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AQUACULTURE IN TURKEY

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Abstract

Marine and freshwater aquaculture in Turkey have grown substantially. The first trout farm was established in the 1960s and the first marine cage farm for sea bream and sea bass in 1985. From the beginning of the 1970s to 1999 the number of licensed fish farms increased from two to 1,444. Since 1995, the number of cage farms has grown to 57 and production reached 4,100 tons in 1999. Total aquaculture production grew from 3,075 tons in 1986 to 63,000 tons in 1999. Production is dominated by inland production, mainly of trout (*Oncorhynchus mykiss*), which supplies 60% of the total.

From 1995 to 1999, marine production increased from 8,494 tons to 25,230 tons. The major contributors are sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*). Because of the relatively high temperatures in the Black Sea, Atlantic salmon (*Salmo salar*), cultured from the late 1980s to 1997, is no longer grown; only rainbow trout (*O. mykiss*) in floating net cages is produced.

Because of the growing demand caused by increased population and export, aquaculture production and consumption in Turkey are expected to grow. New fish and shellfish species, mainly marine, are being developed. The bureaucracy involved in licensing fish farms, especially in marine environments, is complicated, time-consuming, and suffers from a lack of technical knowledge and insufficient exchange of know-how and cooperation concerning new developments.

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Introduction

Inland aquaculture activities in Turkey began in the 1960s when trout eggs (*Oncorhynchus mykiss*) were imported from Europe and reared in a private fish farm established in the region of Marmara. Since then, the number of fish farms increased from two in the early 1970s to 1,444 in 1999. Turkey, today, is the thirtieth largest aquaculture producer in the world (FAO, 1999a).

The coastline of Turkey (8,333 km) has several small and large estuaries, bays and gulfs that are well protected from storms, currents and winds. The Black, Marmara, Aegean and Mediterranean Seas surrounding Turkey are non-tidal and their salinity, dissolved oxygen and temperature are influenced by seasonal, morphological and hydrological conditions such as depth and water currents. The climate, water resources and topography along the coast create several favorable aquaculture sites. The Aegean Sea, more than the others, has many sheltered bays that are especially suitable for marine cage culture.

In the southeastern part of Turkey, the huge Southeast Anatolian Project (GAP in Turkish) with its 22 dams, 19 power plants and total water capacity of approximately 43 billion m³ on 1.7 million ha of land will be used to produce hydroelectric energy and for agriculture irrigation and aquaculture.

Economic crisis and high inflation rates in recent years have affected industries and caused some fish farms to close. Although any prognosis of future supply and demand in fisheries is precarious at this moment and in spite of the negative economic situation, Turkey's aquaculture industry is optimistically looking forward and hoping for new investments. In this paper, the present status and constraints, as well as legislative and administrative problems related to aquaculture in Turkey, are reviewed.

Present Status of Fisheries and Aquaculture

Between 1995 and 1999, locally produced fish originated mainly from marine and inland fisheries (Table 1). Freshwater aquaculture grew from 13,113 to 37,770 tons (188%) and marine aquaculture grew from 8,494 to 25,230 tons (197%). Between 1986 and 1999, fishery catches fluctuated (Fig. 1) from a peak of 672,000 tons in 1988 to a low of 357,000 tons in 1991. Overfishing of anchovies was the main cause for this decrease. Total production from catch fisheries in 1999 was 575,097 tons (Table 1). Aquaculture production grew from 21,607 tons in 1995 to 63,000 tons in 1999 (FAO, 1999a,b; Atay and Bekcan, 2000). Production in 1999 (Fig. 2) was dominated by freshwater trout culture that totaled 36,870 tons (58.5%), followed by 23,000

Table 1. Fish production in Turkey from 1995 to 1999 (tons).

	1995	1996	1997	1998	1999
Freshwater fisheries	47,976	49,600	50,460	54,500	50,190
Marine fisheries	585,992	478,226	408,693	433,200	524,907
Total fisheries	633,968	527,826	459,153	487,700	575,097
Freshwater aquaculture	13,113	17,960	27,300	33,290	37,770
Marine aquaculture	8,494	15,241	18,150	23,410	25,230
Total aquaculture	21,607	33,201	45,450	56,700	63,000
Total production	655,575	561,027	504,603	544,400	638,097

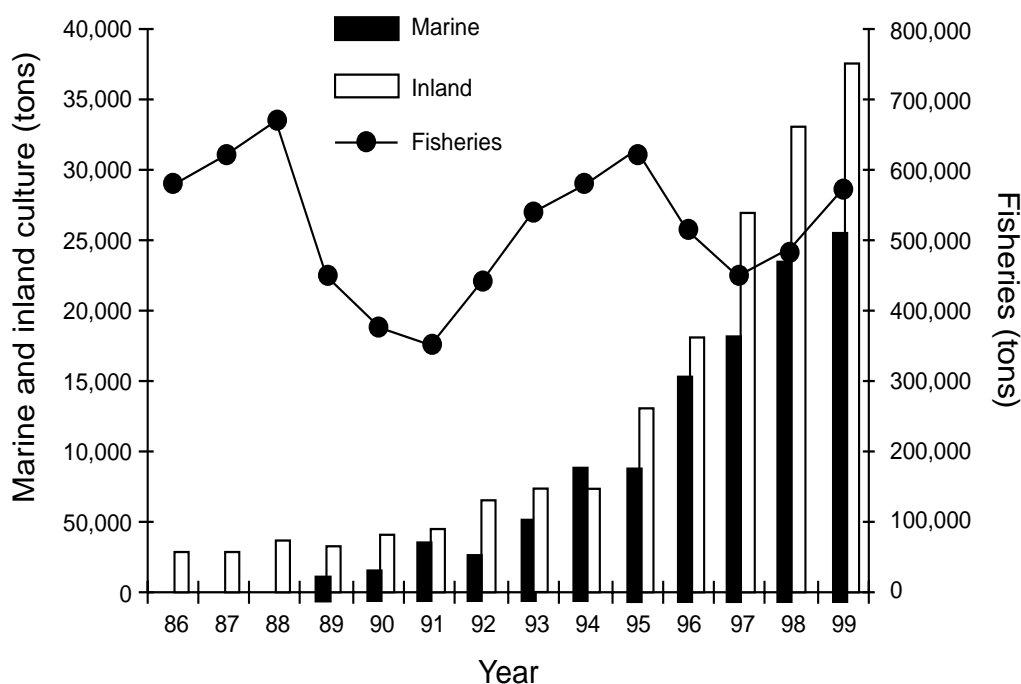


Fig. 1. Production from inland and marine aquaculture and capture fisheries in Turkey from 1986 to 1999.

tons of sea bass and sea bream (36.5%), 1,700 tons (2.7%) of sea trout, 900 tons (1.4%) of carp and 530 tons of mussel and shrimp (0.84%). Because of limited demand, carp production in Turkey is stable and carp are mainly used for stock enhancement of lakes and reservoirs. There were 1,120 licensed inland fish farms in 1999 (Anonymous, 2000) which produced 37,770 tons. Of them, 253 farms have a low annual production capacity of 1-3 tons and are incapable of using advanced production technologies or high quality feeds. Together with poor management, these factors inhibit the growth potential of the farms.

Inland aquaculture. The first freshwater cage farm was established in 1995. By 1999, their number had grown to 57. Rainbow trout cage farms are mainly located in lakes and reservoirs and reached a capacity of 4,100 tons/year in 1999 (Anonymous, 2000). With the

completion of the Ataturk Dam (81,700 ha reservoir area with 84.5 million m³ water volume) and other structures of the Southeast Anatolian Project (GAP), the potential of inland fisheries will be greatly enhanced. Within the framework of this project, a total of nearly 220,000 ha will be added to the inland freshwater capacity of Turkey. Even if only a fraction of this area were used for aquaculture, it would make a significant contribution to fish production (Diler et al., 2000). Nevertheless, before this enterprise can be efficiently exploited, a survey of the water quality of the dams and artificial lakes and a study of the possibilities of culturing fish species such as tilapia (*Oreochromis* spp.), pike (*Esox lucius*), European catfish (*Silurus glanis*), eel (*Anguilla anguilla*), etc., must be made.

Marine aquaculture. Marine aquaculture on the Mediterranean and Aegean Sea coasts

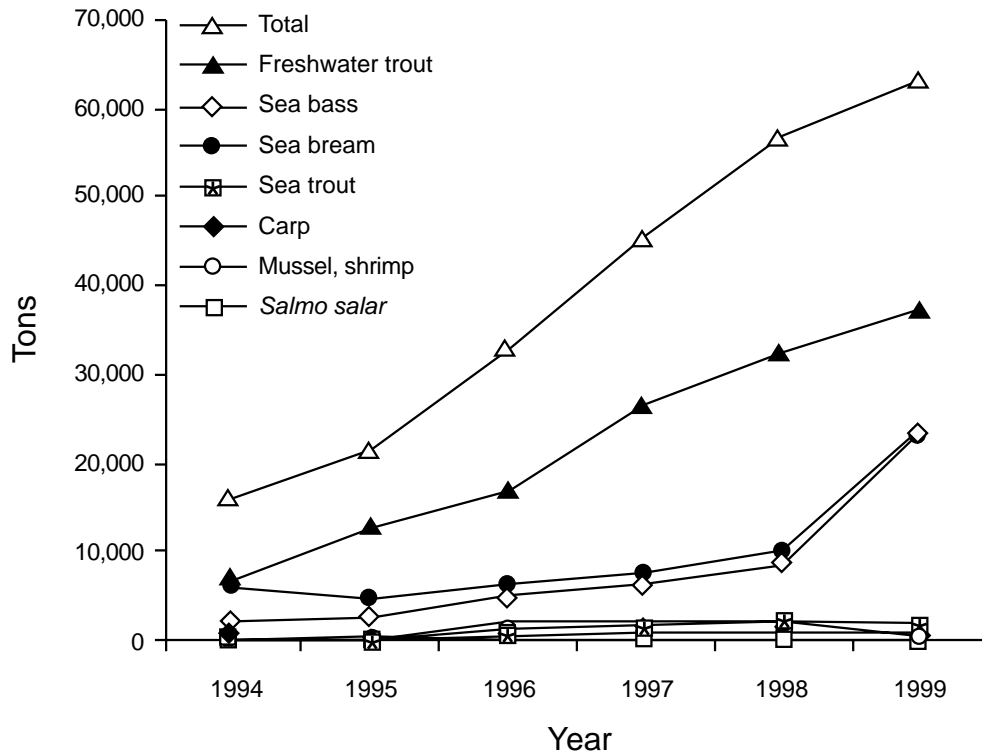


Fig. 2. Aquaculture production by species in Turkey, from 1994 to 1999.

consists mostly of the cage culture of sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*). The first cage farm was established on the Aegean Sea coast for the production of sea bream and sea bass in 1985 and was stocked with fry collected from natural stocks. The number of licensed marine cage farms increased rapidly from one in 1986 to 324 in 1999 (Anonymous, 2000). The total production of market size marine fish, mussels and shrimp has increased constantly from 35 tons in 1986 to 25,230 tons in 1999. In the past, recruitment for cage farms depended totally on natural stocks. Currently, Turkey has 19 private and governmental marine fish hatcheries that provide the needs of local farmers for 1-5 g fry with a total capacity of approximately 50 million sea bass and sea bream fry. Growth to commercial size of 300-600 g takes 12-18 months, depending upon the temperature,

management, culture system and feed quality (Alpbaz, 1990; Çelikkale et al., 1999).

Marine culture of trout and salmon began in the late 1980s. The salmonid species, rainbow trout (*Oncorhynchus mykiss*) and Atlantic salmon (*Salmo salar*), were originally produced in the brackish waters of the northern coast of the Black Sea but because of the intolerance of salmon to the high water temperature, trout eventually replaced them. These conditions provide better growth conditions for rainbow trout, which are transferred directly from inland fresh water to the brackish waters of the Black Sea without any adverse effect. In this environment, trout require 60-90 days to grow from 20-30 g to the market size of 200-300 g or 300-360 days to the market size of at least 1,500 g (Çelikkale et al., 1999; Sahin et al., 1999). Fish are harvested during the summer when temperatures are relatively high.

Shrimp farms in the Mediterranean Sea, established in the mid 1990s, encountered many critical problems that still need to be solved.

New species. At present, cultured fish species are still undiversified but new species such as tilapia (*Oreochromis* spp.), sturgeon (*Acipenser baeri*, *A. gueldenstaedtii*), turbot (*Scophthalmus maximus*), red porgy (*Pagrus pagrus*), bluefin tuna (*Thunnus thynnus*) and common dentex (*Dentex dentex*) are being cultured on a research level in universities and by the private sector. The most promising species (Çelikkale et al., 1999; Atay and Bekcan, 2000; Köksal et al., 2000; Memis and Ercan, 2001) are grouper (*Epinephelus guaza*, *E. aeneus*), yellow tail (*Seriola dumerillii*), shi drum (*Umbrina sirrosa*), crayfish (*Astacus leptodactylus*), mullet (*Mugil cephalus*), bluefish (*Pomatomus saltator*) and European lobster (*Homarus gammarus*).

Imports, Exports and Local Consumption

Total consumption of fish in Turkey was around 646,097 tons (local production less export plus imported food supply; Tables 1 and 2). The majority of fish consumed in Turkey are marine species (85% of the total consumption). Imports increased from 65,927 tons in 1996 to

98,437 tons in 1999, 60.9% of which was fishmeal and fish oil for which there is a growing demand in the fish feed industry. Imports accounted for 6% of the total food fish consumed in 1999.

Annual per capita fish consumption increased from 8.5 kg in 1996 to approximately 9.6 kg in 1999 (12.9%). Urban populations consume more fish in terms of quantity and variety than rural populations. Fish consumption amongst rural populations is very low and limited mainly to canned anchovies and inexpensive freshwater fish such as carp (Diler et al., 2000). Imports and exports of food fish in 1999 were 38,456 tons and 30,336 tons respectively (Table 2; FAO, 1999c). Imports comprise fresh, chilled, frozen, dried, salted, canned and smoked fish, crustaceans and mollusks.

To meet the predicted increase in local demand caused by population growth and increased export activity, the growth of Turkish fisheries and aquaculture production will have to accelerate. Substantial growth in demand and sales will require development and better organization of marketing channels, commercial promotion and customer education. The current lack of export facilities and processing technology limits the export of cultured fish. If

Table 2. Import and export of aquaculture products in Turkey from 1996 to 1999 (tons).

	1996	1997	1998	1999
<i>Import</i>				
Food supply	30,063	40,206	32,141	38,456
Fishmeal and oil	35,864	47,120	42,613	59,981
Total quantity	65,927	87,326	74,754	98,437
Total value (US\$'000)	60,975	84,852	76,286	59,207
<i>Export</i>				
Food supply	27,020	35,154	27,378	30,336
Fishmeal and oil	96	0	20	120
Total quantity	27,116	35,154	27,398	30,456
Total value (US\$'000)	101,510	124,644	94,483	98,196

farmers choose to export their products, professional processing facilities must be constructed. In most cases, farmers can cooperate in constructing these facilities and, thereby, contribute to the reduction of investment costs.

Because of the lower prices during the fishing season, captured fish supply most of Turkey's domestic demand. Especially during the restricted fishing period (June-September), further demand will have to be supplied by the aquaculture industry.

Problems, Constraints and Regulations

Aquaculture and fisheries are regulated by the Turkish Fisheries and Aquaculture Law No. 1380. This law, however, is incapable of solving all aquaculture-related problems. The government of Turkey recognizes and supports aquaculture as a growing sector, but the following issues still need to be addressed: (a) the absence of a general plan for economical aquaculture development and effective marketing; (b) the low quality and high price of feed caused by the high price of imported fishmeal; (c) insufficient technical knowledge; (d) the absence of a private sector organization; (e) insufficient early diagnosis and prevention of fish diseases and the establishment of environmental standards; (f) availability of healthy fry and production of live food organisms and artificial feeds for post-larvae and juveniles; (g) conflicts between tourism authorities and the marine culture industry; (h) bureaucracy involved in establishing fish farms. The licensing process is complicated, time-consuming and bureaucratic and requires authorizations from the Ministry of Agriculture and Rural Affairs, the Ministry of Forestry, the Ministry of Environment, the Ministry of Tourism, the Ministry of Transportation, the Ministry of Culture, the Ministry of Public Works, the Ministry of Health, the Ministry of Finance, the Ministry of Energy and Natural Sources, the Council of Navigation, the Council of Foreign Trade and the State Planning Organization; (i) the absence of a plan for utilizing freshwater reservoirs for aquaculture; (j) insufficient cooperation between universities and the private sector.

One of the main constraints to enhancing yields from marine culture is the limited avail-

ability of fry. In 2000, fry collected from natural stocks provided 20% of the total rearing capacity. Collection of fry from the wild is no longer permitted. Turkey recently developed the resources and know-how to produce fish fry which will eventually equal or even surpass those of neighboring countries. The use of modern management strategies and feed regimes, together with high technology, are of primary importance in reducing the pollution discharged into the environment. Today, applications to construct new fish farms must follow the new procedures defined by the Environmental Impact Assessment Regulations of the Ministry of Agriculture and Rural Affairs that require that fish farmers provide proof that their farms will not negatively affect the environment. The growth of marine aquaculture will depend on competition with other coastal zone users for the limited resources, the impact of the farm on the environment and its users, and the impact of other coastal activities on aquaculture development. The future of marine culture in Turkey will depend on the attitude of the government towards its coastal environments.

Licensing

The following procedures must be followed to obtain a license for a fish farm.

Pre-application. Farmers are required to submit an application to the Province Agricultural Administration stipulating the location and type of farm to be constructed. Then, the Agriculture Production and Development Center must be acknowledged before proceeding with the venture and permission must be received. The application must include details concerning the type of farm, production targets and farm units to be constructed, a declaration of ownership of the land or permission to use the land issued by the Ministry of Forestry, a detailed map of the site including all farm units, neighboring farm operations and their capacity, presence of fish diseases and a report of consultations held with the local administration for water exploitation. All these documents must be prepared within six months after the pre-application is submitted.

Preparation of a project. Projects must follow the form determined by the Ministry of

Agriculture and Rural Affairs and be completed within eight months or, if given an extension, within 12 months.

Attachments. The project must be submitted to the Province of Agricultural Administration together with the following documents: the pre-permission document described above, a document from the Ministry of Health stating that the farm poses no hazards to human health, a document from the Ministry of Transportation stating that the farm does not interfere with transportation, a document from the State Water Works stating that the project presents no flood or landslide dangers, permission for construction issued by the Ministry of Public Works and the publication of the project in the Journal of Trade Register.

The approval of the Province of Agricultural Administration is required for projects with a production target of less than 60 tons per year; approval of the Agriculture Production and Development Center is required for projects with a production target of more than 60 tons per year. After approval of the project, the Ministry of Agriculture and Rural Affairs asks the State to rent the land. If, for example, the land belongs to the Ministry of Forestry, the request is addressed to them. In theory, land can be rented for 49 years but, in practice, rentals are limited to 15-25 years. Hence, implementation of the project should begin without delay. An extension of up to twice the amount of time allowed the project can be obtained.

Conclusion

As a consequence of the rising local demand for fish, Turkish aquaculture production is expected to grow in the coming years. New fish and shellfish species now under development are expected to diversify marine farm production. Limitations on collection of fry from wild stocks and enhancement of commercial culture require establishment of new hatcheries which specialize in producing new species such as sturgeon, sea trout, turbot, lobster, etc. Further improvements of development plans

and management will require a greater contribution from both the private sector and the government. A revision of bureaucratic procedures concerning new fish farms is urgently needed.

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