Review of marine aquaculture development in Turkey

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Turkey is located between the continents of Europe and Asia. The Black Sea, Aegean Sea and Mediterranean Sea surround it. It has 8,333 km of coastline including the coastline of the islands, 177,714 km of rivers, 200 (200,000 ha) large and small lakes and many dams. In the near future, estimated dam reservoirs will total 5,628 km^2 with a water capacity of 186 billion m^3. The Black Sea is the most productive of the Turkish seas in term of available nutrients and fish stocks. It is followed by the Sea of Marmara, the Aegean Sea and the Mediterranean Sea. Characteristic water parameters of those seas are given in Table 1 (Çelikkale *et al*. 1999, Diler *et al*. 2000). Sea bass, sea bream and sea-reared rainbow trout farms are located mostly on the Aegean Sea coast and the Black Sea coast.

Turkey is a subtropical country with varied environmental conditions. This situation has positive affects on fisheries and the aquaculture industry. It has appropriate climate, landscapes, bays and significant inland water resources; an ideal environment for marine aquaculture.

Development of Turkish Marine Culture During the Last 10 years

Aquaculture production statistics published by the United Nations Food and Agriculture Organization (FAO) show that Turkey is the 57th largest fish capturer and 30th largest fish producer in the world (FAO 1999).

Since the middle 1980s, there has been an increasing trend in the production of finfish and shellfish at marine culture sites in Turkey (Figure 1). A total of 1,444 licenced aquaculture establishments exist (Table 2), though not all are active (Anonymous 2001).

The main species produced in Turkey are sea bass (*Dicentrarchus labrax*), sea bream (*Sparus auratus*), Atlantic salmon (*Salmo salar*), sea-reared rainbow trout (*Onchorhyncus mykiss*), mussel (*Mytilus galloprovincialis*) and shrimp (*Natantia* spp.).

The production of farmed sea bass increased from 102 tons in 1990 to 12,000 tons in 1999. Over the same period, the production of sea bream increased from 1,031 tons to 11,000 tons. Total production of both species reached over 33,337 tons by 2000 (FAO 2000).The production of farmed Atlantic salmon dropped from 300 tons in 1990 to 40 tons in 1998. Because of the intolerance of salmon to the higher Black Sea summer temperatures, sea-reared rainbow trout eventually replaced them. Salmon is not being produced now. The production of sea-reared rainbow trout increased from 1,380 tons in 1996 to 1,700 tons

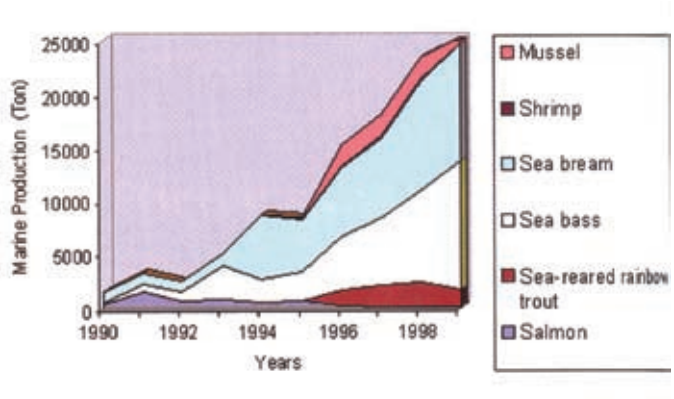

Fig.1. Marine aquaculture production by species in Turkey, between 1990 and 1999 (FAO 1999).

Fig.2. Labeled turbot captured in Black Sea

in 1999. Mussel and shrimp production grew from 220 tons in 1995 to 530 tons in 1999 (Figure 2) (FAO 1999). Mussel and shrimp culture farms in the Aegean and Mediterranean Seas still need to be improved. Because of poor market conditions and relatively high production costs, expected production from those farms has not been realized.

At first, marine fish fry were collected only from the natural environment, but today they are also obtained from private and government hatcheries. Turkey now has 19 private and government marine fish hatcheries, with a total capacity of

approximately 50 million sea bass and sea bream fry. These hatcheries provide for the needs of local farmers for 1-5 g fry for stocking cages and land based farms. Growth to a commercial size of 300-400 g takes 14-18 months depending on the growing system and feed used for cultivation (Alpbaz 1990, Çelikkale *et al*. 1999, Memis *et al*. 2002). As of 1999, the number of licensed marine fish farms has reached 324 (Table 2; Anonymous 2001). Live prey and formulated diets are provided for the nutrition and growth of marine fish under culture. Some formulated diets are domestic products and others are imported from abroad. The daily feed ration for cultured marine fish depends on ambient water temperatures. The daily ration for caged fish is about 1-2 percent of body weight. Typically, the fish are fed two times daily during growout.

Fig.3. Sturgeon culture studies in Istanbul University, Fisheries Faculty

Competent Authority-enforced Rules and Regulations

Aquaculture and Fisheries are regulated by the Turkish Fisheries and Aquaculture Law No. 1380 of 4 April 1971.The authorized public administrative bodies involved are: Ministry of Agricultural and Rural Affairs, Ministry of Forestry, Ministry of Energy and Natural Sources, Ministry of Public Works, Ministry of Culture, Ministry of Environment, Ministry of Tourism, Ministry of Finance, Ministry of Heath, Ministry of Transportation, Council of Navigation, Council of Foreign Trade, State Planning Organization and State Agricultural Bank. In general, the licensing and operation of marine aquaculture farms is complicated, time-consuming and bureaucratic.

Cage farms that are established on closed bays are no longer permitted by the Ministry of Agricultural and Rural Affairs. Recently, cage farms in the Aegean Sea must locate offshore because of the sea water pollution problems of closed sites and tourism activities.

Table 1. Characteristics of water parameters in surface area and volume of Turkish seas.

Seas	Surface Area Km^2	Volume km^3	Temp ˚C	S ‰	O_2 ppm
The Black Sea	423 488	534 000	4-27	18-22	6-7.5
The Marmara Sea	11 500	3 378	4-26	18-26	6
The Aegean Sea	214 000	74 104	24	26-39	6-8
Mediterranean Sea	2 512 300	3 327 000	15-28	38-40	5

Table 2. The number of fish farms in 1999 in Turkey (Anonymous 2001).

	Active		Still not Active		Total	
	Number	Capacity(t/yr)	Number	Capacity(t/yr)	Number	Capacity(t/yr)
Inland fish farms	887	28,993	233	10,212	1,120	39,205
Marine fish farms	192	16,642	132	7,820	324	24 462

Phytoplankton unit in government hatchery

The Application and Administrative Procedure

An application for a permit to start a fish farm is very detailed. Some of the main points are:

- The application for the permit according to the Province Agricultural Administration (PAA), Ministry of Agricultural Rural Affairs (MARA),
- First contact; the Province Agricultural Administration,
- Permission from the other Ministries[2],
- First permission from MARA and the Agricultural Production and Development Center (APDC),
- Preparation of the project (owners of the farm duty),
- Control of the project by the Province Agricultural Administration,
- Approval of the project by the PAA, MARA, APDC,
- Permission to follow the project,
- Renting the farming area from private or governmental areas,
- Credits or the capital from owner of the farm or State Bank,
- Setting up the farm (owner of the farm),
- Starting fish culturing activities.

Conclusions

Although the Turkish economy was faced with a serious economic collapse, devaluation during 2000/2001 and low market prices, the EU market is open again. Increasing economic recovery will be possible with new investments being made in the marine aquaculture sector.

In the near future, new species should be cultured in experimental and/or pilot studies, after which many aquatic species may be produced in Turkey.

Thus, aquaculture production is expected to expand, with interest being shown in a number of new species and culture methods. These new species, such as turbot (*Psetta maxima*; Figure 2), sturgeon (*Acipenser gueldenstaedtii*); Figure 3), red porgy (*Pagrus pagrus*), common dentex (*Dentex dendex*), common pandora (*Pagellus erythrinus*), sharpsnout seabream (*Puntazzo puntazzo*) grouper (*Epinephelus aeneus*), yellowtail (*Seriola dumerillii*), shi drum (*Umbrina sirrosa*), bluefin tuna (*Thunnus thynnus),* mullet (*Mugil cephalus*), lobster (*Homarus gammarus*), oyster (*Oestrea edulis*), mussel (*Mytilus galloprovincialis*) and shrimp (*Penaeus japonicus* and *P. semisulcatus*).

Notes

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Artemia culture unit in private hatchery

Fish vaccination in the private cage farm

Wooden cages in Aegean Sea

Offshore cages in Aegean Sea

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Fig.10. Marine fish harvesting in Aegean Sea