Marine fish farming in Italy

Landoli C.

in

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

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

2000
pages 33-44

Marine fish farming in Italy

C. Iandoli
ICRAM, Istituto Centrale per la Ricerca Scientifica e Tecnologica Applicata al Mare,
Via di Casalotti 300, 00166 Rome, Italy

SUMMARY – Italian aquaculture in brackish waters today can be recognized as the evolution of the "vallicoltura" system practiced in the Venetian region since Roman times. Its expansion has occurred mainly during the last two decades, and was preceded by the development of fresh-water aquaculture. At present, Italian aquaculture, with a tonnage of about 40% of the fish catch, appears in line with key international trends. The sector could consequently be assigned an increasingly strategic role, and new approaches of exploiting the coastal environment might be proposed, considering aquaculture production as a means of reducing and rationalizing fishing effort. Italian fish culture production mainly follows two technologies: productive management of the coastal environment (mostly lagoons), performed principally in marine and brackish water using extensive and semi-intensive techniques, and the intensive farming of highly valuable species, carried out mostly in tanks and cages. In recent years Italian aquaculture has been characterized by a strong increase in output due to the technological optimization of existing installations as well as to the application of innovative technology and the setting up of new facilities; in 1997 the total production of marine species reached 14,700 MT.

Key words: Italy, marine fish farming, sea bream, sea bass, eel.

RESUME – *"L'aquaculture marine en Italie". L'aquaculture moderne italienne en eau saumâtre peut être considérée comme un développement de la Vallicoltura, pratiquée dans la Région de Vénétie dès le temps des Romains. Elle s'est développée surtout pendant les dernières 20 années, précédée par le développement de la production en eau douce. A l'état actuel, l'aquaculture italienne, avec un tonnage d'environ 40% de la production de capture, semble être en accord avec les meilleures tendances internationales. Ceci peut permettre l'assignation d'un rôle stratégique croissant du secteur, et la conception de nouveaux modes d'utilisation de la ceinture côtière qui, dans une vision toujours plus intégrée, considèrent les productions d'aquaculture comme un instrument de support à la réduction et à la rationalisation de l'effort de pêche. La production italienne de la pêche suit les technologies suivantes : l'aménagement productif des milieux côtiers (surtout lagunes) conduit en eaux marines et saumâtres principalement à des techniques extensives et semi-intensives et à l'élevage intensif d'espèces à haute valeur commerciale, en bassins et cages. Récemment, l'aquaculture italienne s'est caractérisée par une forte hausse de production, due à la mise au point technologique optimale des fermes existantes ainsi qu'à l'application de technologies innovatives et au démarrage de nouvelles fermes. En 1997, la production totale d'espèces marines a atteint 14 700 MT.*

Mots-clés : *Italie, espèces marines, dorade, loup.*

Introduction

Italian aquaculture in brackish waters today can be recognised as the evolution of the "vallicoltura" system practiced in the Venetian region since Roman times. It has expanded mainly during the last two decades, and was preceded by the development of fresh water aquaculture.

In 1990, aquaculture in Italy represented only 27% of the total fishery production. During the following years the sector developed constantly, reaching an output of 243,700 MT in 1997 (Table 1), accounting for about 45% of the total fishery production.

The growth trend in this sector is the result of two main factors. Firstly, a change in diet, which has resulted in an increase in fish consumption to 23 kg per capita, and, secondly, the difficulties associated with fishing and with excessive exploitation of the sea. Once the consumers' preference for fresh foods is added to these two factors, the need to focus on aquaculture and on the industry that transforms the fresh product becomes obvious. Indeed, it is felt that the opportunities have not yet been fully exploited, as the supply of marine products from foreign markets is equal to about 50% of national consumption.

Table 1. Aquaculture production in 1997 (Source: ICRAM)

Species	Intensive (MT)	Extensive (MT)	Total quantity (MT)	Total value (million lire)	Avg. value (lire/kg)
Sea bass	4,000	600	4,600	64,400	14,000
Sea bream	3,100	800	3,900	50,700	13,000
Sharpsnout sea bream	200		200	2,800	14,000
Eel	2,700	2,900	2,900	57,350	19,780
Grey mullet		400	3,100	20,300	6,550
Trout	51,000		51,000	204,000	4,000
Cat fish			800	5,600	7,000
Carp			700	4,200	6,000
Sturgeon	500		500	6,000	12,000
Other fishes			1,000	10,000	10,000
Total fishes			68,700	425,350	6,190
Mussels[†]			130,000	130,000	1,000
Manila clams			40,000	160,000	4,000
Total molluscs			170,000	290,000	1,710
Gracilaria			5,000	3,000	600
Total aquatic plants			5,000	3,000	600
Total aquaculture			243,700	718,350	2,950

[†]Including fishery.

At present, aquaculture in Italy, with a tonnage of about 40% of the fish catch, appears in line with main international trends. The sector could thus be assigned an increasingly strategic role, through the development of new approaches exploiting the coastal environment. Within a more integrated perspective, this could consider aquaculture production as a means for reducing and rationalizing fishing effort. In this context, further development of aquaculture along the coast would call for a constant respect and attention to the environment in which it is introduced.

In short, the present day Italian aquaculture sector shows a dynamism, which, if harnessed within a well planned programme, could make a real contribution towards alleviating the deficit of Italy's food budget for marine products.

Macro-economic framework of the sector

The Italian fish production sector has initiated a process to try to overcome the artisanal and fragmentary characteristics of its aquaculture enterprises. The level of technological innovation and the role of its commercial associations indicate a high level of dynamism in its productive structure.

An evaluation of the overall weight of Italian fisheries and aquaculture in terms of trade balance and employment confirms the trend already estimated in preceding years, both in relation to the sector itself as well to other comparable sectors.

The overall trade balance of the sector in 1995, including the fish products transformation industry, and taking into account the commercial deficit, amounted to LIt. 9429 billion, of which 3361 related to capture fisheries, 711 to aquaculture, 1484 to the transformation sector, and 3873 for imports (Table 2).

Recent estimates enable us to quantify employment of those workers engaged in fisheries and aquaculture related industry to be 78,023. Of these, about 44,000 are engaged in fishing activity, 8080 in aquaculture (1400 in both fishing and exploiting the shoals of clams bred along the upper Adriatic coast), and 7800 in the transformation industry, while active workers in the distribution and commercial sector estimated by ISTAT amounted to 19,523. This latter figure, however, should be considered an underestimate because commercial activities also occur outside the recorded markets.

Table 2. The macro-economic view: workers and sales 1991/1995. Current prices (mil. lire), (Source: IREPA, ICRAM, ISTAT)

Sector	Workers	Sales 1991	Sales 1995	Var. %
Fishery	44,000	3,217	3,361	+4.5
Aquaculture	8,080	442	711	+60.8
Transformation, commercialization	7,800	1,503	1,484	–1.2
Import		2,252	3,873	+19.1
Distribution, commercialization	19,523			
Total	78,023	8,414	9,429	+12.0

From the marketing point of view, it should be noted that national consumption is becoming increasingly oriented towards fishery and aquaculture products, such that in 1995, total internal consumption was more than 1321 million tonnes, corresponding to a per capita consumption of ~23.07 kg (Table 3). While, such figures demonstrate the tendency for Italian consumer preferences to align with consumption models typical of industrialized countries, given the state of exploitation of national fishery resources, they imply a continuous and progressive worsening of the fish food deficit.

Table 3. Internal production and trade balance 1991/1995 (Source: IREPA, ICRAM, ISTAT)

Sector	1995	1995	1991	1991	Var. 95/91 (%)	Var. 95/91 (%)
	Quantity (000 MT)	Value (billion lire)	Quantity (000 MT)	Value (billion lire)	Quantity (000 MT)	Value (Billion lire)
Fishery	563	3,361	547	3,217	0.03	0.04
Aquaculture	262.7	711	157	442	67.3	60.8
Internal production	825.7	4,072	704	3,659	17.2	11.3
Fresh frozen Import	474	2,796	516	2,351	–8.1	18.9
Transformed Import	126	1,078	117	901	7.7	19.6
Total Import	600	3,874	633	3,252	–5.2	19.1
Fresh frozen export	92	438	67	206	37.3	112.6
Transformed export	12	111	14	85	–14.2	30.6
Total export	104.2	549	81	291	28.6	88.6
Internal Consumption	1,321.5	7,397	1,256	6,620	5.2	11.7
Total *per capita* consumption	23.07		22.02		4.7	

Production

Italian fish culture production is primarily based on two technologies: the productive management of the coastal environment (mostly lagoons), performed mainly in marine and brackish water using extensive and semi-intensive techniques, and the intensive farming of highly valuable species, carried out mostly in tanks and cages.

In recent years Italian aquaculture has shown a strong increase in output (Table 4) due to the technological optimization of existing installations as well as to the application of innovative technology and the setting up of new facilities. With regard to sea bass and sea bream, there are 65 land-based farms and 11 open-sea farms; there are also 120 eel farms. There are 27 hatcheries, of which 20 breed sea bass and sea bream (Table 5).

Euryhaline species production

Italian production of euryhaline species has been intensified over the past ten years and has reached an intensive/extensive production ratio approaching 2:1, compared with around 1:1 in 1986. The number of working units is shown in Table 5.

Table 4. Marine fish production (tonnes) (Source: ICRAM)

Species	System	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Sea bass	Inten.	530	600	600	1,055	1,378	1,836	2,150	2,900	3,150	4,000
	Exten.	400	500	450	483	448	630	700	700	650	600
	Total	930	1,100	1,050	1,538	1,826	2,466	2,850	3,600	3,800	4,600
Sea bream	Intens.	300	350	350	360	460	882	1,100	2,350	2,800	3,100
	Extens.	450	500	500	605	610	645	750	850	850	800
	Total	750	850	850	965	1,070	1,527	1,850	3,200	3,650	3,900
P. puntazzo[†]	Inten.										200
Grey mullet	Exten.	2,685	2,500	3,000	2,880	2,942	2,892	2,900	3,000	3,100	2,900
Eel	Inten.	2,550	2,500	2,200	2,095	2,010	2,020	2,100	2,300	2,650	2,700
	Exten.	1,700	2,000	1,500	1,490	1,300	1,060	900	700	350	400
	Total	4,250	4,500	3,700	3,585	3,310	3,080	3,000	3,000	3,000	3,100
Total		8,615	8,950	8,600	8,968	9,148	9,965	10,600	12,800	13,550	14,700

[†]*Puntazzo puntazzo* = sharpsnout sea bream.

Table 5. Production farms (1997) (Source: ICRAM)

Species	Intensive			Extensive (hectares)
	Land based (no.)	Open sea (no.)	Hatcheries (no.)	
Sea bass, sea bream	65	11	20	
Eel	120		7	
Total	185	11	27	63,485

Eel *(Anguilla anguilla)*

Eel production in 1997 was 3100 MT and occupies a leading position in the European species sector (Table 4). Eel farming is concentrated in fresh water and low salinity areas and about 90% of output is achieved through intensive technology. This technology is carried out on a small number of large farms (around 15 units) located in Northern Italy. Extensive production amounted to 400 MT and has shown a decreasing trend over the past eight years. The fluctuation of eel production and the decrease of extensive production is be probably due to the lack of available seed and the conversion of some eel units to sea bass and sea bream production.

The need to provide weaning facilities for elves represents one of the most important factors in the consolidation of this production, for which there is still room for improvement. Furthermore, as eel seed is exclusively of wild origin and there is a growing demand to supply the international market, a strict protection policy for this species should be promoted at national and international levels.

Mullet *(Mugil cephalus, Chelon labrosus, Liza aurata, Liza saliens, Liza ramada)*

Mullet farming is almost entirely based on extensive techniques, with coastal lagoons and semi-intensive ponds being restocked with wild juveniles. Since 1990, mullet production has remained constant at around 3000 MT, according to market demand (Table 4). Artificial reproduction trials are currently under way attempting to establish standard reproduction techniques for mullet, especially *Mugil cephalus* and *Chelon labrosus*.

Sea bass *(Dicentrarchus labrax)* and sea bream *(Sparus aurata)*

Sea bass and sea bream production has grown rapidly during the past ten years and in 1997, output was 4600 MT and 3900 MT, respectively (Table 4). During the 1994-1995 period, production

decreased due to market difficulties and to the new bacterial and viral diseases that affected both species. Nevertheless, production is now increasing due to the competitiveness of national farms and to the higher availability of fingerlings. Finally, the recent offshore production has opened up new opportunities for the growth of this sector.

In the past, production was traditionally carried out in extensive systems, but is now primarily based on intensive farming in land-based and open-sea plants (Table 5). Thus intensive production of sea bass and sea bream amounts to 4000 MT and 3100 MT, respectively representing around 85% and 80% of production (Table 4). The increase in intensive production is due to technological improvement of production units, the availability of locally produced seed and the new units which have come into operation in the last five years.

From a managerial point of view, breeding euryhaline species still contains a strong artisanal component, which is reflected both in the production process as well as in the limited capacity to penetrate modern markets. The artisanal character of such systems is also demonstrated by the companies' production capacity. Table 6 shows that 65% of companies produce between 100 and 500 MT, 31% less than 100 MT and only 4% produce more than 500 MT. Extensive production is undertaken in the northern Adriatic "vallis" and in coastal areas and brackish waters located in Tuscany, Apulia and Sardinia. Different productive models are used, depending mainly on the trophic resources in the natural environment and human intervention for water flow management. Ichthyophagous birds represent one of the most serious problems in extensive culture management.

Table 6. Sea bass and sea bream production units by size class in 1997 (Source: ICRAM)

Unit production	No. units	% total number of units
<100	24	31
100 m to 500 m	50	65
500 m to 1000 m	3	4
Total number of units	77	100

However, there is potential for change. Improved control techniques have already been trialled outside of Italy, and modernization of some phases of the process has recently been reported, i.e., mechanisms for computerized feed distribution and for monitoring and controlling parameters essential to maintain water quality. For the latter, the most significant innovation concerns the already very extensive use of aeration, mainly via liquid oxygen.

The need to overcome two of the factors that limit development of the sector, i.e., protection of coastal landscapes and high investment costs, has resulted in a significant development of floating cage installations in protected sites or in the open sea. A comparison with other countries with broadly similar conditions, such as Greece and Turkey, shows that Italy is still strongly penalized with regard to the number of units, as at present there are only 11 operating plants (Table 5). However, considering the constant improvement of technology for floating cages and the levels of production obtainable, this sector is undoubtedly the one with great potential for future development.

New finfish species

In the late Eighties a diversification process of finfish species production was implemented and reproduction techniques have now been set up for *Dentex dentex*, *Diplodus* sp., *Puntazzo puntazzo*. Artificial reproduction of *Sparus pagrus*, *Umbrina cirrosa* and *Pagellus erythrynus* is currently in progress, while the reproduction of *Epinephelus marginatus* and *Seriola dumerilii* is still at experimental level.

Fry and fingerling production

Italian seed production covers mainly sea bass and sea bream. Until 1991 seed production was insufficient to meet the internal demand, but over the past five years it has grown rapidly in quantity

and quality. In 1997, 67,550,000 fry or fingerling were produced, of which 33,000,000 were sea bass and 28,000,000 sea bream (Table 7). Twenty private hatcheries are now producing both sea bass and sea bream fingerlings, and eight of these also produce other marine fish species.

Table 7. Fry and fingerling production in 1997 (No.) (Source: ICRAM)

Species	Fingerlings
Sea bass	33,000,000
Sea bream	28,000,000
Sharpsnout sea bream	6,000,000
Red pandora	150,000
Marine drum	100,000
Common dentex	300,000
Total	67,550,000

Regional distribution of marine fish farming

The distribution of the installations throughout Italy has remained more or less unchanged over recent years. Table 8 shows the territorial distribution of companies producing euryhaline species, by EU geographic subdivision. Apart from production centred around the upper Adriatic, represented mainly by the Venetian farms, the peninsula may be subdivided into four macro areas: North, Centre, South and the Islands.

Table 8. Euryhaline species units, 1995, by EU subdivision of geographic areas (number) (Source: API/ICRAM)

Area	Regions	EU code	Intensive sea bass and sea bream units (No.)	Intensive eel units (No.)	Extensive culture (hectares)
(1) NW + Lombardia	Valle d'Aosta	312	1	20	
(2) NE + Emilia Romagna	Trentino alto Adige	331	15	70	32,126
(3) Centre + Lazio	Toscana	351	14	11	7,028
(4) South + Abruzzo e Molise + Campania	Calabria	393	18	20	13,722
(5) Islands	Sicilia	3A	10	2	1,045
	Sardegna	3B	6	2	9,564
		Total	64	125	63,485

This shows that in 1995 there were 64 companies breeding sea bass and sea bream and 125 producing eel. Substantial installation, development and strengthening of existing marine fish culture operations has already occurred, particularly in Sicily and Sardinia. Further detail of regional development is provided below.

North

Units in the "vallis" and coastal lagoons in the northern part of the country mainly use extensive breeding techniques. "Valli" culture, in particular, had been developed in small lagoon or delta areas; in the latter, the movement of the tides generally guarantees the water replacement needed to preserve water quality. However, a few installations have pumps. Costs in extensive breeding systems appear quite limited, for example, to the cost of feed sufficient for guaranteeing the survival of the fingerlings.

Centre

The central area is represented almost exclusively by aquaculture in Tuscany, with a yearly production of around 2000 MT. A particular number of farms (7 out of 10) is concentrated in the Orbetello municipal district alone. This extraordinary development is based on the exceptional environmental conditions, which make the Orbetello lagoon one of the most suitable areas for fish production, and the excellent business capacity of the local producers, who have obtained remarkable results in a few years. This has resulted in it being held as an example, even in the EU, of European aquaculture production, and in Tuscany being recognised as one of the most profitable production areas nationally.

South

Southern Italy is represented (for number of installations and production), almost exclusively by Apulia. This region possesses all types of hatcheries and, given the level of aquaculture achieved, can be considered as one of the most important aquaculture areas in Europe. In 1997 Apulia boasted around 30 productive units dedicated to producing euryhaline species with an overall production of around 1800 MT, which represents 12% of national production for these species.

The area which offers the most favourable environmental conditions for producing euryhaline species is the Lesina lagoon, which constitutes a good example of both exploiting natural potential and experimenting with improvements. There are no official data regarding production levels of the extensive system, but according to accurate estimates the supply would be around 2000 MT a year.

The effectiveness of the intensive system is due in large part to efficient control of temperature and the general characteristics of the waters used. In almost all of these, water is enriched with liquid oxygen. The origin of the waters – groundwater supplies or industrial process waters – also facilitates control and management. The primary effect of using good quality waters is to decrease the average time needed to rear the product.

Islands

Production of euryhaline species, in particular sea bass and sea bream, has seen such development in Sicily and Sardinia as to make the two largest Italian islands very significant in their own right, compared with the national sector (Iandoli and Alaio, 1997).

In Sicily, ponds and lagoons cover an area of 1045 ha; the most interesting part is the western tip of the island with the salt-works of Trapani and the Stagnone of Marsala. Aquaculture activities have recently been developed in these areas; total extensive and semi-intensive output in 1997 was around 300 MT. The sector has been developed mainly using the intensive technique, especially along the West Coast; there are currently 14 operational fish farms; intensive production in 1997 amounted to 650 MT. The production of euryhaline species in 1997 was around 1000 MT.

Sardinia is the Italian region with largest number of coastal lagoons. These basins, most of which are small, number over a hundred, covering an overall area of 9564 ha; the central-west coastline is the richest in lagoons. Due to the great potential of ponds and lagoons, most of the production is carried out using extensive and semi-intensive technology; production in 1997 was around 750 MT. Intensive technology has also been developed: there are 7 farms producing sea bass and sea bream. The total production of euryhaline species in 1997 was around 1000 MT.

Production systems

Extensive farms

Extensive marine fish production involves "valli" culture and coastal pond culture. Valli culture is practiced in confined portions of lagoons or in delta areas; the smaller vallis are in Friuli, Venezia Giulia and the largest in Veneto and Emilia Romagna.

In these systems, hydraulic circulation is achieved by exploiting tides, with inputs of inland fresh water flowing by gravity. Operating costs are low, are mostly limited to administering feed externally to increase the survival level of juveniles.

Examples of valli culture are rare in other regions, while coastal pond culture, i.e., management of the environment for marine production in coastal lagoons, is generally located in central-south Italy. The principal areas in the Centre are represented by the Orbetello lagoon and the coastal lakes of Lazio (around 7000 ha); in the larger islands around 10,000 ha are involved, of which more than 9000 are in Sardinia. Coastal pond culture is a form of extensive aquaculture using less technology than valli culture, production being based on simple water management and controlling marine migration of fish in the lagoon. These production systems can be seriously affected by the impact of agricultural, industrial and urban development. Productivity per unit area is less than for valley culture, which now ranges between 50 and 300 kg/ha. Though examples of high productivity do exist, 50 kg/ha generally represents the maximum production limit in pond culture.

It should be underlined, however, that of the approximately 63,000 workers employed in extensive aquaculture in Italy, around 50% are involved in pond culture, which contributes notably to the national production. The value of extensive systems in Italian aquaculture is also particularly linked to their essential role in conserving coastal wetland areas of primary environmental interest, in a strip of national territory subject to strong human impacts.

Intensive farms

Intensive fish breeding in Italy is still mostly undertaken in installations on land with relatively small units (100-1000 m^2 each) with a high load of biomass per unit area (10-30 kg/m^2). These systems are characterized by highly specialized production and generally operate as monocultures. The technology derives from that successfully developed earlier for breeding trout, with similar systems for ensuring water circulation, feed distribution and aeration of the tanks.

With regard to production of sea bass and sea bream, these installations always have a system for pumping intake waters, with flowrates ranging between 100 l/sec and 2-3 m^3/sec. Feed distribution is either manual or automatic. Aeration is obtained through turbo or rotor blade aerators or via pure liquid oxygen supplies.

The first investments in systems on large areas of land where control is more difficult proved to be ineffective because of the increased number of ichthyophagous birds. This has accentuated the trend to install intensive systems that are easier to control, and imposed the use of covering nets, which, in addition to increasing investment costs, also make the installations more visible.

Companies operating cage systems in coastal waters, in protected bays or in the open sea, are still only few in number, although the latest technology available should lead to a growing interest in this type of system. The thrust towards cage culture development can be ascribed mainly to economic reasons, as it involves lower capital investment compared to intensive production systems on land which use continuously flowing or recycled water.

Numerous structural constraints also play a decisive role in the national situation and tend more and more to limit the development of traditional fish farming. These are the impacts of man and urbanization on the land, the conflicts of use that weigh on the water bodies, the high land value of the coastal areas, the general deterioration of internal waters and, in this connection, the need to limit any activity likely to increase pollution of surface waters.

Other reasons, which are economic in character, can be linked to the progressive restrictions imposed on marine fisheries by EU directives. The effect of these restrictions on employment calls for the reorganization of the fishery entrepreneurial and professional structure. The plan should consider fish farming in the sea as a practical option for the fishery sector, and as a means to meet national needs for marine supplies.

Fish farming in the sea is a recent activity in Italy compared to other countries in North Europe and the Mediterranean: at present a census has been undertaken only of installations situated along the

continental, Sicilian and Sardinian coasts. These are mainly located in protected marine areas and have an estimated production of about 1700 MT of sea bass and sea bream, equal to 22% of the national production of these species. However, the evolving nature of the sector highlights ample margins for improvement in the technological, biological, managerial, economic and environmental contexts. Moreover, the limited availability of protected marine sites and the widespread deterioration, which characterizes many of the existing ones, emphasizes the opportunity for appropriate scientific support to develop systems suitable for use in unprotected sea areas.

Mariculture

As stated above, mariculture in Italy is a comparatively recent activity. The limited availability of protected sites, the conflicts of other activities (tourism, recreational and commercial navigation) and the impact of intensive fish production on the environment are all factors which may influence marine aquaculture. Consequently, there are only a few installations in Italy, but these have emphasized its remarkable potential for productivity (Ceccarelli *et al.,* 1998).

Until now mariculture has been characterized by the introduction of foreign technology and know-how. At present, attention is concentrated on submersible cages and some examples have demonstrated that even when cages are able to resist unfavourable marine conditions, they present managerial problems for operators in the fishery sector. To date, the fishermen tend to underestimate the importance of technology as well as professional training, factors that are fundamental in changing from fishery to mariculture.

Technology and localization

The Tirrenic area contains about 18.7% of the national production; two important productive zones are at Gaeta (LT) and La Spezia. In the southern area, at Marina di Camerota (SA) there is a mariculture installation operated by fisherman's co-operative.

Submerged cages have been installed about 1 mile from the coast at Marina di Camerota in the Tirrenic area. Although the site is completely exposed to the winds, immersion enables the cages to resist the frequent rough seas in the area. In the Gulf of Gaeta the structures are diversified; one company has just installed partially submersed Farmocean cages and partially floating plastic cages, both square and circular. Other companies have floating metal cages. Lastly, the company at La Spezia has adapted recreational landing wharves to marine fish farming.

The Sicilian area represents about 36.5% of national fish production. Important initiatives have been made at Pachino (SR), and Sciacca (AG), and other companies operate on the islands of Filicudi and Favignana. The technology is foreign, mainly north European and Japanese, and although implying considerable investments it guarantees excellent results, especially in extreme meteorological/sea conditions.

Lastly, the Sardinian area represents 13.5% of national fish production. Sardinia has a great number of sites suitable for mariculture but tourism and environmental protection are serious constraint to its development. The most important installation is in the Aranci Gulf (SS) and represents more than 97% of the island's production, with an output of around 45,000 m^3. The structures are floating circular cages.

Commercial distribution of aquaculture products

The Italian market for sea bass and sea bream has been estimated at around 30,000 MT a year; more specifically, 8500 MT comes from aquaculture, 1500 MT from fishing and 20,000 MT from imports. Unlike landed production, aquaculture products follow a distribution chain that often penalizes the role of the fish markets to the advantage of specialized retailers and catering firms.

There are generally two channels which commercialize fresh marine products, and therefore also aquaculture products, i.e., traditional wholesalers who then distribute to retailers such as fishmongers,

fixed and travelling markets, and the large organized retail distribution sector generally comprising supermarkets, hypermarkets and discount stores. Traditional retail channels are specialized, as opposed to the modern retailers, which are unspecialized.

The consistent development of Italian aquaculture production has caused a real revolution over the last few years in the ambit of the various channels for commercializing the final product. The small retailers, i.e., fishmongers and street sellers, still play a key role in the distribution of fish products, in particular fresh fish. However, the growth of large organized retail distribution has begun to progressively erode the market prices of the specialized retail outlets.

While the fishmonger remains the selling point chosen by more than 60% of the Italian families and that small retailers account for about 75% of the market, at the beginning of the 1980s this latter figure was more than 90%. In just over a decade the large organized retail distribution has been able to attract 15% of the fishmongers' and street sellers' business. This phenomenon can be attributed mainly to production and technological evolution of the aquaculture sector and to the commercial agreements between aquaculture companies and the large organized retail distribution buyers.

The aquaculture product has competitive advantages over the traditional sector because of it being able to enter the modern trade structures. In fact, the basic requirements of the large organized retail distribution are constant purchase levels, standard quality products, participation of the producers in transport and logistic services, and being able to undertake regular publicity campaigns. It follows that commercial relations between the large organized retail distribution and aquaculture companies have intensified enormously since only a cultured fish production can guarantee a constant supply of the required quality, with stable prices.

The entrance of large organized retailers in the distribution of fish products in Italy dates back some 15 years, which is quite recent compared with other European countries. Consumers obviously appreciate being able to acquire fresh fish from supermarkets, based on the evidence of their quota of the market, now just over 25% and reaching more than 40% for fresh-water fish.

Furthermore, the growth in fish marketing by the large organized retail distribution sector has not affected the fishmongers' quota. At the beginning of the last decade 90% of the production attributed to specialized retail outlets was broken down as follows: 60.7% to fishmongers, 19.5% to area markets, 10.1% to street sellers and 9.5% to other means of selling. It can be seen that large organized retail distribution has somehow substituted for the area markets. The origin of this phenomenon can be found in the different types of consumers: the more demanding who value a close and trusting relationship with the selling structure along with a good knowledge of sea products, and those for whom the principal reasons for buying are price, variety and quality service.

The existence of different classes of consumers also influences the penetration of the modern distribution formula in different areas of the country: the recent transformation of sales channels is not homogeneous, indicating that we can speak of commercial revolution only in some areas. With regard to purchasing fresh fish in the South, the fishmonger and small retailers in general serve 76% of the purchasers, while in the North and especially in the Northeast, the purchases at large organized retail distribution of the same products reaches 46%. In conclusion, consumers of the lower socio-economic level mainly make their purchases at traditional retail selling points, while the higher level classes show a major preference for the services offered by supermarkets and hypermarkets.

Regulation for the establishment of marine farms

Generally, aquaculture is considered as part of the field of fishing; the definition of fishing according to the law is set under article 1 of the law No. 963 of 14 July 1965 "Fishing is every activity intended to catch animal species whose natural or habitual life environment is the water", but it also includes aquaculture activity by article 10 DPR 1639/68 "Professional fishing is that practised by fixed or moving, temporary or permanent structures destined to pisciculture".

Although this definition was brought into force a long time ago, aquaculture in Italy has had a specific law only since year 1992, No. 102 of 5 February 1992 "Rules regarding aquaculture activity". This law establishes aquaculture as an entrepreneurial agricultural activity; it states that aquaculture is:

"all the activities finalized to the production of animal proteins in an aquatic environment through partial, total, direct or indirect control of the growth cycle of aquatic organisms".

Though this generic provision, allows aquaculture activity to be set up legally, entrepreneurs cannot take advantage of some of the factors that help agriculture, such as the use of agricultural diesel oil, cheaper electricity and more favourable water rates. In spite of this, the legislation is a valid tool for setting down the main points for regulating aquaculture (Panunzio and Iandoli, 1999).

For the above-mentioned reasons and because of its natural location, aquaculture requires legislation and general rules concerning the use and protection of water, preservation of landscape and a more efficient use of land areas. Legislation on the protection of water is based on the distinction between public and private water resources, according to its possible utilization. Public waters, which belong to the government, can only be used if the administrative authority grants a licence. In order to obtain this, it is necessary to meet the requirements of several local authorities.

Where there are competing applications, preference is given to those that respect the "Galli law", No. 36 of 5 January 1994 "Regulations for water resources".

The protection of water resources is regulated by the "Merli law", No. 319 of 10 June 1976 "Regulation for the protection of waters from pollution", in conjunction with law No. 650 of 24 December 1979.

Discharge water must receive prior authorization by the responsible authorities. Legislation in Italy targeting environmental conservation is ruled by the following laws:

(i) 1089 of 1 June 1939 "Protection of artistical and historical sites".

(ii) 1497 of 29 June 1939 "Protection of the natural beauties".

(iii) 431 of 8 August 1985 "Urgent regulation for the protection of environmental interest areas".

(iv) 349 of July 1986 "Ministry of Environment".

These laws protect the aesthetic and historical value of the territory by requiring administrative authorisation to be able to establish an aquaculture activity on these sites.

The above-mentioned authorisation required for environmental protection is not itself enough to establish a fish farm. It is also necessary to obtain licences for building, thereby controlling the enterprise's conformity to planning regulations.

Legislation in Italy is especially complex and the procedures and applications for the installation of a new enterprise, or for the modification of an existing one, may take a long time. To obtain an administrative licence, authorisation by many different authorities is required, and this is often very difficult to acquire; if the new fish farm is located in area subject to special protection laws, a *"nulla-osta"* is necessary from each public body entrusted with the protection of the area. Examples of the authorizations required include: (i) administrative licence for maritime state property from local harbour office, which is obtainable after many authorizations (for example customs office); (ii) permission from the municipal building commission; (iii) permission from the local board of health; (iv) permission from the provincial office for the protection of environmental resources; (v) opinion of Chamber of Commerce; (vi) *"nulla-osta"* from the regional division of forestry; and (vii) *"nulla-osta"* from the Mountain Community (for the alpine region).

Financial aid

Italian aquaculture has benefited from EC funds; in the period 1983-1986 under Reg. 2908/83, 12, 333,067 ECU were granted; under the subsequent Reg. 4028/86 (1987-1992), 87 projects were approved with a total grant of 44,312,113 ECU. The financial participation to the present Financial Instrument for Fisheries Guidance (FIFG) requires that each aquaculture project is presented within the framework of a Pluriannual Orientation Programme. Based on these provisions, the Ministry of

Agriculture drew up the "Triennial plan for fishing and aquaculture" under the law No. 41 of 17 February 1982 (Iandoli and Bianco, 1992).

The plan in force at the moment (1997/99) is the fifth under Ministerial Decree of 24 March 1997, of the Ministry of Agriculture. This plan is targeted to the promotion of a rational exploitation and development of the biological resources of the sea, through a well-balanced development of fishing and aquaculture. In addition, Law no. 41/82 has set up the "Central Fund for Fishing boats loans". These funds are used to grant low interest loans for the following:

(i) Construction, purchase, enlargement or improvement of aquaculture installations in marine and brackish waters for the reproduction and growth of fish, crustaceans and molluscs.

(ii) Construction of artificial structures for active re-population.

(iii) Purchase of existing installations net of any contribution for their making from the state, region or other body, or EU.

The Fund for fishing boat loans financed eight projects for a value of 4500 MECU in the period 1994-1996.

Research

In Italy, several public institutions are involved in scientific research in aquaculture. ICRAM (Central Institute for Marine Scientific Research and Technology) is the main national institute responsible for marine fishery and aquaculture research. Other bodies are CONISMA (National Inter University Association for Sea Science), ENEA (Agency for new Technologies, Energy and Environment), the Central Hydrobiology Laboratory, and INEA (National Institute of Agricultural Economics). The main national instrument providing funds for research in aquaculture is the above-mentioned "Triennial plan for fishing and aquaculture" under the law No. 41 of 17 February 1982.

Within the framework of the present Three-year Plan, 120 operating units have been established. These are working on aquaculture/environment relationship, techniques for producing new species with quality control of innovative production methods, pathology, animal nutrition, quality control, genetics and bio technology, development of technologies for open sea production, studies of artificial reefs, and studies of mollusc culture. These are all targeted for rapid growth of the sector and to exploit the growing opportunities. Contracts have also been assigned to study the economic, juridical and market aspects.

References

Ceccarelli, R. *et al*. (1998). *Le imprese della pesca e la maricoltura: Limiti e prospettive nella realtà italiana.* Appunti CIRSPE.

Iandoli, C. (1997). Realizzazione di un osservatorio per il settore acquacoltura nel Mediterraneo. Mipa, *Relazione finale III Piano Nazionale della pesca e dell'acquacoltura nelle acque interne e salmastre.*

Iandoli, C. and Alaio, E. (1997). Aquaculture sectorial analysis: Sicily and Sardinia case studies. *EAS Conference,* Martinique, 5-9 May 1997, EAS Book of Abstracts.

Iandoli, C. and Bianco, R. (1992). *Stato dell'acquacoltura e ruolo della politica comunitaria di supporto.* Quaderno ICRAM No. 4.

Ministero per le Politiche Agricole, D.M. 24 March 1997. *Adozione del quinto piano triennale della pesca e dell'acquacoltura 1997-1999.*

Panunzio, P. and Iandoli, C. (1998) Legal aspect of aquaculture in Italy. In: Aquaculture Planning in Mediterranean Countries (1999), Proceedings of the Workshop of the SELAM Network of the CIHEAM/FAO/INRH, Tangier (Morocco), 12 to 14 March 1998. *Options Méditerranéennes, Séries Cahiers,* 43: 63-68.