

# Current Status of Fisheries and Aquaculture in Tunisia

Meher Bellakhal<sup>1\*</sup> and Abdel Majid Shel<sup>2</sup>

<sup>1</sup>Department of Fisheries and Aquaculture, High Institute of Fisheries and Aquaculture, Of-Bizertd, Menzelyemil 7021, Tunisia

<sup>2</sup>Head Office of Regional Fisheries and Aquaculture, Ministry of Agriculture and Hydraulics Resources, Mahdia 5100, Tunisia

**Abstract** Compared to other North African countries, Tunisia has reached a significant level of fish consumption. The only relevant historical dimension of aquaculture in Tunisia are traditional lagoon management (80,000 ha of lagoon and coastal lakes) and culture of shellfish. Semi-intensive and intensive cultures are relatively new concepts in Tunisia and only recently also the public sector is involved. The Tunisian fishing industry has expanded over the last 20 years and annual catches at present are more than four times those registered in mid-fifties. Production of the year 2007 reached 105 thousand tons against 111 thousand tons during the same period of 2006 thus recording a fall of 5%. Unfavorable weather conditions mainly during the last quarter year had the effect to reduce the number of days out at sea. Exports reached 24.3 thousand tons for one value 240.5 MD against respectively 22.2 thousand tons and 234.1 thus recording MD at the end of the past year a rise of 9% in volume and from 3% in value. Commercial value such as shellfish - consequence of one regression of the production - with in parallel raises blue fish exports. The imports were stabilized in volume of 39.1 thousand tons and increased from 6% in value with respectively 67.4 MD in 2007 against 63.7 MD at the end of 2006. The importation in larger quantities of intended fish to the fattening of tuna in floating cages explains partly this rise. Nevertheless, the pay of balance import/export of produced fishing remains positive with a surplus of 173.1 MD against 170.4 MD in 2006.

**Key words :** Aquaculture, fisheries, shell fish, Tunisia

## Introduction

Tunisia has an area of 15,536 km<sup>2</sup> (Fig. 1). The Atlas Mountains dominate the topography of the northern part of the country, rising to a maximum elevation of 1,544 m asl. The south is mainly desert (40% of the total land area). The interior is hot and dry, while the coastal zone is more moderate. The north generally receives adequate rainfall. Due to low runoff and high salinities water quantity and quality limit irrigation agriculture in most parts of the country.

Compared to other North African countries, Tunisia has reached a significant level of fish consumption. The only relevant historical dimension of aquaculture in Tunisia are traditional lagoon management (80,000 ha of lagoon and coastal lakes) and culture of shellfish.

Semi-intensive and intensive cultures are relatively new concepts in Tunisia and only recently also the public sector is involved.

The Tunisian fishing industry has expanded over the last 20 years and annual catches at present are more than four times those registered in mid-fifties. The catch of small pelagic fish increased greatly, while the catch of demersal species has remained nearly stable. All the production is utilized for human consumption and most of it is consumed fresh on the local market.

## Structure of fisheries resources

### Lakes

Kelbia (100 km<sup>2</sup>) and Ichkeul (35 km<sup>2</sup>) are the two largest low-salinity lakes. There are several others of

\* Corresponding author

Phone: +216-2288-0879, Fax: +216-7249-0391

E-mail: meher2976@yahoo.fr



Fig. 1. Map of Tunisia

less than 1.0 km<sup>2</sup>. A number of salt lakes and marshes occur in the country, some of large basin size (i.e., Chott Djerid, 4,580 km<sup>2</sup>; Chott Fedjadj, 570 km<sup>2</sup>; Sabkhet Sidi El Hani, 360 km<sup>2</sup>). The term “chott” or “sebkha” defines a non-permanent water body (swamp or lake), submitted to the occurrence of seasonal precipitations.

### Rivers, floodplains and swamps

Four small river systems discharge into the Mediterranean Sea; the Oued Medjerda is the largest of these. Several landlocked rivers discharge into salt lakes. Total national runoff is only 2.5 km<sup>3</sup>/year of rainfall of 33 km<sup>3</sup>/year (90% is lost as evaporation).

### Reservoirs

There are 14 large dams/reservoirs with a combined area of over 176 km<sup>2</sup>. The two largest are Bourguiba-Sidi Saad (90 km<sup>2</sup>) and Sidi Salem (43 km<sup>2</sup>). The total impounded volume is 1,451 km<sup>3</sup> or 58% of total annual runoff. There are some 15 small earthen dams, which store irrigation and potable water. Combined area is circa 2.0 km<sup>2</sup>. There are also small reservoirs associated with nine principal oases, with a combined area of 0.03 km<sup>2</sup>.

### Coastal Lagoons

There are seven important coastal lagoons with a

combined surface area of 550 km<sup>2</sup>; the largest are Bibane (230 km<sup>2</sup>) and Bizerte (150 km<sup>2</sup>).

## Current status of aquaculture

### Overall assessment of Tunisia’s experience in the field of aquaculture

Tunisia’s experience in aquaculture is fairly long-standing, going back to the sixties. It began as a private sector initiative with the establishment of a shellfish farm in Bizerte in 1963 and a marine-hatchery in Ghar el Melh in 1973 [3]. The shellfish facility was later taken over by the National Fisheries Office (ONP), which continued its operation. In the seventies the ONP began to construct ponds in the lagoons of Monastir and Tunis and to stock some dam reservoirs for fishing. Experiments in freshwater pisciculture conducted in a dam reservoir by the National Scientific and Technical Institute for Oceanography and Fisheries (now called the National Institute of Marine, Sciences and Technologies) held out hopes for the rapid development of this activity. At the beginning of the eighties, one of the first Mediterranean hatcheries was constructed in the south of Tunisia by private operators, supported by regional banks. Since then, despite the success of research work on both marine and fresh water species, freshwater pisciculture in indoor and extensive systems is the only activity to have undergone sustained development. Tentative initiatives have been undertaken by private operators in two main areas. First, shellfish farming: there are currently four shellfish facilities in operation in Lake Bizerte, producing mussels and oysters. Mussel spat are collected locally from the Bizerte lagoon and juvenile oysters are imported from abroad. In 2005, these facilities produced 120 tones, although potential output is five times that amount. Second, marine pisciculture: five private facilities are currently in operation, producing sea bass and sea bream. In 2005, 1,208 tones were produced in the three facilities in operation at the time. The past few years have seen the rise of a new aquaculture practice, which represents a groundbreaking innovation in breeding techniques: the fattening of red tuna. It provides not only for a weight gain of more than 20% in just a few months, but also ensures that the product can be sold on the international market at the best prices consumption per capita when the tuna meat is fatty. In 2003, four new red-tuna fattening operations were established,

which helped double the total output. Tuna destined for fattening is caught by fishermen and transferred alive in cages submerged in the sea. It is kept there for a few months for fattening and is then sold fresh at a relatively high price. It should be pointed out here that the total output from Tunisian aquaculture in 2006 was about 2,981 tones, comprising 1,140 tones of sea fish (sea bass and sea bream), 1,150 tones of fresh-water fish, 511 tones of red tuna and 180 tones of bivalve shellfish (mussels, oysters and clams).

### Consumers respond to Tunisian aquaculture products

Tunisian consumers are still quite wary about aquaculture products. Farmed sea fish are generally thought to have less nutritional value than wild fish. Fresh-water fish for their part tend to be judged by their flavor and are considered to be inferior to their salt-water cousins in this respect. Bivalve mollusks (mussels, oysters and clams) tend not to be fully appreciated by Tunisians either in terms of flavor and nutritional value or as a culinary ingredient. Consumers' reservations are further increased by the problem of biotoxins associated with these species. On the other hand, the rise in prices and the shortage of fisheries products in recent years have prompted many consumers to try aquaculture products, particularly sea and fresh-water fish. In the end more information and media coverage is needed if demand is to increase.

### Areas of Tunisian aquaculture might attract local and foreign investors

With a coastline of some 1,350 km, Tunisia offers numerous possibilities for the aquaculture sector. More importantly, it offers the right set of conditions for success: the climate is fairly well suited to the biology of the Mediterranean species most in demand, the natural environment is still well preserved compared with that of other Mediterranean coastlines, there is a generation of trained executives who have demonstrated their ability to manage this work, and it is close to the European market. Moreover Tunisia is on the A-list of countries eligible to export sea-food products to the EU market by virtue of the standard of hygiene in its private facilities and the effectiveness of its procedures for monitoring the marine environment and its products. There is potential for a great many Tunisian aquaculture sectors:

In marine pisciculture the submersible cage technique offers the most appropriate solution to the problem of selecting the best site. Species that bring in a fair return on the local and international markets include red tuna, croaker, meager, Lumberjack, red sea bream.

In continental pisciculture, integrated aquaculture in pools laid out next to dam reservoirs and hill lakes provide for optimum exploitation of fresh-water resources. Walleye, black bass and eels are of particularly interest to operators on account of their flavor and market value.

In lagoon environments, the technique of suspending shellfish cages from wires is used to keep costs down, widen the range of possible sites and ensure greater mobility in the event of eutrophication or pollution. Species with the most potential are the flat oyster (*Ostrea edulis*) and the Pacific oyster (*Crassostrea gigas*) on account of their high market value. Lagoons are also used for algae culture, both of macrophytic species, notably *Gracilaria verrucosa* for its value in agar production, and micro algae, such as spirulina and *Dunaliella* for their use in agrifood and various other applications [7].

In geothermal water, the tilapia (*Oreochromis niloticus*) has shown particularly good zoo technical performance and has adapted perfectly well to the environment.

New directions in Tunisian aquaculture that might also be of interest to future investors include farming of frogs, sponges, shrimps, pearls, and octopus, given the constant demand for these products and their increasing market value.

### Foreign countries contribution to the sustainable development of Tunisian aquaculture

Neighboring and friend countries could make a useful contribution by sharing technologies and experiences relevant to the different sectors. The experience of some countries in recycling aquaculture waste, organic matter and mineral moods would certainly be of help in improving the monitoring and control procedures needed to preserve inland lake areas. It is also worth noting that other possibilities include developing models to determine long-term prospects for aquaculture, taking account of the trophic capacity of the environment, the socio-economic context, and above all the potential offered by the species in question. We also propose that cooperative work with other countries in this field be consolidated to improve the quality of inert or con-

solidated feed and ensure that organic ingredients are introduced into the feed ration. Moreover it is now imperative that Tunisia take steps to improve the development of hatcheries and food industry, which play an essential role in aquaculture. On this score we urge the different players to work collectively and transparently to preserve biodiversity and protect the environment in general and the aquaculture environment in particular.

### Fishery production potential

#### Fish production and per caput supply

Production of the year 2007 reached 105 thousand tons against 111 thousand tons during the same period of 2006 thus recording a fall of 5%. Unfavorable weather conditions mainly during the last quarter year had the effect to reduce the number of days out at sea. Aquaculture production of 2007 was sea fish of 1,140 tons, fresh-water fish of 1,150 tons, red tuna of 511 tons, bivalve shellfish of 180 tons. The overall fisheries productions in Tunisia are shown in the following graphs (Fig. 2-4).

Inland catch range and potential yields are in Table 1. Exports reached 24.3 thousand tons for one value 240.5 MD against respectively 22.2 thousand tons and

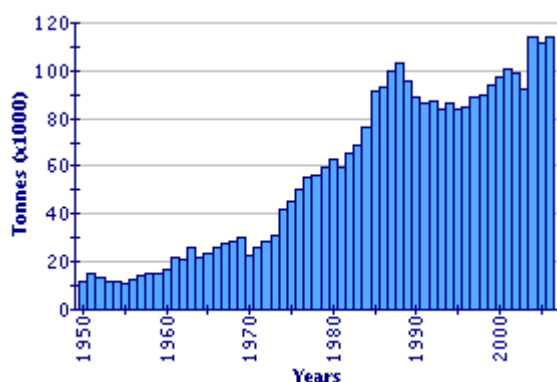


Fig. 2. Fishery production in Tunisia (1950-2006) [3].

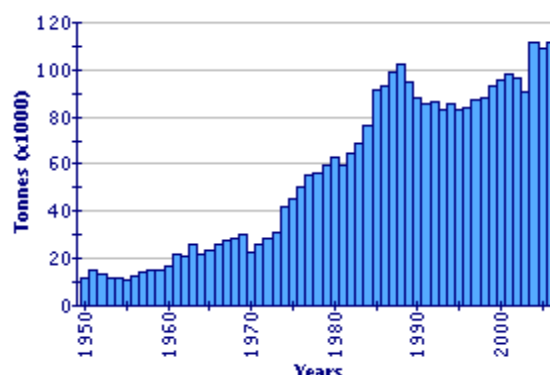


Fig. 3. Capture fisheries production in Tunisia (1950-2006) [3].

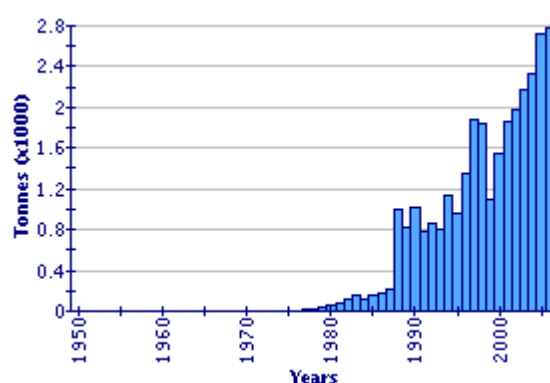


Fig. 4. Aquaculture production in Tunisia (1950-2006) [3].

234.1 thus recording MD at the end of the past year a rise of 9% in volume and from 3% in value (Table 2) [3]. Commercial value such as shellfish - consequence of one regression of the production - with in parallel raises blue fish exports. The imports were stabilized in volume with 39.1 thousand tons and increased from 6% in value with respectively 67.4 MD in 2007 against 63.7 MD at the end of 2006. The importation in larger quantities of intended fish to the fattening of tuna in floating cages explains partly this rise. Nevertheless, the pay of balance import/export of produced fishing remains positive with a surplus of 173.1 MD against 170.4 MD in 2006 [3].

Table 1. Inland catch range and potential yields [3].

Type of culture	Spieces	Main areas	Production potential
Marine pisciculture	Sea bream, Sea bass	North coast	10.000 to 15.000 tones
Inshore pisciculture	Tilapia, Eel, Walleye, Catfish, Great mullet	Dams and lakes	3.000 tones
Shellfish	Mussel, Oyster	Bizerte lake and Tunis gulf.	10.000 tones (including 5.000 on shore)
Clams	Local clam (Tapes decussates)	Gabès gulf, Bourghrara lake	19.000 ha 3.500 ha.

**Table 2.** Export value of fisheries products comparing to olive oil [4].

Years	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fish, crustaceans and mollusks	74.1	90.9	107.5	125.8	102.1	119.9	126.5	134.6	144.7	153.2
Olive oil	216.6	117.1	288.4	212.6	382.7	263.9	200.3	55.8	114.3	708.0

Millions TND (1 TND = 0.9 USD).

## Marketing

Total exports in 1986 were 60 t each of seabass and sea bream and 110 t of eels, No mullets were exported [1]. About 9,000 t of molluscs are exported, mainly octopus, shrimps and cuttlefish [2]. About 75% of the total fish production of 75,000 t is consumed fresh. After deduction of exports and addition of tuna imports for canning, 67,900 of fish and fishery products are available to the Tunisian consumer [5]. Average per caput consumption reached 9.75 kg in 1984 compared to 8.7 kg in 1982. A per caput consumption of 10 kg per year is aimed at in 1986 [5]. Yet the regional distribution of fish consumption is very unbalanced. Per caput consumption reaches about 20 kg in coastal areas, whereas rural districts in the interior of the country remain largely undersupplied. In 1983, the "Société pour la Distribution des Production de la Mer" (SDPM) was founded in order to increase fish supply in the interior of the country. More than 10,000 t (18.6% of total fresh fish production) was absorbed solely by the Tunis wholesale market. Other important markets are Sfax and Bizerta.

The canning industry absorbed 9,300 t of fish; canning and fish meal plants are concentrated in Mahdia and Sidi Daoud. The main species utilized for canning are sardine, sardinella and tuna. Only minor quantities of anchovy and mackerel are canned. Offal from canning factories is utilized for the production of about 1,300 t of fish meal [5]. Only a negligible quantity of canned fish is exported (100 t/year).

## Supply and demand

Since the mid-1950's total inland catch has generally remained between 900 and 1 500 t/yr. Most of this is derived from the lagoons. A significant production is obtained from aquaculture (finfish and shellfish). The total catches in 1977 were 38,441 t. Imports, consisting almost entirely of frozen tuna, amounted to 1,300 t and were valued at US\$ 1.41 million in 1974. In the same year, exports of fish and edible products were 3,200 t, valued at US\$ 5.13 million [2].

## Potential for aquaculture development

### Crustaceans

At present, there is a good potential for growing shrimp in polyculture with mullet. There is also a good longer-term potential for growing shrimp in intensive, controlled environment systems, but this is dependent on the development and testing of new technology and should receive a low priority for the time being.

### Molluscs

Technically, there is a good potential for increasing production of oysters and mussels, but the demand in Tunisia is limited. Any increase in production, therefore, would depend on the development of the domestic market or better arrangements for export to Europe. In contrast, there is a good demand for clams, both in the home market and for export. Methods for culture of clams are being developed in various parts of the world. It will be possible in the future to increase production by planting small clams grown in hatcheries. Developments in clam culture in France and Spain may have particular significance for Tunisia over the next few years.

### Fish

There are a number of ways that fish culture methods now in use could be improved, particularly in lagoons. The present system, which entails more trapping than culture, could be upgraded by growing the small fish that enter the lagoons to a larger size before harvesting. This could be accomplished by applying the "valli" culture techniques that have been developed in Italy. A second approach would be to follow the recommendations proposed by [8] that the mesh size of the screens on the lagoon side of the traps of the bordigues be increased to allow small-sized fish to return to the lagoons.

There is a very good potential in Tunisia for the culture of sea bass, mullet, sea bream, sole and eel in pond systems. The principal needs are for a dependable supply of both seed stock and feed.

## Programmes needed to expand aquaculture

### Limiting factors

The main limiting factors for fish and shrimp culture are: (i) a lack of seed for stocking; (ii) pond and intensive (controlled environment) methods of culture to replace the low yielding lagoon culture; and (iii) feed.

The limited demand for oysters and mussels in Tunisia will restrict the expansion of shellfish culture in Lake Bizerte. The high cost of young oysters imported from France for growing in Lake Bizerte also limits the profitability of oyster culture.

#### General programme requirements

To ensure adequate supplies of fry required for an expanded programme of aquaculture, it will be necessary to establish the mullet hatcheries to boost-up this popular species production through seed production. This can be accomplished by integrating advanced technology, developed elsewhere, into the procedure used at present at the INSTOP experimental hatchery and, at a later stage, to build one or more production-scale hatcheries [6].

Another major problem is the lack of grow-out technology applicable to ponds in Tunisia. Development in this line will involve improving the existing facilities at El Akharit and Lake Monastir. Improved culture methods developed in other countries should also be tested and applied. These will require appropriate feeds, and local mills should be encouraged to produce rations using diet formulations developed elsewhere. An evaluation of the economics of various systems is needed to determine profitability or to indicate areas where more research is required. All pilot or commercial-scale tests of culture systems should be planned jointly with an economist and adequate records kept to permit economic analysis.

To increase profitability of oyster culture, research and development is needed to test the use of small *C. gigas* seed oysters instead of larger-sized ones now imported from France. If 3–10 mm diameter spat, attached to scallop shells or synthetic materials can be grown successfully, the economics of oyster culture in Lake Bizerte could be improved. Also, a market development programme to increase sales of oysters and mussels is desirable.

### Recommended projects or actions

#### Development of the hatchery at Gahr el Melh

The INSTOP experimental hatchery should be ex-

panded and upgraded to incorporate recent advances in technology made in other countries. In addition to larval culture facilities, additional holding facilities for broodstock and nursery tanks are needed. The hatchery should be designed to produce 500,000 sea bass fry, 2 million post-larval shrimp and 100,000 sea bream fry per year. This project should provide design criteria for production-scale hatcheries needed to expand pond culture of various species.

#### Expansion of INSTOP experimental fish culture in ponds at El Akharit

This facility should be expanded to provide earthen raceways for the intensive culture of sea bass. Such a system of culture should make maximum use of the high water temperature of the artesian wells during the cold winter months. Ponds for the semi-intensive culture of mullet should be enlarged to 2–4 ha and a “progression” system should be tried. In this type of culture, small fish are stocked at high density and then transferred to larger ponds as they increase in size. Shrimps should be stocked in polyculture with the mullet.

#### Expansion of pond culture experiments at Lake Monastir

Alternate systems of water management should be tried to control entry of predators into the ponds. Development of simpler ponds is essential if construction costs are to be lowered to a point where fish culture would be profitable. Additional ponds should be constructed using different types of construction to determine costs. Nursery facilities are also needed. The cost-effectiveness of the present diet, using locally available wastes, should be compared with that of standard pellet rations.

#### Arrangements for a feasibility study of aquaculture at the Bay of Bou Grara

Tests should be conducted to determine the most appropriate type of grow-out facility for fish culture in this bay.

#### Development of local sources of fish feed

It should be necessary to establish adequate fish feed mills to supply quality feed to the farmers with lowest rate. This could be possible through selecting locally

available feed ingredients.

### Improvement of economics of oyster culture in Lake Bizerte

Experiments should be conducted to test growth and survival of small seed oysters from France or from the Trieste area of Italy. Collection of seed of *C. gigas* and *Ostrea edulis*, which reportedly reproduce in Lake Bizerte.

### Institutional context

The fishery sector is administered by CGP (Commissariat Général à la Pêche). This body is responsible for the administration of all activities related to the fishery sector. The specialized departments of the CGP collected statistical information, carry out surveys and prepare analyses and policy recommendations. CGP is also responsible for fishery schools, legislation, export permits, fishing permits, etc. The office National des Pêches (ONP), was established as a semi-governmental body to develop the lagoon fisheries, the tuna fishery and the fishing fleet. ONP is also responsible for marketing fish, establishing cold stores, operating shipyards and processing fish.

### Acknowledgement

This research was partially supported by a grant from the Fisheries Technicians Training Program for African Countries of the Overseas Fisheries Cooperation Center, KOICA, Korea.

### References

1. ACDP and REP. 1987. The markets for the prime Mediterranean species - sea bass, sea bream, mullets and eels and their links with investment. ACDP/REP/87/29.
2. FAO. 1985. Yearbook of Fishery Statistics, vol. 60–61. 1985.
3. FAO FishStat Plus. 2008. [http://www.fao.org/fishery/countrysector/FI-CP\\_TN/3/fr](http://www.fao.org/fishery/countrysector/FI-CP_TN/3/fr). Cited on August 06, 2008.
4. FID, CP, and TUN. 1985. Fishery Country Profile. Tunisia, FID/CP/TUN/Rev. 3, October 1985.
5. FSCP. 1985. TUNISIA - Fishery Sector Country Profile. Tunisian German (GT2) Fisheries Project. July 1985.
6. MEDRAP. 1986. Socio-economic Aspects of Aquaculture Development in the Mediterranean Countries. Djerba (Tunisia), MEDRAP - TD/86/06. November 1985
7. Pillay, T.V.R. 1971. Report of travel to Tunisia for a rapid survey of lagoon fisheries and aquaculture. FAO Fish.Travel Rep.Aide Mem., (565): 6 p.
8. Sivalingham, S. 1976. On the possibilities of operating the bordigues during March and April in some Tunisian lagoons and lakes. 10 p.