

Current Status of Floating Net Cages Aquaculture in Sivas Province (Turkey)

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ABSTRACT

Rainbow trout represents a valuable food source and also has an important share in production in the world. The climate and available water resources of Sivas province are generally suitable for aquaculture in floating net cages. This study is about aquaculture in net cages in Sivas province located in the Central Anatolia Region of Turkey. The data used in the research were obtained from the records of the Ministry of Agriculture and Forestry. The only species cultivated in floating net cages in Sivas province, which has no sea shore, is rainbow trout (*Oncorhynchus mykiss*). As of 2023, the capacities of the 7 enterprises that carry out rainbow trout cultivation in floating net cages in Sivas province vary between 50000 and 950000 kg/year, and the total production amount is 5250000 kg. Rainbow trout cultivation in floating net cages is still at an early stage in Sivas province and its development is uneven throughout the province. In Sivas province, intensive production is preferred in rainbow trout farms in floating net cages. A rapid increase has been recorded in rainbow trout farming in floating net cages in Sivas province, especially after 2008. The biggest factors in this increase in rainbow trout farming in floating net cages in Sivas province have been the initiation of trout farming in floating net cages in Çamlığöze, İmranlı and Gölova dam lakes in the province. The freshwater areas in these unused dam lakes are being transformed into areas producing rainbow trout in floating net cages. These businesses are important initiatives for the benefit of Turkey and Sivas. There is both business and a great export potential. On the other hand, although there are many areas suitable for rainbow trout farming in floating net cages in Sivas province, the number of floating net cage businesses is very few. With the initiation of farming in other dam lakes suitable for rainbow trout farming in floating net cages in Sivas province, the amount of rainbow trout farming in the province will increase even more. Therefore, rainbow trout farming in floating net cages in Sivas province should be supported and encouraged more. Rainbow trout farming in floating net cages in Sivas province must be done according to the rules. If the rules are followed, rainbow trout farming in floating net cages in Sivas province will be sustainable.

Keywords: Aquaculture; Facilities; Floating net cages; Rainbow trout; Reflection; Reliability; Responsibility; Sustainability; Traceability; Welfare.

1. Introduction

The rapid increase in the world population also brings with it a nutritional problem. Aquatic products have an important place in the nutrition of the world population. Aquatic products, which are a quality protein source, have an important place in meeting people's protein needs. It has become one of the goals of countries to provide a balanced nutritional habit to the ever-increasing population. The demand for aquatic products, which are both healthy and nutritious, is increasing, especially in the supply of animal protein. Aquatic products have an easily digestible, high-quality protein content that contains all essential amino acids at high levels. In addition, aquatic products are a functional food and a source needed to protect against many health problems, especially coronary heart diseases and diseases based on the nervous system, thanks to their rich long-chain polyunsaturated omega-3 fatty acid content. Considering the increasing population, the demand for aquatic products will increase even more, and this increasing demand can only be met through aquaculture [1]. However, population growth, overfishing and negative environmental factors have caused the rapid decrease in natural aquatic product resources and even the risk of extinction of some species. This situation shows that aquaculture is an indispensable activity for the world. Today, approximately half of the world's aquaculture production is obtained through aquaculture. In order to increase the amount of aquaculture, it is important to ensure that water resources, which have a vital value, are used correctly. With economic development and population growth, the demand for water resources is constantly increasing. As a result, water resources are changing in terms of both quantity and quality. This change brings with it many problems related to water. Therefore, a good sustainable water management is needed to overcome these

problems. For this, it is necessary to make maximum use of the existing water resources potential, to expand aquaculture investments, to introduce new species to aquaculture, and to operate and manage natural resources within the framework of sustainability principles. The difference in altitude affects the temperature. The temperature difference is felt more in the interior than in the coastal areas [1].

Turkey is among the lucky countries in the world in terms of aquaculture due to its geographical location. Turkey is surrounded by seas on three sides and has water resources where many warm and cold water fish can be produced. Turkey is quite rich in terms of aquaculture potential with its seas, natural lakes, dam lakes and streams. In addition to approximately 24 million hectares of sea area, the total surface area of 200 natural lakes, 850 dam lakes and 500 ponds is more than 1.4 million hectares. Turkey is of great importance due to its climate and water conditions being suitable for aquaculture. Aquaculture activities in Turkey, which started with trout and carp farming in the 1970s, gained momentum with sea bream and sea bass farming in the Aegean Sea and the Mediterranean from the mid-1980s onwards, trout farming in cages in the Black Sea in the 1990s, and tuna farming in the Aegean Sea and the Mediterranean in the early 2000s [2]. According to 2022 data, the total annual capacity of 553 enterprises engaged in aquaculture in the seas in Turkey is 525812000 kg. The number of enterprises engaged in aquaculture in inland waters is 1829, and the total annual capacity is 259052000 kg. Accordingly, the total number of enterprises engaged in aquaculture in sea and inland waters in Turkey is 2382, and the total annual production capacity is 784864000 kg [3]. Turkey's 2023 aquaculture export target has been updated to 2 billion USD. Turkey exports aquaculture products to approximately 80 countries, primarily the European Union.

The most common trout species cultivated in the world and in Turkey is the rainbow trout, *Oncorhynchus mykiss* (Walbaum, 1792). The leading producers of rainbow trout are Norway, Chile, Canada and Scotland, encouraged by the increasing global demand and market. The reasons why this species, which has spread to many parts of the world, is preferred in cultivation are its high adaptability, high feed utilization ability, ease of egg collection with artificial methods, short incubation periods and resistance to diseases [1]. The total production amount of rainbow trout obtained by cultivation in inland waters and seas in Turkey is 191103000 kg in 2022 [3]. According to these figures, Turkey is at the forefront of aquaculture among both the European Union and other countries of the world. Only the rainbow trout species is cultivated as cultured fish in water resources throughout the Sivas Province. The water resources available in the Sivas province are generally suitable for aquaculture.

1.1. Study Objectives

This study aims to determine and summarize the following specific objectives regarding the current status of floating net cage aquaculture in Sivas Province, Turkey. The specific objectives were: (i) to assess the current status of floating net cage aquaculture in Sivas Province, (ii) to reveal its potential, (iii) to assess the main problems in its development, (iv) to assess what needs to be done for its sustainability, and (v) to present possible recommendations for its future direction.

2. Materials and Method

Turkey is located where the continents of Asia, Europe and Africa come closest to each other. Sivas province in Turkey is an important province in the Central Anatolia Region with its history, culture and natural riches (Figure

1). Sivas province is a logistics base in both national and international areas. Sivas is located between $35^{\circ} 50' - 38^{\circ} 14'$ east longitudes and $38^{\circ} 32' - 40^{\circ} 16'$ north latitudes. It is the second largest province in Turkey with its 28488 km² surface area. Sivas neighbor's provinces Tokat, Ordu, Giresun to the north; Malatya and Erzincan to the east; Kayseri and Kahramanmaraş to the south; and Yozgat to the west. Sivas province, geographically located in the Central Anatolia Region, has a total of 17 districts including the central district. The districts of Sivas province; Akıncılar, Altınyayla, Divriği, Doğanşar, Gemerek, Gölova, Gürün, Hafik, İmranlı, Merkez, Koyulhisar, Kangal, Suşehri, Şarkışla, Ulaş, Yıldızeli and Zara. The distance between the districts of Sivas province, which has a large surface area, varies. Sivas is generally located in a high and mountainous area due to its geographical structure. The average altitude of the province is around 1000-1500 m.

Sivas generally has a landform consisting of high plains, mountains and deep valleys. 47.6% of the province's land is plateau, 46.2% mountain and 6.2% plain. The altitudes increase from the western part of the province to the eastern part. The eastern parts of the province are steeper and more rugged. Sivas is one of the coldest provinces of the Central Anatolia Region. In general, winter months are long and severely cold, summer months are short and hot and dry. In Sivas province, which has a continental climate, precipitation occurs in winter, spring and autumn. The regions where the most important rivers of Turkey, the Fırat, Ceyhan, Yeşilırmak and Kızılırmak rivers, originate are within the borders of Sivas province. There are many natural lakes and dam lakes in Sivas province, resembling a lake region. The surface water potential of Sivas province is 10300 hm³/year, the groundwater potential is 902 hm³/year, and the total water potential is 11202 hm³/year [4].



Figure 1. Location of Sivas Province in the World and in Turkey

According to the address-based population registration system results for 2022, the population of Sivas province is 634 thousand 924 people. The majority of the population in Sivas province lives in the city center. In terms of population, the district with the largest population in Sivas province, excluding the central district population, is Şarkışla, followed by Yıldızeli and Suşehri districts, respectively. Unemployment rates in Sivas province are close to the Turkish average. When we look at the structure of unemployment in Sivas, we see that youth unemployment is 6 points above the Turkish average and female unemployment is ahead of male unemployment [5]. When we look

at the sectoral distribution of the workforce in Sivas province, agriculture and animal husbandry have great economic activity in the province.

In the study, firstly the study area was determined and its limitation was made. Literature study was conducted on aquaculture in floating net cages in Sivas province. The number, capacity and similar data of the enterprises performing aquaculture in floating net cages in Sivas province were obtained from the current aquaculture facility list on the website of the Republic of Turkey, Ministry of Agriculture and Forestry, General Directorate of Fisheries and Aquaculture. The obtained data were tabulated and examined in the findings section. Some data were obtained and recorded with the field studies and observations made in the field. As a result, literature, field observations and office studies were synthesized together and an attempt was made to reveal the aquaculture in floating net cages in Sivas province.

3. Results and Discussion

In Sivas province, rainbow trout is raised in floating net cages in 7 facilities in dam lakes, making a significant contribution to the economy. Rainbow trout production facilities in floating net cages established in dam lakes in Suşehri, İmranlı and Gölova districts of Sivas province contribute to the economic development of both the region and the country, and also ensure the utilization of dam lakes. Some information about facilities performing aquaculture in floating net cages in Sivas province is presented in Table 1. Approximately 5250000 kg of rainbow trout is raised annually in 7 facilities in floating net cages in Sivas province (Table 1). Sivas Agriculture and Forestry Provincial Directorate teams conducting field work continuously inspect facilities producing in floating net cages and help them eliminate deficiencies. In addition, they inform the relevant parties about rainbow trout farming and diseases. Rainbow trout facilities producing in floating net cages in Sivas province are also supported by the state.

Table 1. Aquaculture Facilities in Floating Net Cages in Sivas Province

S.No.	Province	District	Name of Dam Lake	Facility Type	Project Capacity (kg)	Species Cultivated
1	Sivas	Suşehri	Çamlığöze	Growth	500000	<i>Oncorhynchus mykiss</i>
2	Sivas	Suşehri	Çamlığöze	Growth	950000	<i>Oncorhynchus mykiss</i>
3	Sivas	Suşehri	Çamlığöze	Growth	900000	<i>Oncorhynchus mykiss</i>
4	Sivas	Suşehri	Çamlığöze	Growth	950000	<i>Oncorhynchus mykiss</i>
5	Sivas	Suşehri	Çamlığöze	Growth	950000	<i>Oncorhynchus mykiss</i>
6	Sivas	İmranlı	İmranlı	Growth	950000	<i>Oncorhynchus mykiss</i>
7	Sivas	Gölova	Gölova	Growth	50000	<i>Oncorhynchus mykiss</i>

Sivas province has suitable geographical and climatic conditions for rainbow trout farming. 5 floating net cage facilities established in Suşehri district of Sivas province in 2008 were followed by 1 floating net cage facility each established in İmranlı and Gölova districts. Thus, rainbow trout farming culture in floating net cages is gradually developing in Sivas province. Rainbow trout production can be carried out in floating net cages in Sivas province

for 12 months of the year. Rainbow trout raised in floating net cages in Sivas province are sold to Sivas province as well as neighboring provinces and abroad. Rainbow trout that have reached marketing weight in particular are sold to Russia, Japan and European Union countries. In addition, rainbow trout raised in floating net cages in Sivas province contributes significantly to the economy of Turkey and Sivas province. In addition, rainbow trout farming in floating net cages is a sector that benefits angling. Because the areas where floating net cages are placed are more protected areas compared to other open areas. Since fishing is not allowed under the net cages here, when the floating net cages and their immediate surroundings are protected, they emerge as a reserve area. For this reason, natural fish find feeding and sheltering opportunities under the floating net cages and their immediate surroundings. Natural fish spreading from the under the floating net cages and their immediate surroundings also create important hunting opportunities for anglers. For this reason, Çamlığöze, İmranlı and Gölova dam lakes have a significant potential in terms of inland water fish hunting and angling.

Rainbow trout is a world-renowned, recognized and demanded fish species. In some dam lakes located in the landlocked province of Sivas, rainbow trout, scientifically known as *Oncorhynchus mykiss*, is cultivated in floating net cages (Table 1). Trout species are systematically included in the Salmonidae family. Morphologically, they are characterized by their adipose fins. Rainbow trout is a very rich and valuable fish species in terms of both meat quality and omega-3 fatty acids. In addition, rainbow trout is an important cultured fish species remembered for its delicious meat. Rainbow trout is a fish species that can be safely consumed, especially since it is produced and cultivated in clear, clean, cold and dissolved oxygen-rich waters. It is desired that the origin and quality of the water source to be used in rainbow trout cultivation is high. Rainbow trout is not a fish species of hot and polluted waters. Rainbow trout are very sensitive fish and are reliable fish because they are cultivated in cold and clean waters and with quality feeds.

The highest number of rainbow trout in floating net cages in Sivas province is raised in Suşehri district, where there are 5 facilities. In Suşehri district, 4250000 kg of rainbow trout was produced in floating net cages in 2023. This corresponds to 80.95% of the rainbow trout production in floating net cages in Sivas province. İmranlı district ranks second in production in floating net cages with 950000 kg and 18.10%. In contrast to all this, Gölova district ranks last with 50000 kg and 0.95%, producing the least rainbow trout in floating net cages. Therefore, 100% of the rainbow trout production in floating net cages in Sivas province is carried out in Suşehri, İmranlı and Gölova districts, respectively. Although there are places where farming can be done in floating net cages in the other 13 districts of Sivas province, no production is made.

The Suşehri district, where the Çamlığöze Dam Lake is located, is 144 km away from Sivas. Suşehri is located in the northeast of Sivas province and has a surface area of 980 km². The Kılıçkaya and Çamlığöze dam lakes built on the Kelkit Stream passing through the district borders are located. The Çamlığöze Dam Lake was completed in 1998 downstream of the Kılıçkaya Dam Lake for energy and flood protection purposes. The height of the Çamlığöze Dam Lake from the stream bed is 38 m and the lake area is 4.7 km². The maximum water depth of the Çamlığöze Dam Lake is around 30 m [6]. İmranlı is 106 km away from Sivas. İmranlı is the easternmost district of Sivas province. The İmranlı district is in the Kızılırmak valley at the foot of Kızıldağ Mountain. Its surface area is 1229 km². The source of the Kızılırmak River, the largest river in Turkey, is located in İmranlı district. İmranlı Dam

Lake was built between 1994-2002 on the Kızılırmak River within the borders of Sivas province for irrigation and energy production purposes. The elevation of İmranlı Dam Lake from the river bed is 49 m and the lake area is 6.50 km². The maximum water depth of İmranlı Dam Lake is around 30 m [7]. Gölova is 198 km away from Sivas province. It is located in the inner parts of the Central Black Sea region in the northeast of Sivas province. Gölova is the smallest district of Sivas province with a surface area of 286 km². Gölova Dam Lake has natural beauty with its surroundings and plateaus. Gölova Dam Lake is on Çobanlı Creek. Gölova Dam Lake, which was built for irrigation and energy production purposes, was put into operation in 1990. Gölova Dam Lake is established on Çobanlı Stream. The height of Gölova Dam Lake from the river bed is 26 m and the lake area is 4.85 km². The maximum water depth of Gölova Dam Lake is around 13 m [7]. The good quality and cold waters of Çamlığöze, İmranlı and Gölova dam lakes allow for the cultivation of delicious rainbow trout in floating net cages. This situation has been an important factor in the development, progress and growth of rainbow trout farming in Çamlığöze, İmranlı and Gölova dam lakes within the borders of Sivas province. Rainbow trout raised in floating net cages in Çamlığöze, İmranlı and Gölova dam lakes provide employment opportunities for the local people and are also in high demand both domestically and internationally.

Floating net cage facilities in Sivas province have been established on dam lakes. The facilities on the dam lakes use the production method in floating net cages. Table 1 shows the facility numbers according to project capacities. In this study conducted in Sivas province, there is 1 floating net cage facility with a capacity of 0-50000 kg. Similarly, there is 1 floating net cage facility with a capacity of 251000-500000 kg. There are 5 floating net cage facilities with a capacity of 501000-1000000 kg in Sivas province that produce rainbow trout (Table 1). Accordingly, except for 1 of the floating net cage facilities operating in Sivas province, the others consist of large-capacity facilities with a production capacity of 500000 kg/year and above. However, the vast majority of floating net cage facilities in Sivas province produce below their capacities. The main reason for this is factors such as inability to produce fingerlings and lack of fish feeding and feeding. It is important to eliminate such deficiencies in order to be able to produce at full capacity in floating net cages. The amount of economic support for floating net cage facilities by the state should be increased and various funds should be used in production. Rainbow trout sales from facilities producing in floating net cages in Sivas province are carried out in two ways: retail and wholesale. Rainbow trout is sold live and fresh in floating net cages in the water on the shores of the dam lake where the facilities are located.

In Turkey, per capita consumption of aquatic products is considerably lower than the European Union and world averages. While the annual per capita consumption is 16 kg in the world and 22 kg in the European Union countries, it is 5.4 kg in Turkey [8]. In a study conducted by İbiş [9] evaluating aquatic product consumption behaviors in the Central District of Sivas Province, 49.08% of the participants reported consuming white meat, 34.72% red meat, and 16.20% fish. In addition, while seafood ranked first in the list of the most consumed aquatic products with 78.82%, it was reported that the consumption of freshwater fish in Sivas Province, which has many inland waters, was quite low at 20.94%. In Sivas Province, which has no seashore, 51.97% of individuals preferred to consume anchovy. This fish was followed by trout with 13.79% as the second most preferred fish. In addition, the consumption of aquatic products more than once a week in Sivas was determined as 6.65% [9]. According to these figures, aquatic product consumption levels are not sufficient both in Turkey and in Sivas province. The only way to

close this gap is aquaculture. A total of 7 facilities that carry out rainbow trout farming in floating net cages in Sivas province make a significant contribution to the healthy and balanced nutrition of the public. In addition, it is recommended to consume aquatic products at least twice a week to close this gap. For this purpose, public service announcements, advertising and promotion activities should be increased in order to break the prejudice against rainbow trout consumption and to encourage consumption. Rainbow trout consumption should be popularized by making use of the developing internet technology opportunities especially in Turkey and in Sivas province. In addition, various activities related to catching and consumption should be organized regularly, especially in places where rainbow trout production is carried out.

In Sivas province, rainbowfish production, which was 770000 kg in 2007, increased to 5124500 kg in 2010 [1]. This major leap in aquaculture production in Sivas province was realized in 2008 with 5 floating net cage facilities that started production in floating net cages in Çamlığöze Dam Lake in Suşehri district. This was followed by 1 floating net cage facility that started operating in İmranlı and Gölova dam lakes of Sivas province as of 2010. Aquaculture in floating net cages in Sivas province started to gain importance as of 2008, but it has not yet reached the desired level. Aquaculture in floating net cages in Sivas province is currently carried out on dam lakes. The deficiencies of both producers and those working in the facilities regarding rainbow trout farming should be eliminated. In order to achieve the desired efficiency in floating net cage facilities, producers and employees must be trained in modern and organic rainbow trout production methods, fish feeding, feed use, grading, harvesting, packaging and processing.

Sivas province, which was selected as the study area, has many dam lakes suitable for aquaculture in terms of hydrography. However, when Sivas province is examined in general, it is observed that the number of floating net cage facilities is very low in return for this hydrographic richness. Accordingly, in Sivas province, except for the potential that can be developed, the entire production potential of the existing floating net cages is not used today. In Sivas province, it is necessary to identify potential areas where aquaculture can be carried out and to encourage local people and large-capital entrepreneurs to establish floating net cage facilities in these areas. If local people and large-capital entrepreneurs are made aware of rainbow trout in floating net cages and encouraged, the number of facilities will increase. Therefore, this situation will also bring an increase in the income of local people and large-capital entrepreneurs. In addition, it will provide a solution to unemployment in the province by providing new employment areas. When Sivas province is examined on a district basis, it is observed that the highest number of floating net cage facilities is in Suşehri with 5 floating net cage facilities. Suşehri district is followed by Gölova and İmranlı districts with 1 floating net cage facility each (Table 1). There is no facility in Akıncılar, Altınyayla, Divriği, Doğanşar, Hafik, Merkez, Gemerek, Gürün, Koyulhisar, Kangal, Şarkışla, Ulaş, Yıldızeli and Zara districts that cultivate rainbow trout in floating net cages. If the necessary incentives, supports, trainings and similar are provided, it is foreseeable that the number of these floating net cage facilities in Sivas province will increase. New floating net cage facilities to be established on existing dam lakes in Sivas province should have high capacity. It would be much more profitable to establish large floating net cage facilities with high capacity. One of the biggest input items in floating net cage facilities is feed. The high prices of feed constitute a major problem for the facilities. It is necessary to establish feed factories producing trout feed in Sivas province and to provide feed at affordable

prices. However, the lack of facilities that store and process aquatic products in Sivas province is an important problem. Therefore, the establishment of facilities that store and process aquatic products in Sivas province is very important. When the full potential of aquaculture in floating net cages in Sivas province is used, it is at a level that will meet a significant portion of the rainbow trout needs of the entire region and Turkey.

As a result of the increase in aquaculture production in Sivas province since 2008, it is expected that the amount of solid and dissolved waste released into the environment by floating net cage facilities will increase. In order to benefit from this potential in a sustainable manner, an environmentally conscious production should be carried out. In aquaculture, pollutants originating especially from floating net cages consist of insoluble or soluble substances formed by unconsumed feed, feces and excretory products. These substances are found in the water column as organic carbon, nitrogen and phosphorus and vary depending on the size of the facility and its hydrological structure [10]. Rainbow trout feed consists of organic, inorganic substances, moisture, vitamins and mineral substances. Trout feeds generally contain 0.9-1.5% phosphorus and 7-8% nitrogen. The amount of nitrogen taken in with feed varies according to fish species, but is approximately 20-30%. The remaining 70-80% is thrown back into the water. Phosphorus, nitrogen, organic matter and suspended solids in water are the factors that cause pollution in fish farms. In addition, excessive nitrogen and phosphorus in the environment cause excessive algae production, decreased oxygen levels and eutrophication. Eutrophication caused by aquaculture can cause some changes in water quality, generally decreased light transmittance, and increased nutrient, electrical conductivity and chlorophyll-a levels. Pollution caused by feed in fish production occurs due to the physical and chemical properties of the feed and the applied feeding management. In order for the feed used in fish production to cause less pollution, the required nitrogen-phosphorus balance should be provided according to the type and age of the fish. If the optimum protein and energy requirements of the fish are met, uneaten feed waste and loss of nutrients are prevented. Storage of organic waste causes an increase in the oxygen used by the sediment and, as a result, a decrease in the amount of dissolved oxygen at the bottom [11]. In particular, since the amount of dissolved oxygen in dam lakes is more difficult to renew, more attention should be paid to the high nutrient load in such ecosystems. Rainbow trout farming in floating net cages in dam lakes can be sustainable by conscious use of resources and minimizing environmental impacts. These can be achieved by scientifically based planning, ecosystem-based management, strict monitoring and controls.

Global warming and climate change are increasingly making their effects felt all over the world. In Sivas province, especially in the summer months, decreases in water levels are observed due to drought in dam lakes. However, with the increase in air temperature, increases in water temperature are observed first and then decreases in oxygen levels of the water begin. Accordingly, slow growth rates can be observed in rainbow trout raised in floating net cages in dam lakes. In addition, environmental effects associated with climate change can facilitate the spread of known diseases to previously unaffected aquaculture areas, exacerbate existing diseases and cause new pathogens to emerge. Sustainable aquaculture has become a current issue in recent years. Sufficient and good quality water is primarily needed for the sustainability of rainbow trout farming in cages. Considering the drying and shrinking dam lakes, it is mandatory to determine protection and monitoring programs and management strategies in aquatic ecosystems for the sustainable use of water resources and the continuity of rainbow trout farming. In order to ensure

sustainability, measures should be taken to protect the environment and water resources at all stages from the beginning of production to the presentation to the market. These protective measures should be followed meticulously and rainbow trout should not be produced beyond the project capacity. When we comply with the rules in rainbow trout farming, our inland waters will not be polluted and Turkey and Sivas province will develop in this regard by benefiting economically from our unused dam lakes. We should benefit from our inland waters in accordance with the rules. In this sense, rainbow trout farming in floating net cages in Sivas province is very important as a sector that enables the benefiting of our dam lakes. In addition, rainbow trout farming in floating net cages is important in terms of feeding the public and has a great export potential. In addition, rainbow trout farming in floating net cages in Sivas province should not be neglected as a source of both work and income.

Sustainability is the ability of a society to continuously operate an ecosystem or other similar interactive systems without depleting their basic resources and without negatively affecting the environment. Sustainable development is a management approach that protects natural resources while making technological and institutional changes aimed at continuously meeting the needs of current and future generations [12]. Aquaculture production activities have an impact on the ecosystem in which they are located. The concept of sustainability in aquaculture is important in order to manage this impact correctly. Sustainability can only be achieved with rational planning and appropriate management strategies. Environmental sustainability is the regulation of not degrading ecosystems with the understanding that the environment is a natural capital. Sustainable aquaculture is to balance the use of resources, to use the ecosystem that meets human needs by protecting it and to evaluate the quality of the environment without reducing it [13]. Since 2008, the rapid increase in the production capacity of rainbow trout farming in floating net cages in Sivas province has brought environmental pressure with it. In order to prevent this environmental pressure, sustainable aquaculture management in floating net cages has come to the fore. Sustainable farming is very important in Sivas province, which has great potential for rainbow trout farming in floating net cages. The environmental dimension is also very important in terms of the sustainability of the dam lakes where rainbow trout farming is carried out in net cages in Sivas province. However, especially in dam lakes where rainbow trout farming is carried out in floating net cages, the current and depth, which are important parameters in site selection, are important elements in terms of the facility's impact on the environment. The dam lakes used for rainbow trout farming in floating net cages in Sivas province should be used without polluting and by considering future generations.

4. Conclusion

Aquaculture, which started in the early 1970s in Turkey, has only become important in Sivas since the early 2000s. Accordingly, a significant increase in aquaculture production in Sivas has been observed over the years since 2008. The most important factor in this increase has been the intensive start of fish farming in floating net cages in Sivas. Integrative aquaculture in floating net cages is an important trend for the development of aquaculture in Sivas due to its significant advantages in terms of lower water consumption, higher productivity and sustainability. The rainbow trout facilities established in Çamlığöze, İmranlı and Gölova dam lakes have become quite important in terms of their modern infrastructure, quality and meeting the animal protein needs of people. However, information on their current status has been scarce so far. Today, rainbow trout farming in floating net cages has become a popular and

distinguished investment area in Sivas. In Sivas province, *Oncorhynchus mykiss* is the only species that stands out in freshwater fish farming in floating net cages. In this study, the current status of rainbow trout farming in floating net cages in Sivas province was discussed. As a result, Sivas province, which has a significant potential for aquaculture, cannot sufficiently use its potential in floating net cages, including today. In this context, the necessary incentives and supports should be increased for Sivas province to sufficiently use its potential in floating net cages. In Sivas province, rainbow trout farming in floating net cages is still in the development phase and has been distributed only in a limited number of dam lakes. Therefore, research and development studies should be accelerated to increase the dam lakes and aquatic ecosystems where rainbow trout farming in floating net cages can be applied in Sivas province. If dam lakes and aquatic ecosystems suitable for aquaculture in floating net cages in Sivas province can be adequately evaluated, a significant increase in production will occur. Depending on this increase, the environmental impacts of aquaculture in floating net cages should be regularly monitored and controlled. It should be ensured that rainbow trout farming in floating net cages in Sivas province is carried out in accordance with the rules. In the medium term, increasing rainbow trout production in floating net cages in Sivas province will require more sustainability, welfare, reliability and efficiency gains.

Declarations

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Competing Interests Statement

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Consent for publication

The author declares that he consented to the publication of this study.

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