Assessment of the environmental sustainability of the Tödürge Lake sensitive area to be strictly protected in Sivas province, Turkey

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INTRODUCTION: None of the compounds found in the world is as important as water for the survival of life. Water is the liquid component of all living structures. In addition, water creates an ecosystem in which aquatic creatures' shelter, find food, reproduce, raise their young and benefit from dissolved gases. Aquatic ecosystems are important in having many rich species diversity and legacies of bio-ecological diversity. The idea of the protection ecosystem in the hydrological regime and are vulnerable to change. Aquatic ecosystems have many benefits locally, regionally, and globally, such as providing a habitat for wildlife and meeting their basic needs, regulating atmospheric processes and geochemical cycles for humans. These benefits are critically important (Tanyolac, 2009). Uncontrollable industrial, agricultural and domestic wastes are mixed in the lakes and the lakes are polluted and living things in aquatic ecosystems are threatened (Dirican et al., 2013; Dirican, 2009). A lake is a stagnant body of water that covers a certain area and is not related to the sea (Tanyolac, 2009). The number of lakes, which are spread almost all over the continents, exceeds tens of thousands. The lakes differ in terms of their size, as well as the physiochemical structure of their waters, their depths being, and the formation of the lake pit where the waters are collected. Lakes are fed by underground and surface waters. There are mineral salts dissolved in the lake waters. Due to evaporation, the salt density of the lake water increases. Especially in closed basins, the lake waters are salty since there is no surface flow. On the other hand, in open basin lakes, the mineral salt ratio is low because the waters are discharged from the surface. Lake waters can be bitter, fresh, mineralized, and salty. The reasons for this difference are climatic conditions, nutritional resources, the structure of the land where the lake is located, the size of the lake, its depth and whether there is a lake foot. Lakes have attracted the attention of human beings for centuries with their unique resources. Lakes are used for domestic, agricultural, and industrial water supply and recreation, flood control, commercial fishing, irrigation, and power generation. There is a constant exchange between the lake and the land by means of Direct Surface and subsurface flows enter and exit the lake. These flows carry various physical, chemical, and biological components, organic materials, sediments, and many other substances with them. The speed of these flows may differ depending on the lake's geographical structure, climate, and seasonal conditions. Lakes are critical natural resources sensitive to climate change. Lakes support the global legacy of bio-ecological diversity and provide essential ecosystem services. Lakes are also key indicators of local and regional watershed changes. This makes lakes useful for detecting Earth’s response to climate change. Lakes are important stagnant water bodies that protect the ecological integrity of any region, and they have an effective role in maintaining the ecosystem (Isidar and Eroçoşkun, 2021).

In the world, where the population has increased in recent years, industrialization and technology have developed rapidly, environmental pollution, deterioration of ecological balance, global warming, climate change, decrease in natural resources and uncontrolled growing cities and unplanned constructions are the important problems. These environmental and economic problems encourage people to be conscious and to work to prevent these problems from carrying them to future generations. At this point, the concept of sustainability and the systems based on this concept are seeking solutions to many issues that concern the future of humanity. With sustainability, the principle of maintaining the well-being and health of the environment will at least meet today’s conditions and needs for future generations. Environmental sustainability is based on the idea of transferring the bio-ecological environment to future generations with better conditions than the present, or at least preserving current conditions. Reducing the pressure on natural resources and not harming the ecological environment while continuing development are necessary to ensure environmental sustainability. Reducing resource consumption, using materials through recycled or renewable resources, recycling waste, protecting energy resources and meeting energy demand through renewable resources are the main objectives of environmental sustainability (Akgül, 2010). Environmental sustainability means protecting natural wealth. It requires that the rate at which we consume renewable materials, water and energy resources does not exceed the rate at which natural systems absorb and dissolve capacity by air, soil and water. Moreover, environmental sustainability includes the preservation of biodiversity and human health, as well as maintaining the quality of air, soil, and water at standards sufficient to always sustain life on earth. The Eastern Mediterranean, and its lake, is a protected area within the borders of Sivas Province, which must be strictly protected.

The objectives of this study were to evaluate the environmental sustainability of the Tödürge Lake sensitive area to be strictly protected to make suggestions regarding its sustainability.

MATERIALS AND METHODS: Tödürge Lake, which is a strictly protected area within the borders of Sivas Province, was chosen as the research area. Sivas Province is located between 35° 50’ and 38° 14’ east longitudes and 38° 32’ and 40° 16’ north latitudes in the Central Anatolian Region of Turkey. The province area, which starts on the high plateaus of Central Anatolia and rises to the east, ends with a mountainous and steep part in the Northeast and Southeast. Due to the geographical location of the region and its natural and cultural values, Sivas Province has important potential. Sivas Province has seventeen districts. The Black Sea climate is dominant in the part of the province’s territory that enters the Kızılırmak Basin, and the Eastern Anatolian climate is dominant in the part that enters the Euphrates Basin. All the natural lakes of the province are gypsum karst lakes, the main ones being Tödürge,
Tödürge Lake has been determined as a sensitive area to be strictly protected with ED50 6 Degree 37 Slice Number (Gazette, 2021). With this decision published in the Gazette (2021), Tödürge Lake and its vicinity were registered and declared as a “Sensitive Area to be Strictly Protected”, which will contribute to better protection of the lake. Thus, Tödürge Lake will be a much more specific area soon. To reveal the potentials of Tödürge Lake and its surroundings with its natural landscape features and bio-ecology, on this figure it is especially important to reveal the necessity of environmental sustainability for Sivas province and the country, its contribution to the region within the scope of urban ecology, its ecological importance, problems, and threats. Tödürge is a calcareous and slightly salty lake located in the Upper Kızılrmak Basin. Tödürge Lake is located on the side of Sivas-Erzincan highway, approximately 50 km from Sivas Province, between HAfk and Merkez districts on the left bank of the Kızılırmak River and 10 km away. The mathematical location of Tödürge Lake is between 39° 53’ north and 37° 36’ east coordinates. The area of the lake is approximately 5 km² and its height above sea level is 1295 m. Tödürge Lake is the biggest lake of Sivas Province and there are two islands in it. In most of the lakes, the depth varies between 4-10 m. At the entrance of the lake, there is Aksu Creek and a deep ravine where excess water is drained. There is a drying channel at the northwest end of the lake, and Tödürge Lake joins with the Kızılrmak River through this channel. For these reasons, Tödürge Lake has the characteristics of an open lake in terms of limnology. The water of the lake, which is fed both from the sources at the bottom and from the waters in the region, is calcareous and slightly salty.

A total of 8 fish species determined in Tödürge Lake, including six species (Cyprinus carpio, Silurus glanis, Squalus acanthias, Squalecephalus chalcoides, Chalcalburnus chlorolepis, Coopeta capoeta, Capoeta tinca, Chondrostoma nasus) belonging to the Cyprinidae family, one species (Orthisia angore) belonging to the Cobitidae family and one species (Silurus glanis) belonging to the Siluridae family (İnal et al., 2016). Among these fish species, the most abundant and therefore economically important fish species is carp (Cyprinus carpio L., 1758). According to the literature, carp is the most characteristic species in Tödürge Lake and is endangered and susceptible, while Silurus glanis and Orthisia angore are among the vulnerable and rare species in Tödürge Lake. Fishing, especially Cyprinus carpio, is carried out in the lake. Tödürge Lake and its surroundings, seventeen bird species belonging to eleven families are hatching. There are bird species such as Netta rufina, Podiceps cristatus, Anas crecca, and Cygnus cygnus which are endangered and susceptible. Although Tödürge Lake has gained the status of Important Bird Areas, especially as a habitat for waterfowl, this lake has not yet been declared a Ramsar Site. However, Tödürge Lake is one of the two nationally important wetlands in Sivas Province (Dirican, 2023).

There are many environmental problems today. Global warming, climate change, depletion of the ozone layer, desertification, deforestation, loss of biodiversity, industrial toxins, water, air and soil pollution are the first examples that come to mind (Liu and Zheng, 2016). The biggest source of pollution in the Kızılrmak Basin is natural resources. With the geological factors originating from the bed of the Kızılrmak River and the land it passes through, the Kızılrmak water contains high levels of salt and sulfate. The Kızılrmak River is not suitable for use as drinking water or for industrial use, except for the upstream section, which does not have a gypsum area. In addition to the Kızılrmak River, Tödürge Lake in Sivas Province is also exposed to salt and sulfate pollution by natural means. Tödürge Lake is in class-I water quality and the average annual nitrate amount is 7.6 mg/L. Due to global climate change, temperature increases and changes in precipitation regimes have negative effects on the sustainability of the Tödürge Lake and it is necessary to carry out the necessary actions and investigations in this area. The lake is the largest natural lake of Sivas Province. Existing water resources in this lake are exposed to some negative consequences due to changes in precipitation regimes and temperature increases. There

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**Table 1:** Primary properties of Tödürge Lake, which is a sensitive area to be strictly protected.

<table>
<thead>
<tr>
<th>Conserva tion Area</th>
<th>Province</th>
<th>District</th>
<th>Protected Area Size</th>
<th>Declared on Date</th>
<th>Protected Area Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tödürge Lake</td>
<td>Sivas</td>
<td>Zara</td>
<td>ED50 6</td>
<td>26.06.2012</td>
<td>137894 ha</td>
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<td></td>
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<td>Hafik</td>
<td>Derese 37</td>
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</tbody>
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**Figure 1:** Tödürge Natural Protected Area located within the borders of Zara and Hafik districts of Sivas Province, it was decided to be registered and announced as a sensitive area to be strictly protected on 26 June 2021 in accordance with Article 109 of the Presidential Decree No. Tödürge Lake, which is a sensitive area to be strictly protected, is 1378.94 hectares (table 1).
is an analogous situation not only in Tödürge Lake, but also in lakes in many parts of the world. However, Tödürge Lake has been affected by environmental pollution in recent years, and around the lake, visually disturbing pollution and neglect are observed. For these reasons, it is especially important to protect Tödürge Lake, use it correctly and transfer it to future generations.

Tödürge Lake stands out among the many natural beauties and touristic areas of Sivas Province. Tödürge Lake is of immense importance especially in terms of meeting the creative needs of the people of Sivas such as picnicking, walking and resting. Tödürge Lake and its vicinity is a recreation area frequently visited by the people of Sivas. Facilities for diving and water sports are provided by the lake. There are recreational facilities around Tödürge Lake, where boat trips are made. Natural lake areas are the most key areas for the city and the country. It is our responsibility to protect and preserve the natural environment, which is the basic resource of these lake ecosystems. Any break in one or more of the rings of the chain that creates the ecological balance affects the entire chain and disrupts this balance. The main purpose in water resources management is sustainability. It is the determination of a system that will not change the hydrological system's functioning without causing permanent damage to the source, but will also consider the needs of today, and the future generations. When designing this system, it should be considered that it complies with legal frameworks and that it is in a structure suitable for use under social and economic conditions. In addition to the sustainability of water resources management, another key factor is its effectiveness, that is, the most appropriate use (Aktüzüm et al., 2010). Tödürge Lake, wetland management plan was made in 2012, and in this management plan, targets for the protection, usage principles and sustainable development of this lake area were determined. A new management framework should be established that will ensure the protection of the sensitive area to be protected by Tödürge Lake, and then its integration with today’s cultural, social, and economic life. The management framework and sustainability of the sensitive area to be protected by Tödürge Lake should be ensured and the planning studies should be renewed according to variable community needs. The problem is that, the actions taken are in the basin status in the planning studies to be carried out in this direction, it would be beneficial to consider them within the scope of basin planning that considers into account all bio-ecological and urban structure. For a more effective and sustainable use of resources, it is important that planning strategies include bio-ecological and sustainable approaches. That is, considering the sustainability of the resources, which is the basic resource of these lake ecosystems. To protect Tödürge Lake, it is necessary to introduce it well, to understand all its complex bio-ecological, cultural, and social importance of Tödürge Lake. As a result of these, Tödürge Lake will become more beneficial for the region, region and country and can be transferred to the next generations in a healthy way.

CONCLUSION: The bio-ecological diversity, physicochemical properties, productivity, and natural beauty of the lakes constitute the environments preferred by people. The destruction of lakes, accelerated by population growth and technological developments, disrupts this balance. Unfortunately, lakes, which are the most valuable aquatic ecosystems in the world, are under great threat today. Negative human interventions in aquatic ecosystems cause serious problems especially in the environmental sustainability of our natural lakes. It is especially important for the region and the country that Tödürge Lake, one of the most important natural resources, is protected. It is an important symbol of Sivas Province, attracting the attention of visitors by taking on a different natural beauty in every period of the year. To protect Tödürge Lake, its environmental sustainability, and social importance of Tödürge Lake. As a result of these, Tödürge Lake will become more beneficial for the region, region and country and can be transferred to the next generations in a healthy way.

CONFLICT OF INTEREST: Authors have no conflict of interest.


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