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in

Muir J. (ed.), Basurco B. (ed.).
Mediterranean offshore mariculture

Zaragoza : CIHEAM
Options Méditerranéennes : Série B. Etudes et Recherches; n. 30

2000
pages 71-77

Developments in the Turkish marine aquaculture sector[†]

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SUMMARY – With significant resources in both the Black Sea and the Mediterranean, fisheries are an important element in the primary production sector of the Turkish economy. While major changes have occurred in capture fisheries, with a significant drop in production in the Black Sea, the marine aquaculture sector in Turkey is developing rapidly, with sea bass and sea bream farming the most important areas of growth, primarily in the south and west coastal regions. The large part of this development has been based on small farm units using simple inshore cage systems. However, the increasing move towards larger scale production is bringing about greater interest and investment in larger and more robust cage systems, sited in more open and exposed locations. This paper summarizes the current status of the industry and identifies trends towards offshore development.

Key words: Offshore mariculture, fish farming, cages, fisheries.

RESUME – *"Développements dans le secteur de l'aquaculture marine turque". Grâce aux ressources conséquentes de la Mer Noire et la Méditerranée, la pêche et l'aquaculture représentent un élément majeur dans le secteur des productions primaires de l'économie turque. Alors que les résultats de la filière pêche ont connu des changements importants dus à une chute significative de production de la Mer Noire, le secteur aquacole s'est développé très rapidement, l'élevage du bar et de la dorade représentant la plus grosse production, particulièrement dans les régions côtières du sud et de l'ouest du pays. Une grande partie de ce développement s'appuyait sur des fermes de petite taille utilisant des cages disposées près des côtes, dans des zones protégées. Cependant on assiste à une évolution vers des productions à plus grande échelle, évolution qui implique une augmentation des opportunités d'investissements, notamment dans des systèmes de cages plus grands et plus robustes, qui peuvent être installés dans des zones plus ouvertes et plus exposées. Cet article résume l'état actuel de l'industrie et identifie les tendances vers un développement de l'élevage en pleine mer.*

Mots-clés : *Mariculture, mer ouverte, pisciculture, cages, pêcheries.*

Introduction

As one of the four agricultural sub-sectors in Turkey, fisheries has great importance in national production and food supply, providing raw material for the industrial sector, creating employment possibilities and high potential for export. With its favourable geographic position between the Black Sea and Mediterranean Sea. Turkey has access to fishery resources of both water bodies. The country is also endowed with rich inland waters and river systems with significant capture fishery and aquaculture potential. For 1996, fish landings, including aquaculture production, at 551,642 t show Turkey, as one of the important producers in the region. However, the fisheries sector is relatively insignificant in national economic terms, representing only 0.4% of NGI (National Gross Income).

Three sides of Turkey's land mass are surrounded by seas; total marine coastline is 8333 km (Table 1). Being in half closed position, these seas have different biological, physical, chemical and ecological characteristics.

[†]Collated and updated by J.F. Muir, from contributions by Deniz, Korkut and Telioglu.

Table 1. Marine resources of Turkey (Source: The Ministry of Agriculture and Rural Affairs)

Sea areas	Coastline length (km)	Surface area (hectare)
Black Sea, Aegean Sea and Mediterranean	7,144	23,475,000
Sea of Marmara, Istanbul and Dardanelles	1,189	1,132,200
Total	8,333	24,607,200

Sectoral output

Total fish production from domestic sources in Turkey in 1996 totalled 551,642 t, made up of 476,239 t (86.3%) from marine capture fisheries; 42,202 t (7.6%) from freshwater capture fisheries; 33,201 t (6.0%) from aquaculture. With a population of 65 million, this represents a per capita output of ~8.5 kg. Table 2 summarizes the composition of fish production, while Table 3 outlines recent trends in regional capture fishery production.

Table 2. Fisheries sector production in Turkey, 1996† (Source: Fisheries Statistics, Prime Ministry DIE)

		Amount (tonne)	Amount (US$)	Average value (US$/tonne)	Main species
Capture fishery	Marine	476,239	30,762,380	64.6	Anchovy, horse mackerel
	Inland	42,202	2,645,158	62.7	Carp
Aquaculture	Marine	15,241	1,828,730	120.0	Sea bass, sea bream
	Inland	17,960	1,062,390	59.2	Trout
Total		551,642	36,298,658	65.8	

†Estimated note, values are nominal only – high inflation rates have reduced apparent values.

Table 3. Distribution of marine fish production by region, 1988-1996 (Source: Fisheries Statistics, Prime Ministry DIE

Regions	1988	1989	1990	1991	1992	1993	1995	1996†
Black Sea	480,400	264,170	199,830	182,656	231,715	302,939	442,059	359,561
Marmara	53,791	36,892	42,064	38,505	36,630	47,733	35,288	48,527
Aegean Sea	31,505	37,647	31,731	43,940	55,801	60,162	51,995	42,913
Mediterranean	15,005	23,061	23,498	24,945	41,914	42,289	27,796	23,242
Total	580,701	361,770	297,123	290,846	366,060	453,123	557,138	476,239

†Estimated.

The dramatic fall in catch after 1988 was most pronounced for small pelagic fish, especially anchovy, in the Black Sea. From 310,298 t in 1987 anchovy production decreased by 68.2% to 98,620 t in 1989. Pelagic species play a major role in marine fisheries production, while demersal stocks such as whiting, red mullet and turbot have important economic value. The two most important factors were considered to be overfishing and water pollution and enrichment. In the 1990-1995 period, production has recovered to some degree, though supply has still to reach earlier levels.

Table 4 outlines recent sectoral trade characteristics, demonstrating a substantial surplus of external trade in both quantity and value terms.

Table 4. Export and import in Turkey, 1995

	Amount (t)	Amount (US$)	Ave (US$/t)	Main commodity	Countries
Export	125,706	90,902,126	723.1	Chilled and frozen	EU, Japan
Import	31,153	36,102,000	1158.9	Frozen	Norway
Balance	94,553	54,800,126			

Aquaculture

Until recently, aquaculture in Turkey was almost entirely confined to the production of rainbow trout *(Onchorynchus mykiss)* and common carp *(Cyprinus carpio)* in fresh water. Commercial-scale utilization of coastal waters began only in the late 1980s, and has grown rapidly into an important activity, considered by industry and government alike to have potential for increasing both domestic fish supplies and export earnings. The numbers of farms in 1996 of different sizes in each sub-sector are summarized in Table 5 below. With the notable exception of the sea bass and sea bream production, many sectors are still undeveloped, perhaps due to technical and market limitations.

Table 5. Licensed aquaculture farms and their capacities, 1996 (Source: Ministry of Agriculture)

Species	No. of licensed farms	Licensed farm capacity (t/year)	Production 1996	% age utilization
Trout	629	38,120	18,510	48.6
Salmon	2	1,600	193	12.1
Carp	97	10,710	780	7.3
Mussel	8	4,750	1,918	40.4
Turbot	1	200	0	0
Shrimp	3	470	270	57.4
Sea bass and bream	141	11,975	11,530	96.3
Total	881	67,825	33,201	49.0

According to informal sources, the production and number of farms are higher than those shown on Table 5. Thus in 1994, compared with 695 licensed farms, with a production of 37,750 t, it is estimated that there were 990 farms with a production of around 44,000 t. It is expected that the number of farms will reach 1500, and production will reach 70,000 t by the year 2000.

Infrastructure

The construction of fishery ports and other facilities has been accelerated with the commencement of the planned 5 year economic programme (Table 6). Developments of fishery ports and their locations are determined by a Commission which consists of representative of the State Planning Organization, Ministry of Transport and Ministry of Agriculture and Rural Affairs. Construction is undertaken by a General Directorate of Ministry of Transport.

Table 6. Ports and related infrastructure in Turkey (Source: SIS Fisheries Statistics, Prime Ministry DIE

Type of structure	Black Sea	Marmara Sea	Aegean Sea	Mediterranean Sea	Total
Fishing ports	29	33	36	11	99
Small fishing ports	15	8	2	2	27
Shore facility	33	–	–	–	33
Total	77	41	38	13	

At present, 3 institutes carry out research, in the Black and Aegean Seas (marine fisheries) and central Anatolia (inland fisheries). After 1982, 16 fisheries faculties were established. A fisheries college has also been providing education. There are no specialized aquaculture centres, though training is available as part of broader programmes. There are 270 fisheries co-operatives with over 14,259 members involved in production, storage, processing as well as marketing. About 40% are concerned with freshwater fish. A number of recent sectoral assistance projects have also been established:

(i) A grant of $US 2.5 million was provided by the Government of Japan to conduct various studies addressing problems of the Turkish fishery sector. These studies are still being undertaken.

(ii) $US100,000 was provided by the French Government for lake fisheries studies.

(iii) The Italian Government provided funds to promote sea bass and sea bream culture.

(iv) NATO has funded studies in the Black sea to determine anchovy stocks.

Marine aquaculture

Marine aquaculture has been carried out in Turkey since 1984, using net cages (Sahin, 1995), with seabream and seabass the predominant species group (Table 7). By 1990, there were almost 500 cage farms, mainly located in the west and south Aegean region. Species produced intensively include the gilt head seabream, and sea bass. Quantities of Mugilidae (Grey mullet, *Mugil cephalus) and* other Sparidae family species (Sharp-Snout Bream *Puntazzo puntazzo.* White *Bream Diplodus sargus,* Dentex *Dentex dentex,* Two-Banded Bream *Diplodus vulgaris,* Pandora *Pagellus erytltpitius,* Striped Bream *Litliognatitus mormyrus)* and Serranidae family species (White grouper *Epinephelus aeneus,* Dusky grouper *Epinephelus quaza),* are also produced, usually extensively. Turbot *Psetta maxima,* Spotted Flounder *Platichthys flesus* and Salmon *Salmo salar* are also produced experimentally in the Black Sea region. In 1992, some 14 hatcheries and 15 lagoons supplied fry, hatcheries primarily producing sea bass and bream larvae, with an estimated production of 2 million seabream and 12 million sea bass larvae, plus around 300,000 other species (MARA, 1995); a total output of 24 million was estimated in 1996.

Table 7. Marine aquaculture production (Source: Ministry of Agriculture/SIS)

Species	Production (tonnes)		Registered No. of farms	
	1997	1998	1997	1998
Sea-bream and sea-bass	13,300	18,810	290	350
Salmon	50	40		
Shrimp	300	270		
Trout	2,000	2,290		
Mussels	1,918	2,000		
Total	17,568	23,410		

In 1997, total production of seabass was recorded at 6300 t, and seabream, 7500 t, a total 13,800 t. This rose to a total of 18,810 t in 1998, an increase of 36.3%, (Table 7). The FCR is typically 2.0, and the production period is 10 and 16 months for seabream and sea bass respectively, though this depends on farm location. Water temperature is higher in the south Aegean, so reducing the growing period. In 1998, a total of 350 cage units, 8 raceway and tank units, and 3 earth pond systems were employed. Unregistered cage units will add to this number. Table 8 summarizes recent trends in numbers of units for seabass and seabream, and their relative production levels, showing a steady evolution towards larger unit sizes.

Table 8. Sea-bream and sea bass production units by class of size (Source: Ministry of Agriculture/SIS)

Unit production	No. units			% number of units, 1998	% production 1998
	1990	1998	Expected 2000		
5 t to 30 t	43	189	200	54	16.7
30 t to 100 t	26	100	100	28.6	22.2
100 t to 200 t	7	46	60	13.1	33.5
200 t to 500 t	3	10	25	2.9	11.7
500 t to 1,000 t	1	5	10	1.4	15.9
>1,000 t	–	–	5	–	–
Total no. units	80	350	400	100	100

Table 9 outlines the development of different types of unit from 1990 to 1998, and shows the dominance of inshore cage types, with a small number of units in more exposed conditions. Most cages are still of simple locally fabricated timber construction, with some of galvanized steel. Some farms are also beginning to use PVC cages. Dimensions are generally 5 x 5 x 5 m or 6 x 5 x 6 m, with rigid frames. However, some flexible cage designs have been developed in Turkey, used experimentally for salmon culture in the Black Sea. Cage nets are knotted or unknotted with mesh size 5-20 mm. Almost all cages are currently located inshore in coastal bays with suitable water flow, sheltered from strong winds (Table 9). Five units (1.4% of total number) were recorded in 1998 in semi-offshore/offshore conditions, accounting for 13.3% of production. Though there are no truly offshore cages installed at this stage, the expansion of the industry, increasing shortage of space, and potential conflicts with other users are leading the government to restrict access to sheltered bays and require farmers to develop new farms in open waters. Current regulations also aim towards removing unlicensed cage capacity and thereby greatly reducing the number of small scale operators.

Table 9. Production techniques for sea-bream and sea-bass farming (Source: Ministry of Agriculture/SIS)

	No. units		% total		Prod. (t)		% total prod.	
	1990	1998	1990	1998	1990	1998	1990	1998
Earthponds	1	3	1.2	0.8	20	40	1.8	0.2
Raceways and concrete tanks	–	8	–	2.3	–	200	–	1.1
Cages in inshore condition	79	334	98.8	95.5	1,113	16,070	98.2	85.4
Cages in semi-offshore or offshore conditions	–	5	–	1.4	–	2,500	–	13.3
Total	80	350	100	100	1,133	18,810	100	100

Key factors for developing offshore mariculture

Offshore mariculture is a very new development for Turkey, and though there are no truly offshore marine fish farms at this stage, some investors and existing inshore farm owners are seeking technology in this field. With growing conflict between the mariculture sector and tourist sectors, this demand is likely to increase. Other problems may include increased risks of disease outbreaks in inshore farms, increased interactions with sea traffic, historical remains, sunken cities, problems with marine pollution and increasing difficulties in renting coastal land. Current problems with the existing sector include:

(i) Dimension of presently used cages is very small, these are not flexible; considerable investment may be required for improvement.

(ii) Most farms do not automatic feeders, feeding programmes or better quality feeds. This causes considerable pollution risks in inshore areas.

(iii) Farms are close to each other and their numbers may exceed the capacity of individual bays.

(iv) Fish diseases can occur as a consequence; important diseases include Vibriosis, Lymphocystis, and various bacterial diseases and parasitic infections.

(v)Most farms are private, often family companies, do not use technical specialists and have very limited relationships with sources of expertise such as universities or research institutes.

(vi) As it is a new area, the regulatory system is relatively undeveloped. There are currently almost no regulations concerning the establishment of offshore mariculture. However, licensing might be easier than for inshore farms, as fewer permissions may be required from related ministries.

(vii) No studies done have been done about the potential and constraints of moving offshore.

A further constraint for development is seed supply. At present, many small farms obtain their juveniles from the wild, though there are also many big commercial and government fish farms using modern technology. Larger commercial fish farms produce their own juveniles from hatcheries and selling the remainder to other farms. Some 10-15 large commercial farms now operate in this way. A key problem for many farms is to find enough juveniles, and to reduce mortality during the transportation and in associated disease losses, Seabass production has been more successful than that for sea bream, where the rate of mortality in juveniles is high due to abnormalities, shortened opercula, and deficiencies in feeding and swim bladder inflation. A larger, more commercial offshore sector will require good quality and reliable seed supply for profitable development.

The basic requirements for the development of offshore mariculture in Turkey are finance, technology, expertise, and government support. Biological, physical and chemical conditions such as water quality, wave, climate, infrastructure, etc., are potentially very suitable for offshore mariculture, The Mediterranean and Aegean Seas are especially convenient for sea bass and bream culture, and the Black Sea for salmon and turbot culture. However, the cost of moving sites and installations is high, and the minimum viable size of an off-shore farm much larger than that for an inshore farm. The problems currently experienced with the Turkish government for in-shore marine culture (obtaining licences from Ministries of Tourism, Forestry, Environment, Culture, Transport and from Municipalities) may be overcome by new laws to encourage better managed offshore and semi-offshore systems. Marketing problems and reducing prices may also need to be addressed if major new investment is to be considered. However, if farms are moved offshore and greater supplies of good quality fry are produced by hatcheries many of the present problems of small-scale production may be overcome, and the industry can move into a more modern development phase.

Conclusions

Around half of national fish culture production comes from fresh water systems, the remainder coming from sea fish cages. In the future, an increase it is expected in the production amount from sea water, though with recent permissions to develop reservoir cage culture, fresh water aquaculture production may also increase further.

Turkey has a great opportunity to culture a wide range of species as it has quite different ecological conditions. With its long coastal borders, good water quality, tidal range, climatological conditions Turkey has a number of suitable locations for aquaculture development, Infrastructure elements such as road, electricity and water are increasingly available to farms, either with government support or by direct investment by fishfarms and other enterprises. There is a great demand to produce fish in cages, especially in the Aegean Sea region, where demand is particularly stimulated by high income levels, fish consumption habits and tourism (Alphaz, 1999). In spite of various problems the marine aquaculture sector has been very successful, bringing production from nil to 12,000 t annually over a very short period and creating new employment and markets.

In summary, with these positive features, Turkey has a good potential to develop offshore aquaculture. Legal and institutional arrangements must be carried out as soon as possible if an acceleration in aquaculture production is desired, and confidence and security can be given to companies prepared to invest in developing a modern aquaculture sector.

References

Alphaz, A. (1999). Supplying demand – Turkey's unfulfilled potential. *Fish Farming International*, 26(7): 32-33.

MARA (Ministry of Agriculture and Rural Affairs) (1995). *Identification of fish culture sites in marine and brackish water in Turkey, Ankara.* Survey document, General Directorate of Agricultural Production and Development.

Sahin, M. (1995). Sea bass and sea bream in floating cages in Turkey. In: Aquaculture Production Economics, Proceedings of the Seminar of the SELAM Network of the CIHEAM, Montpellier (France), 17-19 May 1995, *Options Méditerranéennes, Séries Cahiers*, Vol. 14, Zaragoza, CIHEAM/MEDRAP II (FAO/UNDP)/IFREMER, pp. 57-63.

SIS (State Institute of Statistics) (1986-1998). *Statistical yearbook of Turkey.* Prime Ministry, Republic of Turkey, Ankara.