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Current Situation of Dam Lakes on Kızılırmak River in Türkiye with Fisheries Production Rights Leased

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ABSTRACT

The increase in the diversity of needs arising due to population growth, technological development and globalization leads to greater use of limited natural resources and brings with it consequences such as resource depletion and pollution. This study focused on the dam lakes on the Kızılırmak River in Türkiye, whose fisheries production rights were leased. On the Kızılırmak, the longest river within Türkiye's borders, there are İmranlı, Yamula, Bayramhacılı, Hirfanlı, Obruk, Boyabat and Derbent reservoirs, where the right to produce fishery products is leased. Among these, the most rented reservoir is Hirfanlı Dam Lake. The sustainability of fisheries in these reservoirs on the Kızılırmak River is important for meeting healthy protein needs and socio-economic development. The fisheries that have commercial value in these dam lakes, provide both employment and a significant economic contribution to the population of the province and district in which they are located. In order to utilize this potential in a healthy way, it has been concluded that it is very important to operate these dam lakes with a balance between protection and use. However, it is necessary to increase incentives and support for fishermen particularly in these fishing regions.

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Introduction

Water resources, one of the basic elements of human life, are one of the most important elements of economic activities. Water resources, that enable distribution of the population and the diversification of economic activities, are crucial for every society. Fishing activities in water resources are one of the oldest forms of human use of water resources (Koç, 2010). Since the past, fisheries has an important share in the nutrition of people. Fishing has always played an important part in people's diet. While most fisheries production in the past came from fishing, today fisheries and aquaculture have almost reached the breakeven. Population growth, excessive or unconscious hunting and adverse environmental factors unfortunately lead to a rapid decrease in natural fish stocks and even the risk of extinction of some species. Since natural resources are limited, it is known that the production obtained by hunting from nature cannot be increased any more. When fishery products are evaluated from an economic perspective oint of view, they are one of the important issues that show an intense supply and demand trend all over the world, and accordingly develop economic cooperation processes between countries. In addition to the fact that consumption habits are the most important determining factor, the developments in marketing capability as a reflection of globalization policies also increase the countries' demands for fishery products (Şakıma and Çevirimli, 2021).

Aquaculture is the most developed sector within the agricultural. Like everywhere else in the world, the aquaculture in Türkiye is developing day by day with its production and commercial dimensions. The seas surrounding Türkiye from three sides and the numerous rivers, lakes, ponds and dam lakes offer ample opportunities for fishing. Türkiye's annual inland water fishing production varies according to years, and between the years 2000-2020, 30.139-46.115 tons of fishery products were caught annually from inland water resources (GDF, 2021).

Humans use river water for various purposes. Rivers are one of the most important natural resources used by human for energy production, drinking water, irrigation and flood control. When we evaluate the rivers in Türkiye, the Kızılırmak River has the largest basin. There are provincial borders of Sivas, Kayseri, Nevşehir, Kırşehir, Kırıkkale, Ankara, Çankırı, Çorum and Samsun in the Kızılırmak River Basin. On the Kızılırmak River and its tributaries respectively; In total there are 12 important dam lakes in total, namely İmranlı, Yamula, Bayramhacılı, Hirfanlı, Kesikköprü, Kapulukaya, Buğra, Obruk, Dutludere, Boyabat, Altınkaya and Derbent (Arslan et al.,

2016). For this reason, the lease of the fisheries production rights of the dam lakes on the Kızılırmak River, where the right to produce fishery products is leased, is of great importance to the of inland water fishing in the region and Türkiye. This study is about the dam lakes on the Kızılırmak River in Türkiye, whose fisheries production rights have been leased.

Materials and Methods

The Kızılırmak Basin, the study area, is located in the eastern part of the Central Anatolia, although it is connected to the Black Sea. The Kızılırmak Basin is located between 37° 58' - 41° 44' north latitudes and 32° 48' - 38° 22' east longitudes. While the northern and eastern parts of the basin, which has 11% of Türkiye's surface area, are mountainous, the remaining part is hilly. Kızılırmak is the longest river in Türkiye with a length of 1151 km. It originates from Kızıldağ Mountain, near the İmranlı district of Sivas province, and passes through the provincial lands of Kayseri, Nevşehir, Aksaray, Kırşehir, Ankara, Kırıkkale, Çankırı, Çorum, Sinop and Samsun, respectively, and pours into the Black Sea from the Bafra Plain (Terzi and İlker, 2021). The Kızılırmak River flows mainly in April and July. With a width of 8.641.635 ha, the Kızılırmak Basin constitutes 10.87% of Türkiye's total surface area. Its average annual flow is 6.48 km^3. Kızılırmak River, which has such a wide basin, is exposed to domestic, agricultural and industrial pollution, especially while passing through the major urban centers of Anatolia (Taş, 2005).

The leasing of fisheries production sites until 2021 is carried out in accordance with the "Regulation on the Lease of Water and Water Areas Required for Fisheries Investments and the Right to Produce Fisheries in Sea and Inland Waters" published in the Official Gazette of 01 June 2011 numbered 27951 (Official Gazette, 2011). Since this regulation was amended in 2020, the leasing of fisheries production areas as of 2021 is carried out in accordance with the "Fisheries Products Rental Regulation" published in the Official Gazette dated 31.10.2020 and numbered 31290 (Official Gazette, 2020). According to the current law, the right to harvest by hunting in fisheries production areas can be leased by the Provincial Directorates of the Ministry of Agriculture and Forestry, taking into account with the approval of the General Directorate of State Hydraulic Works.

The determination of the annual size of fish stocks capable of being caught shall be carried out by the Ministry before the fishery production areas whose lease term has expired are leased for the new term. The rental price is determined according to the calculation method established in the Fisheries Information System according to the criteria to be determined by the Ministry of Agriculture and Forestry. The commercial production right for fishery products can be rented for a maximum of 5 years, the duration is being determined by the Commission. Amateur fishing be carried out in areas and at certain times to be determined by the Provincial Directorate, in accordance with the conditions determined in the communiqués published by the Ministry of Agriculture and Forestry, regulating commercial and amateur fishing, in places where the right to practice commercial fishing is leased.

Fishing activities were examined in seven dam lakes on the Kızılırmak River, where the right to produce fishery products was leased in accordance with the above criteria. In this study announcement information and data belonging to the Ministry of Agriculture and Forestry and Provincial Directorates of Agriculture and Forestry of these dam lakes within the scope of the research were used.

Results and Discussion

According to the January-2022 data of the Ministry of Agriculture and Forestry in Türkiye, there are seven dam lakes located on the Kızılırmak River, for which the right to produce fishery products is leased. These are İmranlı Dam Lake, Yamula Dam Lake, Bayramhacılı Dam Lake, Hirfanlı Dam Lake, Obruk Dam Lake, Boyabat Dam Lake and Derbent Dam Lake. Among these, a region has been leased in the lakes of İmranlı, Yamula, Obruk and Derbent. While two regions were leased in Bayramhacılı and Boyabat dam lakes, six regions were leased in Hirfanlı Dam Lake. The information on the fishing regions on the Kızılırmak River for which the production rights are leased are presented in Table 1. While Yamula Dam Lake and Bayramhacılı Dam Lake 2nd Region were leased for 3 years, the lease was realized as 5 years in other dam lakes (Table 1).

Table 1. Dam lakes of Kızılırmak River for which fisheries production rights are leased.

N	Dam Lake Name	Province	District	Leasing Dates
1	İmranlı Dam Lake	Sivas	İmranlı	17.08.2021-16.08.2026
2	Yamula Dam Lake	Kayseri	Kocasinan	01.02.2021-31.01.2024
3	Bayramhacılı Dam Lake 1st Region	Nevşehir	Avanos	05.11.2018-05.11.2023
4	Bayramhacılı Dam Lake 2nd Region	Kayseri	Bayramhacılı	30.12.2020-03.12.2023
5	Hirfanlı Dam Lake 1st Region	Ankara	Bala	15.04.2019-15.04.2024
6	Hirfanlı Dam Lake 2nd Region	Ankara	Şereflikoçhisar	20.12.2019-20.12.2024
7	Hirfanlı Dam Lake 3rd Region	Ankara	Evren	11.07.2019-11.07.2024
8	Hirfanlı Dam Lake 4th Region	Aksaray	Sarıyahşi	15.05.2017-15.05.2022
9	Hirfanlı Dam Lake 5th Region	Kırşehir	Merkez	27.03.2017-27.03.2022
10	Hirfanlı Dam Lake 6th Region	Kırşehir	Kaman	22.03.2017-22.03.2022
11	Obruk Dam Lake	Çorum	Oğuzlar	30.06.2017-30.06.2022
12	Boyabat Dam Lake 3rd Region	Çorum	Osmancık	12.10.2021-12.10.2026
13	Boyabat Dam Lake 2nd Region	Sinop	Saraydüzü	18.08.2021-18.08.2026
14	Derbent Dam Lake	Samsun	Bafra	11.11.2021-10.11.2026

There is İmranlı Dam Lake in the administrative part of Sivas province, where Kızılırmak River originates. İmranlı Dam Lake was built on the Kızılırmak River between 1994-2002 for irrigation and energy generation. The body volume of the dam, which is an earth body fill type, is 2.100.000 m^3, its height from the river bed is 49 m, the lake volume at normal water level is 62.50 hm^3, and the lake area at normal water level is 6.50 km^2. Many fish species such as *Cyprinus carpio*, *Capoeta baliki*, *Capoeta sieboldii*, *Barbus escherichi*, *Chalcalburnus chalcoides*, *Onchorhynchus mykiss* and *Squalis cephalus* are caught in İmranlı Dam Lake. İmranlı Dam Lake, located within the borders of İmranli district of Sivas province, has been leased to a person for 5 years, effective from 17 August 2021 (Table 1).

Yamula Dam Lake, which was established on the Kızılırmak River, was opened in 2005 and has a surface area of 82 million square meters, is among the few dams in Türkiye. Yamula Dam Lake is in Kocasinan district of Kayseri province (Table 1). The body volume of the dam, which has a clay core rock fill body, is 1.582.000 m^3, its height from the river bed is 120 m, the lake volume at normal water level is 2025 hm3, and the lake area at normal water level is 85.30 km^2. Thanks to the Hydroelectric Power Plant with a total installed capacity of 100 megawatts, approximately 423 million kilowatt-hours of electricity can be produced annually. In addition, with its 3.5 billion cubic meters of water storage capacity, Yamula Dam Lake makes a great contribution to the development of fisheries in Kayseri province. In cage fishing 23 enterprises engaged in Yamula Dam Lake have a production capacity of approximately 19.300 tons. Besides electricity generation, agricultural irrigation and fishing activities, Yamula Dam Lake also makes significant contributions to tourism, sports and the social life of the city. The people of the region, who catch fish at certain times with the permission of the Ministry of Agriculture and Forestry in the Yamula Dam Lake, which is about 25 km from the city center of Kayseri, see fishing as an important source of income for themselves (Kars, 2021). Fish species such as *Cyprinus carpio*, *Capoeta sp*., *Atherina boyeri*, *Onchorhynchus mykiss*, *Squalis sp*., *Sander lucioperca* and *Siluris glanis* are caught in Yamula Reservoir.

Kocasinan district of Kayseri province Yamula Dam Lake Fishing Region fisheries production right, in accordance with the procedures and principles of the "Regulation on Rental in Fisheries Production" dated 31.10.2020 and numbered 31290, by the Kayseri Provincial Directorate of Agriculture and Forestry Fisheries Rental and Tender Commission on 01.02.2021. It was leased to the Limited Liability Yamula Dam Fisheries Cooperative for a period of 3 years.

Bayramhacılı Dam Lake is on the Kızılırmak River, which passes between the provincial borders of Kayseri and Nevşehir in the Central Anatolia Region. Bayramhacılı Dam Lake, located on the Kızılırmak River, started to hold water in 2010. Bayramhacılı Dam, which is a rock body fill type, has a height of 45 m from the stream bed. Bayramhacılı Dam and Hydroelectric Santali have an installed capacity of 47 megawatts. Fish species such as *Cyprinus carpio*, *Capoeta sp*., *Squalis sp*., *Atherina boyeri* and *Siluris glanis* are caught in Bayramhacılı Dam Lake.

In Bayramhacılı Dam Lake, fisheries production rights were leased in two regions. The fishing right of the 1st Fishing Region of Bayramhacılı Dam Lake in Nevşehir province, Avanos district, for a period of 5 years, "Water and Water Areas Required for Aquaculture Investments, and Fisheries in Sea and Inland Waters," published in the Official Gazette dated 01 June 2011 and numbered 27951, It was leased to the Limited Liability Göynük Town Fisheries Cooperative between 05.11.2018 and 05.11.2023 in accordance with the "Regulation on Lease of Rights" (Table 1).

Kayseri province, Bayramhacılı district Bayramhacılı Dam Lake 2nd Fishing Region fisheries production right, in accordance with the provisions of the "Regulation on Rental in Fisheries Production" dated 31.10.2020 and numbered 31290, Kayseri Provincial Directorate of Agriculture and Forestry Fisheries Rental and Tender Commission between 30.12.2020 and 3.12.2023, for 3 years, to the Limited Liability Bayramhacılı Fisheries Cooperative.

Located in the Middle Kızılırmak Basin, Hirfanlı Dam Lake started its construction on the Kızılırmak River in 1953 and was put into operation in 1959. Hirfanlı Dam Lake, which is within the borders of Ankara, Kırşehir and Aksaray provinces, has an area of 26.300 ha. While the distance of Hirfanlı Dam Lake to both Ankara and Aksaray provinces is between 100-120 km, it starts from 15 km to Kırşehir. The dam, which is a rock body fill type, has a body volume of 2.000.000 m^3 and is 78 m high from the river bed. The volume of the lake at the normal water level of the Hirfanlı Dam Lake is 5.980 hm^3, and the lake area at the normal water level is 263.00 km^2. The hydroelectric power plant with a power capacity of 128 megawatts provides 400 GWh electrical energy production per year. The purpose of the Hirfanlı Dam Lake is to provide electrical energy, irrigation and flood control. The surroundings of the Hirfanlı Dam Lake are also used for recreation and entertainment purposes.

Rainbow trout farming is also done intensively in Hirfanlı Dam Lake. However, fishing is an important source of income in the villages around the Hirfanlı Dam Lake. Some of the people earn their living by fishing. Many fish species such as *Cyprinus carpio*, *Capoeta sp*., *Atherina boyeri*, *Onchorhynchus mykiss*, *Squalis sp*., *Sander lucioperca*, *Siluris glanis* and *Tinca tinca* are caught in Hirfanlı Dam Lake.

In Hirfanlı Dam Lake, fisheries production rights were leased in six regions. The fishing right of Ankara province Bala district Hirfanlı Dam Lake 1st Region Fishing Region is based on a total of 512 tons/year catchable stock for a period of 5 years. It has been leased to the Limited Liability Büyükbıyık Village Fisheries Cooperative between 15.04.2019 and 15.04.2024 in accordance with the "Regulation on Lease of Fisheries Production Rights in Sea and Inland Waters" (Table 1).

The fishing right of Ankara province Şereflikoçhisar district Hirfanlı Dam Lake 2nd Region Fishing Region is for a period of 5 years. It has been leased to the Limited Liability Şereflikoçhisar District Fisheries Cooperative between 20.12.2019 and 20.12.2024 in accordance with the "Regulation on Lease of Rights" (Table 1).

The fishing right of the Ankara province Evren district Hirfanlı Dam Lake 3rd Region Fishing Region is valid for a period of 5 years. It was leased to the Limited Responsible Evren District Fisheries Cooperative between 11.07.2019 and 11.07.2024 in accordance with the "Regulation on Lease of Rights" (Table 1).

Fishing right of Aksaray province Sarıyahşi district Hirfanlı Dam Lake 4th Region Fishing Region for 5 years "Water and Water Areas Required for Aquaculture Investments and Fisheries Production in Sea and Inland Waters" published in the Official Gazette dated 01 June 2011 and numbered 27951 It was leased to Peram Food Products Industry and Trade Joint Stock Company between 15.05.2017 and 15.05.2022 in accordance with the "Regulation on Lease of the Right" (Table 1).

The fishing right of the Kırşehir province Merkez district Hirfanlı Dam Lake 5th Region Fishing Region is valid for a period of 5 years. In accordance with the "Regulation on Lease of the Right", it was leased to Limited Liability Toklomon, Uzunali, Uşak, Sıdıklı Village Cooperative between 27.03.2017 and 27.03.2022 (Table 1).

The right to fishing for Kırşehir province Kaman district Hirfanlı Dam Lake 6th Region Fishing Region is valid for a period of 5 years. In accordance with the "Regulation on Lease of Rights", it was leased to the Limited Liability Prosecutor, Kurutlu, Kekilliali, Büyükoba, Ebeyiğit, Yeniköy, Hirfanlı Villages Fisheries Cooperative between 22.03.2017 and 22.03.2022 (Table 1).

The Obruk Dam Lake was built on the Kızılırmak River between 1996 and 2002 for the purpose of producing irrigation, drinking water and energy. Obruk Dam Lake is in Çorum province Oğuzlar district (Table 1).

Obruk Dam Lake is located in a geography where the Black Sea Region begins, where the Central Anatolia Region ends. The Obruk Dam is in a narrow valley in the north of Çorum province and is 30 km long, with a width not exceeding 600-700 meters. Obruk Dam, which is a soil body fill type, is 127.00 meters high from the river bed. The body volume of the dam is 12.00 cubic meters and the maximum lake area is 50.21 km^2. The installed power of the hydroelectric power plant is 202.8 megawatts and its annual energy production is 515 million KWh.

Fish species such as *Cyprinus carpio*, *Capoeta sp*., *Barbus sp*., *Squalis sp*., and *Silurus glanis* are caught in the Obruk Dam Lake. There is a fishing region of 5021 ha in Obruk Dam Lake. Obruk Dam Lake, which is located within the borders of Oğuzlar district of Çorum province, has been leased to Limited Liability Obruk Dam Fisheries Cooperative for 5 years, effective from 30.06.2017. Lease and tenders of the fishery production right of the Obruk Dam Lake Fishing Region are subject to the Law No. 6111 of 13/02/2011 on the "Restructuring of Certain Receivables, Social Security and General Health Insurance Law and Amendments to Some Other Laws and Decrees. It was made in accordance with the "Regulation on Lease of Fisheries Production Rights", which was published in the Official Gazette dated 01/06/2011 and numbered 27951, prepared by the Ministry of Agriculture and Forestry based on the temporary 12th Proviso.

Boyabat Dam Lake is located on the Kızılırmak River and approximately 80 km inland from the Black Sea. The construction of Boyabat Dam, which was established for energy and flood prevention purposes, was completed in 2012 and put into operation. Boyabat Dam Lake is 200 km from Çorum province and 80 km from Sinop province. Boyabat Dam, which is a concrete-weighted body type, is 195.00 meters high from the river bed. The volume of the dam's lake is approximately 3.5 billion cubic meters at normal water level. The length of the lake is 60 km and the area it covers is 65.5 km^2. Boyabat Dam Hydroelectric Power Plant has a power of 513 megawatts.

Fish species such as *Cyprinus carpio*, *Capoeta sp*., and *Silurus glanis* are caught in Boyabat Dam Lake. In the Boyabat Dam Lake area, fisheries production rights were leased in two regions. Boyabat Dam Lake 3rd Region, which is close to the borders of Çorum province, Osmancık and Kargı districts, has been leased to the Limited Liability Osmancık-Kargı Fisheries Cooperative for 5 years, effective from 12.10.2021.

Similarly, Boyabat Dam Lake 2nd Region, which is close to the borders of Saraydüzü district of Sinop province, has been leased to the Limited Liability Kızlırmak Fisheries Cooperative for a period of 5 years, effective from 18.08.2021.

Derbent Dam Lake is 15 km south-west of Bafra district center of Samsun (Table 1). Derbent Dam Lake was built on Kızılırmak River for irrigation, energy and flood control purposes. The dam, whose construction started in 1984 and started to hold water in 1991, is of rock body fill type. The body volume of the dam is 2.500.000 m^3 and its height from the river bed is 33.00 meters. It is approximately 17 km long and 1-2.5 km wide. It has a reservoir area of 16.50 km^2 at normal water level. The installed power of the hydroelectric power plant is 56.4 megawatts. Derbent Dam Lake is important in terms of fishing activities as well as energy and irrigation benefits. Derbent Dam Lake is very important for irrigation of the fertile Bafra Plain in the Kızılırmak Delta. Derbent Dam Lake provides a livelihood for the local people in terms of fishing in addition to agriculture. In Derbent Dam Lake, along with aquaculture, trout farming is also carried out in net cages (Taş, 2005). The area around the dam is also a place for promenade and rest.

In 1991, 70.000 mirror carp (*Cyprinus carpio*) and 80.000 rainbow trout (*Oncorhynchus mykiss*) fry were thrown into Derbent Dam Lake by Amasya-Yedikır Fisheries Production Station. Fishing activities continued in 1992, 1993 and 1994 by throwing carp and rainbow trout offspring. Existing fishes in Derbent Dam Lake; *Cyprinus carpio*, *Oncorhynchus mykiss*, *Capoeta sp*., *Perca fluviatilis*, *Sander lucioperca* and *Squalius cephalus* (Taş, 2005).

The fishery production right of Derbent Dam Lake, which is under the Rule and Disposition of the State of the Republic of Türkiye in the Bafra district of Samsun, has been leased to the Limited Liability Kolay, Boğazkaya and Environmental Villages Fisheries Cooperative for a period of 5 years as of 11.11.2021. The reservoir area is 1,650 ha at 58 m normal water level of the mentioned production area.

However, due to the fact that aquaculture is also carried out in Derbent Dam Lake, fisheries cannot be done up to 200 m from the aquaculture facilities as per the legislation. The estimated annual catchable amount for this region is 17.570 kg.

Ankara is the province that benefits the most from the dam lakes established on Kızılırmak, within the borders of the provincial administration through which Kızılırmak River passes, by leasing fisheries right. This is followed by the provinces of Kayseri, Kırşehir and Çorum. The provinces of Sivas, Nevşehir, Sinop and Samsun benefit the least. As in the rest of the world, the catchable stock size has been reached in the dam lakes where the right to fisheries has been leased on the Kızılırmak River, and there is not much opportunity to increase production through fishing. The protection of inland waters from all kinds of pollution and deterioration should be considered as the first priority while creating fisheries hunting policies. The fish is a nutrient that is among the indispensable elements of healthy nutrition. Among the foods of animal origin, fish has an important place in terms of its nutritional value and especially its high protein content. The protein value of fish is around 18-20%. Fish oil is the source of the most omega-3 fatty acids compared to other oils. In general consumption calculations, it is reported that fisheries consumption is 20 kg in the world, 24-25 kg in Europe, and 6-8 kg in Türkiye on average (Şakıma and Çevirimli, 2021). Accordingly, our per capita consumption of fisheries is quite low when European and world averages are taken into account in Türkiye. The fish is a nutrient that is among the indispensables of healthy nutrition recommendations. For this reason, we need to increase our per capita consumption of fisheries. This indicates that it is very important to ensure sustainable fisheries in the dam lakes established on the Kızılırmak River.

Carp (*Cyprinus carpio*) fishing is an important source of income in the dam lakes established on the Kızılırmak River and the right of production is leased. Carp is one of the most important inland water fish for human food due to its meat and eggs. In all dam lakes established on the Kızılırmak River, common carp fish are caught. It is extremely important to protect and sustain the stocks of species such as *Capoeta sp.*, *Squalis sp.*, and *Silurus glanis* whose catches are constantly changing due to hunting pressure. For this reason, area and species-based management plans should be made for the management of fish stocks in the dam lakes established on the Kızılırmak River and whose right of production has been leased.

New large stagnant water ecosystems, namely dam lakes, occur due to dams built on river ecosystems for purposes such as energy production, flood control and irrigation (Barlas and Dirican, 2004). Changing the natural structure and beds of the river can affect the life cycle of fish, causing the disappearance of some species or their isolation in certain areas over time. It is thought that after the construction of the dam lakes on the Kızılırmak River, anadromous and catadromous fish, which migrate for feeding and breeding, could not reach the upper parts of the Kızılırmak River and the existing individuals decreased or became extinct over time (Polat et al., 2008).

Fishes such as *Atherina boyeri*, *Oncorhynchus mykiss* and *Sander lucioperca* caught in the dam lakes established on the Kızılırmak River are not the native fish species of our inland waters. These are important invasive species that introduce into these fishing regions for various reasons.

The threat posed by invasive fish species in the dam lakes of the Kızılırmak River Basin is growing. Therefore, it is necessary to monitor the distribution of invasive species in the Kızılırmak River and the dam lakes established on it and to determine their effects on the natural fish species in the ecosystems they enter. Especially in Hirfanlı, Boyabat and other dam lakes, the invasive species *Atherina boyeri* is hunted. *Atherina boyeri* is excluded from the hunting ban by the Ministry of Agriculture and Forestry because it harms other species. *Atherina boyeri* (Risso, 1810) is a small fish and its body is covered with large cycloid scales. Their color is bright silver. That's why it's called silverfish. Although they are of marine origin, they can easily live in inland waters. They roam in large groups, usually near the water surface. Although this species is not consumed in Türkiye, it has been exported abroad in recent years because it is hunted in abundance. It is also used as a feed in the production of fish meal and in the feeding of cultured fish. *Atherina boyeri* is an alternative source of income for fishermen when fishing for other fish species is prohibited. While this invader, which is becoming increasingly important for both the people of the region and the economy of the country, is becoming important economically, it is also important for the functioning of the ecosystem to keep the *Atherina boyeri* under control from an ecological point of view. Otherwise, it is thought that *Atherina boyeri*, which is an invasive species, will have a negative result in terms of the ichthyofauna of dam lakes such as Hirfanlı and Boyabat, where the population density is high.

Prices of fish species obtained by fishing vary considerably in the dam lakes on the Kızılırmak River. In general, as the amount of fishing increases, prices decrease, and in periods when fishing decreases, fish prices increase. On the other hand, there are differences in fish prices between provinces. The reason for this is the increase in fish prices due to the transportation cost between provinces. Fishermen who make small-scale fisheries in the dam lakes established on the Kızılırmak River, whose right of production is leased, sell their products directly to the consumers, restaurants, or market them to the country and abroad through local brokers, without using any marketing.

Although there is no obstacle in terms of fishing ship license in inland water fishing, there is a condition that the water source to be hunted must be leased by the fishermen's cooperatives in order to participate in fishing. Fishing can be done on the Kızılırmak River by obtaining a fishing vessel license on behalf of the members in the regions where the right to produce fisheries is leased by cooperatives or individuals. Since almost all of these inland water fishing vessels are small vessels, their ship qualities and technological equipment are not as strong as those in the sea.

The Kızılırmak River passes through important industrial areas and city centers or merges with the streams coming from these regions. Industrial, agricultural, domestic and similar pollution sources coming to the Kızılırmak River ecosystem change the physical, chemical and biological properties of the water. This affects the entire aquatic ecosystem, especially the food chain in the ecosystems of the Kızılırmak River and the dam lakes established on it. With the water stored in the Kızılırmak

River and the dam lakes above it, a great income is provided to the economy of the region and Türkiye. In addition, both fisheries and aquaculture fisheries are actively carried out in some of the dam lakes established on the Kızılırmak River, and the majority of fish and other fishery products are consumed in the region. Especially the fisheries and aquaculture activities on the dam lakes established on the Kızılırmak River constitute an important source of income for the local people. In order for these fishing activities to be productive and continuous, it is necessary to preserve the natural balance in the Kızılırmak River and the dam lakes above it and transfer it to the future. For this reason, the biological, physical and chemical properties of Kızılırmak River and the dam lakes established on it should be determined regularly and necessary precautions should be taken, protected and its continuity should be ensured.

Conclusion

As a result, there are İmranlı, Yamula, Bayramhacılı, Hirfanlı, Obruk, Boyabat and Derbent dam lakes on the Kızılırmak River whose fisheries production rights have been leased. It is estimated that fisheries production will be adversely affected and fishing production will not increase further due to possible reasons such as pollution of the Kızılırmak River and the dam lakes on it, deterioration of habitats, climate change, fishing pressure and decrease in fisheries stocks. For this reason, the basic principle in fisheries of the Kızılırmak River and the dam lakes on it should be to maintain the current production. However, for sustainability, the Kızılırmak River and the dam lakes on it must be operated in a balance of protection and use. Because fisheries is a valuable food source that can meet a significant part of animal protein needs.

References

Arslan, O., Bilgil, A., Veske, O. (2016). Meteorological drought analysis in Kızılırmak Basin using standardized precipitation index method. *Niğde University Journal of Engineering Sciences*, 5(2): 188-194.

Barlas, M., Dirican, S. (2004). The fish fauna of the Dipsiz-Çine (Muğla-Aydın) Stream. *Gazi University Journal of Science*, 17(3): 35-48.

GDF. (2021). Fisheries statistics. Ministry of Agriculture and Forestry, General Directorate of Fisheries, July 2021, Ankara, 1-21.

Kars, F. (2021). Investigation of the Yamula Dam and hydroelectric power plant benefits to Kayseri province. *Turkish Journal of Hydraulic*, 5(1): 1-7.

Koç, Y. (2010). The operations and problems of fishing in Turkey from the aspect of economic geography. İstanbul University, Institute of Social Sciences, Department of Geography, Master Thesis, İstanbul, 1-135.

Official Gazette. (2020). Rental regulation in fisheries production. Official Gazette Number: 31290, Date: 31 October 2020, Ankara, 1-6.

Official Gazette. (2011). Regulation on lease of water and water areas required for aquaculture investments and the right to produce fisheries in sea and inland waters. Official Gazette Number: 27951, Date: 01 June 2011, Ankara, 1-7.

Polat, N., Uğurlu, S., Kandemir, Ş. (2008). Fish fauna of lower Kızılırmak Basin (Samsun-Turkey). *Journal of FisheriesSciences.com*, 2(3): 489-498. DOI: 10.3153/jfscom.mug.200745.

Şakıma, İ., Çevirimli, M.B. (2021). The current situation, problems and solutions in Turkey's fisheries and aquaculture sector. *Journal of The Turkish Veterinary Medical Society*, 92(2): 198-218. DOI: 10.33188/vetheder.891760.

Taş, B. (2005). General characteristics and some environmental problems of Derbent Dam Lake (Bafra-Samsun). *Turkish Journal of Aquatic Life*, 3(4): 199-205.

Terzi, Ö., İlker, A. (2021). Trend analysis of precipitation data: case study of Kızılırmak Basin. *Academic Platform Journal of Engineering and Sciences*, 9(2): 371-377. DOI: 10.21541/apjes.735378.