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DEVELOPMENT AND SITUATION OF TROUT CULTURE IN TURKEY

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Abstract

The production of rainbow trout (*Oncorhynchus mykiss*) is developing and it is most cultured finfish species in Turkey. It was first introduced in Turkey in the mid 1970s from Italy. In the following years, culture studies of native trout strains, mainly Black Sea trout; *Salmo trutta labrax* and Abant Lake trout, *Salmo trutta abanticus* started in late 1990. Market size trout production was performed in two main categories, inland areas (mainly concrete ponds by flow through fresh water and cages) and in sea (off-shore cages). Total trout production was 61.173 tons in 2007.

Key words: Aquaculture, rainbow trout, *Oncorhynchus mykiss*, fish farming, Turkey.

Introduction

Aquaculture in Turkey is very new when compared with European countries. The first fish farm was established as a rainbow trout farm in mid 1970s. The following years, new fish farms have been established year by year. When it comes to 1980s, cultured fish species were varied such as carp (*Cyprinus carpio* L.), trout, sea bream (*Sparus aurata*), and sea bass (*Dicentrarchus labrax*). Nowadays, although main aquatic production consist of mainly three carnivore species (trout, sea bass and gilthead sea bream), culture of new species are also performing such as Black Sea turbot (*Psetta maxima*), Black Sea trout (*Salmo trutta Labrax*), bluefin tuna (*Thunnus thynnus*), Mediterranean mussel (*Mytilus galloprovincialis*) and Shrimp (*Penaeidae* spp).

The rainbow trout is the most farmed fish species. The rainbow trout is one of the oldest fish in culture. Gall and Crandell (1992) report that Mr. S. Green transferred eyed eggs in 1874 from the McCloud River in northern California to his private hatchery at Caledonia, New York. The First successful shipment of rainbow trout outside of North America was realised in 1877. The European rainbow trout farming began in Denmark in 1890 (Laird and Needham, 1988; Gall and Crandell, 1992). Trout farming is widely exercised in the world because of some

characteristics of rainbow trout. It is highly adaptable to its environment, can tolerate water temperature from 0 to 26 °C, can be cultured in sea water after reaching a minimum size.

The European trout farming industry has grown in the 1980s. Small quantity of trout production, developed rapidly due to development of feed industry in Turkey in last three decades. In early years of trout culture history, trout production was less than 1000 tons per year. In following years, trout production increased and production amount reached up to 61.170 tons in 2007 (Figure 1).

According to Ministry of Turkish Agricultural and Rural Affairs (MARA), the trout farms number that is active recently has reached to 1.170 in 2007. Majority of those trout farms are small scale family owned farms. Some of them have great production capacity. Although trout farms were allocated mainly in the west of the country called Aegean Region of Turkey, they are distributed in all over of Turkey. On the other hand, investment of 732 trout farms is going on by the year 2007.

In this paper, trout production, current situation and its potential for future expansion in Turkey were reviewed.

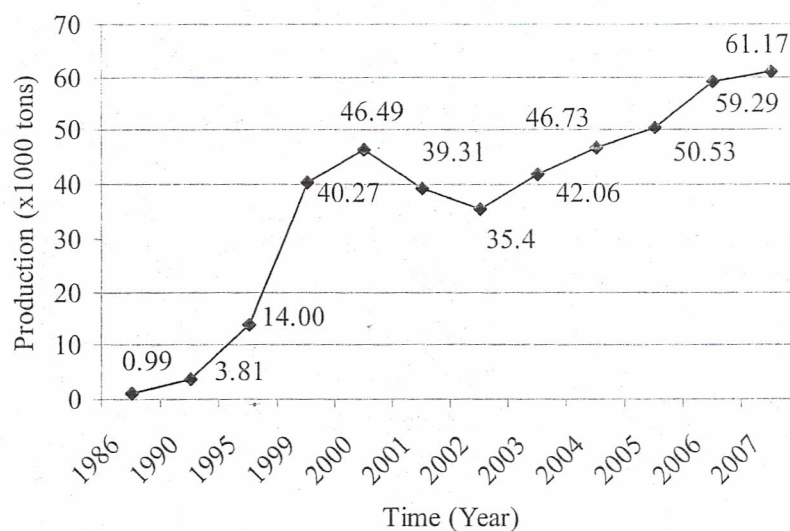


Figure 1. Total trout production in Turkey in years 1986-2007 (Turkish Statistical Institute, 2007).

Trout Farming: Methods, Production Strategies

Trout farming has begun at the beginning by concrete ponds in 1970s (Canyurt, 1977 and 1978). In later stages, cage-culture has developed in lakes and dam lakes which are suitable for trout culture in 1990s. Trout farming started also in Black Sea early 1990s by cages (Sahin et al., 1999). Trout culture can be discussed as hatchery production, inland culture and marine culture. The majority of trout farms are pond farms inland area. The marine production is possessed in off-shore cage farms activated in Black Sea and Aegean Sea.

Hatchery

The hatcheries for fry production of trout and other native trout strains in Turkey, their size, capacity and the type depend on the quality and the quantity of water and demand for fry to produce the market size fish. On the other hand, according to Turkish Ministry of Agriculture and Rural Affairs (2007), 18 trout hatcheries have produced only fry and their production capacity is 76,760.000 fry per year (Table 1).

Also, The General Directory of Nature Conservation and National Parks of the Turkish Ministry of Environment and Forest produce native trout strains' fry in three government hatcheries. In these hatcheries, 15 different native trout strains' fry are produced and restocked in streams and rivers.

The spawning time of brood rainbow trout is varying between November and April in Turkey. The production of high quality and disease-free eggs is a specialized activity requiring a high degree of skill and management. Most

of the eggs used in commercial trout production in the Turkey are produced in the western part of the country. Trout eggs are usually stripped using conventional methods and are incubated in vertical and horizontal incubators. Swim-up yolk-sac fry are transferred to larvae tanks for first feeding. These equipments are made from generally fibreglass material. In general fry are kept during 10 to 12 weeks in the hatchery under controlled conditions with careful feeding and protection against infections and diseases.

Trout Culture in Inland Waters

Inland trout farms consist of pond farms and cage farms. Pond production was performed mainly concrete ponds. The ponds used for trout farming are generally 1m to 1.4 m depth, 2 m to 4 m width and 15 m to 50m length. Stock density varies between 10 and 40 kg m⁻³. The fingerlings reach to market size (200-250g) in 8-12 months. Total 25.350 tons rainbow trout produced in 999 pond farms in 2006 (Table 1). Large amount of production (30.695 tons) comes from 171 pieces of cage farms. Fingerlings are stocked in September-October generally, and production season is ended up to July when the lake water gets warmer. The cages are made by wooden or High Density Polyethylene (HDPE) and cage shape is square (5x5 m). But nowadays fish farmers prefer circular HDPE cages. Trout grows faster in cages than concrete ponds. The food conversion ratio vary between 0.8 and 1.1 is also lower than concrete ponds. Cage net depth varies between 5 and 8 meters. Stock density varies between 10 and 25 kg m⁻³.

Table 1

Number of inland trout farms (Turkish Ministry of Agriculture and Rural Affairs, 2006)

	Number	Capacity (tons/year)
Cage farm [†]	171	25.350
Pond farm	999	30.695
Hatchery	18	76,760.000*
Total	1,188	57.170

*fry number, †generally those trout farms produce their own fry

Extruded fish feed is used to feed the trouts. Due to the growth in production of trout aquaculture, aqua feed market has significantly grown parallel to these increases. There has been a substantial improvement in feed efficiency. The average FCR for trout was estimated to be 2 in 1980s, but nowadays it is about 0.8 - 1.1 in cages (Gullu and Guzel, 2006) and 1.1-1.2 in ponds (Harmantepe and Büyükhatoğlu, 2007).

Trout Culture in Marine Water

The rainbow trout has been cultured in Black Sea coast of Turkey since 1990s (Akbulut et al., 2002). In recent years, increasing numbers of trout farmers establish off-shore cage farms in Black Sea shore. This method consists to transfer 100-250 g rainbow trouts from the fresh water

ponds to sea-cages in autumn and harvest them until June. This production strategy reduces rearing time when comparing pond production in fresh water condition. In Turkish fish market, Black sea reared rainbow trout was won approval by consumers. As a result of this, the cage farms number has raised in the course of recent years. At the beginning, early 1990s, cage farms were established only in winds and waves sheltered Black Sea bays and farmers have used kames type wooden cages. After off-shore cages technology has been developed, new farms were established and some of them have been in investment stage (Table 2). Annual trout production was occurred as 300 tons in 1990 and reached 1961 tons in the year 2000 (Figure 2).

Table 2

Actively trout producing and investment stage cage farms number and their capacity (Turkish Ministry of Agriculture and Rural Affairs, 2006)

Status of cage farms	Farm numbers	Capacity (tons / years)
Active cage farms	12	4,810.00
Investment stage farms	8	2,779.00
Total	20	7,589.00

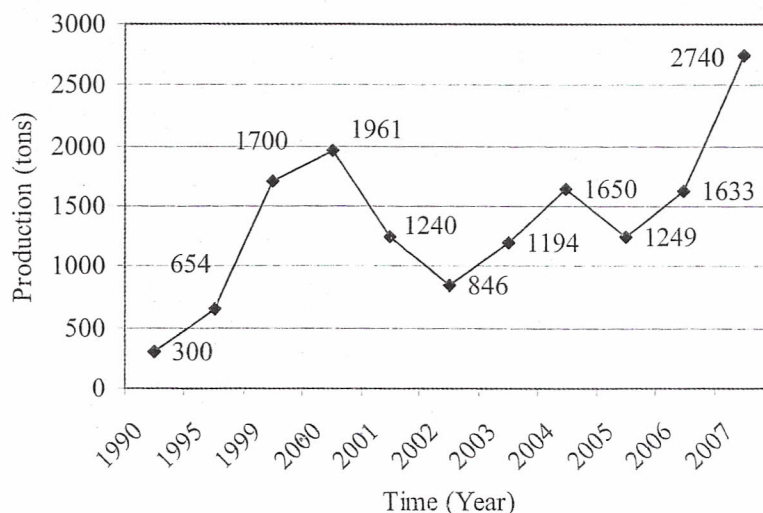


Figure 2. Annual trout production in marine farms (Turkish Statistical Institute, 2007).

Start weight were offered by B. Akbulut et al. (2002) for cage culture of rainbow trout in Black sea condition as 150-200 g. In this research results indicated that 150-200 g rainbow trout had reached up to 900-1000 g final weight for 7 months. This is consumer preferred market size of sea reared rainbow trout. Although the researchers also reported that feed conversion rate (FCR) was realized as between 1.4 and 1.7. T. Sahin et al. (1999) reported that 200 g rainbow trout were grow up to 1036-1226 g in six months and feed conversion rate was recorded as between 1.5 and 2.2.

Stock density varies between 10-20 kg m⁻³ in routine culture process. Cages in use are circular (10-20 m diameter) and made by HDPE material. Net depth of cages varies between 8-18 m.

Trout Harvesting and Marketing

The rainbow trout is widely consumed in Turkey. Harvesting size of rainbow trout ranges from 200 g to 250 g for pond cultured fish and >1000g for sea reared one. The 200-250 g fish weight are the more suitable fish size for harvesting in ponds because higher feed efficiency. On the other hand, harvesting size are >1000g in sea cages. In generally, market size rainbow trout served as fresh and frozen. Some restaurants and consumers prefer live trout and some markets serve them freshly. Old broods and sea reared trout are filleted. Therefore harvested trout should be package and transport to Turkey wide by cold

chain. Generally harvested trout from medium size and some of large trout farm was transported to great cities, wholesalers. Major of great trout farms and fish processing firms produce smoked trout and export to Europe.

Economics of Trout Farming

The costs of establishing and creating a fish farm are generally higher. Investment cost for a pond farm is much higher in comparison with cage farm projects. This is due to more expensive facilities needed, such as concrete cemented ponds.

The key to increasing trout production profits lies in understanding and controlling production costs. A majority of trout producers throughout the Turkey, production costs probably break out as in Table 3.

Trout is very much appreciated by the consumers in Turkey. It is consumed fresh or frozen especially. According to the data obtained from Turkish Statistical Institute (Turkish Statistical Institute, 2007) important quantities of salmonidae like Rainbow trout, Pacific salmon, Atlantic salmon and Danube salmon are imported as fillets, frozen and smoked from the North European countries. The amount of salmonidae importation was 170,910 kg and the value of this importation is about \$1,755,322. The amount of trout exportation and other salmonidae species from Turkey to European Countries was 5 197 468 kg and the value of this exportation is \$29,155,968 (Table 4 and Table 5).

Table 3

Estimated cost break-out for trout production in ponds and net-cages

Category	% of Costs	
	In pond farms	In cages farm
Feed	44%	61%
Fry ^a or Start fish ^b	20%	18
Labour & Salaries	30%	12%
Mortality	2%	4%
Others (chemicals, analysis, laboratories materials, etc.)	4%	4%

^a0.10 € is for 10 g fry and ^b 200 g trout is for cage culture,
 1 € per kg is price of feed and 2.3 € per kg of market size fish price in ponds
 2.6 € per kg of market size net cage reared market size fish accepted for calculation

Table 4

Importation of Salmonid fishes of Turkey (Turkish Statistical Institute, 2007)

Fish Products	Quantity (kg)	Value (\$)
Rainbow trout, fillets-fresh	10 135	70 917
Pacific Salmon, fillets	30 323	276 683
Rainbow trout, frozen	32 682	189 856
Pacific, Atlantic and Danube salmon, smoked	44 122	490 479
Rainbow trout, smoked	53 658	727 387
TOTAL	170 590	1 755 322

Table 5

Exportation of Salmonid fishes of Turkey (Turkish Statistical Institute, 2007)

Fish Products	Quantity (kg)	Value (\$)
Pacific, Atlantic and Danube salmon, fresh	1 899	11 701
Salmonidae, frozen	2 929 935	9 921 491
Rainbow trout, fillets- frozen	408 061	3 013 903
Rainbow trout, smoked	1 857 574	16 208 873
TOTAL	5 197 468	29 155 968

Conclusions and Recommendations

Aquaculture development, especially trout farming in inland waters and sea bass and sea bream in marine waters in Turkey is growing rapidly. Turkey has the third fastest growing aquaculture sector in the world (Deniz, 2007). Marine and inland water resources provide an important source of protein for human nutrition. In addition to this appreciation, aquaculture has some

advantages over capture fisheries in term of marketing the products. One of these advantages is that aquaculture creates jobs. More than 25 000 persons are working in the sector of aquaculture in Turkey (Deniz, 2007). But some ecological and socio-economical interactions should be discussed for a sustainable aquaculture (Canyurt, 2005; Deniz, 2007). That is why it is necessary to support the development of sustainable aquaculture.

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