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COUNTRY REVIEW

An overview of aquaculture in Turkey: with emphasis on sea bass and sea bream

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Abstract

Aquaculture is a relatively recent industry in Turkey, enjoying great potential for development. Both freshwater and marine aquaculture are being practiced in over 800 operational units. Rainbow trout (Oncorhynchus mykiss), Sea bream (Sparus aurata), Sea bass (Dicentrarchus labrax), comprise 90% of the total production, together with Atlantic salmon (Salmo salar), Common carp (Cyprinus carpio), Shrimp (Penaeidae spp.) and Mussel (Mytilus galloprovincialis). Total aquaculture production reached 45,450 t in 1998, constituting 9% of total national fisheries production. Sea bass and sea bream farms are located along Aegean Sea and Mediterranean coasts and comprised 16% of the total number of aquaculture enterprises and 30% of total aquaculture production in 1997. Supplies of these two species have been steadily increasing in Turkey and other producing countries since 1990 resulting in market saturation and declining prices both locally and internationally. Mediterranean species including Epinephelus spp., Puntazzo puntazzo and Pagrus pagrus, are considered to be new candidates offering good prospects for mariculture.

Keywords: Aquaculture, Sea bass, Sea bream, Turkey

Introduction

Turkey is situated in the Eastern Mediterranean region, 3% of its territory is in Europe and 97% in Asia. Its mainland coastlines comprise: 1,695 km on the Black Sea, 2,805 km on the Aegean and 1,677 km on the Mediterranean Sea (Muthoo & Onul, 1996). Agriculture, including capture fisheries and aquaculture accounted for 13.5% of Turkey’s US $ 191.3 billion GNP in 1997 (Anon. 1998a). The GNP is projected to be US $ 803.0 billion in the year 2025 (Anon. 1999a). The growth rate in GNP was 7.4% in 1997 (Anon. 1998a). Economic crises in South Asia and Russia had a negative impact on economic growth in Turkey in 1998 but indicators show signs of recovery, with growth in 1999 expected to be around 2.5% (Çetinkaya 1999).

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The population of Turkey is estimated as 65.3 millions (1998) of which 60% live in urban centers and the rest in rural areas. Average national income per capita was US $ 3 130 in 1997 (Anon. 1999b).

Turkish fisheries landings reached a peak level of 676 000 t in 1988 mainly due to increase in anchovy *(Engraulis encrasicolus)* landings from Black Sea (Anon. 1998b). This was followed by a sharp decline in overall capture fisheries production between 1989-1992 due to lack of appropriate management and over-fishing in the Black Sea. An apparent recovery has been observed since 1993. In 1997 fisheries production of Turkey was 500 260 t, of which 45 450 t came from aquaculture and the remainder from marine and inland capture fisheries (Anon. 1998b). The share of aquaculture in overall fisheries production increased from around 1.5% in 1990 to 9% in 1997. In consumption terms, 90.8% of the production was consumed domestically as fresh or processed products and 3.9 % was used in fish meal and fish oil production (Anon. 1998b). Export and import of fisheries products in 1997 were 35 791 t (US $ 128.0 million) and 40 324 t (US $ 52.3 million) respectively (Anon. 1999c). Following EU decisions, limiting the import of fresh seafood from Turkey in June 1998, exports dropped to 9 674 t (US$ 35.2 million) towards the end of 1998 (Anon. 1999c). This issue was resolved towards the end of 1998 and export was resumed.

Demand projections for fisheries products indicate that Turkey will face an annual supply deficit of 95 000 t in the beginning of 21\textsuperscript{st} century (Gözgözoglu 1997). In this regard aquaculture is of strategic significance as far as food security and socio-economic issues are concerned. Within this framework, Turkish government has been encouraging aquaculture through credit provisions, seed production and publicly funded research and development (Gözgözoglu 1997).

This overview aims to present an objective picture of the Turkish aquaculture sector, with further emphasis on biotechnical and economic aspects of its key areas of sea bass and sea bream production. Insights into future developments are also discussed.

**Specific Market Data**

**Characteristics of fish consumption**

Annual per capita consumption of fish is low in Turkey (7.5 kg), below the world average of 13 kg (Josupeit 1995). Availability of fisheries products and dietary traditions appear to be the main factors limiting the consumption of fish. Though, the prices of many fish species are competitive with meat and poultry, Turkish consumers prefer the latter due to their ease of use in traditional dishes and wider availability. Thus, it is not surprising to see that the ratio of consumption of meat to fish is 5 to 1 (Anon. 1994a). Nevertheless, 98.5% of Turkish families consume fish at least once a year and the perception of fish as a ‘healthy’ food item is the norm among the majority of consumers (Anon. 1996a).

Anchovy *(Engraulis encrasicolus)*, rainbow trout *(Oncorhynchus mykiss)* and whiting *(Merlaingius euxinus)* are the predominant species consumed regularly by all socio-economic classes and along with horse mackerel *(Tracharus tracharus)* characterize Turkish market and are regarded as national fish species (Anon. 1996a). Certainly, anchovy is the dominant species as far as consumption and landings are concerned.

The income elasticity of fish is estimated as 0.4 and 0.92 in the lowest and highest income groups respectively. For the high-priced fish species the income elasticity was found to be 1.33. Price elasticity of meat, poultry and fish has been estimated as -0.45, -0.52 and -0.43 respectively (Anon. 1996a).

Turkish consumers prefer fresh fish to processed products. However, consumption rate of fresh fish is showing a decreasing trend and has decreased from 87% in 1970’s to 78% in
1990's (Elbek 1993). This trend has been accelerated by increasing consumption of canned fish (tuna) in the recent years, around 2000 t in 1994 (Anon. 1996a).

Aquaculture products enjoy a relatively positive image among Turkish consumers (74%) and rainbow trout seems to be the most well-known farmed fish species among consumers followed by carp (Cyprinus carpio), Atlantic salmon (Salmo salar), sea bream (Sparus aurata) and sea bass (Dicentrarchus labrax) (Anon. 1996a).

Characteristics of distribution channels and trends
In 1997, 72.6% (in volume) of fisheries products was handled by commissioners and whole-salers. Fishermen cooperatives and direct sales to consumers constituted 3.7 and 3.0% of the overall trade respectively. The remaining was purchased by canning (3.4%) and fishmeal industries (17.5%) (Anon. 1998b).

The main wholesalers are localized in Istanbul, Samsun, Trabzon and Izmir (Anon. 1996a). However; there are also small fish docks and local markets along the Black Sea, Marmara, Aegean and the Mediterranean coasts (Anon. 1994a).

The distribution patterns of aquaculture products are more or less similar to capture fisheries products and about 75% of the products reach the consumers through wholesalers (Anon. 1994a). Some fish farmers have contracts with wholesalers and some sell directly to retailers in large cities (Anon. 1996a).

In an attempt to reduce the length of distribution channels many large-scale fish farms such as Bağcı Trout (Province of Muğla) and Liman Trout (Province of Bilecik) have established their own marketing network, particularly in the trout farming industry where the domestic market plays an important role. Farm-gate sales are very common among medium and small-scale fish farms enabling them to increase profitability by applying retail rather than wholesale prices. In tourist areas many farms run their own restaurants.

Since sea bass and sea bream production is export-oriented, the home market for these species is not as significant as for rainbow trout. In 1996, about 80% of the production was exported, mainly to Italy, Greece and France (Anon. 1996a). Industrial scale sea bass and sea bream farms such as Pınar Seafood (Province of İzmir) and Kılıç Seafood (Province of Muğla) have established their own export mechanisms and infrastructure. Small farms have contracts with export companies through which their products reach the international markets. The volume of supply of sea bass and sea bream to domestic market and price formation in the home market depends on the developments in the export markets and mainly Italy.

Supermarket chains are becoming important retail outlets for aquaculture products in the recent years. Many supermarket chains (Real, Metro, Migros) sell fresh, processed and live aquaculture products. This trend is relatively new in the Turkish market and it is difficult to find any data for comparison but, is probably far behind Europe as far as the volume of trade (Stephanis 1995; Paquotte 1995) is concerned. However, the prospects are very promising and in the coming years the share of supermarkets in overall trade is expected to increase.

Sectoral Management in Aquaculture

Government policy
Government policy towards aquaculture development emanates from statements and goals in the Seventh Five-year Plan (1996-2000). Protection and control of natural environment, increase of output by effective and continuous utilization of resources, improvement of farming, efficient reorganization of the institutional structure, improvement of cold-storage and freezing facilities at marketing stage and supporting R&D constitute the theoretical framework of government policies regarding fisheries (including aquaculture) (Anon. 1996b).
most solid and specific action regarding aquaculture has been the preparation of a draft master plan for development of aquaculture by cabinet in 1998. This draft will be materialized in 1999 (Anon. 1998c).

Administrative structure and legislation
The Ministry of Agriculture and Rural Affairs (MARA) is responsible for development, administration and control of aquaculture in the country through legislation in 1971 (Law no. 1380). However, a number of other ministries and institutions are also involved in decision-making processes regarding different aspects of aquaculture e.g. licensing, planning, environmental monitoring, allocation of sites and leasing procedures.

With a central administration in Ankara, MARA has 80 provincial bodies. Aquaculture related activities i.e. technical evaluation of license application, authorization for other ministries to issue leases for sites, authorization for Agricultural Bank to offer subsidized loans, collection of statistics and issuing licenses for relevant imports are administrated by General Directorate of Agricultural Production and Development (Anon. 1994a).

Local Infrastructure

Education and extension services
There are over 18 educational institutions (either faculty or department) in Turkey offering undergraduate and post-graduate studies in fisheries and aquaculture (Anon. 1995a). There is so far no organized government extension services for aquaculture. However; universities occasionally hold training courses, conferences or workshops. A number of aquaculture research institutes within the body of MARA and universities also offer technical and consultancy services. There are also several private consultancy offices.

Seed production facilities
The majority of trout farms in the country (93%) have their own hatcheries for fingerling production. A number of seed production facilities within the body of MARA and universities also offer seed for on-growing purposes.

On-growing is the norm in mariculture and only a few enterprises have their own hatcheries (Pınar Seafood in İzmir Province, Kılıç Seafood in Muğla Province). However, there are 2 governmental (Beymelek and Güvercinlik) and 10 privately owned marine hatcheries offering sea bass and sea bream juveniles for on-growers. The private marine hatcheries have a theoretical capacity of 14 million juveniles per annum (Korkut 1998). In 1997, 12-13 million juveniles were produced (Keskin, personal communication, 1998).

Fishmeal and feed manufacturers
In 1997, 21,000 t of anchovy were processed for meal and oil, compared with 106,000 t in 1994 (Anon. 1998b). Due to a decrease in anchovy landings the number of meal and oil factories has decreased from 21 to 12 in recent years (Anon. 1996a). The supply of fishmeal is highly dependent on importation.

However; the fish feed industry has been steadily developing and there are now 7 major fish feed factories supplying different varieties of dry feeds (including extruded feeds) to freshwater and marine farms.
Financial support and credits
Investment certificates (aquaculture, processing) are awarded to successful applicants (including foreign investments) which entitles them to various investment incentives e.g. Income tax and VAT exemption (Gözgüçoğlu 1997).

Aquaculture is also offered subsidized interest loans for capital costs and operational costs through the Agriculture Bank of Turkey. In 1997, the amount of subsidized loans provided by the Agriculture Bank to fish farmers reached US$ 20 million (Usman 1998).

Characteristics of Production and Trends
Aquaculture is a relatively recently established sector in Turkey, starting from 1980’s (Anon, 1996a) and showing a rapid growth in 1990’s. Both freshwater and marine aquaculture are practised. Number of licensed farms has increased from 70 in 1985 to 895 in 1997 (Figure 1).

Turkey enjoys a good potential for development of both freshwater and marine aquaculture (Anon. 1994a; Anon. 1996a), with some 200 natural lakes, 750 reservoirs, 159 barrages, 9x10^9 m^3 of underground water potential and an extensive coastline of 8 333 km suitable for mariculture with sheltered bays (Aegean Sea), productive coastal lagoons and ready access (Anon 1995a; Acara 1996). The irrigation and energy-oriented South Eastern Anatolia Project (SAP) consisting of several dams and a huge irrigation network will supply a further 220 thousand ha of water surface (Gözgüçoğlu 1997) in the near future, providing notable potential for freshwater aquaculture.

![Graph](image_url)

Fig. 1 Trends in establishment of aquaculture enterprises (Based on data from Küürüm 1994; Emre and Küürüm 1998).

Except for Atlantic salmon (Salmo salar) aquaculture species of interest to Turkey are all indigenous or have been introduced some years ago and are now well established (Anon. 1994a). These are; Rainbow trout (Oncorhynchus mykiss), Sea bream (Sparus aurata), Sea bass (Dicentrarchus labrax), Common carp (Cyprinus carpio), Shrimp (Penaeidae spp.) and Mussel (Mytilus galloprovincialis).

The distribution of farms by species, project capacities and actual production figures for 1997 is given in Table 1. For number of farms and production figures, Turkish aquaculture sector is characterized by 3 species namely; rainbow trout, sea bass and bream. Rainbow trout farms constituted almost 71% of the total number of aquacultural enterprises in 1997. Mariculture, specifically sea bass and sea bream farms comprise about 16% of the total number, while the remaining 13% consists of carp, salmon, mussel and shrimp farms. In produc-
tions terms, rainbow trout is the dominant subsector constituting 63% of total aquaculture production in 1997.

Table 1 demonstrates that sea bass and sea bream on-growing farms are operating well above their projected capacities (8 900 t), both in terms of absolute production figures (13 800 t) and their theoretical share (15%) in overall production, constituting 30% of the actual production in 1997. In 1997, average yield per site for sea bass and sea bream, correspond to 98 t, well above the average yield per farm in other subsectors e.g. trout, carp and Atlantic salmon. With only 6% of farms having an annual production of above 100 t/year (Figure 2), this phenomena is mainly due to contribution of large-scale farms such as Pınar and Kılıç Sea-food producing about 1000 tons per year (Çahin 1997) and operating in several sites with their own hatcheries.

Table 1  Distribution of Turkish fish farms by species, project capacity and actual production figures in 1997 (Based on data from Emre and Kürüm 1998 and Anon. 1998b).

<table>
<thead>
<tr>
<th>Species</th>
<th>Farms</th>
<th>%</th>
<th>Capacity</th>
<th>Actual Production in 1997</th>
<th>Performance in 1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainbow trout</td>
<td>634</td>
<td>70.8</td>
<td>29 000</td>
<td>28 500</td>
<td>45.0</td>
</tr>
<tr>
<td>Carp</td>
<td>97</td>
<td>10.8</td>
<td>10 700</td>
<td>800</td>
<td>2.0</td>
</tr>
<tr>
<td>Sea bass &amp; Sea bream</td>
<td>141</td>
<td>15.7</td>
<td>8 900</td>
<td>13 800</td>
<td>98.0</td>
</tr>
<tr>
<td>Mussel</td>
<td>7</td>
<td>0.8</td>
<td>4 600</td>
<td>2 000</td>
<td>4.5</td>
</tr>
<tr>
<td>Shrimp</td>
<td>3</td>
<td>0.4</td>
<td>340</td>
<td>300</td>
<td>0.4</td>
</tr>
<tr>
<td>Atlantic Salmon*</td>
<td>13</td>
<td>1.5</td>
<td>6 300</td>
<td>50</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>895</td>
<td>100.0</td>
<td>59 840</td>
<td>45 450</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Most of their production is of large rainbow trout rather than salmon

Fig. 2 Size distribution among sea bass and sea bream farms (Based on data from, Anon. 1996b).

The shares of rainbow trout, sea bass and sea bream in overall production have been steadily increasing since 1990 (Figure 3), with sea bass and sea bream showing slight fluctuations. This was due to the partial reliance of on-growing operations particularly, in sea bream on catches of wild juveniles.
Trend indices for production of sea bass and sea bream since 1991 are given in Table 2. The relative growth in sea bass production has been greater since 1994 due to the reliable supply of hatchery produced juveniles making production planning possible. The pattern of growth has been less stable in sea bream production where on-growing operation has been more dependent on catches of wild juveniles, though, in 1998 hatchery production of sea bream has been successful (Keskin, 1999, personal communication).

Table 2 Production index for sea bass and sea bream

<table>
<thead>
<tr>
<th>Year</th>
<th>Sea bass</th>
<th>Sea bream</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons</td>
<td>Index (1994=100)</td>
</tr>
<tr>
<td>1991</td>
<td>777</td>
<td>35</td>
</tr>
<tr>
<td>1992</td>
<td>808</td>
<td>36</td>
</tr>
<tr>
<td>1993</td>
<td>1,158</td>
<td>142</td>
</tr>
<tr>
<td>1994</td>
<td>2,229</td>
<td>100</td>
</tr>
<tr>
<td>1995</td>
<td>2,773</td>
<td>125</td>
</tr>
<tr>
<td>1996</td>
<td>5,210</td>
<td>234</td>
</tr>
<tr>
<td>1997</td>
<td>6,300</td>
<td>283</td>
</tr>
</tbody>
</table>

Based on Fisheries Statistics, various years

Biotechnical Aspects of Sea Bass and Sea Bream Farming

Sea bass and bream on-growing is dominantly carried out in floating cages (95%), though there are also a few land-based facilities using earthen ponds (Isgoren 1995). Along the Turkish coast on the Aegean Sea and the Mediterranean, climatic and marine conditions are very favorable for the culture of these species, and the abundance of suitable sheltered sites on the Aegean coastline in particular has had a positive impact on initial investment costs, with inexpensive wooden in-shore cages with dimensions of 5x5x5m commonly employed for on-growing. However, in a recent attempt to resolve issues of user conflict and site allocation between mariculture and tourism sectors, farms operating in-shore have been required to shift their activities off-shore within five years and will therefore need to use more complicated and expensive off-shore cages. This is regarded as a positive step towards a more ecologically sustainable mariculture.
The on-growing period for market size fish varies depending on the initial weight of stocking material. For sea bream on-growing to harvest size of 250-350 g takes 12-14 months, while bass are grown to 400-1000 g in 16-24 months (İşgören 1995). The average mortality rate throughout on-growing is about 20% for both species. This criterion is highly dependent on the initial size of stocking juveniles. For example, survival rate of hatchery produced sea bass (1-3 g) throughout on-growing varies between 75 to 92%. Harvesting densities are about 10 to 18 kg/m³ (Şahin 1995).

Feed conversion ratio, formerly around 3:1 in previous years due to poor quality of feed and inadequate managerial skills, has improved to an average FCR of around 2 in recent years for both species (Ertürk, personal communications, 1998).

Labor efficiency in small-scale farms (1-40 t/year) is low, varying between 1.9 to 8.2 t/person-year (İşgören 1995), while in larger farms efficiency could be as high as 25.0 t/person-year (Dorlay, personal communications, 1998). This is based on 10 working hours daily and 300 working days, the coefficient being 1 for the 16-49 age group (Aras 1988).

Characteristics of Demand and Trends in Prices

The unpredictability of supply level (due to partial dependence of on-growing operations on wild juvenile stocks) and the dependence of demand on fluctuating export levels have prevented the formation of stable supply and demand in sea bass and sea bream farming.

The overall supply and international trade in farmed sea bass and sea bream is not as large as salmon or shrimp. The Mediterranean EU countries, Italy, Spain and France, are the main consumers. Italy is the major market for Turkey, absorbing 70% of its production (Anon 1996a). Supply and demand developments in Italy, therefore, have a major role in the formation of prices and supply level in the domestic market. Though North European countries are seen to have potential, new market penetrations are still at the development stage and further promotion activities are needed.

Table 3 Annual changes in supply and market prices of sea bass and sea bream in the Mediterranean region.

<table>
<thead>
<tr>
<th>Year</th>
<th>Sea bass Supply</th>
<th>Average price</th>
<th>Sea bream Supply</th>
<th>Average price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons</td>
<td>An. change (%/year)</td>
<td>US$/kg</td>
<td>An. change (%/year)</td>
</tr>
<tr>
<td>1990</td>
<td>3 921</td>
<td>75.0</td>
<td>16.5</td>
<td>2.0</td>
</tr>
<tr>
<td>1991</td>
<td>6 744</td>
<td>72.0</td>
<td>15.5</td>
<td>-6.0</td>
</tr>
<tr>
<td>1992</td>
<td>10 149</td>
<td>50.5</td>
<td>16.7</td>
<td>8.0</td>
</tr>
<tr>
<td>1993</td>
<td>18 763</td>
<td>65.0</td>
<td>9.7</td>
<td>-42.0</td>
</tr>
<tr>
<td>1994</td>
<td>17 092</td>
<td>2.0</td>
<td>8.5</td>
<td>-12.5</td>
</tr>
<tr>
<td>1995</td>
<td>22 480</td>
<td>30.0</td>
<td>8.8</td>
<td>3.5</td>
</tr>
<tr>
<td>1996</td>
<td>26 472</td>
<td>19.0</td>
<td>8.4</td>
<td>-4.5</td>
</tr>
<tr>
<td>Average annual change</td>
<td>45.0</td>
<td>-7.5</td>
<td>43.0</td>
<td>-6.0</td>
</tr>
</tbody>
</table>

* Based on data from Anon. 1998d

Contrary to demand, supplies of farmed sea bass and bream have been steadily increasing in the Mediterranean region, production of sea bass rising from 3 921 t in 1990 to 26 472 t in 1996, and corresponding to an average annual increase of 45% in supply. Sea bream production has also increased from 4 568 t in 1990 to 32 727 t in 1996 with an average annual in-
crease of 43%. The upward trend in supply has been accompanied by a downward trend in prices of both species, particularly for sea bass which used to fetch a higher price than sea bream in the past. On average, the annual decrease in price of sea bass has been around 7.5% in the Mediterranean region (Table 3). Similarly prices of sea bass and bream in the Italian market have decreased by more than 60% in the last seven years (Caggiano 1999). In 1990 average prices of sea bass and sea bream in the Milan wholesale market were US$27.70 and US$24.00 per kg respectively. In 1994, the sea bass price dropped to US$11.25 per kg while bream was sold at US$12.5 per kg in the Italian market (Anon, 1996a). Average prices for sea bass and sea bream in the Italian market were 7.97 and 7.20 ECU/kg respectively in 1998 (Anon. 1999d). In November 1999 the price (CIF) of sea bass in the Milan wholesale market has been reported to be 3.0 Euro/kg (Hough 1999, personal communications).

The domestic market for these two species are mainly confined to the Aegean region and Istanbul, sea bream being very popular in the Aegean region (Izmir being the major market) and sea bass being more familiar to consumers in Istanbul. Prices at home have been naturally affected by developments in export markets, showing a declining trend and similar patterns since 1993. Prices (ex-farm) have dropped from US$17.5-14.0 in 1992 to US$ 6.3-5.4 per kg in 1997 (Table 4), the decline being much sharper for sea bass gradually fetching a similar price to sea bream due to over-supply (Figure 4 and 5). In January 1999 ex-farm prices of sea bass and bream were around US$4.60 to 5.00 per kilogram (Ertürk, 1999, Personal communication). The weighted aggregate price index (Newbold 1988) for sea bass and sea bream are given in Table 4.

Table 4 Weighted aggregate price index for sea bass and sea bream*

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean Price (US$/kg)</th>
<th>Fisher's Ideal Price Index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sea bass</td>
<td>Sea bream</td>
</tr>
<tr>
<td>1992</td>
<td>17.5</td>
<td>14.0</td>
</tr>
<tr>
<td>1993</td>
<td>7.8</td>
<td>5.0</td>
</tr>
<tr>
<td>1994</td>
<td>6.0</td>
<td>5.0</td>
</tr>
<tr>
<td>1995</td>
<td>6.2</td>
<td>5.7</td>
</tr>
<tr>
<td>1996</td>
<td>6.5</td>
<td>5.6</td>
</tr>
<tr>
<td>1997</td>
<td>6.3</td>
<td>5.4</td>
</tr>
</tbody>
</table>

* Based on prices from Fisheries Statistics, various years and İşgören 1995

Fig. 4 Price evolution for sea bass (Based on Fisheries Statistics, various years and İşgören, 1995)
Financial Aspects and Expected Developments

Official financial data regarding the economic performance of sea bass and bream farms in the country are scarce, making it difficult to conduct any cost-benefit analysis. However, a small number of academic studies provide financial data for previous years (İşgören 1995; Şahin 1995).

The results of survey carried out by İşgören (1995) covering 96 farms indicate that the mean production costs for sea bass and sea bream in the 92-93 season were US$5.4 and 5.20 per kg respectively. 1994-95 season production costs estimates for both species are around US$5.5 per kg (Çahin 1995). The authors have not been able to find more recent consistent production cost and cost structure data, making it difficult to comment on trends. However; slight reduction is expected due to lower prices of hatchery raised juvenile which ranged between US$0.20-0.35 for sea bass and bream respectively in 1998 (Keskin, personal communication, 1999), compared with 1995 price of hatchery raised juvenile of about US$0.40-0.45 (Anon 1996a).

Regardless of the declining costs, the downwards trend in prices of table sized sea bass and bream (Table 3), are a clear indicator of declining profit margins in the sector, not only in Turkey but also in other producing countries. Sea bass and sea bream farms are now going through a critical period similar to that for Atlantic salmon in early 1990’s due to over-supply and stagnant price. In this regard, small and industrial scale farms seem to be in a better position than medium-scale ones. Small-scale owner-operated farms (1-30 t/year) have the comparative advantages of using family labor and local markets (at farm-gate sales), while the industrial scale farms (>100 t/year) have advantages of scale economy, a more efficient and organized marketing network, and better financial resources allowing them to withstand critical periods. The results of economic optimization modeling carried out by İşgören (1995) indicate that the optimum capacity for sea bass and sea bream on-growing is 282 t/year. It will not be surprising to see more integrated and large-scale farms in the future.

Increasing the demand by finding new export markets, promoting domestic consumption, shortening the marketing chain, product diversification, market segmentation and value-addition, along with more effective managerial techniques for lowering production costs are of crucial importance as far as the sustainability of the sea bass and sea bream farms are concerned. Species diversification and new candidates species (mainly Mediterranean species) may also offer good prospects. In this regard, the results of R&D activities carried out by Pmar Seafood on common sea bream (*Pagrus pagrus*) are promising (Şahin 1997).
With regard to competition, shorter on-growing periods and earlier harvesting due to favorable climatic and marine conditions (Şahin 1995) combined with lower energy, labor and depreciation costs appear to be Turkey's comparative advantages (Anon. 1996a).

Concluding Remarks

Surveys (Anon. 1994a; 1996a) indicate that Turkey enjoys good potential for development of aquaculture. However; as far as administrative, policy and legal issues are concerned, certain constraints exist including; decentralized administrative and managerial structure, excessive bureaucracy involved in licensing and site leasing procedures, lack of a integrated national master plan for promotion of aquaculture and an aquaculture-specific legislation, remain to be resolved. Fortunately, these issues have been discussed in the Seventh Five-year Plans and positive actions have been foreseen, some of which will be in effect in 1999, e.g. more effective administration. There are also encouraging initiatives towards the preparation of a national action plan and an aquaculture-specific legislation by the Ministry of Agriculture (Anon. 1998c).

Overall aquaculture production is expected to rise in the coming years. Improved farm management and productivity in existing farms, introduction of new potential species for aquaculture and SAP project (South Eastern Anatolia Project) will contribute to this end. However, the growth of aquaculture sector in the new millennium will not be as fast as early 1990's due to declining profit margins. Major investments in the new millennium are expected to be towards production of new candidate species and processing.

Government policy towards aquaculture and the main aim of farms have focused on stimulating production, without wider economic considerations. However; demand-stimulating policies will have to be implemented to improve profitability in the sector, and future competition for resources may require closer appraisal of comparative costs and benefits.

The composition of farmed species is expected to change in the coming years. Mediterranean species (Epinephelus spp., Puntazzo puntazzo, Pagonus pagrus) offer good prospects; as may Black sea turbot (Scophthalmus maeticus) and Siberian sturgeon (Acipenser baeri). Mussel culture also seems to be promising and is expected to increase. Sea bass and sea bream production may stabilize around its present level due to limited demand and declining prices, though species composition may change, increasing production in favor of new Mediterranean species in present farms. Rainbow trout will however, continue to be the backbone of aquaculture in Turkey.

While Japan appears to be a new potential market and a partner for turbot aquaculture, Lebanon is becoming a new market for Turkish sea bass and sea bream. Mediterranean EU countries will however continue to be an important market for Turkish seafood and the custom union with EU will form a good platform for cooperation and trade in the future. Being a major consumer, Italy will continue to play a decisive role in the evolution of sea bass and sea bream prices, which are not expected to rise.

Processing will gain further interest, as domestic demand for value-added products will continue to increase along with increased GNP per capita. Declining prices for fresh products may also accelerate this process. A number of industrial scale trout farms have already started feasibility studies.

The aquaculture sector is very dynamic in Turkey and will continue to use its comparative advantage in terms of biological diversity, potential domestic market, climatic conditions and geographical position. Effective promotion and advertising campaigns to increase domestic demand, improving farm management and productivity to decrease production costs, re-
search and development of value-added products and new species, concepts of quality management and product image, environmental considerations and sustainability will be key issues for the coming years.

References

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