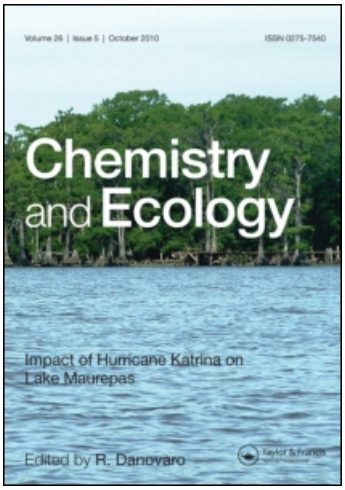

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V. Borsellino[a]; M. Crescimanno[a]; V. De Stefano[a]
[a] Dipartimento di Economia dei Sistemi Agro-Forestali (ESAF), Università degli Studi di Palermo, Palermo, Italy

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Political and economic fishery management in the Channel of Sicily

V. BORSELLINO*, M. CRESCIMANNO and V. DE STEFANO

Dipartimento di Economia dei Sistemi Agro-Forestali (ESAF), Università degli Studi di Palermo, Viale delle Scienze 13, 90128 Palermo, Italy

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Fishery activities in the Mediterranean Sea are characterized by a number of distinctive features which include relative extension of national to international waters, straddling and shared stocks, overall characteristics of fishing activities, availability of scientific information and the absence of a policy fisheries management in many coastal States. Therefore, the principal objective of this paper is to portray a framework on the politics of management of the fish resources in the Channel of Sicily, by examining both the CFP in the Mediterranean or the Italian–Tunisian relationship, and then to inspect the fishing effort of the Sicilians and Tunisian productive structures to carry out a comparative analysis. We also analysed the economic performance of the representative segments of the island fleet in the Channel of Sicily. The information gained from the economic results can be used by local institutions to draw up plans for intervention following European requirements.

Keywords: International cooperation; Sicily; Tunisia; Fishing effort; Economic parameters

1. Introduction

The world of fishing is going through dramatic changes worldwide, largely due to technical innovation, new powers emerging in the field, and the legitimate aspirations of many developing countries hoping to develop a competitive structure in the fishing sector. Facing a situation of over-fishing, which has caused a reduction in catches since the 1990s, it has become of vital importance to ensure the sustainable management of the sector's development, based on the balance between exploiting resources and the environment [1].

The contribution made by the 25 EU countries has become an ever-decreasing proportion of world catches. In the 20 yr from 1982 to 2002, it fell from 10.7% to 6.7%. In the Mediterranean Sea, which represents 8% of EU catches (2002), the fall in catches from EU countries is equal to 28.4%, compared with a fall of 16.4% in non-EU countries (according to FAO data) [2].

This paper seeks to outline the state of fishing in the Channel of Sicily. Following a brief examination of the Common Fisheries Policy (CFP), with particular reference to the

*Corresponding author. Email: valeria.borsellino@unipa.it

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Mediterranean, we will examine the structural, social, and economic characteristics within the sector concerning the south-west of Sicily and Tunisia.

A representative sample of Sicilian fishing companies was examined, and the economic data concerning these companies were evaluated. The companies in the sample used fishing techniques which were most widespread in the area under examination (otter trawling, mid-water pair trawling, purse seining and long lining, and small-scale fishing with gillnets and purse seines, trawls, long lines, lines, and pots).

The economic indicators determined were then examined in relation to parameters regarding fishing effort, capacity (tonnage), and activity (days spent at sea), in order to determine the economic productivity [3] of the various fishing techniques used in the Channel of Sicily (according to current regulations). These results are used as a technical tool for policymaking.

The study is divided into three parts. The first is an analysis of policy guidelines laid out by the European Union, examing specific points of action for the Mediterranean, also in relation to Italian–Tunisian relations. The second part gives a structural overview of fishing in the Mediterranean, with particular reference to Sicily and Tunisia, while the third part is dedicated to a microeconomic analysis of a sample of Sicilian fisheries operating in the Channel of Sicily.

2. Management policies for European Union fishing resources and proposed course of action for the Mediterranean area

2.1 *Reference framework*

The Mediterranean Sea has a surface area of 2.5 million km^2, equivalent to 0.7% of the world's waters, and its total coastal area stretches for approx. 46 000 km. It is surrounded by a number of countries, and the distance between their neighbouring coasts is never more than 644 km from each other. The continental shelf is generally narrow, and the fishing depths are fairly close to the coasts within territorial waters. This situation, when considered together with a whole series of political issues, probably explains why no coastal country in the Mediterranean has so far made provision in the area of setting up exclusive economic zones (EEZ) as outlined by the 1982 Montego Bay Convention. This is the area adjacent to the territorial waters where the coastal state has:

- sovereign rights to the mass of water lying over the sea bed, for exploration purposes, use, conservation and management of natural resources, living or nonliving, including the production of energy from the waters, currents or winds;
- jurisdiction in matters of installation and use of artificial islands or permanent structures, scientific marine research and protection and conservation of the marine environment.

The exclusive economic zone (EEZ) may extend as far as 322 km from the line marking the beginning of territorial waters. In the case of territorial waters of 19 km, this may therefore reach a maximum of 303 km.

'Mare nostrum', in fact, is an important stretch of water, through which an average of 25% of the world's oil passes (about 350 million tonnes each year). This situation is of primary interest to the international community, and in particular to countries with strong naval interests, such as the USA, in order to guarantee freedom of navigation at all times.

The delimitation of EEZs between countries with adjacent or facing coasts should be done by agreement so that the most balanced solution is found. Sovereign rights exploration, exploitation, and conservation of natural resources of each country in its own EEZ are mainly expressed in exclusive fishing rights. For an enclosed sea such as the Mediterranean, it is

vital that there be cooperation in fishing. This exigency was acknowledged in the form of the General Fisheries Council for the Mediterranean (GFCM), established on 24 September 1949 under the aegis of the FAO. This body, made up of all the coastal countries of the Mediterranean, has an advisory role for the Mediterranean area as regards development, conservation, and rational management of living marine resources. To achieve this aim, the Council may recommend the use of appropriate measures for regulating fishing methods to its member states, while seeking to promote community projects for the management and protection of marine species.

In spite of the obvious need to develop cooperation between countries in the Mediterranean, the situation remains difficult and fragmentary, characterized by numerous inconsistencies. All the coastal countries in the Mediterranean adopted the 19 km limit for territorial waters, except Syria, which in 1981 announced a limit of 56 km, Greece, which maintains a limit of 10 km from the coast, and Turkey, which also has a frontier of 10 km, extending to 19 km in some stretches. Spain unilaterally instituted an area of fishing protection stretching for 79 km, Malta has extended its exclusive fishing rights to 40 km, and so has Algeria (52 km to the west and 84 km east of Ras Tenès). In the same way, among the areas declared to be repopulation areas in open sea, there is the so-called 'Mammellone', the fishing area to the south-west of Lampedusa, over which Tunisia now claims exclusive fishing rights (in part corresponding to those outlined in the EEZ). Many attempts have been made over the years by various countries to extend their own territorial waters or EEZs, particularly Croatia, Albania, and Libya.

Within this scenario, there is the Community's Common Fisheries Policy, which is divided into four main areas: the management and preservation of fishing resources, market policy, structural policy and relations with other countries.

The most recent guidelines of the CFP will be examined, with an in depth look at the contents of the European Action Plan for the Mediterranean and the technical measures proposed by the Commission and submitted for academic, political and professional discussion.

2.2 *Common Fisheries Policy*

The Common Fisheries Policy, whose first measures were adopted in 1970, but were actually only fine-tuned at the beginning of the 1980s, covers four main areas, in which many legislative changes have taken place, but in some areas the new laws have hitherto been largely ineffective. In recent years, the Commission has produced the Green Paper, 'The Future of the Common Fisheries Policy'—COM (2001) 135 def. [4] document which outlines the policies of the EU for the coming years, providing a basis for debate on the CFP reform, which came out in December 2002. The Green Paper contains the challenges and objectives that Europe must face in order to regulate the fishing sector.

The questions which concern the Commission are: (1) the alarming state of a large part of the fishing stock, which has exceeded the biological safety limits; (2) the capacity of the community fishing fleets, which is far greater than that necessary to sustainably exploit fishing resources; and (3) the economic fragility of the fishing industry, both in terms of profitability and in terms of the continual fall in employment. Between 1990 and 1998 alone, a loss of 66 000 jobs was recorded in the fishing 'catches' sector, and a fall of 14% in the processing sector. In addition to this is the fact that in the last decade, the international situation has changed dramatically, and developing countries now contribute to a greater degree to the world's fishery problems, having fully justifiable economic expectations.

Based on the Green Paper, during 2001 the Commission started a vast consultation initiative, which involved all the interested parties, and more than 300 observations were presented.

In 2002, at the end of this initiative, the Commission published a document for the Council and Parliament concerning the conservation and management of resources in the Mediterranean Sea, taking into account the details and application of the CFP in the Mediterranean (COM (2002) 535 def.) [5]. In the same year, Parliament adopted a resolution in which it called for

> a fisheries policy based on rational and responsible management of stock, based on the protection of fish stocks and the protection of the way of life of those who traditionally depend on the sea. It must also safeguard the fundamental principal from which these aims derive, that of relative stability; a policy which promotes a fair and just system of distributing fish resources according to the specific needs of the regions that depend on fishing, a policy which is impartial and stable, workable and submitted to community checks.

The above makes clear the new aims of the EU in modifying the current CFP, and an admission of the incapability of the previous norms in offering economic sustainability to the fishing sector or to effectively halt the fall in community fish stock, which has currently exceeded biological safety limits.

Regarding the Commission's proposal to end public subsidies for the fleet, Commissioner Fischler observed that instead of protecting the fleet, subsides actually weaken it because they help maintain fishing capacity at a level which implies exploitation of fish stock beyond their means.

The only aspect that the Commission does not address is that regarding the organization of the market, because it believes that the growing demand for fish and higher prices due to scarcity of the product will protect fishermen from the effects of stock reduction. The CFP reform was launched during the Agriculture and Fisheries Council held in Brussels on 16–20 December 2002; the new measures, which took effect from 1 January 2003, concern conservation and structural policies. The aims of the CFP were re-examined and redirected towards the sustainable exploitation of living marine resources, based on expert scientific advice and adopting a precautionary approach to fishery management on one hand, and sustainable fish farming on the other. Regulations 2369/2002, 2370/2002, and 2371/2002 form the main normative tools on which the reforms are based. Regulation 2369/2002, which modifies CE 2792/99, concerns structural policy and guarantees coherency between this and resource protection policy. One innovative measure is that found in 2370/2002, which institutes emergency community measures for the dismantling of fishing fleets during the period 2003–2006, should fisheries be hit by plans to replenish stock, thereby limiting fishing.

Regulation 2371/2002, concerning conservation and sustainable exploitation of fishing resources within the CFP, proposes a series of measures guaranteeing the sustainable exploitation of living aquatic resources from an economic, environmental, and social point of view.

On the burning issue of conservation and sustainability of fishing resources, the Council has adopted as a priority a long-term recovery plan regarding the fishing of stocks that have exceeded their biological safety limits, and a long-term precautionary approach management plan, to guarantee the sustainable exploitation of resources and to keep stock within their biological safety limits. These plans will include long-term objectives for fishing and will avoid sudden modifications to fishing limitations (TAC) from one year to another, allowing fishermen to plan their activities more accurately.

A new positive point of these reforms is the steps it takes towards involving the sector in the work of the CFP, with creation of the Regional Advisory Councils (RAC). Community policy regarding the Mediterranean Sea, which to date has been only partially considered, is reassessed, taking into consideration the necessary economic, environmental, and social equilibrium. The Commission has thus presented a discussion paper on the problems of Mare Nostrum, which will become the basis for an Action Plan for the Mediterranean.

2.2.1 Action Plan for the Mediterranean. In October 2002, the Commission sent a document to Parliament and the Council—COM (2002) 535—concerning a Community Action Plan for the conservation and sustainable exploitation of fisheries resources in the Mediterranean Sea under the Common Fisheries Policy. The plan is based on the Barcelona system, which proposed an initial plan of action for the Mediterranean in 1975, although the issues dealt with concerned the environmental rather than those of preserving fishing resources (this latter point was referred to the General FAO Council for the Mediterranean, GFCM). Nearly 30 yr later, the issues surrounding fisheries in 'Mar Nostrum' have expanded and now take place within a political arena that has changed considerably.

The new Action Plan initially lays out some specific points about the Mediterranean, namely (a) the limited area of national waters compared with international waters, which has led to a substantial lack of EEZ, (b) the relative importance of common and trans-zonal stock, (c) the traditional/artisanal nature of fishing leading to limited capital investment, (d) the limited scientific partnership between institutions working on the problems of fishing resources management, and (e) competition, especially at certain times of year, between commercial and sport fishing. Regarding the stock levels of some pelagic and demersal species, the plan highlights the need to reduce the fishing effort by 15–30%, and to adopt types of management that avoid exceeding the safety limits of some stock.

If, on the one hand, the scientific community feels the need to include a specific course of action by the CFP in the Mediterranean sea, on the other hand it cannot be denied that 'Mare Nostrum' requires ad hoc measures, different from those required by continental oceans and by the Atlantic. Therefore, if the objectives are to be referred to the EC, the management of maritime activity should involve different institutions according to the specific type of fish under consideration. In the case of highly migratory species, fishing should be handled by the EC together with the GFCM and ICCAT; in the case of common fishing, it should be subject to community/international regulation with agreed measures coming from GFCM and with the help of the Scientific Advisory Committee (SAC); finally, in the case of the fishing of species present in national waters, fishing should continue to be managed on a national level.

Indeed, in the Commission's proposal, the most relevant topics regarding fishing in the Mediterranean are considered, from international policy to restricting levels of fishing effort, from the protection of fishing resources at risk to increasing scientific research—a necessary corollary to regulate the evolutionary process of common policy for fisheries.

In order to clarify the European Commission's chosen line of policy, the aims, strategies, and those involved in the European action plan are explained in the following section.

In October 2003, the Commission presented a whole series of management measures to deal with the causes of over-fishing, with reference to unsustainable fishing methods practised in the Mediterranean. The proposal is based on existing measures but also puts forward new measures, such as the progressive enlargement of mesh size, the enforcement of vetoes on certain trawling activities in order to protect juveniles, specific initiatives regarding swordfish, an improvement in the checking system, and the division of management responsibilities among the Union and its member states.

In spite of the effort made by the Commission to gather consensus on the proposal, the organization of conferences on Mediterranean fishing (Venice 2003) and the creation of a trans-mediterranean association of fisheries, Medisamak (May 2004), the normative process has not yet been completed (at the time of writing). The European Commission is, however, reluctant to withdraw the proposal for new Mediterranean Regulations containing new technical measures for fishing, a proposal which, nevertheless, has been refused by the European Parliament, by the Social and Economic Committee, and by various fishing Associations. These latter groups claim that the revision of technical measures was just one of the many areas of intervention that should be in the Mediterranean Plan, together with development of

international cooperation, the streamlining of current measures in the Mediterranean basin, and the acquisition of necessary scientific knowledge—elements which are neglected in the Commission's proposals.

2.3 *Relations with other countries and fishing agreements*

The absence of EEZs in the Mediterranean allows the exploitation of fishing resources also by fishing fleets that do not come from coastal countries, such as Japanese and Korean fleets, etc., attracted by stock of high commercial value, like bluefin tuna and swordfish. The lack of fishing resources in some traditional fishing areas, caused by over-fishing, induces coastal countries to ratify all the relevant international agreements and to give their full support for the conservation and sustainable exploitation of fishing resources in international waters. Without doubt, international cooperation contributes to reinforcing the regional organization of fishing, as laid out by the convention on marine law and by the UNFA (United Nations Fish Agreement; The United Nations convention on marine law in 1982, coming into force in November 1994, recommending the setting up of EEZs for the coastal states, contains some gaps regarding management of highly migratory and trans-zonal fish stock, which the UNFA, set up for this aim in August 1995, intends to bridge), and helps efforts made to stamp out illegal, un-notified, unregulated fishing taking place in international waters.

Adhering to the United Nations Convention on marine law in 1982, the European Community and other cosignatory states have undertaken, among other things, to find a balance between the rights and obligations of coastal states and those of countries which carry out fishing activities on the high seas. This balance requires, as its main aim, the sustainability of fishing-resource exploitation.

Thanks to its exclusive responsibility for fishing, the European Union is able to coordinate international efforts together with other countries or other international organizations in the field of fishing. The European Commission thus negotiates bilateral agreements with other countries in the name of the Union, on the strength of a mandate given by the Council of ministers, and takes part in various regional fishing organizations (RFOs). The bilateral fishing agreements set up by the European Union with other countries make up the general framework for the access of the EC fleet to the waters of those countries. Within each agreement, the fishing protocols specify the conditions for the implementation of the agreement (technical, financial, types of resources available, etc.) [6].

Regional fishing organizations (RFOs) originate from international agreements and form a framework within which government representatives can meet to agree on ways to manage high sea fish resources and trans-zonal stock. Such organizations put forward recommendations regarding management and conservation measures, based on the best scientific opinions available. Recommendations put forward in this way must be observed by all the parties belonging to the RFO.

The definition of fishing agreements differs according to the partnership. For countries in northern Europe, for example, which have the means to fully exploit their fishing resources, agreements tend to be reciprocal. The Community and these countries exchange opportunities to fish in each other's waters, whereas in the case of other countries, especially those of Africa and the Indian Ocean, but also Greenland (countries which are not yet able to fully exploit their fishing resources), the Community gives financial compensation in exchange for access to their fishing areas [7]. It also establishes proposals with them which aim to sustain development of their fishing sector and to contribute to sustainable fishing in their waters. Financial contribution is also required from shipping companies that wish to operate in the area of these agreements. The progressive removal of fishing resources, however, makes it increasingly

difficult for the EU to stipulate bilateral fishing agreements that would allow its fleets to have access to surplus stock present in the waters of other countries. Thus, in order to deal with the immediate situation, the Commission, within the CFP reforms, has proposed a strategy based on the evaluation of stock which Community fishermen have access to outside EU waters on one hand, and on the other hand, on the creation of a whole framework which could help the creation of partnerships with developing countries. These new partnerships aim to promote dialogue with the countries in question, to help them create a policy which enables them gradually to practice sustainable fishing in their waters, contributing at the same time to achieving their aims of development. These agreements aim to create joint ventures for the development of fishing in other countries and guarantee a quota of certain species mentioned in the agreement. In conclusion, it may be said that stabilizing international legal relations and creating effective cooperation are essential elements in the future of community high sea fishing [8].

2.4 *Italian–Tunisian relations*

The contentious issues surrounding fishing in the waters around the coast of North Africa, especially those of Tunisia, are an old problem but still very much present today, caused by the need for Sicilian fisheries, particularly those of Mazara, to extend their fishing areas into ever deeper bathymetric zones (600–1000 m). This requirement springs from the need to compensate for the limited resources available in the Sicilian coastal area along the traditional bathymetry of 50–400 m [9]. The shift of the fleet towards the African coast has obviously led to changes in fishing techniques for the fisheries (especially for catching red shrimp), investments in larger boats, and greater business management, requiring more crew members, higher maintenance costs for boat and parts repair, and more advanced technology for navigation and fish storage. The invasion of Sicilian fishing boats close to Tunisian territorial waters caused the phenomenon of Sicilian boat confiscation in the Sicilian channel during the 1970s and 1980s [10].

The most contested area has always been the area of high seas south-west of Lampedusa, known as the 'Mammellone', which the Italian government declared an area of fish repopulation but for which Tunisia has claimed national responsibility for years. The issue which has damaged Italian–Tunisian relations for over 20 yr was resolved at the beginning of the 1990s with the creation of the first Italian–Tunisian joint ventures.

In 1992, the first joint venture was set up between a Mazara and a Tunisian company, which was followed by the setting up of six joint ventures in 2000, between five shipping companies from Mazara del Vallo and one from Marsala, and a similar number of Arab companies, working on cooperation projects set up between Federpesca and UTAP (Tunisian Union of Agriculture and Fisheries), receiving aid from FIFG through MOP Sicily 1994–1999 [11].

Any new progress begun by the Italian–Tunisian joint fishing ventures, however, is slow to take off, partly due to Tunisian refusal to accept obsolete Mazara vessels.

Over recent years, 17 Italian–Tunisian joint fishing and fish farming ventures have been set up, notably under the Governorship of Bizerte. In the industrial sector, there are numerous companies which deal with processing, freezing and deep-freezing of fish products. Among these are seven companies based entirely on Italian investment.

3. Structure of Mediterranean fishing

Fishing in the Mediterranean basin represents an activity of great economic, social, and biological value, whose characteristics have not always been fully appreciated. Yet, fishing is

an activity which throughout history has created bonds of common cultural identity between populations which are otherwise very different from each other. It should be said, however, that the simultaneous presence of countries with high socio-economic levels such as those of the European Union, with countries with fragile economies and unstable political situations, makes joint management of resources and, therefore, of fishing activities more complicated. Mediterranean fishing has always been considered as artisanal labour-intensive work, largely located along coasts and requiring a wide range of gear and aimed at a broad number of species. Thus, it is very different from fishing in continental oceans or in the Atlantic.

The Mediterranean fleet numbers 89 953 boats (see table 1), of which 53.8% belong to Community countries, with a high proportion from France, Greece, Italy, and Spain (51.2% of the Mediterranean total). Among other Mediterranean countries, there are large fleets from Croatia (15.4%) and Tunisia (14.0%).

Catches in 2001 amounted to 991 062 tonnes, equivalent to 1.2% of world catches, but have been continually falling (−8.1%) since at least 1996, in spite of the fact that there appears to have been an increase if we measure from 1980 (when the catch totalled 873 000 tonnes). The main species that are fished are sardines (19.6% of total catches in 2001) and anchovies (10.0%), while bluefin tuna constitutes a small percentage (2.4% of the total), as does swordfish (1.5%) [12].

As regards employment, records show that the sector employs 448 492 workers (1997), 24% of whom are in the Community and the rest from other Mediterranean countries.

3.1 *Fishing in the Channel of Sicily*

The naming of the Straits of Sicily was introduced by the national cartographic association, acting on a recommendation by the Bureau Hydrographic International (BHI), aiming at bringing marine toponyms into line. The term refers to the stretch of sea between Tunisia and

Table 1. Mediterranean fleet: number of vessels (1998).

Countries	Vessels (*n*)	Rate (%)
France	1725	1.9
Greece	20 496	22.8
Italy	18 779	20.9
Spain	5081	5.6
Cyprus	500	0.6
Malta	1767	2.0
Slovenia	56	0.1
Total Mediterranean European countries	48 404	53.8
Albania	146	0.2
Algeria	2310	2.6
Croatia	13 814	15.4
Egypt	2408	2.7
Israel	385	0.4
Lebanon	2500	2.8
Libya	749	0.8
Morocco	3563	4.0
Serbia and Montenegro	193	0.2
Syria	1340	1.5
Tunisia	12 574	14.0
Turkey	1567	1.7
Total Third Mediterranean countries	41 549	46.2
Total Mediterranean countries	89 953	100.0

Source: ISMEA, FAO.

Sicily, between Cape Bon and Cape Lilibeo. From a legal point of view, the Channel of Sicily is not an international strait, since, in the middle, there is a 80-km-wide area of international waters stretching between the territorial waters of Italy and Tunisia (where there is the freedom of transit).

3.1.1 Sicily. In order to provide the most precise and detailed picture possible of the structure of regional fishery in the Channel of Sicily, the entire fishing effort carried out in 2004 by Sicilian fishing fleets along the western coast overlooking the area in question has been analysed, taking into consideration capacity, activity, and the composition of the fleet.

Research was conducted by analysing data regarding production by the 11 fisheries located along the southern coast of western Sicily (Mazara del Vallo, Porto Empedocle, Lampedusa, Licata, Sciacca, Egadi islands, Marsala, Pantelleria, and Trapani), which administratively speaking come under the three coastal sectors of Mazara del Vallo, Porto Empedocle, and Trapani (see figure 1).

Information regarding company production is based on the EU register of fishing fleets, available from the European Commission General Directorate of Fishery [13] (http://europa.eu.int/comm/fisheries/fleet/index_it.htm). In 2004, the fishing fleet belonging to Sicilian ports along the western stretch of coast facing the Channel of Sicily numbered 1080 boats, equivalent to a tonnage of 40 149.8 GRT and 45 845.0 GT with an engine capacity of 158 855.5 kW. The average tonnage for the vessels was 37.18 GRT (43.25 GT), while the average engine capacity was slightly less than 150 kW per vessel (see table 2).

Comparing these indicators with the national 'fishing capacity', the importance of the fleet in question emerges. Although, numerically, it represents only 6.9% of the national fleet (15 572

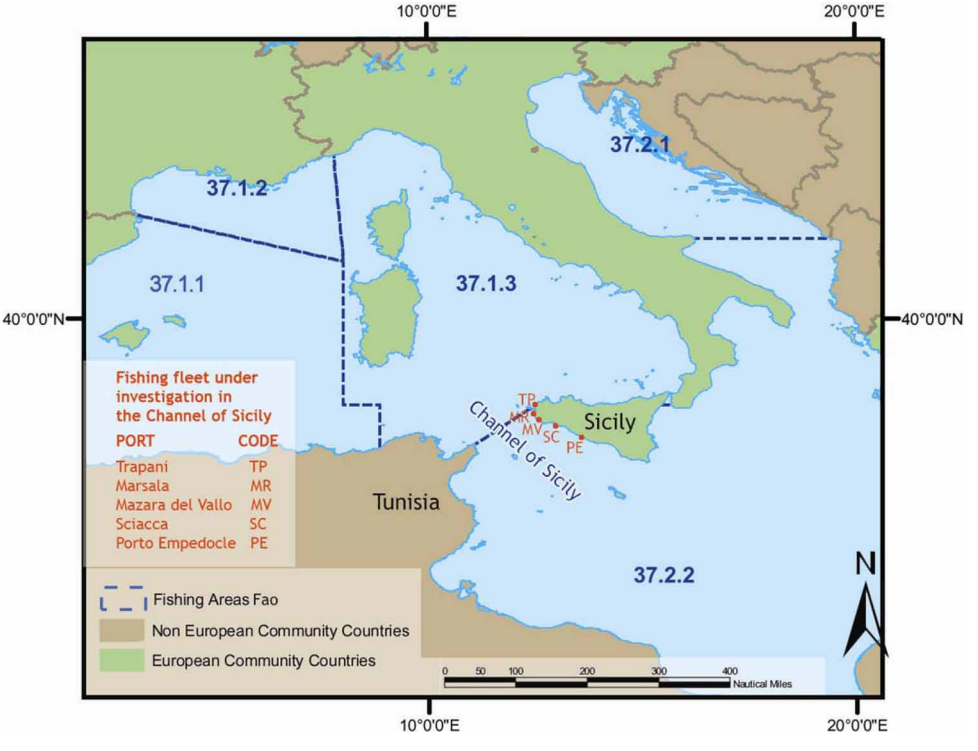

Figure 1. Channel of Sicily, Mediterranean Sea.

Table 2. Structural characteristics of Sicilian fishing fleet in the ports of the Channel of Sicily (2004).

Indicators	No.	$\bar{x}$	S	CV
Vessels	1080	–	–	–
Gross tonnage (GT)	45 845.00	43.25	75.87	1.75
Gross registered tonnage (GRT)	40 149.79	37.18	62.92	1.69
Engine power (kW)	158 855.46	147.09	194.12	1.32
Overall length (m)	16 062.82	14.90	8.95	0.60
Construction year	–	1974	13.53	–

Source: Our processing on the EU Fishing Fleet Register database.

boats), it does, however (as far as size is concerned) represent 12.3% of engine capacity and more than a fifth of the tonnage (expressed in GT) used throughout Italy (respectively equal to 1 289 117.6 kW and 214 349.6 GT).

Division of the fleet based on levels of tonnage gives the first key to understanding the infrastructures: more than half (57.0%) of vessels reach less than 10 GRT; in terms of capacity, this sector reaches barely 6.7% of the entire tonnage (see table 3).

Such figures highlight the artisanal origins of the fishing activities of the Sicilian ports examined [14], confirmed by the fact that vessels exceeding dimensions of 100 GRT, which make up a productive segment of a more industrial nature, represent barely 13.1% of the fleet being examined.

Dividing the fleet by levels of kW, the highest number (56.7% of the total) are those types characterized by a lower engine capacity (less than 100 kW), while out of the rest of the fleet, the most frequent level is that of engine capacity over 300 kW (13.15%) (see table 4).

One particularly significant indication of the fleet efficiency is that of the age of its vessels, also because of the effects that this would have in terms of subsidized financial investments. Information regarding the age of the fleet shows the high level of obsolescence of the vessels (with an average age of 25 yr), and the low rate of new investment into the sector.

Of all the fleet, 58.7%, equivalent to 59.4% of total tonnage, is older than 25 yr, while more recently constructed vessels (less than 5 yr old) represent just 3.1% of the fleet and 9.4% of total GRT (see table 5).

A breakdown of the Sicilian fleet according to fishing gear (regarding the most frequently used equipment over the year) shows that the most commonly used gear is bottom otter trawls

Table 3. Number of Sicilian fishing vessels in the ports of the Channel of Sicily by tonnage classes (2004).

Tonnage classes (GRT)	No.	%
Up to 2.99	289	26.76
3–5.99	165	15.28
6–9.99	162	15.00
10–20.99	48	4.44
21–35.99	115	10.65
36–50.99	87	8.06
51–99.99	72	6.67
100 and over	142	13.15
Total	1080	100.00

Source: Our processing on the EU Fishing Fleet Register database.

Table 4. Number of Sicilian fishing vessels in the ports of the Channel of Sicily by power classes (2004).

Power classes (kW)	No.	%
Up to 49.99	428	39.63
50–99.99	184	17.04
100–149.99	87	8.06
150–199.99	101	9.35
200–299.99	138	12.78
300 and over	142	13.15
Total	1080	100.00

Source: Our processing on the EU Fishing Fleet Register database.

Table 5. Number of Sicilian fishing vessels in the ports of the Channel of Sicily by age of the hull classes (2004).

Age classes	No.	%
Up to 4 yr	33	3.06
5–9 yr	28	2.59
10–14 yr	60	5.56
15–19 yr	130	12.04
20–24 yr	137	12.69
25 and over	634	58.70
Unknown	58	5.37
Total	1080	100.00

Source: Our processing on the EU Fishing Fleet Register database.

and gillnets, used exclusively—or in alternation with other methods—by 82.9% of vessels (see table 6).

It is worth pointing out that only 9.2% of vessels use a variety of fishing gear; regarding the use of one type of gear only, the most commonly used is bottom otter trawls (39.5% of vessels,

Table 6. Sicilian fishing fleet in the ports of the Channel of Sicily by fishing segments (2004).

			Tonnage (GRT)			Engine power (kW)		
Fishing segments	No. vessels	%	$\bar{x}$	S	CV	$\bar{x}$	S	CV
Small-scale coastal <12 m	182	16.85	3.39	2.17	0.64	23.95	24.74	1.03
Bottom trawlers in coastal zone	213	19.72	57.31	46.49	0.81	212.99	131.20	0.62
Small purse seiners	502	46.48	11.02	15.46	1.40	74.18	82.92	1.12
Polyvalents in coastal zone	90	8.33	48.23	208.21	4.32	39.89	118.02	2.96
Bottom trawlers in mediterranean zone	62	5.74	169.15	40.99	0.24	502.82	183.25	0.36
Polyvalents non trawlers	8	0.74	136.57	50.93	0.37	490.39	252.78	0.52
Tuna purse seiners	7	0.65	97.15	60.77	0.63	375.70	199.63	0.53
Trawlers and purse seiners	15	1.39	347.23	90.57	0.26	1027.25	352.24	0.34
Not covered by IV MAGP	1	0.09	1.67	0.00	0.00	14.70	0.00	0.00
Total	1080	100.00	37.18	62.92	1.69	147.09	194.12	1.32

Source: Our processing on the EU Fishing Fleet Register database.

equivalent to 81.8% of total tonnage), gillnets (in 36.4% of boats, with tonnage equivalent to 5.2% of the total), and purse seines (9.1% of boats, equal to 4.9% of total GRT).

The figures for other types of gear are much lower, both in numerical terms and in tonnage (towed lines, fixed longlines, beach seines), or almost none (other fixed gear and other types). As far as tonnage is concerned, based on the type of fishing equipment used, it is clear that while fishing fleets that use trawls are made up mostly of medium to large vessels, the use of gillnets is used almost exclusively by smaller boats.

A close look at the data for each single port reveals the importance of Mazara del Vallo, both from a numerical point of view and in terms of 'capacity' (see table 7). Its 264 vessels, equivalent to 25 274.8 GRT and 77 478.5 kW, make up about a quarter of boats, almost half of engine capacity and just under two-thirds of fleet tonnage for the area in question. In fact, the average tonnage and engine capacity are markedly higher than those of the rest of the fleet.

The second most important area, numerically and due to the fleet's engine capacity, is the port of Trapani whose 212 craft represent 19.6% of the fleet in question, 12.7% of total engine capacity, and 9.5% of total GRT, followed by the ports of Porto Empedocle, Licata, Sciacca (on the coast of the Province of Agrigento), and Marsala. These ports, although similar in fleet numbers (about 10.0% of the total), have different fishing capacities; principally Sciacca, but also Porto Empedocle, registers the highest figures for GRT and engine capacity, even when referring to average figures.

More limited fishing activity takes place on the small islands: Lampedusa, Pantelleria, Favignana, Marettimo and Levanzo.

The most frequently occurring register tonnage in the fleet under examination is of less than 3 GRT (which covers 25.3% of the entire fleet in the area being studied), including many of the fleets from Marsala, Trapani, Licata, and Mazara del Vallo (see table 8).

Of the entire fleet in question, 29.4% has a tonnage of 3–9.99 GRT. It is significant that there is a high concentration (21.0%) of boats with tonnage of over 100 GRT; this group, second in numerical terms, is made up almost exclusively of Mazara and Sciacca boats (equivalent to 48.1% and to 77.0%, respectively, of the relative fleets).

The small island fleets represent a tonnage of less than 10 GRT, apart from Lampedusa, whose boats in any case have a tonnage capacity of less than 100 GRT. Therefore, among and even within the different ports in question, clear differences emerge in figures regarding size

Table 7. Sicilian fishing fleet in the ports of the Channel of Sicily by structural characteristics (2004).

	Vessels		Gross tonnage			Engine power			Age of
Ports	No.	%	GRT	%	$\bar{x}$	kW	%	$\bar{x}$	hull (yr)
Mazara del Vallo	264	24.44	25 274.80	62.95	95.70	77 478.50	48.77	293.50	28
Trapani	212	19.63	3821.00	9.52	18.00	20 174.20	12.69	95.20	30
Porto Empedocle	123	11.39	2837.30	7.07	23.10	15 721.00	9.90	127.80	30
Licata	117	10.83	1532.60	3.82	13.10	9762.80	6.15	83.40	27
Sciacca	113	10.46	3879.00	9.66	34.30	15 855.70	9.98	140.30	36
Marsala	106	9.81	1591.10	3.96	15.00	9430.00	5.93	89.00	28
Lampedusa	84	7.78	981.80	2.45	11.70	8444.80	5.32	100.50	29
Favignana	26	2.41	131.97	0.33	4.90	1096.40	0.69	41.00	28
Pantelleria	20	1.85	51.60	0.13	2.60	519.80	0.33	26.00	24
Marettimo	13	1.20	38.10	0.09	2.90	296.00	0.19	22.80	30
Levanzo	2	0.18	10.40	–	5.20	76.20	–	38.10	34
Total	1080	100.00	40 149.67	100.00	37.20	158 855.40	100.00	147.10	29

Source: Our processing on the EU Fishing Fleet Register database.

Table 8. Sicilian fishery fleet in the ports of the Channel of Sicily by tonnage classes (2004).

	GRT classes							
Ports	0–2.99	3–5.99	6–9.99	10–20.99	21–35.99	36–50.99	51–99.99	>100
Mazara del Vallo	65	28	13	1	6	2	22	127
Trapani	74	35	47	3	21	9	13	10
Porto Empedocle	15	17	24	14	24	17	10	2
Licata	35	21	16	19	15	10	1	–
Sciacca	–	–	1	3	16	4	2	87
Marsala	38	20	21	1	7	10	8	1
Lampedusa	10	23	28	8	9	5	1	–
Favignana	11	8	6	–	1	–	–	–
Pantelleria	15	2	3	–	–	–	–	–
Marettimo	9	3	1	–	–	–	–	–
Levanzo	1	–	1	–	–	–	–	–
Total	273	157	161	49	99	57	57	227

Source: Our processing on the EU Fishing Fleet Register database.

parameters. Such differences are due to the varied fishing techniques; each port, in fact, has its own unique system of fishing.

The Mazara del Vallo boats are specialized in trawling and tuna purse seining. Most of the fleet (55.7%) uses bottom otter trawls; in fact, there are 153 vessels that use this type of fishing gear, of which 126 have a tonnage higher than 100 GRT. This would explain the high average tonnage found in this fishery. The use of gillnets, found almost exclusively in vessels with a tonnage lower than 10 GRT, occurs in 31.8% of the fleet, while purse seines are the main gear in 27 boats (8.3%).

In the Trapani fleet, there is a clear prevalence of coastal fishing and purse seining. Of the different types of gear used, gillnets are by far the most common; used on 92 boats, they represent the most commonly used technique for the local fleet (43.5%). Next, numerically, are the boats which use bottom otter trawls, equivalent to 60 (28.3%). This section includes the larger boats in the fleet with an average tonnage of 38.9 GRT. The purse seine is the main gear for 50 vessels (23.6%); the average tonnage of purse seiners is 19.8 GRT.

In Porto Empedocle, fishing activity is mainly characterized, apart from purse seining, by the use of small-scale fishing, especially trawling. More than half the fleet (58.5%) uses mainly bottom otter trawls, while gillnets and purse seines are the main gear of 29.3% and 9.8% of the vessels, respectively.

In Licata, the fleet is essentially made up of boats which practise small-scale coastal fishing, with the use of gillnets and bottom otter trawlers with an average tonnage of 22.75. There is very little use of other gear.

In the port of Sciacca, trawling is a particularly important form of fishing, together with purse seining and pair trawling. This is seen in the clear prevalence, regarding fishing gear used by the local fleet, of bottom otter trawls (used by 76.1% of vessels), followed by gillnets (22.1%) and purse seines (1.8%).

The Marsala fleet employs mainly small-scale fishing, using exclusively gillnets, and alternating them in some cases with longlines. Bottom otter trawls are fairly commonly used (19.8%), and longlines and beach seines are also fairly frequent.

In Lampedusa, the fleet employs mostly small-scale purse seining and, albeit to a lesser extent, small-scale coastal fishing and trawling. The main gear used on board the island fleet is towed lines (29.8%), followed by gillnets (28.6%), trawls (19.0%), purse seines (11.9%), and fixed longlines (10.7%).

Finally, of the fishing methods practised on the Egadi islands (Favignana, Marettimo, and Levanzo), small-scale purse seining with the use of gillnets (48.8%), purse seines (31.7%), and beach seines (17.1%) represent the most common methods.

3.1.2 Tunisia. A structural analysis of marine fishing in the Channel of Sicily was carried out, looking at the structure and typology of the fishing fleet, the type of fishing, and the work force in the area under whose governorate the north-west coastal area falls—facing the area being studied. However, in order to have some idea, at least in general terms, of the significance of the fishing industry in the Tunisian economy, the main macro-economic variables in the sector were examined. This analysis was based on studies in the area by ICE [15, 16, 17], and on statistics released by the General Directorate of Fisheries and Aquaculture in Tunisia and by contacting experts and workers in the sector who have been involved in Italian–Tunisian joint ventures.

The fishing sector in Tunisia occupies an important position in the national economy, in terms of both product worth and product quantity, as well as the employment it provides.

Production in 2002 (ICE, 2004) of 96 685 tonnes, was the result of the growing trend which has characterized the sector over recent years; in the decade 1993–2002, the quantity fished increased by 14.3%, a rise in real terms from 85.4 million tonnes in the 2 yr period of 1993–94, to 97.6 million tonnes in the 2 yr period of 2001–2002. During the period in consideration, production increased annually, except for 1994, 1995, and 2002 (see table 9). The most important types of fishing for these results were coastal fishing and oily fish fishing (anchovies, sardines, and mackerel, etc.), which represent 39.5% and 34.3%, respectively.

The fishing sector (2002) generates a wealth of 182 million euros, 39.1% of which comes from coastal fishing; the income from aquaculture is 5.2% (see figure 2).

The coastal infrastructure is located on about 1300 km of coastline, where there are 41 ports and 50 small landing areas; these latter are able to provide for the basic needs of small vessels only, while there are 11 deep-sea ports (allowing for a depth of over 3 m), 21 coastal ports and eight docks.

The most recently available information (2003) registers a fishing fleet made up of about 13 000 units, of which 11 000 are for coastal fishing, and of these, 40% are motor boats. The governorate with the highest number of vessels is that of Sfax, located on the central southern coast of Tunisia; however, geographical division appears not to be homogenous, in

Table 9. Tunisian total production by fishing tipology (tonnes).

	1993–1994		2001–2002	
Fishing typology	$\bar{x}$	%	$\bar{x}$	%
Coast fishing	33 734	39.5	26 516	27.2
Benthic trawl fishing	16 897	19.8	25 638	26.3
Pelagic trawl fishing	390	0.5	703	0.3
Mediterranean blue fish fishing	29 297	34.3	36 639	37.5
Tuna fish fishing	1893	2.2	4794	4.9
Lagoon fishing and aquiculture	1729	2.0	2451	2.5
Shellfish harvest	1412	1.7	846	0.9
Shrimp fishing	49	0.1	37	–
Sponge fishing	25	–	34	–
Coral harvest	1	–	2	–
Total	85 411	100.0	97 657	100.0

Source: APIA.

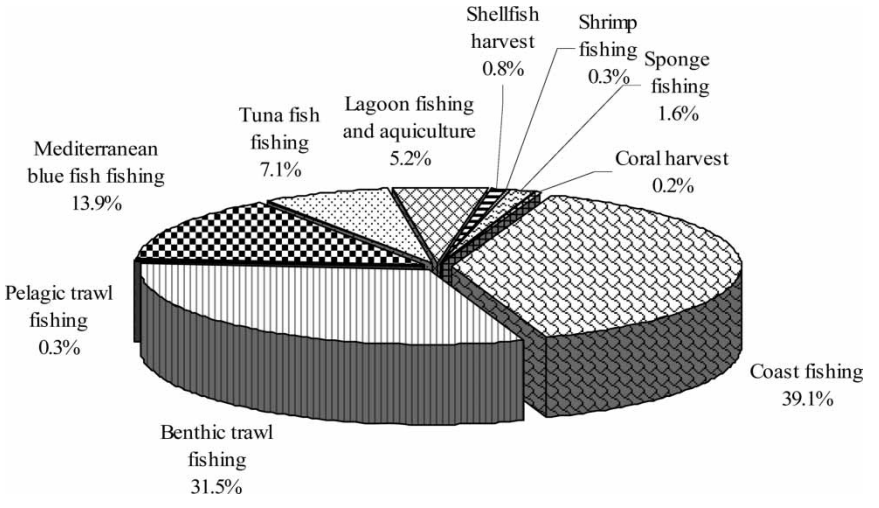

Figure 2. Production percentage according to fishing activity (2002).

as much as the northern area is less well supplied with vessels compared with the centre and south.

From an employment perspective, it appears that the sector provides work for just over 50 000 workers, of which 67.4% are employed in coastal fishing.

The Tunisian fleet working in the Channel of Sicily is under the responsibility of five governorates spread over the northern part of the country: Jendouba, Beja, Bizerte, Ariana, Tunis, and Ben Arous, Nabeul. The fleet is made up of 2577 vessels, equivalent to 20% of the whole country's fleet (see table 10); the highest number of vessels is found in Bizerte (50%) and Nabeul (19.7%). Under the governorates in question, a little less than 20% of the whole Tunisian fleet is concentrated.

According to the suitability of the fleet for the type of fishing practised, it can be seen that 86.5% of the vessels practise coastal fishing, while 4.5% of the craft is equipped for trapping; only a small number, equivalent to 2.8%, are equipped for trawling. The rest of the vessels cannot be said to be adapted to any specific method of fishing (see figure 3).

Regarding employment, in general a lower rate of employment is recorded under northern governorates compared with those in the central-southern area (see table 11); in fact, the fishermen working in the Channel of Sicily total 9596, which corresponds to 17.9% of the total.

The incidence distribution of employment in each governorate largely reflects that of the vessels, except in the case of the governorate of Nabeul, where 25.6% of the workforce are employed, in just 19.7% of the registered vessels (see figure 4).

Table 10. Tunisian fishing fleet in the northern Governorships (2003).

Governorships	No. vessels	%
Jendouba e Beja	287	11.1
Bizerte	1300	50.4
Ariana	105	4.1
Tunisi e Ben Arous	377	14.6
Nabeul	508	19.7
Total	2577	100.0

Source: ICE Tunisi.

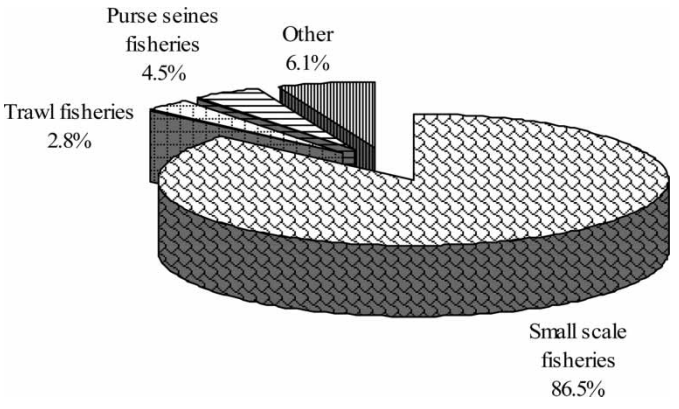

Figure 3. Tunisian vessels divided by fishing technique (2003).

Table 11. Fishermen on Tunisian fishery (2003).

Governorships	No. fishermen	% of northern Governorships	% on total Governorships
Jendouba e Beja	809	8.4	1.5
Bizerte	4813	50.2	9.0
Ariana	223	2.3	0.4
Tunis e Ben Arous	1291	13.5	2.4
Nabeul	2461	25.6	4.6
Total northern Governorships	9597	100.0	17.9
Others Governorships	43 941		82.1
Total Tunisian fishers	53 538		100.0

Source: ICE Tunisi.

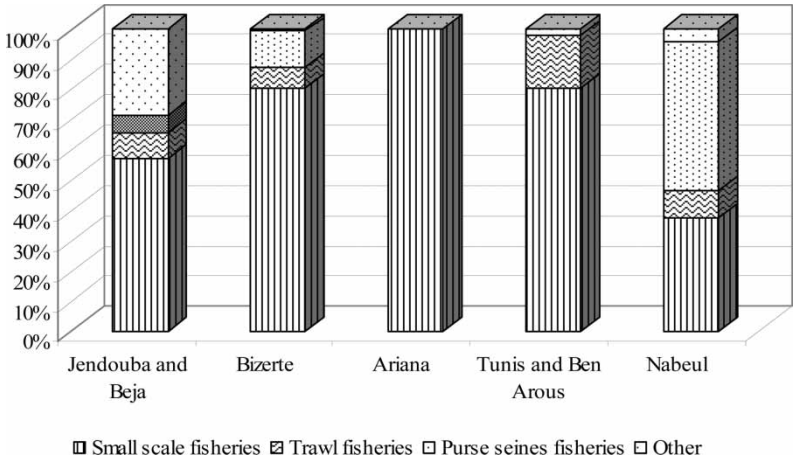

Figure 4. Employment percentages according to type of fishing, amongst the fishing population of governorships in the north (2003).

4. Micro-economic analysis of the companies in question

4.1 *Data collection*

Micro-economic data on fishing companies from a judgement sample of companies operating in the Channel of Sicily was collected thanks to the assistance of on-the-spot experts, such

as employees from the fishing department of the Harbour Office, business advisors to fishing companies, directors of fishing cooperatives, and the use of direct interviews.

The decision behind using a judgement sample, rather than a random sample, was based on the need to form a reliable panel and to limit sources of uncertainty which could compromise the reliability of the results.

Based on the resources available and the survey's operative requirements, attention was focused on the most important ports in the Channel of Sicily as regards the various fishing systems.

Trawling is the most widely used fishing technique used in the Channel of Sicily. The most important ports for this technique are Mazara del Vallo (151 vessels for a total of 28 055 GT), Sciacca (85 boats for a total of 4562 GT), and Porto Empedocle (59 boats for a total of 2539 GT). Trawlers from these Sicilian ports catch bottom demersal species in the Channel (i.e. red shrimp, white shrimp, violet shrimp, and Norway lobster, but also surmullet, hake, squid, etc.).

Mazara del Vallo is also important for its small-scale-fishery boats (104 vessels equal to 2780 GT) catching mainly demersal coastal species (i.e. hake, red mullet, surmullet, common pandora, picarel, horned and musky octopus, sagro bream, red porgy, squid, lobster, etc.) by gillnets, pots, lines, and beach seines.

Small pelagic species (sardine and anchovy) and large pelagic species (in particular bluefin tuna) are mainly caught by vessels using purse seines from Trapani (17 vessels for a total of 1.318 GT).

Mid-water pair trawl fishing is mostly carried out at Sciacca (10 vessels equal to 492 GT), the port most well known for oily fish fishing and processing.

Marsala is the Italian most important port for long lining (vessels equal to 1222 GT) for catching large pelagic species (tuna and swordfish) crossing the Channel.

There were a total of 66 fishing companies involved in the research, of which there were four from Trapani, nine from Marsala, 27 from Mazara del Vallo, 15 from Sciacca, and 11 from Porto Empedocle. The research method used was that of direct interviews by filling out questionnaires, designed to supply a report on economic activity for the year 2003 and to identify the main characteristics of the vessels in use (tonnage, engine capacity, equipment on board, fishing gear, etc.), of the crew and of the fishing itself.

The data collected were expressed as average data for each boat ($\bar{x}$), listed with other variability indices: standard deviation (S) and coefficient of variation (CV).

4.2 *Characteristics of the sample companies under analysis*

The samples analysed are fairly heterogeneous, as the methods of fishing are different in the area in question (see table 12). The sample from Trapani (four boats for a total of 322 GT) is represented by companies with large boats (80.50 GT per vessel) and engine power (319.75 kW per vessel), in spite of the high variability indices, which employ purse seine fishing with a high average number of crew (about 11 members). In Marsala (nine boats for a total of 829.26 GT fishing large deep-sea species with longlines) the average values of tonnage and engine capacity are also high (92.14 GT and 235.00 kW), but there are fewer fisherman per vessel (around 6). However, the larger fishing boats, equipped with complex on-board equipment and processing systems for the catch, are the trawlers from Mazara del Vallo (16 boats equal to 2292.96 GT). These vessels, due to their large tonnage (143.31 GT per vessel) and engine power (374.06 kW per vessel), can travel right up to Tunisian and Libyan territorial waters on long fishing trips that last for approx. 20 d. In Mazara, there is also a sample of smaller boats in terms of capacity

Table 12. Technical characteristics of fishing fleet under investigation (2003).

Indicators		Trapani ($n = 4$) Purse seines	Marsala ($n = 9$) Longlines	Mazara del V. ($n = 16$) Bottom otter trawls	Mazara del V. ($n = 11$) Gillnets and pots	Sciacca ($n = 9$) Bottom otter trawls	Sciacca ($n = 6$) Mid-water pair trawls	P. Empedocle ($n = 11$) Bottom otter trawls
Gross tonnage (GT)	$\bar{x}$	80.5	92.14	134.13	1.18	46.22	35	56.45
	S	70.6	54.75	29.41	0.6	6.96	5.29	26.81
	CV	0.88	0.59	0.22	0.51	0.15	0.15	0.48
Gross tonnage (GRT)	$\bar{x}$	66.75	64.61	125.6	2.69	35.57	25.63	45.63
	S	59.72	38.92	36.42	0.79	6.18	7.29	20.53
	CV	0.89	0.6	0.29	0.29	0.17	0.28	0.45
Overall length (m)	$\bar{x}$	25.28	23.36	28.83	4.3	19.39	18.16	21.04
	S	8.54	5.01	2.56	0.9	1.41	1.75	3.55
	CV	0.34	0.21	0.09	0.21	0.07	0.1	0.17
Engine Power (kW)	$\bar{x}$	319.75	235	351.48	21.55	179.37	172.92	208.23
	S	273.92	57.89	126.57	9.97	44.11	78.72	70.06
	CV	0.86	0.25	0.36	0.46	0.25	0.46	0.34
Age of hull (years)	$\bar{x}$	30.5	17	24.5	27.33	33.56	26	37.82
	S	18.57	9.52	9.4	5.72	14.04	17.56	6.91
	CV	0.61	0.56	0.38	0.21	0.42	0.68	0.18
Days at sea	$\bar{x}$	135	145	176.06	120.09	171.67	165.33	175
	S	30.28	18.48	6.22	1.04	5	0.52	8.66
	CV	0.22	0.13	0.04	0.01	0.03	0	0.05
Units of crew	$\bar{x}$	11.25	5.86	7.5	1	3.67	4	3.82
	S	4.86	1.68	0.82	0	0.5	0	0.4
	CV	0.43	0.29	0.11	0	0.14	0	0.11

(1.18 GT per vessel and 21.55 kW per vessel), 11 one-man vessels (equal to 12.98 GT) working on small-scale fishing with gillnets and pots.

The sample from Sciacca is made up of several companies that trawl (nine boats equal to 415.98 GT) and others that fish with a pelagic pair trawl system (six boats equal to 210.00 GT). The technical characteristics, however, are similar (respectively 46.22 GT per vessel and 35.00 GT per vessel in terms of tonnage, 179.37 kW per vessel and 172.92 kW per vessel in terms of power). Finally, the companies studied in Porto Empedocle (11 boats for a total of 620.95 GT) fish with trawlers that are just a little larger than those in Sciacca (56.45 GT per vessel and 208.23 kW per vessel).

Data on the average age of the fishing fleet (which fluctuates between a minimum of 17 yr for the small craft of Mazara, and a maximum of 38 yr for those in Porto Empedocle) show that the boats are becoming increasingly obsolete.

As far as the levels of activity are concerned, in 2003 average figures registered between 120 d per vessel for the small-scale fishing of Mazara and 175 d per vessel for the trawlers of Porto Empedocle. Small-scale fishing is characterized by low operative levels since its ship-owners/fishermen are employed in other supplementary activities during the course of the year.

4.3 *Economic results*

Analysis of the data gives a clear outline of the assets and liabilities regarding the balance sheets [18] of the fishing companies from the ports involved in the research (see table 13).

The highest revenues, calculated on the basis of the total quantity of fish unloaded and sold, are those of the trawling companies in Mazara del Vallo (€347 764 per vessel). Such high revenues are proportional to the high capital investment and the high risks attached to

Table 13. Economic acconts of fishing companies under examination (2003).

Indicators		Trapani ($n = 4$) Purse seines	Marsala ($n = 9$) Longlines	Mazara del V. ($n = 16$) Bottom otter trawls	Mazara del V. ($n = 11$) Gillnets and pots	Sciacca ($n = 9$) Bottom otter trawls	Sciacca ($n = 6$) Mid-water pair trawls	P. Empedocle ($n = 11$) Bottom otter trawls
Revenue	$\bar{x}$	265 042	184 878	347 764	13 586	154 000	141 667	138 955
	S	267 078	132 735	97 141	2839	14 465	6831	18 364
	CV	1.01	0.72	0.28	0.21	0.09	0.05	0.13
Various costs	$\bar{x}$	32 399	42 756	130 863	1073	42 933	30 933	41 973
	S	20 270	29 575	37 604	356	5306	1944	5185
	CV	0.63	0.69	0.29	0.33	0.12	0.06	0.12
Of which fuel	$\bar{x}$	19 427	24 972	82 680	878	33 433	23 700	35 141
	S	14 028	19 922	21 678	300	4197	410	5067
	CV	0.72	0.8	0.26	0.34	0.13	0.02	0.14
Depreciation costs	$\bar{x}$	45 649	24 272	29 828	163	14 217	11 765	8864
	S	65 427	25 957	18 657	213	3515	1129	1414
	CV	1.43	1.07	0.63	1.3	0.25	0.1	0.16
Maintenance costs	$\bar{x}$	21 922	5954	15 448	151	4282	7658	5095
	S	38 038	11 176	8242	117	496	1316	863
	CV	1.74	1.88	0.53	0.78	0.12	0.17	0.17
Labour costs	$\bar{x}$	115 378	61 074	113 239	0	59 756	56 667	46 551
	S	95 921	36 674	35 825	0	8156	2733	6508
	CV	0.83	0.6	0.32	0	0.14	0.05	0.14
Value added	$\bar{x}$	165 071	111 896	171 625	12 199	92 568	91 310	83 023
	S	144 723	69 377	50 172	2754	11 288	5056	12 875
	CV	0.88	0.62	0.29	0.23	0.12	0.06	0.16
Net income	$\bar{x}$	49 694	50 822	58 386	12 199	32 812	34 643	36 471
	S	49 254	33 963	20 938	2754	5347	2394	6469
	CV	0.99	0.67	0.36	0.23	0.16	0.07	0.18

the type of fishing (far from the coast and at extremely deep water). The revenue of purse seining companies (€265 042 per vessel) and of longliners (€184 878 per vessel) is much lower. Slightly lower, in decreasing order, are the revenues made by trawlers in Sciacca and Porto Empedocle (€154 000 per vessel and €138 955 per vessel, respectively). Lastly, strongly characteristic of artisanal fishing are the low revenues of small-scale fishing in Mazara (€13 586 per vessel). The variability indices indicate the presence of fairly homogenous data, except for the samples from Trapani (CV = 1.01) and Marsala (CV = 0.72).

Regarding liabilities, 'sundry expenses' includes fuel costs, other variable costs connected to production (the purchase of nets, cordage, various accessories, etc.), trading costs (crates, ice, packaging, etc.), and other costs connected to the boat (expenses for book keeping, pay registers, insurance, licenses, etc.). It should be noted that these costs are considerably higher for trawling companies in Mazara (€130 863 per vessel), and this has the biggest impact on net income. Undoubtedly the highest figure for expenses is that of fuel which, for small-scale fishing, represents nearly the whole amount (€878 of the €1073 per vessel).

Given the increasing age of the fleet, depreciation allowances (which are included in the company balance sheets for tax purposes) are low on average. In spite of this, purse seining and small-scale fishing exhibit the highest coefficients of variation (respectively CV = 1.43 and CV = 1.30). Maintenance costs also exhibit high variation coefficients, since these are ongoing expenses during the course of the year for work on the hull and engine (the highest being in Marsala; CV = 1.8).

Regarding costs, salaries are the heaviest drain on net income, except in the case of the Mazara trawlers. Here, the cost of labour is determined through a contractual relationship based on 'shares' that provides for the division of the equivalent value of the 'net catch'

(i.e. minus the ship-owner's out-of-pocket expenses—fuel, ice, crates, repair and maintenance of nets and equipment, etc.) into two parts, one for the ship-owner and the other one for the crew (which in turn is divided into further levels according to the crew member's responsibilities).

In order to establish salary levels, the ship-owner is always assumed to be on board, therefore, as well as the amount that he obtains as the owner of the vessel, he receives a further amount for the role he plays as a crew member. This amount is not included in 'salaries' but falls under net income. The highest labour costs are found in purse seining (€113 378 per vessel), which has a larger crew, gradually decreasing to zero in the case of small-scale fishing—where there is only one fisherman on board, who is the owner (so payment for his work on board falls under net income).

Detracting sundry expenses and maintenance and depreciation costs from the revenue, the actual wealth generated by the company can be calculated, or rather its value added before taxation.

The net income is that part of the balance sheet which shows the remuneration for productive elements in their entirety, as supplied by the actual entrepreneur (the ship-owner).

In this analysis, the net income (calculated before tax) was obtained by subtracting sundry expenses, maintenance and depreciation costs, and labour cost from the revenue. In conclusion, it represents remuneration for the work of management and for the ship-owner's work on board, and a return on the capital investment and entrepreneurial activity. The highest profits are those made by the trawling fleet in Mazara (€58 386 per vessel), followed by long-liners (€50 822 per vessel) and purse seining (€49 694 per vessel). Lower profits, (accompanied, however, by lower variability indices) are made by the trawling companies in Porto Empedocle (€36 471 per vessel) followed by the mid-water pair trawls and trawlers from Sciacca (respectively €34 643 per vessel and €32 812 per vessel), and lastly, the small-scale fishing companies (€12 199 per vessel).

4.4 *Economic productivity*

The economic efficiency of the companies examined was measured using indicators of economic productivity construed as the relationship between given parameters from the balance sheet and the tonnage used (see table 14). From this analysis, small-scale fishing registers the highest unitary figures per unit for all the indicators. This shows the high level of productive efficiency in very small vessels compared with those of high tonnage. The lowest indicators of 'Revenue/GT' and 'Value added/GT' are not those of the large fishing vessels in Mazara, but those of the long-liners in Marsala (with €1907 and €1212). In terms of net income per unit, the indicator figures seem to come into alignment for all fishing methods, except for that of small-scale fishing (from €459 for the trawlers in Mazara to €1010 for the mid-water pair trawls in Sciacca).

Considering the average daily economic parameters per gross tonnage employed in the various fishing methods in consideration (see table 15), the gap between small-scale fishing and other methods widens. Small-scale fishing boats, apart from being very small indeed, go to sea for just a few days, marking up a high daily revenue per gross tonnage (€108.86).

The unitary profitability of mid-water pair trawlers is the highest after small-scale fishing. Purse seining, practised by larger boats and for few days (135 d per vessel), also registers a high daily revenue per gross tonnage utilized (€22.91), but in terms of net income, it falls into line with the figures recorded for the trawlers of Porto Empedocle and Sciacca (between €4.70 and €4.21). The lowest indicators were found in the long-lining sector, especially in terms of revenue, and in trawling in Mazara, in terms of value added and net income.

Table 14. Annual economic productivity indicators of fishing companies under examination (average value in Euro per vessel. 2003).

		Bottom otter trawls			Mid-water pair trawls	Longlines	Purse seines	Gillnets and pots
Indicators		Mazara del V.	P. Empedocle	Sciacca	Sciacca	Marsala	Trapani	Mazara del V.
Revenue	$\bar{x}$	2710.06	3132.38	3369.25	4123.41	1907.15	3042.13	13 090.48
GT	S	1009.52	1876.57	362.01	638.14	372.28	686.16	4080.99
	CV	0.37	0.60	0.11	0.15	0.20	0.23	0.31
Value added	$\bar{x}$	1335.65	1886.45	2022.65	2659.86	1212.03	2013.28	11 775.18
GT	S	513.81	1196.20	251.96	434.94	213.21	422.99	3796.14
	CV	0.38	0.63	0.12	0.16	0.18	0.21	0.32
Net income	$\bar{x}$	459.73	832.22	721.31	1010.50	533.93	581.25	11 775.18
GT	S	239.93	541.35	147.01	180.16	128.15	82.29	3796.14
	CV	0.52	0.65	0.20	0.18	0.24	0.14	0.32

Table 15. Daily economic productivity indicators of fishing companies under examination (average value in Euro per vessel. 2003).

		Bottom otter trawls			Mid-water pair trawls	Longlines	Purse seines	Gillnets and pots
Indicators		Mazara del V.	P. Empedocle	Sciacca	Sciacca	Marsala	Trapani	Mazara del V.
Revenue	$\bar{x}$	15.40	17.75	19.64	24.94	13.17	22.91	108.86
GT*days	S	5.75	10.20	2.16	3.83	2.18	5.44	33.59
	CV	0.37	0.57	0.11	0.15	0.17	0.24	0.31
Value added	$\bar{x}$	7.57	10.67	11.79	16.09	8.46	15.42	97.92
GT*days	S	2.78	6.49	1.53	2.61	1.83	4.64	31.30
	CV	0.37	0.61	0.13	0.16	0.22	0.30	0.32
Net income	$\bar{x}$	2.59	4.70	4.21	6.11	3.70	4.38	97.92
GT*days	S	1.24	2.93	0.92	1.08	0.92	0.68	31.30
	CV	0.48	0.62	0.22	0.18	0.25	0.15	0.32

The parameters on fishing effort taken into consideration are not the only factors affecting the economic productivity of each of the fishing systems. There are other factors, such as the fishing zone, the expertise of the Captain and crew, the number of boats, the type of commercialization used, prevailing market prices, etc. An examination of the various systems of fishing shows that the small-scale fishing companies (with small catches—approx 10 kg per boat) offer a high quality product both as far as the type of fish is concerned (white fish and fine-quality shellfish) and the quality of the fish (not subject to refrigeration processes before being brought to market).

The indicators of economic productivity relating to purse seining and pair trawling can be explained partially by the high levels of oily fish caught (although market prices remain modest) and partially by the fact that activity is restricted by the limited fishing season for this type of fish.

The trawling sector, characterized by large catches, differs in economic productivity according to the port under examination: on the one hand, Mazara del Vallo, whose economic productivity is affected by low prices offered for a catch (this latter has undergone on board

preservation processes), and on the other hand Sciacca and Porto Empedocle who enjoy higher prices due to the fresh catch which they bring to market.

The productivity of the long-lining fleet is influenced, above all, by the quantity of tuna caught, which has a considerable effect on company revenue.

5. Conclusions

This research has led to several points of consideration concerning both political aspects and the economic performance of the companies in question. Regarding the first point, we hope for the development of international cooperation in order to determine the fishing zones, to share management of fishing resources, to publish scientific data and sustainable manage resources from an environmental, economic and social point of view. Regarding the second point, from this analysis, and particularly from the economic data, it emerges that there is an imbalance between exploitation of fishing resources by trawling and the resources available, in spite of the high revenue for the companies. Small-scale fishing, the most frequent method in use in the Channel of Sicily, in its specificity should be strongly supported; the revenue per unit it obtains allows it (also in terms of reducing the fishing effort as proposed by the CFP) to combine environmental and economic sustainability.

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