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Geographical Distribution and Importance of Sea Bass, Sea Bream and Trout Breeding in Turkey

Türkiye’de Kültür Balığı Olarak Levrek-Çipura ve Alabalık Yetiştiriciliğinin Coğrafi Dağılışı ve Önemi

Sühyela Balcı Akova* - Mustafa Kahraman**

Abstract: Fish were used as a food source during the hunting-gathering period of humans. It continued its development and transformation with the developments in science and technology and continued its importance today. The demand for fish, which is a valuable food, is increasing day by day. Fish consumption is increasing day by day, even in countries that generally supply their animal protein needs from terrestrial animals. Today, the increase in the population, the increase in the demand for fish, and the developments in science and technology, have caused an increase in the amount of fish caught, but this also puts pressure on the fish reserves. At this point, aquaculture gains great importance. Increases in both fish production amounts and the number of producers are quite high. Between 1990 and 2018, the increase in fish caught was 12.24%, while the increase in aquaculture was 525.28%. 46% of the world's total fish production and 52% of people's fish consumption are obtained from aquaculture. In aquaculture, firstly carp and trout were bred. In 2018, aquaculture production reached 114.5 million tons (including plants and others), with a sales value of \$263.6 billion. In Turkey, as in the rest of the world, the development in aquaculture is very important. Aquaculture production, which was 5 782 tons as of 1990, reached 373 356 tons as of 2019 with an increase of 6457.2% between 1990 and 2019. The production of finned fish is also dominant in Turkey. Among these species, especially sea bass, sea bream and trout farming takes the first place. The fact that the total of the three species constitute 97.2% of the total aquaculture production clearly reveals the importance of sea bass, sea bream and trout farming. The fact that the total of the three species constitute 97.2% of the total aquaculture production clearly reveals the importance of sea bass, sea bream and trout farming. As both a source of export income and an employment provider, fish and fish products trade makes a significant contribution to economic growth in developing countries. For these reasons, the geographical distribution of sea bass, sea bream and trout in Turkey and their importance as an economic activity are discussed in this study.

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Structured Abstract: Fish were also used as a food source during the hunting-gathering period of humans. In the following process, it continued its development and transformation with the developments in science and technology and continued its importance today. The demand for fish, which is a valuable food, is increasing day by day. Fish consumption is increasing day by day, even in countries that generally supply their animal protein needs from terrestrial animals. Today, the increase in the population, the increase in the demand for fish, the developments in science and technology, together with the increase in the amount of fish caught, this also puts pressure on the fish reserves.

At this point, aquaculture gains great importance. Although the construction of aquaculture goes back to ancient times, its development has been realized with advances in science and technology as in hunting fisheries. Both the fish production amounts and the increase in the number of producers are quite high. While 96.4 million tons of the world fish production, which is 179 million tons (2018), consists of natural fisheries (fishing), 82.1 tons is aquaculture. Between 1990 and 2018, the increase in game fishery was 12.24%, while the increase in aquaculture was 525.28% (<http://www.fao.org>, 2021).

Global fish consumption increased by an average of 3.1% annually from 1961 to 2017. In the same period, it increased more than all other animal protein foods (meat, dairy products, milk, etc.). While an average of 9.9 kg of fish was consumed per capita in the 1960s around the world, it increased to 20.5 kg in 2018. 46% of the world's total fish production and 52% of people's fish consumption are obtained from aquaculture. Although it varies according to countries and regions, approximately 17% of animal proteins and 7% of all proteins are obtained from fish. 20% of the animal protein of 3.3 billion people in the world is obtained from fish (2018). In Bengaldesh, Cambodia, Gambia, Ghana, Indonesia, Siri lanka and many small island developing states, 50% or more of animal protein per capita comes from fish (<http://www.fao.org>, 2021).

In aquaculture, firstly carp and trout were bred. In 2018, aquaculture production reached 114.5 million tons (including plants and others) and a sales value of 263.6 billion dollars. 82.1 million tons of the total production and 250.1 billion dollars in value belong to fish. 54.3 million tons and 139.7 billion dollars worth of finfish, similarly, 7.3 million tons and 35.4 billion dollars worth of marine and coastal areas were predominantly grown. It is followed by mollusks with 17.7 tons and 34.6 billion dollars, crustaceans with 9.4 million tons and 69.3 billion dollars, marine invertebrates with 435,400 tons and 2 billion dollars, and aquatic turtles with 370,000 tons and 3.5 billion dollars. frogs (<http://www.fao.org>, 2021).

In Turkey, as in the rest of the world, the development in aquaculture is very important. Aquaculture production, which was 5 782 tons as of 1990 and 79 031 tons as of 2000, reached 373 356 tons as of 2019 with an increase of 6%357.2 between 1990 and 2019. The production of finned fish is also dominant in Turkey. Among these species, especially sea bass (137 419 tons), sea bream (99 730 tons) and trout farming takes the first place with great differences. Seabass accounts for 36.8% of all production, sea bream 26.7% and trout 33.7%. The fact that the total of the three species constitute 97.2% of the total aquaculture production clearly reveals the importance of sea bass, sea bream and trout farming.

The fish that are followed by the breeders from the hatchery to the market not only create a planned and controllable food supply chain, but also constitute an important foreign currency inflow since more than half of the fish produced is exported to various countries, especially European countries. When Turkey's geographical potential is evaluated, it will turn into a much more effective economic activity.

The production of finned fish is also dominant in Turkey. Among these species, especially sea bass (137 419 tons), sea bream (99 730 tons) and trout farming takes the first place with great differences. Seabass accounts for 36.8% of all production, sea bream 26.7% and trout 33.7%. The fact that the total of the three species constitute 97.2% of the total aquaculture production clearly reveals the importance of sea bass, sea bream and trout farming.

In recent years, the fishing industry has played an important role in contributing to economic growth and global food security, and trade has expanded and increased. As both a source of export income and an employment provider, fish and fish products trade makes a significant contribution to economic growth in developing countries. For these reasons, the geographical distribution of sea bass, sea bream and trout in Turkey and their importance as an economic activity are discussed in this study.

Keywords: Economic geography, fisheries, fishing, trout, sea bream, sea bass, aquaculture

Öz: Balıklar, insanların avcılık–toplayıcılık döneminde de besin kaynağı olarak değerlendirilmiştir. İlerleyen süreçte bilim ve teknolojiadaki gelişmelerle gelişim ve dönüşümünü sürdürerek günümüzde de önemini devam ettirmiştir. Değerli bir besin olan balığa olan talep gün geçtikçe artmaktadır. Hayvansal protein ihtiyacını genellikle karasal hayvanlardan temin eden ülkelerde bile balık tüketimi gün geçtikçe artmaktadır. Günümüzde nüfusun artması, dolayısıyla balık talebinin artışı, bilim ve teknolojiadaki gelişmeler, avlanan balık miktarının da artışı beraberinde getirmekle birlikte bu aynı zamanda balık rezervleri üzerinde baskı da oluşturmaktadır. Bu noktada kültür balıkçılığı büyük önem kazanmaktadır. Gerek balık üretim miktarları, gerekse üretici sayısındaki artışlar oldukça fazladır 1990 ile 2018 yılları arasında, av balıkçılığında artış %12,24 iken kültür balıkçılığında artış %525,28 dir. Dünya toplam balık üretiminin %46'sı ve insanların balık tüketiminin %52'si kültür balıkçılığından sağlanmıştır. Kültür balıkçılığında ilk olarak sazan balıkları ve alabalıklar yetiştirilmiştir. 2018'de kültür balıkçılığı üretimi 114,5 milyon ton'a (bitki ve diğerleri dahil), satış değeri 263,6 milyar dolara ulaşmıştır. Türkiye'de de, Dünya genelinde olduğu gibi, kültür balıkçılığındaki gelişme oldukça önemlidir. 1990 yılı itibarıyla 5 782 ton olan kültür balıkçılığı üretimi 1990 yılı ile 2019 yılları arasında %6457,2'lik artışla 2019 yılı itibarıyla 373 356 tona ulaşmıştır. Türkiye'de de yüzgeçli balıkların üretimi hâkimdir. Bu türler içinde de özellikle levrek, çipura ve alabalık yetiştiriciliği büyük farklarla ilk sırada yer almaktadır. Üç türün toplamı da, toplam kültür balığı üretiminin %97,2'sini meydana getirmesi levrek, çipura ve alabalık yetiştiriciliğinin önemini açıkça ortaya koymaktadır. Son yıllarda ekonomik büyüme ve küresel gıda güvenliğine katkıda bulunması bakımından balıkçılık sektörü önemli bir role sahip olmuş, ticaret yayılmış, artmıştır. Hem ihracat geliri kaynağı hem de istihdam sağlayıcısı olarak balık ve balık ürünleri ticareti, gelişmekte olan ülkelerde ekonomik büyümeye çok önemli katkı sağlamaktadır. Bu sebeplerle çalışmada levrek, çipura ve alabalığın Türkiye'deki coğrafi dağılışı ve bir ekonomik faaliyet olarak önemi ele alınmıştır.

Anahtar Kelimeler: Ekonomik coğrafya, su ürünleri, balıkçılık, alabalık, çipura, levrek, kültür balıkçılığı

Introduction

It would not be wrong to say that fishing is one of the first economic activities of people. Fish was one of the staple foods of early humans. During the hunting-gathering period, people obtained a significant part of their food from fish. Fishing activity has increased its importance even more today by continuing its development and transformation with the developments in science and technology. The demand for fish, which is an important food, is increasing day by day, and fish consumption is increasing day by day, even in countries that generally obtain animal protein from terrestrial animals. Today, the increase in the population, the increase in the demand for fish, and the developments in science and technology bring about an increase in the amount of fish caught, but this also increases the pressure on the fish reserves. At this point, aquaculture gains great importance. Although aquaculture goes back to ancient times, its development has been with developments in science and technology. The increases in both the production amount and the number of producers are quite high. While the world's total fish production was 99 million tons in 1990, it reached approximately 179 million tons in 2018. Of the 179 million tons of aquatic products produced in 2018, 156.4 million tons were used as food, while 22.2 million tons were used for non-food uses, especially fish meal and fish oil (Fao 2020: 3). While 96.4 million tons of fish production consists of natural fisheries (fishing), 82.1 tons of it is aquaculture. While the amount of fish caught was 85.88 million tons in 1990, it reached 96.4 million tons in 2018. On the other hand, total production in aquaculture reached 82.1 million tons in 2018, from 13.13 million tons in 1990. In the same year, the increase in the amount of fish caught was 12.24%, while the increase in aquaculture was 525.28%. Total income in fisheries is estimated to be 401 billion, of which 250 billion dollars comes from aquaculture.

Global food fish consumption increased by an average of 3.1% annually from 1961 to 2017. In the same period, it increased more than all other animal protein foods (meat, dairy products, milk, etc.). While the average per capita consumption of fish was 9.9 kg in the 1960s, it

increased to 20.5 kg in 2018. 46% of the total production and 52% of the fish consumption of the people were obtained from aquaculture (<http://www.fao.org>, 2021).

Although it varies according to countries and regions, approximately 17% of animal proteins and 7% of all proteins are obtained from fish. 20% of the animal protein of 3.3 billion people in the world is obtained from fish (2018). In Bengaldesh, Cambodia, Gambia, Ghana, Indonesia, Siri lanka and many small island developing states, 50% or more of animal protein per capita comes from fish (<http://www.fao.org>, 2021).

In developed countries, per capita consumption has reached 24.4 kg in 1961 from 17.4 kg. 4 kg in the least developed countries, from 6.1 kg in 1961 to 12.6 kg in 2017, in low-income food-deficient countries (LIFDCs), fish consumption was 4.0 kg in 1961. increased to 9.3 kg in 2017 from The increase in both fish production and fish imports has been very effective in these increases (<http://www.fao.org>, 2021).

The need for nutrition is met by fishing, and many people are employed through fishing activities. Estimated employment in the fishing sector is 59.51 million people, of which 20.5 million are employed in aquaculture. As of 2018, 85% of the population employed in fisheries and aquaculture is in Asia. Asia (9%), the Americas (4%), and Europe and Oceania (1% each). The number of people employed in aquaculture in our country is 10 750 people (<https://suymerbir.org.tr>, 2021). Approximately 19% of those employed in aquaculture are women. When post-harvest operations are included in the sector, one out of two employees is women. Subsistence fishing still maintains its importance in the world (<http://www.fao.org>, 2021).

In the world aquaculture, firstly carp and trout were bred. In 2018, aquaculture production reached 114.5 million tons and the sales value reached 263.6 billion. 82.1 million tons of the total production and 250.1 billion dollars in value belong to fish, and 54.3 million tons and 139 7.3 million tons and 35.4 billion dollars worth of finfish were predominantly grown in marine and coastal areas, with a value of 0.7 billion dollars. It is followed by mollusks with 17.7 tons and 34.6 billion dollars, crustaceans with 9.4 million tons and 69.3 billion dollars, marine invertebrates with 435,400 tons and 2 billion dollars, and aquatic turtles with 370,000 tons and 3.5 billion dollars. frogs (FAO, 2020).

Development in aquaculture is very important in Turkey, as in the rest of the world. Aquaculture production, which was 5,782 tons as of 1990 and 79,031 tons as of 2000, reached 373 356 tons as of 2019 with an increase of 6357.2 % between 1990 and 2019. The production of finned fish is also dominant in Turkey. Among these species, especially Sea Bass (137 419 tons), Sea Bream (99 730 tons) and Trout (125 745 tons) take the first place with great differences. Seabass accounts for 36.8% of all production, sea bream 26.7% and trout 33.7%. The sum of the three species constitutes 97.2% of the total aquaculture production (<https://www.tuik.gov.tr>, 2021).

In recent years, the fishing industry has played an important role in contributing to economic growth and global food security, and trade has expanded and increased. For example, it exceeded 40% of the total commercial products in Seychelles and Maldives. From 1976 to 2018, the value of world fish exports reached 164 billion dollars from 7.8 billion dollars. Exports of fish and fish products constitute 11% of the export value of agricultural products (excluding forest products) (<https://www.tuik.gov.tr>, 2021).

As both a source of export income and an employment provider, fish and fish products trade makes a significant contribution to economic growth in developing countries. For these reasons, in the study; The geographical distribution of sea bass, sea bream and trout, which are important both in the world and in our country in terms of production amount and income, and their importance as an economic activity are discussed.

Materials and Methods

In this study, document analysis, one of the qualitative research methods, was used. The bibliography, statistical data and field studies on the subject, which has been followed and researched for many years, form the basis of the study. In particular, researches were carried out in these regions, and field studies were further concretized with statistical data. In the study, statistical data of FAO on fisheries, statistical data of TUIK about fisheries, Ministry of Food, Agriculture and Livestock, statistical data of the General Directorate of Fisheries and Aquaculture, statistics data of Fisheries Breeders Producer Center Union were used. The obtained statistical data were mapped using ArcGIS.

I. Aquaculture and Species in Turkey

In Turkey, as in the rest of the world, pressures on fish stocks have been effective in production and a decrease has been observed in general. While hunting production was 503 345 tons in 2000, it was 485 939 tons in 2010 and 463 168 tons in 2019 (<https://www.tuik.gov.tr>, 2021). Fish consumption in Turkey is very low compared to international standards and world averages, and the fish consumed per capita has decreased to an average of 6.3 kg (2019). When these indicators and fisheries around the world are evaluated, the importance of aquaculture becomes clearer. Aquaculture in Turkey is carried out with the permission of the Ministry of Food, Agriculture and Livestock, and the Ministry has made new regulations in order to ensure that aquaculture is carried out more regularly, to keep the environmental impacts at a minimum, to realize healthy and high quality production, and the European Union Common Fisheries Policy. Within the framework of the acquis harmonization rules, the “Aquaculture Regulation” was published in the Official Gazette dated 29.06.2004 and numbered 25507 and entered into force. Aquaculture was included in the scope of support for the first time in 2003. Production support practices, which have been implemented since 2003, have contributed significantly to the rapid development and progress of the aquaculture sector.

A protocol was signed and put into practice between DSI and the General Directorate of Agricultural Production and Development in 1994 in order to start aquaculture in cages in reservoirs (dam lakes) under the ownership of the General Directorate of State Hydraulic Works (DSI). The protocol was revised in 2004 and expanded to allow semi-intensive and extensive production. The start of breeding in natural lakes by the Ministry of Agriculture and Rural Affairs and in net cages by DSI in dam lakes in 1995 is also one of the reasons for the increase in production. The fish farms established in the seas were moved to open and deep waters in accordance with certain criteria in accordance with the legislation enacted by the Ministry of Environment and Urbanization after 2009. According to these criteria, fish farms cannot be established up to 0.6 nautical miles from the shore and in shallower waters than 30 m. In addition, technological developments such as the introduction of automatic feeding systems, feeding according to programs, and monitoring and monitoring in the digital environment have largely prevented feed-related contamination (DPT, 2014).

Turkey has a rich potential for aquaculture. Both inland and sea water resources are suitable for aquaculture, and the total aquaculture resources in terms of surface area (average 25 million hectares) are more than forest areas and almost equal to agricultural areas. The fact that Turkey is surrounded by seas on three sides, there are many river sources, natural lakes, dams and ponds appear as important potentials for aquaculture. Numerous dams and pond projects under construction or project can also be considered as potential aquaculture areas. To be specified with some data; We have a country with a high production potential with 8333 km of coastline with different ecological characteristics, 906 thousand hectares of natural lakes, 342 thousand hectares of dam lakes and 177 thousand kilometers of rivers (Balçı Akova, 2015: 171). Incorporating the

existing potential into production with the developing science and technology is of great importance for the development of the country's fisheries.

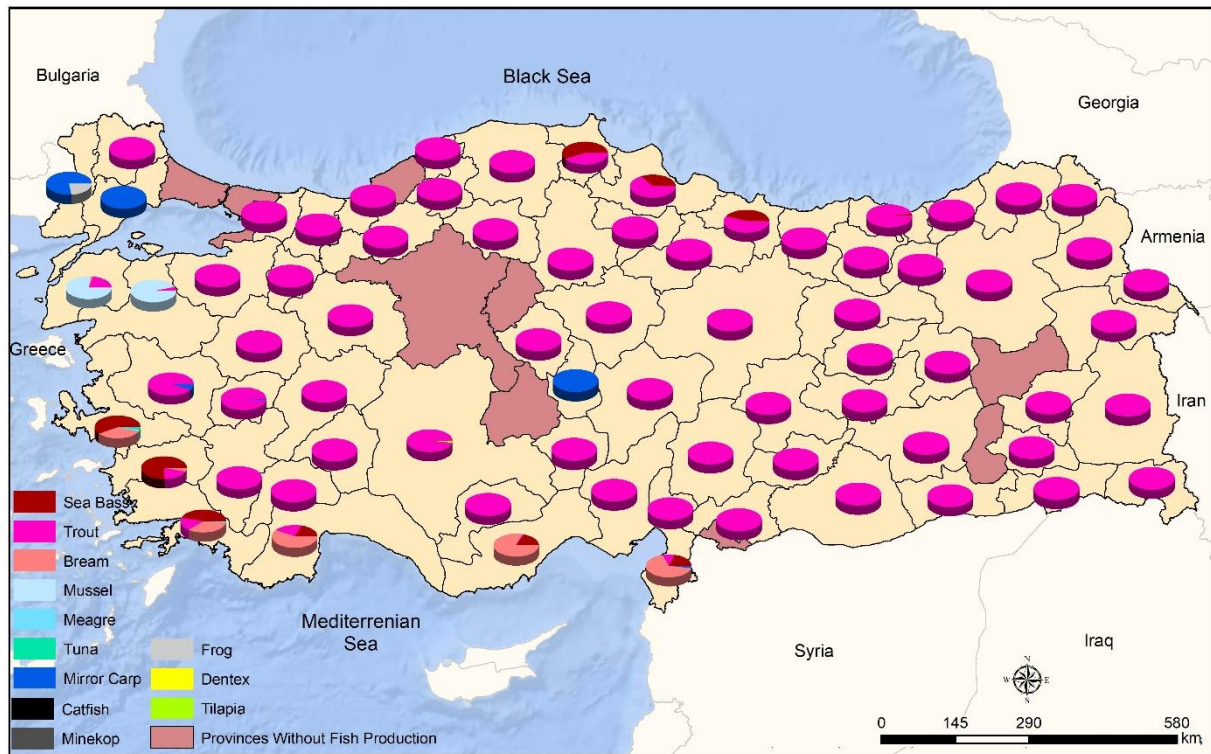
The water resources we have have suitable conditions in terms of water temperature and salinity rates. While the Mediterranean Sea has a salinity of ‰38-39, the Aegean Sea has a salinity of ‰38, the Marmara Sea has a salinity of ‰22, and the Black Sea, which has a lower evaporation intensity and more fresh water inflow, is 18‰. The water temperature of the Mediterranean Sea, located in the south of the country, is 27-17 °C, the Aegean Sea is 24-13 °C, the Marmara Sea is 24-9 °C, and the Black Sea is 24-7 °C.

In our country, 836 524 tons of fishry products were produced, 200 226 tons were exported and 90 684 tons were imported. Domestic consumption is 624 182 tons, processed (fish meal and oil) 209 109 tons and 3 233 tons that cannot be utilized. In the light of the said data, when we evaluate over the years, significant increases have occurred in production, especially in aquaculture, and significant increases are observed in domestic consumption and fishmeal and oil production (Table 1). Significant increases in imports indicate that the demand for fish has increased. While the production share of aquaculture was 1.5% as of 1990, it reached 44.6% as of 2019. As can be seen in Table 1, aquaculture is increasing steadily and rapidly.

Table 1: Amount of Fisheries Production Obtained Through Hunting and Breeding in Turkey

Year	Hunting(Ton)	Aquaculture (Ton)			Grand Total (Ton)	Share of Aquaculture in Total (%)
		Marine	Inland water	Total		
1990	379 332	1 545	4 237	5 782	385 114	1,5
1995	627 593	8 494	13 113	21 607	649 200	3,3
2000	503 345	35 646	43 385	79 031	582 376	13,6
2005	426 496	69 673	48 604	118 277	544 773	21,7
2010	485 939	88 573	78 568	167 141	653 080	25,6
2015	431 907	138 879	101 455	240 334	672 241	35,8
2018	314 094	209 370	105 167	314 537	628 631	50,0
2019	463 168	256 930	116 426	373 356	836 524	44,6

Source: TÜİK, Access 2021 and Previous years



Map 1. Distribution of Fisheries Production by Provinces in Turkey (2019)

Although all of the species that are grown or planned to be cultivated in aquaculture are of great importance for the fishing sector, the importance of trout, sea bream and sea bass production, which constitutes the first three, is clear (Map 1). Trout farming is carried out in many provinces of Turkey and it appears as the dominant breed in the inner regions. Species grown in coastal areas are diversified.

As can be seen in Table 2, the species cultivated both inland and in the sea are diverse in our country, and studies on breeding new species are ongoing. However, as can be seen in the table, trout, sea bream and sea bass production has been at the highest levels in every period. While rainbow type is dominant in inland waters in trout production, as of 2014, *salmo* sp. also started to be cultivated, especially the production of this species has increased in inland waters.

Table 2: Fish Species Cultivated in Marine and Inland Waters and Amount of Production (Tons)

Type of fish	2010	2012	2014	2016	2018	2019
Total	167	212 410,0	235 133,0	253 395,0	314	373 356,0
Inland water						
Trout (Rainbow trout)	78 165,0	111 335,0	107 533,0	99 712,0	103	113 678,0
Trout (Salmo sp.)*	-	-	450,0	1 585,0	1 695,0	2 375,0
Carp	403,0	222,0	157,0	196,0	212,0	203,0
Sturgeon*	-	-	17,0	6,0	2,0	-
Tilapia*	-	-	32,0	58,0	12,0	6,0
European catfish**	-	-	-	-	5,0	121,0
Frog*	-	-	50,0	44,0	49,0	43,0
Marine water						
Trout (Rainbow trout)	7 079,0	3 234,0	4 812,0	4 643,0	9 235,0	9 411,0
Trout (Salmo sp.)*	-	-	798,0	1 073,0	375,0	281,0
Sea bream	28 157,0	30 743,0	41 873,0	58 254,0	76 680,0	99 730,0
Sea bass	50 796,0	65 512,0	74 653,0	80 847,0	116	137 419,0
Common seabream*	-	-	106,0	225,0	2,0	5,0
Bluespotted seabream**	-	-	-	-	74,0	74,0
Redbanded seabream**	-	-	-	-	1,0	-
Carb*	-	-	39,0	20,0	30,0	47,0
Meagre*	-	-	3 281,0	2 463,0	1 486,0	3 375,0
Dentex*	-	-	113,0	43,0	24,0	27,0
Sharpsnout seabream*	-	-	8,0	2,0	-	-
Blue spatled bream*	-	-	75,0	61,0	70,0	66,0
Bluefin tuna*	-	-	1 136,0	3 834,0	3 571,0	2 327,0
Mussel	340,0	-	-	329,0	907,0	4 168,0
Other	2 201,0	1 364,0	-	-	-	-

*It was compiled starting from 2014.

**It was compiled starting from 2017.

Source: TÜİK, accessed 2021

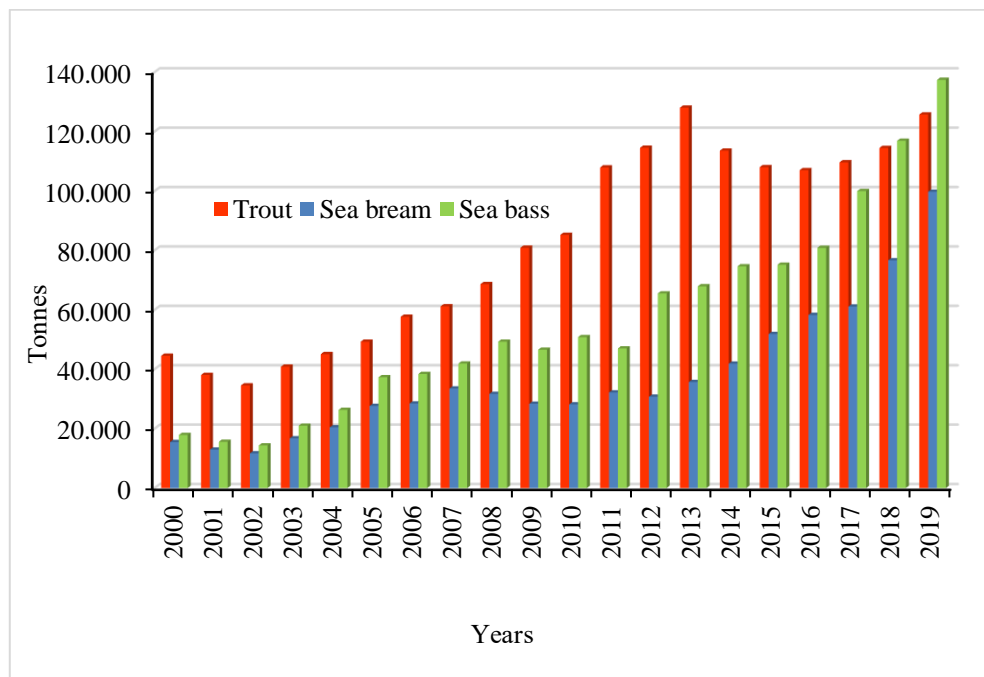
1.1. Trout, Sea Bream and Sea Bass Farming in Turkey

Trout, Sea Bream and Sea Bass production is of great importance in aquaculture in Turkey. We see this clearly in the data (Table 2). The total production share of the three species is 98.5% of the aquaculture production as of 2000, 96.6% as of 2005, 98.2% as of 2010, 97.8% as of 2015, and 2019. and 96.6% (Table 3 and Graph 1). Its share in the total has not fallen below 96% in the last twenty years, when we evaluated it.

Table 3: Amount of Trout, Sea Bream and Sea Bass Production (Tons) and their Share in Total Aquaculture in Turkey

Year	Trout			Share in Total Production (%)	Sea Bream	Share in Total Production (%)	Sea Bass	Share in Total Production (%)
	Inland Water	Marine	Total					
2000	42 572	1 961	44 533	56,3	15 460	19,6	17 877	22,6
2005	48 033	1 249	49 282	41,7	27 634	23,4	37 290	31,5
2010	78 165	7 079	85 244	51,0	28 157	16,8	50 796	30,4
2015	101 166	6 872	108 038	45,0	51 844	21,6	75 164	31,3
2016	101 297	5 716	107 013	42,2	58 254	23,0	80 847	31,9
2017	103 705	5 952	109 657	39,7	61 090	22,1	99 971	36,2
2018	104 887	9 610	114 497	36,4	76 680	24,4	116 915	37,2
2019	116 053	9 692	125 745	33,1	99 730	26,7	137 419	36,8

Source: Calculated from TÜİK data, Access 2021

**Graphic 1:** Trout, Sea Bream and Sea Bass Breeding in Turkey by Years

1.1.1. Trout Breeding and Its Importance

The trout species grown in Turkey as well as in the world is "Rainbow Trout". The most important reason for the widespread cultivation of rainbow trout is its suitability for the growing conditions. The breeding of this species in Turkey started in the 1970s. Initially, production was carried out by small enterprises, but in the 1990s, production began to be carried out in integrated facilities.

Trout is a member of the Salmonidae family, and the genus *Salmo*, *Salvelinus* and *Oncorhynchus* are preferred for breeding. Worldwide, *Salmo salar* (Atlantic salmon), *Salmo trutta*

trutta (Sea trout), *Salmo trutta fario* (Stream trout), *Oncorhynchus mykiss* (Rainbow trout), *Salvelinus fontinalis* (Source trout), *Salvelinus alpinus* (Alpine trout) and *Salmaycushvelin* trout) are among the most preferred species.

Optimum conditions required for the growth of trout may vary. However, clean, clear, cool and oxygen-rich waters are required in trout farming. Having a water flow of at least 100 lt / sec is ideal for establishing an average trout farming business. It is ideal if the water temperature is 14-15 °C. However, in waters with good flow, rainbow trout can survive in water temperatures of 23-24 °C (Alpaz 2021).

Trout production increased by 177.5% between 2000 and 2019. Studies are continuing to bring local and natural trout species into aquaculture. Major local trout subspecies; *Salmo trutta macrostigma* Dumeril (Anatolian Mountain trout), *Salmo trutta abanticus* Tortonese (Abant trout), *Salmo trutta caspius* Kessler (Aras trout), *Salmo trutta labrax* Pallas (Black Sea trout), *Salmo trutta f.lacustris* Linnaeus (Lake trout) (Lake trout) , 1994). However, *Oncorhynchus mykiss* (Rainbow trout) is the most cultivated trout species in our country. In addition to this, *Salmo* breeds are also grown (Table 4).

Table 4: Trout Production by Years

Type of fish	2010	2012	2014	2016	2018	2019
Total Production	167 141	212 410	235 133	253 395	314 537	373 356
Inland water						
Trout (Rainbow trout)	78 165,0	111 335	107 533	99 712	103 192	113 678
Trout (Salmo sp.)	-	-	450	1 585	1 695	2 375
Marine water						
Trout (Rainbow trout)	7 079	3 234	4 812	4 643	9 235	9 411
Trout (Salmo sp.)	-	-	798	1 073	375	281
Share in Total Production(%)	51,0	53,9	48,3	42,2	36,4	33,1

1.1.2. Bream Breeding and Its Importance

Sea bream (*Sparus Aurata*), which has an important place in aquaculture production in the world and in our country, has been hunted for many years in our country on the shores of the Mediterranean and Aegean Seas. Although the cultivation of sea bream started in the 1980s, the production amount has increased since the 2000s (Graph 1). Sea bream production increased by 545% between 2000 and 2019. As of 2019, sea bream constitutes 26.7% of the total fish production.

Sea bream is the most cultivated fish species in Turkey after trout and sea bass. The fact that sea bream is resistant to diseases, the natural water temperature and salinity rates of the Mediterranean and Aegean Seas and the fact that it is a fish consumed in the Mediterranean and Aegean Regions for many years are effective in its preference for aquaculture.

Optimum water temperature should be 22-25 °C for bream to grow. However, it can survive in water temperatures of 6-32 °C (Ökte, 2002:84). The ideal portion weight is between 300-400 g, and it reaches this weight after the age of 2 (Alpaz, 2001).

1.1.3. Aquaculture of Sea Bass and Its Importance

According to 2019 data, the most commonly grown fish species (*Dicentrarchus labrax* Lin) in our country is sea bass. Its natural habitat is the Mediterranean and the Atlantic Ocean, and it spreads over a wide area. Sea bass can continue to grow at an optimum level at temperatures of 22-24 °C. However, it can withstand temperatures up to 2-38 °C (Stickney and Allan, 2000: 869).

Perch is resistant to changes in salinity of the water. They can survive in salinities of ‰3-50. They can even adapt to waters with a ratio of ‰0 (Firat and Saka, 2021). Another advantage in sea bass production is that it has been cultivated for a long time, so there is sufficient knowledge about potential diseases, prevention and treatment. On the other hand, it is an important disadvantage that the fish get stressed easily and the yield decreases in sea bass farming.

Sea bass production in our country started in the 1990s and reached 20 000 tons per year in 2000. Since 2000, the amount of production has increased in general. It increased by 668.7% between 2000 and 2019 (Chart 1). As of 2019, it constitutes 36.8% of the total fish production.

1.2.Economic Value of Trout, Sea Bream and Sea Bass Farming in Turkey

Although the first aquaculture experiences in our country started in the 1960s, it became an important economic activity in terms of production and economy, coinciding with the 2000s. Since the 2000s, the economic value obtained from aquaculture has been steadily increasing in our country, as it has been at the global level. As can be seen in Table 5, the share of aquaculture in value was 27.5% as of 2000, while it reached 76.4% as of 2019.

Table 5: Fisheries Production Value and Its Share in Total

Year	Hunting and Aquaculture (₺)	Aquaculture (₺)	Share of Aquaculture in Total Value (%)
2000	507 393 600	139 552 950	27,5
2005	2 279 271 300	704 283 000	30,9
2010	2 145 293 800	1 066 778 600	49,7
2015	3 814 228 971	2 569 208 590	67,4
2019	10 074 539 388	7 694 124 480	76,4

Source: TÜİK, Access 2021

According to the 2018 data of the Food and Agriculture Organization, Turkey ranks twenty-first in aquaculture production in the world. However, most of the countries in the first place are geographically distant from Turkey, such as China, Indonesia, India and Vietnam. A significant portion of the aquaculture products are exported to European countries. As of 2019, the top five countries we export to; Italy (24.308 tons), the Netherlands (23.493 tons), Russia (19.293 tons), Greece (17.427 tons), and Germany (12,254 tons). <http://www.fao.org/fishery/> last accessed 08.06.2021

A significant part of the fish produced in our country is exported. As can be seen in Table 6, the total export value of fisheries products as of 2019 is 1 025 617 723 dollars. In fisheries exports, trout is 117 million dollars, sea bream is 286 million dollars, and sea bass is 332 million dollars, the sum of which is 735 million dollars. This constitutes 71.7% of the total export value. Trout constitutes 11.4% of the total export value, Sea Bream constitutes 27.9% of the total export value, and Sea Bass constitutes 32.4% of the total export value.

Table 6: Fisheries Exports of Turkey

Year	Production (ton)	Value (\$)	Value (₺)
2000	14 533	46 374 937	28 752 958
2005	37 655	206 039 936	277 963 150
2010	55 109	312 935 016	471 459 989
2015	121 053	692 220 595	1 879 701 163
2019	200 226	1 025 617 723	5 818 776 189

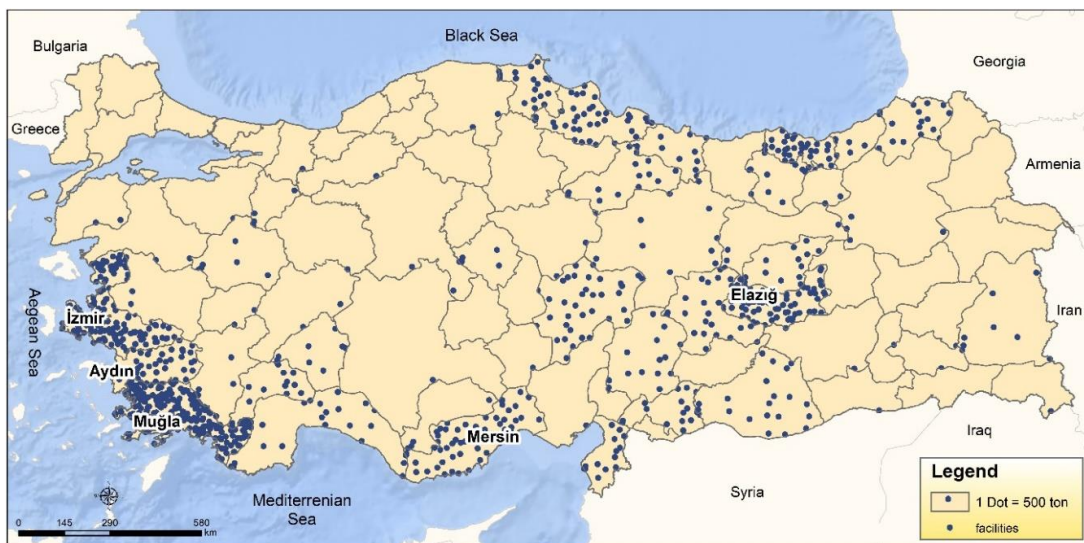
Source: TÜİK, Access 2021

1.3. Number and Capacities of Trout, Sea Bream and Sea Bass Facilities in Turkey

As stated in the lines above, the amount of fish provided by aquaculture since the 2000s in our country exceeds the amount of fish provided by hunting. This situation is indirectly reflected in the number and capacity of hatcheries and fish farms. According to the data of the Ministry of Agriculture and Forestry, as of 2021, the number of facilities where trout, sea bream and sea bass are grown is 1843. Trout is produced in 1545 of these facilities, sea bream is produced in 148 of them and sea bass is produced in 150 of them. Sea bream is also grown in most of the facilities where sea bass is grown. Although the facilities where sea bream and sea bass are grown are less in number, their production capacity is higher. While the average annual capacity of the trout facilities is 128 tons, the annual production capacity of sea bream and sea bass is 653 tons (<https://www.tarimorman.gov.tr>, 2021).

Some of the fish farms have their own hatcheries. As of 2021, 55 of the 1840 registered facilities of trout, sea bream and sea bass farms are hatcheries and 387 are integrated breeding facilities with a hatchery.

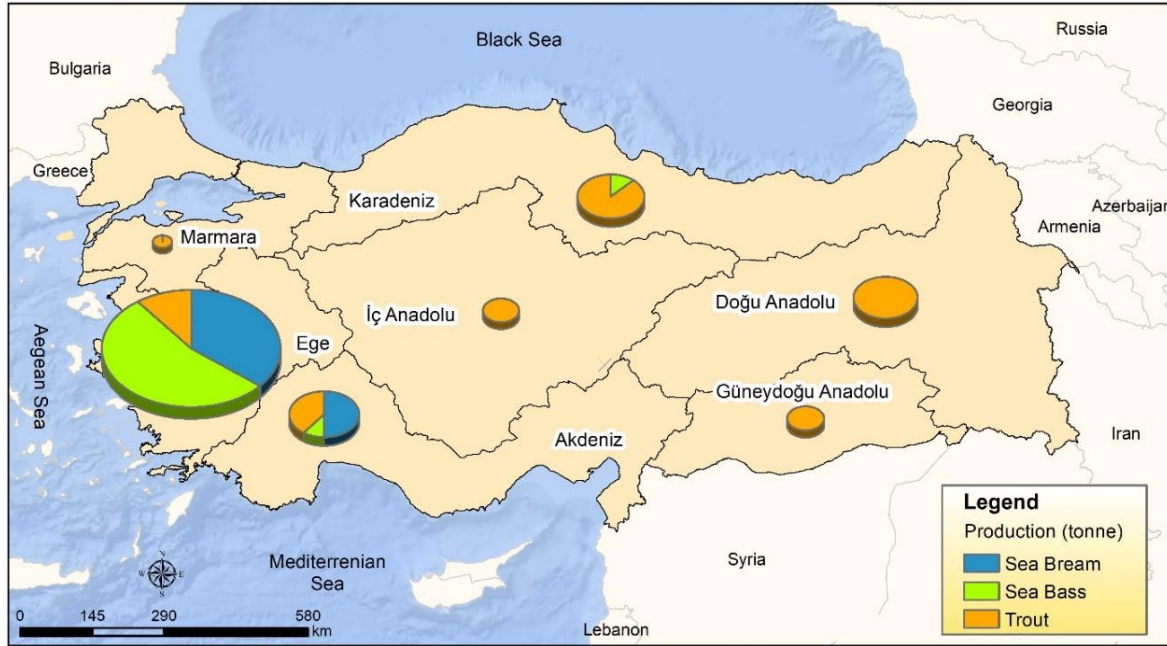
The production capacities of enterprises related to aquaculture throughout the country vary between 3 900 tons and one ton. When analyzed by provinces, Muğla (101 910 tons), İzmir (58 953 tons), Elazığ (32 180), Mersin (26 177) and Aydın (17 924) provinces have the highest capacity in trout, sea bream and sea bass production (Map 2). . Muğla is also the province with the highest number of facilities (278). İzmir, on the other hand, is in the second rank in terms of the capacity of the facilities, although it is relatively few in terms of the number of facilities (49).



Map 2. Distribution of Facilities by Production Capacity (2021)

1.4. Geographical Distribution of Trout, Sea Bream and Sea Bass Farming in Turkey

It is not possible to talk about a homogeneous distribution throughout the country in seafood production in Turkey. The Aegean Region is the region with the highest trout, sea bream and sea bass production (Map 3). According to 2019 data, 23% of trout production, 81% of sea bream production and 94% of sea bass production are made in the Aegean region (Table 7).



Map 3. Distribution of Trout, Sea Bream and Sea Bass Production by Regions (2019)

Table 7: Sea Bass, Sea Bream and Trout Production by Regions (tonnes) (2019)

Regions	Trout	Sea Bass	Sea Bream	Total
Ege Bölgesi	29 511	128 432	81 251	239 194
Akdeniz Bölgesi	13 951	4 370	18 448	36 769
Karadeniz Bölgesi	28 816	4 608	-	33 424
Doğu Anadolu Bölgesi	30 497	-	-	30 497
Güneydoğu Anadolu Bölgesi	10 430	-	-	10 430
İç Anadolu Bölgesi	9 849	-	-	9 849
Marmara Bölgesi	2 691	9	31	2 731
Total	125 745	137 419	99 730	362 894

Source: TÜİK, 2021

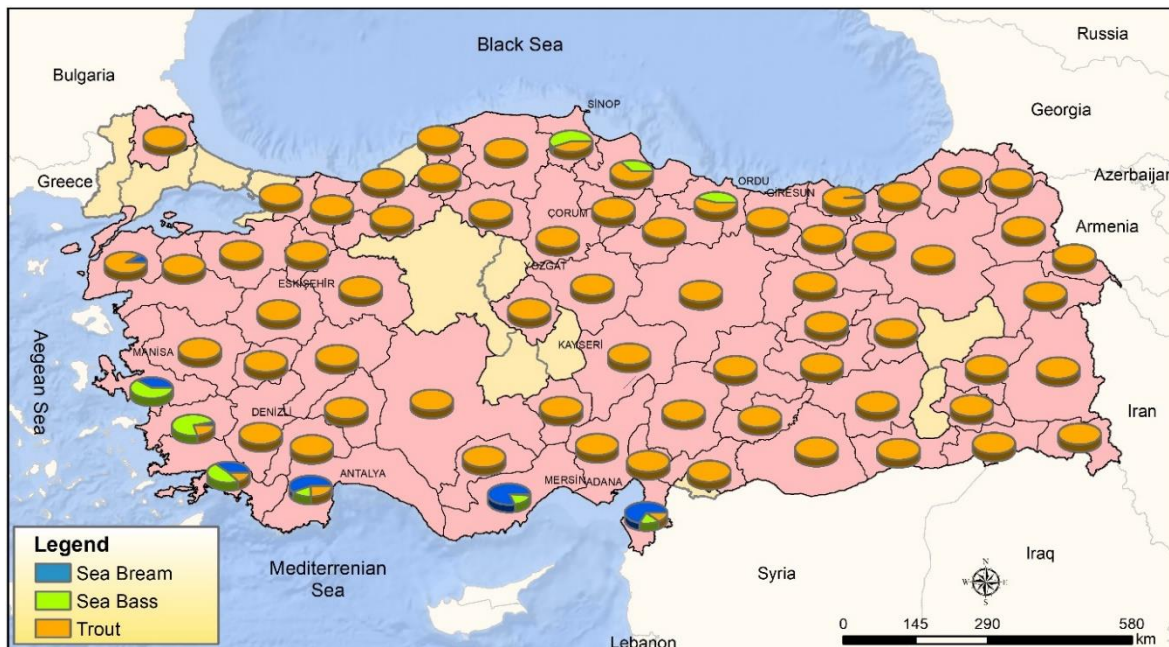
Although the Aegean Region has an average coastline of 300 km as a bird flight, it actually has a coastline of 2805 km due to the fact that there are many coves and gulfs along the coast. These coves and gulfs positively affect the off-shore fishing activities in the seas. Three fish species that are the subject of the study are also grown in the Aegean region. Especially in the production of sea bass and sea bream, much more production is made than in other regions. In trout

farming, it ranks second after the Eastern Anatolia Region (Table 7). All of the trout grown in the Aegean region are grown in inland waters.

The highest production in the three products selected after the Aegean Region is made in the Mediterranean Region. All of the trout produced similarly to the Aegean Region are produced in inland waters. In the Black Sea Region, which has approximate production figures with the Mediterranean Region, there is no sea bream production, while the sea bass production is 4 604 tons. Another remarkable feature in the Black Sea Region is the use of the marine environment as well as inland waters as a trout production center. As of 2019, only 8% (9,692 tons) of the trout produced in Turkey is produced from the sea and all of this production is done in the Black Sea Region. This situation is related to the temperature and salinity ratios of the Black Sea water (the average salinity ratio of the Black Sea is ‰ 18) as well as the trout type. Trout can also live in salty waters with a rate of ‰ 20 if the water temperature is colder than 17-18 °C.

It is not possible to grow sea bass and sea bream in three landlocked regions of Turkey. However, as of 2019, over 30 thousand tons of annual trout were produced in the Eastern Anatolia Region, in other words, 25% of the trout produced in Turkey (Table 7). In trout production, South East Anatolia Region has a share of 8% and Central Anatolia Region has a share of 8%. The lowest values for the three fish species in the study belong to the Marmara region. According to 2019 data, 2% of trout production and less than 1% of sea bass and sea bream production were produced. These three species have a 1% contribution to their total values.

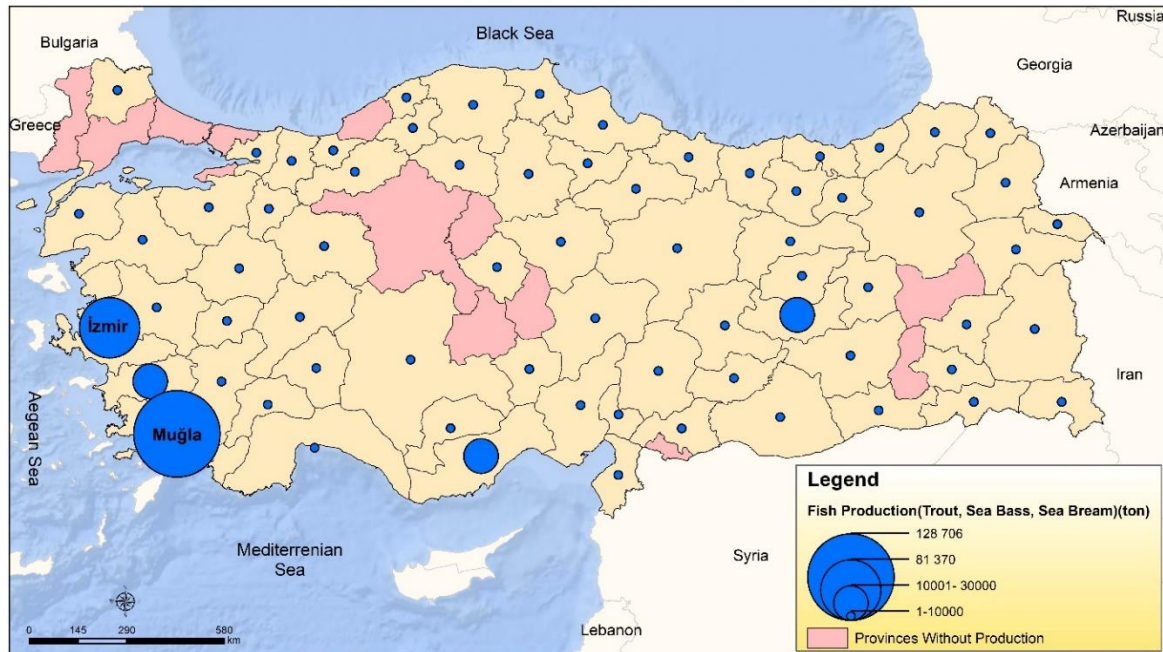
When we look at the distribution of trout, sea bream and sea bass production by provinces, it is seen that at least one of the fish species is grown in 69 provinces (Map 3). The spread of production over such a wide area is largely related to trout farming. While the number of provinces where trout is grown is 69, the number of provinces where sea bass is grown is 11, and the number of provinces where sea bream is grown is 7. Reasons such as the production of sea bass and sea bream and the fact that trout is one of the first cultured species affect this distribution.



Map 3. Distribution of Trout, Sea Bream and Sea Bass Species by Province (2019)

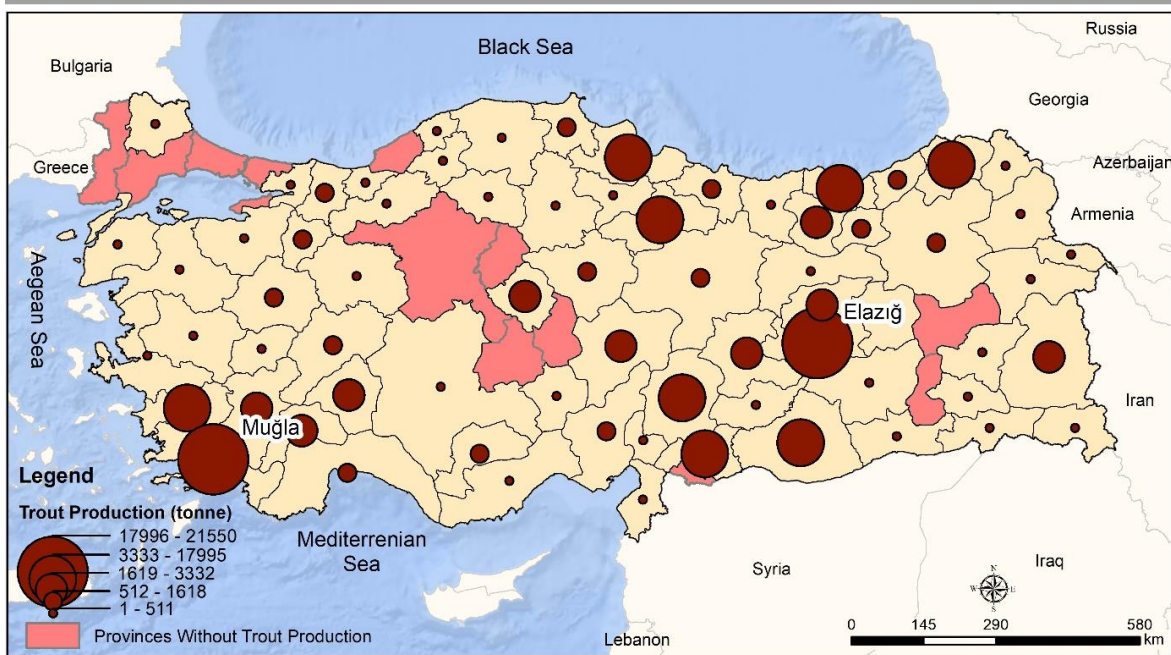
Among the provinces, Muğla has the highest annual production of 128 thousand tons and İzmir 81 thousand tons for the three selected fish species (Map 4). The indented coastline and the

favorable conditions for aquaculture paved the way for aquaculture in Muğla to begin in 1982. Successful applications increased after 1986. Muğla Province meets 35% of total production and İzmir Province meets 22%.

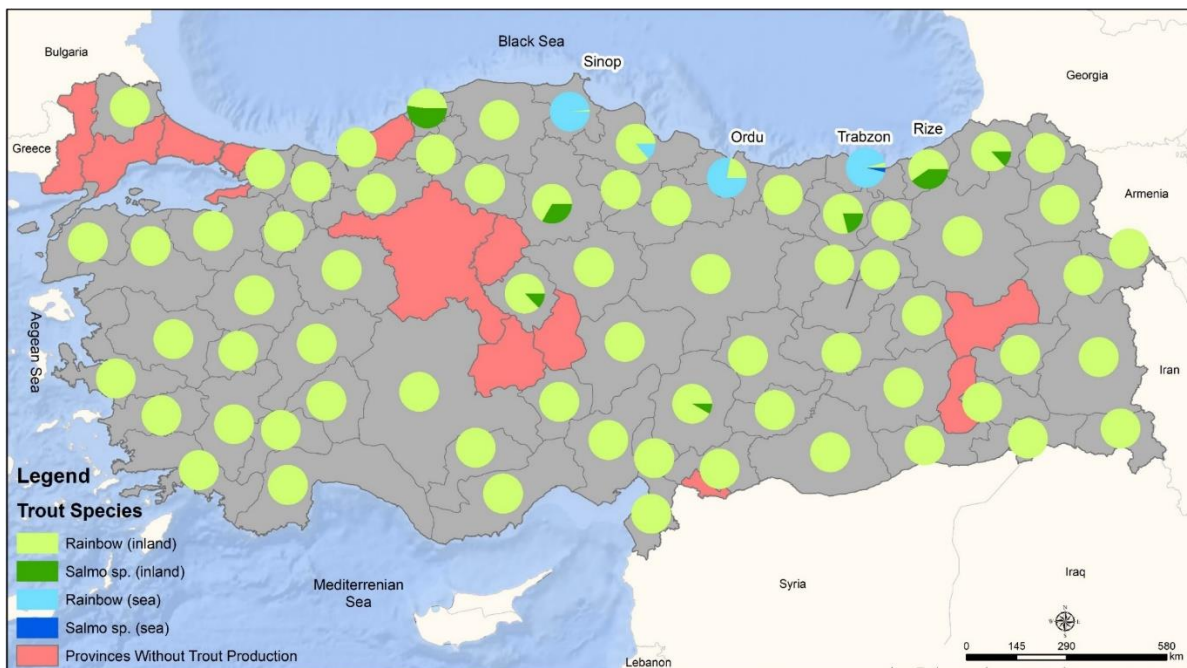


Map 4. Trout, Sea Bream and Sea Bass Production by Province (2019)

Trout farming is carried out in 69 provinces in Turkey (Map 5). Provinces with the highest total trout production are Elazığ (21550 tons), Muğla (18750 tons), Trabzon (7535 tons), Artvin (5353 tons), Aydın (5342 tons), Şanlıurfa (5025 tons), Kahramanmaraş (4945 tons), Tokat (4761 tons), Gaziantep (4477 tons) and Samsun (4058 tons). The total production of these first ten provinces is 81 796 tons, and the total trout production of other provinces is 43 949 tons. Rainbow trout raised in inland waters constitute 90.4% of the trout raised, Rainbow Trout with a share of 7.5%, *Salmo sp* trout raised in inland waters with a share of 1.9% and *Salmo* grown in the sea with a share of 0.2%. *sp.* trout species. Four species are also grown in Trabzon, and 6936 tons of 7535 tons grown in the sea are Rainbow Trout. *Salmo sp*, which grows in inland waters, constitutes 700 tons of 5353 tons of trout grown in Artvin, and 413 tons of 4945 tons of trout grown in Kahramanmaraş. tons), Kırşehir (311 tons) and Rize (403 tons) are also grown. Sea-raised Rainbow Trout is also grown in Ordu (1262 tons) and Sinop (652 tons) apart from Trabzon and Samsun (Map 6).



Map 5. Distribution of Trout Production by Provinces (2019)



Map 6. Distribution of Trout Species in Turkey by Provinces (2019)

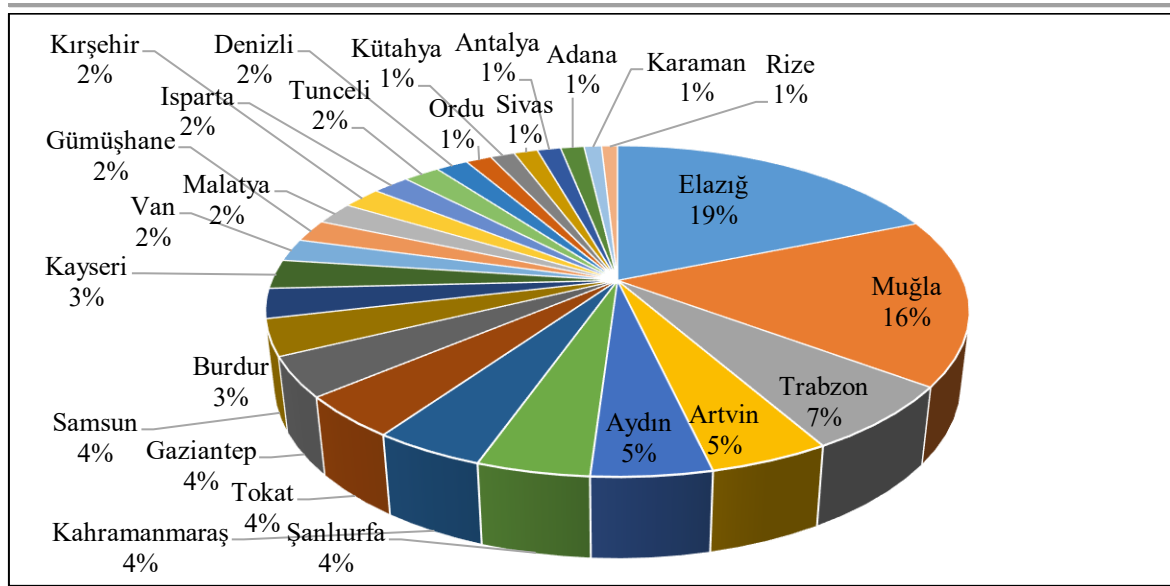
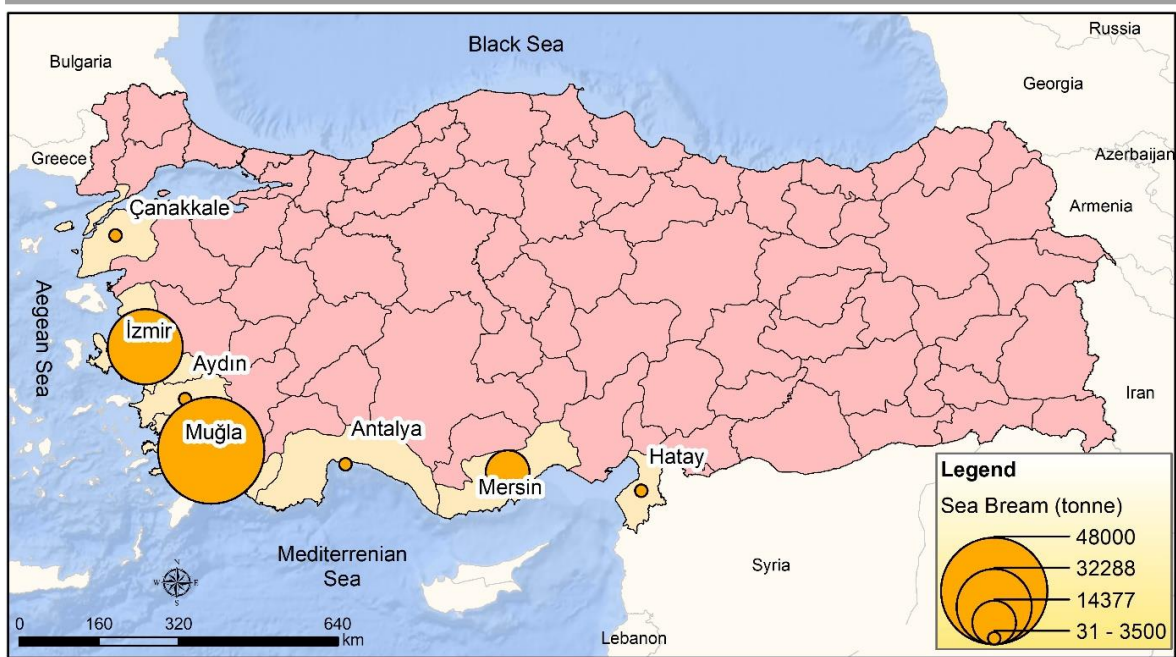


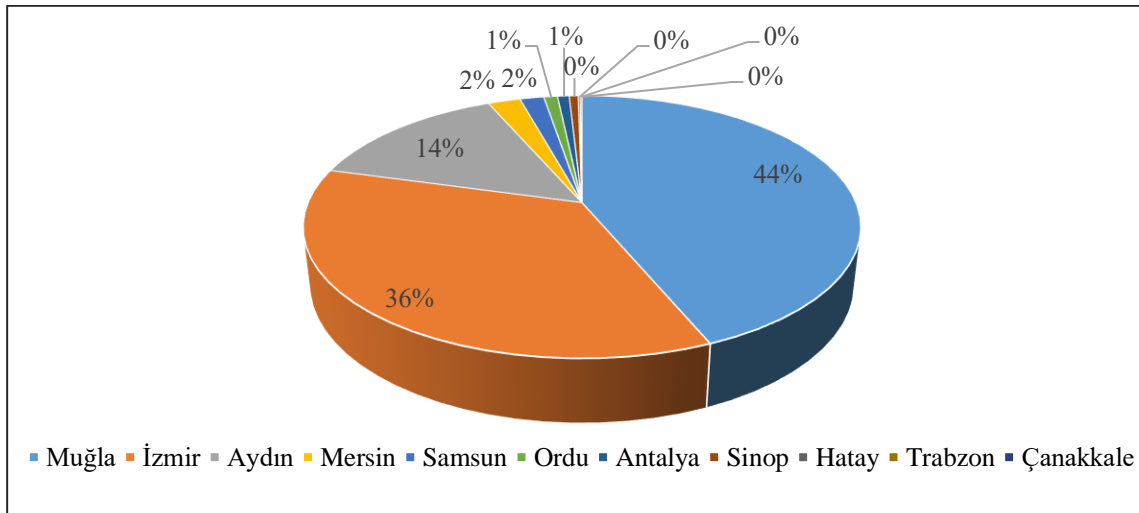
Chart 2. Trout Production by Provinces (2019)

Sea bream is grown in seven provinces in Turkey. The provinces where sea bream are produced are Muğla (48000 tons), İzmir (32288 tons), Mersin (14377 tons), Antalya (3442 tons), Aydın (963 tons), Hatay (629 tons) and Çanakkale (31 tons). The total amount of sea bream grown by provinces is 99 730 tons. Muğla and İzmir provinces stand out in sea bream breeding. As of 2019, 48 000 tons of sea bream were produced in Muğla and 32 288 tons in İzmir. Total production of Muğla and İzmir constitutes 81% of Turkey Sea Bream production. Other provinces where sea bream are grown are the ones that have coasts to the Mediterranean, Aegean and Marmara Seas. However, bream farming is not practiced on the Black Sea coasts (Map 7). The share of Muğla in sea bream production is 48%, followed by İzmir with 32%, Mersin with 14%, Antalya with 4%, Aydın with 1%, Hatay with 1% and Çanakkale with 0.03%.



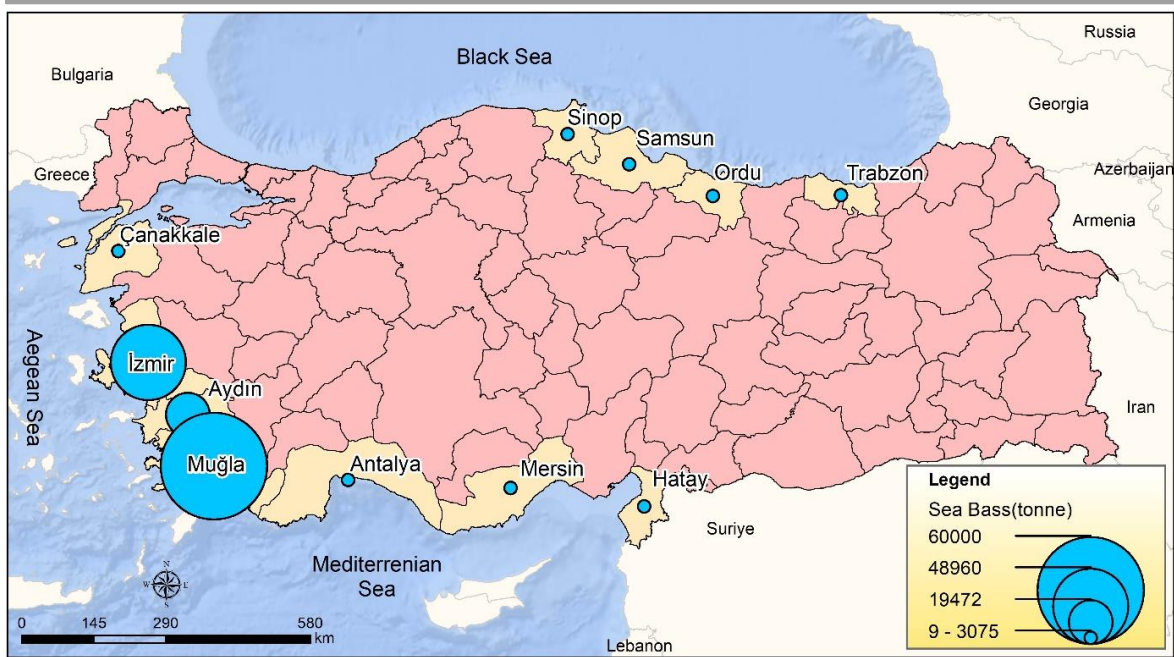
Map 7. Distribution of Sea Bream Production by Provinces (2019)

Sea bass is grown in eleven provinces in Turkey. The provinces where sea bass are produced are Muğla (60 000 tons), İzmir (48 960 tons), Aydın (19 472 tons), Mersin (3075 tons), Samsun (2283 tons), Ordu (1299 tons), as seen on map 8. Antalya (1114 tons), Sinop (859 tons), Hatay (181 tons), Trabzon (167 tons) and Çanakkale (9 tons). The total amount of sea bass grown by provinces is 137 419 tons.



Graph 3. Sea Bass Production by Provinces (2019)

Muğla and İzmir provinces stand out in sea bass production. This production, carried out in Muğla and İzmir Provinces, constitutes 79% of the Sea Bass production in Turkey. Different from sea bream, sea bass is grown in all our seas (Map 8).



Map 8. Distribution of Sea Bass Production by Provinces (2019)

Conclusion

Today, the demand for fish has increased due to the increasing population and the demand for healthy nutrition. On the other hand, fish products obtained by hunting for many years are insufficient to meet the demand for seafood. In addition, the amount of fish and fish species in the world's water resources are decreasing day by day. Aquaculture is seen as a good option both to meet the increasing demand and to reduce the pressure on fish reserves. In addition, not only the nutritional needs are met by fishing, but also a large number of people are employed through fishing activities.

Aquaculture, which has increased worldwide especially since the 1980s, has developed rapidly in the last 20 years in our country. Although the developments in the world are late, the current situation is not enough, but it is pleasing. Among the fish species studied, trout is the first economically cultivated species in our country. Afterwards, sea bream and sea bass fish started to be produced. In the first place, the fish farms established near the coast were not requested by the touristic businesses, and production started in the open seas, which is called off-shore. This situation increased the investment costs and for a short period, there was a decrease in sea bream and sea bass farming.

Today, most of the fish produced in Turkey consists of trout, sea bream and sea bass. While a significant part of the trout produced is produced in inland waters, all sea bream and sea bass production is done in the sea. In general, although the number of trout farms is higher, they have a lower production capacity than sea bass and sea bream farms. While the Eastern Anatolia Region, especially the province of Elazığ, stands out in trout production, the Aegean region, especially Muğla and İzmir provinces, stand out in sea bream and sea bass production.

The fish that are followed by the breeders from the hatchery to the market not only create a planned and controllable food supply chain, but also constitute an important foreign currency inflow since more than half of the fish produced is exported to various countries, especially European countries. When Turkey's geographical potential is evaluated, it will turn into a much more effective economic activity.

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1. Yazar/First author %50,
2. Yazar/Second author %50.

2. Yazarlar tarafından herhangi bir çıkar çatışması beyan edilmemiştir (No potential conflict of interest was reported by the authors).