

# INTENSIVE MARINE FISH FARMING IN THE MEDITERRANEAN ISLANDS : PRESENT STATE AND PERSPECTIVES

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## Résumé

*Grâce à de bonnes conditions de milieu et à une volonté politique affirmée, l'élevage des poissons marins s'est développé récemment dans la Méditerranée. Le bassin méditerranéen possède un très grand nombre d'îles qui sont très diverses de par leur caractéristiques géographiques, politiques ou socio-économiques. Près du tiers de la production de poissons marins d'élevage des pays méditerranéens est réalisée dans des îles. Les raisons qui ont incité tant d'entreprises à s'établir sur des îles sont diverses. La motivation principale avancée par les promoteurs de l'aquaculture insulaire méditerranéenne est la qualité de l'environnement des îles et la disponibilité en sites, justifiée par le fait que les îles sont moins soumises à certaines contraintes comme l'extension des villes, le développement de zones industrielles ou l'intensification de l'agriculture. La politique d'aide envers les régions ultra-périphériques ou en retard de développement a permis d'attribuer des subventions spécifiques aux îles pour développer l'aquaculture dans un objectif de création de richesse et d'emploi. Comme toute autre activité économique dans les îles, l'aquaculture doit faire face à des contraintes directement liées à l'insularité. Le transport est plus coûteux et moins régulier, ce qui a un effet négatif sur la compétitivité prix des produits. Les marchés locaux sont souvent trop petits pour permettre aux entreprises de se développer d'abord en interne et de profiter d'économies d'échelle. Une réponse possible à cette contrainte de concurrence internationale pourrait être la promotion des produits sur la base de l'origine géographique, de la qualité de l'environnement ou de procédés de production spécifiques afin de valoriser l'image très positive et la notoriété de ces îles dans le monde entier. Les réseaux dédiés à l'information, à la recherche et au transfert technologique sont des outils nécessaires pour compenser les contraintes dues à la petite taille et à l'isolement dans le but de fournir le vaste marché européen en produits de la mer de qualité.*

## Abstract

*Due to favourable environmental conditions and political will, marine fish farming has developed recently around the Mediterranean. The Mediterranean area is characterised by a large number of islands which are extremely diversified from geographical, political or socio-economic point of views. As a matter of fact, it turns out that almost a third of the Mediterranean fish farming production comes from these islands which have proven to offer good conditions for the development of that new activity. The reasons why so many enterprises have been established on islands are very diverse. Taking advantage of good environmental conditions is the most common motivation, since islands are usually less submitted to constraints due to town extension, industry development or intensive agriculture. Moreover, as far as European Union countries are concerned, incentive policy towards ultra-peripheral or late development regions has made it possible to attribute specific subsidies to islands for aquaculture in the aim of more employment and wealth. Like any other economic activity, aquaculture has to face some specific constraints due to the insular context. Transport to and from the islands is more expensive and less regular, which has a negative impact on the price competitiveness of the insular products. Local markets are often too small to make it possible for the enterprises to develop first at a domestic level and to take advantage of economies of scale. Thanks to their positive and attractive world-wide image, Mediterranean islands could promote the quality of their products on the basis of geographical origin, of quality of the environment or of specific production processes. Information networks implementation and marketing approach in terms of image are challenges Mediterranean islands have to take up in order to supply the large European seafood market with quality products.*

## Introduction

This study has been carried out in the framework of the activities of the SELAM network. The SELAM network, which has been initiated by the FAO, is dedicated to the economic aspects of aquaculture in the Mediterranean. In order to figure out whether aquaculture may be considered as a potential activity for Mediterranean islands, a survey of aquaculture in these islands has been realised with the contribution of the SELAM members. Through this survey, constraints and assets for aquaculture are analysed and perspectives for future are discussed.

Generally speaking, there is a lot of concern from governments and from international organisations towards Mediterranean islands since most of them are considered in a situation of late development. Numerous measures for economic development of Mediterranean islands have been proposed recently, in order to diversify the activities in islands where tourism has become predominant or to keep some activities in the non touristic islands which are depopulating (Brigand et al., 1992). This paper includes also some archipelagos like the Canaries and Madeira which depend politically on Mediterranean states although situated in the Atlantic ocean.

At the present time, aquaculture in the Mediterranean countries is a steady activity which produces every year 500 000 tonnes of molluscs (mainly mussel *Mytilus galloprovincialis*,

oyster *Crassostrea gigas*, clam *Tapes phillipinarum*), 220 000 tonnes of fresh water fish (trout *Onchorynchus mykiss*, tilapia *Oreochromis niloticus*, carp *Cyprinus carpio*) and 70 000 tonnes of marine fish (mullet *Mugil cephalus*, seabass *Dicentrarchus labrax*, seabream *Sparus aurata*) for a total turnover of 1 200 millions Ecus in 1995. Although the growth rate of the activity has been quite low during the last ten years with an average yearly increase under 5%, intensive marine fish farming has been developing at a much faster pace. With 45 000 tonnes in 1995, intensive marine fish farming accounts for 5% only of the Mediterranean aquaculture production in volume but for almost 30% in value. In Mediterranean islands, traditional forms of aquaculture like mussel farming or extensive fish farming in ponds and valli are not widely developed but intensive marine fish farming has been experienced almost everywhere.

## **Main features of Mediterranean islands**

These islands which are scattered all around the Mediterranean represent only 5% of the Mediterranean watershed surface and no more than 4% of the population of the area. Nevertheless, they constitute one of the most important insular systems of the planet, as a par with the Caribbean and the Pacific islands. Despite their small size, they play a large economic, social, political and cultural role. Moreover, they used to be historical strategic poles at the crossroads of the Mediterranean international trade flows. The coastal length of the Mediterranean islands represents 18 000 km, i.e. 39% of the total Mediterranean coastal length (Brigand et al., 1992)

There is a high diversity of sizes including very large islands which are sort of mini-continents like Sicily and Sardinia, large islands like Corsica, Cyprus or Crete and small islands like the numerous Greek islands in the Aegean sea, the Maltese islands or the Tunisian Kerkenna islands. All these islands are characterised by a progressive concentration of population and activities along the shore and consequently a desertification of the inside of the island. Traditional activities like small cattle breeding, fisheries or handicraft are most often declining. Agriculture which used to be very diversified for domestic consumption has become specialized in typical Mediterranean fruit and vegetable products for export markets (Bensidoun and Chevallier, 1996). Meanwhile, tourism has been soaring on many islands since the seventies. More than 15 million persons every year go to the Mediterranean islands for vacation (Brigand et al., 1992).

## **Constraints to economic development in small islands**

Like any other economic activity, aquaculture has to face some specific constraints due to the insular context. Transport to and from the islands is more expensive and less regular, which has a negative impact on the price competitiveness of the insular products (Hein, 1988). Some extra costs have to be considered in order to cover transit and storage operations. Islands are also more subdued to problems of traffic congestion in airports, harbours or even telecom networks. In some islands, real estate has turned out very expensive due to touristic pressure. Economic development may suffer also from a lack of technical and scientific formation structures which obliges to rely on outside for technological transfer and graduated manpower.

Local markets are often too small to make it possible for the enterprises to develop first at a domestic level and to take advantage of economies of scale. In the case of seabass and seabream, most insular companies have had to face international competition on export markets from the very beginning despite the disadvantages in terms of transport costs they have to cope with. Given the new rules of free trade for sea products following the GATT agreement, the same constraint of international competition has to be taken into account by islands which, like Madeira and Cyprus, have targeted the local market in priority.

## The situation of aquaculture in Mediterranean islands

### *Economic development of Mediterranean islands*

Mediterranean islands are mostly in the northern part of the Mediterranean and belong to the most developed part of the Mediterranean basin. Nevertheless, they are usually in the southern part of the countries they depend on and constitute therefore sort of an intermediate step between North and South of the Mediterranean (Filippi and Torre, 1996). Except the Kerkenna islands in Tunisia, Mediterranean islands either belong to European Union countries or are state-islands in the process of being integrated in or associated with the European Union like Cyprus and Malta.

In term of National Gross Product per inhabitant, all the Mediterranean islands where aquaculture has been developed are below the European average, except Majorca in the Spanish Balearic islands (Table 1). In the same way, all these islands but Majorca have a NGP per inhabitant inferior to the average NGP of their country. According to the usual standards, these islands may be considered in situation of late development which may call for specific public policy.

Table 1 : Population and NGP indicators in the Mediterranean islands

Insular region	Country	Population	% total population of the country	NGP* basis 100 = European Union	island NGP* in % of country NGP
Balearic islands	Spain	686 000	1,8%	103	134%
The Canaries		1 503 000	3,8%	75	97%
Corsica	France	251 000	0,4%	79	71%
Ionian	Greece	194 000	1,9%	53	87%
Northern Aegean		199 000	1,9%	45	74%
Southern Aegean		259 000	2,5%	60	98%
Crete		542 000	5,3%	55	90%
Sicily	Italy	5 073 000	8,8%	73	70%
Sardinia		1 679 000	2,9%	79	75%
Azores	Portugal	238 000	2,4%	41	61%
Madeira		254 000	2,6%	44	66%
Dugi Otok	Croatia	not av.	not av.	16**	-
Cyprus	Cyprus	742 000	100%	96	
Malta	Malta	366 000	100%	48	

\* 1992 PIB/inhabitant at standard purchasing power

\*\* for all the country

Source : CRPM (Conférence des régions périphériques maritimes d'Europe), L'état du monde 1996

## **Marine fish farming production in Mediterranean islands**

Greek islands are by far the first aquaculture producers of marine fish in intensive conditions among the Mediterranean islands. They should deliver 10 000 tonnes of seabass, seabream and other marine fish in 1997. Behind Greek islands, there is a group of islands aiming at producing between 1 000 tonnes and 2 000 tonnes of marine fish in 1997 including Malta, Corsica, Sicily, the Canaries and the Croatian islands (Table 2). Then Madeira, Majorca and Sardinia are in the process of developing intensive marine fish farming but are still below 500 tonnes in 1997. In the case of Sardinia, an important production of marine fish in extensive conditions in lagoon (mullet, eel, seabass) has to be noticed.

Table 2 : Marine fish farming production in the Mediterranean islands

Island	Number of fish farms	production 1995 (tonnes)	% total production of the country (1995)	Expected production 1997 (tonnes)
Greek islands*	100	8 000	45%	10 000
Malta	3	1 300	100%	2 000
Corsica	9	1 177	20%	1 500
Cyprus	8	500	100%	1 200
The Canaries	5	490	13%	1 000
Sicily	14	650	9%	1 000
Croatian islands	10	700	41%	1 000
Sardinia	7	300	4%	500
Majorqua (Balearic islands)	3	240	6%	250
Madeira	2	0		200
<b>Total</b>	<b>170</b>	<b>13 500</b>	<b>30%</b>	<b>18 500</b>

\* estimation

Source : SIPAM network, IFREMER

As far as techniques of production are concerned, a great diversity may be noticed for marine fish farming with the coexistence of inland tanks and ponds, cages in lagoon, cages in sheltered bays and more recently offshore floating cages (Table 3). Traditional extensive fish farming exists also in Sardinia and Sicily. Mussel farming is frequently developed in Mediterranean islands either on rafts in rias (Minorca), on rafts in lagoon (Corsica), on long lines (Greece) or on tables (Sardinia).

Table 3 : Aquaculture production techniques in the Mediterranean islands

	technology of marine fish farms				other aquaculture productions in islands
	tanks and ponds	cages in lagoon	cages in sheltered bay	off-shore cages	
Balearic islands	x		x		mussels on rafts in ria (Minorqua)
The Canaries				x	
Corsica		x	x		mussels and oysters on rafts in lagoon
Greek islands			x	x	mussels on long lines in sheltered bay*
Sicily	x		x	x	mussels on tables in sheltered bay, eels
Sardinia	x				mussels on tables, eels, trouts
Madeira	x			x	
Croatian islands			x		
Cyprus				x	trout farms in rivers or reservoirs
Malta				x	tilapia in ponds

\* Salamina island in Attica

Source : SELAM network

Different strategies may be observed concerning the origine of the juveniles (Table 4). Majorca, Sicily, Sardinia and Cyprus have developed a fry production capacity for seabass and seabream large enough to cover all their needs. There are some hatcheries in Corsica, the Greek islands and Malta, but the fattening farms of these islands have to import also juveniles from mainland or from abroad. On the contrary, there is no hatchery yet on the Canaries, Madeira or the Croatian islands. In the case of the Croatian islands, it may be explained both by the short distance from mainland and by the former state planned economy. Given the distance between the Canaries or Madeira and their mother countries, the fish farming entrepreneurs prefer to rely on large industrial and well equipped hatcheries on the continent, despite freight cost, rather than having to manage local hatcheries with all the risks due to a quite sophisticated technology. Nevertheless, some projects of hatcheries using an extensive technique are under study at the present time.

Table 4 : Origine of juveniles for marine fish farms in Mediterranean islands

	species			origine of juveniles
	seabass	seabream	others*	
Balearic islands		100%		1 local hatchery
The Canaries		100%		import from mainland Spain
Corsica	32%	67%	1%	2 local hatcheries + import
Greek islands	49%	49%	2%	local hatcheries + import
Sicily	100%			1 local hatchery
Sardinia	40%	60%		1 local hatchery
Madeira		100%		import from France
Croatian islands	69%	31%		import from mainland Croatia
Cyprus	9%	90%	1%	3 local hatcheries
Malta	39%	69%	2%	1 local hatchery + import

\* mainly *Puntazzo puntazzo* and *Pagrus pagrus*

Source : SELAM network, IFREMER

In order to market their production, small islands with no touristic activity are obliged to export the bulk of their output, which is the case of the Croatian islands. But the same situation exists also in Corsica, in the Canaries, in the Greek islands and in Malta for different reasons (Table 5). In Corsica, an agreement has been reached with the local fishermen in

order to avoid unfair competition. Despite an increasing touristic demand, domestic fish consumption in the Canaries, the Greek islands and Malta is not high enough to sell on site a big part of the aquaculture production. There is also a question of price, for both local demand and touristic demand are turned toward cheap product, very often imported, rather than toward expensive seabass or seabream. On the contrary, the Spanish and Italian markets have proved to be much more attractive despite the market price decrease which occurred in 1993. Therefore, most of the Balearic and Sicilian productions are sold on mainland markets (respectively Barcelona and Roma). On the contrary, the domestic consumption is traditionally very high in Madeira and Sardinia, and the fish farms find their total outlets on the island itself. Surprisingly, Cyprus is not an exporter of seabass and seabream any more. Indeed, given the economic development of the island which has now a NGP per inhabitant as high as the average European one, the living standard of cypriots makes it possible to sell locally big quantities of seabass and seabream. In the case of Cyprus, tourist consumption is also a good complement to the local consumption.

Table 5 : The markets for aquaculture products coming from Mediterranean islands

	markets for marine farmed fish			
	on the island	export mainland	export abroad	main market
Balearic islands	25%	75%		
The Canaries	11%	50%	39%	France
Corsica	10%	40%	50%	Italy
Greek islands	5%	22%	73%	Italy
Sicily	20%	80%		
Sardinia	100%			
Madeira	100%			
Croatian islands	2%	8%	90%	Italy
Cyprus	100%			
Malta	11%		89%	Italy

Source : SELAM network, IFREMER

## Reasons for having implemented a farm on an island

According to the survey carried out among the members of the SELAM network, the reasons why so many enterprises have been established on islands are also very diverse (Table 6). Taking advantage of good environmental conditions is the most common motivation, since islands are usually less submitted to constraints due to town extension, industry development or intensive agriculture. That is the case of the Greek islands, Sicily and Sardinia in Italy, Corsica in France, the Balearic islands in Spain and the Croatian islands. In some cases, an other valuable asset may be the temperature pattern which fits much better the fish requirements. That is the case of Corsica in comparison with mainland France, and especially of Canaries and Madeira which have the advantage to be in the flow of the temperate Gulf stream. Thanks to higher temperatures in winter, the growth cycle may be considerably shortened which gives less risk and better capital productivity.

Table 6 : Main motives put forward when choosing an island for marine fish farming

	Balearic islands	Canaries	Corsica	Greek islands	Sicily	Sardinia	Madeira	Croatian islands	Cyprus	Malta
Environmental conditions	X	X	X	X	X	X	X	X	X	X
Less users conflicts			X		X		X	X		
Availability of new cage technologies	X	X		X	X	X	X	X	X	X
Specific subsidies	X	X	X	X						
Tax policy			X	X						
Cost of manpower				X	X					
Public policy for economic development	X	X	X					X	X	X
Objective of economic self-sufficiency		X					X		X	X

Source : SELAM network survey

Offshore cages availability has been quoted as the second most important reason to have developed aquaculture in Mediterranean islands. Indeed, aquaculture has developed lately in Mediterranean islands because of technical constraints which have been recently removed due to the transfer of northern European offshore technologies to Mediterranean conditions. In small islands where space is a scarce resource, offshore fish farming has proved to be the major way to develop aquaculture. Indeed, it makes it possible avoid use conflicts with coastal tourism which is a major activity around the Mediterranean and especially in the islands.

Moreover, as far as European Union countries are concerned, incentive policy towards ultra-peripheral or late development regions has made it possible to attribute specific subsidies to islands for aquaculture in the aim of more employment and wealth. In order to help aquaculture to reach the European markets despite a 15% tariff, the Croatian government provides subsidies till 1DM per kilo of fish for the farms implemented on islands.

When islands are state-islands, like Malta and Cyprus, or autonomous regions far from their mother country like Madeira or Canaries, economic independence is at stake and may be a strong motivation to develop aquaculture as a factor of food security and self sufficiency. On the contrary, the labour cost does not seem to be a major attractive factor for aquaculture development in Mediterranean islands. This may be explained by the fact that most of these islands belong to developed countries where labour cost is high, as well on mainland as on the islands.

## Assets and constraints of aquaculture in the Mediterranean islands

According to the Mediterranean experience of intensive marine fish farming, the main constraints of aquaculture in islands are extracosts due to transport and specific conflicts with tourism when it is an important activity (Table 6). Shortage of private investment remains a key issue in some islands too, when they are particularly small and remote, like Madeira or the Canaries, or when political troubles may drive off potential investors like in Corsica. Uncertainty concerning the position of the Maltese government towards integration in the European Union may be an issue for investors too. In any case, attention has to be paid to the socio-economic context when assessing the opportunity of investment in aquaculture in an island. Taking lessons from different experiences in Greece, Cyprus, Malta, Croatia and Corsica, the key elements for success seem to be the sharing of initiatives and the pooling of

financial and political assets, with a preliminary consultation of the coastal populations (Duché, 1995). Two famous cases remain in mind, one in Lesbos where the Kellonia Sea Farm project has been by error accused of pollution and the other one in Cyprus where the first inland fish farm was designated as the pointsource of a green tide, although the ecological disturbance remained long after the farm had called off (Stephanou, 1997). In both cases, a lack of negotiation with the population may be incriminated.

Despite extra costs due to the isolation, price competitiveness may be considered as an asset for islands. Indeed, the favourable environmental conditions fasten the fish growth which reach a bigger size in less time, which is an important comparative advantage. According to the Nireus fish farm group in Greece, production costs in their farms operating on islands are 5 to 10% less than in farms on mainland (Tzoumas, 1997). Aquaculture in islands may also take advantage of a well trained manpower coming from the fishing activity (Bourgeois, 1997).

Table 6 : assets and constraints of aquaculture in Mediterranean islands

	Balearic islands	Canaries	Corsica	Greek islands	Sicily	Sardinia	Madeira	Croatian islands	Cyprus	Malta
<b>Assets</b>										
Better zootechnical performances	X	X	X	X	X	X	X	X	X	X
Less conflicts with other users			X	X	X	X	X	X		
Well trained manpower (fishermen)				X		X				X
Better image					X					
<b>Constraints</b>										
More conflicts with other users				X					X	X
transport costs	X	X	X		X		X			
Lack of scientific support	X		X		X	X				
Lack of investment			X		X			X		X

Source : SELAM network survey

An other important asset which has to be taken into account by the Mediterranean islands is their positive and attractive world-wide image. The strong symbolic image of islands is a non merchantable good which may be used as a competitive advantage by aquaculture producers. This could be done through the promotion of quality products based on geographical origin, on quality of the environment or on specific production process. Such an approach is not usual yet because of the lack of objective criteria of product differentiation in fish farming at the present time (Paquotte, 1995). However, two possibilities of evolution may be considered in this objective. The islands may just take advantage of the differential rent they have due to natural endowments or may try and construct a set of norms and specifications in order to consolidate the specific quality they put forward (Filippi and Torre, 1996).

As intensive marine fish farming is a new activity and as there is no tradition in the transformation of this product, it is difficult to refer to specific local process of production. Nevertheless, some social factors specific to islands may be used to promote aquaculture products and must not be considered as exogeneous to the products (Allaire and Sylvander, 1995). Nevertheless, attention must be given to the risk of multiplication of geographical labels which may be induced by the competition between different territories. In this aim, institutional support, cooperation between producers and financial means are absolute

prerequisites which may not be eluded. Such an approach has to be carried out in terms of industrial economics and of spatial economics as well.

## Conclusion

The importance of marine fish farming in the Mediterranean islands proves that islands offer more assets than constraints to aquaculture. Both environmental, cultural and social factors contribute to make islands attractive for aquaculture development, all the more as offshore fish farming technologies are available now. So, aquaculture turns out as a good mean to valorize the natural endowments of Mediterranean islands and to provide economic diversification. In these islands where resources are scarce but where public policy has implemented good quality infrastructures, it may be relevant to develop an intensive and capitalistic activity, despite the constraints due to distance and small size. This way of development is all the more justified as agriculture has already done such a transition in most Mediterranean islands. Aquaculture may take benefit of the agricultural channels which are export oriented. Anyhow, private investment availability remains a key issue in some islands, when they are particularly small and remote, like Madeira or the Canaries, or when political troubles may drive off potential investors like in Corsica.

The future of aquaculture in Mediterranean islands depends on the ability of investors, institutions and entrepreneurs to take advantage of their favourable environmental conditions and of their good image in the realisation of coordinated regional development strategies. Networks for information, research and technological transfer may be essential tools to balance the constraints due to small size and isolation. Indeed, the link with other partners in other regions makes it possible for local enterprises to appropriate new technologies and know-how and to induce an economic diversification. New telecom means, like internet, may be developed in islands without suffering the usual island constraints. Nevertheless, the question is how to conciliate development of interregional networks and traditional links with the mother countries. Information networks implementation and marketing approach in terms of image are challenges Mediterranean islands have to take up in order to supply the large European seafood market with quality products.

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