin, is one of the oldest settlements in human history. The basin has been the cradle of many civilizations from the past to the present. One of these civilizations is the Urartians. Since the Urartians, the Lake Van basin has always been the preferred place compared to the immediate surroundings. As a matter of fact, Van, which is the largest city of the basin today, and its immediate surroundings hosted people from distant areas (for settlement purposes).

The aim of this study is to examine the major closed basins in the world in general and the Van Lake closed basin in particular. In addition, it is to reveal the course of lakes in these closed basins in human history and the effects of human factors on lake level changes.

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*The Effect of Human Factors on Closed Basin Lakes: The Example of Lake Van**

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Öz

Dünya üzerinde bulunan kapalı havza göllerinin oluşumunda birçok faktör etkili olmakla birlikte yeryüzü şekilleri, arazi yapısı ve iklim faktörü etkili olan unsurların başında gelmektedir. Özellikle orta kuşak karalarının iç kesimlerinde bulunan yarı kurak iklime sahip kapalı havza alanları, yakın çevrelerine göre daha alçakta bulundukları için kış sıcaklık ortalamaları daha yüksektir. Söz konusu yerler gerek buralarda bulunan göllerin etkisiyle gerekse çevrelerinin dağlarla çevrili olması nedeniyle kış aylarında soğuk hava kütlelerine karşı korunaklı yerler olmuştur. Bu nedenlerle bu alanlar insanların tarih boyunca en çok tercih ettikleri alanlar olmuştur.

Türkiye’de bulunan kapalı havza alanları, eski tarihi dönemlerden bu yana yakın çevrelerine göre nüfuslanmanın fazla olduğu yerler olmuştur. Bu alanlardan biri olan Van Gölü havzası, insanlık tarihinin en eski yerleşim yerlerinden birisidir. Havza, geçmişten günümüze kadar geçen sürede birçok medeniyete beşiklik etmiştir. Bu medeniyetlerden biri de Urartulardır. Urartulardan bu yana, Van Gölü havzası, yakın çevreye göre her zaman daha fazla tercih edilen yer olmuştur. Nitekim, günümüzde de havzanın en büyük kenti konumundaki Van ve yakın çevresi uzak alanlardan gelen (yerleşme amaçlı) insanlara ev sahipliği yapmıştır/yapmaktadır.

Bu çalışmanın amacı, genelde dünya üzerinde bulunan belli başlı kapalı havzaları, özelde ise Van Gölü kapalı havzasını incelemektir. Ayrıca bu kapalı havzalardaki göllerin insanlık tarihi içindeki seyrini ve beşerî faktörlerin göl seviye değişimleri üzerindeki etkilerini gözler önüne sermektir.

INTRODUCTION

Closed basins in the world are mostly formed in the inner parts of the land and in places that are low compared to their surroundings. For this reason, humid air masses cannot be introduced into these regions and as a result, arid and semi-arid climates are formed. Closed basin lakes are the places with the highest number of people within their geographical boundaries. In addition, living species and numbers decrease as you move away from the immediate surroundings of these places, which are rich in living species. Any hydrographic intervention to the closed basin lakes can cause a serious change in lake level. Because these lake ecosystems find habitat on very delicate balances. When we examine both the important lakes in many parts of the world and the closed basin lakes in Turkey in the last century, it is seen that the main reason for the decrease in the levels of these lakes is human. Because as people increase irrigation and mechanization, perhaps more importantly, as people's needs increase and diversify, their needs for fresh water resources also increase. This situation causes the Rivers feeding the closed basin lakes to not reach the lakes. On the other hand, there are some closed basins on the sea or ocean coasts.

The factors forming the closed basin areas in these areas are the same as those forming the closed basin areas in the inner parts of the land. The presence of mountain ranges that prevent the arrival of moist air masses in these areas and even the fact that these mountain ranges cause the incoming air masses to have a Föhn effect on the places they arrive, is an important factor affecting the water levels of closed basin lakes. In other words, the surface shapes around the closed basin areas not only reduce the amount of precipitation, but also increase the evaporation in the basin and cause a drying effect.

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1. PURPOSE

Throughout history, there has been an ongoing reciprocal relationship between man and the natural environment. There are numerous examples of human destruction on the natural environment in this relationship. One of these examples is the changes that occurred in closed basin lakes due to human influence. At this point, the aim of the study is to examine the main closed basins in the world in general, and the closed basin of Lake Van in particular. It is also to reveal the course of the lakes in these closed basins in human history and the effects of human factors on lake level changes.

2. MATERIAL AND METHOD

In the study, firstly, the literature on the subject was searched and the necessary data were obtained from the relevant institutions. Then, notes were taken during the field studies (excursion-observation method), and the literature and field studies data were compared and synthesized.

Google Earth Pro, MGM Sphere and ArcMap 10.5 programs and satellite photos were used for the maps shown in the study.

3. CLOSED BASINS ON THE WORLD AND CHANGE OF WATER POTENTIAL IN THESE BASINS

The lakes in the Asian continent are at the forefront of the places where people have clearly influenced the change of closed basin lake levels throughout history. Cutting the rivers feeding the Hazar and Aral Lakes, the world's largest lakes, for energy and irrigation purposes, has irreversibly affected the levels of these lakes. Since the aforementioned areas are in the closed basin position, their chemical structures are affected as well as their levels, resulting in the extinction of many living species. The deterioration of the ecosystem balance in these areas can cause serious ecological problems (Figure 1).

Source: <http://www.gribilge.com>

Figure 1: Closed Basins on Earth

When the map above is examined, it will be seen that there are mountainous areas that are high enough to form a barrier against the air masses which may come to the Asian continent. These mountainous areas make their presence felt especially in the southern and southeastern parts of the basin where the lakes are located. Moreover, these basins are quite far from humid air masses. However, when the fronts of the Rivers feeding the lakes are cut off for irrigation and energy etc. this collective chain of negativities, which occurs together with seasonal factors, adversely affects the lakes (Figure 2 and Figure 3).

Figure 2: Location of the Caspian Sea and Aral Lakes on the Physical Map

Figure 3: Location of the Caspian Sea and Aral Lakes on the Political Map.

Caspian Sea: The climate seen in the Hazar Lake basin varies according to the regions. Continental climate prevails in the north of the lake, and temperate climate conditions prevail in the central and southern parts of the lake. However, in general, the average temperature in the area where the lake is located varies between 24-26°C in summer while temperatures vary between -10 and 10°C in winter. The annual precipitation in the region is between 200-1700 mm and varies greatly from place to place. (Karaağaçlı, 2013). Since the lake is not connected to the open seas, there are constant changes in the water level. Between 1930 and 1957, the lake level decreased by 26 m. For this reason, the area it covers has narrowed to 53,300 km² and has been reduced to 371,000 km². The reason for the decrease in the water level is the use of the Volga (Idil) River, which constitutes 80% of the water that feeds the lake, for irrigation and industry. After this date (after 1957), all efforts to restore the level of the Hazar Sea have been inconclusive.

Lake Aral: The Lake Aral, which has the characteristics of a closed basin, is located within the borders of Kazakhstan and Uzbekistan. It was previously the fourth largest lake in the world with an area of 68,000 km². In recent years, it has lost 90% of the area it covers due to excessive irrigation. In the early 1960s, economists decided to intensify cotton cultivation in Uzbekistan and Kazakhstan. The waters of the Syrdarya and Amuderya rivers flowing into the Lake Aral were used to irrigate these lands. Thus, 20 to 60 km³ of fresh water was used for land use.

As a result, the level of the lake decreased by about 20 cm per year in the 1960s, 50-60 cm in the 1970s, and 80-90 cm in the 1980s. Due to excessive irrigation, the Lake Aral was divided into two as Small Lake (in the north) and Big Lake (in the south) in 1989. The Lake Aral, which was 68,000 km² in 1960, became small at around $\frac{3}{4}$ (51,000 km²) in 2005 (Figure 4).

Source: <https://www.akvaryum.com>

Figure 4: Temporal change in the Aral Sea area / Satellite Image of Lake Aral

As can be seen in the satellite maps given above, the world's 4th largest lake has faced the danger of extinction as a result of the unconscious interventions of people over a period of 50-60 years. The most important reason for the drying up of the lake can be shown as human intervention. Many documentary films have been made about the lake, which has a great contribution to the economy and ecosystems. (<https://www.youtube.com/watch?v=yDX3Hm8mjCo>).

Lake Chad: It is a partially swampy lake located in Chad. It is located in the west of the country, close to the border of Niger, Nigeria and Cameroon (Figure 5). The area of the lake is 25,600 km². The northwest of Lake Chad is indented. Its northeast is covered with sand and looks like an area suitable for settlement.

Figure 5: Location Map of Lake Chad

The salinity of the lake water is low. For this reason, corn and wheat cultivation is carried out in the lands recovered by drying the depressions around the lake. The salt accumulated in the hollow areas on the shores of Lake Chad is processed by the local people living on the shores. The waters of Shari and its important branch, Lagona, coming from the south of the country, flow into Lake Chad. Lake Chad, which is among the few lakes in the world, is now shown among the lakes that are about to dry out in Central Africa. The lake, which once bordered Niger with Cameroon, Nigeria and Chad, appears to have disappeared from its border with Niger since the early 2000s (Figure 6). The water part of the lake is bordered by Chad, Nigeria and Cameroon today. About 75% of the lake is on the border with Chad while the remaining 25% is on the border of Cameroon and Nigeria. The surface area of the lake, which increases to 20-25 thousand km² in rainy months, decreases to 8-10 thousand km² in the dry period. The main reason for this is that the water cannot reach the lake due to human factors at the time of feeding. The average depth of the lake is 3-4 meters and many parts of the lake are covered with reeds. Lake Chad has been searching for the days when it gave life to the region today (<http://www.cografya.gen.tr>).

Source: <http://turkbilimi.com>

Figure 6: Level Change of Lake Chad in Photographs Taken at the Same Periods of Different Years

Lake Urmia: It is located in a tectonic trough extending in the South-North direction. It is situated in the northwest of Iran, between East Azerbaijan and West Azerbaijan Province. The Urmia Lake basin is mostly dominated by semi-arid climatic conditions. Typical topographic forms of semi-arid regions are particularly evident in the geomorphological units around the lake. Besides, the fact that the basin is wide and the presence of various rocks has caused the presence of elements different from the semi-arid topography forms in the basin.

Lake Urmia is the second largest salt lake in the world in terms of size. It is one of the important salt production areas of the world and Iran. It forms the lowest part of the Urmia depression. The height of the lake from the sea is 1,274 m. Due to the changes in the lake level, an average of 4 m change has occurred over time. It is observed that there is a continuous decrease in the level of Lake Urmia (Figure 7). Depending on the level changes, the surface area of Lake Urmia varies between 6,000 and 4,500 km². Its basin has an area of 52,209 km². Urmia Lake has an average depth of 5-6 m. The areas with the greatest depth are located in the northwest of the lake. This depth is 16 m. The rivers feeding the lake are Acıçay in the northeast, Azerşehr Stream, Sofi Stream and Merdi Stream in the east and southeast. There are Simineh and Zerrineh Rivers in the south, Godar River in the southwest, and Baranduz, Nazlu, Berdsur and Zola Rivers in the west. There are quite a lot of groundwater outlets on the lake sides and inside the lake. Tabriz and Urmia are the largest settlements on the shore of the lake. In the lake, whose area has been shrinking for a long time, evaporation occurs between 0.6 mm and 1 mm per year (Akar, 2011).

Source: <http://turkbilimi.com>

Figure 7: Satellite Images Showing the Change of the Urmia Lake Boundary

Irrigation canals and dams built on the main rivers feeding the Urmia Lake prevent the lake from being fed. The height of the evaporation intensity may cause the lake to become small or even disappear over time. A large bridge connecting Urmia to Tabriz over the lake is now completely inland.

The lakes given above are the largest closed basin lakes in the world. While these are lakes with

a history of one hundred thousand years, it is seen that there are great changes in their levels due to the wrong and unplanned use of water by people. Perhaps they will never be able to reach the same level again. Changes in lake levels or the disappearance of lakes cause serious problems on the ecosystem and environment. This unpredictable course will cause the drying up of many lakes in Turkey, and it will also cause significant adverse events for Turkey's largest lake, Lake Van.

Lake Van: A large part of Lake Van is situated within the borders of city Van. The lake is located between 42°-44° east meridians and 37°-39° north parallels. The surface area of the lake is 3764 km². Its length is approximately 125 km. Its width is 65 km. Its height above sea level is 1649 m.

The boundary of the Van Lake basin is determined by the surface waters feeding the lake. For this reason, the hydrological boundaries (like other basins in Turkey) are accepted as the boundary of the basin. The Lake Van basin is bordered by the Tigris (Dicle) in the south and the Euphrates (Fırat) in the north and west. The area of the lake basin is approximately 20,000 km², of which 3,764 km² is the lake itself (Çiftçi et al., 2008:61). The height of the basin above sea level (basin average) is 2,185 m, the average slope of the basin is 6,5%. This shows that the rivers in the basin have a high potential to erode backwards and deeper.

In order to understand the level changes related to Lake Van, the general characteristics of the basin should be well known. Therefore, it would be appropriate to examine the geological and geomorphological features and climatic data that introduce the basin. In scientific studies on the level changes of Lake Van in recent years, the effects of geological and geomorphological factors along with climate changes are frequently mentioned. In fact, many studies have been conducted that link the main reasons for the climatic differences of the Van Lake basin compared to its immediate surroundings to these factors.

Rivers of different lengths flow in the Van Lake basin. Due to the low flow rates of rivers pouring into Lake Van, seasonal flow differences, and high slopes, they are not used in transportation. However, the valleys of these rivers facilitate the development of highways. Rivers in the basin have also attracted settlements. When we look at the distribution of settlements in Van, it is seen that they are collected either in the plains near the lake or along the rivers. The people living along rivers and on plains near the lake, primarily use the rivers for agriculture, irrigation and housing, etc. (Baytar, 2014: 56).

Geological Features: Perinçek says about the geological structure of Eastern Anatolia: "The compression that occurred in the Middle Miocene begins in the neotectonic period in Eastern Anatolia. When the compression was in the north-south direction, folds with east-west axes and landforms with slopes directed to the north and south were formed. Because of this, strike-slip faults, opening cracks, and widespread volcanics emerging from the cracks have occurred. (Perincek, 1980:30-57).

Şaroğlu and Güner made the following determination. "They state that Eastern Anatolia, including the basin, had a shallower structure in the Oligocene, and the basin became prominent in this period. There are rocks that can form in deep seas in the basin. At the same time, there are sedimentary sediments that can form in shallow seas. However, it is determined that the latest sediments were formed in the lower Miocene during the paleotectonics. According to determinations in this study, sandstone, claystone, marl, conglomerate, limestone, tuff and agglomerates in the basin are the fourth period rocks" (Şaroğlu and Güner, 1981:39-50).

The Van Lake basin consists of rocks of all ages and different lithological features from Paleozoic to current sediments. The geological distribution of these rock groups can be considered relatively regular. The geological structure of the Van Lake basin is generally composed of faults and folded structures. In other words, it is the excess of folds and faults that mark the Van Lake Basin. The north of the lake was formed by volcanic activities. (Şaroğlu and Güner, 1981; Güner, 1984; Şengör et al,

1985; Toker and Şengör, 2011). Regarding the geology of the Van Lake basin, Çiftçi and his friends say the following: "There are rocks of all ages in the basin from the Paleozoic to the present. Generally, the rocks in the south and southwest of Lake Van are metamorphic, there are young volcanics on the north and northwest sides, and Mesozoic aged oceanic rocks on the east sides"(Çiftçi et al, 2008.61) (Figure 8). Due to geological factors, as a result of the sedimentary layers taking on an inclined structure towards the basin, there is an underground flow from the province of Bitlis to the basin. This situation causes the underground waters of Bitlis province, which is located in the inner part of Turkey but has a high amount of precipitation, to have a greater effect on the level change of the lake. Many studies have been conducted on the great changes in the level of Lake Van during the Quaternary. (Lahn, 1948; Maxon,1936; Bobek, 1938; Ardel, 1944; Erinç, 1953; Valetton, 1978; Kempe et al., 2002; Yıldız and Deniz, 2005; Litt et al.,2009).

Figure 8: Generalized Tectonic-Stratigraphic Column Section of the Van Lake Basin (Çiftçi et al., 2008, p. 61)

Geomorphological Features: The Van basin has a mountainous structure with high elevation and slope (Figure 9). However, the lake surroundings and some high plateau areas are different from these features. The plains on the coasts and the Erciş, Başkale, Özalp and Gürpınar plateaus are among the important plains. In general, there are peaks from place to place on the high mountain ranges and individual mountain areas that define the borders of the basin. The heights of these peaks can sometimes reach 4,000 meters. While the mountains in the southwest of the lake rise right after the lake, the ones in the east are far from the lake. Therefore, the Van Lake basin is among the places where the landforms differ the most in Turkey. From the northwest to the northeast of the lake, there are generally volcanic mountains and lands. Nemrut, Süphan and Tendürek volcanic mountains are the ones that define the western and northwestern borders of the Van Lake basin. The tectonic origin mountain ranges define the borders on the east and south sides of the lake. Pirreşit, İspiriz, Mengene İsabey, Ereğ, Sudis and Başet mountains are the ones with heights of 3,000 meters. There are many mountains in the south of the lake with an altitude exceeding 3,000 (Gürer and Yıldız, 1996).

Figure 9: Location of Lake Van Basin

There are many lakes around Lake Van. The leading ones of these lakes are Nemrut, Erçek, Nazik, Aygır and Sihke Lakes. Erçek is an inner basin or micro-basin located in the Van Lake basin. Erçek Lake has a size of around 100 km².

The important rivers feeding Van Lake are as follows: Deliçay flows into the lake from the east of Erciş district, and Zilan River into the lake from the west of Erciş. Bendimahı River pours into the lake from the southwest of Muradiye district, while Karasu River reaches the lake from the east of the lake, And Engil River feeds the lake from Gevaş and Gevaş River from the southeast. Surfesor River is one of the rivers feeding the lake from the northwest side.

Climate Characteristics: The climate of the Van Lake basin cannot be fully understood when only local factors are considered. Because although Van Lake is under the influence of local factors, the general climatic elements that determine the characteristic features of the Turkish climate can produce results that eliminate the influence of local factors. Erinç says the following about the climatic conditions of “Turkey is a piece of land located between 36-42 northern parallels. When evaluated in terms of large climate types, it is seen that our country is not under the influence of only one directional air mass throughout the year. In Turkey, it is under the influence of the macro-climate known as the Mediterranean climate, which emerges on the western coasts of the continents in the middle belt in general, and is under the influence of other factors that make up this climate. In the north of this area are the core areas of the polar air masses and in the south of the equatorial air masses. Therefore, Turkey is under the influence of polar air currents in winter and tropical air masses in summer” (Erinç, 1996: 295-302). In addition to general factors, local factors also have important effects on the climate of the basin. Altitude differences, viewing conditions, location according to local air movements coming from the lake, and the climate in the basin, which changes with short distances, can show sudden changes locally. The Van Lake basin, which is in parallel with Turkey in terms of annual temperature and precipitation changes, differs from the average of Turkey according to the distribution of temperature and precipitation in the basin and the altitude average of the basin. Districts such as Çaldıran, Başkale and Özalp, located on the border of the Van Lake basin, constitute the coldest and continental parts of the basin in terms of average temperature. Precipitation, on the other hand, is more common in the west and southwest directions of the basin, while it is less in the east and south directions of the basin. The sunbathing situation also differs within the basin according to the slope and aspect, and this situation is effective in the difference in humidity and pressure in the basin.

The water temperature of Lake Van, which is the world's largest soda lake, drops below 20-23 °C on the surface in summer and below 0 °C in winter (Erginyürek, 2018:5). The closed basin of Lake Van is one of the places with the highest average elevation in Turkey. This situation also causes a decrease in the temperature of the lake water and thus a lower evaporation rate on the lake surface.

In terms of climatic and physical factors, Lake Van has similar characteristics with the lakes located in different parts of the world, which were mentioned before. Terrestrial climatic features are present in Lake Van as well as in the Hazar, Aral and Urmia lakes. The fact that Lake Van is surrounded by mountains can be counted among the most important factors preventing humid air masses that may come from the north and south directions. Towards the east of the lake, the great Asian land mass is approached. This is a situation that increases terrestrial factors. In such a case, the sustainability of these rivers feeding the Van Lake, together with the existence of the rivers, also has a significant impact. The average rainfall in the Van Lake basin is 385 mm. The months with more precipitation are March, April, May, and the ones with less precipitation are July, August, and September. April and November are the months with the highest precipitation in the basin (Figure 10).

Figure 10: Seasonal Distribution of Precipitation in the Van Lake Basin

Both the insufficient amount of precipitation and the irregular distribution of precipitation over the seasons make it necessary to use rivers for irrigation purposes. Dams for irrigation purposes, which were built long ago in the basins where other lakes are located, started with a delay for the Van Lake basin. The problems faced by the closed basin lakes in the examples given above are also seen in Lake Van. Many factors were effective in the slower course of this situation in Lake Van.

These factors can be listed as follows:

1. The average depth of the lake is high (174 m). The low depth of the lakes mentioned above has been the main reason for the decrease in their levels and the rate of level decrease.
2. Low average temperature due to the high average elevation in the basin. (1727 m)
3. Low evaporation intensity due to low average temperature (9,3°C).
4. Since the mountains start just behind the shore in a large part of the lake, there are few shallow places.
5. The formation of a significant part of the water feeding the lake in the form of snow and rain water seasonally. (The area covered by the surface waters that flow in this way and feed the lake is approximately the surface area of Lake Van). In this case, it is more difficult for people to turn these waters into investment vehicles or to control them.
6. It can be listed as the fact that the dams and ponds built on the rivers still have not reached the level to prevent all of the main sources feeding the lake.

As a common result of all the studies carried out to date, the following conclusion can be reached. The main reason for the level change in Van Lake and all other closed basin lakes is climatic factors. Climate elements such as temperature, precipitation, precipitation pattern, evaporation and evaporation intensity, humidity amount and rate have affected the changes in the levels of these lakes. As a result, both short-term and long-term climatic variations for various reasons are effective in the level changes of closed basin lakes.

Lake Van is one of the largest lakes in the world. The level of Lake Van has changed many times from past to present. It is seen that the level changes of the lakes, especially after the 2000s, are only in the form of a decrease in level. One of the main factors affecting these level drops is human activity. This situation emerges as a different reason from the level drops seen so far. Unfortunately, the most basic factor that causes many lakes in Turkey to decrease in level and even dry out after the mentioned time period is unfortunately the human factor. Population growth causes the growth of cities and the rapid depletion of natural resources (Baytar and Doğan, 2019: 178). The increase in the population in the basin and the opening of new agricultural areas to irrigation accelerate the depletion process of natural resources.

Considering the precipitation and evaporation of climate elements, it can be said that the amount of precipitation did not decrease in this time period (after 2000), on the contrary, it increased. Both the acceleration of the construction of dams and ponds for the purpose of irrigation and energy generation, and the formation of precipitation in the form of rain due to the greenhouse gases released into the atmosphere, mostly due to human origin, are effective on the lake level change in this period.

Except for the Zerneke and Sarımehtmet Dams, which were among the first dams built in the late 1980s, on the rivers around Lake Van, ponds and regulators, irrigation channels and irrigation facilities started to be active after the 2000s. Taşkonak and Topsakal 2010, Işıkpınar 2012, Bağrıyanık 2013 etc. irrigation facilities can be given as an example (Bozkoyun and Elmastaş, 2019: 1247). After this date, it can be said that there was no noticeable increase in the level of Lake Van. For example, the level of Lake Van rose by 2 m after the 1994-1995 snowfalls (120 cm) and low evaporation intensity. On the other hand, in the year with the highest snowfall in the last 90 years (2019- 2020, 100 cm), it is seen that the lake level does not increase, but decreases. In other words, it can be said that the level of Lake Van shows a decrease in general after the 2000s with the effect of human factors. The areas where this drop in lake level is best observed are shallow areas. The shallow areas around Lake Van, where the lake depth is low, are generally the places in which the rivers pour into the lake. These are also sample areas that will give clues to the lake level change. The lake depth in and around the mouths of Zilan, Deliçay, Bend-i Mahi, Karasu and Engil rivers is shallow due to the alluvial materials brought. It is possible to observe the decreases in lake level from Google Earth maps. Of course, before looking at these images, the following should be known.

- There are 30-50 cm fluctuations in the lake level annually. This is due to the fact that the precipitation is not regularly distributed over the seasons, the precipitation type and the intensity of evaporation.

- The month in which the lake level rises the most during the year is July, and the month with the lowest is December-January. The reason for this situation is the increase in the severity of continentality with the effect of altitude and latitude, and as a result, the climate in the basin turns into a harsh continental climate and the variation in precipitation and evaporation.

Satellite images of the years 2011 and 2020 below prove that the lake level has decreased by 900 m in the same area. Although the lake level reached its highest level as of the end of July in previous years, it is seen that the lake level decreased in 2020 on the contrary to this situation. Moreover, the year this image was taken (2020) was the one in which the most snowfall of the last 90 years was seen in the basin. This shows that human factors other than climatic factors have an effect on the change in the lake level (Figure 11-12).

Figure 11: A Google Earth Satellite Image of Shallow Sites at the Mouth of the Bendimahi Stream Showing Inundated Sites in June 2011

Figure 12: A Google Earth Satellite Image of Shallow Sites at the Mouth of the Bendimahi Stream Showing Inundated Sites in June 2020

Below, in the satellite images taken at two different times (2009-2019) and showing the same area (island and land), it is seen that the island merges with the land (<https://www.haberturk.com>). Again, when attention is paid to the places indicated by arrows, it is seen that there is a retreat of hundreds of meters (Figure 13,14).

Figure 13: Google Earth Image in 2009 in Çelebibağ Town, Van / Around Erciş

Figure 14: Google Earth View in 2019 in Çelebibağ Town, Van / Around Erciş

Every year, Lake Van recedes a little more. Looking at these images taken ten years apart (in the same season), it is seen that there is a narrowing of 300 m to 1 km between different shallow coasts (Figure 15-16).

Figure 15: North of Lake Van, South of Erciř Google Earth 2009 Satellite Image

Figure 16: North of Lake Van, South of Erciř Google Earth 2019 Satellite Image

It is possible to increase the examples showing the lake level change above. When the meteorological data of the basin are examined, it is seen that although there is a change in the amount of precipitation, there is no significant decrease and even the average amount of precipitation has increased in the last ten-year period. The year 2019-2020 shows this situation. Despite this situation, the

decrease in the lake level is due to the increase in irrigation canals, irrigation water, dams and ponds, as in all other lakes with closed basins, because of the fact that the rivers that need to reach the lake and constitute a balancing element cannot reach the lake.

Considering all the positive reasons that prevent the lake level from falling, it is clear that Van Lake has/will experience a decrease in its level, although it is not as fast as other lakes. In order to prevent this, they should give up activities (dam construction, pond, excessive irrigation, etc.) that will prevent the rivers that feed the lake from reaching the lake.

CONCLUSION AND RECOMMENDATIONS

- As in the closed basin lakes of the world, the lake water level is in a delicate balance in the closed basin of Van Lake. Therefore, the water budget for the Rivers feeding the lake should be well calculated in order not to encounter irreversible ecological problems as in the closed basin lakes in Asia, Africa and America.
- The decrease in the level of Van Lake is a negativity that will cause significant economic costs in every respect.
- It is obvious that the dams and irrigation canals built on the rivers feeding the Van Lake, increasing day by day, will cause the negative situation of the Caspian (Hazar), Aral, Urmia and Chad lakes to be experienced for Van Lake as well.
- Transfer of modern methods and technologies for water saving by relevant institutions and organizations to the people engaged in agriculture will create a positive result.
- Distillation methods should be expanded so that the resources that feed the lake can reach the lake more and feed the lake.
- Necessary measures should be taken by relevant institutions and organizations (public, civil) in order to protect the wetlands in the Van Lake basin, which is one of Turkey's most important plant-bird species and diversity areas, and to prevent the natural balance from being destroyed by the influence of humans.
- The risk of lowering the level of Lake Van negatively affecting the living conditions of 1,500,000 people in the basin should not be ignored.
- A "basin planning" should be done in absolute terms with the participation of all stakeholders in the basin.
- It is important to raise public awareness about water saving.
- As a result, Lake Van, like other closed basin lakes in the world, is at great risk. If necessary precautions are not taken, this risk will increase due to population growth, unplanned growth of settlements and other factors.

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