



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

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ABSTRACT

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Lakes are important stagnant water bodies that protect the ecological integrity of any region, and they have an effective role in maintaining the ecosystem. Tödürge Lake, which is karstic, is in Sivas Province of Turkey. The average depth of Tödürge Lake, which is the largest natural lake of Sivas Province, is around 4 m. The lake has an extraordinarily rich habitat in terms of flora and fauna. Tödürge Lake and its surroundings are an area that should be protected with both natural environmental characteristics and cultural resource values. This study is about the environmental sustainability of Tödürge Lake, which was registered and announced on 26 June 2021 as a sensitive area to be strictly protected in Sivas Province of Turkey. A total area of 1378.94 hectares in and around Tödürge Lake has been determined as a sensitive area to be strictly protected. This is an incredibly positive step and is of immense importance for the future of Tödürge Lake. The Lake has gained an important status with its registration and announcement as a sensitive area to be strictly protected. With this status, the sensitive area of Tödürge Lake, which must be strictly protected, will now remain cleaner and be used in a more controlled manner. To leave a sustainable Tödürge Lake not only for the present but also for future generations, environmental impacts must be well managed individually and institutionally.

Keywords: Environmental sustainability, nature conservation, Tödürge Lake.

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 sustainability of ecological balance. Aquatic ecosystems adapt to 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 under threat (Dirican *et al.*, 2013; Dirican *et al.*, 2015). 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 physicochemical structure of their waters, their depths being, and the formation of the lake pit where the waters are collected. The 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 surrounding the lake. Surface and subsurface flows enter and exit the lake. These flows carry various physical, chemical, and biological components, organic materials, sediment, and many other substances with them. The speed of these flows may differ depending on the lake's geographical structure, climatic, 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 Ercoşkun, 2021).

In the world, where the population has increased in recent years, industry 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 the idea of sustainability, it is aimed to leave an environment that will at least meet today's conditions and needs for future generations. The environmental dimension of 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 regenerate. In addition, environmental sustainability means that the intensity of pollution released to nature does not exceed its absorption and dissolution 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 both human existence and well-being and the life of flora and fauna. Therefore, the main aim of environmental sustainability is the sustainability of natural resources, in other words, their protection, non-pollution and development. The aim of this study is to assessment the environmental sustainability of the sensitive area of Tödürge Lake, which is in Sivas Province of Turkey, which must be strictly protected.

OBJECTIVES: 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,

Hafik and Lota lakes. Sivas Province is very rich in terms of wild animals due to its geographical location. The fact that the province is a gateway between the Anatolian, Eastern Anatolian and Black Sea climates, and that the province's lands are rugged and steep, diversify its wildlife. There are plenty of partridges and rabbits in the rural areas of Divriği, Zara, Yıldızeli and Suşehri districts. There are plenty of winged game animals around Hafik, Kangal, Merkez and Ulaş districts; hawk and quail live. There are wild ducks in the reeds and marshes in Hafik and Merkez districts. Wild geese live around all lakes in the province. Cranes live on two small islets in Tödürge Lake (SDRRP, 2022). Fishing is plentiful in all the rivers and Tödürge, Hafik and Lota lakes in Sivas Province. The legislation on how to register, protect and use natural protected areas in Turkey was amended in 2017. It was published in the Official Gazette on 25.01.2017 with the name of "Conservation and Use Conditions of Natural Sites". With this legislation, the concepts of I, II, and III degree natural sites were changed (Gazette, 2017). While this legislation was being renewed, it was aimed to fill the gaps in the old regulations regarding the identification, registration, and approval of natural protected areas. With this update, natural site ratings have been rated as "Sensitive Areas to be Strictly Protected, Qualified Nature Protection Areas, Sustainable Conservation and Controlled Use Areas". In the same legislation, sensitive areas to be strictly protected, use of land for the protection of resource values and all effects on the area are limited. Land, water, and sea areas where people are prevented from entering the area when necessary and to be protected by taking special precautions for scientific research, education or environmental monitoring are defined as areas that must be strictly protected, where a building ban is imposed. (1) No action will be taken that may disrupt the effect of flora, fauna and their habitats, as well as topography and silhouette, (2) However, with the permission of the Regional Commission for Conservation of Natural Assets in these areas; (2.1) Although there is a definite construction ban, sewerage, drinking water, natural gas line, energy transmission line and forest fire road can be built from technical infrastructure services in areas that are mandatory by official and private institutions, (2.2) It is possible to construct structures that are necessary for the security and safety of the state, (2.3) The existing infrastructure and superstructure facilities and the licensed or licensed structures can be maintained and repaired, (2.4) It has been decided that beekeeping activities can be carried out provided that no structures are built. In this study, the general condition and environmental sustainability of Tödürge Lake, which was registered and announced as a sensitive area to be strictly protected by the Presidency of the Republic of Turkey, was evaluated. In this study, firstly, previous studies on the subject were investigated. Later, the announcement date of Tödürge Lake, which is a sensitive area to be protected, the surface area it covers and other information about this lake were collected. In addition, the environmental sustainability of Tödürge Lake was evaluated by making use of the observations and examinations made in the field.

RESULTS AND DISCUSSION: As a result of the evaluation of the protection status of the Tödürge Lake potential natural protected area (figure 1),

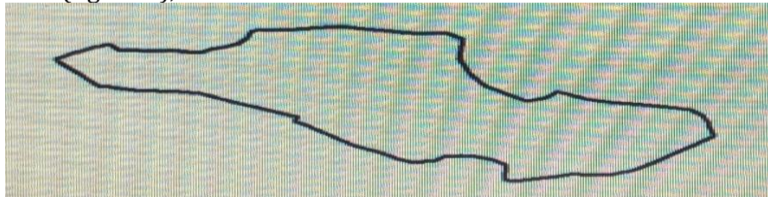


Figure 1: Tödürge Natural Protected Area located within the borders of Zara and Hafik districts of Sivas Province, it was decided to be registered and announced as a sensitive area to be strictly protected on 26 June 2021 in accordance with Article 109 of the Presidential Decree No. Tödürge Lake, which is a sensitive area to be strictly protected, is 1378.94 hectares (table 1).

Conservation Area Name	Province	District	Protected Area Slice Number	Declaration Date	Protected Area Size
Tödürge Lake	Sivas	Zara and Hafik	ED50 6 Derece 37	26.06.2021	1378.94 ha

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

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; at this stage, 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 Kızılırmak Basin. Tödürge Lake is located on the side of Sivas-Erzincan highway, approximately 50 km from Sivas Province, between Hafik and Zara districts. There is a village with the same name about 1 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 Acisu Creek and a discharge channel where excess water is drained. There is a drying channel at the northwest end of the lake, and Tödürge Lake joins with the Kızılırmak 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*, *Squalis cephalus*, *Chalcalburnus chalcoides*, *Capoeta capoeta*, *Capoeta tinca*, *Chondrostoma nasus*) belonging to the Cyprinidae family, one species (*Orthrias angorae*) belonging to the Cobitidae family and one species (*Silurus glanis*) belonging to the Siluridae family (İnnal 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 European Council's conservation criteria, *Cyprinus carpio* and *Chalcalburnus chalcoides* are endangered and susceptible, while *Silurus glanis* and *Orthrias angorae* 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 strepera*, *Phalacrocorax carbo*, *Ciconia ciconia*, *Ciconia nigra*, *Grus grus*, *Fulica atra*, *Larus ridibundus*, *Plegadis falcinellus*, *Himantopus himantopus*, *Ardea alba*, *Ardea cinerea*, *Ardea purpurea*, *Egretta garzetta*, *Aquila chrysaetos*, *Buteo rufinus*, *Accipiter nisus* and *Carduelis carduelis* in Tödürge Lake. Tödürge Lake has the status of an important bird area because it is an incubation area for about 40 pairs of *Netta rufina*. Tödürge Lake is among the important aquatic ecosystems of Turkey that must be strictly protected. 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 Kızılırmak Basin is natural resources. With the geological factors originating from the bed of the Kızılırmak River and the land it passes through, the Kızılırmak water contains high levels of salt and sulfate. The Kızılırmak River is not suitable for use as drinking and irrigation water or for industrial use, except for the upstream section, which does not have a gypsum area. In addition to the Kızılırmak 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 Tödürge Lake. Tödürge Lake is actually the most important and 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

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 main natural beauties and touristic areas of Sivas Province. Tödürge Lake is of immense importance especially in terms of meeting the recreational 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 as humans to protect, manage and sustainably use 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. When determining 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 (Aküzüm *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 conditions. Considering that Tödürge Lake and its surroundings 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, in the use of natural resources, it is necessary to develop strategies that will ensure the absolute protection of the natural and cultural resources of the settlement and their effective use.

Tödürge Lake is a sensitive area to be strictly protected, which includes different habitats such as natural lake ecosystem, lakeside ecosystem and reed field ecosystem. Tödürge Lake, like other lakes, has many natural and cultural functions. All these features increase the bio-ecological sensitivity of Tödürge Lake. There is a village with the same name, approximately 1 km from Tödürge Lake. The word Tödürge is the modified form of Dodurga, one of the old Turkish tribes. The word dodurga means "Taking a country, Making a khanate". Tepecik Tumulus located to the north of Tödürge Lake and Kültepe Tumulus to the northeast constitute the oldest civilization remains. Tödürge Rock Caves also contain about 100 caves that were created by carving into the rocks and used as dwellings. For this reason, Tödürge Lake and its vicinity, which stands out with its natural heritage, is the most important indicator of the rich cultural heritage of the region, which is home to a civilization that can be clearly traced from the first ages to the present.

Sustainability is also related to development. It aims to improve the quality of life of people, including future generations, by combining sustainable development, economic growth, social development, and nature protection. Sustainability is not only about the factors that threaten nature, but also about the rights that take care of all people and future generations. These rights include social and economic, civil, and political, cultural, and environmental safeguards (Gedik, 2020). Environmental sustainability aims at the balance of shelter, water, energy, and food within the framework of respect for the nature cycle. This concept provides integration between nature and humans by increasing bio-ecological diversity and ecosystem renewal. Environmental sustainability includes objectives such as clean

water and natural resources, renewable energy, organic culture, soil and food development, development and dissemination of green building technology, and evaluation and study of waste as a valuable resource. In environmental sustainability, preserving the current resource stock in the world and transferring it to future generations at least at the current level has a prominent place. Agriculture and animal husbandry are at the forefront in Hafik, Zara districts and Tödürge Village. Tödürge Village, Hafik and Zara districts, located near Tödürge Lake, benefit from the functions of this sensitive area to be protected. To minimize the situations that will cause eutrophication in agricultural activities around Tödürge Lake, it would be more beneficial to expand organic farming practices in agricultural production areas around the lake. Tödürge Lake, which has been discussed within the scope of this study, is one of the most important natural and culturally critical areas of Sivas Province. In this sense, more use should be made of Tödürge Lake, and it should be made more usable. It is a necessity of the modern nature protection approach to increase the welfare of the people living in the region by including the Tödürge Lake in ecotourism activities by considering the environmental sustainability balances. At the same time, it is especially important to develop nature-friendly economic activities based on Tödürge Lake, which is important for the region, and to support individual, state-supported, and private sectors in terms of theory and practice. To protect Tödürge Lake, it is necessary to introduce it well, to understand all its complex bio-ecological relations, to determine its carrying capacities and to comply with these capacities in use. All these situations are important for the environmental sustainability of the 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, has reached levels that will seriously damage the ecosystem. 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 beauties of Sivas Province, is registered and announced as a sensitive area to be strictly protected in 2021. Tödürge Lake will be safer and more sustainable with this decision. It is clearly seen how important the bio-ecological potentials of the region are, with the evaluations made for Tödürge Lake and its surroundings, the determination of the problems and the studies on solutions. In general terms, Tödürge Lake has a wide variety of bio-ecological and urban potentials. It covers the dimensions of environmental sustainability of Tödürge Lake related to the protection of the environment, cultural and natural order. It is especially important that the natural order of Tödürge Lake is preserved, and that the self-renewal feature of its resources is not damaged. Tödürge Lake 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 transfer it to future generations in a healthy way, it is especially important to use it smartly and manage it well.

CONFLICT OF INTEREST: Authors have no conflict of interest.

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