Chapter 14

Strategies for pursuing sustainability in Italian fisheries

14.1 Local Management Plans: intervention tools for rebalancing fishing effort and living resources

Spagnolo M.

As from the second half of last century, the evolution of world fisheries (and Italy is no exception) has been characterised by a constant and progressive increase in fishing capacity. Financial and fiscal policies to support expansion of capital invested in exploitation activity have contributed in a decisive way to developing a fishing fleet whose size would prove to be in excess of the available living resources. Although no accurate estimates are available, concurrent and marked advances in technology have played an even more incisive role by improving the efficiency of fishing operations[1]. The community strategy of reducing fishing capacity by scrapping vessels has been more than compensated for by the introductions of technological innovations and by the increase in on-board installed engine power.

Beginning in the early 1990s, after the Rio de Janeiro conference[2], the perception of both excessive over-exploitation of resources and of the need to safeguard fishery resources for current and future generations has become increasingly more widespread at an international level. It should be underlined how Italy, early on, with Law 41/1982, had already made a first attempt at promoting resource management by implementing controls on fishing effort. At an EU level, nevertheless, it was necessary to wait until the early 2000s to obtain a Common Fisheries Policy review and approval of a coordinated series of regulations aimed at pursuing environmental sustainability as well as the recovery of by then, in many cases, impoverished fish stocks. In particular, Council Regulation (EC) 2371/2002 made significant modifications to resource conservation policy, and introduced Stock Rebuilding Plans and Management Plans.

[1] EU Green Book for Common Fishing Policy Reform, COM (2009)163 final, Brussels, 22.4.2009. The Green Book contends that the increase in the efficacy of capital investments in fishery exploitation is estimated as being at around 2-3% on an annual basis.

[2] United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, June 1992.

Fishing resource management in Italy

The specific nature and management complexity of Mediterranean fishery resources, has for many years limited the choices made by competent authorities to merely controlling fishing effort and to introducing technical measures. Given that Italian fisheries are strongly multispecies, and unlike other production contexts, capacity variations were not defined according to the state of exploitation of single or groups of stocks, but rather generalised fishing capacity reduction strategies were adopted.

Strategies based on Management Plans, according to fishery area and fishing system, were adopted only many years later. It was only then that the hypothesis of associating capacity variations to one or more specific stocks, in differentiated areas, was implemented along with other intervention measures.

Basically, Fisheries Multi-Annual Guidance Programmes (MAGP) adopted at an EU level, have been for many years the mainstay intervention measure aimed at restoring an acceptable balance between fishery resources and fishing capacity, and have produced a noticeable and generalised reduction in fishing capacity via definitive curtailment measures. The efficacy of this approach in rebuilding biological resources has yet to be fully verified, given that no appreciable improvements in this direction have been recorded over time.

Other factors, both internal and external to Italian fisheries, have contributed to a worsening of the situation. Amongst the former, undoubtedly the increase in running costs, in particular fuel, has given rise to a concurrent reduction in fishing activity, that is the time spent at sea, as well as to an intensification of exploitation of areas nearer the coast. Amongst the latter, the progressive and continuous growth of fleets from other countries which compete in exploiting the same fish stocks, an intensification of sea pollution, and an increase in demand from consumers in the Mediterranean area have all contributed to reinforcing biological unsustainability factors.

As time goes by, therefore, it would appear to be totally evident that traditional intervention tools would not seem to have been able to restore a suitable biological, social and economic balance. Particular attention, therefore, should have been given to the need to modify “the tool box”, in an attempt to remove the causes of unsustainability, even by involving different stakeholders. An appropriate answer to these new needs could not but be found within Management Plans.

Management Plans

The legislative and regulatory framework as regards Management Plans is somewhat intricate. There currently are three Community regulations which stipulate, necessarily in some cases, and optionally in others, that Management Plans be prepared. Each set of regulations allows for different plan types and procedures.

Council Regulation (EC) 2371/2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy

These regulations introduced Fishery Activity Recovery Plans (art. 5) and Management Plans aimed at keeping stocks within the biological safety limits for fishery activities (art. 6). The architecture set out for preparing these plans makes this tool more suited to managing mono-specific stocks, typical of Northern European waters. Hence, in the Mediterranean Sea, this type of plan has been used exclusively for the bluefin fish recovery plan subject to community regulation.

Council Regulation (EC) 1198/2006 on the European Fisheries Fund - (EFF)

The second Regulation, concerning the European Fisheries Fund, on the one hand recalled plans already identified by the previous Regulation, and on the other hand introduced two new types of plans:

- Management Plans, adopted at a national level within the context of Community conservation measures to financially support the sector should a temporary moratorium on fishery activities be ordered (art. 24). This type of intervention is compulsory in order to be able to order temporary moratorium measures and plays a central role in the Italian resource conservation strategy.
- Local Management Plans that are capable of making sustainable contributions towards better management or conservation of resources (art. 37). This is a completely innovative intervention tool in the range of available management tools. The novelty introduced by this specific type of plan lies in the fact that, once specified organisational criteria have been satisfied, such as a minimum percentage of 70% of registered eligible beneficiaries in the area having subscribed to an ad hoc management consortium, it will be possible to introduce self-management rules thereby attributing local ownership rights in favour of these consortia. A non-marginal novelty associated with implementing Local Management Plans, within the European Fisheries Fund (EFF) Operating Programme framework, concerns the possibility of envisaging a strategy that harmonises coastal fishery resource conservation needs with socio-economic and structural requirements, within the framework of a local area development approach. Paradoxically, this type of action was introduced as a measure for implementing a set of regulations that are financial in nature, such as the EFF, and there is no sign of references to similar measures in other regulations related to fishery resource conservation.

Reg. (EC) 1967/2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea

The third Regulation introduced another three types of Management Plans (Community Management Plans, National Management Plans, Management Plans for requesting both mesh size and coastal distance exemptions.

Community Management Plans (art.18).
Where the opportunity arises, the Council can adopt Management Plans for specific Mediterranean fishery activities carried out in areas that extend fully or partially beyond Member State territorial waters. Amongst the measures that can be introduced in an EU plan are:

- fishing effort management measures;
- specific technical measures;
- an extension of the obligatory use of a Vessel Monitoring System (VMS);
- other temporary or permanent restrictions.

During the first five years in which the Mediterranean Regulation was in force, the Council did not deem it necessary to adopt any plan on the basis of its provisions.

National Management Plans (art. 19).
Art. 19 of the regulation obliges each Member State to prepare a Management Plan for the following fishing systems: towed nets, boat seine nets, beach seine nets, surrounding nets, and

drag nets. The article, also, defines the factors that should be taken into account when preparing the plan, and these comprise:
- the state of conservation of a fish stock or stocks;
- the biological characteristics of a fish stock or stocks;
- the characteristics of the fishing activities which result in fish stocks being caught;
- the economic impact of the measures on the fishing activities concerned.

Not unlike the Management Plans indicated in article 24 of the EFF, these Plans, too, are under the jurisdiction and responsibility of Member States.

Management Plans for requesting both mesh size and coastal distance exemptions.

The Mediterranean Regulation introduces restrictions on mesh size (art. 9) and coastal distance (art.13). In both cases it is possible to allow exemptions at given conditions, and provided that they are part of a Management Plan, as per article 19.

To bring this outline of current Management Plan Regulations to an end, the role played by the various articles of these regulations should also be mentioned since they impose on National Management Authorities the need to make delicate procedural choices which, to be sure, do not facilitate the task. To conclude, there is a need for a legislative framework that is common to the various regulations and that can set out straightforward procedures which are not subject to arbitrary interpretations from individual member states.

The Italian experience in Management Plans

Regulatory aspects

The EU regulatory system, shared and supported by the Italian government, considers Management Plans as the most suitable action tools for obtaining resource conservation objectives. Besides, the EFF has allowed the European Commission to encompass objectives and resource conservation tools within a single Regulation. In particular, article 21 of the EFF requires that fishing effort adjustment plans be prepared which, amongst others, can be listed as follows:

- Recovery Plans as per art. 5 of Council Regulation (EC) 2371/2002;
- Management Plans as per art. 6 of Council Regulation (EC) 2371/2002;
- Decommissioning Plans pursuant to articles11 to 16 of Council Regulation (EC) 2371/2002 on adjusting fishing capacity.

It is completely evident that the Recovery and/or Management Plans mentioned above allow fishing capacity levels to be identified that are in keeping with both the conservation objectives to be pursued, and, in particular, with the maximum sustainable yield for the stocks affected. These form the basis for producing suitable Decommissioning Plans.

Except for the Bluefin Fish Recovery Plan, subject to exclusive Community regulatory activity, the choice made by the Italian Management Authority, pursuant to regulations, was to follow the indications of article 24 of the EFF in relation to temporary fishing moratoria. In this sense, a Management Plan was initially drafted for each Geographical Sub-Area (GSA), and fishing system, including bottom trawling, seine fishing and other systems, giving a total of 22 Management Plans. In accordance with regulatory provisos, the other plans envisaged by the Mediterranean Regulation were written at a later stage, namely those indicated in article 19, regarding seine net and dredges.

Methodological and scientific aspects

The Italian Management Authorities believe that it is opportune to evaluate biological objectives and to harmonise them with economic and social objectives whereby conditions for workers in fisheries are improved and employment levels are protected. On a concrete level, the following were all taken into account when producing the plans: the multi-species nature of stocks subject to exploitation, the competition of various fishing systems in capturing the same species, the socio-economic constraints defined by the objectives themselves, and the greater uncertainty created by environmental, social and economic interdependences which contribute towards determining the decision-making mechanism of a fishery business.

The traditional fishing activity stock-impact indicators: Z (total instantaneous mortality rate), F (instantaneous mortality rate due to fishing), E (exploitation rate), were integrated with broodstock biomass and stock spawning biomass (SSB) estimates. The parameters which define the biological, economic and social objectives of Management Plans are shown in Table 14.1 below. The bio-economic model used to define the Management Plans features a series of methodological innovations which, as a result of data exchange between the biological and economic models, is capable of providing a coherent response that is consistent with prefixed objectives.

Table 14.1 - Biological, economic and social objectives and indicators.

Objectives	Specific objectives	Indicators
Biological: conservation of the regeneration capability of commercial stocks	Return of fishery activity to values compatible with the stock safety levels identified via *Biological Limit Reference Points*, and exploitation oriented towards medium-/long-term sustainability identified via *Biological Target Reference Points*	Total instantaneous mortality rate (**Z**) Instantaneous mortality rate from fishing (**F**) Exploitation rate (**E**) Reproductive potential (exploited spawning stock biomass (**ESSB**) / unexploited spawning stock biomass (**USSB**)
Economic: improving economic conditions for sector workers	Improving the earnings capacity of fishery businesses so that it rises above the rate of inflation	Gross profits/vessel Added value/worker
Social: Maximising work opportunities in fish-dependent areas	Given the biological objectives, developing job opportunities in correlated activities	Number of fishermen Work costs per worker

Table 14.2, pertaining to the Sicilian GSAs, provides a concrete example of biological, economic and social indicators. Limit Reference Points identify a threshold beyond which the chance of compromising fish stock regeneration capacity is very high. Target Reference Points are values that on average are compatible with precautionary management objectives.

The plan under discussion aims, for demersal species fisheries, to obtain an improvement in stock spawning biomass (SSB) by reducing the exploitation rate (weighted for a pool of species: hake, red mullet, rose shrimp, Norway lobster, blue and red shrimp) from the current level of 0.64 to a level of 0.35 (Target Reference Point). The objective identified can be reached via a set of measures amongst which are: permanent withdrawal, temporary withdrawal , adoption of mesh regulation, interdiction from fishing in nursery areas, in biologically-protected areas and in marine protected areas.

Table 14.2 - Quantifying the biological, economic and social indicators.

Fleet segment	Objectives	Indicators	Baseline*	Reference Points
Bottom trawling and other systems	Biological	Total instantaneous mortality rate (Z)	Z = from 1.0 (hake) to 2.7 (pink shrimp)	Limit Reference Points:
		Instantaneous mortality rate from fishing (F)	F = from 0,59 (hake) to 1,40 (red mullet)	F_{max}, E 0.5, ESSB/ USSB=0.2
		Exploitation rate (E); Reproductive potential (ESSB/USSB)	E (weight) = 0.64 (GSA 19) to 0.68 (GSA 16)	Target Reference Points
			ESSB/USSB = from 4% (hake) to 15% (pink shrimp)	Z at Maximum Biological Production (ZMBP), $F_{0.1}$, E 0.35; ESSB/USSB=0.35
Bottom trawling	Economic	Gross profits/vessel	Gross profits/vessel = € 56,180	+139% of baseline
		Added value/worker	Additional value/worker = € 33,900	+98% of baseline
	Social	Number of fishermen	Number of fishermen = 954	-25% of baseline
		Labour costs per worker	Labour costs per worker = € 16,400	+54% of baseline
Other systems	Economic	Gross profits/vessel	Gross profits/vessel = € 25,240	+52% of baseline
		Added value/worker	Additional value/worker = € 21,000	+43% of baseline

* For socio-economic indicators the baseline refers to average values for the period 2004-2006.

Conclusions

Although it is still premature for an overall evaluation of the impact of Management Plans, it should nevertheless be underlined that several qualifying objectives have in the meantime already been reached. These are, amongst others, as follows:

- harmonising as far as possible, the national management tools with Community ones on the basis of the scientific methodologies traditionally adopted at an EU level;
- identifying the fishing capacity levels compatible with the state of the resources and at the same time quantifying the definitive curtailment levels that are to be co-financed as per the EFF;
- assessing the impacts connected with implementing the various management provisions both in relation to living resources and to economic- and social-related aspects;
- sharing the same methodologies by all Italian operating units involved in evaluating marine living resources, thereby giving rise to an effective virtual research network capable of supplying the maximum level of scientific responses to the administrative bodies;
- sharing any new working methodologies underlying the adoption of appropriate management provisions with all players in the sector.

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14.2 Optimising production through certification tools

Cozzolino M.

The Italian production system has to deal with the effects of globalisation, which has led to the arrival of foreign fish products on the national market. The opening of the markets also caused the loss of territorial characterisation relating to fish consumption. In this scenario, it is important to renew and establish the territorial identity of the national offer.

Added value through certification tools and systems

Certification provides a good opportunity to increase the added value of fish products that have adopted a certification protocol and received official recognition from the competent bodies. The added value comprises both better positioning of the certified fish offer and a more efficient professional relationship between the crews and ship owners. Since 2000 the adoption of certification practices by certain fisheries has been noted. The goal of standardising fishery activity procedures favoured production efficiency, the biological protection of stocks and safe food handling. Market needs and product distribution methods led to two different approaches in fisheries, one addressing capture fisheries and the other aquaculture.

Certification in fisheries

The first interventions in fisheries were promoted by the Ministry of Agriculture and Forestry in the early 1990s. The first project carried out was the "Development of integrated total quality management in fisheries", aimed at implementing Total Quality (TQ) in fisheries. This project allowed the effects of certification to be tested with the addition of a sputtered fish offer, shortening of the supply chain and reassurance for end consumers. The strategy underlying the project allowed mandatory rules to be integrated with voluntary ones (such as UNI standards and the Eco management and Audit Scheme regulation[3]). The output of the TQ Project was TQ regulation in which all the real needs of the fisheries involved were addressed in a pilot phase (Civitavecchia and Chioggia). This was the first standardised fish production process in which the particular features of the fisheries were not neglected; the TQ regulations safeguarded the characteristic traditions and customs of fishery activities. The effects of the project showed that TQ can be accomplished while respecting the typical features of the fisheries being certified. The following process management tools were

[3] EMAS Regulation: the latest version of which is Regulation(CE) 1221/2009.

produced to allow the pilot project to be replicated by other Italian fisheries:

- certification guidelines and codes of good conduct;
- procedural files and working practices for achieving improvement goals;
- performance indicators and target/limit reference values;
- systematic management plan and total quality declaration scheme.

The pilot project showed that certification can give clear results if implemented and coordinated by Producer Organisations (POs). However until recently the traceability of the national offer was particularly difficult, as the fisheries chain is extensive and managed by numerous parties. The wholesalers, for instance, proved on several occasions to be the weak link in the chain, invalidating certain certification experiences. It is only in the last few years that some quality certification procedures have improved, due to mandatory traceability (Regulation EC 178/2002) and the adoption of a control system and official control tools (Regulation EC 1224/2009).

Selection of certification tools in fisheries

The concept includes an *ex ante* feasibility analysis to classify the types of fishing practiced by the fishery requesting certification. With small-scale or monospecies fisheries it has proven strategic to apply *ad hoc* regulations or certifications suited to the types of equipment used or the target species. With fisheries on a "massive" scale, however, it is helpful to identify and show a link with the fishery areas in order to be able to request PGI or PDO recognition. In economic terms, PDO and PGI certified fish products attract greater consumption on the market, which is prepared to pay and grant a premium price of around 15% of the average price paid for the same non-certified product. Marine Stewardship Council (MSC) certification can be requested for particularly abundant fish products. This certification evaluates intensive fishery systems. The MSC process is aimed at qualifying not just the catch, but the entire process, including the end marketing phase. The MSC label can guarantee a premium price, which compensates the efforts made to obtain the label. However, there are no MSC recognised products in Italy. Foreign products with MSC certification showed an average wholesale price increase of around 10-12% for highly abundant products with a medium-low commercial value, whereas an increase of 15-20% in seen in the case of more valued species for which wholesale prices are already on a higher basis.

Certification in aquaculture

Certification in accordance with international ISO standards is more common in aquaculture. The use of quality and environmental management manuals is due to the possibility of offering products that are more in conformity with specific market requests. Fish farms have also adopted and promoted the so-called supply chain protocols. These protocols are directly coordinated with large-scale retail chains that aggregate and market the offer. ISO certification is the prerequisite for fish farms to have access to large-scale retail chains. In reality, approximately 15% of the medium and large-scale fish farms operating in Italy have ISO standard certification (Vision 2000, for quality, or ISO 14001, for the environment). This is due to the greater interest in signing contracts with large-scale retail chains. In 2011 over 70% of active companies signed supply contracts with large-scale retail chains. Intensive aquaculture in Italy has always adopted a proactive approach to innovative sustainable production paradigms; this enabled the creation of the first EU-funded project in 1999, aimed at developing a quality and environmental management system in accordance with the EMAS Regulation. With the application of EMAS, environmental aspects

were analysed in order to qualify large-scale productions. The main advantages are the following:

- reduction of costs and increases in efficiency of up to 10%;
- reduction in accident-related risks, 12%;
- improvement of market competitiveness;
- improved relations with stakeholders.

Aquaculture national products have undergone over the last ten years a rapid loss in identity in relation to imported products . The main reason for this is the sale of products under the label of the marketing chain that distributes them rather than the name and indication of the Italian fish farm. In response to the excessive mixing of imported products with national ones, producers asked for greater support from the MiPAAF in terms of wide-scale communication. The promotional activities included communication focussed on environmental sustainability. In 2004 as an entirely innovative operational research method, environmental balance sheets for fish farms, were introduced for the first time in Europe[4]. These are documents of a voluntary and systematic nature that communicate the commitment of the fish farm to reduce the environmental impacts caused by its activities. Environmental balance sheets make it possible for the first time to inform all the stakeholders of the cause-effect relationships of the costs and revenue recorded in the financial statements, with specification of the costs incurred for the environment. By way of example, table 1 shows the costs and investments recorded by the organisations for different financial years (YYY1, etc.) under various headings.

The methodological solution adopted in green accounting has produced an *ad hoc* matrix of environmental indicators in which data are grouped according to various main topic areas and expressed under the form of indicators (water, energy consumptions, waste products, etc.). Each company has its own matrix with its indicators expressed in both absolute and relative values. The relative value is calculated in relation to the average biomass present (ABP) on the fish farm during each civil year. Environmental balance sheets allowed fish farms to absorb the competitive disadvantages caused by the expenses and investments required for environmental protection. The study, moreover, examined the general taxonomy of company environmental costs, so as to highlight those costs that are applicable to aquaculture. The cost categories relevant to intensive aquaculture are shown in green colour in the figure below. The other indicated categories represent types of environmental costs that rarely apply.

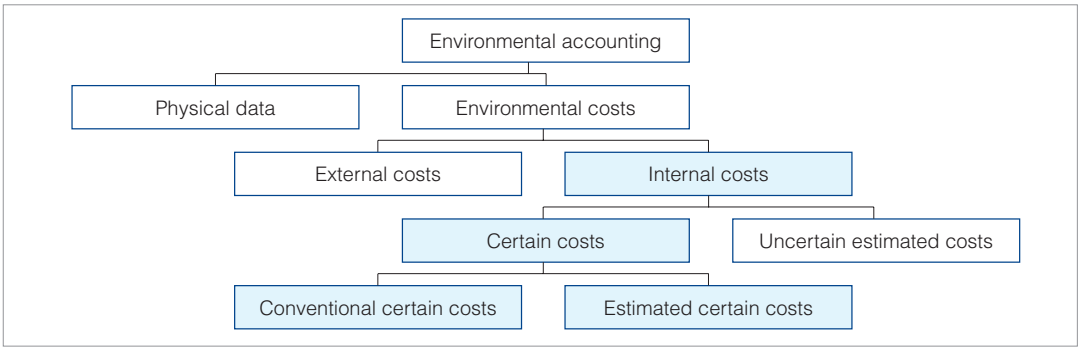

Figure 14.1 - Perception of wild fish with respect to farmed fish (Source: Irepa elaboration).

[4] Project for the Development of Environmental Balance Sheets for intensive technologies in the acquaculture sector, jointly carried out by ICRAM, Irepa and Tor Vergata Ecology Department.

Table 14.3 - Sample outline for calculating environmental costs and expenses.

Environmental costs and investments account (thousands €)	YYY1	YYY2	YYY3
Investment expenses:			
Plant and machinery (for water treatment, waste disposal/reduction/recycling, noise reduction, natural heritage protection)			
Maintenance			
Provisions for environmental risks			
Total Investment expenses:			
Current expenses:			
Air and climate protection			
Water treatment			
Waste			
Noise reduction			
Natural heritage protection			
Research and development:			
Environmental insurance			
Fines for non-compliance with regulations			
Environmental conflict management costs			
Environmental communication costs			
Total current expenses			

Source: Irepa elaboration.

Environmental balance sheets have also proved to be a valid planning tool for the strategies pursued by Public Administration, as well as for managing the conflicts between various economic activities that use the same resources (tourism, fish farming, fisheries, agriculture, sailing, transport, etc.).

Conclusions

Certification is a strategic lever that can produce advantages, but can also limit certain possible forms of quality promotion. To develop certification as an tool, greater awareness among fish operators is needed, in order to make them responsible for the positioning and qualification of the fish offer.

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14.3 Strategies for reducing production costs through technological innovation: energy saving measures

Sacco M.

As shown in figure 14.2, there has been a downward trend in the Italian fisheries economy over the last decade, due on the one hand to the impoverishment of living resources, and on the other to a constant growth in production costs.

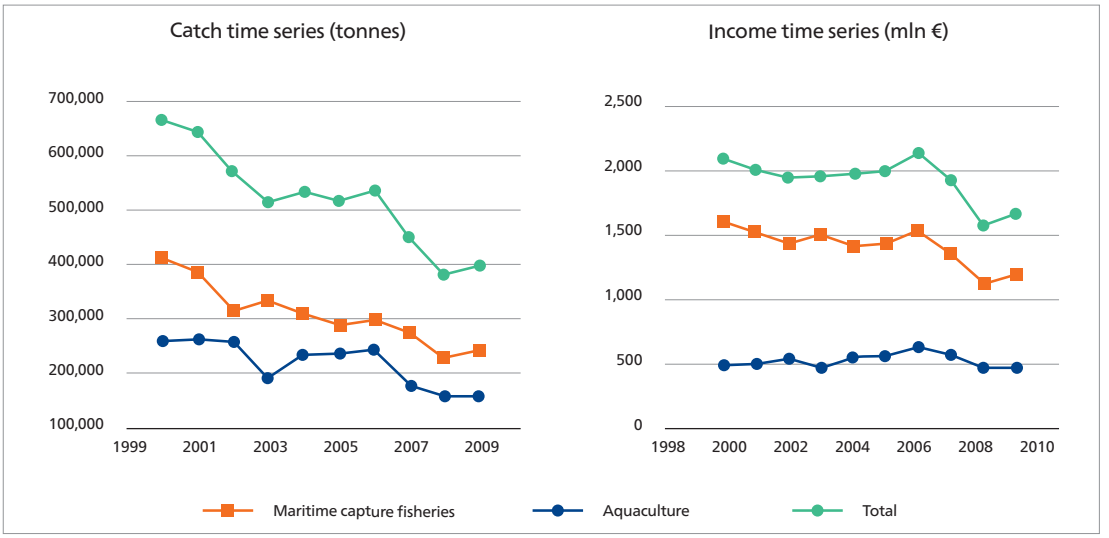

Figure 14.2 - Trends in catches and income from 2000 to 2009 (Source: Irepa Observatory).

A description of the scenario

About 90% of Italian fisheries consists (in numerical terms) of vessels that are up to 12 metres long, equipped with passive gear (small-scale fishing) with an overall tonnage[5] of 16,525 GT, and trawlers with an overall gross tonnage of 113,322 GT (Source: Italian Ministry of Agriculture, Food and Forestry Policies (MiPAAF) - Institute for Economic Research on Fishery and Aquaculture (Irepa). They form three quarters of overall national tonnage. The remaining 10% comprises hydraulic dredges, passive polyvalent fishing vessels, seine fishing vessels and mid-water trawlers.

[5] The tonnage of a vessel represents the volumetric measurement of the vessel itself; in particular Gross Register Tonnage (GRT), represents a measurement equal to 100 cubic feet (that is 2.832 cubic metres). As from 2004, Gross Tonnage, or simply GT was introduced for EU vessels. Gross tonnage, as set out in the Convention of London (1969), is defined as a function of the moulded volume of all enclosed spaces of a ship.

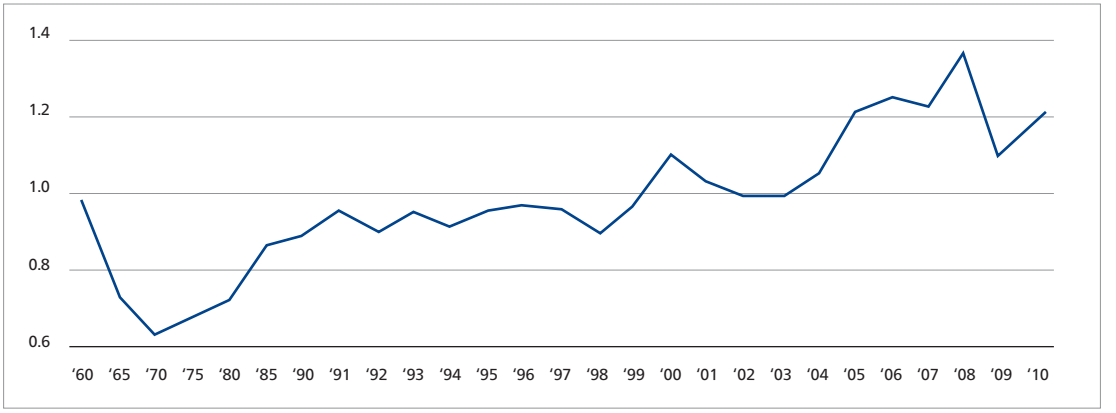

Figure 14.3 - Pump price of automotive diesel (price converted to Euros) (Source: ilsole24ore.com).

The cost of fuel, in general, accounts on average for more than 50% of a fishing firm's expenses which peaks at about 60% for trawlers. It is, therefore, evident that the rising trend in fuel cost over the years has led any strategy to reduce consumption to be defined as being a growth factor for the sector.

Procedures for reducing the impact of fuel costs

The main institutional and industry players connected with fisheries have tackled the issue of reducing fuel consumption in order to increase the competitiveness of fishery entrepreneurs, through a rationalisation in the use of technical equipment, or an introduction of more energy-efficient propulsion or winching technologies.

The "management"-type technique has mainly tried to obtain system operating conditions that could maximise the catch/consumption ratio without neglecting any operating constraints such as gear trawling speed.

Research into "technological innovation" has led, instead, to technical solutions being found that are characterised by greater intrinsic efficiency and which have brought research workers to set their targets directly on obtaining systems that are structurally more efficient in terms of energy savings.

Management techniques

The main principle underlying this area is the sound management of available resources, which concerns measures that have been often implemented on the basis of operator experience and optimized as a result of input from the scientific research community.

Rational management of technical resources

Fishing for small pelagic fish (prevalently anchovies and sardines but also sprat, whitefish mackerel) is carried out using semipelagic nets dragged by pairs of vessels (paired mid-water trawling) or by purse seines with light source systems for attracting fish (fishing lamp), with rotation in the use of equipment according to season.

For paired mid-water trawling using a 60-70 metre net kept open horizontally by two vessels and

vertically by floats and weights on the upper and lower edges respectively, the biomass detection and transfer phases have roughly equivalent energy efficiencies, which are nonetheless greater than for the net dragging phase.
Research in this context indicated that suitable speed ranges can be found that allow up to 20% savings in fuel consumption to be made during net towing phases. One of the most important scientific contributions was the one made as part of the EU project denominated "*Energy saving in fisheries*" (ESIF), which used the CorFu-meter (CorFu-m)[6], devised at the National Research Council – Institute of Marine Science (CNR – ISMAR) in Ancona (Italy), and developed together with Marine Technology Srl of Ancona (Italy) and Race Technology Ltd of Nottingham (England, UK). This survey showed how a reduction in cruise speed from 11.0 to 10.0 knots enables fuel savings of up to about 34% to be made, without requiring any further technological modifications.
Another way to intervene in order to obtain energy savings is via optimum screw pitch management (figure 14.4) in relation to a vessel's forward speed. In this case, if "variable pitch" screws are used it is possible to better manage screw thrust output through regulating a screw's pitch in relation to its rotational speed.

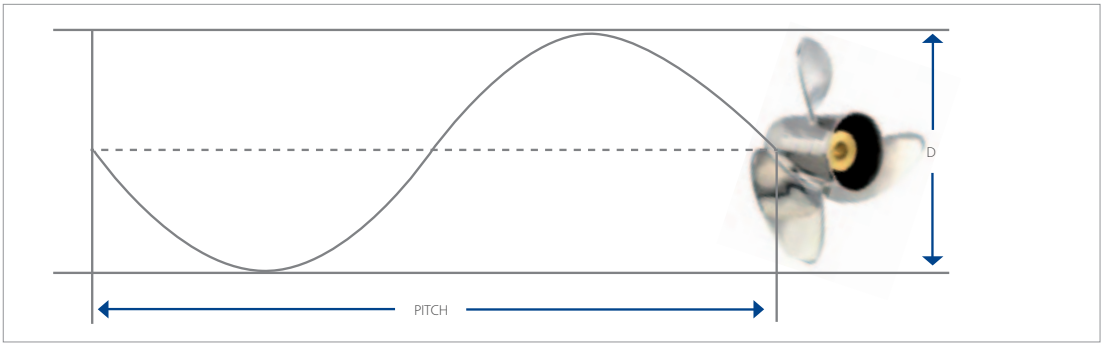

Figure 14.4 - Screw pitch.

As part of Energy saving in fisheries (ESIF) project, the use of variable pitch screws, regulated through reading the CorFu-m allowed further fuel savings (about 40-45% while in transit and 10% in the towing phases).

Use of electronic devices for detecting target species

The use of GPS systems on the one hand, and echo-sounder systems on the other have simplified navigation procedures, both as regards the memorising of specific routes (characterised by a great abundance of fish) and the efficient detection of fish shoals.
They have made it possible for fishing firms to be more competitive, by reducing the time taken to locate fish and ensuring consequent savings in fuel consumption.

[6] An electronic device capable of making instant real time measurements of fuel quantities used. The CorFu-m comprises the following three main components:
- two mass flow sensors that use the Coriolis principle, thereby being able to operate independently of the physical properties of fluids, such as viscosity and density;
- a Multi Channel recorder, able to record a series of heterogeneous data from different acquisition units (such as temperature, liquid flow rate, etc.);
- a GPS Data Logger, for recording positions in time via the integrated GPS.

Technological innovation

In general, each technological innovation aimed at saving energy is hindered by the restrictions imposed by the European Commission on the building of new vessels. These make it currently possible to carry out almost only modifications that are aimed at improving the existing fleet or at developing fishing gear characterised by a greater degree of energy efficiency.

The resistance to the vessel moving forwards in the fishing gear towing phases proved to be slight when compared to the resistance resulting from the fishing gear, so much so that fuel costs for a typical trawler can reach 58% of the total expenses for a single trip (Irepa, 2008).

Hull innovations

As a result of the currently-available design techniques, it is possible to design keel shapes that perform particularly well in terms of propulsive resistance, thus allowing solutions characterised by high speeds and reduced specific consumptions to be obtained.

“Reverse-bow” fishing vessels can be highlighted amongst the various types that are available (figure 14.5) in that they allow top-level performances in heavy seas, with reductions in fuel consumption and greater overall safety in adverse weather conditions.

Conversely, in the case of existing vessels, it is possible to carry out only a number of modifications that allow limited improvements in performance, such as, for example, installing a bow bulb[7], which is the most widespread innovation for existing hulls (figure 14.6), and normally leads to a reduction of about 15% in propulsive resistance with a consequent fuel saving and increase in speed.

Figure 14.5 - A new concept of ”reverse-bow” hull.

[7] The bow bulb was discovered by chance during World War II when several US destroyers were retrofitted with sonar devices in an add-on protuberance to their bows.

Figure 14.6 - Converting an existing hull by adding a bow bulb.

Retrofitted bulb modifications on existing hulls (figure14.6) are, in general, poorly-integrated in the vessel's upper-works, and create aerodynamic profiles which are not optimum and often give rise to vortices and turbulence. On the contrary, designing a bow bulb *ex novo* (figure 14.7) allows a more homogenous keel profile to be designed which would permit excellent performance levels with cruising speeds of more than twenty knots.

Figure 14.7 - Optimum integration of a bow bulb on a hull designed *ex novo*.

Engine system innovations

Reciprocating diesel-cycle engines have always proved to be the most suitable ones for marine applications, given their distinguishing characteristics of robustness and reliability. In general, the propulsion systems fitted on diesel fishing vessels are derived from those used for heavy road vehicles, hence all the technological developments (control and regulating systems, conduit and combustion chamber geometries) have been the result of "land-based" research.

A widespread example is the replacement of electromechanical injection fuel systems with electronic ones, that allow more efficient fuel dispensing and therefore lower specific consumption as well as a reduction of polluting agents. Another example is a radical modification of engine design procedures as a result of 3D computer-aided design (CAD[8]) systems and numerical programs for modelling the operating fluids in the inner engine assembly[9] via numerical analysis[10] which has enabled more efficient engines to be produced, leading to improved combustion and an immediate reduction in emissions.

Further potential benefits could arise from the use of hybrid-type systems (figure 14.8) which would allow the use of combustion engines for producing primary energy and secondary electrical motors dedicated exclusively to propulsion and operating auxiliary equipment or even zero-emission engines based on fuel cells.

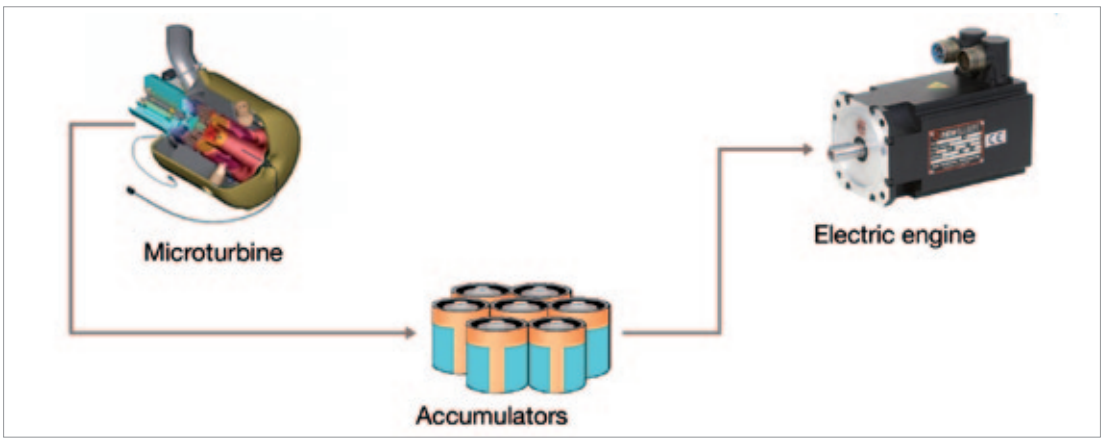

Figure 14.8 - Hybrid propulsion system layout.

Auxiliary system innovations

As part of the research programme entitled "Experimentation on new attraction systems for regional seine fishing" (SFOP 2000-2006 (Financial Instrument for Fisheries Guidance) programme – Measure 4.4), it was shown how innovative lighting systems (Hydrargyrum quartz iodide (HQI) lamps) have made it possible noticeable savings in energy to be made.

[8] The acronym CAD (Computer Aided Design) indicates that design is carried out with the aid of digital technologies.

[9] The thermodynamic assembly of an internal combustion engine is the set of principal mechanical parts from which it is composed (cylinder, piston and head) The thermodynamic evolutions of the operating fluid occur within this.

[10] Numerical analysis is an applied mathematical discipline for resolving problems of continuum mathematics in a "practical" manner through algorithms based on simplified models.

Furthermore, even the most recent cooling techniques based on “absorption” systems, can contribute to a net reduction in consumption, allowing amongst other things the recovery of heat energy which would normally have to be dissipated (engine cooling).

Fishing gear innovations

Numerous tests carried out to develop innovative trawling gear have shown how better performance can be obtained by working on both equipment design and materials.
The experimentation carried out as part of the “Energy Saving In Fisheries” (ESIF) project showed how these nets can lead to a reduction in consumption of up to 30%, through the use of larger mesh, more resistant materials and a new otter board design.
Another example is the use of multiple nets (figure 14.9) for crayfish, shrimp, flatfish, hake and cuttlefish fishing (double trawls) which are towed in a conventional manner via two cables from a single vessel. This system allows an increase in the trawled surface, with a consequent rise in catches compared to conventional systems based on single trawls.

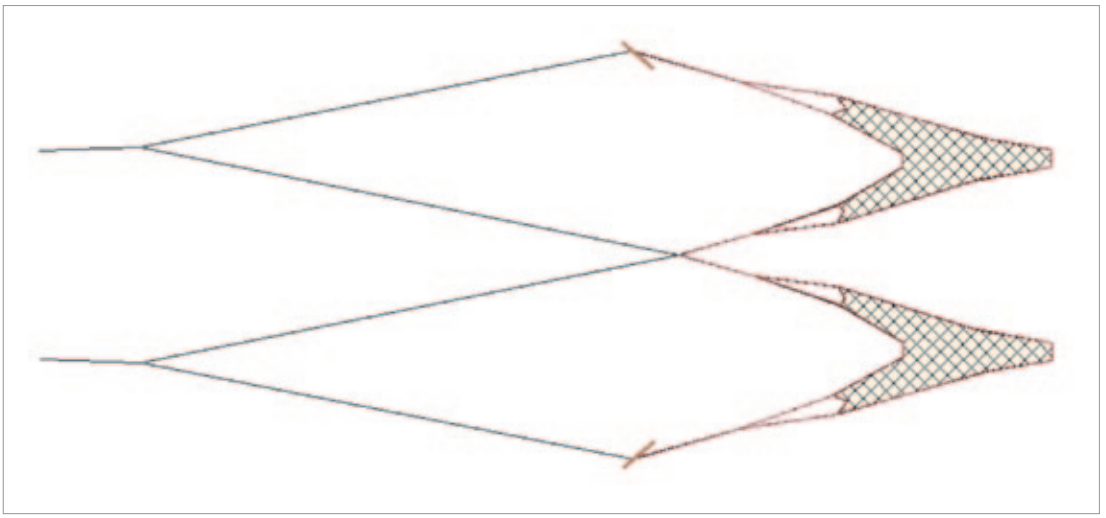

Figure 14.9 - Twin rig trawl gear: double wire twin nets.

In this case towing resistance does not substantially vary compared to the traditional system, but the possible increase in catches (by at least 30%) allows shorter fishing trips to be made, as well as a higher quality level of landings.
Disadvantages in the use of twin nets are that they pose a potential threat to stocks, given their high catch efficiency (this possibility can be countered by allocating individual quotas) and cause greater damage to the seabed.

Conclusions

The competitiveness of Italian fisheries has been highly affected by running costs, consisting mainly of fuel costs which have tended to increase over time. There has therefore been a progressive reduction in profit margins for fishing firms, which have driven operators and institutions to search for management and technological strategies capable of reducing the depressing effect on the sector.

Many areas have been affected, but only in some cases has radical action been taken on the production facilities that in effect are currently displaying a moderate level of technological development, due above all to the EU policy of reducing fishing effort.
Globally speaking, therefore, the measures taken were largely the result of research work carried out by national and community institutions, as well as the massive introduction of electronic navigation support instrumentation, which is also widely used in biomass detection techniques.
Continuous technological progress will without doubt prove to be a further opportunity for efficiently obtaining on the one hand a reduction in consumption and on the other hand a lower environmental impact for the sector.

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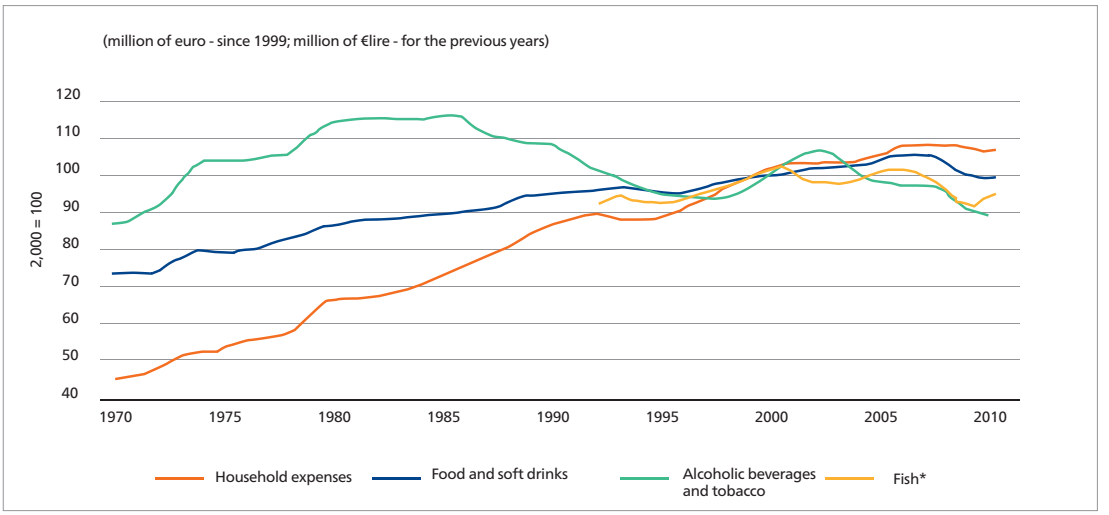
14.4 Consumer perception and behaviour through the evolution in the consumption and distribution of fisheries products

Carbonari F.

The evolution in the consumption of fish products in Italy

The last 40 years have seen a profound change in the Italian diet, as well as in the consumption of fish products. During the 1970s, once basic needs had been met, there was a strong growth in consumptions, including that of food (figure 14.10). This was followed by the growth trends in food spending of the 1980s, characterised by genuinely euphoric consumption. In this period, the favourable economic circumstances and the drive to reach a higher standard of living encouraged consumers to purchase an increasing number of luxury goods, with less attention paid to the price. New factors also came into play regarding the choice of foods, such as their health and nutrition content (the Mediterranean diet became the model for healthy food), which also explains the increase in per capita consumption of fish from 11 kg in the early 1980s to around 20 kg in the early 1990s. Food expenditure per capita continued to rise during the 1980s, but at a more moderate rate than that of the previous decade, whereas family consumption decreased. There was a further slowdown in the growth trend in food spending in the 1990s, when the food demand changed profoundly. The change in the structure of the nuclear family (smaller average size, an increase

in the number of singles, a lower birth rate and an ageing population) and changes in work organisation (increase in female employment; changes to the working day, with shorter lunch breaks and eating out becoming more relevant) led to the purchase of products that were easy and quick to prepare or ready for consumption (convenience goods with a high service content). Preferences in the fish product market shifted towards frozen, packaged and preserved goods, instead of traditional products such as dried, salted and smoked fish. There was a continued growth in attention to health and quality aspects, which were particularly appreciated in fresh fish products. Modern distribution also became prevalent, changing the purchase habits of Italians. This was also the case in the fish segment, due to a growing presence of fresh fish counters offering a wide variety at genuinely competitive prices.

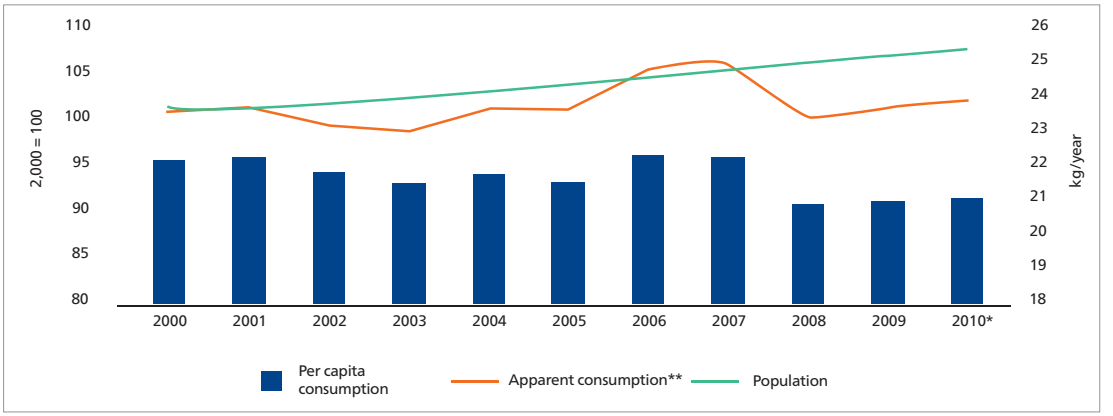


* Data available from 1992.

Figure 14.10 - Evolution of real family expenditure (chain-linked volumes) (Source: derived from ISTAT data, National statements of revenue and expenditure).

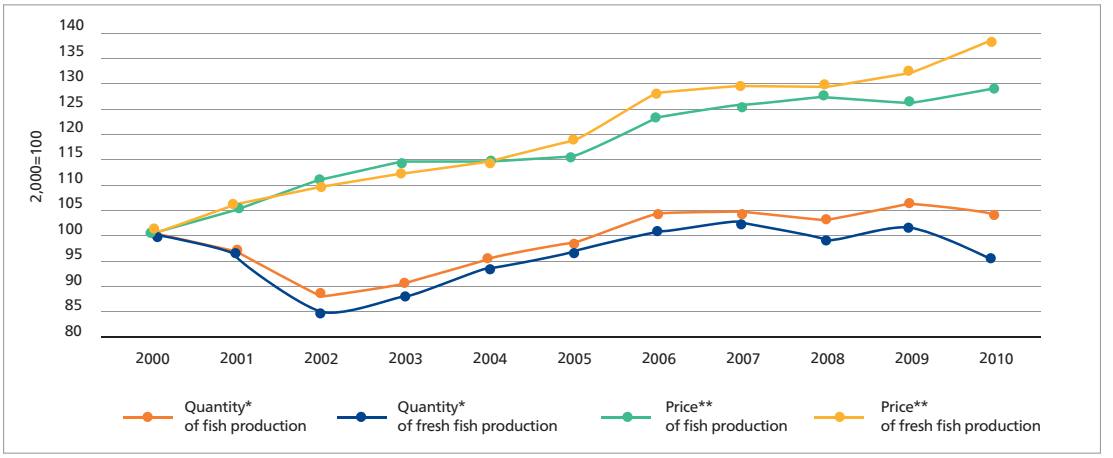
Other factors influenced food consumers in the 1990s. With the slowdown in the growth of Italian economy, consumers showed a renewed concern for convenience and value for money in particular. Furthermore, the globalisation of markets and consequent food emergencies (the first crisis concerning BSE, transmissible spongiform encephalopathy or mad cow disease, occurred in 1995, followed by a second occurrence in late 2000 and early 2001) made consumers more diffident towards the products they purchased and therefore more attentive to food safety issues. As a result of these dynamics, fish consumption not only changed in terms of its composition, as described above, but also showed a clear slowdown in its growth rate: per capita consumption grew on average, with considerable fluctuations, by just 2 kg during the 1990s, reaching 22 kg in 2000.
During the 2000s, family food consumptions initially showed a substantial stagnation and then decreased due to the serious economic crisis. Per capita fish consumption did not exceed 21 kg in the period 2008-10, returning to the levels of the early 1990s (figure 14.11). With reference to domestic demand in particular, the consumption of fresh fish products decreased, accompanied by a net increase in average consumption prices (figure 14.12). In 2010 alone there was a 5.7%

reduction in annual domestic fresh fish purchases (with a 2.4% reduction in total consumption) in relation to a price increase of 4.4% (a 2% overall rise), in a general context in which food consumption levels were in fact stationary in terms of volumes and prices.



* Estimate.
** Fish production + imports - exports.

Figure 14.11 - Population development and the consumption of fish products in Italy (reference year 2000=100) (Source: MiPAAF-Irepa, API, ISTAT, Ismea).



* Index of quantities purchased by Italian families.
** Price indices of the products purchased by Italian families.

Figure 14.12 - Trend in the Ismea index quantity and price indices for fish products purchased by Italian families (2000-2010) (Source: Ismea, Family panel).

Despite being surrounded by sea, Italy has an appreciably lower per capita fish consumption than that of Spain (44.8 kg in 2007) and France (34.2 kg), although higher than that of Germany (15.3 kg). The figures for Italy are more or less similar to those for Greece and the United Kingdom. Portugal stands out among the 27 EU countries with a consumption of 60 kg per capita.

Perception and habits of Italian fish product consumers: the imagined world and daily reality

Perceptions of fish product consumers

Consumers attribute various qualities to fish products, some of which have a rational basis, whereas others are based purely on feelings. Thus, for certain aspects they have an ideal vision related to emotive and sentimental factors, which tends to diminish at the time of purchase.

These are the main results from a recent Ismea survey of preferences and opinions among fish product consumers. What are the perceptions of Italian fish product consumers? The study shows above all a clear preference for fresh fish products compared to other types of fish (deep frozen, frozen and defrosted). Consumers attribute various positive values to it, some with a rational basis (fresh products taste better taste and are more nutritious) and others based on feelings (the purchase and consumption is more gratifying for the consumer, who sees a particular appeal in fresh fish, particularly in coastal areas where there is a genuine fresh fish culture). The perceived obstacles to the consumption of fresh fish are the lower hygiene-health guarantees, its less practical nature, the difficulty of preparation (particularly in inland areas) and above all the higher purchase price. However, these negative factors have a lower impact than the positive variables.

At a rational level, consumers also believe that farmed fish offers better safety guarantees and is cheaper than wild fish, but has less flesh and flavour (figure 14.13). In terms of feelings, however, farmed fish is perceived as artificial and standardised, whereas wild fish is associated with a series of positive values, which make it better overall from a quality perspective. These perceptions are even more evident among consumers in coastal areas, where there is a deeply rooted culture of fish caught from the wild.

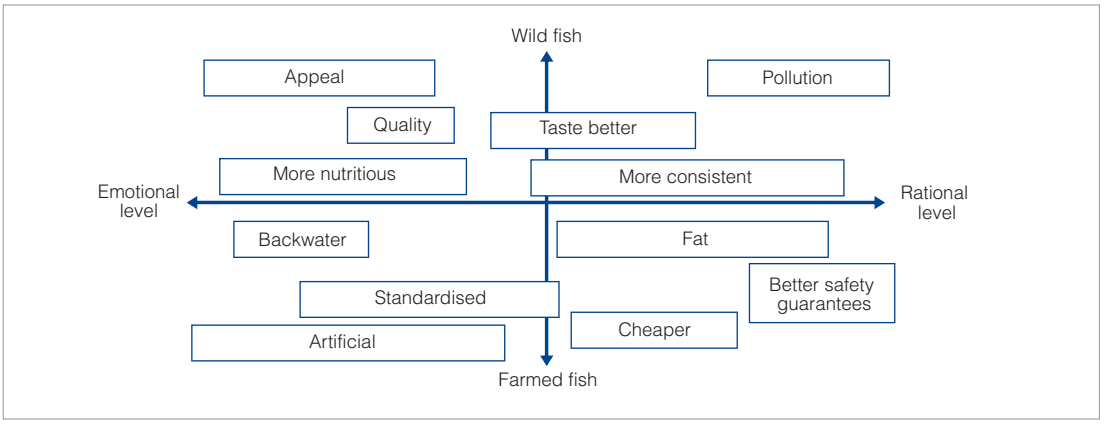


Figure 14.13 - The perception of wild fish compared to farmed fish (Source: Ismea).

In comparison with meat, the main product replaced by fish, purchase price is the main factor making fish less competitive; in addition to this, particularly among consumers in inland areas, there is the greater difficulty of preparation. Fish is also perceived in these areas as less safe

from a hygiene-health perspective, because it is less consumed and less familiar than meat. The opposite is the case in coastal areas, even if short distances from the sea are sufficient to create a different attitude towards fish consumption than that found on the coast. Opinions of fish in terms of wholesomeness are positive everywhere, however, as it is considered easier to digest than meat, with a lower fat content, and therefore a fundamental component of a healthy diet. In regard to places of purchase, the research shows that the preference in inland areas is for hypermarkets and supermarkets: the reasons given include convenience, greater trust in compliance with hygiene-health standards, due to the implementation of controls and the presence of more information, together with other values connected with feelings, such as the factor of habit, which implies assurance and trust in the distribution chain. Consumers in coastal towns associate the modern distribution sales points with a sense of coldness and sterility, although they acknowledge the guarantee of hygiene and control; they nevertheless believe that they can buy a fresher product, with a more intense and genuine taste, from the street market. Finally, with regard to the origin of the fish, the consumers that participated in the survey showed a clear preference for a nearby origin, such as the Mediterranean Sea, or better still, “Italian seas”. This preference is based on greater freshness, due to shorter transport times and more effective and systematic controls. It is felt that controls are more random in distant, unfamiliar countries, therefore without the factor of assurance that consumers have with fish from a nearby source.

Purchase habits

The preferences and opinions expressed by the consumers nevertheless contrast in reality with different purchase behaviour, influenced at the moment of decision by the price factor, the practicality of purchase and lack of time. Fresh fish products now account for little over half of domestic purchases in volume and value (the figures fell by about 4 percentage points during the period 2000-10), while the remaining share consists of preserves and semi-preserves (mainly canned tuna, the most highly consumed product, with a share of around 19% of total domestic consumption) and packaged frozen/deep frozen fish (soft seafood, fish fingers and cod fillets); total domestic consumption for both categories has increased over the last 10 years (figure 14.14). The purchase share for unpackaged frozen fish and dry, salted and smoked fish is marginal and in decline.

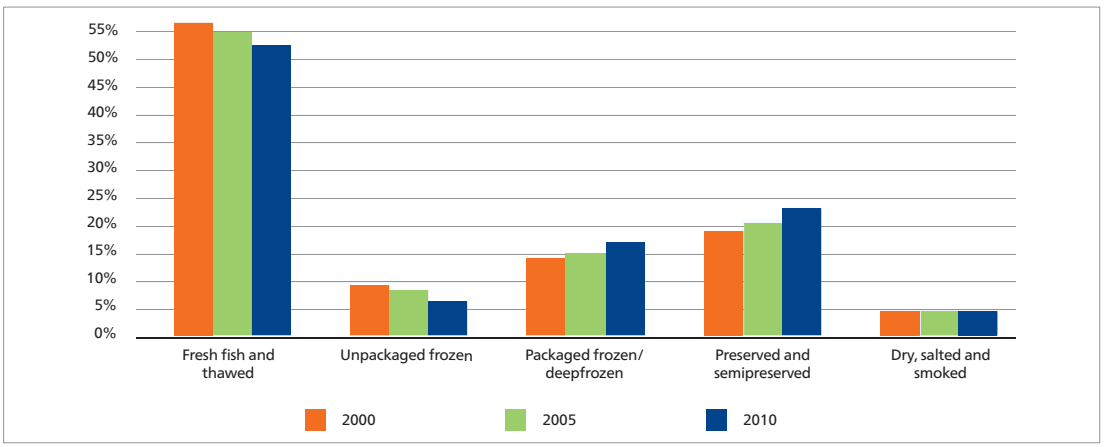


Figure 14.14 - Composition of domestic fish product consumption in Italy (% share by volume) (Source: Ismea, Family panel).

The consumption of fresh fish products is clearly focussed on a limited number of species: the top ten products accounted for almost 56% of domestic demand in 2010 (around 46% of expenditure) and four of the top five are prevalently or almost exclusively from fish farms, i.e. mussels, gilthead bream, sea bass and Manila clams, with anchovies being the only top ranking product from national capture fisheries (figure 14.15). In addition to these, there are also other farm products of national origin, such as white trout and rainbow trout. If the top 20 products consumed by Italian families are considered, these amount to just below 80% of total fresh products.

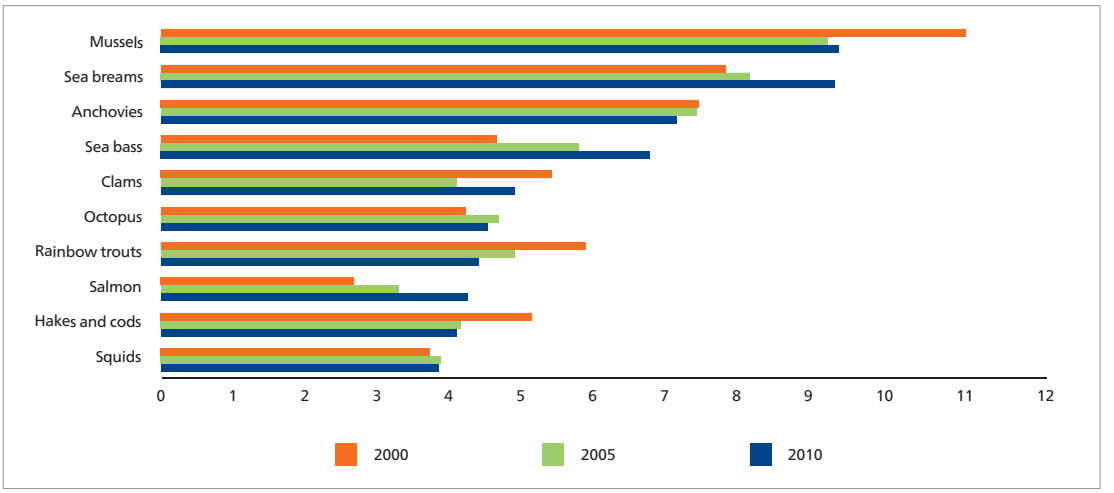
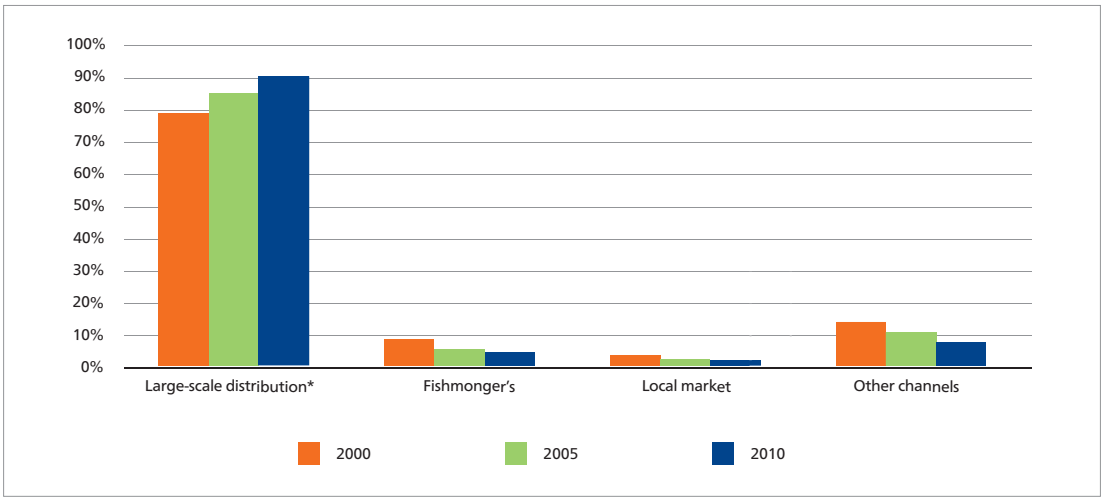


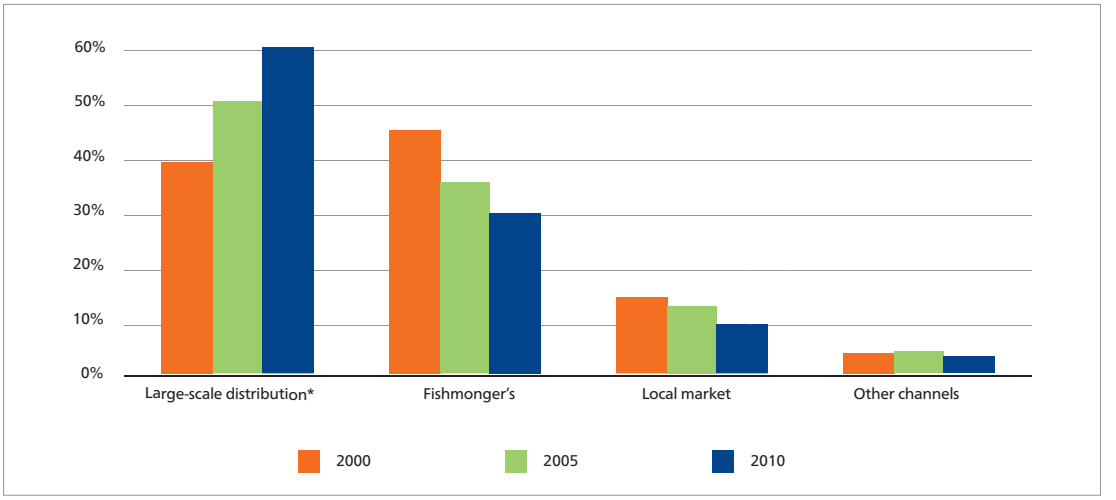
Figure 14.15 - Incidence of the top ten products on total fresh fish purchases by families (% share by volume) (Source: Ismea, Family panel).

Among the main fresh products, there has been a clear increase over the last ten years in domestic consumption of gilthead bream, sea bass, salmon, shrimps, caramote prawns and perch due to the import of products at very low prices.
The particularly difficult economic circumstances of recent years have increased the tendency among Italian consumers to purchase more farmed or imported fresh products and their preference for mass distribution sales points, where these products are sold at competitive prices. Modern distribution favours these products because they are available in large quantities, with standardised quality and low price fluctuations – requirements that cannot be matched by the fragmented nature of the national catch, with a wide variation of landed species and inconsistency in sizes. The change in lifestyle, which is more frenetic now than in the past, also explains the growing tendency among consumers to buy fish from large retail outlets, due to their wide range of products that are simple to cook or ready for consumption.
The modern distribution network has thereby consolidated its market share in the sale of processed fish products over the last ten years (figure 14.16); at the same time, it has also become the market leader in the sale of fresh fish, to the detriment of traditional fishmongers. For example, the market share by volume held by fishmongers, mobile vendors and street markets in the sale of fresh fish has steadily fallen from 58% in 2000 to 47% in 2005 and 38% in 2010 (figure 14.17).



* Hypermarkets, supermarkets, self-service, discount.
** Unpackaged frozen fish, packaged frozen/deep frozen fish, dried, salted and smoked fish, preserves and semi-preserves.

Figure 14.16 - Market share of the main distribution channels in processed fish sales (% by volume) (Source: Ismea, Family panel).**



* Hypermarkets, supermarkets, self-service, discount.

Figure 14.17 - Market share of the main distribution channels in the sale of fresh and defrosted fish* (% by volume) (Source: Ismea, Family panel).

The sustainability of fish consumption

The demand for fish products in Italy is largely met by imports. Import levels were around 74% in 2010 (58% in 2000), while the normalised balance was around -75% (-68% in 2000), indicating a net disadvantage in the balance of trade for fisheries and a poor level of export coverage (8.6% in 2010).

The dependence on imports has increased constantly over time. The determining factor over the last ten years has been the visible decrease in Italian fish production (-30% from 2000 to 2010), mainly due to a reduction in fished products. Domestic demand (growing slightly only due to the population increase) has therefore been met through a gradual reliance on purchases from abroad: imports grew by around 30% in terms of volume during this period, while exports remained stable. 80% of the import volume in 2010 consisted of numerous processed products, mainly frozen (shellfish, including squid and squidlets, octopus, cuttlefish and flying squid; crustaceans, including caramote prawns, shrimps, caridean shrimp and Norway lobster; and fish, including swordfish, iridescent shark, hake and cod – both whole and filleted – as well as tuna loin from the tuna industry and other fish products, such as fish fingers), prepared, preserved (mainly tinned tuna, as well as caridean shrimp, Atlantic bonito, anchovies, sardines and mussels), dried, salted and smoked. The list of fresh fish is much more limited, with mussels, gilthead bream, sea bass and salmon accounting for 45% of total fresh product imports in 2010 (9% of total imports). The large dependence on imports, the progressive decrease in the national catch and the concentration of consumption on a few species is related to the topic of sustainable eating habits.

According to FAO estimates, 28% of world fish stocks are overexploited, 3% are depleted and 1% are recovering from depletion; 53% are fully exploited and only 3% are underexploited, with a further 12% moderately exploited.

Most stocks of the main species fished globally are fully exploited (which means that their catches are close to the maximum sustainable limit and will not show further increases). These include, for example, stocks of Peruvian anchoveta (*Engraulis ringens*) in the South-east Pacific, Alaska pollock (*Theragra chalcogramma*) in the North Pacific, and various species of anchovies; 60% of the 23 tuna stocks are fully exploited, while 35% remain underexploited.

In addition to the excessive exploitation of fishery resources, which is well beyond the regeneration capacities of marine ecosystems, there are also by-catches of undesired fish, illegal fishing and climate change.

In this worrying global fisheries scenario, the growing demand for fish (world consumption per capita, which was 17.4 kg in 2011, will reach 17.9 kg in 2020) is met by the continuous increase in aquaculture, with forecasts that the share of fish for human consumption produced by aquaculture will overtake that from fisheries by 2015. The development of aquaculture, however, raises certain questions related to its sustainability, in consideration of the resources used (other fish have to be caught to feed farmed fish), the environmental impact (the destruction and pollution of aquatic habitats and the use of enormous quantities of water) and food safety (due to the use of antibiotics, drugs and other chemical substances in farming).

Assessments should be made in this context, specifically in reference to the Italian situation, of the need to reduce consumptions or to select fish in a more enlightened manner, favouring species that are not consumed because they are relatively unknown to consumers. These are neither more expensive nor less appetising, but merely unrelated to dietary habits that have become settled on a few species.

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