DEFINITION OF DATA COLLECTION

NEEDS FOR AQUACULTURE

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Part 1.

REVIEW OF THE EU AQUACULTURE SECTOR

and

RESULTS OF COSTS AND EARNINGS SURVEY

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EXECUTIVE SUMMARY

Background

Development of the EU aquaculture can offer interesting opportunities for diversification of the economy of rural regions, generating employment and income. Furthermore, it would positively affect the large EU deficit on the fish market, where 50-60% of the consumption is imported from non-EU countries.

The policy intentions to support the development of the EU aquaculture have been formulated in 2002 in the '*Strategy for sustainable development of European aquaculture*'[1]. This strategy document sets out 3 main objectives:

1. Creating long term secure employment, in particular in fisheries dependent areas;
2. Assuring the availability to consumers of products that are healthy safe and of good quality, as well as promoting high animal health and welfare standards;
3. Ensuring an environmentally sound industry.

This document elaborates a large number of actions which should be taken and supported the structural funds, first by FIFG and at present by the European Fisheries Fund (EFF) which states that[2]:

> *The development of the aquaculture sector also represents real potential for the creation of remunerative jobs and new economic activities. The aquaculture sector should be included in a perspective for the sustainable development of quality products while at the same time ensuring that the environmental impact is reduced.*

In order to formulate new policies and to direct EFF support effectively and efficiently, the European Commission requires sound, accurate and up-to-date statistical information about the economic performance and the competitive positions of the various sub-segments of the EU aquaculture. Therefore it is also necessary to design a data collection system and to assess how such system should be operated cost-efficiently. STECF has stressed this need in February 2006[3].

Objective

The main objective of the study is to identify the data required to assess the evolution and economic performance of the aquaculture sector and the best mechanisms for collecting this data.

Terms of reference

The terms of reference of the study can be summarized as follows (see annex for full text):

1) Review available punctual studies describing the sector's performance;
2) Establish a "Catalogue of Best Practices" in current data collection programmes;
3) Assess the feasibility of a European permanent scheme for the collection of economic data;
4) Assess the feasibility of collecting a set of specific indicators and the costs of collecting them on a regular basis. The required indicators regard earnings, costs components, balance sheet values, employment (including unpaid labour) and number of enterprises.
5) Establish the most appropriate and cost-effective structure for the collection of the data;
6) Collection of baseline data based on original field work to be validated through the cross-check of the results with other already existing sources.

[1] COM(2005)511 of 19.9.2002
[2] SEC(2005)965
[3] STECF/SGECA, Processing Industry and Aquaculture: Review of Economic Issues, 13-17.2.2006

Review of punctual studies

All partner have compiled relevant studies on aquaculture which have been prepared in their countries. The studies have been uploaded into a database, accessible on internet[4]. Apart from the standard information on author, title and publication details, the database also contains abstracts and either full texts of the studies or references where the studies can be obtained. The database is hosted by LEI and it is proposed to transfer it to for example the European Association of Fisheries Economists or another institutional which could maintain it in the future.

On the basis of these studies, the pilot survey and the available statistical information, a 'Review of the EU aquaculture sector' has be prepared, which is presented in the Part 1 of the main report.

Catalogue of best practice

At early stages of the project it was concluded that a 'Catalogue of best practice' for collection of statistical data has been designed by Eurostat and is presently being implemented throughout the Member States. It is recommended that this catalogue be also applied to the future compilation of data on aquaculture, as it was designed by the most professional body in this area in the EU.

Feasibility of regular data collection on aquaculture

Feasibility of regular data collection on aquaculture firms has been tested through design and implementation of a pilot survey and through contacts with institution which would be most suitable for the implementation of the on-going future programme. During the implementation of the present project in 2008 new regulations on data collection in the fisheries sector (incl. aquaculture) have been adopted (EC Reg. 199/2008 and 665/2008) making the collection of data on saltwater aquaculture compulsory while exempting the freshwater aquaculture.

On the basis of the pilot survey, the following conclusions can be drawn regarding the feasibility and scope of an on-going data collection programme in aquaculture:

- Freshwater fish farming (trout, carp) as well as some segments of saltwater aquaculture (oysters) are characterized by large numbers of small producers, many of whom do not maintain detailed accounting records which would allow an easy overview of costs and balance sheet indicators. Compilation of the data from these firms will rather labour intensive and consequently costly.
- Main activities in saltwater fish farming (seabass, seabream and salmon) are increasingly concentrated in hands of relatively large multinational companies. Obtaining access to their accounts, beyond publicly accessible annual reports, proved in many cases difficult. Furthermore, vertical integration makes it also in this case relatively difficult to specify all costs related to fish farming in sufficient detail.
- Most new aquaculture activities (e.g. turbot, sole, cod, tuna fattening, etc) are carried out by only one or several firms in one Member State. Collection, processing and use of the data is consequently constrained by the confidentiality regulations.
- Economic performance of large and small firms can be quite different. For statistical purposes these two groups should be separated in order to obtain reasonably homogeneous populations. However, the number of large firms (which also account for very significant shares of the national production) is inherently small. Consequently, confidentiality problems may arise.

Despite these problem the pilot survey proved that it is possible to collect data on aquaculture on regular basis.

[4] http://www3.lei.wur.nl/literaturedatabase/home.aspx?AspxAutoDetectCookieSupport=1

Feasibility of collecting specific indicators

While the pilot survey proved that most required indicators could be collected, the following specific problems have been identified:

- Small aquaculture firms, not having a legal status as a limited or anonymous company, are not obliged to prepare a formal balance sheet or a profit and loss statement. Consequently, compilation of balance sheet data faces problems and may have to rely on estimations.
- A reliable assessment of the value of 'unpaid labour' is problematic. It requires implementation of a system comparable to FADN in agriculture, where the sampled firms would be willing to keep regular records.
- Costs of live raw material may significantly differ between enterprises within one segment as some may rely on their own reproduction while others buy fingerlings from hatcheries. In integrated firms it is often impossible to separate costs belonging to hatchery and on-growing activities.
- The variables to be compiled under the pilot survey have been defined according to the guidelines and definitions of 'Structural Business Statistics' of Eurostat. However, the pilot had to rely on the available accounts of individual firms. While these account can be expected to reflect broadly the SBS approach, it is not certain to which extent this is also the case on detailed level. Clearly, for some segments 'Other operational costs' may contain costs components which should be classified under different headings.

As with all statistics, it is considered feasible to obtain at least some indications on all required indicators. However, it remains to be seen which level of precision can be achieved. Part 2 of the main report presents the results of the survey, including relative standard deviation and relative standard error for most indicators. These show clearly that attention will have to be given to the proper definition of homogenous segments (fields of observation), determination of the type of distribution with those segments and the sizes of the samples.

Structure for data collection

It is recommended that this task should be carried out by organizations which are already involved in data collection either for agriculture (FADN) or for fisheries (DCR). The total annual costs of data collection in the sixteen countries contributing to this report is estimated at about 2.5 million Euro, while another 1 million Euro would be required for initial investments. The costs vary significantly between the various MS, depending on the specific local situation. Additional resources will have to be made available as none of the selected institutions can provide funding from its present budget, except when a data collection programme is already on-going, as for example in Denmark or the Netherlands.

In relation to the feasibility, effectiveness and efficiency it is important to stress that response to the pilot survey could be only achieved through intensive personal contacts. In general it seems unlikely that written surveys will lead to sufficient response. Provision of statistical information is considered by the firms as an additional administrative burden. As EU and national policies are implemented to reduce administrative costs, successful data collection in aquaculture will require to demonstrate clearly to the aquaculture firms the value added of this information for the policy and for their operations.

Compilation of baseline data – main results of the pilot survey

A pilot survey was carried out in sixteen participating Member States, covering in total 59 aquaculture segments, defined in terms of farmed species and applied technologies. The definition of technologies was based on the on the proposal for collection of data on aquaculture COM(2006)864. The data covers fifteen main cultured species. Data was compiled in the year 2006.

The 59 covered segments have produced in 2006 1.26 million tonnes of fish with an estimated value of 3.8 billion Euro. This means that the segments cover over 95% of the EU aquaculture production in terms of volume, which amounted to 1.3 million tonnes according to FAO and Eurostat. On the basis of this detailed assessment it could be concluded that the value of EU aquaculture output is than the value estimated by FAO, which was little below 3.1 billion Euro in 2006.

These 59 segments represent almost 11,000 firms, which employed a total of about 55-60,000 engaged persons and some 33,700 FTEs. The gross value added of these segments was almost 1.6 billion Euro, i.e. 41% of the value of production and about 44,600 Euro per FTE. This latter value is broadly consistent with GVA / FTE in many other sectors of the EU economy.

The economic performance of the various segments appears to be extremely diverse. Furthermore, it is not recommended to draw generalized conclusions on the basis of the first survey of its kind.

Reports

Part 1 of the main report contains an assessment of the aquaculture in the EU-27 on 'macro-level', assessing level of production in the Member States, trends in the six main segments of aquaculture (carp, trout, seabass/seabream, salmon, mussels and oysters), international trade and a summary of the new developments.

The sixteen national chapters are all organized in six sections discussing:

- Situation in 2006
- Main trends in 1996-2006
- Present structure of the sector
- New developments
- Economic performance
- Statistical tables

Part 2 contains the feasibility assessment and the statistical evaluation of the data collected under the pilot survey. Each national chapter is composed of six sections presenting:

- Suitable organization for implementation of the on-going scheme
- Method of data collection
- Size of the survey
- Estimation of costs
- Availability of funding
- Problems and solutions

Part 3 of the report contains various annexes. In addition to the Terms of Reference, annex has been included summarizing the SWOT analysis of the aquaculture sector presented in the National Strategic Plans, which were prepared under EFF.

1. OVERVIEW OF EU AQUACULTURE

1.1. Introduction

This chapter presents a general overview of the structure and trends of the aquaculture sector of EU-27. It based on data compiled by the national partners and on aggregate information available at FAO or Eurostat.

1.2. Situation in 2006

In 2006 some 16,400 firms, employed almost 64.000 people and produced almost 1.3 million tonnes of fish with a total value of about 3 billion Euro. These figures imply that the average value of production per man amounted to 48,000 Euro

Table 1.1 EU-27 – Overview of the aquaculture sector, 2006 [5)]

	Value of production (mln Euro) [1)]	Volume of production (1000 tonnes) [1)]	Employment [6)]	Number of firms
Austria [7)]	12.3	2.5	500	400
Belgium [7)]	2.7	1.2	84	na
Bulgaria [7)]	8.0	3.3	na	na
Cyprus [7)]	14.5	2.6	127	na
Czech Republic	34.9	20.4	3,255 [2)]	1,194
Denmark	102.3	37.2	690	193
Estonia [7)]	2.7	0.7	42	96
Finland	41.6	12.9	265 [2)]	302
France	518.1	238.9	11,449 [2)]	4,531 [3)]
Germany	121.8	35.4	6,624	2,600 [4)]
Greece	462.7	132.7	6,811	555
Hungary	25.7	14.7	1,681	400
Ireland	116.9	53.1	2,082	163
Italy	472.1	173.1	5,213 [2)]	591
Latvia [7)]	1.1	0.6	426	na
Lithuania	4.6	2.2	1,047	55
Luxemburg			na	na
Malta [7)]	6.2	1.1	105	na
Netherlands	95.1	43.9	353 [2)]	198
Poland	73.5	35.9	2,610	903
Portugal	32.9	6.8	4,051	1,065
Romania [7)]	9.1	8.1	na	na
Slovakia [7)]	2.1	1.3	233	na
Slovenia [7)]	3.0	1.4	254	na
Spain	283.3	293.3	13,683	2,465
Sweden	21.8	7.5	297	215
United Kingdom	602.4	171.8	1,878	511
Total [7)]	**3,071.4**	**1,302.6**	**63,760**	**16,437**

Sources: [1)]Value and volume – FAO Fishstat; Employment: national chapters [2)] Full time equivalents; [3)] Employment and number of companies regards census 2002.; [4)] Full time firms. Furthermore about 20,000 part time firms, attached to farms, etc.; [5)] Excl. hatcheries and nurseries. [6)] Number of engaged persons, unless specified otherwise. [7)] Source for Employment: LEI/Framian, Employment in the fisheries sector – Current situation, data refers to 2002/2003. Numbers of companies from various national sources. Data refers to 2000-2005.

The five most important countries (France Spain, Italy, United Kingdom, Greece) account for about 75% of the total value and volume, and the following 5 countries[5] account for further 17%. This means that aquaculture production in at least 17 Member States is at a very low level.

The pilot survey, carried out by the project covers 59 individual segments[6] (combinations of species and on-growing technique) in 16 countries. These segments represent more than 95% of the total EU production in volume. The estimated value of the production is about 800 million Euro (25%) higher than the value estimated by FAO.

Table 1.2 Summary of the pilot survey

	Number of segments	Turnover total	Gross value added	Number of employed persons	Full time equivalents (FTE)	Number of firms	Volume (1000 tonnes)
Czech Rep.	1	37	18	1,961	1,301	570	21
Denmark	5	131	44	679	498	187	42
Finland	4	70	24		423	343	
France	2	477	256		6,389	2,285	177
Germany	2	133	70	1,872	1,599	632	39
Greece	3	619	5	11,982	6,628	555	104
Hungary	1	33	15	1,891	1,203	321	21
Ireland	5	114		1,950	1,052	131	
Italy	6	512	261	7,307	3,626	636	218
Lithuania	1	7	4	349	315	18	4
Netherlands	4	127	53	0	405	180	68
Poland	2	94	41	2,610	2,587	870	
Portugal	4	64	31	1,322	421	1,006	11
Spain	6	431	255	14,445	4,461	2,365	368
Sweden	9	28	9	285	285	207	9
United Kingdom	4	954	492	2,569	2,096	465	176
Total	59	3,830	1,575	49,222	33,289	10,771	1,257

Table 1.3 EU-27 - Composition aquaculture production by species, 2006

	Value (mln Euro)	Volume (1000 tonnes)
Atlantic salmon	574.1	144.6
Rainbow trout	494.9	201.0
Gilthead seabream	314.0	73.0
European seabass	282.8	56.0
Pacific cupped oyster	278.0	125.4
Japanese carpet shell	218.9	58.7
Blue mussel	207.3	146.9
Common carp	134.9	66.1
Mediterranean mussel	80.0	105.6
European eel	74.6	8.3
Sea mussels nei	62.9	229.2
Turbot	45.8	7.6
Grooved carpet shell	40.8	8.2
Atlantic bluefin tuna	36.7	3.2
European flat oyster	13.7	4.7
North African catfish	10.2	6.6
Other species	201.9	57.4
Total	**3,071.4**	**1,302.6**

Source: FAO – FishStat.

[5] Netherlands, Ireland, Germany, Denmark, Poland.

[6] Almost complete details of the required indicators have been collected for 53-56 segment. 3-6 segments are relatively incomplete.

The aquaculture is concentrated in a relatively small number of species. In terms of value the most important today is farming of seabream and seabass (20% of total), followed by trout and salmon (each 19% and 17% respectively) and mussels (12%). These four (groups of) species represent 68% of the total value of production and 75% of the total volume.

1.3. Main trends 1991-2006[7]

Different trends can be distinguished between freshwater and saltwater[8] aquaculture.

Freshwater production has slowly decreased from some 316,000 tonnes worth 803 million Euro in 1991 to 284,000 tonnes and 702 million Euro in 2006. This implies an annual decrease of the volume by 0.7% and of the value by 0.9%. However, two periods can be distinguished. During the first decade (1991-2000) the production value and volume were relatively stable around 330,000 tonnes and 810 mln Euro. In second period, between 2001 and 2006, the value was decreasing by 7.1% per year and volume by 3.7%.

The production volume of saltwater fish farming shows quite a distinct growth of 7-8% per year from 1993 till 1999, after which the production has levelled off at approximately 1 million tonnes worth 2 billion Euro. Overall saltwater farming has grown from 726,000 tonnes in 1991 to 999,000 tonnes in 2006, an average growth rate of 2% per year. The value of the production has grown quite regularly by some 5% per year from 1.1 billion Euro in 1991 to 2.3 billion Euro in 2006.

Overall development of the EU aquaculture is rather modest compared to the global development, monitored by FAO. According to SOFIA[9] 2006*: "World aquaculture (food fish and aquatic plants) has grown significantly during the past half-century. From a production of below 1 million tonnes in the early 1950s, production in 2004 was reported to have risen to 59.4 million tonnes, with a value of uS$70.3 billion. this represents an average annual increase of 6.9 percent in quantity and 7.7 percent in value over reported figures for 2002. SOFIA shows that the average world growth of aquaculture output between 1990 and 1999 amounted to over 10% per year and 6.5% in the period 2000-2004."*

[7] Analysis of trends is based on FAO Fishstat because it provides data on volumes as well as values, while Eurostat offers only volume data.
[8] Marine aquaculture is the sum of salt and brackish water production, as proposed in EC Reg 762/2008.
[9] FAO, *The state of world fisheries and aquaculture 2006*, Rome 2007

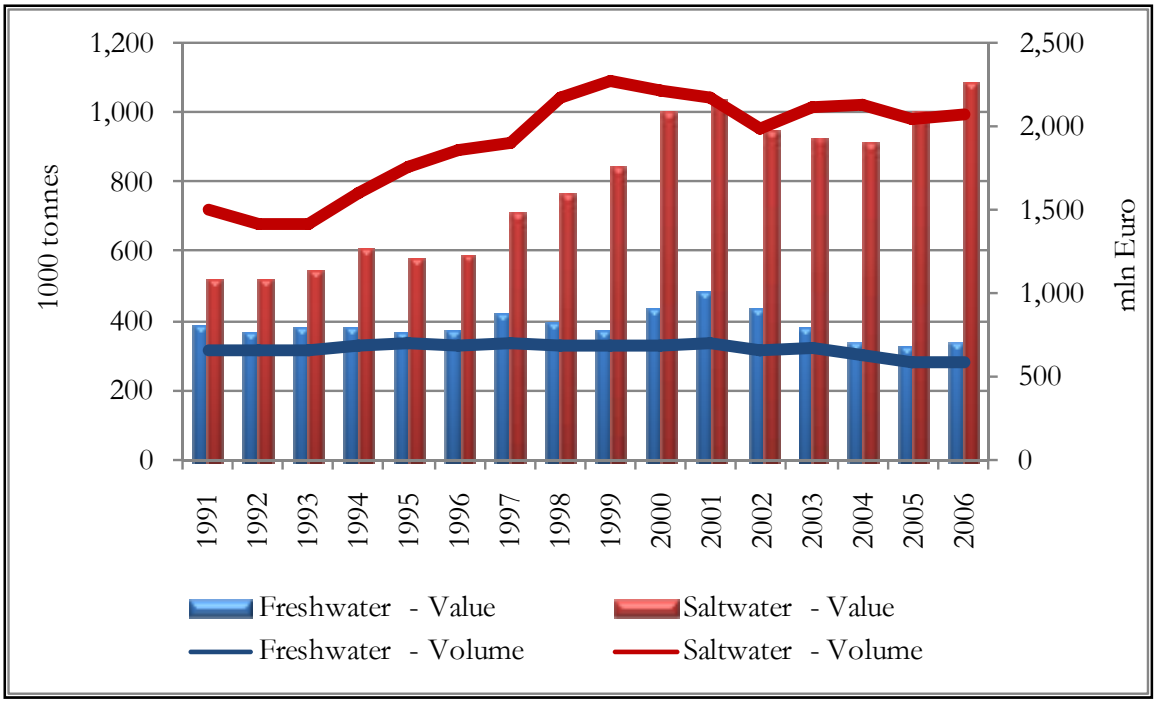

Figure 1.1 EU-27 - Value and volume of saltwater and freshwater aquaculture, 1991-2006
Source: FAO Fishstat

Looking at the trends of individual species it is apparent that the only species with a consistent growth in value and volume are seabass/seabream. Production of salmon has developed successfully between 1991 and 2000, after which a stagnation occurred. In 2005 seabass and seabream became economically the two most important species farmed in the EU.

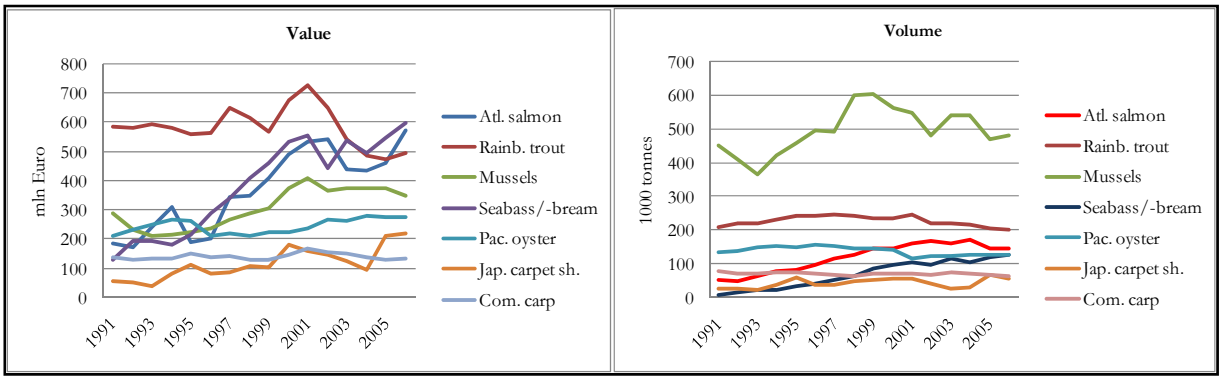

Figure 1.2 EU-27 - Value and volume of aquaculture production, 7 major species, 1991-2006
Source: FAO Fishstat

The volumes of production of the other species mostly do not show any clear trend, except carp which is decreasing. The production values of these species are determined by the prices which sometimes fluctuate quite substantially. This illustrates that economic performance depends significantly on the situation on the (global) market.

Prices of shellfish have been increasing since approximately 2001 and are presently well above the average level of the period 1991-2006. On the other hand, prices of most fish species have either decreased very substantially (seabass and seabream) or remained approximately constant (salmon, carp). The consumer price index for EU-15 has increased from 84 in 1996 to 100 in 2005, which would have a slight negative effect on the shown price trends.

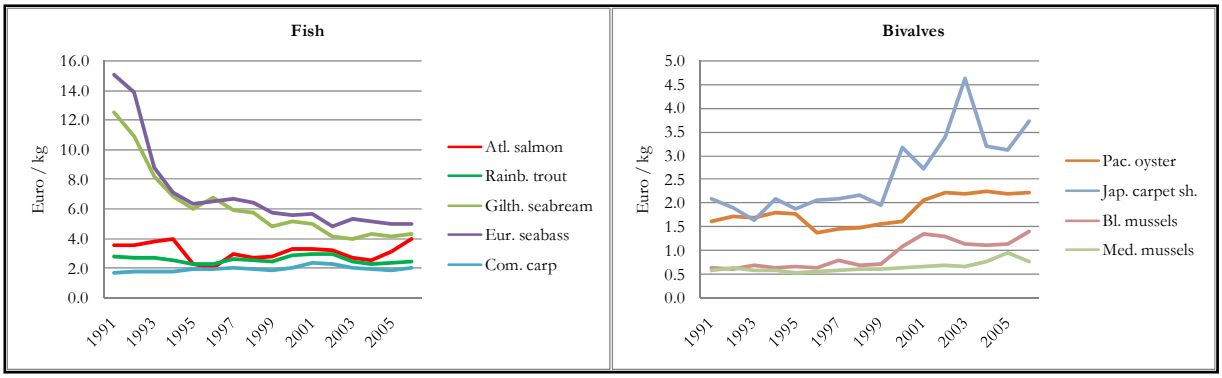

Figure 1.3 EU-27 - Nominal prices of farmed species, 1990-2005
Source: FAO Fishstat

1.4. Structure of the sector

The economic structure of the sector can be characterized by its segmentation in terms of on-growing technologies and species. The species are determinant of the market potential (volume of demand and price levels) while the technologies determine the efficiency of production (productivity and costs). Structure of the sector is the result of historical development and physical conditions in the various EU regions.

The national chapters present structure of the national sectors in terms of combinations of species and on-growing technologies, called segments. The following three tables[10] present an overview of the importance of these segments. However, while it is known which technologies are used in the various countries, it is not yet possible to determine precisely value and volume of production for all combinations of species and technologies. Therefore the tables show a significant value under 'Combinations'. The specifications of these combinations can be found in the country chapters.

Table 1.4 Freshwater farming, mln Euro

Species	Cages	Enclosures and pens	Ponds	Recirculation systems	Tanks and raceways	Combinations	Total
Carp			147.8				147.8
Catfish			3.1	6.4		0.9	10.4
Char			1.7				1.7
Crayfish			0.2				0.2
Eel				59.9	3.5		63.4
Pike			0.1				0.1
Pikeperch			10.7				10.7
Sturgeon					9.9	14.1	24.0
Tench			0.8				0.8
Tilapia				1.0			1.0
Trout	0.8	15.2	2.2	11.8	189.1	344.2	563.3
Whitefish			1.1			0.6	1.7
Other			15.1	13.2	0.6	12.0	40.9
Total	**0.8**	**15.2**	**182.8**	**92.3**	**203.1**	**371.8**	**866.0**

Source: country surveys

[10] The figures in the tables do not always add up to the indicated totals, as some minor segments have been left out.

Table 1.5 Saltwater farming, mln Euro

	Cages	Enclosures and pens	Recircula-tion systems	Tanks and raceways	Combina-tions	Total
Barramundi			6.4			6.4
Cod					3.1	3.1
Eel & Mullet					27.8	27.8
Halibut					1.2	1.2
Salmon	5.2			0.7	646.0	651.9
Seabream / -bass	421.4	106.9			165.4	693.7
Sole			0.1			0.1
Trout	52.8	4.7			2.4	59.9
Tuna	58.5					58.5
Turbot			2.2	37.5		39.7
Whitefish	3.0					3.0
Other	17.7			1.1	47.6	66.4
Total	558.6	111.6	8.7	39.3	893.4	1,611.6

Source: country surveys

Table 1.6 Bivalves farming, mln Euro

Species	Off-bottom	On-bottom	Combination	Total
Clams		238.7		238.7
Mussels	307.9	108.9	26.9	443.7
Oyster	9.7	278.4	0.7	288.8
Scallops	0.2	0.0		0.2
Other		17.2	1.6	18.8
Total	317.8	643.2	29.2	990.2

Source: country surveys

From the tables above it follows that the most important segments are:

- Freshwater:
  - Trout, farmed in various types of on-growing units.
  - Carp, farmed in ponds.
  - Eel farmed in recirculation systems.
- Saltwater
  - Salmon, farmed in cages, tanks and raceways.
  - Seabass and seabream is farmed in tanks & raceways and in enclosures and pens.
- Bivalves
  - Mussels are farmed on- as well as off-bottom
  - Oysters and clams are farmed on-bottom
  - Oysters, farmed off-bottom

Apart from the above segmentation it also seems relevant to point to the segmentation based on economic actors (i.e. who are the owners). While quantitative data is not available three main groups of firms can be distinguished.

- Large numbers of small producers, many of whom are only part time involved in fish farming and have other sources of employment and income. This regards in particular carp farming in the new MS, trout farming in Germany and Austria, oyster farming in France and production of clams in Portugal.
- Small number of large internationally orientated firms, of EU as well as non-EU origin. This regards salmon farming in Scotland (large share of production being in hands of Norwegian and Dutch multinationals) and seabream/seabass farming in the Mediterranean MS, with EU companies having interests in other parts of the area. Also mussel farming is becoming an increasingly international activity.
- Development of farming of new species (turbot, halibut, cod) requires significant resources for R&D and consequently only relatively large firms can afford to enter into this activity.

1.5. New developments

While the production of (more) traditional aquaculture species seems to be stabilizing, new developments are under way in three areas:

- Introduction to new species;
- Development of new technologies;
- Addressing environmental concerns.

Introduction of new species takes place in a broad spectrum, from low to highly prized and from cold water (native European) to (sub-)tropical species. This development is triggered by market opportunities, as large retailers put increasing stress on sustainable production chains. Among the most important are:

- Low price / native: cod;
- High price / native: turbot, sole, halibut;
- Low priced / non-native: tilapia;
- High priced / non-native: shrimp and tuna fattening.

Furthermore new developments are also taking place in farming algae and microalgae for human consumption and for applications in pharmaceutical and food industry.

New technologies are being developed in several key-areas:

- Propagation of species which still depend on wild catches of young specimen;
- Dealing with diseases;
- Adaptation of diets to achieve higher efficiency (decrease food input per kg of output) and to shift from animal to vegetable protein.

Finally, solutions are being developed to deal with environmental risks and social objections. These regard topics like:

- Waste water management, and
- Development of submersible cages to avoid 'horizon pollution'.
-

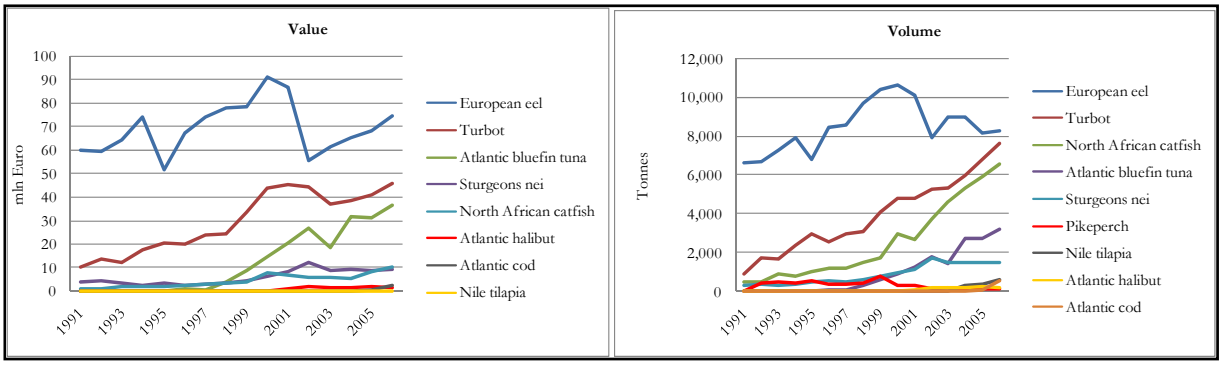

Figure 1.4 EU-27 - Trends in selected new species, value and volume, 1991-2006
Source: FAO - FishStat

Figure 1.4 shows that only two species show a convincing up-trend in volume and value: turbot and Atlantic bluefin tuna. The quantity of farmed catfish has been rising, but its aggregate value does not follow this trend, which implies a contrary movement of the prices. Various countries report that market for this species is indeed difficult.

1.6. Economic performance

The performance appears to differ in many different aspects – not only species and on-growing technologies, but also country and size of the company. In this context it needs to be pointed out that in the more dynamic segments of the European aquaculture sector the globalization trends can be clearly discerned. Companies and production facilities within the EU are not necessarily owned by EU interests (although they are evidently a legal person under EU law), while some EU companies develop increasing interests in production outside the Union.

Main factors affecting economic performance are at the moment:

- Heavy (global) competition with imports of cultured species from other parts of the world depress price levels (see chapter 1.7).
- Strong demand for fish in Europe and worldwide.
- Main marketing channels (supermarkets) require constant supply of constant quality, with guarantee of environmentally friendly production chains.
- Increasing costs of feedstuffs, particularly animal proteins (fish meal) (see Figure 1.5)

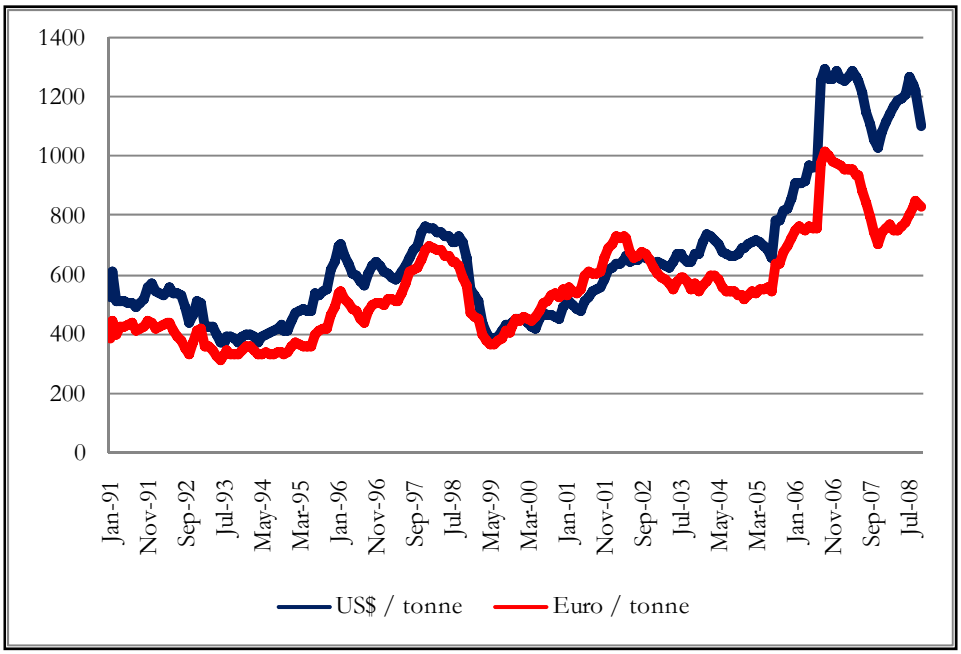

Figure 1.5 Fishmeal prices January 1991 – October 2008
Source: www.indexmundi.com (prices in US$) and Eurostat (exchange rates)
Fishmeal, Peru Fish meal/pellets 65% protein, CIF, US$ per metric tonne

Other factors affecting negatively the development of the EU aquaculture, though not directly its economic performance, are mainly in the area of user conflicts and environmental concerns and regulations. On the other hand, however, many MS are devoting substantial share of the funds under the European Fisheries Fund (EFF) to the promotion of knowledge intensive fish farming in recirculation systems.

In general the following impression of the main segments of the EU aquaculture sector can be given.

1.6.1. Freshwater culture – carp and trout

The most important producers of carp are Czech Republic, Poland, Germany and Hungary which produce about 85% of the EU carp production of 166 million Euro. The economic situation in the carp farming is in general rather weak for the following reasons:

- Stagnating prices of carp and rising prices of input, mainly feeds, labour and energy;
- Market preference for sea fish rather than freshwater fish and in general severe competition on the market;
- Low investment levels lead to stagnation of productivity, caused by the relatively small size of most carp producers.

Total production value of common carp was in 2006 at a similar level to 1996-99, thanks to relatively constant volume and a price which has significantly recovered since 2000.

The major EU producers of trout are Denmark, Germany, France and Italy, with a 60% share in total EU value of about 600 mln Euro. The economic performance of trout farmers depends significantly on the firm size:

- Small producers have difficulty to maintain sufficient growth of productivity and must focus on local niche markets as they are not able to offer regularly sufficient quantities to sell to supermarket chains. Over the past years a consolidation process has been going on and the numbers of small producers have been falling.
- Large scale production has the capacity to support on-going technological development and productivity growth. Larger companies are also a suitable partner for main retail channels.
- Lack of new suitable locations, environmental restriction and dependence on animal feed stuff are among the main problems faced by this industry.
- Stagnating demand for rainbow trout is being addressed by diversification to salmonid trout.

Total EU value of production of rainbow trout has been subject to increasing fluctuations since 1995 due to the combined effect of price and volume. In 2006 it was at a historically low level, about 40 percentage points below the peak of 2001. This was caused by the fall of volumes as well as of price.

- Freshwater fish farming is for most producers only a supplementary source of income. Small producers manage to integrate their farming activities in for example agro-tourism or sports fishing to be less dependent on sale of food fish.
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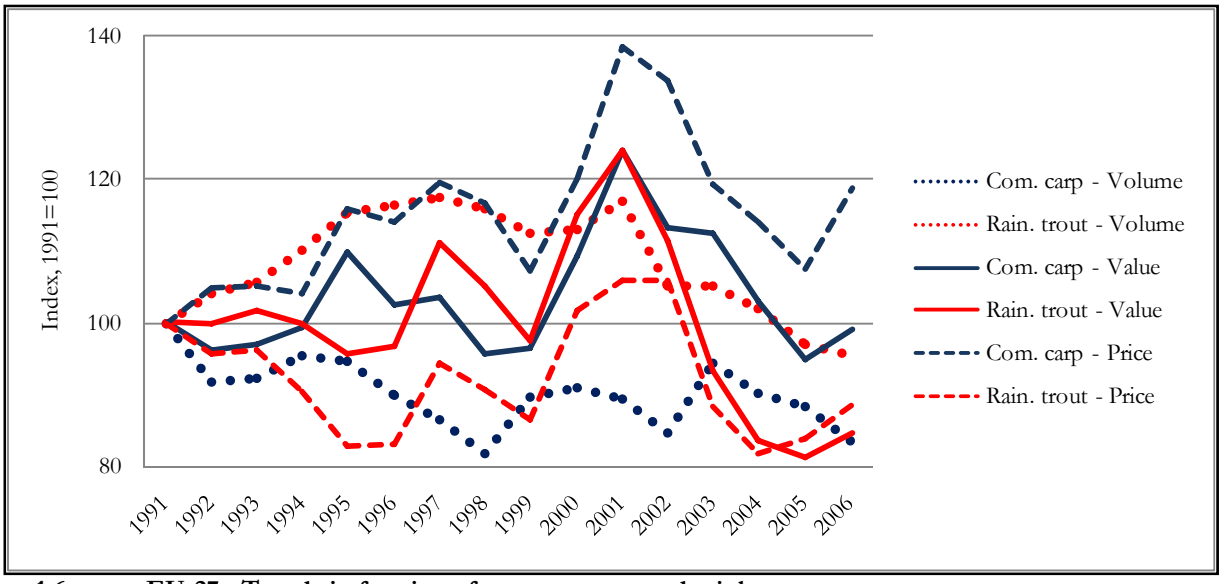

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Figure 1.6 EU-27 - Trends in farming of common carp and rainbow trout

- Source: FAO Fishstat

-
- Economic performance of carp firms
-
- Costs and earnings data regarding farming of carp was collected in five countries: Czech Republic, Germany, Hungary, Lithuania and Poland. Figure 1.7 shows that the nature of the firms in these countries is rather different[11]. The firms in Lithuania and Germany are relatively large, with a turn-over of 350-400,000 Euro, while the firms in the other three countries realize turn-over between about 70 and 150,000 Euro. There are similar differences in the GVA/firm.
-
- The differences in labour productivity are not as pronounced. German firms realize GVA/FTE of little over 30,000 Euro, while in the other countries this is little over 10,000 Euro.
-
- The most important cost component are the labour costs, which represent about one third of the total. The labour costs vary across the MS from about 24% to almost 40%. Measuring the value of unpaid labour proved in most countries impossible. Two other most important cost items are feed (19%) and Other operational costs (17%). There are large differences in the composition of costs between the various countries. The reasons for these differences range from available data and statistical definitions to differences in technologies and prices of inputs.
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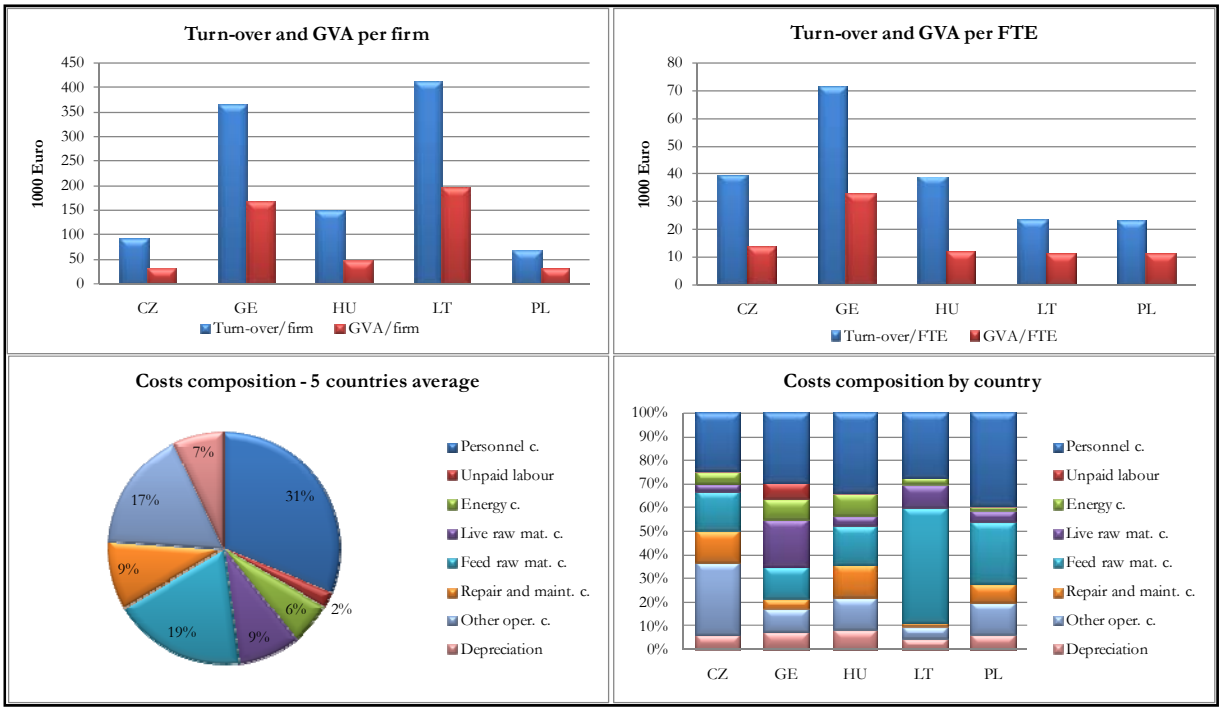

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Figure 1.7 Main indicators for carp firms

- Source: country surveys
-
-

[11] This statement refers to the firms from which the data could be collected. The structure of the national sector can be (somewhat) different.

- Performance of trout firms
-
- Trout farming is a widely spread activity and it was possible to collect data from nine countries. By far the largest firms are in Spain, with an average turn-over of 1.2 million Euro. On the other hand firms in Sweden, Portugal, Poland and Germany are much smaller, realizing a turn-over of little over 200,000 Euro. There are also major differences in labour productivity, with GVA/FTE ranging from 25-30,000 Euro in Portugal, Poland and Sweden to 90,000 Euro in Spain.
-
- Raw feed material is the largest cost component, amounting on average to about 34%. Cost of labour, live raw material and other operational costs amount to 19%, 16% and 14% respectively. Other costs components are relatively small. The differences in costs composition by country may have some statistical causes. They also show differences in technology, e.g. the differences in costs of live raw materials may imply that the firms rely to greater or lesser extent on their own reproduction
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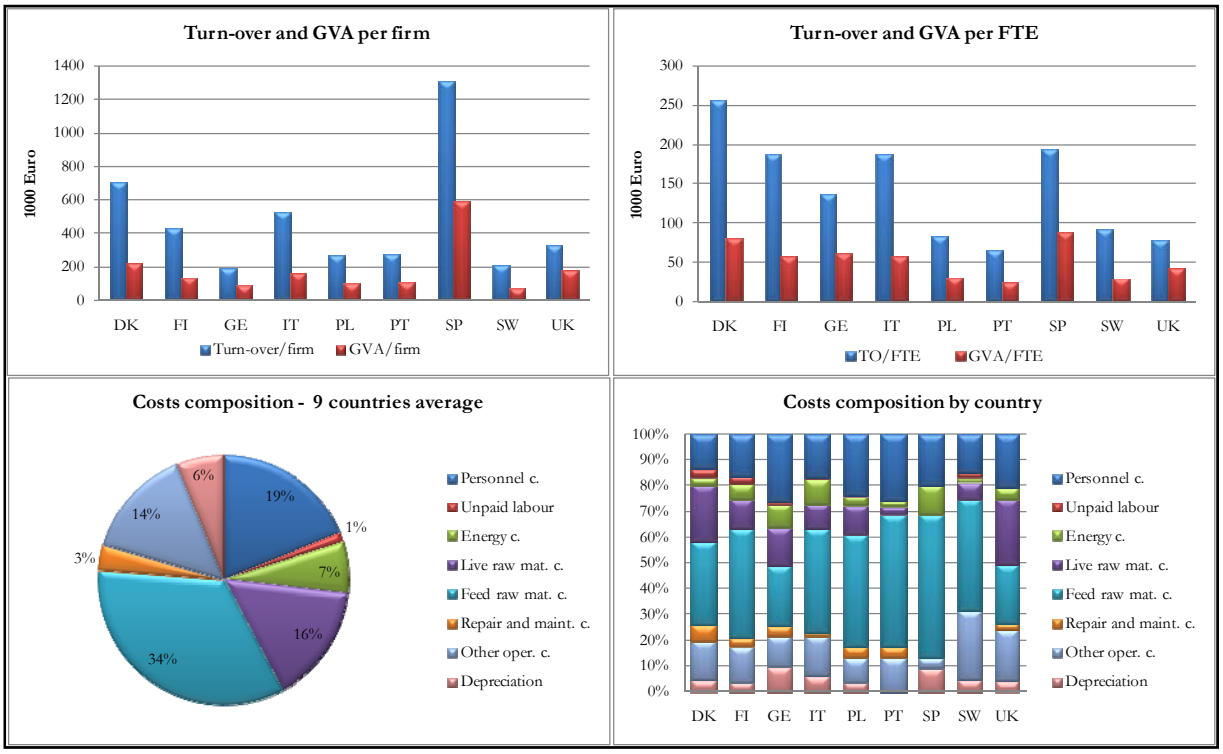

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Figure 1.8 Main indicators for trout firms

- Source: country surveys
-

1.6.2. Saltwater farming of salmon and seabass / seabream

- Most EU salmon production is concentrated in Scotland (almost 90%) and the rest in Ireland. The economic performance has recently recovered, after difficult years between 2001 and 2004. A major consolidation process has taken place. The number of Scottish firms was reduced from 131 in 1994 to mere 41 in 2005, of which 14 firms produce 86% of the total output. Salmon farming is a globally oriented activity. Some 85% of the Scottish firms are in the hands of Norwegian or Dutch companies, which also have major interests in the main competing production areas as Norway and Chile. The main problems of the EU salmon farming are:
- Increased price of fishmeal, as feed represents a significant share of the production costs. In this respect Scotland, not being a fishmeal producer, is in relative disadvantage compared to the main competitors.
- Negative publicity about health and environmental impact of salmon farming.
- Competition for space with other users and consequent difficulties to obtain new permits.

- The value of EU salmon production has steadily increased over the period 1996-2005 thanks to higher prices and especially greater volumes.

- The production of seabream and seabass is dominated by Greece (56% of the total EU value), followed by Italy and Spain with 15-16% each. This sector shows similar trends to salmon – consolidation into a small number of internationally operating (Greek) companies which account for a significant share of the total production. Because of increasing constraints on growth within the EU, new production facilities are built in non-EU Mediterranean countries. After a crisis of this sector in 2001 and 2002 due to low prices, there has been a general recovery and profitability is illustrated by on-going new investments. The sector enjoys strong demand. The leading companies are vertically integrated, from hatcheries through on-growing to processing and wholesale trade. The most important constraint seems to be the lack of new licenses.

- The value of EU production of seabream and seabass shows steady growth over the period 1996-2005 thanks to higher volumes. The prices were in 2005 significantly below the 1996 level.

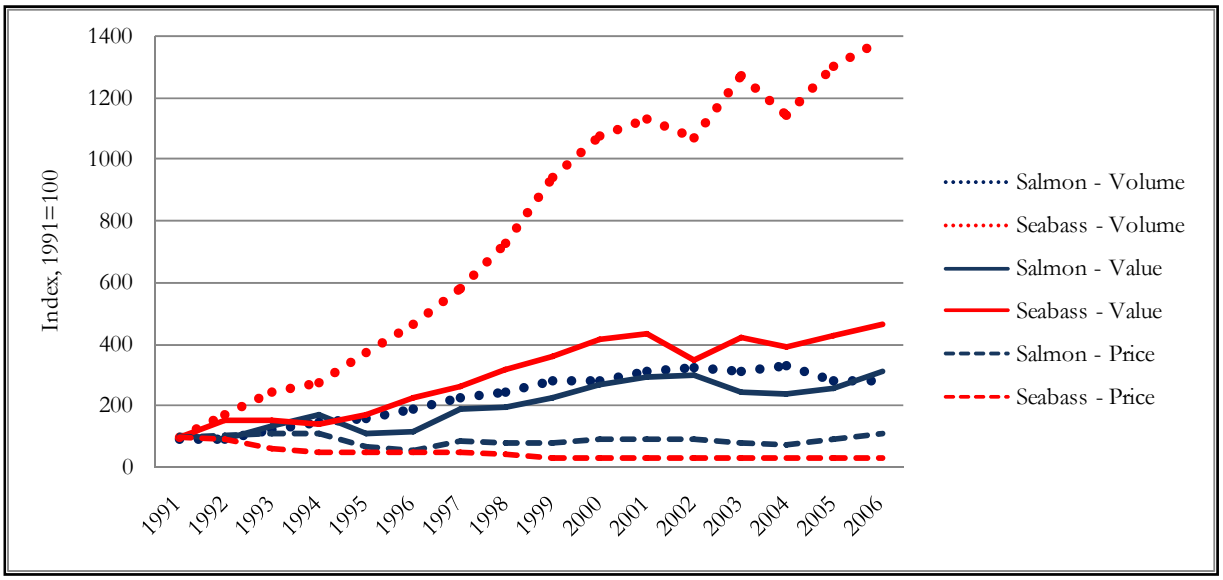

Figure 1.9 EU-27 - Trends in farming of Atlantic salmon and gilthead seabream / European seabass

- Source: FAO Fishstat

1.6.3. Performance of salmon farming

- Costs and earnings data regarding farming of salmon could be collected in both main producing countries – United Kingdom and Ireland. Figure 1.10 shows that the nature of the firms in these countries is rather different[12]. The firms in the UK are much larger than those in Ireland. Turn-over and GVA per firm are approximately three time greater, while these indicators peer FTE are four times higher.
-

The other operational costs, live raw material and labour costs are the most important costs components, accounting for 34%, 21% and 17% respectively. There are large differences in the composition of costs between the two countries. The reasons for these differences are probably related to the different size of the firms and the economies of scale which they can achieve.

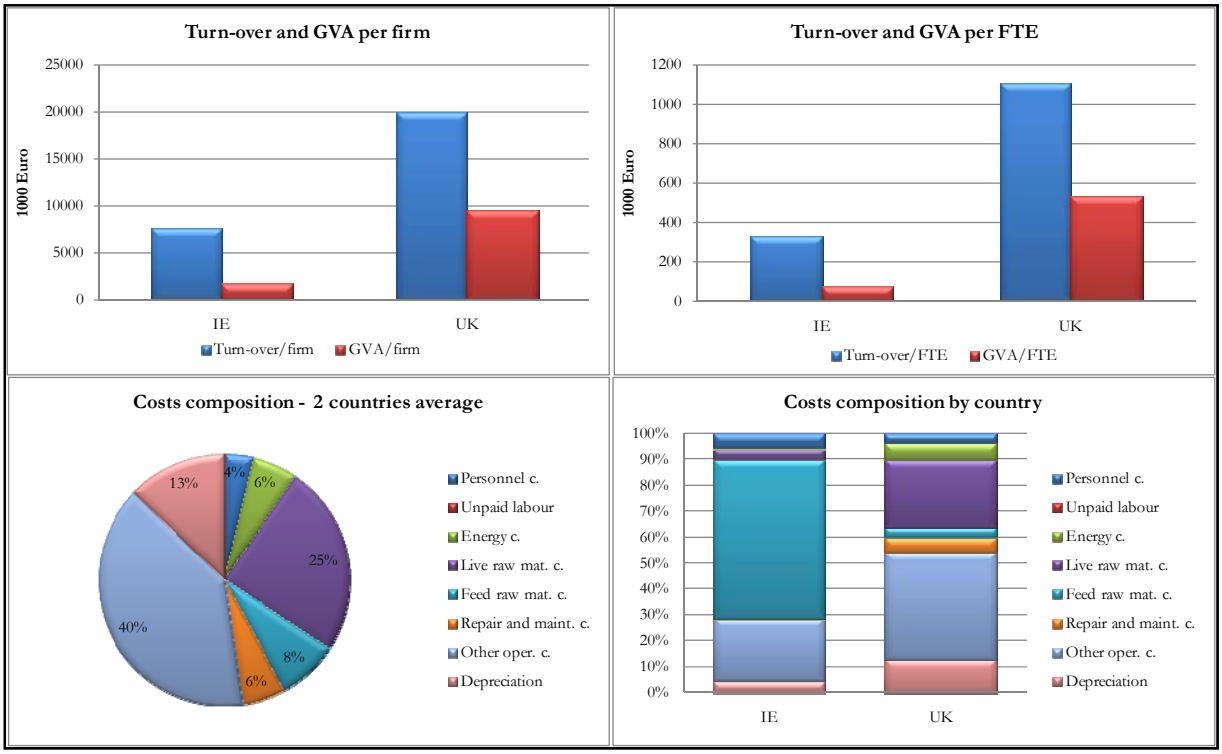

Figure 1.10 Main indicators for salmon firms
Source: country surveys

[12] This statement refers to the firms from which the data could be collected. The structure of the national sector can be (somewhat) different.

1.6.4. Performance of farming of seabream and seabass

- Costs and earnings data regarding farming of seabass and seabream was collected in Italy, Portugal and Spain and some partial data became also available from Greece. Figure 1.11 shows that the nature of the firms in these countries is rather different[13]. The large Greek firms realize a turn-over of about 3 million Euro, the small Portuguese firms are below 400,000 Euro. Labour productivity, in terms of GVA/FTE, could be estimated for three countries, where it lies between 60,000 and 80,000 Euro.
-

The feed and labour costs are on average the most important costs components, accounting for 31% and 24% respectively. There are large differences in the composition of costs between the various countries. Unfortunately, detailed costs composition for the most important producer Greece is not available. The reasons for these differences range from available data and statistical definitions to differences in technologies and prices of inputs.

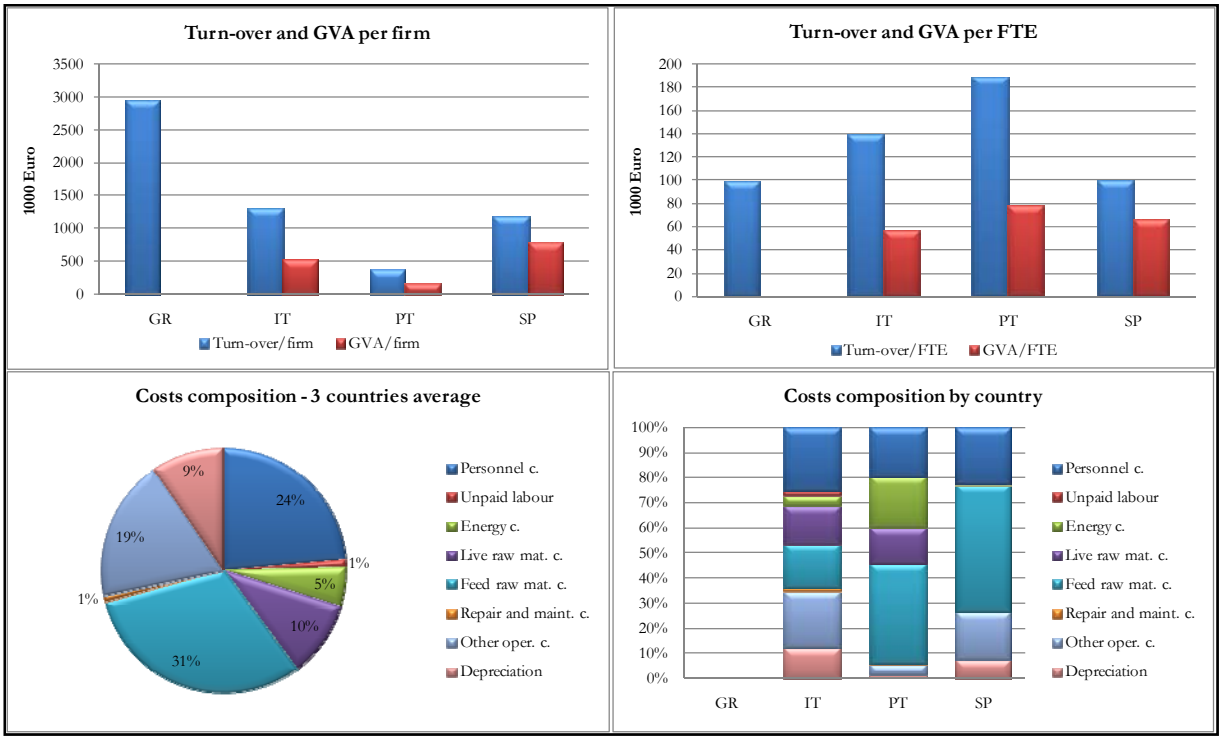

Figure 1.11 Main indicators for seabream and seabass firms
Source: country surveys

[13] This statement refers to the firms from which the data could be collected. The structure of the national sector can be (somewhat) different.

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1.6.5. Bivalve farming – blue mussels and Pacific cupped oysters

The most important producers of blue mussels are France, the Netherlands, Spain and the United Kingdom with a share of 85% in the total EU value of 350 million Euro. Overall value of the EU mussel production has increased by 50% between 1996 and 2005, mainly due to steady rise of the prices, while the volume has remained relatively constant.

Over 90% of the EU production of the Pacific cupped oyster takes place in France. There is a large number of small producers whose profitability appears to be significantly determined by their regional location. The location determines the suitability of on-growing conditions but also specific profitable specializations / activities such as the purification. The value of the EU production of Pacific cupped oysters has increased since 2001, exclusively due to the continuous increase in price. The volume was in 2005 about 20% below the 1996 level.

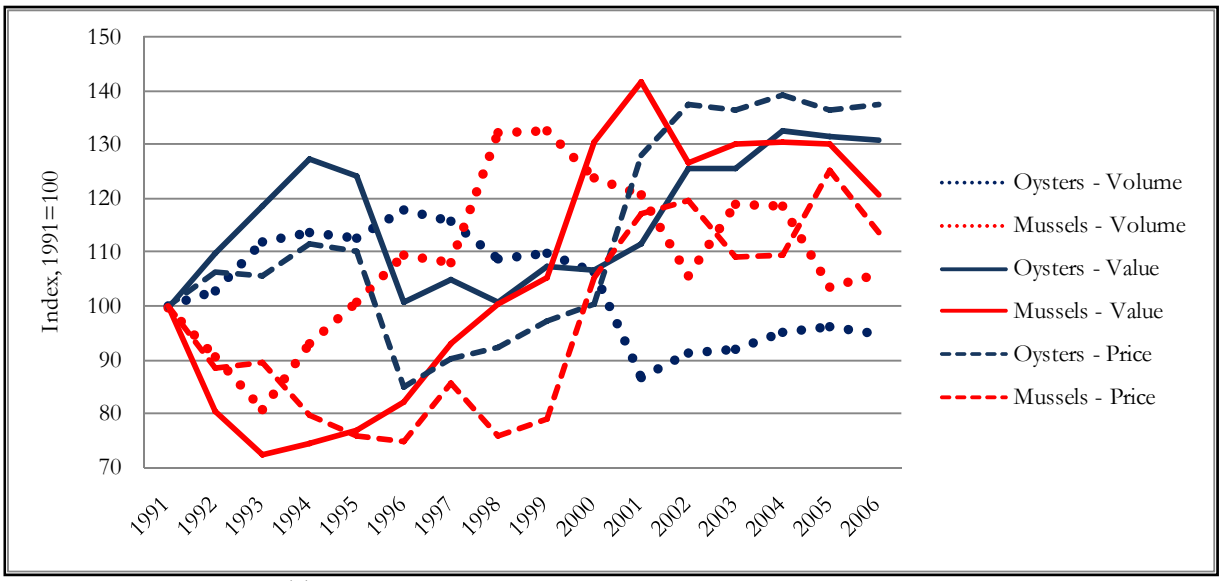

Figure 1.12 EU-27 - Trends in farming of mussels and Pacific cupped oysters, 1991-2006

- Source: FAO Fishstat
- All mussel species are included: blue mussels, Mediterranean mussels and other (nei)

- Costs and earnings data regarding farming of carp was collected in eight countries: Denmark, France, Greece, Ireland, Italy, Netherlands, Spain and the UK. Figure 1.13 shows that the nature of the firms in these countries is rather different[14]. The Dutch firms are highly productive, achieving a turn-over of 1.3 million Euro, while in all other countries the firms realize turn-over of 50-300,000 Euro. Comparable differences occur in relation to labour productivity – GVA/FTE ranges mostly between 20-70,000 Euro, while in the Netherlands it reaches almost 280,000 Euro.
-

The most important cost component is the labour costs, which represent about 40% of the total. The labour costs vary across the MS from 10% in Ireland to 60% in Italy. In some countries where the value of unpaid labour could be estimated (France, Greece and Denmark) it is quite a significant costs item accounting for 10-20% of the total costs . There are large differences in the composition of costs between the various countries. The reasons for these differences range from available data, accounting practices and statistical definitions to differences in technologies and prices of inputs.

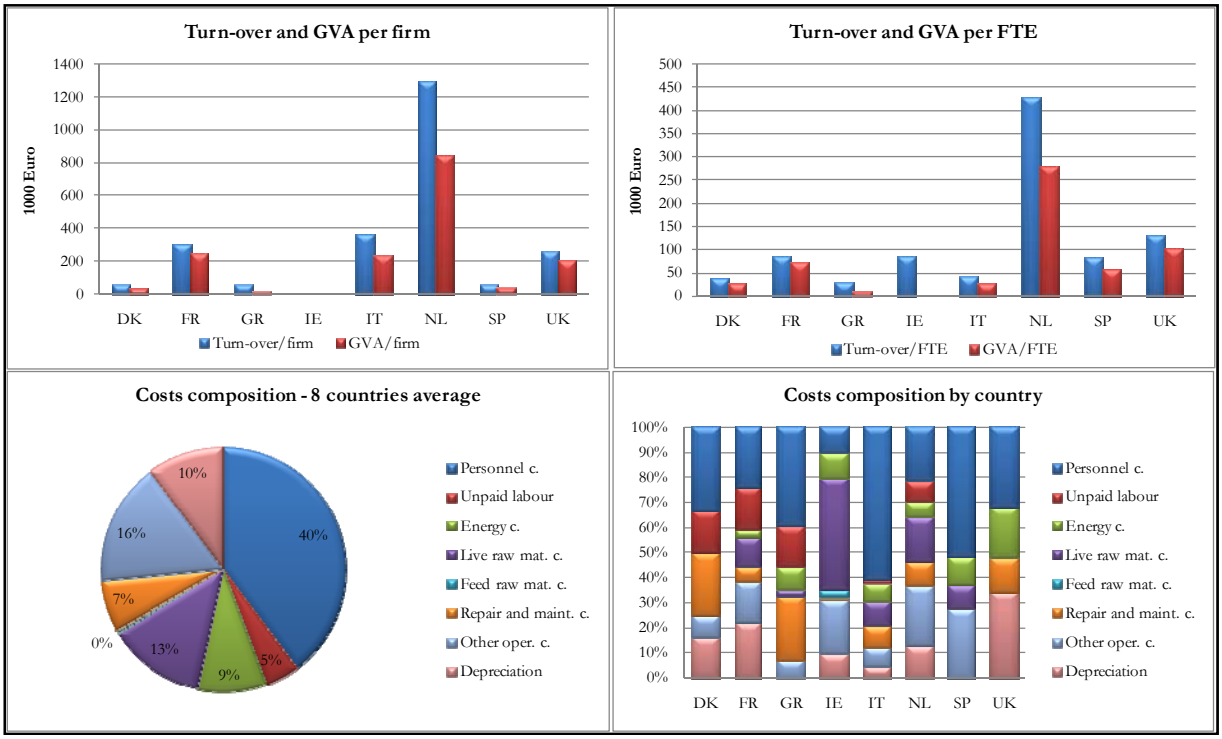

Figure 1.13 Main indicators for mussel firms
Source: country surveys

[14] This statement refers to the firms from which the data could be collected. The structure of the national sector can be (somewhat) different.

- Costs and earnings data regarding farming of oysters was collected in five countries: France, Ireland, Netherlands, Spain and the UK. Figure 1.14 shows that most oyster firms realize a turn-over of 100-200,000 Euro/year, with the exception of the Netherlands which shows a higher productivity. The labour productivity (GVA/FTE) lies between 40,000 and 80,000 Euro, with Ireland slightly below 20,000 Euro.
-

On average, live raw material is the most important costs component, with 36% of the total. This, however, is a consequence of the specific production chain in France, which is also by far the most important producer of oysters in the EU. The French oyster farming is composed of a chain of firms specialized in various on-growing stages. Consequently, trade in live raw material plays an important role.

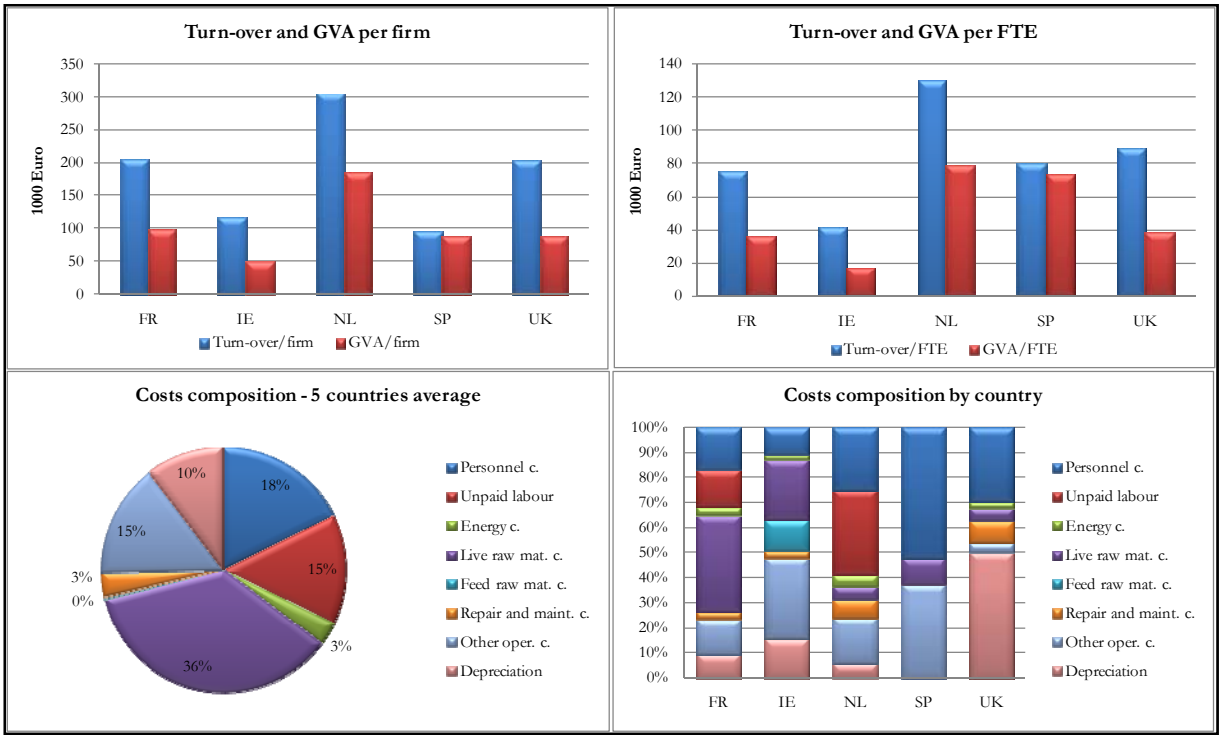

Figure 1.14 Main indicators for oyster firms
Source: country surveys

1.7. International trade

-
- General overview
-
- Analysis of the international trade (EU fish imports and export) from the perspective of cultured fish species is not straightforward for a number of reasons:
- The most detailed specification (NC8) distinguishes species and product forms for most important cultured species (salmon, trout, seabass / seabream, mussels, oysters and carp), but even these species are in case of some product forms aggregated with other species.
- Some important species are not individually specified. This applies particularly to tilapia and pangatius, which have shown a very rapid increase in the past few years.
- In case of species which are farmed and also caught in the wild, separation between farmed and caught fish is not feasible. This applies particularly to shrimp (but also to pikeperch, sturgeon, turbot, etc.) and for this reason shrimp is entirely excluded from the analysis below. In the coming years this will become an increasingly 'serious' problem as farming of new species like sole, turbot, cod and halibut will increase in scale.

The above remarks imply that the following analysis presents a probably good indication with a reasonable precision, but is not exhaustive and the interpretations must keep the above comments in mind.

EU imports of all fish and fish products from the rest of the world have increased from 11.7 billion Euro in 2000 to 15.8 billion Euro in 2006. i.e. almost 5% per year. On the other hand EU exports have grown from 1.8 to 2.4 bln Euro, i.e. a little more than 4% per year. Intra-EU trade has grown by more than 5% per year and achieved a total value of about 14.3[15] billion Euro in 2006.

Trade in farmed fish products has experienced an even more rapid growth. EU imports of farmed fish products, which can be distinguished in the statistics, amounted in 2006 to almost 3 billion Euro and have grown more than 7.5% per year since 2000. These figures are an underestimate as they exclude shrimp, pangatius, tilapia and possibly some other species. Intra EU trade of farmed fish products achieved a value of 3.5 billion Euro in 2006. On the other hand, EU exports of farmed fish to other parts of the world amounted to mere 270 million Euro, i.e. less than 10% of its imports.

The figures on intra-EU trade imply that a substantial part of the products imported from outside EU is re-exported again within the Union.

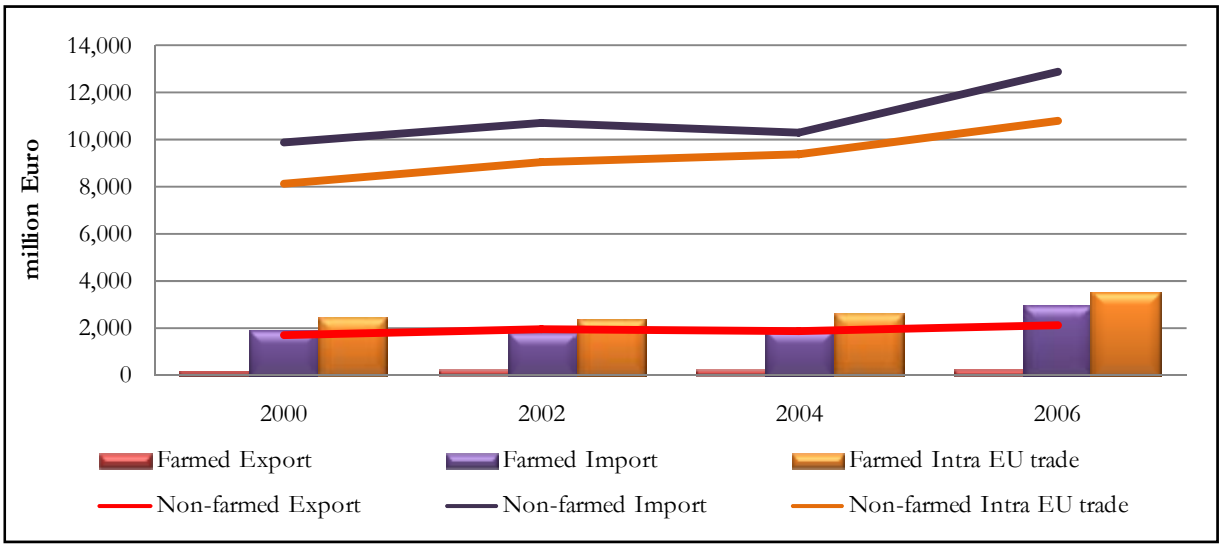

Figure 1.15 EU-27 - Export and import of farmed and non-farmed fish and fishery products

[15] This value is an average between declared intro-EU exports and imports. These two figures are not identical due to the fact that valuation of the same product flow in different countries includes or excludes costs freight, insurance, etc.

Source: Eurostat, COMEXT database.

Trade partners

EU trade of fish and fishery products is concentrated to a relatively limited number of trade partners, Norway being the most important one with a relative share of 18% in EU's imports in 2006. The seven most important countries of origin (Norway, China, Iceland, USA, Argentina, Russia and Morocco) account for 50% of EU's import value. The share of another 18 countries amounted in 2006 to further 30%, leaving mere 20% of the imports to other countries.

EU's imports of farmed fish are even more concentrated. In 2006, Norway alone exported almost 1.7 billion Euro of mainly salmon to the EU, which implies a share of 47%. Norway was followed at significant distance by Chile (338 million Euro), USA[16] (227 million Euro) and China (102 million Euro). Consequently, these four countries alone account for 80% of EU's imports of the considered farmed species.

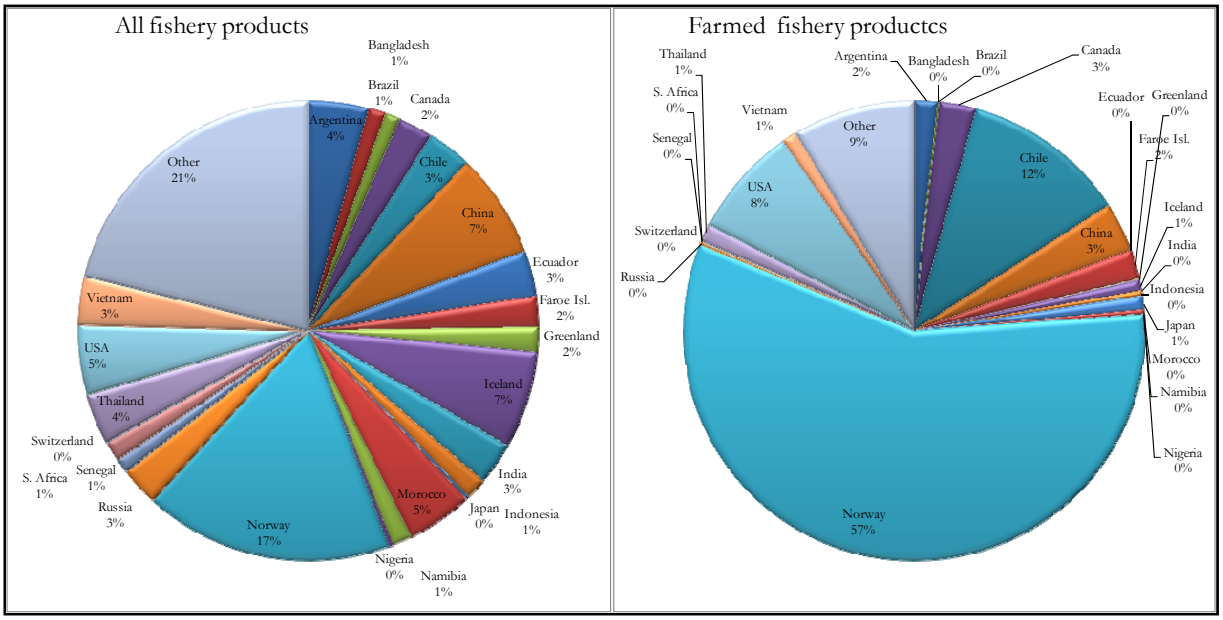

Figure 1.16 EU-27 - Value of imports of all and farmed fishery products by partner country, 2006
Source: Eurostat, COMEXT

Species

By the far the most important farmed species imported to the EU is salmon. Its total imports amounted to 2.3 billion Euro in 2006, representing 78% of the farmed fish imports (bearing in mind comments above). The most important country of origin was Norway, with total exports to the EU-27 of almost 1.7 billion Euro, followed by Chile with 235 million Euro. These countries accounted for 82% of all EU salmon imports.

Second most important group of species imported to the EU are bivalves, with a total value of 419 mln Euro, originating largely from Chile (23% of the value) and USA (20%). Approximately 50% of these imports are scallops and about 38% are mussels in different product forms.

Third most important group of species are ornamental fish. The total import value of this group amounted to 93 mln Euro, originating from a large variety of countries.

[16] This may possibly include also wild salmon.

Vietnam – a special case

Vietnam needs to be mentioned as a special case. Its total export amounted to almost 0.5 billion Euro in 2006, of which 50% was registered as freshwater fish. Vietnam's impressive performance on the EU market is illustrated by the table below. The most important product 'Frozen fillets of freshwater fish' (which is mostly pangatius) decreased in price from 4,030 Euro/t in 2,000 to 2,330 Euro/t in 2006, a decrease of 43%. At the same time the volume increased from 800 to 100,000 tonnes. This illustrates the competitive pressure under which EU fish farmers are operating.

Table 1.7 EU imports from Vietnam, 2000-2006, mln Euro

	2000	*2006*	*Index 2006/2002*
Bivalves	3.8	35.7	937
Freshwater fish	4.9	246.6	4,989
Shrimp	63.9	115.0	180
Squid / octopus	16.8	41.0	244
Saltwater fish	7.5	39.6	529
Other	6.8	65.7	961
Total	**103.8**	**543.7**	**524**

Source: Eurostat

2. CZECH REPUBLIC

2.1. Situation in 2006-7

The Czech Republic is a typical inland state with a structure of fresh surface water having a production role in aquaculture, but also fulfilling a range of non-production functions. In 2007, food fish production in the Czech Republic amounted to 20,447 tonnes and the production value amounted to 41.6 million Euros. More than five hundred entities are involved in the production of aquaculture output, but the bulk of production is concentrated in a small number of large-scale companies, 70 of which account for approximately 90% of production. The fish farming sector employed almost 1,600 people in 2007.

2.2. Main trends

During recent years, food fish production in the Czech Republic has not changed much. In 1996 – 2007 fish farms produced 19,250 tonnes of food fish on average per year. Annual fish production has stabilized at 20,500 tonnes for the last three years. Over the 1996 – 2007 period, 43% of live fish was sold to consumers directly on the domestic market and 47% of the production was exported, whereas on average only 10% of fish was processed.

The production value in 1996 – 2007 increased from 28 million Euros in 1996 to 41.6 million Euros in 2007. This growth, however, resulted mainly from the strengthening of the Czech currency against the Euro. In 2000 – 2007 fish production contributed to GDP generation in the Czech Republic by 0.04% on average. About 85% of the total fish production represented food fish, while the remaining approx. 15% represented juvenile fish breeding.

A favourable aspect of Czech fish production consists in its long-term equilibrium and link to a relatively stabilized market demand. This equilibrium can be characterized as an optimized process of the sector's sustainability, where no overproduction occurs and hence there is also no subsequent price fluctuation related to it.

Employment development since 1996 has experienced a reduction. The number of workers dropped by 40% in the years 1996 - 2007. The reduced employment was related to a continually high share of heavy work in difficult natural conditions, increasing work productivity and the alignment of fish farming methods with new legislation concerning environmental protection.

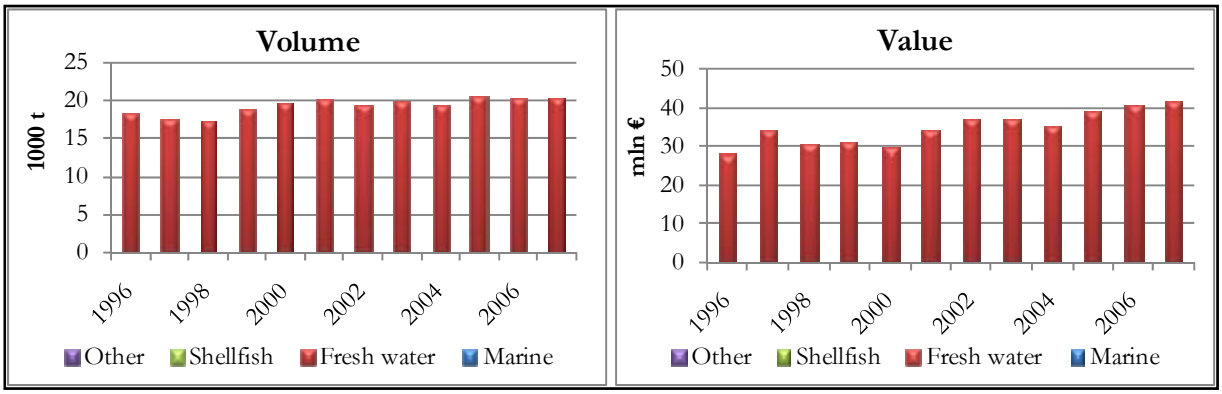

Figure 2.1 Czech Rep. - Volume and value of aquaculture production, 1996-2007

2.3. Structure of the sector

Czech fish farming production is concentrated mainly in ponds and lakes. In the Czech Republic, there are more than 24,000 ponds and lakes utilized in aquaculture. Their total area amounts to 51,800 hectares with a retention capacity exceeding 420 million m^3 of water, of which 81% (i.e. 42,035 hectares) are areas utilized for fish breeding. Fishing is mainly centred on the regions of South Bohemia and South Moravia, where the most significant fish producers are also located.

Apart from pond fish farming, there also exist a limited number of fish farms for the salmonid fish species (rainbow trout and brook trout) using tanks and raceways for fish production. However, there is a lack of suitable water resources and initial working capital for massive development of this segment.

The structure of food fish species is relatively stable and has not changed since 1996. The most important fish bred in the Czech Republic is the carp, which accounted for 88% of the total volume of fish that were bred in 2007. In addition, herbivorous fishes were bred (silver carp, grass carp) at 4%, salmonid fish at 4%, and tench at 1%. In 2007, predatory and other fish species contributed 3% to the total fish production in the Czech Republic.

The most significant producers in the sector are organized in the Czech Fish Farmers Association. The contribution from members of the Czech Fish Farmers Association toward total food fish production in 2007 was 18,169 tonnes, which represented more than 88% of total production. In 2007, the Czech Fish Farmers Association had in their registry 49 members involved in food fish production. Of this number, 40 members of the association list carp as the prevailing fish they produce, but most of them also produce other species of freshwater fish. Specialization in other species is very limited. Only nine members of the Czech Fish Farmers Association were specialized in species other than carp in 2007.

Information about the structure of other producers is insufficient and very inaccurate. Outside the Association, 38 registered breeders were identified, of which 23 had an annual fish production of more than 10 tonnes in 2007. According to estimates, in 2007 these breeders produced 1,708 tonnes of food fish (8% of production).

It can be assumed that during the years since 1990 a number of small entities have been established, mainly small-scale breeders. There is practically no information about their production specializations and volumes. Some agricultural holdings and farms with a primary focus on agricultural production are also engaged in fish farming. Some of these companies produce fish largely for farmhouse consumption. In 2007, a production estimate for these entities was 600 tonnes of fish, utilizing 2,000 hectares of ponds of different quality in an extensive way. Estimates for a number of these entities can only be generated from several inaccurate sources of information.

The lack of information is the same regarding hatcheries and nurseries. The majority of big companies run their own hatcheries and nurseries as subsidiary enterprises. Information concerning small entities which specialize in hatcheries, nurseries and other lines of production is not available.

As noted previously, carp producers specialized in the pond-based farming system dominate the fish farming sector in the Czech Republic. According to estimates from the Czech Fish Farmers Association, about 20 fish farmers are specialized in trout breeding in tracks and raceways. Nevertheless, the number of these entities is too small to be surveyed as a separate segment.

Classifying the population into two segments by economic size proved to be optimal. The first segment is represented by a small number of large farms with fish production exceeding 10 tonnes per year. These companies account for approximately 90% of total fish production. The second segment includes a large number of small farms with fish production lower than 10 tonnes per year. These farms represent approximately 10% of total fish production.

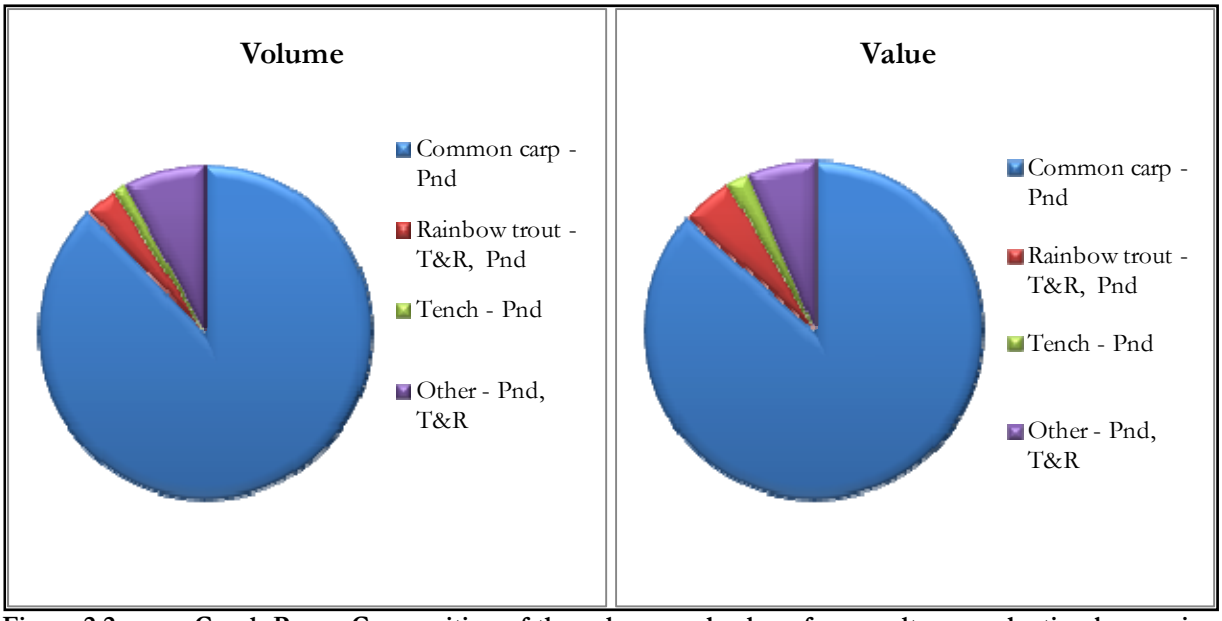

Figure 2.2 Czech Rep. - Composition of the volume and value of aquaculture production by species and on-growing technique, 2007

Table 2.1 Czech Rep. - Main segments of the national aquaculture sector

Group of species	On-growing technique	Number of firms in population
Carp combined with other species (tench, bighead carp, grass carp, trout) Large-scale producers	Ponds	Approximately 70
Carp combined with other species (tench, bighead carp, grass carp, trout) Small-scale producers	Ponds	Approximately 500

2.4. New developments

There have been neither crucial innovations within aquaculture, nor significant development of new branches within the monitored period. Lack of capital (the need for high input investment and high operating costs) and insufficient capacities of suitable water sources (water quantity and quality) are impediments to the expansion of farms breeding salmonid fish (rainbow trout and brook trout) in the Czech Republic.

Uncertainty of a sufficient demand within the domestic market due to conservative consumers impedes the implementation of breeding high-quality, more expensive fish species, whether they be domestic (wels catfish, zander) or imported (European sea sturgeon, Nile tilapia). Intensive aquaculture focused on thermophile species is not sufficiently developed in the Czech Republic and its current production is negligible.

A specific area within aquaculture is the breeding of ornamental fish. Increased demand has enabled some producers to expand production capacities in this direction during recent decades. However, it is only a minor activity for the large aquaculture entities. Small fish farmers, in particular, produce ornamental fish.

Organic fish farming according to Council Regulation (EC) No 2092/2000 is hardly represented in the Czech Republic at all, but checking into its possibilities via some pilot projects is nevertheless being considered.

2.5. Economic performance

2.5.1. Carp in ponds, large-scale and small-scale producers

One big problem in the Czech market for fish production is low profitability, which was confirmed by the results of the survey taken. The total profit (EBIT) generated by farms in this sector was only 3 million Euros in 2007. If other business activities are not taken into account, almost one half of the companies in this field are operating at a loss. The value of subsidies represents, for the surveyed farms, approximately 70% of the total other receipts relating to fish farming. More than three quarters of these farms would show losses without this type of support.

Low profitability in this sector is caused mainly by stagnant prices and insufficient market demand, while input prices are increasing. Other unfavourable factors include the importation of cheap sea fish, high technological costs, a long-term production process, production seasonality, a high share of manual labour and imports of freshwater species replacing domestic production. Damage caused by predators (cormorant, otter and heron) is a big problem, because compensation for it is insufficient, according to fish farmers. Fish farms are also affected by a strengthening of the Czech currency, as was mentioned, approximately one-half of production is exported.

Cost structures are similar for most fish farms. Personnel costs are the most considerable item, valued at 11.9 million Euros and representing 24% of total costs for the surveyed farms. There is a high share of manual labour within fish farming in the Czech Republic. Average wages over the long term remain below the national average wage for this sector. Over 8 million Euros (16% of total costs) was spent on feed. The high cost of repair and maintenance (6.5 million Euros, 13% of total costs) implies a high level of age and wear for machinery and equipment in the fish farming sector of the Czech market. A total depreciation amount of 3 million Euros (6% of total costs), energy costs (2.5 million Euros, 5% of total costs) and live raw material costs (1.6 million Euros, 3% of total costs) represented other significant cost items. The low value of unpaid labour (0.2 million Euros) in comparison with other items can be explained by the low occurrence in the survey of very small entities (single holders), which are characterized by a high share of unpaid labour. This item was calculated as the product of unpaid labour hours and the average wage rate in 2007 in the fish farming sector (3.7 Euros per hour). Other operating costs (15 million Euros) included service costs, taxes and fees, insurance, etc. The most significant item within these costs was rent paid for ponds. Approximately 53% of water areas utilized by the surveyed farms were rented ponds, therefore it would appear useful to survey rent paid for ponds as a separate item in the future.

On the basis of the survey results, it can be said that the total market volume of fish production does not create sufficient financial resources and reserves, therefore large investments could not be carried out without public financial support. With respect to the fish production economy and current level of prices, it is not possible to undertake pond reconstructions and maintenance (removing of pond mud). The investment rate is very low in the fish farming sector, which is documented by the negative value of net investments (-0.5 million Euros). Sales of long-term tangible assets slightly exceeded the total amount of investments in long-term tangible assets in 2007 among the surveyed farms.

National regulations such as quotas and licences are not applicable at present in the Czech Republic.

2.6. Statistical tables

Stat. table 2.1 Czech Rep. - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)[a)]	Number of companies [b)]	Employment [c)]
1996	18.3	27.7		2,652
1997	17.6	34.2		2,705
1998	17.2	30.6		2,441
1999	18.8	30.9		2,326
2000	19.5	29.5		2,052
2001	20.1	33.9		1,986
2002	19.2	37.1		2,033
2003	19.7	37.3		1,905
2004	19.4	34.8		1,839
2005	20.5	38.9		1,693
2006	20.4	40.4		1,681
2007	20.4	41.6	570	1,557

Source: Czech Statistical Office

a) Includes food fish and juvenile fish production value b) Data is not available c) Full time equivalents

National overview – Nurseries and hatcheries

Data is not available

Stat. table 2.2 Czech Rep. - Review by sub-sector and species (value and volume), 2007

	Volume (1000 t)	Value (mln Euro)[a)]	Number of companies [b)]	Types of on-growing unit	Employ-ment[c)]
Freshwater fish culture					
- Common carp	17.9	31.2	550	Ponds	1,500
- Rainbow trout	0.6	1.8	38	Tanks and raceways, ponds	110
- Tench	0.3	0.8	66	Ponds	195
- Other	1.6	2.3	540	Ponds, tanks and raceways	1,450
Hatcheries/Nurseries		5.5	50		

a) Estimation, b) Estimation, c) Estimation (full time equivalents), d) bighead carp, grass carp, pike, pikeperch, European eel, brook trout, other

Stat. table 2.3 Czech Rep. - Indicators by segment, 2007 [a)]

(segment totals, value in million Euro)

On-growing technique	Ponds
Species	Carp combined with other species
Environment	Freshwater
OPERATIONS – COSTS AND REVENUES	
Turnover total [b)]	37.0
Other income	14.5
Personnel costs	11.9
Value of unpaid labour	0.2
Energy costs	2.5
Live raw material costs	1.6
Feed raw material costs	8.0
Repair and maintenance	6.5
Other operational costs	15.0
Depreciation	3.0
Profit (EBIT)	3.0
Net interest costs	0.7
Gross cash flow	6.0
Gross value added	18.0
BALANCE SHEET – ASSETS AND LIABILITIES	
Net investment in tangible goods	-0.5
Equity capital	136.5
Debts	28.5
Total assets	164.9
EMPLOYMENT	
Total number of persons employed	1,961
Full time equivalents (FTE)	1,301
LEGAL STATUS	
Total number of firms [c)]	570
Single holder [c)]	500
Limited and anonymous co.'s [c)]	70
PRODUCTION VOLUME	
Volume (1000 tonnes)[d)]	20.7
OTHER DERIVED INDICATORS	
Turnover / FTE (1000 Euro)	28.4
Gross value added / FTE (1000 Euro)	13.9
Personnel costs / FTE (1000 Euro)	9.1
Tons / FTE (Tons)	15.9
Turnover / firm (1000 Euro)[e)]	558.6
EBIT / Total assets (%)	1.8

a) Small and large-scale farms were merged into one segment, because of small number of farms with year volume of production below 10 tonnes.

b) Includes carp 30 million Euros, rainbow trout 1.2 million Euros, bighead carp 0.2 million Euros, grass carp 0.7 million Euros, tench 0.7 million Euros, brook trout 0.4 million Euros, pike 0.5 million Euros, wells catfish 0.3 million Euros, pikeperch 0.4 million Euros, other fish 0.5 million Euros, juvenile fish 2.2 million Euros.

c) Estimation

d) Includes carp 17.6 thousand tonnes, rainbow trout 0.4 thousand tonnes, bighead carp 0.3 thousand tonnes, grass carp 0.4 thousand tonnes, tench 0.3 thousand tonnes, brook trout 0.1 thousand tonnes, pike 0.1 thousand tonnes, wells catfish 0.1 thousand tonnes, pikeperch 0.05 thousand tonnes, other fish 0.4 thousand tonnes, juvenile fish 1.0 thousand tonnes.

e) Sample mean

3. DENMARK

3.1. Situation in 2006

The total gross output value from the Danish aquaculture sector in 2006 was 111 million Euros, and the total volume was 37,500 tonnes. The total population of farms counted in 2006 was 325, they were owned by 193 companies, and the total number of persons employed was 690 of whom 421 were employed full-time, 124 part-time, and 145 were seasonally employed.

The main species produced in Denmark is rainbow trout with a volume of 35,300 tonnes and a gross value of 93.7 million Euros, and European eel with a volume of 1,700 tonnes and a gross value of 15.5 million Euros in 2006. The number of persons employed in trout farming was 632 and the number of persons employed in eel farming was 25.

3.2. Main trends

Production from marine waters, sea farms, was relatively constant in the period 1996 - 2006. The production was between 7,000 and 8,000 tonnes, and the value of production was on average 19 million Euros. The only year with a large fluctuation was 2002, which was a consequence of changes in the data collecting system. The numbers of companies decreased from 2002 to 2006 and also the numbers of employees fell.

The production volume in freshwater fish farms has increased from 34,100 tonnes in 1996 to 36,300 tonnes in 2000. After 2000 the production volume has declined to 29,700 tonnes in 2006. The value of production follows the same pattern. The large fluctuation between 2001 and 2002 is a consequence of changes in the data collecting system. The number of companies has declined from 209 in 2002 to 193 in 2006, corresponding to a reduction of 9%. The total number of employees also declined from 636 in 2002 to 540 in 2006, corresponding to a reduction of 15%.

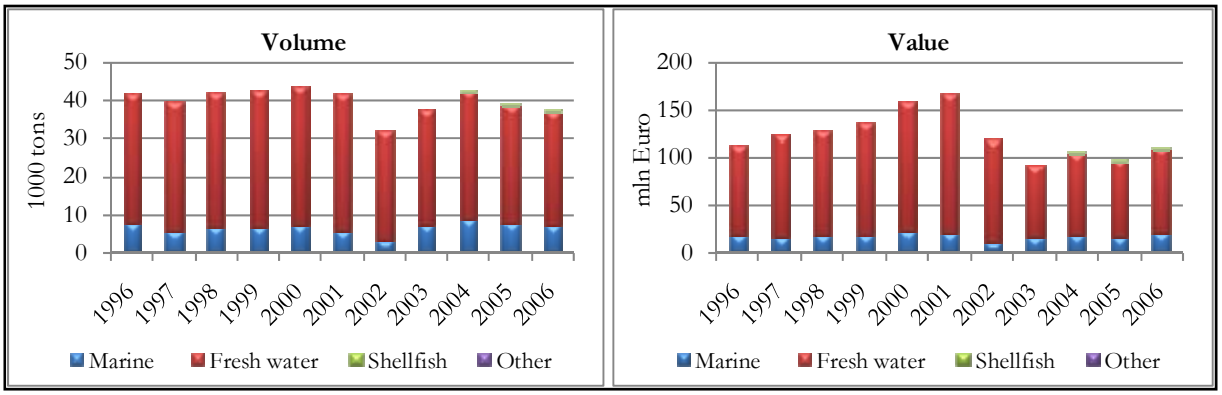

Figure 3.1 Denmark - Volume and value of aquaculture production.
Source: Danish Directorate of Fisheries and Institute of Food and Resource Economics

The shellfish farms commenced producing in 2004, so the production is still very new in Denmark. The Danish Directorate of Fisheries has registered more than 30 licenses for shellfish farming, but it takes a couple of years to start up a shellfish production. For the time being the main species produced is blue mussels.

3.3. Structure of the sector

The 5 segments that are surveyed in Denmark are presented in Table 3.1. To avoid problems with confidentiality, segments should in general include more than 10 companies. In Denmark, both the

production of the sea cages farms of rainbow trout and of eel in recirculation systems are quite significant in terms of value, and even though these two segments include less than 10 companies, they are surveyed. In order to present detailed data collected from these two segments, nearly all companies have agreed to participate in the survey. (Unfortunately some of the largest eel producers did not want to participate in the 2006-survey).

Table 3.1 Denmark - Segment to be surveyed, 2006

Species	On-growing technique	Number of companies in the population	Proposed survey size
Rainbow trout	Cages	6	6
Rainbow trout	Tanks and raceways	142	70
Rainbow trout	Recirculation system	20	15
European eel	Recirculation system	9	9
Blue mussels	Off bottom	10	10

Source: Danish Directorate of Fisheries and Institute of Food and Resource Economics.

Sea cage farms in Denmark produce only rainbow trout. In 2006 there were 19 farms distributed among 6 companies. The production volume was 7,335 tonne and the value was 21.0 million Euros. The production method in the segment is very homogeneous.

Traditional pond farms in Denmark produce 98% rainbow trout in volume and in value. In 2006 there were 248 farms distributed among 142 companies. The production volume was 23,895 tonne and the value was 61.1 million Euros. The last 2% in volume and value produced in the traditional pond farms are other kinds of trout. Companies producing more than one species of trout are mainly allocated to this segment because their main income stems from production of rainbow trout. Most of the companies have an integrated production from hatchery to final product.

Recirculation systems producing rainbow trout consist of 32 farms distributed among 20 companies. The production volume was 4,105 tonne and the value was 11.6 million Euros. Most of the companies have an integrated production from hatchery to final product. It is expected that this segment will grow in the coming years.

Recirculation systems producing European eel constitute 9 farms distributed among 9 companies. The production volume was 1,707 tonne and the value was 15.5 million Euros. The production method in this segment is very homogeneous; all farms are very intensive and re-circulate more than 95% of the water. All companies have the same kind of production from glass eel to the final product. This segment is dominated by one large producer.

Other recirculation system farms are producing several other species. The most important species is turbot. Other species are pike, pike perch, and pollan. There are only 6 companies in this segment, and the segment is not presented separately.

Shellfish farms producing blue mussels just commenced their production activity in 2004. This type of production is still very new in Denmark. For the time being there are 11 farms distributed among 10 companies. The production volume was 406 tonne and the value was 0.4 million Euro. The production methods in the segment has until now been very homogeneous. All companies in this segment are producing blue mussels on lines.

Nurseries and hatcheries are, for the most part, integrated into the production process within each company. Only a few companies have specialised in production of eyed eggs or fingerling. This segment is not separately surveyed.

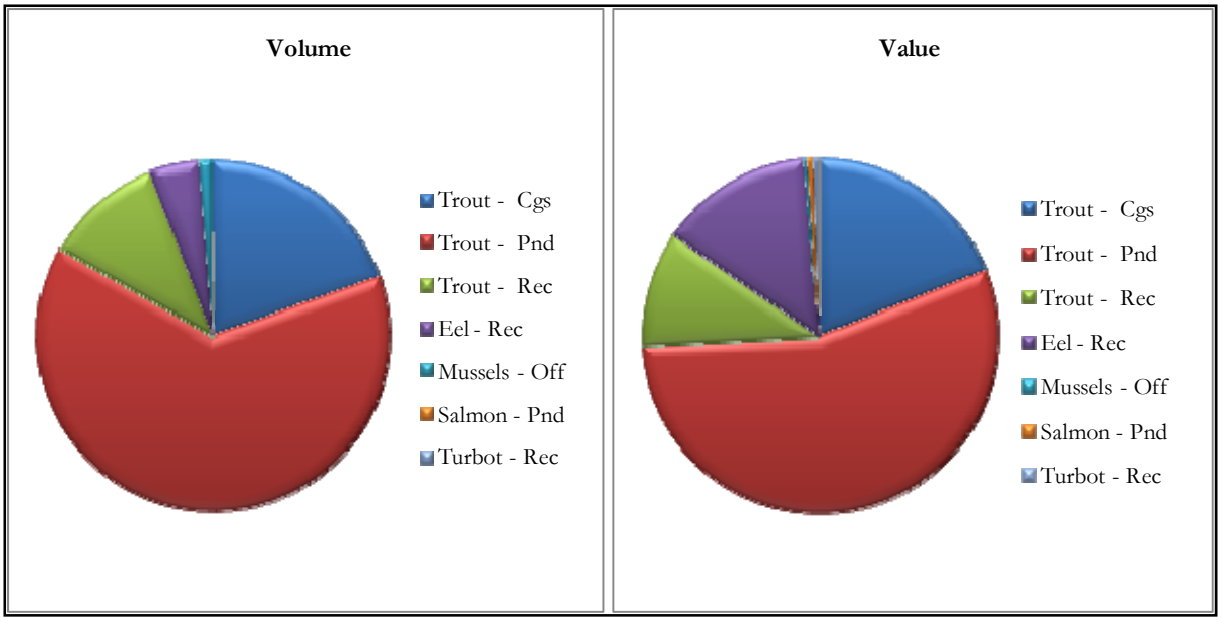

Figure 3.2 Denmark - Volume and value of aquaculture production in 2006
Source: Danish Directorate of Fisheries and Institute of Food and Resource Economics

Data for the Danish aquaculture were collected by the Danish Directorate of Fisheries from 2002. Comparing figures from 2002 and later with figures from before 2002 is not advisable. There are also some uncertainties concerning the data collected by the Danish Directorate of Fisheries in 2002.

The Danish Directorate of Fisheries has a complete list of companies engaged in aquaculture production in Denmark. Every year the aquaculture producers have to fill in a questionnaire concerning the production in volume and value, what kind of species is produced and in which kind of farm(s).

To collect the account data, FOI uses the total population of aquaculture producers and the data collected by the Danish Directorate of Fisheries are used for the segmentation of the aquaculture sector. The segmentation is shown in Table 3.1.

The Danish Account Statistics for Aquaculture collects economic data for costs and earnings and balance sheets. Data is collected on a voluntary basis from the owner's chartered accountant. The accountant's task is to report the accounts of his aquaculture clients to FOI in a special form where the account information is harmonised for statistical use. The accountant gets paid for every account that is reported and approved by FOI. The FOI data is validated in a specially designed data system for quality control.

The Danish Commerce and Companies Agency (DCCA) also collect account data for companies but not for single holders. For those companies that are not willing to participate in the FOI survey, the accounts from DCCA are used instead, even though they are not as detailed as the account collected by FOI via the chartered accountant. There are, however, some difficulties using accounts from the Danish Commerce and Companies Agency due to the fact that they are not harmonised and often both income and expenditures are not specified as separate posts but subtracted from each other into one cost item. It is also difficult to separate aquaculture income and income from other kinds of business.

If a company produces more than one species, then it is allocated to the segment of the species that contributes the most to the total gross value.

Some companies own more than one farm. In Denmark these activities are split up, because the farm is used as data collection unit. When farms are aggregated into companies again, the company is allocated to the segment, where its gross value is highest.

To get the best possible sample, the gross value collected for each farm is used for size class segmentation. The population is divided into 5 size classes. The highest sample is obtained from the class with the highest gross value, because there is a higher dispersion than in the smaller size classes.

After receiving the accounts from the chartered accountant, FOI test and evaluate the accounts before the data is processed for the final aquaculture account statistics.

Data for the aquaculture sector is published once a year on aggregated level for each segment both at the farm and company level. The aquaculture statistics are published on FOI's Danish website approximately 12 months after the end of the reference year.

3.4. New developments

In the last 2-3 years a much more intensive production type has been introduced in Denmark. In this production type water is re-circulated in concrete tanks, and the production volume is much higher than in traditional farms. The new farms are no longer dependent on a nearby stream or river, but take in fresh clean water from the underground. The fish produced by these recirculation farms are small trout's weighing 300 to 500 grams. For the time being there are only 8 of these very intensive farms, but it is expected that within a couple of years there will be about 50.

Presently there are 4 new organic farms producing rainbow trout according to the Danish regulation of organic production in fish farming. The aquaculture producer organisation expects that in the future this segment will be growing. It is more expensive to produce organic trout, but sales prices are also much higher than the prices of conventionally produced trout.

In the Danish strategic programme for 2007 till 2013 under the European Fisheries Fund, the goal for sea cage farming in saltwater is to raise production to five times the amounts that are produced in 2006, which corresponds to approximately 40,000 tonnes.

For freshwater farms producing trout, the goal is to raise production to 60,000 tonnes, and for other species produced in freshwater, the aim is to raise production to 10,000 tonnes. For European eel in freshwater, the goal is to raise production to 5,000 tonnes.

3.5. Economic performance

In this section the results from the Danish Aquaculture Account Statistic 2006 is presented. The Danish survey has been carried out as a 3-year pilot study, from 2004 to 2006.

There are some differences in the volume and value collected by the Danish Directorate of Fisheries and FOI. In general, both volume and value are higher in the Aquaculture Account Statistics. The reason for this is that the value and volume in the Account Statistics are measured in company sales, while figures from the Danish Directorate of Fisheries are measured as farm production. Secondly the data collected by FOI are account data and the account year does not usually follow the calendar year.

Sea cage farms in Denmark produce only rainbow trout. In 2006 there was 19 farms distributed on 6 companies. All 6 companies participated in the survey. The production volume was 8,364 tonne and the value of sales was 36.2 million Euros. The main difference in value between EUROSTAT and the Danish Aquaculture Account Statistics in this segment is caused by the production of roe (trout eggs). The value from roe is not collected by the Danish Directorate of Fisheries, because they only collect data for the volume and value of the produced fish and not the products sold.

The sea cage farms are the largest farms in Denmark in relation to turnover. The turnover per firm in 2006 was 6,100 thousand Euros and the turnover per FTE was 572 thousand Euros. 2006 was a relatively

good year because of quite high trout prices. For 2007 and 2008 the surplus will be lower, due to higher feed prices and falling sales prices on trout.

Intangibles which may get monetary value are production permits and feed quotas. Constrains to the segment are the placement of new farms because of the environmental impact on the sea floor of the shallow Danish waters.

Traditional farms. In 2006 there were 248 farms distributed on 142 companies. 139 farms from 63 companies participated in the survey. The production volume was 23,263 tonne and the value of sales was 62.2 million Euros. The turnover per firm was 438 thousand Euros, and the turnover per FTE was 183 thousand Euros. The traditional trout farms are smaller and more labour intensive than both sea cages and recirculation farms. The small farms in this segment are struggling to survive even though 2006 was a good year. In 2007 and 2008 the performance will be even lower because prices on trout have been falling.

Intangibles which may get monetary value are production permits, water using rights and feed quotas. Constrains to the segment are the placement of new farms and the expansion of existing farms because of the environmental impact on streams and fjords. The producer's organization finds that the most binding constraints for the development of aquaculture are the Local, National and European government bureaucracy and environmental constraints.

Recirculation systems producing rainbow trout consist of 32 farms distributed among 20 companies, and 22 farm from 12 companies participated in the survey. The production volume was 7,623 tonne and the value of sales was 19.0 million Euros. Most of the companies have an integrated production from hatchery to full grown fish. It is expected that this segment will grow during the coming years because the environmental impact from these recirculation farm is much less than from traditional pond farms.

The recirculation system farms are in general larger than the traditional farms. The turnover per firm in 2006 was 945 thousand Euros and the turnover per FTE was 320 thousand Euros. The recirculation farms just began producing in 2004 2005 and 2006 so there is still room for improvement. It is expected that this segment will become more competitive than the traditional farm because the environmental impact from these farm types is must smaller per kilo fish than for traditional farms.

Intangibles which may get monetary value are production permits, water using rights and feed quotas. Constrains to the segment are location of new farms and expansion of existing farms, because of the environmental impact on streams and fjords. The producer's organization finds that the most binding constraints for the development of aquaculture are the Local, National and European government bureaucracy and environmental constraints.

Recirculation systems producing European eel constitute 9 companies and 7 farms from 7 companies participated in the survey. The production volume was 1,926 tonnes and the value of sales was 17.0 million Euros. The turnover per firm was 1,889 thousand Euro and the turnover per FTE was 850 thousand Euros. The revenue from eel farms is expected to drop quite rapidly in 2007 and 2008, because of competition from China. In the last two years, the prices on eel have fallen by 50 %.

Intangibles which may get monetary value are production permits and water using rights. The production of European eel is constrained by the fact that the production is based on the harvesting of wild glass eels. The stock of wild European eel is in a very poor condition, and the harvesting of wild glass eels may be banned in near future.

Other recirculation system farms are producing turbot, pike, pike perch and pollan. The segment has only 6 companies, and 3 farms from 3 companies participated in the survey. The on-growing techniques are very similar in this segment but the species produced are very different. The segment is not presented separately.

Shellfish farms producing blue mussels. There are 11 farms distributed among 10 companies, and 6 farms from 5 companies participated in the survey. The production volume was 650 tonnes and the value

of sales was 0.6 million Euros. The turnover per FTE was 40 thousand Euros, which is very low compared to the other segments. The mussel producers have faced many problems in the first two years and, so far, the profit from this segment has been negative. The result from 2007 is also expected to be negative.

Intangibles which may get monetary value are production permits. The production of mussels is also used around sea cages as an experiment to reduce the environmental impact from the trout production.

Nurseries and hatcheries are, for the most part, integrated in the production process within each company. Only a few companies have specialised in production of eyed eggs or fingerling. This segment is not surveyed separately.

3.6. Statistical tables

Stat. table 3.1 Denmark - Saltwater fish farming

	Volume of production (1000 tonnes)	Value of production (million Euros)	Number of companies	Employment (Total number)
1996	7.8	19.7		
1997	5.9	17.0		
1998	7.1	19.0		
1999	7.1	19.9		
2000	7.3	23.6		
2001	5.9	21.6		
2002	3.1	11.0	11	132
2003	7.7	16.7	9	153
2004	8.8	19.5	6	134
2005	7.8	17.4	6	127
2006	7.3	21.0	6	117

Source: Danish Directorate of Fisheries and Institute of Food and Resource Economics
Note: Production of rainbow trout (Oncorhynchus mykiss)

Stat. table 3.2 Denmark - Freshwater fish farming

	Volume of production (1000 tonnes)	Value of production (million Euros)	Number of companies	Employment (Total number)
1996	34.1	93.5		
1997	33.8	107.3		
1998	35.3	107.7		
1999	35.6	115.6		
2000	36.3	135.4		
2001	35.7	145.5		
2002	28.9	107.8	209	636
2003	30.1	75.3	204	622
2004	34.0	86.1	189	541
2005	30.9	80.8	186	521
2006	29.7	89.3	171	540

Source: Danish Directorate of Fisheries and Institute of Food and Resource Economics
Note: Production of mainly rainbow trout (Oncorhynchus mykiss) and European eel (Anguilla Anguilla)

Stat. table 3.3 Denmark - Shellfish farming

	Volume of production (1000 tonnes)	Value of production (million Euros)	Number of companies	Employment (Total number)
1996				
1997				
1998				
1999				
2000				
2001				
2002				
2003				
2004	0.1	0.1	6	9
2005	0.3	0.1	8	26
2006	0.4	0.4	10	22

Source: Danish Directorate of Fisheries and Institute of Food and Resource Economics
Note: Production of blue mussels (Mytilus edulis)

Stat. table 3.4 Denmark - Review by sub-sector and species (value and volume), 2006

	Volume (1000 tonnes)	Value (mln Euros)	Number of companies	Types of on-growing unit	Employment (Total number)
Mariculture (marine fish)					
- Rainbow trout	7.3	21.0	6	Cages	117
Freshwater fish culture					
- Rainbow trout	23.9	61.1	142	Tanks and raceways	442
- Rainbow trout	4.1	11.6	20	Recirculation system	73
- European eel	1.7	15.5	9	Recirculation system	25
- Other species	0.0	1.1	6	Recirculation system	11
Molluscs and crustaceans					
- Blue mussels	0.4	0.4	10	Off bottom	22
Other					
- Hatcheries / Nurseries					

Source: Danish Directorate of Fisheries and Institute of Food and Resource Economics

Stat. table 3.5 Denmark - Indicators by segment, 2006

(segment totals, value in million Euro)

On-growing technique	Cages	Tanks and raceways	Recirculation system	Recirculation system	Off bottom
Species	Rainbow trout	Rainbow trout	Rainbow trout	European eel	Blue mussels
Environment	Saltwater	Freshwater	Freshwater	Freshwater	Saltwater
Population	6	142	20	9	10
Sample	6	63	12	7	5
OPERATIONS – COSTS AND REVENUES					
Turnover total	35.6	60.4	17.8	16.8	0.5
Other income	1.0	1.8	1.1	0.2	0.1
Personnel costs	2.4	9.0	2.5	1.9	0.4
Value of unpaid labour		3.2	0.3	0.1	0.2
Energy costs	0.0	2.4	1.0	1.6	
Live raw material costs	12.1	9.9	1.9	3.8	
Feed raw material costs	8.1	19.9	6.0	2.0	
Repair and maintenance	1.9	3.9	1.1	1.2	0.3
Other operational costs	7.4	6.5	2.3	1.9	0.1
Depreciation	1.0	2.7	1.3	0.6	0.2
Profit (EBIT)	3.6	4.6	2.6	3.8	-0.5
Net interest costs	0.7	2.2	1.0	0.4	0.1
Gross cash flow	5.3	9.5	4.9	4.8	-0.2
Gross value added	7.7	21.7	7.7	6.8	0.4
BALANCE SHEET – ASSETS AND LIABILITIES					
Net investment in tangible goods	1.7	6.2	3.8	0.6	0.2
Equity capital	8.4	22.3	4.8	8.1	0.1
Debts	21.1	65.7	26.2	12.2	1.2
Total assets	29.5	88.0	31.0	20.2	1.3
EMPLOYMENT					
Total number of persons employed	117	442	73	25	22
Full time equivalents (FTE)	64	340	59	20	15
LEGAL STATUS					
Total numbers of firm	6	142	20	9	10
Single holder	0	95	8	4	5
Limited and anonymous co.'s	6	47	12	5	5
SALES VOLUME					
Volume in (1000 tonnes)	8.4	23.3	7.6	1.9	0.7
OTHER DERIVED INDICATORS					
Turnover/FTE (1000 Euros)	572	183	320	850	40
Gross value added/FTE (1000 Euros)	120	64	131	340	27
Personnel costs/FTE (1000 Euros)	38	36	47	100	40
Tonnes/FTE (1000 Euros)	131	69	129	95	47
Turnover/firm (1000 Euros)	6,100	438	945	1,889	60
EBIT/Total assets (%)	12	5	8	19	-38

Source: Institute of Food and Resource Economics

4. FINLAND

4.1. Situation in 2006

In 2006, there were altogether 343 fish farm firms and enterprises with natural food ponds in operation. Of these, 105 firms had food fish production and 41 firms specialised in fry production. Some firms have both production lines. The number of farmers with natural food ponds was 197. The sector employed 1,263 persons (engaged workers).

The food fish production in 2006 was 12,000 tonnes. The total production decreased slightly but the value of food fish production (41 million Euros) remained stable. In addition to food fish, the sector produces fry, both for stocking and further rearing. The production in 2006 was 56 million individuals.

4.2. Main trends

In 1990, Finnish food fish production reached almost 20,000 tonnes. Since then, the production has declined. The value of production has varied depending on the world market situation for salmon and large rainbow trout. The production value peaked in 2000, which was a very profitable year for aquaculture production globally. Finnish production is heavily concentrated on rainbow trout but during the last ten years, the production of European whitefish has grown steadily. In 2006, whitefish production reached 800 tonnes and had a value of 4 million Euros. Both of these major species are mainly produced in cages in the sea, but also in lakes and raceways inlands.

The number of fish farm companies has declined along with the value of production. Since 1996, the number of firms has dropped by one third. In 2006, there were 187 fish production firms in the business register. These firms account for basically all food fish and juvenile production apart from natural food pond production. The total turnover of these companies was 70 million Euros and employment was 423 FTE. Employment in terms of FTE has halved since 1996.

Natural food pond production is specialized in juvenile production for stocking purposes. The production value of these firms has also decreased during the past decade. In 2006, there were 197 producers that generated a production value of 4.2 million Euros. Due to the seasonality, these firms generated an employment of 24 FTE. Aquaculture is usually not the main line of business of natural food pond producers. Therefore, most of the producers are not classified as aquacultural firms according to the standard industrial classification.

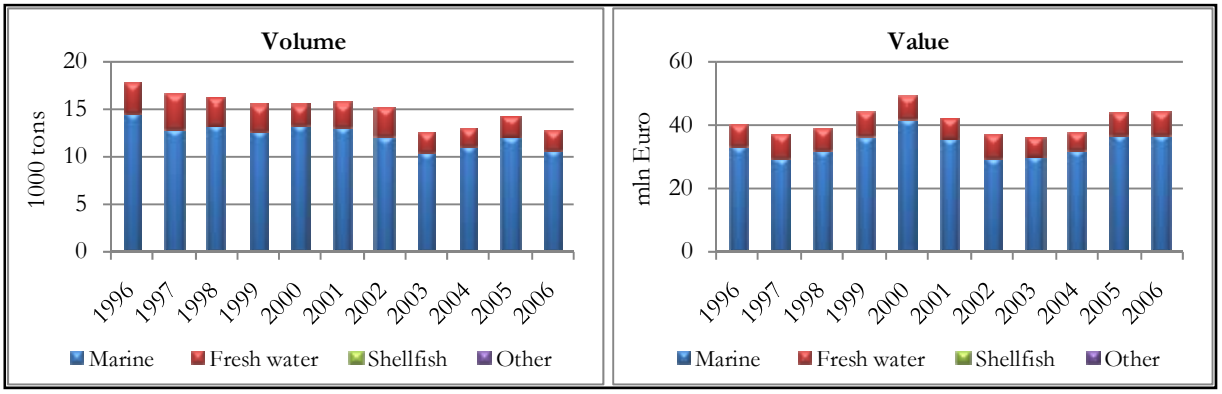

Figure 4.1 Finland - Volume and value of food fish production in 1996-2006.
Source: FGFRI

4.3. Structure of the sector

Finnish aquaculture consists of food fish production and the production of juveniles. Food fish is produced mostly on saltwater farms but also in the inland. Food fish production has traditionally concentrated on rainbow trout, but during the past years it has increasingly turned towards European whitefish.

Rainbow trout is by far the most important species farmed, accounting for over 90% of production both in terms of volume and of the value of food fish. The production of European whitefish has been increasing steadily during the past ten years. In 2006, the value of the production reached 9% of the total food fish production.

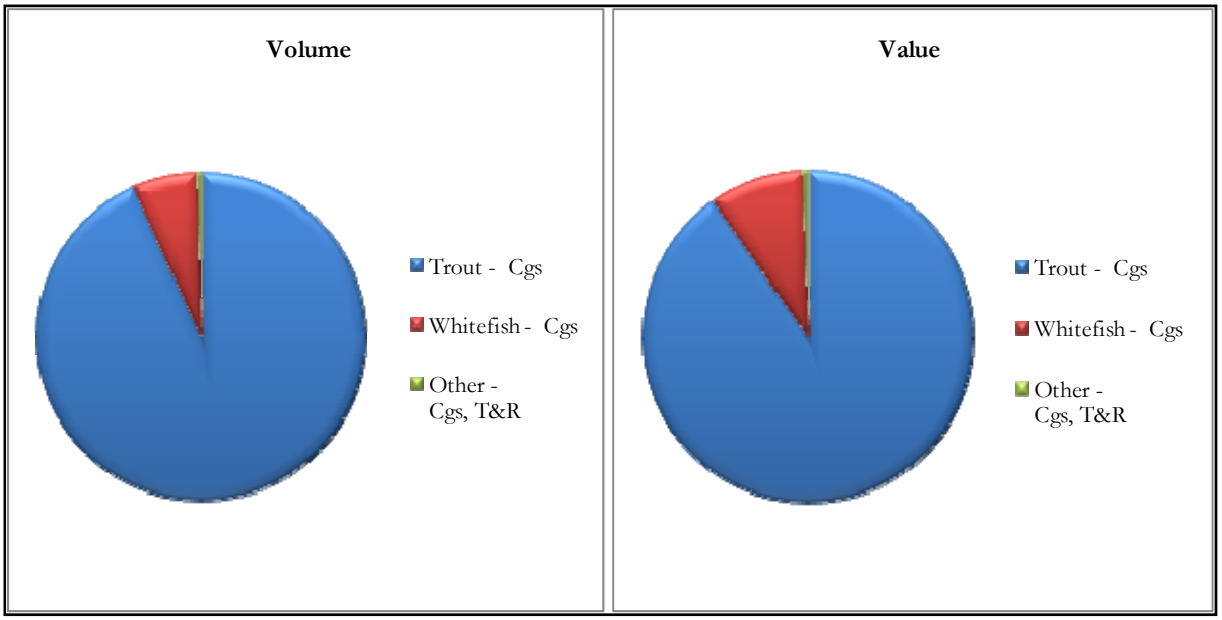

Figure 4.2 Finland - Volume and value of food fish production in 2006.
Source: FGFRI

Some of the food fish firms have integrated fry production but there are also specialised juvenile fish producers. There are two main production methods in juvenile production: tanks and natural food ponds. Hatcheries and nurseries together with natural food ponds produce numerous fish species for on-growing and stocking purposes. There are also a few farms producing crayfish fry, but the number of these farms is limited and therefore it is not possible to place them in a separate segment.

The Finnish aquaculture production is divided into four main segments:

- Saltwater aquaculture (food fish production)
- Inland aquaculture (food fish production)
- Hatcheries and nurseries
- Natural food ponds

Saltwater aquaculture means production in cages. Most marine farms are specialised in rainbow trout production, some also produce European whitefish. Inland food fish production is mainly done in raceways but also in cages in lakes. The production method inland will be used as the stratum in data collection. Some producers have integrated production of fry. Food fish firms will be stratified if they have both food fish and fry production. The production is highly concentrated nowadays. Therefore it is important to have a good representation of the large producers in the industry.

The natural food pond production segment is very heterogeneous and fragmented. Most of the production is considered small scale and is a subsidiary business, mainly in agriculture. This production may be difficult to obtain reliable information on.

4.4. New developments

Finnish food fish production is concentrated on rainbow trout. The profitability of the industry is heavily dependent on the world market prices of rainbow trout and salmon. Finnish producers are not competitive compared to Norwegian production and this has lead to a decrease in the size of the industry. To gain a competitive advantage, there has been intensive development of new species. During the last 10 years, the production of European whitefish has increased fast. The price development has also been favourable and the production has been profitable.

There has been some experimental production in the recirculation production of sturgeon, for example, but this has not expanded significantly.

4.5. Economic performance

According to the financial statement there have been significant cycles of profitability during the past ten years. These business cycles have resulted in clear variation in the turnover and profitability of the industry. In 1996-1998, the profitability was poor, resulting in a decline in the number of firms. The result improved in 2000, which was an exceptionally profitable year. Since then, there have been weaker years. The production volume and value have decreased with the number of firms.

In 2006, the turnover of the fish farm sector as a whole was 70 million Euros and they employed 423 (FTE). The sector is heavily concentrated. The 20 largest firms produced two thirds of the total turnover and accounted for half of the employment. The average turnover of the largest companies was over 2 million Euros, whilst the overall average only reached 350,000 Euros. The profitability of the sector improved from 2005 and was acceptable. All segments were making profits. The e largest companies were very profitable.

Production in the aquacultural sector is based on environmental permission that regulates the maximum amount of feed to be used annually. The environmental regulation of the sector has been tight and has limited the growth and development of production in this sector. The permission system has led to a situation where the average size of production units is small and hence the sector is restricted in gaining economies of scale. This has led to a consolidation of the sector by takeovers. The largest companies have bought a number of smaller producers to receive production licenses to utilize economies of scale. There have also been other attempts to alleviate the environmental effects of aquaculture and to increase the efficiency of the production. Apart from feed development, there has been research on technical alternatives for production and on location guidance for production.

Marine food fish farming: rainbow trout, European whitefish - cages

Marine food fish farms produced half of the turnover of the sector, 35 million Euros. The average turnover of saltwater producers was 0.5 million Euros. The segment was profitable. Earnings before interest and taxes (EBIT) reached 3.6 million Euros, 10% of gross revenues. Return on investment was good, 16%. The total employment of 65 saltwater food fish farms was 163 FTE.

Inland food fish farming: rainbow trout, European whitefish – cages and raceways

The turnover of inland food fish farming in 1996 was 10 million Euros. Inland firms were smaller than the marine ones. Their average turnover was 250,000 Euros, half of that in the saltwater segment. However, profits (EBIT) were at the same level as those in saltwater production: 10% of gross revenue. Due to the high value of invested capital in inland firms, ROI was lower than in saltwater production, at 10%. 40 inland food fish farms employed 78 FTE.

Hatcheries and nurseries: various species - tanks

Hatcheries were the second largest segment in production value. The segment generated a 22 million Euro turnover and employed 158 FTE. The average turnover was 0.5 million Euros. The segment earnings before interest and tax were 2.1 million Euro, 10% of the turnover. The invested capital was higher than in food fish production and ROI was fair, 7%.

Natural food ponds: various species - ponds

Natural food pond production units were significantly smaller on average than other segment firms were. This segment of 197 producers generated a 4 million Euro turnover. The average turnover was 20,000 Euros. However, production costs were low and the profitability was higher than in other segments, being 18% of the turnover. The invested capital in the production was relatively high and ROI was only 6%, i.e. significantly lower than in food fish production.

4.6. Statistical tables

Stat. table 4.1 Finland - National overview – saltwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies*
1996	14.7	33.4	238
1997	13.0	29.3	200
1998	13.3	32.2	190
1999	12.8	36.5	175
2000	13.3	42.0	177
2001	13.2	35.5	173
2002	12.2	29.5	160
2003	10.4	29.9	154
2004	11.0	32.1	158
2005	12.1	37.3	149
2006	10.7	36.9	141 (65 companies)

*1996-2005 only number of fish farms

Stat. table 4.2 Finland - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies*
1996	3.0	6.8	93
1997	3.4	7.7	87
1998	2.8	6.8	91
1999	2.7	7.7	82
2000	2.1	6.6	65
2001	2.5	6.7	74
2002	3.0	7.3	81
2003	2.1	6.0	69
2004	1.9	5.5	67
2005	2.2	6.8	69
2006	2.1	7.3	62 (40 companies)

*1996-2005 only number of fish farms

Stat. table 4.3 Finland - National overview – Hatcheries

	Volume of production (mln juveniles)*	Value of production (mln Euro)	Number of companies**
1996	74.1		147 (349)
1997	67.4		134 (322)
1998	68.5		151 (324)
1999	69.8		143 (312)
2000	79.3		129 (318)
2001	63.1		126 (301)
2002	60.0		103 (300)
2003	63.1		104 (294)
2004	64.4		98 (293)
2005	60.8		102 (286)
2006	58,8		105 (247)

*Not including newly hatched larvae or crayfish larvae

**1996-2006 only number of fish farms, Juvenile farms and Natural food ponds (in parentheses) separately

Stat. table 4.4 Finland - National overview – Number of companies and employment

	Number of companies*	Employment* (fte)	Employment**
1996	284	693	
1997	288	664	
1998	267	575	
1999	247	510	
2000	233	488	1985
2001	231	433	1985
2002	219	396	1985
2003	207	354	1558
2004	188	344	1492
2005	176	332	1511
2006	187	423	1263

*Source: Statistic Finland, **Source: FGFRI(number including natural food bond firms)

Stat. table 4.5 Finland - Review by sub-sector and species (value and volume), 2006.

	Volume (1000 t)	Value (mln Euro)	Number of companies	Types of on-growing unit	Employ-ment (FTE)
Mariculture (saltwater production)					
Mariculture			65	Cages	163
Rainbow trout	9.3	29.2		Cages	
European whitefish	0.6	3.0		Cages	
Others		4.8		Cages	
Inland fish culture			40	Cage/Raceway	78
Rainbow trout	1.5	4.6		Cage/Raceway	
European whitefish	0.1	0.6		Cage/Raceway	
Others		2.2		Cage/Raceway	
Natural food bonds	Mln ind.		197	Ponds	24
Pike perch	10.7	10.7		Ponds	
Eur. whitefish	8.5	1.1		Ponds	
Others	0.3	0.1		Ponds	
Hatcheries			41	Tanks	158
Rainbow trout fry	10.9	4.8		Tanks	
Salmon	2.8	2.6		Tanks	
Trout	2.6	2.5		Tanks	
Others		3.5			

Source: FGFRI

Stat. table 4.6 Finland - Indicators by segment (thousand Euro, 2006)

On-growing technique	Marine fish Cages	Inland fish Cages, raceways	Hatcheries Tanks	Natural food ponds
Species	Rainbow trout, Eur. whitefish	Rainbow trout, Eur. whitefish	Various species	Various
Environment	Saltwater (brackish)	Freshwater	Freshwater	Freshwater
OPERATIONS – COSTS AND REVENUES				
Turnover total	34134	10196	21605	3709
Other income	550	52	495	800
Personnel costs	-4385	-2024	-5174	-772
Value of unpaid labour	-863	-400	-169	-183
Energy costs	-1849	-483	-1041	-86
Live raw material costs	-3832	-1002	-2157	-813
Feed raw material costs	-13456	-3518	-7574	0
Repair and maintenance	-1066	-279	-600	-251
Other operational costs	-4428	-1158	-2492	-1073
Gross cash flow	4805	1385	2894	1332
Depreciation	-1227	-411	-756	-506
Profit (EBIT)	3578	974	2138	826
Interest costs (net)	-233	-158	-142	-111
Gross cash flow	4805	1385	2894	1332
Gross value added	10020	3765	8204	1664
BALANCE SHEET – ASSETS AND LIABILITIES				
Net investment in tangible goods				
Equity capital	10903	4279	11858	5384
Debts	12743	5487	21903	9546
Total assets	23771	9823	33836	14949
EMPLOYMENT				
Total number of persons employed				
Full time equivalents (FTE)	163	78	158	24
LEGAL STATUS				
Number of firms	65	40	41	197
Single holder				
Limited and anonymous co.'s				
SALES VOLUME				
Volume in (1000 tonnes)	9.9	1.6	19.5 (mln ind.)	16.3
OTHER DERIVED INDICATORS				
Turnover / FTE (1000 Euro)	210	131	137	155
Gross value added / FTE (1000 Euro)	62	48	52	69
Personnel costs / FTE (1000 Euro)	32	31	34	40
Tonnes / FTE (tones)				
Turnover / firm (1000 Euro)	525	255	527	19
EBIT / Total assets (%)	15 %	10 %	6 %	6 %

Source: FGFRI, SF

5. FRANCE

5.1. Situation in 2006

The total output of the French aquaculture sector in 2006 was 235,000 tons and 522 million Euros (not including hatcheries' turnover). In volume, shellfish farming ranks first (around 190,000 tons), far ahead of freshwater fish farming (38,400 tons) and saltwater fish farming (7,400 tons). In value, the shellfish farming sub-sector also leads, with a 380 million Euro turnover, followed by the freshwater fish and saltwater fish sub-sectors (respectively a 94 and 47 million Euro turnover).

Latest exhaustive statistics concerning the number of companies and employment rely on 2006 data (Aquaculture survey DPMA). These data again show the dominance of shellfish farming in French aquaculture: about 3,250 companies, mainly small scale and family based, creating around 19,000 jobs, which represent 9,900 full time equivalent jobs. It should be noted that shellfish farming is a big user of seasonal jobs. The number of companies involved in freshwater fish farming was 316 in 2006, and the employment accounted for 1,300 jobs, corresponding to 1,055 full time equivalents. But these figures do not include the number of companies and employment of freshwater fish farming in ponds, as it is not covered by the national statistical survey. By comparison, the saltwater fish farming which has been developing more recently (since the beginning of the 80's) remains a small sector, with about forty companies and 600 jobs.

5.2. Main trends

The whole production from French aquaculture slightly decreased, in volume, over the last decade. This general trend covers a slightly decreasing production for shellfish (-1% per year), downward trend for freshwater fish (-4%/year) and upward trend for marine fish (+3%/year).

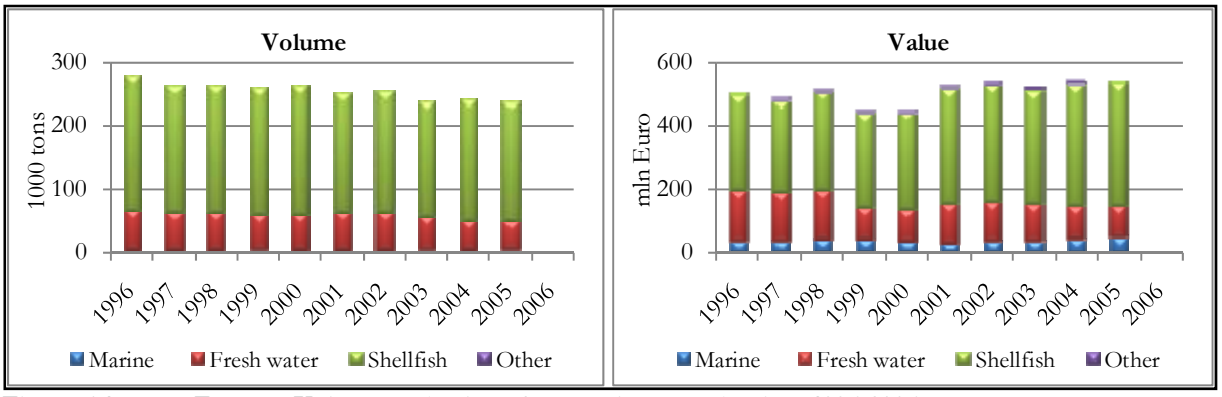

Figure 5.1 France - Volume and value of aquaculture production, 1996-2006

In value, the evolution of the whole aquaculture production turns out to be less continuous with an initial downward trend during the 1996-2000 period, and then a slight increase in turnover of the sector (+2%/year over the 2000-2006 period). This evolution mainly results from a break in the data series of average prices used to estimate the turnover of shellfish farming. The former price indicator, based on raw products, was from 2001 re-valued to integrate the costs of packaging, as wrapped bivalves represent the majority of the sales, in particular for oyster farmers. Indeed, this statistical bias limits the analysis of the evolution of the shellfish farming sector in value.

In the two other sub-sectors, the trends in production value are found to be similar to, or even to be more pronounced that the trends in volume.

- The decrease in production of freshwater fish from 1996 to 2006 (from around 60,000 to 38,000 tons) has been accentuated by the drop in price. From 1996 to 2000, the average price of rainbow trout (75-80% of the freshwater fish production in volume) decreased from 2.87 to 1.74 Euro/kg (-39% in

nominal terms). As far as trout farming is concerned, it may be speculated that this sector has been suffering from the concurrence of imported salmon, which leads fish imports on the French market. Environmental factors also contributed to the drop of the production of rainbow trout in recent years, such as the drought of 2003…As a result of the cut in trout domestic supply and the increase in salmon import prices in 2005 and 2006, the prices of trout slightly recovered at the end of the period (2.29 Euro/kg in 2006), but anyway remained lower than ten years ago.

- The increase of production of marine fish over the 1996-2006 period, from 6,000 to 7,400 tons, mainly results from the revival of the activity of salmon farming since 2001 (the production of salmon had totally stopped by 2000), and a small development of seabass and seabream farming, as well as its related activities (for example the diversification in meagre farming). However, the sector of saltwater fish farming still remains very small. As a recently established activity, it could not be developed in France due to coastal management concerns (competition with tourism).

5.3. Structure of the sector

As previously mentioned, the French aquaculture sector is largely dominated by bivalve molluscs farming, especially the production of oysters (nearly 50% of the whole aquaculture production in volume and value) and mussels (30% in volume, 20% in value).

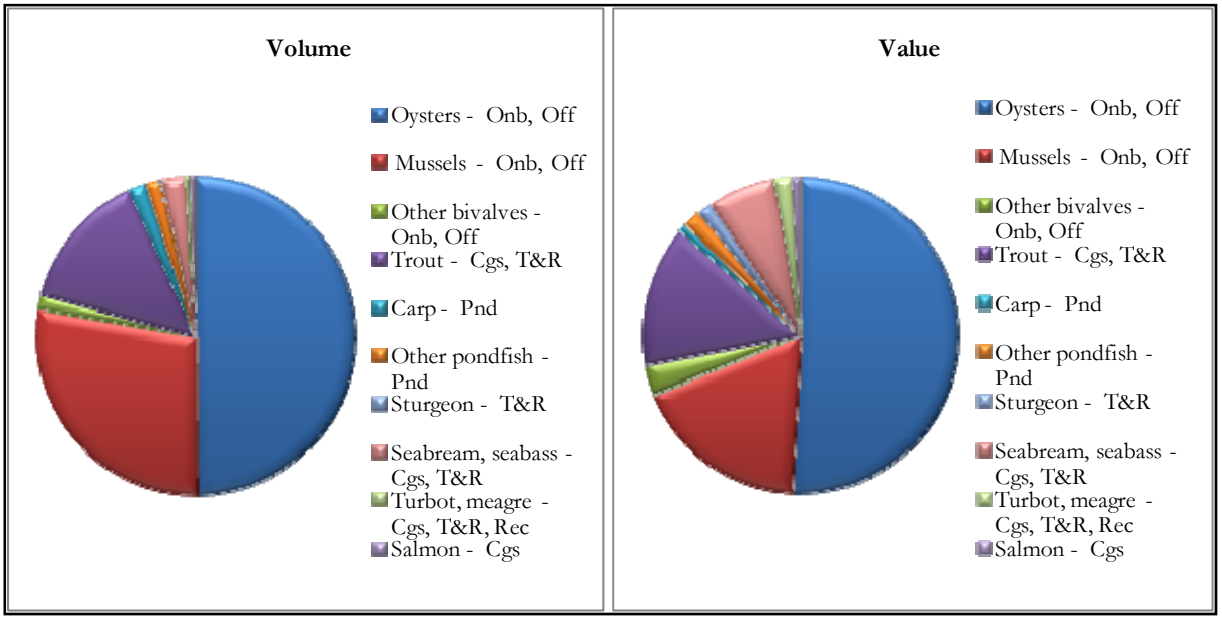

Figure 5.2 France - Composition of the volume and value of aquaculture production by species and on-growing technique, 2006

The third biggest production is farmed trout (mainly rainbow trout) which represents 13% of the total volume. Comparatively marine fish hardly contributes to the French aquaculture sector, with a share of only 3% in volume, but 9% in value.

5.3.1. Shellfish farming sector

Data of the first national census carried out in 2002 by SCEES (2001 data) show that the sector of shellfish farming is dominated by small-scale companies, where family employment plays a significant role, as it represents 56% of the total employment in full time equivalent. The status of "individual company" is predominant (78%) among the population, as well as the mono-activity. The average French shellfish farming company cultivates 5.3 hectares on both public maritime grounds (87%) and private grounds (13%), employs 2.8 people (full time equivalent) and produces around 50 tonnes of bivalve molluscs. A

first breakdown of the companies in respect to their allocation of cultivated surfaces gives the following segmentation[17]:

- 75% of the companies "specialised" in oyster farming [18]
- 8% of the companies "specialised" in mussel farming
- 14% of the companies cultivating both oysters and mussels
- 1% of other companies (other molluscs dominant)

On-growing techniques

In the Channel and Atlantic coastlines, cupped oysters are mainly produced in inter-tidal areas, by elevated cultivation systems (bags on trestles), or using the traditional technique of rearing directly on the ground (less widespread today). The more recent technique of culture on deep water grounds (on-bottom) is comparatively less developed and much localized (Quiberon Bay). In the Mediterranean, where oyster farming mostly takes place in lagoons, other techniques are used, mainly the culture on rope hung under tables.

Mussel farming in the Channel and Atlantic coasts is almost all based on the blue mussel. The predominant cultivation system relies on the so-called "bouchot" technique (fixed wooden poles) used in inter-tidal areas. The development of long-line production in sub-tidal areas is also worth mentioning, as a profitable and alternative technique, which has been contributing to the expansion of the production capacities in some zones. In the Mediterranean, mussel farming is based on the species Mediterranean mussel. The cultivation initially restricted to the lagoons and using "on ropes" technique (under tables) has tried to be expanded by shifting to open sea areas and using long line technique. But the development of this cultivation system has been hampered by successive environmental problems (storm, predation…) and, eventually, some long lines have been reconverted into oyster on-growing.

Specialisation in terms of production stages

As concerns oyster farming, the spat is supplied either by wild spat (produced by the farmers themselves thanks to collectors of different kinds in the regions located at the South of Loire, or purchased to these farmers by others), or spat produced in hatcheries, or both. In the case of mussel farming, the spat supply is exclusively on wild source. If the distinction between specialized hatcheries and on-growing companies (even integrating the operation of collecting wild spat) is obvious, it is more difficult to clearly identify companies with a high rate of specialisation in wild spat production. The same difficulty should be pointed out considering the specialisation in the production of half-grown oysters. These different strategies of production focusing on one stage of production (also called "short cycle") instead of achieving the whole rearing cycle exist, but are not possible to identify from the current company database.

On the contrary, another production phase to be mentioned is the refining ("*affinage*") of oysters. This additional process, which consists in ending the rearing of oysters by a temporary immersion in marshland ponds ("*claires*"), provides a significant added-value to the final product. Data from national census indicate that around 40% of the French oyster production underwent the process of refining in 2001, which is the quasi monopoly of the oyster farmers of Charente-Maritime[19]. In this region, between 700 and 750 companies were involved in the refining of oysters either from their own production or from oysters purchased to other companies at national scale. As a consequence, these companies accounted for 46% of the total sales to final consumption of cupped oysters (in volume), but for only around 22% of the total production. A large share of the intra-regional transfer of adult oysters in France is reported to result from refining operations.

[17] The so-called "specialised" companies have at least 80% of their total surfaces dedicated to either oyster farming or mussel farming.

[18] Including flat oysters as their production is most of the time associated with cupped oysters (except for 5 specialised companies) and diversification in other farmed bivalves (clams, cockles…).

[19] Actually the Marennes-Oleron bay in Charente-Maritime provides almost the entire surfaces of "claires" for bivalve refining in France, which affords the local companies a sales monopoly at a national level.

Integration of the activity of sales to final consumption

In relation to the Council Directive 91/492/EEC laying down the health conditions for the production and the placing on the market of live bivalve mollusc, the majority of the French companies (75%) got the approval[20] in order to be allowed to sell bivalves to final consumption. They package and sell their own production plus the production of not approved companies. Most of the economic studies carried out in the sector differentiate the companies according to their commercial status, and their level of involvement in trade, as strictly only farmers and farmer-traders don't display the same structure of costs (namely the costs of the purchases of live bivalves). Particular attention should be paid to identify the companies with a high specialisation in trade, as they are less representative of the farming activity. On the other hand, the specialisation of small companies in direct sales to consumers also represents a specific economic strategy. The number of companies specialised in direct sales[21] was estimated at about 1000 in 2001, of which 850 were oyster farmers. These companies only represented 12-13% of the whole production, in volume (estimation from SCEES data).

Size criteria

Though not very high compared to other aquaculture sectors, the concentration of the shellfish farming sector is increasing. Most of the companies produce less than 50 tonnes of bivalves according to the census data (76% of the companies representing 28% of the whole production). The companies producing more than 200 tonnes represent 4% of the population and concentrate 33% of the whole volume of production. In terms of employment, the majority of companies employ less than 3 people in full time equivalent (72% representing 41% of the total employment). The share of companies employing 3-5 people reaches 17% (representing 23% of the total employment). The remaining category of companies with over 5 FTE (11%) concentrates 36% of the total employment of the sector.

It follows from this presentation of the general organisation of the shellfish farming sector that the criteria likely to influence the economic performance of the companies are multi-factorial. In addition, the influence of regional factors should also be indicated since the 7 shellfish farming regions (Nord-Normandie, Bretagne-Nord, Bretagne-Sud, Pays de la Loire, Poitou-Charente, Aquitaine and Méditerranée) present quite different attributes and specialisations.

In a first step, in order to comply with the current regulation requirement, the segmentation of the whole population of shellfish farming companies according to the main type of farming (species and cultivation technique) is attempted. Data from the 2006 DPMA survey have been used to update the total number of active enterprises, while the key of the breakdown per type of farming is given by the 2001 SCEES census data.

[20] According to the regulation, « dispatch centres » means any approved on-shore or off-shore installation for the reception, conditioning, washing, cleaning, grading and wrapping of live bivalve molluscs fit for human consumption.

[21] The companies selected for this estimation present a share of direct sales at least equal to 80% in volume.

Table 5.1 France - Overview of the farming of mussels and oysters

Main species	Main on-growing technique	Number of firms in population 2001	%	Number of firms in population 2006 (estimation)
Oysters	"Bottom" (cultivation in inter-tidal areas)	2,326	62%	2076
Oysters	"Other" (deep water)	80	2%	71
Mussels	"Bottom" (cultivation in inter-tidal areas)	234	6%	209
Mussels	" Long-line"	83	2%	67
Oysters and mussels	"Bottom" (cultivation in inter-tidal areas)	340	9%	303
Other bivalves	"Bottom" (cultivation in inter-tidal areas)	50	1%	45
Oysters	"Raft" (tables in lagoon)	380	10%	293
Mussels	"Raft" (tables in lagoon)	62	2%	48
Oysters and mussels	"Raft" (tables in lagoon)	172	5%	133
Total Atlantic & Channel		**3051**	**82%**	**2723**
Total Mediterranean		**676**	**18%**	**521**

5.3.2. Freshwater fish sector

The freshwater fish farming sub-sector is composed of very different activities. The main production results from the farming of rainbow trout and other salmonids (salmon trout, Salvelinus Sp.…). In terms of volume, the second production is represented by the extensive farming in ponds, but as this sector is not covered by the national statistical survey, very few data exist in order to characterize the population of firms. In addition, two other activities have to be distinguished despite the small size of their production: the farming of sturgeon for the production of caviar (and meat) and the farming of Wels catfish.

Structural data originated from the last national census on trout farming (SCEES 1998) provide a detailed picture on the sector but need to be updated as many companies have stopped since that time. In 1997, 635 companies were surveyed which employed on average 2.5 people (full time equivalent). The population of companies was split up into commercial status (504) and non commercial status (131), the latter concerning restocking activities. The whole population comprised 41 specialised hatcheries, 185 specialised on-growing companies and 409 integrated companies. The breakdown of commercial companies according to the volume of production showed the persistence of a significant share of small farms (37% producing less than 10 tons), but which finally accounted for only 2% of the whole production, while on the other side the top4 companies (more than 1000 tons of production each) represented 20% of the total production. The intermediary classes were characterized as follows: 43% of companies with a production level of [10-100 tons] contributing for 18% of the total production, 16% of companies [100-500 tons] (39%), 3% of companies [500-1000 tons] (20%). This indicates a possible way of segmentation for commercial on-growing companies, relying on level of production classes. But the segmentation will be defined more precisely according to the new breakdown of companies which will emerge from the next census of 2008[22].

Few data are available to characterize the companies farming fish in ponds. However, it is essential to distinguish two main categories. The first one comprises of the pond owners, a relatively large population of whom only a few are involved in fish farming activities themselves, or just as a secondary activity. The second category is represented by about 100 specialised fish pond farmers who control the whole process of rearing, from stocking juveniles to the capture and distribution of fish. These farmers own some ponds but also rent others to pond owners. Another characteristic of the fish farming in pond is that the production is mainly dedicated to restocking, while consumption outlets are limited. The AFPPE, the French national association of fish pond farmers carried out a socio-economic study of the sector in 2007 in order to update the latest available data. One hundred questionnaires were sent in order to survey the whole population, but less than a third were fulfilled and sent back. The main results of the survey confirm the specialisation of the fish pond farming in restocking activities (70% of the whole turnover for

[22] The first results from the 2008 census are expected to be published at the beginning of 2009.

the respondents versus 17% for the consumption market). They also show that the size of the companies is globally small, with an average of 2.5 full time equivalents.

4.3.3. Marine fish sector

The last census carried out by SCEES for the saltwater fish sub-sector also dates back to 1998 and concerns seabass, seabream and turbot farming activities. This census surveyed 46 companies in 1997, of which 5 specialised in turbot farming and 41 in seabass/seabream, employing a total of 512 FTE people. In 1997, the production from on-growing activities represented about 80% of the total output of the sector in value (versus 20% from hatcheries). In 2006, the number of saltwater fish farming companies has decreased to around 40, according to the DPMA survey. As far as seabass & seabream farming is concerned, the market leader covers nearly half the French production. More generally, if bearing in mind the small size and the heterogeneity of the saltwater fish farming sub-sector (in terms of species, on-growing technique, size…), it is suggested to focus on the seabass and seabream farming companies, and to survey this population nearly exhaustively.

5.4. New developments

The shift in the supply of wild spat to hatcheries represents the major innovation for the bivalve farming sector over the last decade. This new practice enables the oyster farmers to become less dependant of natural spatfall. Despite the dispute it initially provoked within the profession (about the use of triploid oysters, but also the competition with wild spat producers), the production of bivalve hatcheries has been expanding, and new species are being investigating. Research is currently focusing on flat oyster, as the control of the species through hatchery production is likely to improve its resistance to disease, and to afford new development of the production.

Improving productivity also represents a crucial issue for bivalve farming, especially for oyster farmers cultivating grounds in over-stocking biomass areas like in the Marennes-Oleron bay (Charente-Maritime). Alternative cultural methods are experimenting in offshore sites (long-line). The geographical expansion of bivalve farming however raises crucial issues, in terms of coastal zone management (user conflicts with fishing and tourism activities). Different projects for creating new off-shore farming sites (oyster and mussel long-line cultivation) are underway.

New developments also cover quality labelling. Bivalve farming companies are involved in many labelling schemes, mainly at regional scale in order to differentiate their products in the domestic market, which represents the main outlet for the French production. These labels range from regional brands to official quality labels, such as the French Label Rouge (for green refined oysters from Marennes-Oléron) and AOC (for protecting the geographical origin of mussels cultivated in Mont-Saint-Michel bay), through certification procedures ("bouchot" mussels). At national level, the main quality labelling approach today aims at obtaining the TSG (traditional speciality guarantee) for "bouchot" mussels in order to extend the protection guaranty to European markets.

In saltwater fish farming, new developments of the activity rely on species and geographical diversification. The development of marine tropical fish farming (red drum) in French overseas territories (Mayotte, Martinique and La Reunion islands), is stagnating due to the lack of outlets in European markets. Research & development is currently experimenting new candidate species, such as cobia which is characterised by very fast on-growing (the farming of this new species is currently developing in the South Asian region; a project funded by Norwegian investments is also underway in Belize). In Mediterranean aquaculture, the new development of meagre farming is from now on contributing to the diversification of seabass and seabream farms (for about 5 companies), but still generates a small production. In terms of labelling, organic certification has been achieved for seabass and seabream few years ago, but today organic farming represents barely 2% of the production (2 farms), which targets niche markets. The extent of Label Rouge is more significant, especially for turbot, as nearly half the French production is sold under this label.

As concerns freshwater fish farming, species diversification also aims at specialised markets. The attempt to develop new species farming such as Wels catfish almost failed, in the absence of outlets. The development of sturgeon farming for the production of caviar looks more promising, because of the sturgeon overexploitation worldwide. The recent success in artificial breeding for the European sturgeon offers new prospects in terms of restocking. On the other hand, the main developments in trout farming over the last decade have been devoted to the enhancement of rearing conditions (through selection programs, production of free from disease fry, use of triploid, improvement of feed ratio …) and the diversification in the range of products in order to meet the demand for further processed fish (fresh fillets, smoked fillets, vacuum packed products….). From an organisational point of view, the French trout farming industry has been involved in a collective quality approach, which came to the adoption of a common charter "La Truite, Charte Qualité", relying on the setting up of a production and processing norm (AFNOR NF-V45.100). More adding value labels such as organic label cover a very small share of the trout production (less than 1%).

The market for ornamental fish in France shows a big potential: the domestic market is estimated of 35.9 millions of fish in 2004, idem in 2006 (enquête FACCO SOFRES), but no data have been found in order to estimate the economic role of this sector in France, neither on the production, nor on the number of companies.

5.5. Economic performance

The test survey for France has focused on the bivalve farming sector, such as the main aquaculture sector in France, and the sector which raises most methodological issues. Economic indicators provided by the test survey dedicated to this sector are used for analysing the economic performance of the bivalve farming companies, while for the saltwater and freshwater fish farming sectors the following conclusions only rely on qualitative expertise.

5.5.1. Surveyed segments (Bivalve farming sector)

The test survey carried out in the framework of the current project can be considered as a first attempt to assess the economic performance of the oyster and mussel farming sector at a national level (apart from the Mediterranean), and to analyse the different factors likely to influence the profitability of the bivalve farmers. According to these objectives, two major segments of the sector have been targeted:

- Oyster farmers, "bottom" techniques, located in Channel & Atlantic Coastline, representing 62% of the whole population of companies (76% if excluding the Mediterranean)
- Mussel farmers, "bottom" techniques, located in Channel & Atlantic Coastline, representing 6% of the whole population of companies (8% if excluding the Mediterranean).

Furthermore, additional segmentation has been applied to the predominant "oyster farming" segment in order to get first indications in terms of stratification. The segmentation applied is summed up in the table below and compared with the breakdown of the whole population (from the census 2001 data).

Table 5.2 France - Sub-segmentation of the sample of oyster farmers – "bottom techniques"

	Sample (number of companies)	Sample (%)	Whole segment (%)
OYSTER FARMERS	**144**	**100%**	**100%**
Size < 3 FTE	**111**	**77%**	**72%**
Strict farmers	35	24%	23%
Farmers-Traders	76	53%	48%
Size > 3 FTE	**33**	**23%**	**28%**
Strict farmers	0	0%	3%
Farmers-Traders	33	23%	25%

Mussel farming segment

The sample of mussel farmers comprises 15 companies located in Normandy (Channel coastline), representing around 7% of the number of firms in the whole segment. All the surveyed companies belong to the "farmers-traders" category, which represents the majority of mussel farmers in Normandy. The cultivation technique used is the "bouchot" technique operated in inter-tidal areas. The sample companies are characterised by an average level of employment of 3.5 full time equivalents (versus 2.6 in the whole segment) and an average turnover of 300,000 Euros corresponding to sales volume of around 200 tonnes. Relative standard deviation of the turnover reaches 56%, but if considering the derived indicator "turnover/FTE", it falls to 28%.

Economic indicators calculated for the surveyed sample show strong economic performance for mussel farmers in 2006-2007. The average price of mussel sales reached 1.43 Euro/kg, which is similar to the average price estimated at a national level. The ratios value-added/turnover and EBIT/turnover amounted respectively to 74% and 30%. The profitability of the activity is also reported to be high, with a ratio EBIT/total assets worth to 23%.

These results (subject to statistical representativeness), confirm the higher level of profitability of mussel farming compared to oyster farming. All categories included, the ratio turnover/FTE appears to be a little higher for companies specialised in mussel farming. But main economic differences are emphasized through the comparison of the ratio EBIT/turnover (30% for mussel farming versus 8% for oyster farming) and of the ratio EBIT/total assets (23% versus 7%), which in fact result from the higher level of turnover combined with the lower level of operational costs of mussel farmers (especially as concerns raw material purchases).

Oyster farming segment

The sample of oyster farmers is made up of 144 companies, located in the Channel and Atlantic coastlines, which corresponds to around 7% of the number of companies in the whole segment. As far as the region is concerned, the companies selected in the test survey come from three different departments: Manche/Normandy (45 companies), Morbihan/South Brittany (43 companies) and Charente-Maritime (71 companies).

The oyster farming companies belonging to the total sample employed in 2006-2007 an average of 2.7 FTE (similar to the employment indicator of the whole segment) and generated an average output of 65 tonnes in volume and about 200,000 Euros in value. The turnover value shows a great dispersion (a 137% relative standard deviation), which is indeed reduced when considering the derived indicator turnover/FTE (55%).

For the whole sample of oyster farmers, the economic performance was acceptable in 2006-2007. The average price of oyster sales was 3.1 Euro /kg. The ratio value-added/turnover amounted to 46% while the ratio EBIT/turnover reached 8%. The profitability of investments, measured by the indicator EBIT/total assets was worth 7%.

Economic indicators have also been calculated according to a regional stratification in order to test the presumed stronger performance of Northern oyster companies (in relation to better on-growing conditions). The comparison of the 3 regions actually shows higher economic indicators for Normandy (as regards value-added/turnover, EBIT/turnover and EBIT/total assets). This result relies on the greater labour productivity of the Norman companies compared to the two other regions (30 tonnes/FTE versus 20 tonnes) and on their lower level of input costs, regardless of their lesser valorisation of oyster sales (2.3 Euro/kg versus 3.4 on average in Morbihan and Charente-Maritime). At this stage, it is however difficult to attribute the superior performance of the companies located in Normandy to the regional factor only, as far as the surveyed sample for this region includes a larger share of companies > 3FTE compared to the other regions.

Oyster farming by size

Two categories of size have been targeted within the population of oyster farmers (under 3 FTE and over 3 FTE), which has led to survey 111 companies of the first group (77%) and 33 companies (23%) of the second one. The largest oyster farming companies of the sample are only represented by farmer-traders (see Table above) as they are really dominant for this category of size in the whole population.

The economic performance turns out to be higher for the biggest companies than for the smallest: the indicator turnover/FTE is superior by 48%, the indicator gross value-added/FTE is superior by 24%. Finally, the ratio EBIT/turnover is worth 12% for the companies >3 FTE while it is only 2% for the companies <3 FTE (the same figures have been found concerning the ratio EBE/total assets).

These results globally emphasize the vulnerability of the smallest companies in the sample, considering that their EBIT is just enough to cover the interest costs. In this respect, it is worth mentioning that for the smallest companies (mainly single holders), the labour costs play the role of adjustment variables due to the important share of familial jobs (77% of the total employment versus 31% for companies >3FTE).

Oyster farming by commercial status

Two categories of commercial status have been taken into account in order to stratify the initial sample: the "farmer-traders", dominant within the population, and the "strict farmers". This sub-division only concerns the companies < 3 FTE, the sample of which has been broken down between 76 "farmers-traders" (68%) and 35 "strict farmers" (32%).

The comparison of the two types of companies shows best economic performances for the "strict farmers" as regards the ratio gross value added/FTE (63% versus 47%) and the ratio EBIT/turnover (8% versus 0%). This results from the combination of both lower turnover and lower operational costs (especially the live raw material costs which only represent 11% of the turnover for the "strict farmers" versus 32% for the "farmers-traders"). The higher profitability of "strict farmers" is also apparent through the ratio EBIT/total assets (4% versus 0%), albeit in the two cases the return on investments was weak or non-existent in 2006-2007.

The results of the test survey are in keeping with professional expertises, which relate the decreasing profitability of oyster farming and trading operations with the increasing role of major retailers in oyster distribution channels (resulting in price reduction and margin contraction). More generally, it could be observed that the bargaining power of small companies is too low to influence the setting of price, which in return highlights the factors driving opposite strategies:

- A "growth strategy" for a limited number of companies[23], in order to generate economies of scales
- A "direct sales" strategy for a significant number of small companies, in order to get a better price, more in line with the production costs. If it seems clear that "direct sales" provide the best way of valorisation for small producers, we should also keep in mind that the method used for assessing the labour costs (and especially the family labour) does not take into account the extra work required for direct sale activities.

Preliminary conclusions in terms of stratification

In spite of the limits of coverage of the test survey, the first conclusion that may be drawn from now on relies on the size, as a main discriminating factor of segmentation. Statistical indicators presented in the pre-feasibility part of the document show logically that the breakdown of the sample of oyster farming

[23] As far as farming operations are concerned, growth strategies are mainly dependent on land access to public maritime grounds. The enterprise growth could have been reached in the region of origin of the shellfish farming company, or/and in different regions. Geographical diversification is motivated in that case by the need to access to more productive rearing areas (ex. The strategies of shellfish farmers located in low productive area like in Charente-Maritime, who have acquired "concessions" in Normandy or North- Brittany to benefit from faster on-growing conditions.)

companies in two size classes significantly decreases the relative standard deviation of the main economic indicators. Another question is to determine whether it is required to further stratify the class of companies over 3 FTE or not.

All the evidence presented here also suggests the role played by commercial status in economic performance, and structure of costs, but with a remaining high variability of costs in relation to the level of specialisation in trade/farming. This issue is discussed in a greater depth in the section dedicated to the statistical analysis of the indicators.

On the other hand, the size of the test survey is not sufficient to conclude on the regional criteria. Actually, the comparison of economic indicators between the 3 regions does not provide enough conclusive elements for the companies under 3 FTE (all categories included), and the limited size of the survey prevents further stratification of regional samples which, inevitably, limits the scope of the results. Nevertheless, it can be observed that the regional attribute could provide an alternative segmentation way, as far as it reflects some geographical particularities (as for instance the specialisation in refining, the differential in productivity, the specialisation in direct sales ….) which are not identifiable through the company database.

5.5.2. Other not surveyed segments (Saltwater and freshwater fish farming sectors)

The saltwater fish farming sector could not expand in France as far as it was expected due to hard competition with tourism and conflicts between potential investors and associations of coastal residents. As a result, very few new companies have been created throughout the last ten years, and demands for expansion from established firms have been barely satisfied. This situation favoured external growth (buyout of companies), albeit on a small scale. Another major constraint comes from the market, as the French seabass and seabream farming sector has to face increasing competition in European markets. Following the 2001-2002 market crisis, the French sector could remain quite profitable (in spite of higher production costs) thanks to its strategy of differentiation towards premium quality products or the delivering of large size fish, but indeed this has limited its potential outlets to only specialized domestic or export markets. The overall fish farming sector (especially hatcheries) results highly export-oriented. On the other hand, the extent and the consequences of the recent seabream market crisis which started at the 2008 fall on the European market are not yet known. The oversupply of seabream in major producing countries such as Greece and Turkey is indeed likely to have repercussion on European markets as a whole, but should mainly affect producers specialised in seabream farming, which in fact are few in France.

For the freshwater fish sector, the last decade was characterized by the decline of the farmed trout production (-35% in volume), especially in Brittany. From 1997 to 2006, the number of commercial companies decreased from about 500 to 310, resulting from the cessation of small companies due to environmental restrictions, and also from the consolidation of the sector. Throughout this period, the trout farming industry made significant progress in different fields, such as the sanitary protection, the environment and the economics. From the sanitary point of view, the vaccination of fish has progressively replaced the use of antibiotics. From both environmental and economics points of view, the main efforts have aimed at diminishing impacts and costs through the improvement of feed conversion ratio. In spite of all these efforts, as well as the involvement in product diversification to better meet the consumer needs, the sector has remained subjected to both hard environmental constraints and strong market pressures. French producers complain of the strengthening of the regulation and the lack of national political support, which makes the renewal of farming authorization a strenuous and uncertain task. In a context of increasing international competition on domestic markets, they have also become more and more reliant on big retailer chains, notably through the extension of sub-contracting, and have been suffering from decrease in profit margins. With tight margins, the trout farming sector is particularly exposed to the increase of input prices, as for feed which represents about half the total production costs. After two years of better prices in 2006 and 2007, the price of trout was again downward in 2008, and the concomitant increase in energy and feed costs might severely affect the profitability of the trout farming sector.

5.6. Statistical tables

Stat. table 5.1 France - National overview – saltwater fish farming

	Volume of production (1000 t) (1)	Value of production (mln Euro) (1)	Number of companies (2)	Employment (total jobs) (3)	Employment (full time equivalent) (3)
1996	5.9	40.8			
1997	5.7	39.3	46		512
1998	6.4	44.0			
1999	6.7	42.6			
2000	5.7	38.2			
2001	5.6	34.2			
2002	6.9	39.7	52	746	645
2003	6.7	40.5			
2004	6.8	47.6			
2005	8.0	51.2			
2006	7.4	42.2	39	611	507

(1) Source DPMA-OFIMER

(2) Sources: DPMA (national survey) and SCEES (national census on fish farming). The field investigated differs according to the sources: only farming of seabass, seabream and turbot for 1997 data from census; all marine fish for 2002 and 2006 DPMA surveys.

(3) The data from DPMA survey (2002) as regard marine fish farming employment also includes the employment in shrimp and algae farming (a very small activity).

Stat. table 5.2 France - National overview – freshwater fish farming [1)]

(excluding extensive farming in ponds)

	Volume of production (1000 t) (1)	Value of production (mln Euro) (1)	Number of companies (2)	Employment (total jobs) (2)	Employment (full time equivalent) (2)
1996	48.4	139.6			
1997	47.0	135.6	635	~2,000	1,580
1998	45.5	138.6			
1999	41.2	83.0			
2000	43.8	85.1			
2001	49.1	107.7			
2002	47.8	104.5	360	1,491	1,208
2003	43.7	98.1			
2004	37.4	87.9			
2005	34.5	86.1			
2006	30.6	79.5	316	1,297	1,055

(1) Source DPMA-OFIMER and CIPA,

(2) Sources: DPMA (national survey) and SCEES (national census on fish farming). The field investigated differs according to the sources: commercial and non commercial farming of salmonids (rainbow trout, salmon trout…) including marine salmonids for 1997 data from census; only commercial farming of inland salmonids and sturgeon for 2002 and 2006 data from DPMA survey (7 sturgeon farms in 2006).

Stat. table 5.3 France - National overview – Freshwater fish farming
(extensive farming in ponds)

	Volume of production (1000 t) (1)	Value of production (mln Euro) (1)	Number of companies (b)	Employment (total jobs) (2)	Employment (full time equivalent) (2)
1996	12.0	19.8			
1997	12.0	19.8			
1998	12.0	19.8			
1999	11.9	20.3			
2000	10.4	17.3			
2001	10.0	18.8			
2002	9.6	17.4			
2003	6.8	16.3			
2004	7.8	14.2			
2005	*7.8*	*14.2*			
2006	*7.8*	*14.2*			

(1) Source DPMA-OFIMER
(2) No data available

Stat. table 5.4 France - National overview – shellfish farming (on-growing)

	Volume of production (1000 t) (1)	Value of production (mln Euro) (a)	Number of companies (2)	Employment (total jobs) (2)	Employment (full time equivalent) (2)
1996	213	298.9			
1997	197	289.5			
1998	199	311.0			
1999	199	299.1			
2000	202	309.0			
2001	187	357.6	3,751	21,662	10,407
2002	188	371.0	3,719	19,329	10,542
2003	182	359.3			
2004	190	384.6			
2005	189	385.5	3,350-3,400		
2006	189	380.3	3,244	19,168	9,887

(1) Source DPMA-OFIMER
(2) Sources: DPMA (national survey) and SCEES (national census on fish farming). 2001 data, from the first national census, and 2002 data, from the DPMA statistical survey, include 5 specialised hatcheries.

Note that the first national census (2001 data) was the opportunity for establishing the first exhaustive list of companies at national level. Before the census, the number of companies was a little lower due to non-respondents to the survey (around 3250 active companies counted in 1998).

Stat. table 5.5 France - National overview – Saltwater fish farming (specialized hatcheries)

	Volume of production (million juveniles) (1)	Value of production (mln Euro) (1)	Number of companies (1)	Employment (total jobs) (2)	Employment (full time equivalent) (2)
1996					
1997					
1998					
1999	42.7	13.0			
2000	43.4	12.6			
2001	49.8	14.0			
2002	49.1	14.6			
2003	56.9	16.8			
2004	57.6	15.7			
2005	57.0	14.6			
2006	58.0	13.9	5		

(1) Source SFAM
(2) No data available

Stat. table 5.6 France - National overview – shellfish farming (specialized hatcheries)

	Volume of production (million of spat)	Value of production (mln Euro)	Number of companies	Employment (total jobs)	Employment (full time equivalent)
1996					
1997	319	2.9			
1998	320	2.4			
1999	384	4.1			
2000	400	4.3			
2001	600	6.4			
2002	798	7.7			
2003	890	9.0			
2004	970	9.8			
2005	1,120	11.5			
2006	1,200	12	5		

Source: Estimation from specialized hatcheries
The amount of spat produced in hatcheries mainly concerns cupped oyster, but also clams (around 100 million spats produced in 2006). This total does not include the production of scallop spat for restocking (one non commercial hatchery).

Stat. table 5.7 France - Review by sub-sector and species (value and volume) 2006

	Volume (1000 t) (1)	Value (mln Euro) (1)	Number of companies (1)	Types of on-growing unit	Employment (1) (2)
Mariculture (marine fish)					
Salmon	1.4	5.2	12	cages	611 (507)
Other (rainbow trout)	0.04	0.12		cages	
Seabream / seabass	4.85	31.36	40	cages, raceways	
other (turbot, meagre)	1.15	10.76		raceway, recirculated system, cage (meagre)	
Freshwater fish culture					
Trout (rainbow & salmon t.)	30.4	69.6	309	raceways	1,297 (1,055)
Sturgeon (caviar & meat)	0.15	9.9	7	raceways	
Carp	4.23	4.7	n.a	in ponds	n.a
Other (tench, roach, other cyprinids...)	3.58	9.5	n.a	in ponds	n.a
Other (silure)	0.02	0.6	n.a	raceways	n.a
Molluscs and crustaceans					
Mussels	72.7	106.1	1,040	"bouchot", raft, longlines	19,168 (9,887)
Oysters	112.7	257.0	2,753	on bottom, surelevated, raft…	
Scallops					
Other (clams, cockle, ….)	3.8	17.2	370	on bottom	
Other					
Oyster hatcheries (million spats)	1,200	12	5	recirculated system	n.a
Marine fish hatcheries (million juveniles)	58	13.9	5	recirculated system	n.a

(1) Source : DPMA survey 2006

(2) The first figure corresponds to the total number of jobs (full time and part time), the second one to the number of full time equivalent jobs.

Stat. table 5.8 France - Indicators by segment, 2006-2007
(segment totals, value in million Euros)

On-growing technique	"bottom"	"bottom"		
Species	Oysters	Mussels		
Environment	Saltwater	Saltwater		
OPERATIONS – COSTS AND REVENUES				
Turnover	414.6	62.6		
Other income	9.6	0.5		
Personnel costs	65.5	10.5		
Value of unpaid labour	57.4	7.5		
Energy costs	12.0	1.5		
Live raw material costs	146.1	5.1		
Feed raw material costs	0.0	0.0		
Repair and maintenance	11.5	2.7		
Other operational costs	54.7	7.2		
Depreciation	37.0	9.8		
Profit (EBIT)	34.7	18.7		
Interest costs	9.6	4.7		
Gross cash flow	81.3	33.2		
Gross value added	204.2	51.3		
BALANCE SHEET – ASSETS AND LIABILITIES				
Net investment in tangible goods	43.6	7.0		
Equity capital	264.6	40.8		
Debts	245.0	42.2		
Total assets	509.6	83.0		
EMPLOYMENT				
Total number of persons employed				
Full time equivalents (FTE)	5660	729		
LEGAL STATUS				
Total number of firm*	2076	209		
Single holder	72%	67%		
Limited and anonymous co.'s	28%	33%		
SALES VOLUME				
Volume (1000 tonnes)	134	43		
OTHER DERIVED INDICATORS				
Turnover/FTE (1000 Euro)	73.2	85.9		
Gross value-added/FTE (1000 Euro)	36.1	70.4		
Personnel costs/FTE (1000 Euro)	21.7	24.8		
Volume/FTE (tons)	23.6	59.2		
Turnover /firm (1000 Euro)	199.7	299.5		
EBIT/Total assets (%)	7%	23%		

* Estimation from 2001 census data of segmentation updated with the total number of firms in 2006

(1) The turnover of the segment not only covers the final sales to consumption but also the intermediate sales of adult bivalves from "strict farmers" to "farmers-traders" (source of double counting). In return, live raw material costs are composed of both purchases of spat or half-grown bivalves for farming operations **and** purchases of adult bivalves for trading operations after or without refining.
(2) The imputed value for unpaid labour is fixed at 19,000 euros per FTE (source: accountants)
(3) Net interest costs
(4) The indicator "total number of persons employed" is not fulfilled by the accountants.

6. GERMANY

6.1. Current situation (2006)

The German aquaculture sector comprises an estimated 22,500 mostly non-commercial production entities. Their current annual production amounts to an estimated total of 45,700 tonnes of fish and mussels at a total market value of 193 million Euro (2006). The number of people employed in the whole aquaculture sector is unknown, but has been put by the inland fisheries survey of 2004 at 6,561 persons for the about 3,350 commercial farms alone.

6.2. Main trends

Table 6.1 Germany - Key economic indicators of aquaculture, 1996 and 2006

Year	Number of production entities (n)[a)]	Persons employed (n)[b)]	Production "Total yield" (1000 t)[a)]	„Revenues" or. „Total value" (mln Euro)[a)]
1996	n.a.	(15,677)	67.6	60.9
2006	22,552	(6,561)	45,7	193,6

[a)] Source: Jahresbericht über die Deutsche Fischwirtschaft 1997, Jahresbericht zur deutschen Binnenfischerei 2006, Die Hochsee- und Küstenfischerei in der Bundesrepublik Deutschland im Jahre 2006. The term "total yield" (Gesamtaufkommen) has not been specified, but obviously relates to the turn-over of fish at harvest-weight and not production in the sense of net weight gain. Likewise unexplained and not consistently used are the terms "revenues" and "total value".[24]

[b)] Source: Binnenfischereierhebungen 1994 and 2004. The fisheries surveys are the only sources of employment data specifically relating to aquaculture. In both years the survey confined itself to commercial producers who in 2004 accounted for less than 15% of the total number. The surveys' figures on persons employed therefore fall most likely short of the actual number of aquaculture workers.

According to the published statistics presented in Table 6.2 below, total output in 2006 was nearly one-third lower than ten years earlier, while the total value has more than doubled. The decline has been caused by diminishing mussel yields, the economic impacts of which were, however, cushioned by rising prices.

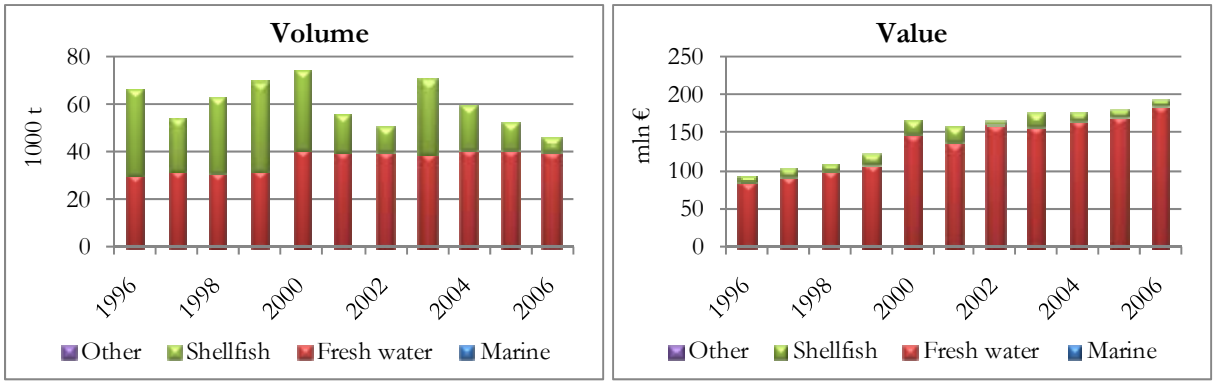

Figure 6.1 Germany - Volume and value of aquaculture production, 1996-2006
Source: Jahresbericht über die Deutsche Fischwirtschaft; Jahresbericht zur deutschen Binnenfischerei 2006, Die Hochsee- und Küstenfischerei in der Bundesrepublik Deutschland im Jahre 2006

[24] Despite of all shortcomings, the mentioned national statistics appear to be more reliable than FAO and Eurostat data, in pArcticular concerning earlier periods. According to both of the latter, for instance, the volume of rainbow trout production in freshwater environment was exactly 25,000 tons for each of the years 1994 to 2001 – which appears very unlikely. In recent years, the figures communicated to FAO and Eurostat were much closer to those published in national statistics (partly broken down along different criteria), and all statistics appear to have improved in quality.

Trends shown in the official statistics concerning the production of trout and carp farming partly have to be attributed to changes in the coverage of the statistics, as the production of stocking material was not included in the data until 1999. The trend in production volumes, excluding stocking material, is presented in Table 6.2 below.

Table 6.2 Germany - Total yields of aquaculture, 1996 and 2006, food fish only

Year	Trout culture	Carp culture	Technical aquaculture	Mussel culture	Total
	(1,000t)	(1,000t)	(1,000t)	(1,000t)	(1,000t)
1996	18,8	11,1	0,4	36,4	66,7
2006	21,1	11,5	1,2	5,4	39,2
Change	12%	4%	200%	-85%	-41%

Source: Jahresbericht über die Deutsche Fischwirtschaft 1997, Jahresbericht zur deutschen Binnenfischerei 2006, Die Hochsee- und Küstenfischerei in der Bundesrepublik Deutschland im Jahre 2006

While trout production increased by 12%, the output of carps remained almost stagnant. The latter has been partly effected by subsidies for extensive aquaculture under agri-environment programmes.

The sales of fish for stocking – not included in Table 6.2 – is an important source of income for many fish farms, in 2006 about 2.9 thousand tonnes of trout and 3.8 thousand tonnes of carp. Buyers are other fish farmers and anglers for stocking of grow-out ponds and open waters respectively. The stocking material reappears again statistically as table fish in the aquaculture and capture fisheries statistics, which thereby are substantially deluded.

Between 1996 and 2006 the value of total carp production has increased by 100%, in the case of trout by 145% and of technical (i.e. net cage and recirculation) aquaculture by 330%. However, the figures of 2006 also include the sales of stocking material, different from those of 1996. The increases came about by increase of value-added through processing and direct marketing. Wholesale prices for carp and trout remained fairly stable throughout the reference period. An incremental share of nursed eels for restocking of open waters has been responsible for the increase of production values in the field of technical aquaculture.

6.3. Structure

6.3.1. Sub-sectors

German aquaculture has been sub-divided into four sub-sectors:

- Trout culture
- Carp culture
- "Technical" aquaculture (referring to intensive production of fish in net cages and recirculation systems)
- Mussel fishery

The graphs below show their relative importance in terms of production volume and value:

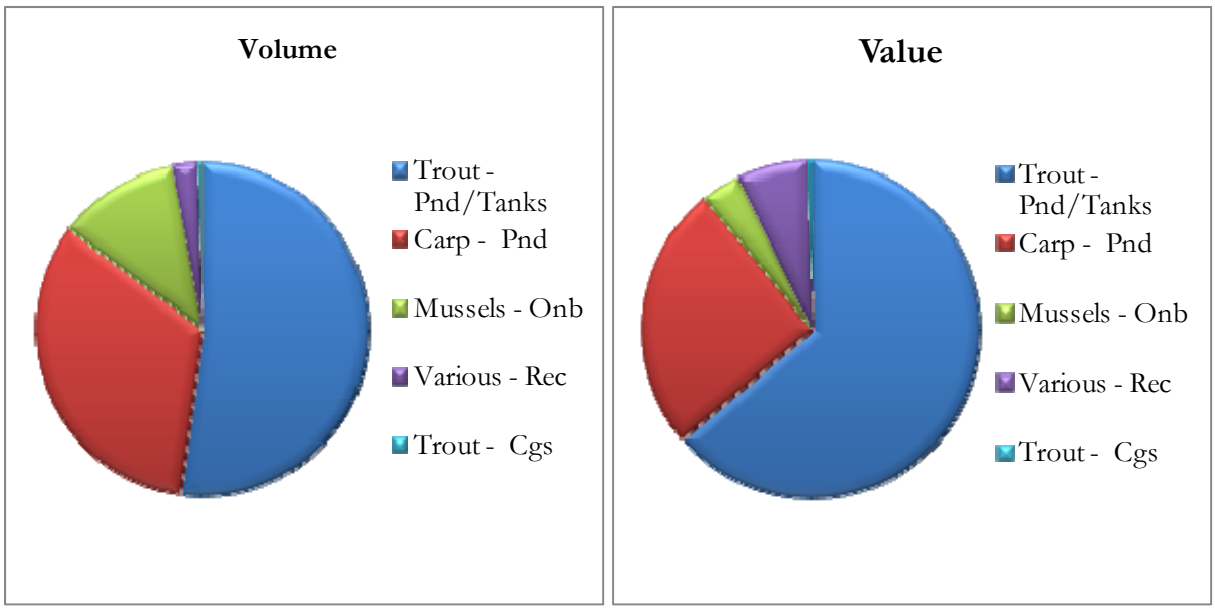

Figure 6.2 Germany - Composition of aquaculture production by species and on-growing technique, 2006

Note: Trout T&R, trout Cgs and carp Pnd include by-fishes. "Various" fish species mainly include eel, sturgeon, wels catfish, pike perch, striped bass and common carp

"Trout culture" and "carp culture" differentiate technically between cold and warm water aquaculture and aim, apart from their main species trout and carp, at the production of about 30 other fish species. "Technical aquaculture" comprises primarily recirculation plants and, to a marginal degree, net cages. The former are mainly used for the intensive production of 15 fish species, above all eel and European catfish, and more recently shrimps and seaweed (see Table 6.4). Coastal aquaculture (mariculture) other than the culture of blue mussel is hardly practiced in Germany and, therefore, not an element of the aquaculture statistics. The mussel culture and (negligible) farming of oysters, however ,has been categorised as coastal fisheries instead of aquaculture, so that shellfish production data are part of the sea fishery statistics. The following summarises the predominant features of the different sub-sectors:

Carp farming

Chiefly extensive farming using medium to large sized ponds of natural appearance (in total app. 39,000 ha), with multi-species stocks that include, besides common carp (93% of total harvest weight), Asian carp, tench, pike, European catfish, pike perch, sturgeon, and others (totally about 18 by-species at 7% share in the total harvest weight). As a consequence of policy as well as market-induced extensification, the production capacities of most carp ponds are grossly under-utilised and in- and output is accordingly low. Most of the carp farming comes as a part-time activity often combined with agriculture as the main source of income. In Bavaria most of the 20,000 ha of ponds belong to small agriculture holdings which are not specialised in fish farming.

With 192 full time and about 11,900 part time commercial carp farms, the sub-sector represents about 54% of the aquaculture entities and 33% of the total output amounting to 25% of the total turn-over (2006). It is well developed and organised, and regionally an integral part of the rural economy and culture. Although widely spread, carp ponds show significant concentrations within their traditional centres in Bavaria (20,000 ha) and Saxony (8,400 ha ponds) where the practice of carp farming reaches back to medieval times. Carp farms are important suppliers of stocking material for the enhancement of wild fish populations, especially those under recreational fisheries management.

Trout farming

Trout farms are relatively small units consisting of small flow-through ponds, tanks or raceways. The production intensity and inputs are usually high. About 90% of the cultured fish species are rainbow trout

and, to a lesser degree, brown trout. The remaining 10% are made up of 8 other cold water species, including brook char (Salvelinus fontinalis) with some importance as a table fish, and other species primarily produced for restocking (e.g. grayling, lake trout, huchen). Providing salmonids for stocking or re-stocking in the context of recreational fisheries and biodiversity conservation gains more and more importance and has become the mainstay of many of the smaller farms. 46% of all German fish farmers produce trout and, in 2006, contributed over 52% of the total aquaculture production. Their share of the overall turn-over had been estimated at 64%.

From a technical point of view, trout farming is quite advanced and uses a wide range of production systems and technologies. In its conventional fashion, situated within ecologically vulnerable grounds using quantities of pristine water (appr. 30 m^3/tonne of fish), it has however little scope for expansion. Not only are suitable sites for setting up new farms very scarce, but due to environmental concerns it has become virtually impossible to obtain water use rights and construction permits.

Technical aquaculture

- *Net cages:*

Net cages are not very common in Germany and, due to environmental restrictions, on the decline. Various attempts to develop saltwater cage aquaculture at a larger scale in the Baltic Sea did not succeed for the same reason. Existing units are often small and mostly combined with land based aquaculture or inland capture fisheries. Only 4 companies operate exclusively net cages. They are used in freshwater environments and the Baltic Sea for the production of rainbow trout and about 6 other species.

- *Recirculation systems:*

These are highly technical, super-intensive systems with central or individual water purification components and are used in freshwater and saltwater aquaculture, dominantly for eel, catfish, sturgeon and others, totally about 24 species.

After two decades of failure, the use of recirculation systems appears to increase under government support and technologies are more varied, technically advanced as well as viable, but often not profitable. A large part of existing units run on an experimental level.

This sub-sector in 2006 contributed about 2% of the total aquaculture production and about 7% of the total turn-over.

Mussel culture

Being a kind of capture-based aquaculture (CBA), mussel culture depends upon the collection of seedlings (spat) from wild stocks of blue mussels and the seeding and maintenance of defined culture banks on the bottom of coastal waters. The harvest is done by dredging. The sub-sector is small and well organised. It operates within stiff government restrictions and management schemes, with respect to mode and time of operation and to sites for spat capture and mussel culture, which are precisely demarcated. Nevertheless, mussel culture has become subjected to considerable conflicts with conservationists. The yields are highly dependent upon sufficient wild spat recruitment and favourable natural conditions at the culture sites. In 2006 mussel yields accounted for 12% of the total aquaculture production and nearly 4% of the value.

Hatcheries

With the exception of an unknown number of nurseries that are operated by fishermen or government for the purpose of enhancing wild fish stocks for capture and/or recreational fisheries, there are no specialised hatcheries and nurseries in Germany. Almost 9% of the companies maintain brood-stocks of their own and sell eggs. Breeding, nursing, and rearing are integral activities of many fish farms. The following table summarises the findings in this respect of the inland fisheries survey of 2004:

Table 6.3 Germany - Structure of the aquaculture production, 2004

Firms surveyed (n)	Number of aquaculture companies producing					
	eggs	fry	seedfish 1y	seedfish 2y	seedfish 3y+	table fish
3,343	264 (7.8%)	593 (17,7%)	1,084 (32,4%)	1,326 (39.7%)	473 (14.1%)	2,736 (81.8%)

Source: Binnenfischereierhebung 2004, figures relating to 3,343 companies

Table 6.4 Fish species used in German aquaculture

Carp farming	Trout farming	Net cages	Recirculation
Common carp, tench, pike-perch, northern pike, wels. Grass carp, bighead carp, silver carp, Crucian carp, koi, ide, roach, burbot, whitefish, sturgeon (4 spp.).	Rainbow trout, brown trout, arctic char x brook trout. Grayling , lake trout, sea trout, brook trout, Danube salmon (Huchen), whitefish, arctic char.	Rainbow trout, common carp. Northern pike, pike perch, sea trout, whitefish, striped bass.	European eel, wels, sturgeon (7 spp.). Grass carp, bighead carp, silver carp, Rainbow trout, African catfish, wels, Nile tilapia, turbot, striped bass, freshwater prawns, whiteleg shrimp, seabass, pike-perch, koi.

6.3.2. Corporate structures

The majority of aquaculture undertakings is legally organised as individual firms, among the 3,343 surveyed companies nearly 95%, and a minority either as co-operative societies (2.6%) or private or public legal persons (2.3% and <1.0%). Of the individual firms 32.2% are full-time commercial and the remainder part-time commercial operations.

6.3.3. Employment

Year-to-year employment data for aquaculture are not available in Germany. Because the sector remained comparatively static over the past decade one may safely assume that the respective information contained in the Inland Fisheries Survey Report of 2004 are also indicative for 2006 and beyond. At the time of the survey the 3,343 pArcticipating firms employed a total of 6,561 persons, of which 22.3% (1,464 persons) worked on a full-time basis, the remainder part-time (at a full-time equivalent of 940). 82% of the total workforce were family labour.

6.3.4. Size

Most companies are small as are their production and facilities. The share of fish farms over 100 ha of fish ponds in the survey of 2004 was less than 2%, nearly 40% were smaller than 1 ha. The largest carp farmer operates about 5,000 ha pond area with a capacity of 3,000 t/y, the largest trout farmer produces appr. 1,500 t/y. Standard gross margins and economic sizes have not been determined for German aquaculture.

6.3.5. Segmentation and consequences for the survey

The current segmentation of the sector clearly reflects the principle types of aquaculture in Germany. Most companies can be readily allocated to one of the sub-sectors; but especially some of the larger companies produce both, carp and trout, a few also using high-tech aquaculture methods thus coming under three sub-sectors at the same time. But such farms can nevertheless be assigned to one sub-sector if classified in accordance with their economically most important type of production.

Because of its inconsistency with the other segments, that have been defined by their main culture species and not by production technology, "technical aquaculture" should not be considered in the survey. The sector is very dynamic and therefore interesting to observe, but at the same time it is extremely small and heterogeneous and therefore difficult to cover by standardised surveys.

The mussel sector has a considerable share in the overall aquaculture production in weight and even some importance in value. However, there are only 9 entities operating in the sector, which creates problems concerning data confidentiality. In addition, fisheries authorities are in close contact with the enterprises and appear to have sufficient information on their financial performance. Whether an economic survey can cover this segment in a meaningful manner strongly depends on the cooperation of the sector, i.e. the

9 enterprises. This should be discussed between the authorities in charge and the enterprises in advance and cannot be determined at this stage.

As a consequence, a regular survey as well as the survey conducted in the context of this study should cover the two main segments of aquaculture in Germany, i.e. carp farming and trout farming, but also mussel farming in case a respective agreement with the sector is reached, and under consideration of information needs and data protection regulations.

Other segments should be monitored by other instruments and included in the survey if they have grown to a sufficient size – in particular in case of technical aquaculture.

6.4. New developments

The following approaches to aquaculture are novelties in Germany:

6.4.1.Freshwater aquaculture

- Domestication of new culture species:
  - Pike perch, perch, and pike: Reproduced and grown experimentally under intensive farm conditions, based on compounded feeds; pilot projects on private and public initiative.
  - Burbot: Brought under culture and product development (food and "sea leather") at two public aquaculture facilities on pilot scale.
  - Striped bass: successfully introduced and produced in recirculation systems at quantities.
- Eco-aquaculture: Since about 2000 numerous initiatives have taken place to meet with an increasing demand on the side of consumers for environmentally safe aquaculture production and products. Guidelines for ecological aquaculture of carp and trout have been elaborated by several organisations, e.g. Naturland e.V. and BIOLAND e.V. and appear, although much disputed among the experts, to be gradually adopted by producers.
- Production of sturgeon and caviar: A number of indoor recirculation fish farms has been set up to produce sturgeon and caviar, the success of these operations cannot be finally judged.
- Trout production in semi-closed indoor recirculation system: Under this pilot project, based in Mecklenburg-Vorpommern and implemented by an agricultural research institute, a highly efficient technology for the production of rainbow trout has been developed and successfully tested. The fully controlled aquaculture system consumes, according to reports, less than 5% of the average water supply of conventional trout farms (0,7 m^3/tonne of trout as compared to conventional 20-30 m^3/tonne) while safely maintaining comparatively high stocking densities of 100 kg fish per m^3 of water. Production cycles were reduced to 12 months (fry to table fish). This pilot project forms perhaps the most significant initiative towards a further development of trout farming in Germany, provided that the novel production system proofs to be both, technically fit for commercial application and economically viable.

6.4.2.Mariculture

- Production of various marine species (turbot, seabass, shrimp species, etc.) in indoor recirculation fish farms. A small number of such plants were set up in the past years, often with substantial public financial support, but mostly suffered from financial and technical problems.
- Production and product development of micro algae as a supplement in human and animal nutrition, as reference substance for food analysis and as a pharmaceutical agent (blue pharmacy) and for cosmetic use. Commercialisation is underway.
- Culture and utilisation (for cosmetic purpose) of the indigenous sugar kelp *Saccharina latissima* in the Baltic Sea by a private company, which aims at the development and operation of sea-based, environmentally neutral poly-culture systems. In the process of commercialisation.
- Integrated aquaculture of macro-algae (as a cleaning agent and food organism) and of the herbivorous sea snail abalone. Pilot project is under implementation by Alfred-Wegener-Institut (AWI).

- Experimental operation of a long-line pilot plant for off-bottom spat collection (blue mussel seedlings). The project reacts on fundamental problems of mussel culture along the North Sea coast, where shortages of spat caused by fluctuating recruitment, excessive predation by birds and environmental restrictions have caused substantial losses, and aims at the development of an appropriate and environmental friendly culture system. The project is implemented on private initiative.

6.5. Economic performance

6.5.1.General

Micro-economic information on aquaculture in general is, with few exceptions, patchy, often incomplete and structurally not standardised; the exceptions are not representative. The data that were published so far clearly indicate, however, that the economic performance of aquaculture enterprises varies widely between and within the sub-sectors and size groups, and, in the absence of systematic economic surveys, cannot be assessed with any accuracy.

Some additional information could be generated by the survey conducted under this project. In spite of a low respondence rate (only 12 out of 267 questionnaires were returned), on the whole the results of this survey can be considered to be representative.

6.5.2.Carp in ponds

Despite considerable economic improvements and substantial financial support under various environmental programmes the economic situation of carp farms, especially with regard to table fish, has remained weak. The improvements relate to an increasing demand of table fish sized carps for recreational fishing (so called sports carp) which are higher prized than table fish, and of ready-to-cook convenient carp products such as boneless fresh or smoked filets. Many producers have successfully invested in direct marketing and thus managed to open up local markets, often combined with agricultural tourism, that are largely untouched by the harsh conditions governing the regional wholesale markets.

When extrapolating the survey results to the overall sector, one arrives at a total turnover of about 49.7 million Euro in 2006. This survey revealed however, that only two thirds of the turnover derived from sales of fish, one third from "other incomes". Other incomes primarily comprise public subsidies under agricultural and environmental programmes.

28% of the overall costs (including unpaid labour and depreciation) are personnel expenditures, another 7% unpaid family labour, 19% stocking material and 12% feed. EBIT was calculated as 20.4 million Euro or 29% of the turnover and other incomes – corresponding to about 134.400 Euro per 100 tonnes of fish produced. This result, however, appears to be influenced by incomplete cost data (see feasibility assessment in annex), as earnings after interests and tax as stated in the profit and loss accounts of the fish farms (i.e. without considering unpaid labour) are only about 31.000 Euro per 100 tonnes.

The cost for unpaid family labour can be calculated – in conformity with practices of agri- and horticulture in Germany – at 3.6 million Euro or 23,500 Euro per 100 tonnes. Many small family farms are a sideline, where incomes hardly compensate for the work invested.

Intangibles which have or may get monetary value

Suitable sites for land based aquaculture – carp as well as trout culture – and unspoiled water for pond supply have become relatively scarce and, more importantly, are subject to national and EU efforts to protect both from further disturbances. Therefore noteworthy increases in size and number of conventional fish farms cannot be expected. In fact, hardly any carp farm has been newly established during the past decades. Therefore, existing fish ponds and permits have gained some value, but the relatively low profits of carp farming sets narrow boundaries to this.

Major constraints

German aquaculture faces many obstacles that impede the performance at different degrees, noteworthy are:

- legal restrictions, particularly relating to nature conservation and environmental aspects;
- intensification schemes, which can be seen as both means or hindrance to survive;
- market limitations – carp is a difficult commodity of limited demand and relatively low market value (too bony, often muddy in taste);
- excessive predation, especially by cormorants;
- a lack of officially approved therapeutic agents.

6.5.3. Trout culture in ponds and tanks

Trout production shows a continued trend towards intensification and diversification by way of a widening range of species and products. The role of direct marketing has steadily gained importance. In particular the small to medium sized companies were thus able to improve and consolidate their economic situation and to foster their local marketing niches. Another corporate strategy, the supply of the mass market, has been deployed by very few larger companies only, which are characterised by their dynamic organisation and rapid expansion and whose products meet with the highly demanding quality requirements of the few bulk buyers. Still, the vast majority of trout products sold in supermarkets and discount stores are imported, as only few German producers can or want to participate in this market segment.

On the grounds of the survey the total turnover of the sector can be estimated at 83.4 million Euro, falling substantially short of the 123.5 million Euro reported in the Jahresbericht zur deutschen Binnenfischerei 2006. The difference may be caused by the biased sample of larger companies, simply because of the higher share of the production being sold unprocessed and/or at comparatively low wholesale prices (3.25 to 3.80 Euros as compared to an average price of 5.17 Euro. Source: Jahresbericht).

Expenditures for staff and feeds are the single most important cost positions in trout farms, amounting to 25% and 23% of the overall costs. The EBIT has been calculated at 20.9 million Euro or 87,400 Euro per 100 tonnes respectively, which corresponds to 25% of turnover and other incomes. Earnings as documented in the profit and loss statements, i.e. without considering unpaid labour and after deducing interests and taxes, were about 40,000 Euro per 100 tonnes. Expenditures for unpaid labour is significantly less than in carp farming, namely 846,000 Euro in total or 3,500 Euro per 100 tonnes.

Intangibles which have or may get monetary value

Water rights, especially of pristine rivers and streams as well as springs, seem to attain a value of their own and often determine the value of the entire farm.

Constraints

Environmental restrictions, chiefly relating to the use of water, are considered to impose the major constraint for both existing and prospective farms, although this can be overcome to a certain extend by modern technologies, such as recirculation of water and application of liquid oxygen.

Another set-back of German trout culture, especially when compared with European neighbours, is the atomistic geographic distribution in combination with the small size. This is a disadvantage in competition over the mass market, but at the same time increases opportunities of regional (direct) marketing and artisanal processing.

6.5.4. Technical aquaculture

Most of the smaller recirculation systems in use have been technically improved to an extent that the commercial production of eel and catfish can be undertaken with sufficient safety, but the economic performance has more often than not remained far below (false) expectations, particularly with a view to production capacities, market demands for products and their market values. Beyond these economic shortcomings there are, e.g. with regard to the reprocessing of circulated water in larger systems, still technical problems that have apparently not been solved. In consequence of economic and technical failure, the majority of the projects was given up.

Some operators and/or manufactures of recirculation systems tried to protect and economically exploit their know-how through patents and licences, but due to the limited viability of the existing systems, no "intangibles" of mentionable economic value appear to exist in this field at present.

In case of net-cages, main constraint is the virtual impossibility to receive a licence, both, in freshwater as well as in marine environments.

6.5.5.Mussel culture

Although mussel production had been on the decline for the past ten years, and has in 2006 reached the lowest level, the economic situation of producers reportedly remained stable, as increasing prices partly compensated for diminishing yields.

As the sector operates under strict management schemes (see above), licences to collect spat and to use the precisely demarcated areas for mussel culture are intangibles of considerable value.

Major constraints are the poor natural recruitment of mussels in the past years and restrictions concerning spat collection. New developments such as spat collection with the help of long-lines as described above may help to overcome these constraints in future.

6.6. Statistical tables

Stat. table 6.1 National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies		Employment
			Full time commercial	Part time commercial	
1996	30.3	84.2	na	na	na
1997	31.9	93.2	na	na	na
1998	31.6	99.6	1,413	26,266	na
1999	31.9	109.8	1,200	20,576	na
2000	41.7	147.3	1,195	24,939	na
2001	40.4	138.7	976	25,124	na
2002	40.5	160.7	1,108	23,262	na
2003	40.0	157.8	1,121	23,183	na
2004	41.7	166.0	1,050	21,499	na
2005	41.5	171.2	1,050	21,499	na
2006	40.3	186.5	655	21,887	na

Source: Jahresberichte über die Deutsche Fischwirtschaft 1997-2006 (Annual reports on German fisheries).
Including production from ponds, flow-through-systems, net-cage-systems and recirculation systems as well as secondary species. Figures prior 1999 only cover table fish of main species; from 1999 onwards partly including "Satzfische" (juvenile fish for restocking) as well as "Nebenfische" (by-species)

Stat. table 6.2 National overview – shellfish farming of blue mussel

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	36.4	9.4	8	60
1997	22.3	11.0	8	60
1998	31.2	8.9	8	60
1999	37.9	13.8	8	60
2000	32.7	19.8	8	60
2001	15.6	20.6	8	60
2002	9.8	4.6	8	60
2003	31.1	17.8	9	62
2004	17.9	11.0	9	62
2005	11.0	9.4	9	62
2006	5.4	7.1	9	62

Source: Jahresberichte über die Deutsche Fischwirtschaft 1997-2005 (Annual reports on German fisheries), Die Hochsee- und Küstenfischerei in der Bundesrepublik Deutschland im Jahre 2006, Own inquiries

Stat. table 6.3 Review by sub-sector and species (value and volume), 2006

	Volume (1000 t)	Value (mln Euro)	Number of companies	Types of on-growing unit	Employ-ment
Freshwater fish culture					
- Carp	15.2	49.2	12,076	Ponds	6,561[a)]
- Trout	23.9	123.5	10,421	Ponds & tanks	
- Trout	0.2	0.8	23	Cages	
- Other[b)]	1.1	13.0	23	Rec	
Molluscs and crustaceans					
- Mussels	5.4	7.1	9	On-b	62
- Oysters	negligible				

Source: Jahresbericht zur deutschen Binnenfischerei 2006 and Die Hochsee- und Küstenfischerei in der Bundesrepublik Deutschland im Jahre 2006;

[a)] Binnenfischereierhebung 2004 (Inland fisheries survey 2004)

[b)] European eel, wels catfish, common carp, sturgeon, striped bass, pike perch

Stat. table 6.4 Indicators by segment (segment totals, value in million Euro), 2006

On-growing technique	Ponds	Ponds & Tanks
Species	Carp + supplementary species	Trout + supplementary species
Environment	freshwater	freshwater
OPERATIONS – COSTS AND REVENUES		
Turnover total	49.7	83.4
Other income	20.5	1.0
Personnel costs	14.6	16.3
Value of unpaid labour	3.6	0.8
Energy costs	4.1	5.9
Live raw material costs	10.0	9.5
Feed raw material costs	6.6	14.6
Repair and maintenance	2.3	2.6
Other operational costs	5.0	7.4
Depreciation	3.6	6.3
Profit (EBIT)	20.4	20.9
Interest costs	2.8	1.2
Gross cash flow	24.0	27.2
Gross value added	42.2	44.4
BALANCE SHEET – ASSETS AND LIABILITIES		
Net investment in tangible goods	-1.0	4.0
Equity capital	110.8	28.8
Debts	24.6	38.1
Total assets	136.4	81.4
EMPLOYMENT		
Total number of persons employed	1,094	778
Full time equivalents (FTE)	984	615
LEGAL STATUS		
Total number of firm	ca. 2,065 [a]	ca. 1,278 [a]
Single holder	[b]	[b]
Limited and anonymous co.'s	[b]	[b]
SALES VOLUME		
Volume in (1000 tonnes) [a]	15.2 [c]	23.9 [c]
OTHER DERIVED INDICATORS		
Turnover / FTE (1000 Euro)	50.5	135.6
Gross value added / FTE (1000 Euro)	42.9	72.1
Personnel costs / FTE (1000 Euro)	14.9	26.5
Tonnes / FTE (tones)	15.5	38.9
Turnover / firm (1000 Euro)	24.0 [d] / 340.6 [e]	65.3 [d] / 759.9 [e]
EBIT / Total assets (%)	15.0%	25.6%

Source: Cofad Survey, undertaken for the purpose of this report, extrapolated with volume data from Jahresbericht zur deutschen Binnenfischerei 2006;

[a] Source: Binnenfischereierhebung 2004, cannot be extrapolated from own survey

[b] cannot be extrapolated from own survey

[c] Source: Jahresbericht zur deutschen Binnenfischerei 2006, refers to overall sector, not only units operated as a main activity

[d] Turnover (extrapolated) / units (from Jahresbericht zur deutschen Binnenfischerei/Binnenfischereierhebung)

[e] Average of units in survey

7. GREECE

7.1. Situation in 2006

Total gross output in value from the Greek aquaculture sector in 2006 was 545 million euro, and the total volume was 132,760 tons. The total number of firms involved in farming in 2006 was 555. The majority of the companies (418) were single holder businesses while the remaining 137 were limited or anonymous. The total number of persons employed was 11,982 and the full time equivalent jobs were 6,628.

The main species produced in Greece are seabream with a volume of 58,000 tons and a gross value of 239 million Euro and seabass with a volume of 40,000 tons and a gross value of 182 million euro in 2006. The number of persons employed in the saltwater fish farming was 11,149 and the full time equivalent jobs were 5,978.

7.2. Main trends

In the last 20 years saltwater fish culture has become a leading activity and displayed a rapid growth. Production doubled every year until 1993. After that year, growth was lower and prices stabilized. This expansion was mainly due to the farming of two species, seabass and seabream. After the year 2000, saltwater fish culture entered a restructuring phase. The formation of groups with large production facilities, vertically organized production and own distribution channels resulted in cost reduction and later in a price war that caused prices to reach their lowest in the years 2001 and 2003. Many of the pioneer producers disappeared and others have been absorbed by the larger companies. This resulted in the concentration of activity, and the decrease in the total value of production due to the price war. After 2003, prices recovered gradually. This process is continued until 2007. The production volume in marine water fish farms has increased from 21,000 tons in 1996 to 100,600 tons in 2006. The value of production increased from 11 million euro to 421.6 million euro in the same period. After 2007 the sector faced once again a crisis that is still on the way.

In freshwater farming and shell fish farming the production situation is stable. The growth of this activity is restricted due to the lack of suitable production sites and emerging environmental problems.

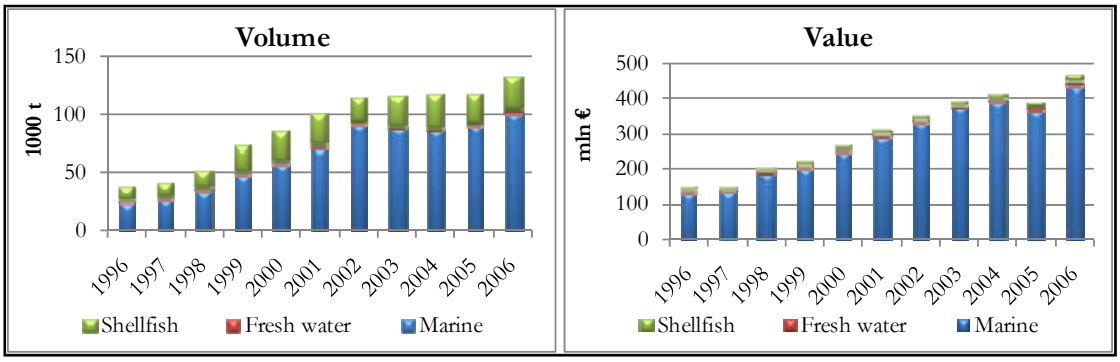

Figure 7.1 Greece - Volume and value of the aquaculture production, 1996-2006
Source: Ministry of Agricultural Development and Food - Hellenic Centre for Marine Research - ICAP S.A.

7.3. Structure of the sector

The Greek aquaculture sector consists of three main segments as they are shown in the table below. The survey implemented in this study is based on the population of 2006.

Table 7.1 Main segments of the national aquaculture sector

Species	On-growing technique	Number of firms in population in 2008	Number of firms in population in 2006
Seabream-Seabass	Cages	107	201
Trout-Eel-Carp	Tanks and raceways	114	122
Mussels	Off bottom	232	232

Source: Ministry of Agricultural Development and Food – Hellenic Centre for Marine Research.

Sea cage farms

Greek marine fish production is dominated by two species, seabream and seabass making together 79% of the total volume, and 92% of the total value. The main technology used is cage technology. Other species have been successfully introduced but they still make no more than 4% of the total production. The most important of the new species are white seabream, sharpsnout seabream, common sea bream, common dentex and greater amberjack. The saltwater fish producers are export oriented firms. Seabass is the most exported fish (73%) followed by seabream (52%).

During the last 10 years, most of the small companies have been taken over by the market leaders or they have been forced to produce on a contract basis. The first that disappeared were those without their own distribution channels. The segment is dominated by 6 large companies. During 2008, the farmers faced a new sharp decrease in prices as a result of the increase in the production combined with the penetration of low cost producers into the traditional export markets of the Greek firms. The emerging world economic crisis in the same period led to the further deterioration of the economic climate in the Greek saltwater culture sector. This situation is expected to have an immediate effect on employment. In the near future, five or six groups will constitute Greek saltwater fish culture. Many of the currently independent producers will either join a consortium or become producers on contract. There will be some room for companies with high standards and diversified production for example, the upcoming organic farming.
Currently, the issue of new licenses for fattening units for seabass and seabream is forbidden. Only licenses for the so called new species are still issued, so in this way, existing production permits for seabass and seabream constitute intangibles with monetary value. Constraints to the segment are the saturation of the traditional export market and the penetration of low cost producers to the same markets.

Pond and raceway farms

Ponds and raceways are traditional installations oriented to the production of trout. Trout contributes to 81% of the total freshwater production volume and 68% of the total segment value. This segment is oriented to the domestic market. The only fish that is exported is eel. Many of the trout farmers operate as processors having small smoking facilities. In this way they process the quantities in excess but also when the market price is not profitable. During this survey some units have reported to practise organic farming.

The establishment of new freshwater farms is not restricted. The firms have to get one license from the local authority and a second one, the so called "environmental suitability license". The second licence concerns a very complex issue and many farms do not have both licenses and in fact are illegal. In this framework, farms with a complete license are considering their license as intangible with monetary value. The main constraints to the segment are the lack of locations and the inability to expand existing farms due to environmental issues. Additionally, water pollution caused by waste waters forms an unpredictable inhibitory factor in the development of the segment

Shellfish farms

Shellfish farms are almost exclusively producing mussels (*Mytilus galloprovincialis*). They are traditional farms located close to estuaries. The lack of appropriate sites is the main restricting factor in the development of the segment. New licences are no longer issued and the existing ones are certainly intangible property. Another constraining factor is the sporadic appearance of a planktonic flagellate (*Dinophysis acuminata*) that contaminates the mussel's flesh. On such occasions entire areas are closed for farming for a long period. This unpredictable factor makes long term management impossible and the farmers request on going monitoring and an early warning system.

Hatcheries

Hatcheries are 99% integrated in the fattening companies. For this reason they are not considered as a segment and are not surveyed separately. The majority of hatchery production has been used so far for fattening and only a small quantity (4%) is exported. Apart of some sporadic efforts of institutional hatcheries, restocking is not practiced by commercial firms, due to the strong opposition of environmentalist groups and the great concern of the people about the impact on the native stocks.

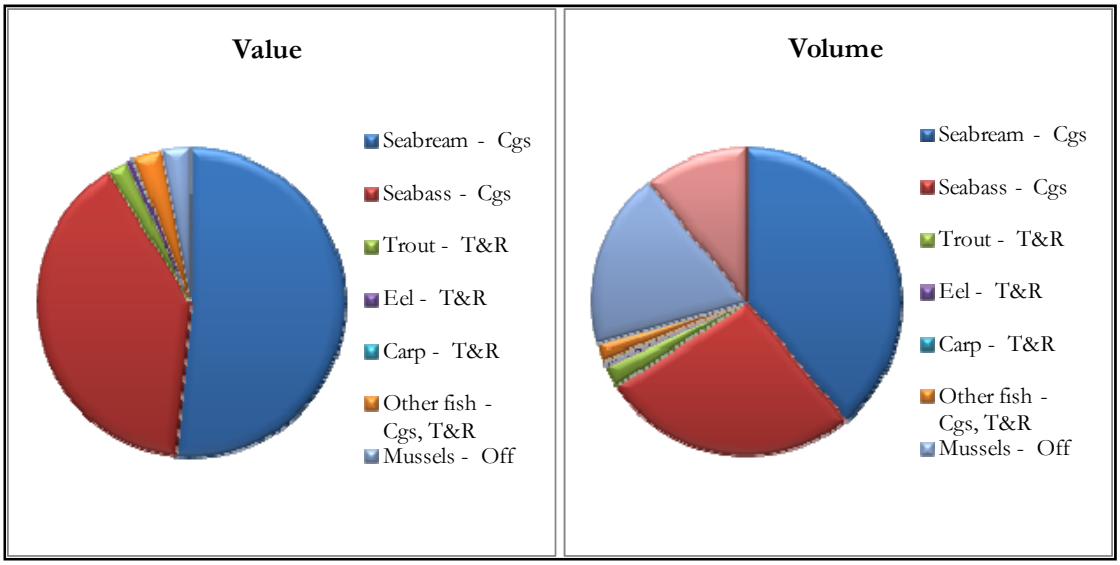

Figure 7.2 Volume and value of the Greek aquaculture production in 2006.
Source: Hellenic Centre for Marine Research

The monitoring of the aquaculture activity in Greece has until now, been the task of the Ministry of Agricultural Development and Food – Directorate of Fishery (MAD&F). This authority is responsible for the issue of all the licenses at the National level for the operation of any farming unit. The activity is monitored by the local fishery inspectors distributed in each prefecture. In this way the directorate always has an up-to-date list of the operational and non operational units. Production monitoring is annual, but it is restricted to the registration of the production by species, value and employment. The monitoring is based on the declaration that the farmers are obliged to provide to the local inspectors every year. The monitoring is exhaustive. A similar survey is carried out by the National Service for Statistics.

Although the two surveys are theoretically independent, they converge to the same result because they get their information from the same source. The segmentation that is followed by the two monitoring authorities is the same as the one used in this study. There are two additional segments, lagoons and lakes-dams. They appear to have very limited production and therefore they are not included in the current survey. The elementary sampling unit for the national survey is the production unit. A production unit is considered the producing entity for which a licence has been issued. In this way the population is the production unit (farm) and therefore the statistics produced refer to the segment. The coupling between production unit and company does not appear in the statistics.

The Federation of Greek Mariculture presents regularly baseline data (production, value, and employment) concerning the sea cage farming segment but there is no available information concerning the methodology of data collection and the estimation procedures.

7.4. New developments

Despite the great development of Greek mariculture, the sector is still based on the seabream and seabass culture. New species have been successfully introduced but they contribute only 4% to the total production. The most important of the new species are white seabream (*Diplodus sargus*), sharpsnout seabream (*Diplodus puntazzo*), common sea bream (*Pagrus pagrus*), common dentex (*Dentex dentex*) and greater amberjack (*Seriola dumerili*). The low production of the new species is due to the low demand for some species while for other species the technology has to improve further (common dentex). As the marketing of the new species assists the increase in demand, the production is expected to increase as well.

A new development for the Greek aquaculture is the tuna fattening. Currently there is one operational unit but there are several new licenses requested and some of them are expected to be established in the coming years.

Open sea farming is a promising new development for the sector. There are several off-shore and other near-shore fattening units for seabass and seabream currently operational. This way of farming is expected to expand in coming years. Off-shore farming is promising for the elimination of conflicts between aquaculture and tourism. This is expected to soften the opposition of the local authorities for the establishment of aquaculture units.

Organic farming has been emerging in the last year. This was initiated by some freshwater farmers but it is expected that this farming practice is going to grow in coming years.

Quality certification has been successfully introduced with the larger firms certified first. It is also expected that this process is going to cover the entire sector in the near future.

7.5. Economic performance

The information presented in this section shows the results of the survey implemented in the framework of the current study. It is the first time that such a survey has been implemented which included account data, production and data having the company as the elementary sampling unit.

The total population of aquaculture producers has been determined using the information of the farm's register provided by the MAD&F. The list has been modified by information collected by a telephone survey. The information has been provided by fishery inspectors and farmers. Despite the difficulties of this approach, a list of producers has been produced that contains the least possible errors. The risk of double counting is not entirely eliminated but it is inevitable in a situation where data are collected during 2008 for the reference year 2006. This look back is not easy, especially in a dynamic changing segment like the cage farming.

The sampling design is based on the segmentation used by the National Service for Statistics. The largest segments have been maintained and only segments providing less than 1% of the total national production have not been taken into account. No size class segmentation has been applied for freshwater and shellfish farming. The size classes in sea cage farming have been determined on the basis of turnover. Two size classes have been determined: companies with turnover above one million euro and companies below that number. The highest sample is taken in the class with the highest turnover, because there is a higher dispersion than in the smaller size class.
The results of the current survey show some differences in t
he volume and value compared with those provided by the estimations of MAD&F and the National Service for Statistics.

Sea cage farms

In 2006 there were 328 production units owed by 201 companies. About 100 companies were approached during the survey, which represent about 90% of the total turnover in the sector. The production in each farm is very homogeneous (they produce seabream and seabass) but in the group there were small and large producers. Response has been received from 73 companies but there were gaps in the cost disaggregation by the majority of the companies. The most valuable product of the Greek sea farms is seabream but seabass has the most lucrative price and is the main export commodity of the segment. The total production of the segment is 100,600 tons having a value of 434.4 million euro. The contribution of the species to the total production is: seabream 58,000 tons with a value of 238.9 million euro, seabass 40.1 tons with a value of 182.5 million euro and the new species 2,500 tons with a value of 12.9 million euro. Of the sampled companies, 81.3% displayed profits and the average profit per company was 596,738 euro.

Ponds and raceways

In 2006 there were 214 production facilities organized in 122 operational companies. Many companies have a small production unit that consumes the entire production in restaurants owed by the same company. This kind of company has not been considered as an aquaculture company. The segment consists of 4 large producers (above 100 tons) and 110 medium and small producers. The segment is homogenous in both size classes. The total production of the segment is 4,488 tons with a value of 15.71 million euro. The main species is trout with a total production of 3,643 tons and a value of 10 million euro. The second species is eel with a total production of 519 tons and a value of 3.5 million euro. No profit has been estimated since most of the companies did not provide profit and loss account or cost disaggregation. The total employment is 253 persons (engaged) or 186 FTE.

Shellfish farming

The production of shellfish farming consists primarily of mussels (99% of the volume). In 2006 there were 602 production facilities owed by 232 companies. The companies that participated in the survey were 29 (12.5% response rate). Most of the companies declared that their cost disaggregation was estimated. The production volume was 27,634 tons and the value was 13.8 million Eeuro. Only 11 companies of the 29 samples (38%) declared to have profits. The average profit per company was 7,220 euro.

7.6. Statistical tables

Stat. table 7.1 Greece - Saltwater fish farming

Year	Volume of production (1000 tons)	Value of production (million Euro)	Number of companies	Employment (Total number)
1996	25.8	145.3		
1997	33.7	179.8		
1998	41.6	222.1		
1999	59.9	268.8		
2000	66.5	288.4		
2001	67.0	250.2		
2002	62.5	222.2		
2003	72.2	260.7		
2004	64.6	276.2		
2005	76.2	318.3	263	
2006	100.6	318.3	201	11,965

Source: MAD&F - HCMR - ICAP S.A.

Stat. table 7.2 Greece – freshwater fish farming

	Volume of production (1000 tons)	Value of production (million Euro)	Number of companies	Employment (Total number)
1996	2.6	10.3	136	352
1997	3.1	10.5	130	385
1998	3.0	12.4	128	340
1999	3.0	9.6	131	321
2000	2.9	9.4	132	337
2001	3.4	12.2	130	323
2002	2.8	9.5	127	239
2003	2.5	8.7	126	239
2004	2.7	9.9	129	347
2005	2.9	11.7	122	336
2006	4.5	14.7	114	253

Source: MAD&F - HCMR - ICAP S.A.

Stat. table 7.3 Greece – shellfish farming

	Volume of production (1000 tons)	Value of production (million Euro)	Number of companies	Employment (Total number)
1996	10.2	3.4		
1997	11.1	3.5		
1998	14.6	5.4		
1999	21.3	7.8		
2000	24.4	7.2		
2001	26.0	8.1		
2002	21.8	8.8		
2003	25.6	10.0		
2004	28.8	11.9		
2005	26.1	11.3		
2006	27.6	13.78	232	580

Source: MAD&F - HCMR

Stat. table 7.4 Greece – Hatcheries

	Volume of production (mln juveniles)	Value of production (mln Euro)	Number of companies	Employment
1996	110.0	32.2	Embedded in the saltwater fish farming	Embedded in the employment of the saltwater fish farming
1997	130.3	33.6		
1998	150.0	57.0		
1999	187.0	45.9		
2000	235.0	56.0		
2001	290.0	69.3		
2002	300.0	65.2		
2003	265.0	53.0		
2004	280.0	59.6		
2005	341.0	73.8		
2006	370.0	81.9		

Source: MAD&F - HCMR - ICAP S.A.

Stat. table 7.5 Greece - Review by sub-sector and species, 2006.

	Volume (1000 tons)	Value (mln Euro)	Number of companies	Employment (engaged)	Types of on-growing unit
Mariculture (marine fish)					
- Seabream	58.0	238.9	201	5978	Cages
- Seabass	40.1	182.5			Cages
- Other	2.5	12.9			Cages
Freshwater fish culture					
- Trout	3.60	10	94	253	Tanks and raceways
- Eel	0.60	3.5	8		Tanks and raceways
- Carp	0.16	0.5	9		Tanks and raceways
- Other	0.13	0.6	11		Tanks and raceways
Molluscs and crustaceans					
- Blue mussels	27.6	13.8	232	580	Off bottom
- Other	16.2	0.1			
- Hatcheries	370 million	81.9	Enbeded in cage farms		

Source: Hellenic Centre for Marine Research

Stat. table 7.6 Greece - Indicators by segment, 2006
(segment totals, value in million Euro)

On-growing technique	Cages	Tanks and raceways	Of bottom
Species	Seabass - Seabream - New Species	Trout -Carp - Salmon - Eels	Mussels - Oysters
Population	201	122	232
Sample	70	54	29
OPERATIONS – COSTS AND REVENUES			
Turnover total	589.0	15.7	13.8
Other income			
Personnel costs		0.9	5.7
Value of unpaid labour		1.4	2.3
Energy costs			1.3
Live raw material costs			0.4
Feed raw material costs			
Repair and maintenance			3.6
Other operational costs			1.1
Depreciation			
Profit (EBT)	43.4		1.7
Interest costs			
BALANCE SHEET – ASSETS AND LIABILITIES			
Net investment in tangible goods			
Equity capital	253.4		
Debts	934.7		
Total assets	1,195.8		45.3
EMPLOYMENT			
Total number of persons employed	11,149	253	580
Full time equivalents (FTE)	5,978	186	464
LEGAL STATUS			
Single holder	91	109	218
Limited and anonymous co.'s	110	13	14

Source: Hellenic Centre for Marine Research

Stat. table 7.7 Greece - Sales by segment and species, 2006

	Species	Volume (1000 tonnes)	Value (million Euro)
Mariculture (marine fish)			
- Cages	Seabream	58.0	238.9
- Cages	Seabass	40.1	182.5
- Cages	Other	2.5	12.9
Mariculture (marine fish)			
- Tanks and raceways	Trout	3.6	10.0
- Recirculation system	Eel	0.6	3.5
- Recirculation system	Other	0.3	1.1
Molluscs and crustaceans			
- Off bottom	Blue mussels		

Source: Hellenic Centre for Marine Research

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8. HUNGARY

8.1. Situation in 2006-7

Aquaculture in Hungary is concentrated mainly in ponds and reservoirs with a total surface of 26,248 ha in 2006. The actually utilised area of ponds is 23,878 ha. The remaining 2,370 ha is under reconstruction.

In 2006 there were 321 companies involved in aquaculture of which 256 companies provided data for statistical purposes while the rest of them are not active[25]. There are 23 firms with more than 1 location.

The number of persons employed was 1,353 in 2006 which has declined significantly from 1,518 in 2005. Employment is mostly seasonal as there are spring and autumn labour peaks. In the case of individual farms[26] unpaid family labour is characteristic.

In 2006 total production of the Hungarian fishery sector was 22,843 tonnes (See) of which intensive production represented 2,081 tonnes. The total production of fish ponds was 20,762 tonnes from which 12,898 tonnes were marketed and 355 tonnes were sold within the frame of "put and take fishery" on the farms. The average yield (total production - stocking) was 551 kg/ha of pond surface.

The total value of Hungarian aquaculture production was 26.1 million Euro in 2006. of which 72% was generated by common carp. The second biggest share (11%) of the total value corresponded to African catfish. Silver and bighead carp production comes next with 5% and grass carp with 4%. These species make up 92% of the total value of Hungarian fish production. All the other species generated a marginal 8% of the total.

8.2. Main trends

The total production of aquaculture has started to shrink from the late 1980s till the middle of the 1990s. Since 1995 there was a turnaround and production has started to grow again until 2000. Then after 4-5 years of stagnation and minor decline, recently aquaculture output has started to increase again. Since 2001 the number of companies involved in aquaculture grew by almost 75% till the end of 2005, but in 2006 there was a 10% reduction.

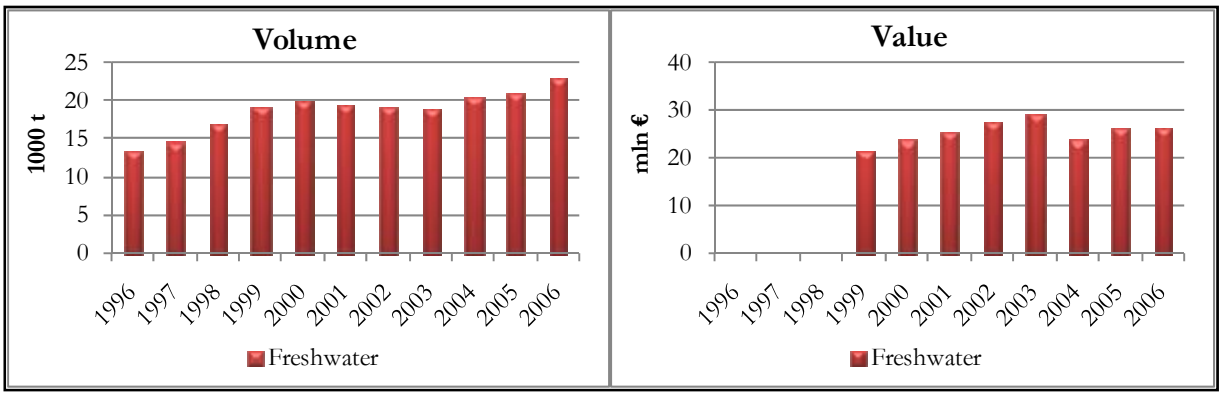

Figure 8.1 Hungary - Volume and value of aquaculture production, 1996-2006

Developments in production value depict a somewhat different picture compared to production volume. The total value of production has reached its peak in 2003 (29.1 million Euro) when the total volume experienced a minor decline. This trend is due to the fluctuation of producer prices reaching their peak in 2002-2003 at almost 2 Euro/kg of common carp in live weight. As prices have decreased to around 1.5

[25] Fish (more precisely carp) production is a three years long process where in the first two years there is no marketable fish realisation. This period is the non-productive phase.
[26] Individual farms refer to individual persons involved in aquaculture often referred as "single holders".

Euro/kg live weigh total production value has also decreased to 26.1 million Euro despite the increase of the total production volume in the last years.

Employment data is gathered only since 2005 which is not enough to detect possible trends. It is clear that together with the reduction in the number of companies the number of workers employed also decreased by nearly 15% by 2006. Mainly unproductive farms with excessive labour force have quit.

8.3. Structure of the sector

In Hungary there are two types of fish production. The traditional way of production is pond-fish culture giving about the 90% of total fish production. The method of the 3 years long production technology[27] has not been altered since several years. This production is considered extensive.

There are 10 companies that are involved in intensive fish production applying flow-through and recirculation systems. They generate around 10% of the total production. Main species are trout, African catfish and eel.

Main species in pond-fish culture are common carp, silver carp, bighead carp, grass carp, pike, pike perch and wels. Common carp is still the most important species with a share of 75% in the domestic fish production. Its role is decisive in pond-fish culture, in reservoirs and in other waters. Big-head carp, silver carp and their hybrids as well as grass carp are the second most important species in pond-fish culture amounting to 17% of volume. Carnivorous fish species (pike, wels, pike perch) contribute to the pond-fish production by 2%.

There are other species making up 6% of the total volume of fish produced in Hungarian aquaculture. Other species in pond-fish culture are tench, crucian carp and bream while in recirculation systems these are European eel, Nile tilapia, sturgeons, brown bullhead, etc.

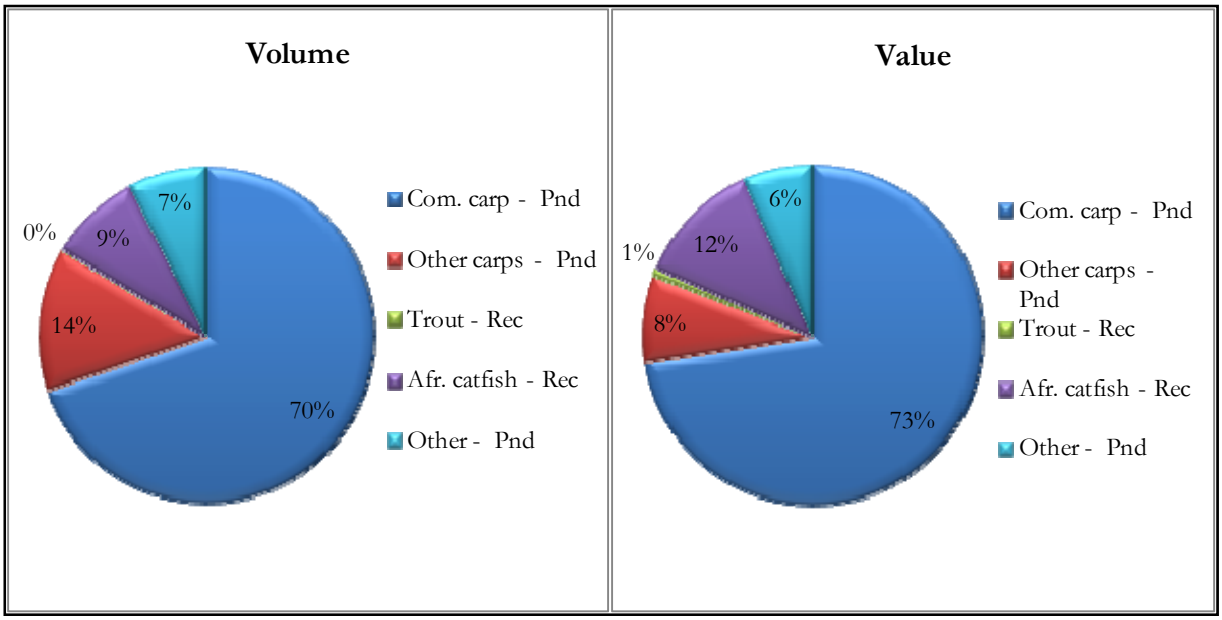

Figure 8.2 Hungary - Composition of the volume and value of aquaculture production by species and on-growing technique, 2007

Farms have different legal status: single holders, cooperatives, limited liability companies and joint stock corporations. According to legal form distribution of farms are as follows (based on the utilised surface area of ponds (2006):

- Individual farms 8.2%

[27] The most common production technology for common carp to reach the marketable 1-1.5 kg live weight.

- Co-operatives 7.4%
- Corporations 84.4%
  - Of which state owned farms 21.2%

There are large differences of the size of the farms within each legal form.

- Individual farms 6-130 ha
- Co-operatives 30-850 ha
- Corporations 45-3,000 ha

There are four large corporations which have a pond surface over 1,000 ha each. They have a total pond surface area of 7,640 ha that makes up a 32% share of the total utilised pond surface. They are fully integrated from hatchery to processed, ready made end products.

As there are no farms specialising in only one species, the pond farmers may be regarded as one segment. Intensive fish farms with recirculation systems would rather specialise to one or few species, however, due to their low number it is not possible to survey them. Thus in Hungary there is only one segment: carp production in ponds. The sufficient number of firms to be surveyed should be 35.

Table 8.1 Main segments of the national aquaculture sector

Group of species	On-growing technique	Number of firms in population
Mixed (mainly common carp, grass carp, silver and bighead carp)	Ponds	220
African catfish, Rainbow trout, Sturgeons	Recirculation system	10

There are no specialised hatcheries in Hungary. Companies involved in juvenile production are also involved in fish production.

8.4. New developments

There have been many discussions on the future of the traditional carp dominated pond aquaculture and it was thought by some that carp market and production will decrease because of the more competitive aquaculture products on the enlarged market. Until now, this has not been observed in Hungary.

The old ponds, where just a very extensive production technology can be applied, represent the highest environmental values. These constructed wetland habitats provide food and shelter for a large number of valuable rare and endangered species. Fish farmers' stocking and feeding activity ensures the high productivity and diversity of these habitats, but produce economic losses for the farmers. In 2002 the government of Hungary launched a national agri-environmental program which also included fish ponds. Thus fish farmers received some compensation for producing environmental values. After some minor changes, this program was accepted by the Commission and recently more than 70% of the farmers participate in the agri-environmental program co-financed by the EU and the Hungarian government.

In 2005 10 farms produced fish in intensive aquaculture. Seven farms involved in African catfish are exploiting geothermal water either for flow-through systems or for heating. The other three farms are traditional trout producers.

The total production of these farms was 1,921 tonnes, of which 1,844 tonnes African catfish. The production of this species increased by 30% in 2004 and in 2005 sales grew by further 15%. The introduction of African catfish is a success story for the Hungarian aquaculture as costumers easily accepted the new species, which has many similarities to the traditionally consumed European catfish (*Silurus glanis*). It is expected that the intensive production of African catfish and perhaps also some other new species still has the capacity to grow, but it needs intensive marketing activity to enlarge the market.

As an answer to the growing demand for customers looking for safe food, the development of organic carp production has started 5 years ago. Supporting the movement recently, a national bio-carp standard system has been implemented in line with Council Regulation (EEC) 2092/91. Organic fish production may open up a new segment, expanding the market by reaching well-situated, health-conscious consumers.

Development of production technologies is only possible in modernised production facilities. Nearly 40% of the fish ponds in Hungary were built or reconstructed before 1960. Reconstructions of some of the facilities have started in the last few years with the financial aid of the FIFG and EFF.

8.5. Economic performance

Carp pond farming

In Hungary only one segment can be identified which is carp production in ponds. Production of trout and African catfish in recirculation systems is so limited that it cannot be surveyed due to statistical and data confidentiality problems.

According to the extrapolated data, fish farms in Hungary in 2006 reached a turnover of 33. million Euros. Wages represent the highest cost component, reaching 13.7 million Euros (incl. social security). 3.8 million Euros was spent on energy, 1.8 million on live raw material, roughly 6.6 million on feed, 5.5 million on repair and maintenance and 5.7 million on other operational costs. The total operational costs amounted to 37.3 million Euros. Net interest costs were 0.9 while depreciation 3.5 adding up 4.4 million Euros as capital costs. The Hungarian fish farms realized Earnings Before Interests and Taxes (EBIT) of approximately 9.8 million Euros. The equity capital of farms amounted to 58.3 million Euros. Debts made up of 29.3 while total assets 87.6 million Euros. During 2006 farms net investments have reached 1.9 million Euros.

According to the extrapolated data farms were employing 1,891 persons. Converting actual working hours to full time equivalents (FTE) (1 FTE = 1800 working hours) would give 1,203 FTEs.

Gross value added of Hungarian aquaculture in 2006 made up 28.26 while gross cash-flow 14.63 million Euros. Considering the main indicators in relation to full time equivalent turnover per FTE was 27,500, while gross value added 23,500 Euros. Employing a person full time has cost 11,400 Euros. Production per FTE was 17.3 tonnes. The average turnover per firm amounted to 102,900 Euros. EBIT as a percentage of total assets was 11.15%.

The main constraint of the Hungarian aquaculture at present is the limited human consumption that needs to be increased by effective marketing activities. Increasing imports of saltwater fish are a growing threat to home produced freshwater fish and fish products. Another constraint of pond farmers is the limitation on waste water deposition into natural waters as they have to meet with the threshold values set out in the national law.

Producer prices in aquaculture

Hungarian producer prices of common carp and silver and bighead carp showed significant volatility in the last 7 years. Prices started to grow from a very low level in 2000. They have reached their peak in 2002 and 2003. A sharp decline has taken place in 2004 and 2005 and than in 2006 prices started to rebound especially in the case of silver and bighead carp.

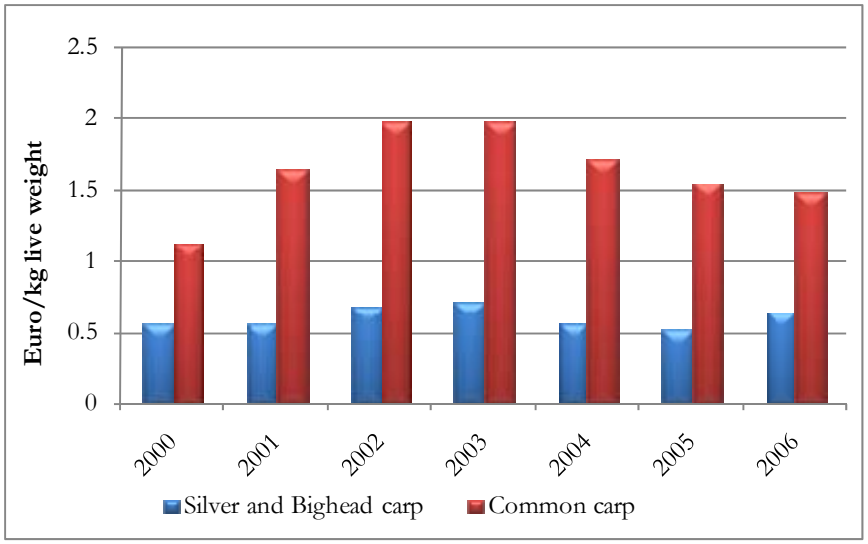

Figure 8.3 Hungary - Producer prices of Common carp and Silver and Bighead carp, 2000-2006

Structure of assets in aquaculture

In pond farming about 75-85% of the total fixed assets is covered by the value of the pond and the connected infrastructure works. The value of other fixed assets, such as buildings (feed storage buildings, social buildings, hatchery, etc.), machines, transport means, etc. is relatively low. The size and the technological equipment of operating ponds as well as the applied technology basically determine fish production and domestic supply.

Fodder use in aquaculture

Pond-fish culture requires a certain extent of fodder-crop area. This is relevant when production is carried out on the basis of own fodder. The necessary size of food producing area depends on several factors (for example yields, food use, weather, soil quality, etc.). About 0.3-0.4 ha field per 1 ha pond area per year is required for fodder production, considering average soil quality and yield.

In extensive pond cultures fish is fed with grain cereals (wheat, grain maize, triticale, etc.) while in intensive technology with granulated fodder mixes consisting of grain cereal meal, fish meal, fat, vitamins and minerals. Carnivorous fish is not fed directly. They feed on other fish species.

Total fodder use in Hungary is around 40,000 tonnes per year. The amount of fodder needed for producing 1 kg of fish was 3.2 kg in 2000. It has improved significantly by almost 30% in the last 2 years.

Table 8.2 Fodder use in Hungary

	2000	2001	2002	2003	2004	2005	2006
Total fodder use, t	40,788	36,832	43,223	42,428	48,324	42,449	42,012
Kg fodder /kg fish	3.2	2.5	2.7	2.7	2.9	2.5	2.3

Source: Agricultural Economics Research Institute

Fodder prices are very much dependent on total production of fodder cereals which is in great respect a function of the weather. In 2003 Hungarian farmers have experienced a severe drought that more than doubled the previous price levels to 180-200 Euro per tonne. Contrary to that in 2004, 2005 and 2006 due to favourable weather conditions farmers have reached record yields and hardly could sell their cereals for 80-90 Euro. The growing need for bio-fuel raw materials has induced a 20% price increase in 2006 especially in the case of grain maize. 2007 drought again has rocketed grain prices up to the sky above 220 Euro that hit fish producers very severely raising their fodder costs more than twofold.

Productivity

Taking the data of the available last two years (2005-2006) productivity has increased significantly. The production value per employed in 2005 was 17,300 Euro. This figure has risen substantially by about 15% to 19,884 in 2006 which was mainly due to the bankruptcy of the least productive farms. Severe competition, low producer prices and growing fodder prices will cause difficult times for farms with lower productivity. The more intensive farms with cost-efficient technology and higher added value products are going to gain bigger share on the market.

Legal conditions of production

Fish production in ponds and tanks do not require special permits or licenses therefore it cannot be considered as business rights. For fish pond construction, a permit is required only from the regional Water Bodies.

8.6. Statistical tables

Stat. table 8.1 Hungary - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	13.5			
1997	14.5			
1998	16.8			
1999	19.1	21.5		
2000	19.9	23.6		
2001	18.2	25.3	210	
2002	17.8	27.3	266	
2003	17.7	29.1	287	
2004	18.7	23.6	347	
2005	19.1	26.3	349	1,518
2006	20.8	26.1	321	1,353

Source: Agricultural Economics Research Institute

Stat. table 8.2 Hungary - National overview – Nurseries and hatcheries

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996				
1997				
1998				
1999				
2000				
2001	5.9			
2002	6.8			
2003	6.5			
2004	6.8			
2005	6.3			
2006	7.5		28	659

Source: Hungarian Fish Farmers' Association

Stat. table 8.3 Hungary - Review by sub-sector and species (value and volume), 2005

	Volume (1000 t)	Value (mln Euro)	Number of companies	Types of on-growing unit	Employ-ment
Freshwater fish culture					
- Carp	16.0	21.1	321	Ponds	1,353
- Trout	0.1	0.2	5	Recirculation systems	15
- Other	4.7	4.8	74	Ponds	313

Source: Agricultural Economics Research Institute

Stat. table 8.4 Hungary - Indicators by segment, 2006 or 2007
(segment totals, value in million Euro)

On-growing technique	Ponds			
Species	Carp			
Environment	Freshwater			
OPERATIONS – COSTS AND REVENUES				
Turnover	33.04			
Other income	14.01			
Personnel costs	13.73			
Value of unpaid labour	0.11			
Energy costs	3.84			
Live raw material costs	1.81			
Feed raw material costs	6.58			
Repair and maintenance	5.53			
Other operational costs	5.67			
Depreciation	3.53			
Profit (EBIT)	9.76			
Interest costs	0.92			
Gross cash flow	28.26			
Gross value added	14.63			
BALANCE SHEET – ASSETS AND LIABILITIES				
Net investment in tangible goods	1.90			
Equity capital	58.26			
Debts	29.29			
Total assets	87.55			
EMPLOYMENT				
Total number of persons employed	1,891			
Full time equivalents (FTE)	1,203			
LEGAL STATUS				
Total number of firm	321			
Single holder	88			
Limited and anonymous co.'s	188			
SALES VOLUME				
Volume in (1000 tonnes)	20,762			
OTHER DERIVED INDICATORS				
Turnover / FTE (1000 Euro)	27.46			
Gross value added / FTE (1000 Euro)	23.49			
Personnel costs / FTE (1000 Euro)	11.41			
Tonnes / FTE (tonnes)	17.26			
Turnover / firm (1000 Euro)	102.93			
EBIT / Total assets (%)	11.15			

9. IRELAND

9.1. Situation in 2006-7

In 2007, the overall total production volume in both the shellfish and finfish sector was 52,500 tonnes, an 9% decrease compared with 2006. The most significant reductions in volume occurred in the salmon and bottom mussel industries where recorded decreases in production were 11% and 20% respectively. Despite these declines there were significant increases in the volumes of rope mussel (10%) and re-laid rope mussel seed (45%), pacific/gigas oysters (17%) and clams (35%). The combined value of all shellfish harvested was € 59.3 million and € 58.4 million for the finfish sector. In 2007, the total value of production in the aquaculture sector was almost € 118 million compared with Euro 125 million in 2006, a 6% decrease.

In 2006, there were a total of 246 aquaculture firms in operation. Some 2,058 persons were employed in the aquaculture sector during 2006, of whom 782 full-time, 498 part-time and 778 on casual basis. Employment increased 12% from 2005.

9.2. Main trends 1996-2006

The aquaculture industry production value grew in output from Euro 65 million (34,930 tonnes) in 1996 to a peaks of Euro 125 million in 2002 and in 2006. Since the year 2002 the industry has experienced significant production and marketing challenges. In 2005, the aquaculture sector represented some 30% of the total value of Irish seafood produce.

Saltwater fish farming production volume peaked in 2001 at 24,352 tonnes while value peaked in 2002 at Euro 80 million. The production of salmon accounts for 95% of this volume and value. A lack of consistent profitability beset the salmon-farming sector in Ireland in recent years. This was brought about by heavy competition and the dumping of below cost salmon on the EU market and sub-optimal stock performance in recent years with regard to feed conversion ratios and survival. There were also difficulties by some companies arising from serious losses in one of the Bays in the north west of Ireland where a substantial stock of fish perished resulting in a sharp fall in production three years ago. The very substantial supplies of salmon, from Norway in particular, placed enormous pressure on Community producers who could not compete at the very low prices obtained as a result of the Norwegian export. The introduction by the EU in 2005 of Minimum Import Prices (MIP) for farmed salmon for five years has largely addressed market issues related to dumping. Recent improvements in husbandry, stockbreeding and feeding practices have improved survival and performance and effective applied research is ongoing and expected to further ameliorate the situation in future The number of people employed in the sector has halved between 2002 and 2006 from 426 to 234, reflecting the decreases in production over the same period.

Freshwater trout is the only species produced in the freshwater category. The volume of production has varied between 1,160 tonnes in 1996 and 970 tonnes in 2006. A two-year comparison of the value of production between 1996 and 2006 shows little variation, Euro 2.9 million (1996) and Euro 2.7 million (2006). The volume of production is currently at capacity and it is not expected that there will be additional inland installations. The number employed in this sector has remained relatively constant since 2003 at 30 employees.

The volume of shellfish production has increased by 135% over the ten-year period 1996-2006, while the value has increased almost four-fold. Bottom mussels dominate the segment, accounting for 52% of the value of shellfish in 2005 and 62% in volume terms. The success of the bottom mussel industry has in part been due to investment in 7 new mussel dredgers in the first half this decade and the transfer of seed from Northern Ireland to the Republic. The rope mussel industry experienced some biotoxin related difficulties in 1999-2000, but has since recovered to a peak production volume of 9,660 tonnes in 2006. It should be

noted that as of 2005, re-laid rope mussel seed has been counted in production figures. Pacific oysters account for approximately 15% of the volume of aquaculture production in 2006.

There are currently 12 hatcheries in Ireland producing salmon smolt. This number has decreased from 2002 when there were 20 operators. This may be due to the fact that the sector is highly regulated and licences are difficult to acquire but more so because the industry deemed it unprofitable for independents to produce smolt as the integrated producers controlled the market. In addition, due to difficulties in the end salmon market, producers were choosing not to re-stock, resulting in the decline in hatchery operations. It is also a very capital-intensive sector, with significant investment required to commence operations.

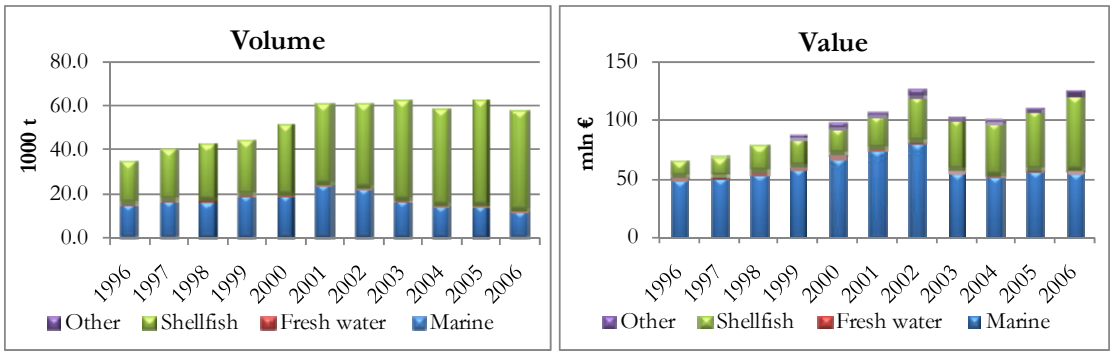

Figure 9.1 Ireland - Trend in volume and value of production, 1996-2006

9.3. Structure of the sector

Ireland has a relatively diverse aquaculture sector operating across a number of different sub-sectors. The main species produced in Ireland are blue mussel (*Mytilus edulis)*, native oyster (*Ostrea edulis)*, Pacific (gigas) oyster (*Crassostrea gigas)*, salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*).

In Ireland, all aquaculture operations must be licensed under the Fisheries (Amendment) Act 1997 by the Minster for the Department of Communications, Marine and Natural Resources (DCMNR). Licences are issued on a site-by-site basis, which means that one aquaculture producer may hold several licences.

In 2006, there were 246 farmers, producing 19 species. For the most part, Irish aquaculture operators tend to concentrate on the production of one type of species. However, there are circa 14 farmers that produce more than one species.

There are 8 salmon farms, 3 sea-reared trout farms and 8 freshwater trout 8 farms in operation. The pacific oyster sector is characterised by having two distinct classes of operator, a substantial number (circa 83) of small players who pursue oyster culture as a part-time or artisanal activity and a smaller number (circa 20) of more substantial growers who farm full-time and account for the bulk of output. The native oyster sector consists of circa 8 growers with 2 growers accounting for 80% of production. The bottom mussel sector consists of 37 operators and the rope mussel sector consists of 61 operators.

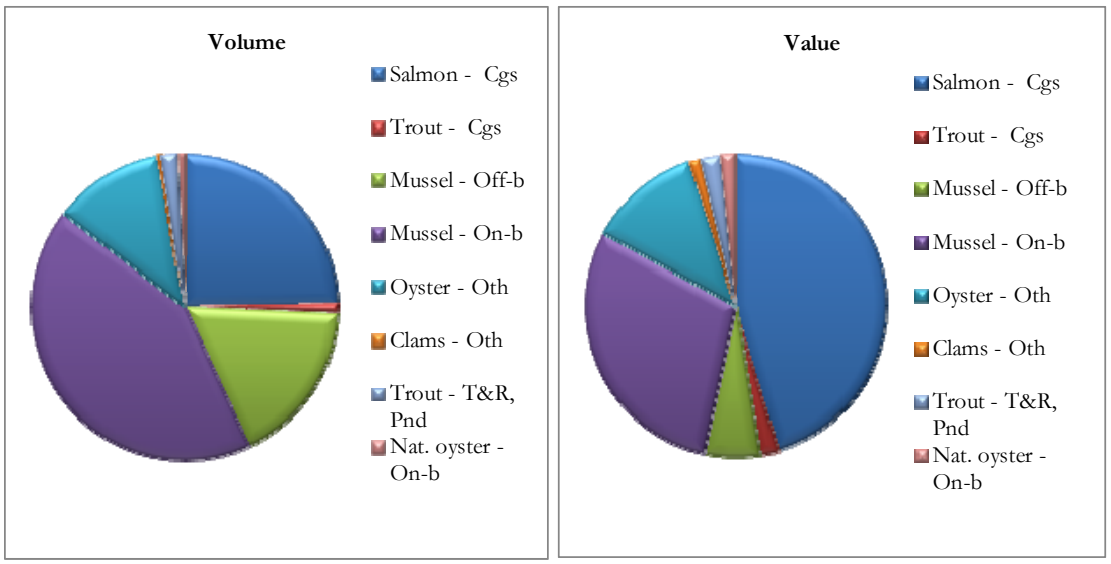

Figure 9.2 Ireland - Composition to the volume and value of production in 2006

Table 9.1 Ireland - Main segments of the national aquaculture sector, 2006

Group of species	On-growing technique	Number of firms in population
Salmon	Cages	8
Trout (saltwater)	Cages	3
Trout (freshwater)	Tanks, raceways, ponds	8
Novel fish		
Oysters	On-bottom	110
Mussels	On-bottom	37
Mussels	Off-bottom (rope)	61
Other shellfish *		
'Novel' shellfish		
Hatcheries (salmon)		12

**Other shellfish includes mainly clams and scallops

Table 9.1 shows that only the segments of oysters and mussels have sufficient number of firms to allow for statistical survey based on samples. Most other segments are too small and diverse to allow for production of reliable statistics. The data compiled under the present survey for salmon farming shows that of the four farms surveyed, the difference between smallest and largest was a factor of approximately 30 (!). Consequently, the relative standard deviation of the calculated averages is very high (105%). The interpretation of the average values is only possible within very broad margins. Also other segments contain small and large firms, making them little homogeneous.

Many salmon and trout producers combine fish farming and hatcheries, which further complicates the interpretation of costs and earnings data, as the various cost components cannot be well separated and in particular costs of fingerlings may be highly different among different firms.

9.4. New developments

The cultivation of clams, scallops and arctic char is new to Irish aquaculture. As comparatively new species to European culture, they are gradually gaining in popularity amongst producers. For various reasons[28], however, it is not considered likely that any of these fish will be produced in large volumes in the short term in Ireland.

[28] These are highly specialised aquaculture products for supply to niche markets and are not produced in large quantities, as there is limited market demand.

The cultivation of cod, perch, sea horses, abalone and urchins is also being explored. **Cod** farming is the latest aquaculture phenomenon, and it may be that there is potential for farmed cod and managed wild fisheries to operate together to supply the market. Farmed cod have the potential to ease the pressure on wild catch and reduce the risk of further over-fishing. A Marine Institute funded project is currently underway at the National University of Ireland (NUI) Galway marine station in Carna, Co Galway. The project, entitled Investigations into hatchery rearing of cod *(Gadus morhua)* in Irish conditions, aims to establish an experimental hatchery to rear cod to 5 grams.

The **perch** market is one that is currently undersupplied and that has demonstrable potential, particularly within Europe. Although there are only two perch farms in Ireland at present, there is a large natural resource of wet and marshy lands, which have been exploited commercially for peat extraction and these offer a unique potential for perch farming.

Seahorses have been exploited for years for their medicinal and ornamental properties. Demand for these beautiful and unusual animals far outstrips supply. The majority of sea horses are harvested from the wild to supply these markets and in some areas the threat of extinction is now very real. Seahorses now feature on the Convention on the International Trade in Endangered Species (CITES). The cultivation of seahorses is imperative to sustain the wild population. Ireland is in a unique position in Europe in having a team of experts in seahorse cultivation techniques. This team has established a successful breeding programme at a hatchery in the west of Ireland. The products of this company are primarily aimed at the highly lucrative aquarium trade.

Abalone and urchins are two of the most prized and highly priced seafood delicacies worldwide. Wild landings of both species have shown significant reductions since the mid 1990s. Ireland is in an unrivalled position in Europe in having two species of abalone – the European and Japanese abalone – in culture systems. Ireland is home to Europe's only urchin hatchery. To date several million urchin juveniles have been planted out in intertidal and subtidal rock pools at sites in the southwest. This will replenish the wild urchin fishery. Ireland used to have a very lucrative urchin fishery with a reported 500 tonnes of urchins exported annually in the 1970s. This fishery has all but collapsed due to over fishing and mismanagement and in 2001 just five tonnes of urchins were landed. The urchin hatchery offers a unique opportunity for reinstating the wild fishery and already harvested product is being sold to market.

In 2001, due to an exception biological occurrence, one the main salmon production sites in Inver Bay in South Donegal ceased operation. The result was the loss of production of 3,000 tonnes.

9.5. Economic Performance

The Irish aquaculture industry consists of some 246 operators, of which 98% fall into the category of micro and small enterprises.

Many of the operators are artisanal in nature, with only a handful of large operators in existence (only 16 operators produce >1% of total production in volume). Most operators have small holdings and in some cases aquaculture is only a supplement to their farming incomes. There were a total of 2,058 people employed in the sector in 2006. This was an increase of 12% compared with 2005.

On an international scale the Irish industry currently has a relatively modest production. It has progressed from being a fledging industry in the 1970s and 1980s to becoming an important economic contributor in rural areas. As an indigenous industry it is therefore relatively young and has over the last few years faced a number of production difficulties and species-specific marketing challenges. Despite these issues, there have been significant efforts and advances made to improve cultivation strategies and overcome the vagaries of markets. The total value of Irish aquaculture production increased to Euro 125 million in 2006. Despite this increase in value, the cumulative total production volume of both the finfish and shellfish sectors fell by 8% to 57,422 tonnes in 2006.

In 2006 an extensive independent[29] public consultation took place with all relevant stakeholders as part of the input to the National Strategic Plan and Operational Programme 2007-2013 for the new EFF. One of the issues facing the industry that emerged during the process was the difficulty in attracting investment and loan finance for fixed and working capital requirements because of a perceived lack of tangible assets in the sector. Currently licences are issued for 10-year periods[30] and the holder has 3-years from the issue of the licence to begin operations. Otherwise, the licence may be revoked by the Department of Marine, Communication and Natural Resources. Aquaculture Licences are non-tradable. A recommendation was made by the Review Group to review the current licensing and regulatory regime and to consider extending the duration of licences to a minimum period of 20 years to provide greater security of tenure so that licences can be used as collateral to raise equity and working capital.

Further challenges facing the industry that were identified include:

- The emergence of significant competition from countries with low cost/large scale industries
- Increased production costs due to disease outbreaks/stock health issues/ and temporary/prolonged closures of bays, due to biotoxins, impacting the rope mussel sector
- Supply chain failures including a failure to supply a consistent quality product from the grower to the processor and underdeveloped marketing/sales arrangements.

The government have approved a substantial investment programme for the period 2007-2013. The objective of this programme is the significant development and expansion of the aquaculture sector, within the context of clearly defined national planning policies, output targets, environmental standards and industry led codes of best practice for production methods and fish health.

Oysters

Cultivation of Pacific (Gigas) oyster is relatively profitable. While the volume of production increased between 2001 and 2007 by 56%, the value of production increased by 120%. Average profit level (EBIT) of the surveyed firms amounted in 2006 to about 19% of their revenues.

Mussels – off-bottom (rope)

Rope culture of mussels shows good results. The volume of output has approximately doubled between 2001 and 2007, while the value of production increased by 150%. Average profit level of the surveyed firms amounted in 2006 to 40-45% of their revenues.

Mussels – on-bottom

The output of the on-bottom culture of mussels seems has fallen to 18,770 tonnes in 2007, the lowest level since 2000. Earnings were still high due to good prices. The year 2006 was a peak year with a value of production of almost 36 mln €, about 50% above the level of 2007. Consequently, in 2006 the on-bottom mussel producers realized a neat level of profits of about 20% of their revenues.

Salmon and trout

Production volume of salmon and trout has been falling since 2001. In 2007 the output of salmon was only about 9,900 tonnes, only 42% of the 2001 output. Production of trout fell be 26% in the same period to 1267 tonnes. The deterioration of the production value was not as pronounced, due to positive development in prices. Still the value of salmon output of 51.3 mln € in 2007 was almost 30% below the 2001 level. The profitability depends significantly on the size of the firms. Large firms in the sample appear to be profitable, while the small ones are making losses.

[29] The consultation was carried out as part of an independent review of the Irish Seafood Sector by Seafood Strategy Review Group. The report is available at http://www.bim.ie/templates/text_content.asp?node_id=854

[30] The exception to this is a "Trial Licence" which can be issued for 3-years.

Novel species

Novel species (fish as well as shellfish) seem to face difficulties. Production of novel finfish species reached in 2007 about 48 tonnes, worth 317,000 €. This is approximately equal to the production level of 2003, after a major dip in 2005. Employment in this segment has been below 10 FTE since 2003.

Production of novel shellfish fluctuates widely. The value of output reached 1 mln € in 2007, after a low 200,000 € in 2006. Employment in this sector has been between 13 and 23 FTEs since 2003. Considering the lack of a consistent trend the economic performance is probably mixed, facing the common problems of an 'infant industry'.

9.6. Statistical annex

Stat. annex 9.1 Ireland - National overview – saltwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	14.7	49.5		
1997	16.4	50.4		
1998	15.9	54.6		
1999	19.2	59.3		
2000	19.1	68.0		
2001	24.4	74.3		
2002	22.4	79.9	13	426
2003	16.8	55.7	15	538
2004	14.4	52.4	10	369
2005	14.5	56.7	12	316
2006	11.8	55.4	11	320
2007	10.4	53.2		206

Source: BIM

Stat. annex 9.2 Ireland - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	1.2	2.9		
1997	1.2	2.9		
1998	1.2	3.3		
1999	1.1	3.1		
2000	1.1	2.7		
2001	0.7	2.0		
2002	0.9	2.6	9	52
2003	1.1	2.3	7	35
2004	0.9	2.1	8	25
2005	0.9	2.4	7	16
2006	1.0	2.7	7	25
2007	0.8	2.0		21

Source: BIM

Stat. annex 9.3 Ireland - National overview – shellfish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	19.0	13.2		
1997	21.9	14.9		
1998	25.2	20.1		
1999	23.5	21.6		
2000	31.1	21.5		
2001	35.9	27.9		
2002	37.7	37.9	250	1,803
2003	44.7	41.8	232	1,988
2004	43.1	43.6	214	1,446
2005	47.5	48.7	234	1,425
2006	44.7	63.2	218	1,722
2007	41.3	59.3		1,800

Source: BIM

Stat. annex 9.4 National overview – Nurseries and hatcheries [a]

	Volume of production (mln juveniles)	Value of production (mln Euro)	Number of companies	Employment
1996	0	0		
1997	0	0		
1998	0	0		
1999	n/a	2.6		
2000	n/a	4.4		
2001	n/a	2.9		
2002	n/a	4.8	20	79
2003	n/a	2.0	15	70
2004	n/a	2.3	16	69
2005	n/a	2.5	16	69
2006	n/a	3.4	12	56
2007		2.7		54

Source: BIM

[a] The value of smolts sold internally are not added to the value of the sector

Stat. annex 9.5 Review by sub-sector and species (value and volume), 2006

	Volume (1000 t)	Value (million Euro)	Number of companies/ Operators	Types of on-growing unit	Employ ment
Mariculture (marine fish) [a]					
Salmon	11.2	52.7	7	Pens/cages	273
Trout	0.5	2.4	4	Pens/cages	47
Freshwater fish culture					
Trout	1.0	2.6	5	Racew./ponds	25
Other (specify) [b]	0.04	0.2	2	Recirculation	15
Molluscs and crustaceans					
Mussels	23.6	35.8		On-bottom	323
Mussels	9.7	7.2		Off-bottom	434
Oysters (gigas and native)	6.9	16.6	124	On-bottom	863
Scallops	0.04	0.2	9	Lines	42
Other (specify) [c]	0.2	1.6	12		60
Other					
Hatcheries / Nurseries (Salmon smolt) [d]		3.4	12		57

Notes: [a] Furthermore a small quantity of Arctic char is produced, but too small to disclose; [b] Includes Perch; [c] Includes 80% clams, 20% abalone and urchin; [d] The value of smolts sold internally are not added to the value of the sector.

Stat. annex 9.6 Ireland - Indicators by segment, 2006 [a)]
(segment totals, value in million Euros)

On-growing technique	Cages	On-bottom	On-bottom	Off-bottom	Hatcheries
Species	Salmon	Oysters	Mussels	Mussels	
Environment					
OPERATIONS – COSTS AND REVENUES					
Turnover total	52.70	14.60	35.80	7.20	3.40
Other income	0.24	0.11	0.00	0.06	0.02
Personnel costs	2.59	1.32	2.38	0.78	0.21
Value of unpaid labour	na	na	na	na	na
Energy costs	0.05	0.25	3.00	0.17	0.11
Live raw material costs	1.99	2.84	14.01	0.07	1.27
Feed raw material costs	28.63	1.44	0.71	0.20	0.26
Repair and maintenance	0.07	0.34	0.17	0.22	0.07
Other operational costs	11.36	3.85	4.37	2.23	1.12
Depreciation	2.15	1.86	2.73	0.48	0.10
Profit (EBIT)	6.11	2.81	8.43	3.11	0.28
Interest costs	0.49	0.10	2.48	1.23	0.02
Gross cash flow	8.25	4.67	11.16	3.59	0.38
Gross value added	11.34	6.09	16.02	5.6	0.61
BALANCE SHEET – ASSETS AND LIABILITIES					
Net investment in tangible goods	10.46	14.67	8.97	2.61	0.69
Equity capital	12.13	10.20	21.77	7.89	0.95
Debts	33.86	22.25	27.35	6.81	2.31
Total assets	45.83	33.16	43.08	12.86	3.19
EMPLOYMENT					
Total number of persons employed	273	863	323	434	57
Full time equivalents (FTE)	159	354	229	269	41
LEGAL STATUS					
Total number of firm	na	na	na	na	na
Single holder	na	na	na	na	na
Limited and anonymous co.'s	na	na	na	na	na
SALES VOLUME					
Volume in (1000 tonnes)					
OTHER DERIVED INDICATORS					
Turnover / FTE (1000 Euro)	333.0	41.6	156.3	27.0	83.4
Gross value added / FTE (1000 E)	71.3	17.2	70.0	20.8	14.9
Personnel costs / FTE (1000 Euro)	16.3	3.7	10.4	2.9	5.1
Tonnes / FTE (tones)	na	na	na	na	na
Turnover / firm (1000 Euro)	na	na	na	na	na
EBIT / Total assets (%)	0.13	0.08	0.20	0.24	0.09

[a)] Extrapolation from sample to population of all financial variables is based on the formula:
Value population = value sample * (average turnover population / average turnover sample)

Stat. table 9.7 Ireland - Sales by segment and species, 2006

	Species	Volume (1000 tonnes)	Value (million Euro)
Cages	Salmon	11.2	53.7
On-bottom (bags & tretles)	Oyster	6.9	16.6
On-bottom	Mussels	23.6	35.8
Off-bottom (ropes)	Mussels	9.7	7.2
Hatcheries	Salmon smolt		3.4

10. ITALY

10.1. Situation in 2006-7

A survey of the Italian aquaculture sector carried out in 2006 identified 715 companies employing 7,764 people with a full-time equivalent of 5,250 units[31].

The 2-year period 2006-7 was also characterized by a modest increase in the production levels of Italian aquaculture. In fact production during 2007 was 247,200 tonnes, registering an increase of 2% due in particular to the increase in clam production. In terms of gross saleable production, the value registered an increase of 4% worth 654.8 million Euro.

10.2. Main trends

The increase in production which has characterized the positive trend in Italian aquaculture over the last ten years was supported by both the consolidation of production in tanks and by the development of off-shore fish farming techniques. The only exception is the decrease in the amount of freshwater species.

The segment of freshwater species represents the traditional production division of national aquaculture. The freshwater segment is characterised by small and medium-sized companies, often family-run businesses. The sector employs about 900 FTE. This segment reached a peak in production of 56,100 tonnes in 1997. In quantitative terms, production actually decreased progressively until 2003 when, after a modest recovery in production, the present level of 45,400 tonnes was reached. Nevertheless, it is to be noted that gross saleable production reached a value of 162.2 million Euro and registered an increase over the decade. This trend is principally due to the production and sale of fresh trout which is the main sub-segment in the freshwater species division. In terms of analysis of the product cycle, fresh trout is thus confirmed to be in a mature phase of the production cycle. In this context, the recent slow recovery in production is due to the process of product innovation which, besides being sold fresh, has recently been commercialised in different forms of packaging of the processed product.

Companies in the saltwater segment are mostly joint-stock companies with average annual production over 100 tonnes per production unit. It is estimated that the number employed within this sector is around 926 FTE. The segment for saltwater has been characterised by a progressive positive trend where production has increased to reach 29,770 tonnes in 2007. The gross saleable production has shown a similar trend which went from 106.2 million Euro, in 1997, to 198.6 million Euro in 2007. This sector produces mostly seabass and seabream which reached production levels of 19,700 tonnes, corresponding to a value of 134 million Euro. It is also to be noted that some installations, specialised in the farming of seabass and seabream, have diversified their production to include the farming of innovative species (*Diplodus sargus* -White seabream, *Puntazzo puntazzo* -Sharp-Snout seabream, *Ombrina cirrosa* –Umbrine, *Dentex dentex* –Dentex). These species have reached production levels of 5,370 tonnes. In this context, eel farming, with a production of 1,700 tonnes, has gradually lost importance. In fact, the production performance of eel farming increased to a peak of 3,000 tonnes in 1999 to then fall to an all-time low in 2003 (1,450 tonnes). This situation is due both to the difficulty in obtaining new stock and to the slowdown in the demand from the main markets of reference in central and northern Europe.

The shellfish segment is composed of fishing co-operatives and their consortiums which operate through a government grant aimed at the management of a marine area. In this context, those employed operate as members of a co-operative and it is estimated that they are around 3,347 FTE.

Production is characterised by the predominance of two species: mussels and clams. The overall positive trend is a consequence of a fluctuating trend in production. These are, in fact, affected by natural

[31]The total number of people employed is subdivided in 4,747 full-time and 3,017 seasonal workers. The survey showed that a seasonal worker is employed for an average of 2 months. The FTE is then estimated considering this assumption.

conditions in the sections of water where the farms are installed, where production levels are affected both by meteorological trends and by the sporadic phenomena of epidemics. Such a phenomenon was evident in the year 2003 when production fell to 125,000 tonnes. Subsequently the slow recovery in production brought the quantity of production up to the average annual level which fluctuates around 170,000 tonnes. In terms of gross saleable production, it is to be pointed out that, production levels being equal at the beginning and end of the period 1996/2007, the value has doubled from 150.3 million to 306.5 million Euro. This performance is mainly due to the increase in the average price of clams.

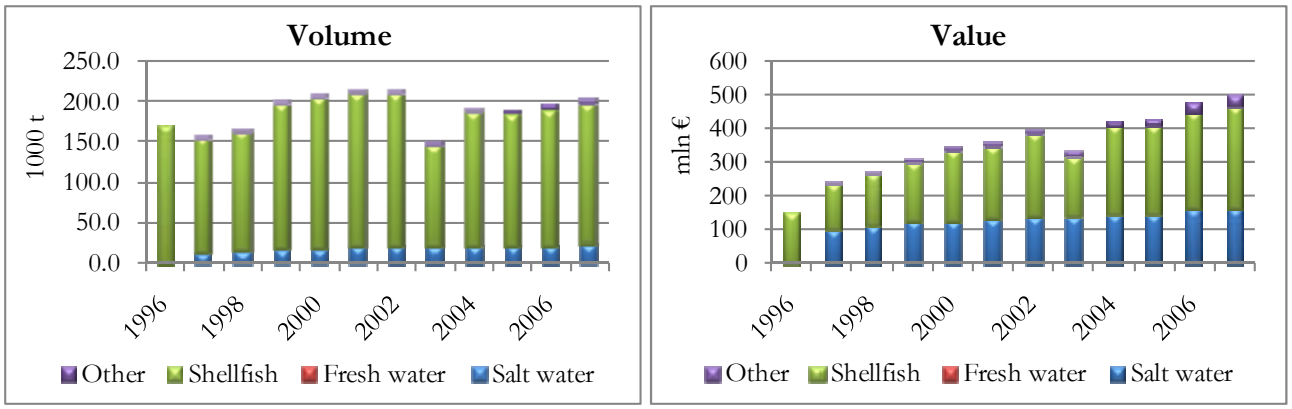

Figure 10.1 Italy - Volume and value of aquaculture production, 1997-2007

10.3. Structure of the sector

The analysis of the structure of the sector was based on the elaboration of data from a census which considered all installations present in all companies which in some way are involved in the aquaculture sector. Considering such a broad spectrum as the starting point and the intention of defining the universe of active companies, the database first needed to be updated. With this aim, as a preliminary step, all installations which had not carried out activities during 2006 were eliminated. The double records of companies which managed more than one installation were also eliminated. In this way the number of active companies to be included in the population to be analysed could be defined. On the basis of this updating, the population of active companies reached 715 units.

Table 10.1 Italy – Main segments of the national aquaculture sector

Group of species	On-growing technique	Number of firms in population
Freshwater		*284*
– Trout	T&R	226
– Sturgeon	T&R	6
– Carp	Pnd	8
– Catfish	Pnd	16
– Trout (Hatcheries)	T&R	6
– Ornamental fish	T&R	18
– Others	Pnd	4
Saltwater		*113*
– Seabream/Seabass	T&R	41
– Seabream/Seabass	Cgs	34
– Seabream/Seabass	E&P	17
– Seabream/Seabass (Hatcheries)	T&R	2
– Eel	T&R	16
– Others	T&R, Cgs	3
Shellfish		*318*
– Mussel	Off-b	224
– Clam	On-b	94

The segmentation of these units, based on the species farmed and the farming technology used, made the analysis of the structure of divisions of fish and shellfish farming possible. Fish farming involves 397 companies which raise both freshwater and saltwater species. Since the farming of a single species is rare, the companies could be subdivided on the basis of association species/farming technique, considering the predominant species. Among freshwater species, companies farming trout in tanks accounted for 84% with a total of 226 units. The companies are small or medium-sized family-run operations and, in many cases, are integrated within agricultural farms. Production capacity is less than 200 tonnes on average and they usually manage their own fry banks. In fact new stock is usually produced in the same installation and raised to commercial size. The production of other freshwater species, such as catfish, sturgeon and carp, is similar, with farming based on the supply of spawn from small fry banks within the individual farms, or imported. Among the freshwater species the traditional farming of catfish is geographically concentrated in Emilia Romagna where businesses operate with low-level technology and limited biomass capacity per surface unit, mainly destined for sports fishing. Carp farming, which has gradually declined to a total of 8 productive companies, completes the group of traditional species. In the group other fish are also included tench and chub which have marginal relevance.

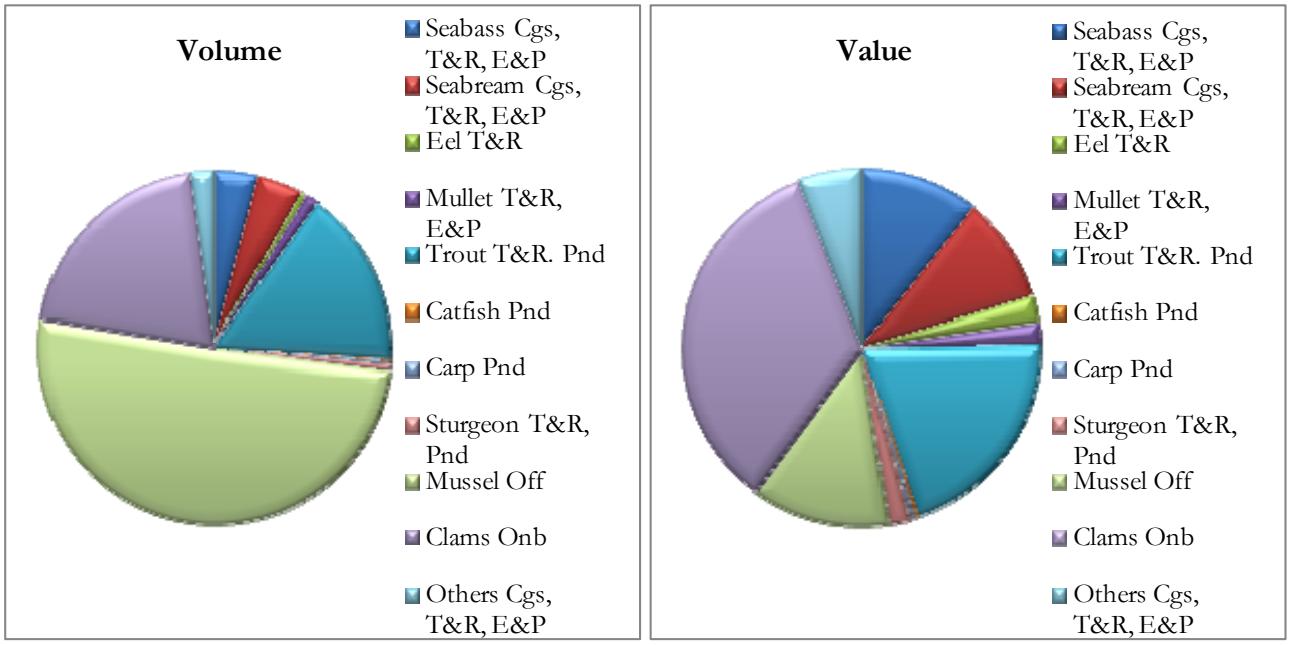

Figure 10.2 Italy - Composition of volume and value of aquaculture production by species and on-growing technique, 2007

As regards saltwater species, farming techniques are further differentiated: traditional farming in enclosed waters has gradually been overtaken by the presence of farming in both tanks and cages. This process has been favoured by the development of seabass and seabream farming which represent the main production division. The farming of species such as eel, mullet and umbrine represents less than 17% of the total volume.

Seabass and seabream farming installations guarantee a coverage of 83% of saltwater production[32], farmed from 92 companies.

The modern installations on land allow a high stocking density of (30-50 Kg/m³) with elevated water changes thanks to the use of pure oxygen. Different types of cages are in use: floating or buoyant, sunken and submersible. In general the productivity per volume unit in cages reaches 18-30 Kg/m³. Both segments, considering the high investments of capital necessary to develop these activities, show a consistent presence of joint-stock companies. Among medium and large-sized farms, the vertical integration of the production process is common: the presence of fry banks in the farming installations

[32] The total production includes quota regarding some other saltwater species: white seabream, sharp-snout seabream, dentex, turbot, sole.

guarantees supply for both internal use and the supply of fry to farms which are not equipped with reproduction installations.

Techniques in the eel farming sector have also been modified over time and the use of tanks has replaced farming in water enclosures. The number of companies involved in this kind of farming has shrunk to 16 units. Most of the companies have an average production capacity less than 30 tonnes. About 90% of production is concentrated in the three +main companies.

The raising of ornamental fish is recent and concentrated above all in Emilia Romagna, with 12 out of the 18 companies located there. Two main species of ornamental *ciprinidi* are produced:

- Goldfish (*Carassius auratus* L.)
- Koi carp (*Cyprinus carpio*)

As regards shellfish farming, mussels and clams are the most important species. The 318 shellfish farming companies, in most cases, farm a single product with the exception of those situated in lagoon areas where clam farming is often combined with mussel farming. There are 224 mussel farms using mainly long-line. The mussel farmers are organized in co-operatives. The mussels are raised in bags suitable to the size of the shellfish; the bags are hung on long lines held in suspension by a series of floats (a sea farming technique known as long-line), or hung on stakes sunk into the sea bed (coastal or lagoon stake system).

The 94 clam farming companies all use on-bottom techniques in water enclosures. Co-operatives also dominate in the case of clam farming but, at the same time, the presence of co-operative consortiums is to be noted. This latter type of organizational structure has been shown to be practical in the rationalisation of the management of the phases of sowing and harvesting of natural resources. Clam farming, in fact, has gained its own experience from the fishing world and the correct management of resources implies planning both from the period of spawning and that of fishing. The spawning is done exclusively in the areas given in concession by the co-operative or consortium. In the same way the harvest is carried out on the basis of a specific daily plan, where areas and harvest quantities are defined.

In consideration of the synthetic analysis of the structure of the Italian aquaculture sector and the subsequent highlighting of the predominant production divisions, the field survey was carried out on a sample of the following main combinations of species and on-growing techniques:

Table 10.2 Italy - Structure of the survey

Species	On-growing technique	Number of firms	Sample
Trout	T&R	226	16
Seabass & seabream	T&R	41	3
Seabass & seabream	Cgs	34	2
Seabass & seabream	E&P	17	2
Clams	On-B	94	7
Mussels	Off-B	224	16
TOTAL		636	46

These main combinations account for 95% of the total production and 88% of the gross saleable production. No survey results are reported for the eel farming sector because, even though the universe is composed of 16 companies, most production is concentrated in three companies and production is limited to 0.6% of national volume.

10.4. New developments

New marine species are being introduced: white bream, umbrine, turbot, sole and tuna. Experimental stage of techniques for farming white bream and umbrine is finished. For both species controlled reproduction techniques are available which are sufficiently reliable to provide an adequate supply of fry in

relation to market demand for consumption size. Production is essentially carried out both in tanks on land and cages at sea. Umbrine farming has reached a production of 370 tonnes in 2007.

Farming turbot and sole, is in an experimental stage. In particular, as regards the reproduction and early stage of raising sole (*Solea solea*), a sufficiently reliable technique has been perfected for the production of fry. The subsequent farming phases to commercial size are in the advanced stage of experimentation.

Bluefin tuna farming has recently been developed. In Italy, in 2006, there were nine active installations, all in three regions in the south of the peninsula, with a concentration of production capacity of 51% in Sicily. Tuna farming is basically tied to the availability of wild fish caught when small or medium-sized. These are then stocked and reared in large cages (several million cubic metres), for short periods (2 - 6/7 months), until a suitable commercial size is reached, to be put on the market when the fished wild tuna is not available. The limits which directly influence the development of tuna farming are represented, on one hand, by the choice of the site of the installation and, on the other, by the difficulty of producing artificial feed. Further indirect restrictions to the development of tuna farming are related to the negative impact on other economic activities, like tourism and maritime traffic (navigation), in the same marine areas.

10.5. Economic performance

10.5.1. Surveyed segments

The analysis of the economic performance is based on the results of the sample survey carried out within the six production segments which characterise Italian aquaculture, as reported in Stat. table 10.7.

Trout in raceway and tanks

The Italian trout farming reached in 2006 a turnover of 116 million Euro. This is mainly due to the sale of the fresh product which represents 77% of gross saleable production in the freshwater sector.

The cost of feed, accounts for 42% of operation costs. Fattening is the most important phase in the production process, of the companies in this sector are vertically integrated, having their own hatcheries to keep down the cost of buying fish for spawning to 11%. In this phase of progressive rationalization of the production structure, marginal companies have left the sector and only the more solid ones have managed to maintain market shares which guarantee an adequate level of profit.

In terms of profitability, the ROE is 8.5% and the profitability of venture capital is also favoured by the difference between the ROI and the ROD[33]. This difference is 0.55 and emphasizes that the resort to loan capital continues to be convenient since the financial costs are covered by an adequate income level.
Small companies managed by a single owner are typical in this sector. The average turnover is 514,402 Euro and the EBIT is shown to be 25,359 Euro. Faced with a low sales price for trout, the prospects of profit in the sector are dependent on diversification of the product. The sale of fresh trout is in the mature phase of the life cycle of the product and the profit margins could come from product innovation. The sales of the fresh product include an increasing share of filets.

In terms of future outlook, recent surveys have shown a growing consumer interest in "Biological trout" for which a premium price of 2.6 Euro/kg can be obtained in comparison with conventional trout (3.3 Euro/kg).

Seabass, seabream in raceways and tanks

At present the turnover of this segment represents 63 million Euro. The cost structure of the segment is characterized by a high "other operational costs" where the external services dominates. This reflects the

[33] ROE: Return on Equity, ROI: Return on Investment , ROD: Return on Debts (ROI- ROD), ROA: (EBIT/Total assets)

tendency to outsource and achieve greater operational flexibility and the costs of personnel remain at a relatively low 24% of total operational costs.

The profitability of the segment has stabilized at an ROE of 4 %. In the majority of cases the companies in this segment are managed by joint-stock companies as the start-up investments for this type of activity are substantial and, on average, amount to 1.6 million Euro per company. The segment is progressively losing its market share to the segment using cages. In terms of outlook in the medium and long-term the companies in the segment must conform to the requirements of environmental regulations which place ever-increasing restrictions during the setting-up of activities. It is foreseeable that the segment will face a further phase of consolidation of the more efficient companies and the consequent elimination of marginal sites.

Seabass, seabream in enclosures and pens

The extensive raising of seabass and seabream represents a niche segment in the production of saltwater species. The importance of this sector is based on the quality of production which meets all the requirements of organic aquaculture. The turnover amounts to 3.4 million Euro. In some cases the areas of lagoon farms are managed by fishing co-operatives who complement their income from fish farming with traditional fishing activities.

The personnel costs are most important accounting for 72% of operational costs. The costs of maintenance and repairs amounts to 6%. Such kind of expenses need to preserve the lagoon environment and to favourite natural fish fattening in lagoon area. Feeding is limited to certain occasions during the so-called period of hibernation when the fish are transferred from the lagoon in tanks at controlled temperatures. Spawning of already fattened individuals (30/50 gr.) is also utilized by certain companies which combine the natural re-population of the stock with the acquisition of modest quantities of fish for spawning.

In the presence of such unique production conditions, lagoon farming shows interesting levels of profitability. The ROE is shown to be 16%, since the amount of equity capital invested in the company reaches an average value of 50,422 Euro.
The average turnover is 206,087, Euro and highlights the presence of small companies. The profitability of the activity is positive as the ROA indicator (EBIT/Total Assets) is 2.45%. The competitive advantage of these companies is due to the management authorization of the marine areas where, having assumed the responsibility of maintaining and preserving the environment, the companies can fish in the area under concession. Thus the outlook for development of the extensive farming of seabass and seabream is conditioned by both the limited availability of suitable sites and the issue of concessions for the management of marine areas. This segment might be able to continue to maintain its own niche on the market emphasizing the qualitative aspects of production rather than by increasing quantity.

Segment 4 – Seabass, seabream /Cage

The farming of seabass and seabream in cages has developed over the last decade. Sales from this segment have at present reached a turnover of 42 million Euro and reflect an important presence in a market characterized by an aggressive price policy, applied especially by Greek producers. In this market situation the profit margins are under pressure and competition concentrates on costs of production. The companies manage to reach a ROE of 15% which illustrates the good position of this production segment in a market where both national and foreign competitors are present.
The dominant presence of joint-stock companies is typical of this production segment and they represent 93% of the active firms. On average, a company farming seabass and seabream in cages reaches a turnover of 1.2 million Euro and an average EBIT, of 178,263 Euro. Nonetheless, the companies in the sector are threatened by competition from exporters who in the past (in 2001) have caused a fall in the average sales price, to below the 6 Euro/kg. The outlook for the consolidation of the segment depends, on one hand, on the increase in productivity, currently at 18 tonnes/FTE and, on the other, on the strengthening of

commercial agreements with the hypermarkets which can guarantee continuity to the potential increase in supply.

Mussels - off-bottom

Mussel farming is characterized by a wide distribution of installations all along Italian coasts which use technology suitable for the exploitation of the open sea. In 2006 the total turnover of the segment reached 79 million Euro.

Many co-operatives, bringing together individual producers, are shown to operate in the sector. The labour cost is the main item in the operational costs, accounting for 64%. This is a labour-intensive activity where other costs are only marginal. The most important among these is the cost of seeds to be "embed" along the rows of long-line, which represents 10% of operational costs.

Companies in the mussels / off-bottom segment have an average turnover of 352,971 Euro and ROE is 2%. Notwithstanding, a labour productivity of 61 tonnes/FTE, the Turnover/FTE amounts to 39,990 Euro. This low level is due to the average sales price which is limited to 0.65 €/kg. At the same time the value of ROA (Ebit/total assets) is limited to 0.37%. The situation is made worse by a negative difference between the ROI and ROD, underlining a level of financial costs which absorbs the gain from investments.

Clams - on-bottom

Clam farming in Italy is a relatively recent activity which coincided with the introduction in the spring of 1983 of Asian veracious clams (*Tapes philippinarum*). This Asian variety was preferred to Mediterranean clams (*Tapes decussatus*) because it is more resistant to changes in salinity and temperature and, over a brief period, has proved to be much more profitable as regards extensive farming on lagoon bottoms. This segment is characterized by the co-operatives which manage state areas obtained through grants. The management of these state areas relates to the farming in that a phase of seeding is required followed by the the harvest on the basis of the state of growth of the biomass. The present organizational structure of the segment has developed through the introduction of a self-governing system which has strengthened the co-ordinating role of the co-operatives. They establish harvesting days, daily quantity of clams to harvest, size of clams, allowed equipment and procedure for quality control.

The co-operatives are made up of members/producers whose labour represents the most important cost item, accounting for 56% of operational costs. The co-operatives and their consortiums, co-ordinate the production activity and buy, at a cost of 19% of operational costs, the seed taken from the nursery and distribute it in the areas granted to them. In the following phase, having regulated the harvest of members/producers, they collect the production and send it first to depuration centres and then take care of the distribution to wholesalers. The growth of the resource occurs naturally and does not require any feeding and related cost.

This segment reaches a total turnover of 208 million Euro. The high value, 20.93%, of the ROA indicator (EBIT/Total assets), shows a positive profit situation, due to a low level of investments.

10.6. Statistical tables

Stat. table 10.1 Italy - National overview – Saltwater fish farming

	Volume of production (1000 t)	Value of production (Euro million)	Number of companies	Employment (FTE)
1996	NA	NA	na	na
1997	15.7	106.2	na	na
1998	18.8	118.4	na	na
1999	21.5	135.2	na	na
2000	22.3	133.3	na	na
2001	25.4	140.1	na	na
2002	26.1	146.7	na	na
2003	26.3	153.9	na	na
2004	26.5	160.7	na	na
2005	27.1	165.4	112	1,044
2006	29.1	193.4	111	976
2007	29.8	198.6	na	na

Stat. table 10.2 Italy - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (Euro million)	Number of companies	Employment (FTE)
1996	NA	NA	na	na
1997	53.0	113.5	na	na
1998	49.8	153.2	na	na
1999	45.9	141.6	na	na
2000	46.3	147.1	na	na
2001	46.1	138.5	na	na
2002	43.5	131.8	na	na
2003	40.4	124.2	na	na
2004	41.4	128.8	na	na
2005	42.1	131.4	290	916
2006	42.8	147.3	278	902
2007	42.4	149.7	na	na

Stat. table 10.3 Italy - National overview – shellfish farming

	Volume of production (1000 t)	Value of production Euro)	Number of companies	Employment (FTE)
1996	170.3	150.3	na	na
1997	143.0	135.8	na	na
1998	148.0	155.9	na	na
1999	180.0	177.1	na	na
2000	189.0	217.4	na	na
2001	190.0	222.2	na	na
2002	190.0	252.8	na	na
2003	125.0	179.9	na	na
2004	165.0	265.3	na	na
2005	165.0	265.3	323	3,782
2006	170.0	288.3	318	3,347
2007	175.0	306.5	na	na

Stat. table 10.4 Italy - National overview – Nurseries and hatcheries

	Volume of production (million juveniles)	Value of production (Euro million)	Number of companies	Employment (FTE)
2006	na	na	8	24
2007	na	na	na	na

Stat. table 10.5 Italy - National overview – Bluefin tuna sector

	Volume of production (1000 tonnes)	Value of production (Euro million)	Number of companies	Employment (FTE)
2005	1.8	19.1	5	41
2006	-	-	9	50
2007	na	na	na	na

Source: ICCAT/Idroconsult ltd

Stat. table 10.6 Italy - Review by sub-sector and species (value and volume). 2007

	Volume (1000 t)	Value (mln Euro)	Number of companies	Types of on-growing unit	Employment (FTE)
Mariculture (marine fish)					
- Seabream & Seabass	19.7	134.0	92	Cgs. T&R. E&P	871
- Eel & Mullet	4.7	27.8	16	Pnd. T&R.	55
- Others (*Dentex dentei, Puntazzo puntazzo*)	5.4	36.8	3	Cgs. T&R. E&P	50
Freshwater fish culture					
- Trout	39.7	132.5	226	T&R. Pnd	641
- Sturgeon	1.35	12.2	6	T&R. Pnd	261
- Carp	0.75	1.9	8	Pnd	
- Catfish	0.55	3.1	16	Pnd	
- Others (*Tinca tinca, Leuciscus cephalus*)		4		Pnd	
Molluscs and crustaceans					
- Mussel	125.0	81.5	224	Off-b	1,970
- Clam	50.0	225.0	94	On-b	1,365
Other organisms (ornamental fish)	0.024	NA	18	T&R	286
Trout Hatcheries	NA	NA	6	T&R	11
Seabass Hatcheries	NA	NA	2	T&R	13

Stat. table 10.7 Italy - Indicators by segment (segment totals. value in million Euro). 2006

On-growing technique	R&T	R&T	E&P	Cgs	Off Bottom	On Bottom
Species	Trout	Seabass/br	Seabass/br	Seabass/br	Mussel	Clam
Environment	Freshwater	Saltwater	Saltwater	Saltwater	Saltwater	Saltwater
OPERATIONS – COSTS AND REVENUES						
Turnover total	116.3	63.0	3.4	42.2	79.1	207.9
Other income	3.6	7.7	0.4	4.5	1.8	10.9
Personnel costs	18.8	14.7	2.6	11.5	49.1	120.4
Value of unpaid labour	0.9	1.1	0.1	1.1	1.1	0.00
Energy costs	11.1	3.2	0.2	1.6	5.7	38.7
Live raw material costs	11.8	8.2	0.1	8.9	7.7	40.6
Feed raw material costs	45.6	11.9	0.1	8.2	0.0	0.00
Repair and maintenance	2.0	0.3	0.2	1.2	6.8	0.00
Other operational costs	17.6	20.9	0.4	4.1	6.1	14.6
Depreciation	7.3	9.0	0.1	5.3	4.1	1.8
Profit (EBIT)	4.9	1.5	0.1	4.9	0.3	4.7
Interest costs	5.7	2.5	0.1	0.7	1.2	0.5
Gross cash flow	17.8	12.9	0.3	10.9	5.5	6.9
Gross value added	36.6	27.6	2.9	22.5	54.6	127.3
BALANCE SHEET – ASSETS AND LIABILITIES						
Net investment in tangible goods	149.9	65.7	1.7	55.9	42.1	2.4
Equity capital	57.0	37.1	0.9	32.4	10.7	3.4
Debts	211.9	111.7	4.7	87.6	48.8	14.0
Total assets	279.6	151.7	5.6	36.8	72.7	22.4
EMPLOYMENT						
Total number of persons employed	697	561	94	374	3,169	2,412
Full time equivalent (FTE)	641	454	78	339	1,977	1,370
LEGAL STATUS						
Total number of firm	226	41	17	34	224	94
Single holder	170	13	6	3	94	22
Limited and anonymous cos.	56	28	11	31	130	72
SALES VOLUME						
Volume in (1000 tonnes)	35.2	9.1	0.3	6.1	121.6	45.2
OTHER DERIVED INDICATORS						
Turnover / FTE (1000 Euro)	181.4	138.9	43.8	124.6	39.9	151.8
Gross value added / FTE (1000 Euro)	57.1	60.9	36.9	66.3	27.6	92.9
Personnel costs / FTE (1000 Euro)	29.3	32.3	33.1	33.9	24.8	87.9
Tonnes / FTE (tonnes)	54.9	20.1	4.3	18.0	61.5	33.0
Turnover / firm (1000 Euro)	514.4	1,537.6	200.9	1,242.3	352.9	2,212.5
EBIT / Total assets (%)	1.7%	1.0%	2.5%	3.5%	0.4%	20.9%

11. LITHUANIA

11.1. Situation in 2006-7

The total number of private aquaculture enterprises in Lithuania is 18 units (mainly small) and there are around 50 farmers who have ponds. The main aquaculture producers are aquaculture enterprises. The enterprises usually produce only fish, but they also sell licenses for anglers to fish in their ponds, or provide some service for anglers (e.g. sell fishing tools and bait, provide accommodation and meals). The total volume of production during 2006-7 increased by about 52% and in 2007 has been 3,378 tonnes. The total value of production increased by 36% and in 2007 amounted to about 6.8 million Euro. The total number of people engaged in aquaculture enterprises in 2007 was 356.

11.2. Main trends

During last 10 years aquaculture production in Lithuania has increased almost by 45% from 1,537 tonnes in 1996 to 2,225 tones in 2006. But the production is still bellow the level of 1990. The value of production during the same period has increased more than 2.9 times – from 1.7 million Euro in 1996 to 4.9 million Euro in 2006.

As the main produced fish specie was carp and the fluctuations in volumes of production have been usually compensated by the price.. So the value of production has been increasing constantly while the volume of production is not so stable from year to year.

The number of people employed in aquaculture in 2006 was 356 and increased by 56% since 2000.

During last 10 years more and more attention is given to reproduction of fish resources in inland waters. Annual governmental programs for the release of fishes in State-owned not rented inland waters are approved. The main body responsible for their implementation is the Lithuanian State Pisciculture and Fisheries Research Centre. Every year about 140-210 million of juveniles and fish fry of various commercial and other rare or disappearing fish species are released into the inland waters.

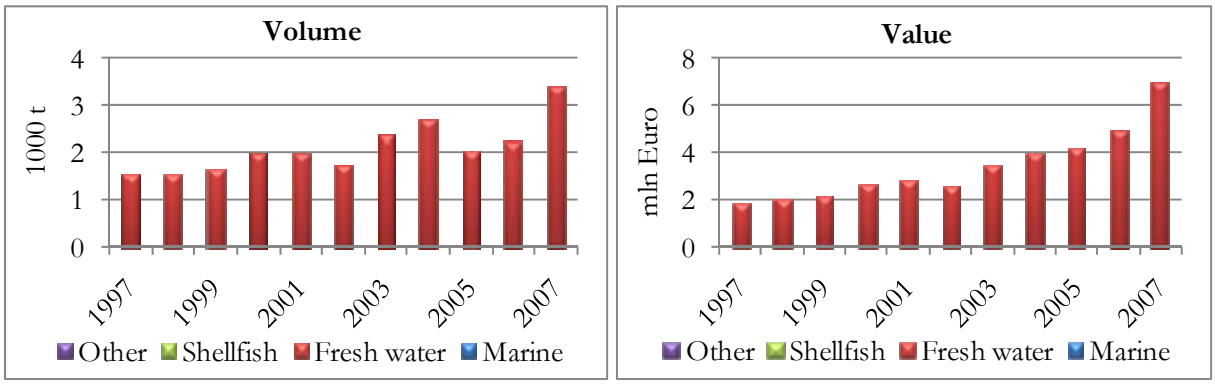

Figure 11.1 Lithuania - Volume and value of aquaculture production, 1996-2007

11.3. Structure of the sector

The Lithuanian aquaculture sector is mostly presented by carp ponds. The total production of this segment amounted to 3,378 t of freshwater fish species in 2007.

Total designed area of aquaculture ponds is 10,500 hectares; the designed aquaculture capacity is 5,000 tonnes of food fish per year. This capacity has been used less then 50% in previous years due to low demand for live carp in the internal market[34].

[34] V. Vaikutis, *Inland fishery,* Lithuanian agriculture and rural development 2006, LIAE, Vilnius, 2007 (in Lithuanian)

About 96% of production in 2007 was represented by carps. However, the aquaculture enterprises are widening their assortment to trout, sturgeon, catfish, pike, crucian carp, peled, etc. New trout and sturgeon breeding and growing units have been built recently. The percentage of other fish in the composition of production has risen from 3% in 2004, to 6% in 2006, but decreased to 4% in 2007.

8 of 18 aquaculture enterprise have their own hatchery and produce fry and juveniles for their own purpose.

There are 6 state-owned fish breeding hatcheries within the Lithuanian State Pisciculture and Fisheries Research Centre which produce this fish fry and juveniles for stocking and make studies in carp and crayfish breeding. These hatcheries are funded by the national government and rarely participate in the market. These hatcheries mostly produce fish fry and juveniles for restocking of natural waters. The total capacity of the Centre's ponds is about 600 hectares.

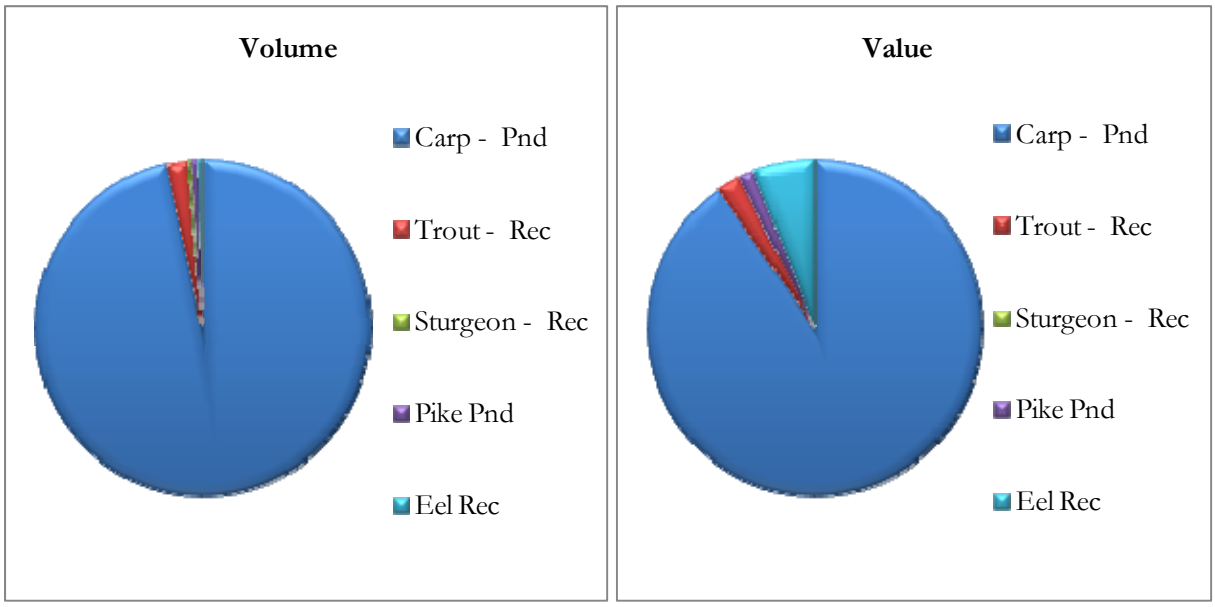

Figure 11.2 Lithuania - Composition of the volume and value of aquaculture production by species and on-growing technique, 2007

Table 11.1 Lithuania - Main segments of the national aquaculture sector

Group of species	On-growing technique	Number of firms in population
Carps	ponds	18
Eel	recirculation systems	1
Freshwater	hatchery	1

The only segment which has enough units in the population is carp ponds. They have been surveyed for the purpose of this study.

11.4.New developments

Organic aquaculture is growing rapidly among the aquaculture enterprises. There were 2,849 hectares of certified areas in 2003, 3,825 hectares in 2004, 4,728 hectares in 2005 and 5,169 hectares in 2006. There were 14 enterprises in 2006 that had certified their ponds. Organic aquaculture production accounted for about 39% of the total aquaculture production in 2006. The area of certified ponds in 2007 decreased by 4% (to 4,940 hectares), but the share of organic production rose by 0.5% of the total volume of organic production in 2007.

Re-circulation systems are rather costly and a new type of aquaculture for Lithuanian producers. It becomes more and more popular for production of valuable fish species as sturgeon, trout and eel in the

existing enterprises. However, the EFF support gives an opportunity to create new aquaculture enterprises in the sector. The production of the valuable fish species is rising.

11.5. Economic performance

11.5.1. Surveyed segments

Carp in ponds

During the 2002-2006 period the price of carp fluctuated from 1,390 to 2,172 Euro per tonne, the average cost of production – from 1,072 to 1,535 Euro per t. The costs of fish feeds accounted for about 32-35%, breeding material – 16-28%, labour costs – 13-14% of the total costs. Due to growth of salaries, fish feeds and other cost categories, the average cost of carp production has increased to 1,535 Euro per ton in 2006[35].

The increasing volume and value of production show the increasing intensity of using carp ponds. The profitability of carp production in 2007 was about 16%. The cost of fish feeds in the same year accounted for more than 50% of the total costs. This increase can be explained by the increased price for cereals in 2007. The personnel costs composed the other large part of the operational costs and accounted for about 20%. The expenses for live raw material accounted for 11% (See Stat. table 11.4).

The average turnover per firm in 2007 was about 386.4 thousand Euro. The personal costs – 94 thousand per firm, or 5.4 thousand Euro per FTE. The average salary in aquaculture is still below the average salaries in Lithuania.

There are no restrictions on entering to the aquaculture sector in Lithuania, as no legal restrictions to produce a certain amount of products. The only restriction for pond production is the capacity of industrial ponds. But as they are not fully used due to restrictions of the demand, there are no reasons for license trading and no intangibles in the sector. The only intangibles which could appear in the balance sheet is the computing costs and the costs for consultancies and business plans which could be ordered by firms. The survey and additional information collected confirmed this.

[35] V. Vaikutis, *Inland fishery,* Lithuanian agriculture and rural development 2006, LIAE, Vilnius, 2007 (in Lithuanian)

11.6. Statistical tables

Stat. table 11.1 Lithuania - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment a)
1996	1.5	1.7	18	
1997	1.5	1.8	18	
1998	1.5	2.0	18	
1999	1.7	2.1	18	
2000	2.0	2.6	18	228
2001	2.0	2.8	17	179
2002	1.8	2.6	17	282
2003	2.3	3.4	17	297
2004	2.7	4.0	18	333
2005	2.0	4.2	18	333
2006	2.2	4.9	18	440
2007	3.4	6.5	19	356

a) number of persons employed

Data sources: Eurostat, Fisheries Department under The Ministry of Agriculture of Lithuania, Department of Statistics to the Government of the Republic of Lithuania

Stat. table 11.2 Lithuania - National overview – nurseries and hatcheries

	Volume of production (mln juveniles)	Value of production (mln Euro)	Number of companies	Employment a)
1996	40.1		1 comp. 6 hatcheries	
1997	125.0		1 comp. 6 hatcheries	
1998	194.4		1 comp. 6 hatcheries	
1999	91.7		1 comp. 6 hatcheries	
2000	210.8		1 comp. 6 hatcheries	
2001	225.8		1 comp. 6 hatcheries	
2002	177.5		1 comp. 6 hatcheries	
2003	218.2		1 comp. 6 hatcheries	
2004	147.6	2.7	1 comp. 6 hatcheries	96
2005			1 comp. 6 hatcheries	
2006			1 comp. 6 hatcheries	
2007			1 comp. 6 hatcheries	

a) number of persons employed

Data sources: Evaluation of Lithuanian fish breeding/stocking and research system report, LIAE, 2005, Vilnius

Stat. table 11.3 Lithuania - Review by sub-sector and species (value and volume), 2007

	Volume (1000 t)	Value (mln Euro)	Number of companies	Types of on-growing unit	Employ-ment
Mariculture (marine fish)					
- Salmon					
- Seabream / seabass					
- Other (specify)					
Freshwater fish culture					
- Carp	3.2	6.2	18	Ponds	349
- Eel	0.0	n.a.	1	Re-circulation	n.a.
- Pike	0.0	0.1	18	Ponds	349
- Other	0.1	0.7	18	Ponds	349
Molluscs and crustaceans					
- Mussels					
- Oysters					
- Scallops					
- Other (specify)					
Other					
- Other organisms (specify)					
Hatcheries / Nurseries b)	141.8 c)	0.6	6	Ponds-hatcheries	87
– Salmon	0.15	0.1			
– Rainbow trout	0.0	0.1			
– Whitefish	2.13	0.0			
– Vendace	49.2	0.2			
– Pike	51.0	0.3			
– Tench	2.1	0.0			
– Burbot	35.3	0.1			
– Pikeperch	6.8	0.1			

a) 2004 data.
b) only 2004 data available.
c) Million units.

Stat. table 11.4 Lithuania - Indicators by segment, 2007

On-growing technique	Ponds			
Species	Carp			
Environment	Freshwater			
OPERATIONS – COSTS AND REVENUES				
Turnover	7.0			
Other income	0.4			
Personnel costs	1.7			
Value of unpaid labour	0			
Energy costs	0.2			
Live raw material costs	0.6			
Feed raw material costs	3.0			
Repair and maintenance	0.1			
Other operational costs	0.3			
Depreciation	0.3			
Profit (EBIT)	1.1			
Interest costs*	0.1			
Gross cash flow	1.8			
Gross value added	3.5			
BALANCE SHEET – ASSETS AND LIABILITIES				
Net investment in tangible goods	0.8			
Equity capital	6.7			
Debts	3.0			
Total assets	18.8			
EMPLOYMENT				
Total number of persons employed	349			
Full time equivalents (FTE)	315			
LEGAL STATUS				
Total number of firm	18			
Single holder	1			
Limited and anonymous co.'s	17			
SALES VOLUME				
Volume in (1000 tonnes)	3.5			
OTHER DERIVED INDICATORS				
Turnover / FTE (1000 Euro)	22.1			
Gross value added / FTE (1000 Euro)	11.0			
Personnel costs / FTE (1000 Euro)	5.4			
Tonnes / FTE (tones)	11.1			
Turnover / firm (1000 Euro)	386.4			
EBIT / Total assets (%)	7.3			

* paid interest

12. THE NETHERLANDS

12.1. Situation in 2006

Total gross output from the Dutch aquaculture sector in 2006 was 127 million Euro, and the total volume was 100,000 tonnes. The aquaculture sector consisted of about 180 companies. The total number of persons employed in the shellfish fleet was 170 (FTE) The total number of people employed in the freshwater fish farms is estimated to be 160 (FTE). The number of people employed in the oyster sector was estimated to be 75 (FTE).

12.2. Main trends

Most of the total production of the Dutch aquaculture comes from the shellfish (60%) and the freshwater fish farming sector. There are three companies that produce marine fish but the production is quite small compared to these other two sectors. Hatcheries, ornamental fish farms and sea-vegetable farms are not included in figure 1 since no production data is available.

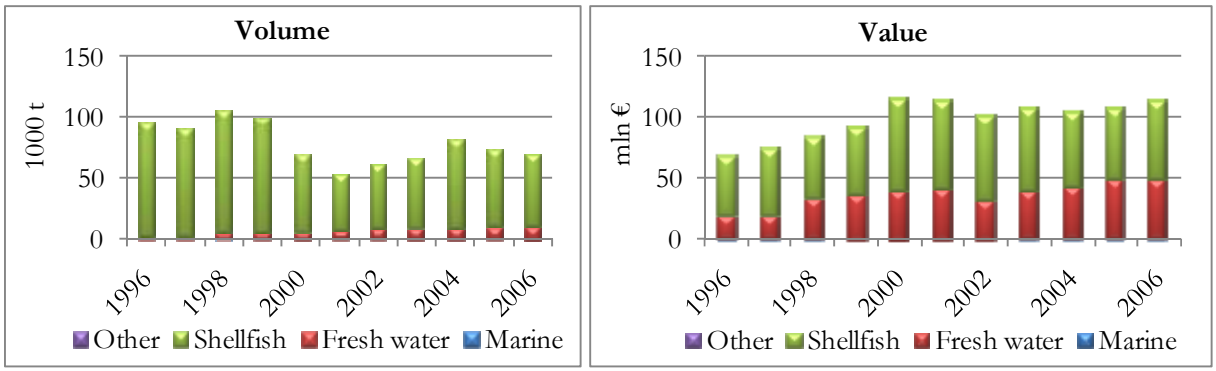

Figure 12.1 Netherlands - Volume and value of aquaculture production, 1996-2006

The production of freshwater fish has been steadily rising over the last 10 years, about 11% per year. Both volume and value of production in 2006 is about 4 times higher then the production 10 years ago. In 1996 about 3,000 tonnes of freshwater fish was produced, with a value of 19.7 million Euro. In 2006 about 11,000 tonnes of freshwater fish was produced with a value of 48.2 million Euro. European eel and North African catfish account for about 96% of the total freshwater fish production.

The production of shellfish farms consists of blue mussels and oysters. The production of oysters has been quite stable over the years (29 million pieces in 1999 versus 32 million pieces in 2006). However, the production of mussels has declined quite a lot since 1996. In 1996 92,000 tonnes of mussels were produced. In 2007 the production was only 36,000 tonnes, a decline of 60%. One of the reasons is a shortage of spat due to environmental restrictions on the catch of wild spat and a natural shortage of spat in the areas where catches are still allowed. A small part of the necessary spat could be imported from other countries like the UK and Ireland, but the sector must first prove that the ecological effects of importing this spat are negligible before the government will approve the import. Due to the shortage of spat the production of the sector is far lower than it could have been.

The value of mussel production fluctuates over time. In the period 2000-2003 the price per kg mussels was very high, thus the value of production was also quite high in these years even when the production of mussels in tonnes was low. In 2001 the production of mussels was just 42,000 tonnes. The total value of production, however, was one of the highest in the last 10 years.

In February 2008 fishing on spat in the Dutch Waddenzee was prohibited because its ecological effects have not been made clear. Since the Waddenzee accounts for 98%of the total spat catch in The Netherlands a ban on spat fishing will have severely negative consequences for the production of mussels in 2008.

12.3. Structure of the sector

All the freshwater fish farms and marine fish farms use recirculation systems. The shellfish farming companies mostly use on bottom growing systems, although a few companies also have started to use lines. Figure 2 shows that in 2006 most of the annual revenue in the aquaculture sector comes from the blue mussel farms and the farms producing European eel.

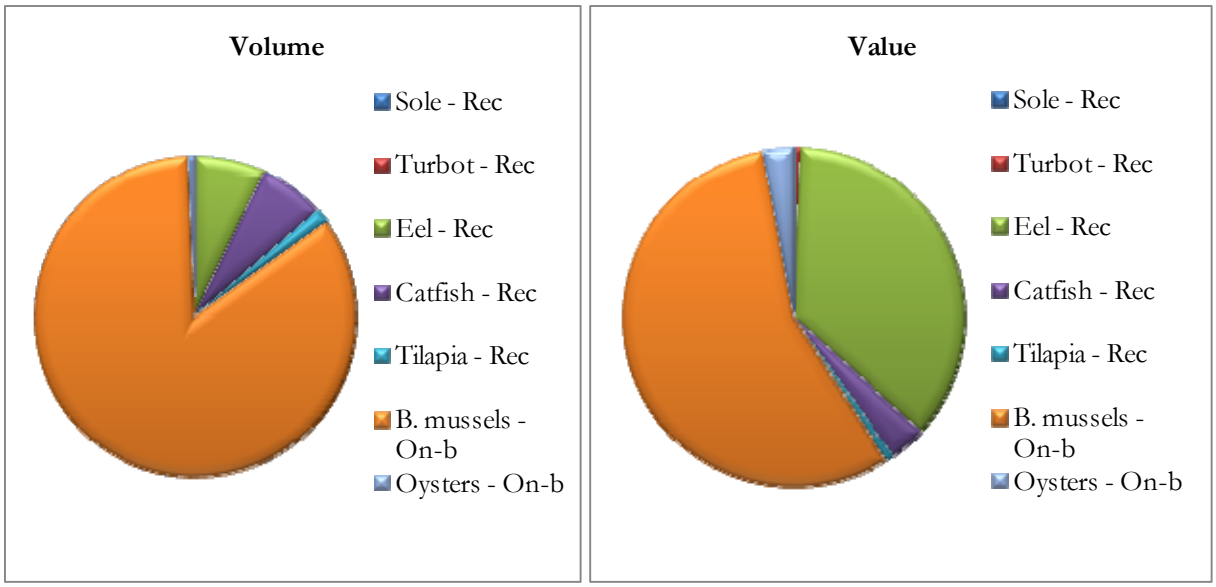

Figure 12.2 Netherlands - Composition of the volume and value of aquaculture production, 2006

Freshwater fish farming
The freshwater fish farming segment is relatively small. Total gross output of this segment in 2006 was 45 million Euro, and the total volume was 11,000 tonnes. About 100 companies operated in this segment. The total number of persons employed is estimated to be 159 (FTE).

European eel is the main fish species produced in the Netherlands. About 55 companies produced European eel in 2006. The total volume of European eel produced was equal to 5,000 tonnes with a total value of about 42 million Euro in 2006.

The second main species produced is the African catfish with a volume of 4,500 tonnes and a value of about 6.5 million Euro. 37 firms produced African catfish in 2006. Other species produced in the Netherlands in 2006 were tilapia, sole and turbot. Sole is only produced by one company at the moment, although the company has been trying to produce sole for some years, 2005 was the first year it produced sole commercially. Most of the Dutch fish farms are just producing one species, although at least one firm produced both European eel and North African catfish.

Several pig and poultry farms have started to produce fish on a small scale since the necessary growing conditions like a large covered space, good water supply, and sewage pits are readily available to them. Estimations show that about 35% of the eel farms and about 50% of the catfish farms only produce fish as a side activity.

Since 2005 there is one company which produces barramundi. This company was still in production in 2006.

Shellfish farming

The shellfish farming segment produces blue mussels and oysters. Total gross output in value from the Dutch shellfish farming sector in 2006 was 78 million Euro, and the total volume was 58,000 tonnes of mussels and 32 million pieces of oysters. As oysters are measured in pieces which can be of various sizes, it is difficult to translate pieces to tonnes. The mussel sector consists of about 50 firms that operate 56 vessels. About 170 persons (in FTE) were employed in the mussel fleet in 2007, including the owners of the vessels. Most of the crew members are working full-time. There are 32 companies that produce oysters, the employment in this sector is about 75 FTE. About half of these companies (17) also produce mussels.

Hatcheries

There are two active hatcheries. One of the hatcheries produces sole, the other produces African catfish fingerlings. There are also some fish farms which operate either a hatchery or nursery apart from their other activities. Estimations show that about 15% of the fish farms have a kind of in-company hatchery.

Ornamental fish and fish produced for sport fishing

There are a few ornamental fish farms, 10 in total in 2006. No data is available about the total production and employment of these firms.

Four fish farms produce trout. The total production of these firms is about 50 tonnes per year. Most of the produced trout is sold to sport fishery sector. 3 companies produce rag-worms which are mostly used as bait for sport-fisheries or as fish food. One farm produces pike perch. Pike perch is also mostly used in the sport fishery sector.

Sea vegetables

Not many companies have specialized in the production of sea vegetables yet. Mostly because the demand for sea-vegetables is too small to justify many companies starting in this niche market. There is one company that produces Sea Aster. Besides that 3 agricultural companies have started to produce glasswort as a side activity in 2006.

12.3.1. Sample size

Table 12.1 Netherlands - Main segments of the national aquaculture sector

Group of species	On-growing technique	Number of firms in population
Sole	Rec	1
Turbot	Rec	2
Eel	Rec	55
Catfish	Rec	37
Tilapia	Rec	4
Trout	Rec	4
Blue Mussels	On-b	56
Oyster	On-b	32
Hatcheries	Rec	2

Most of the freshwater fish farms grow only one species. There is one fish farm that grows both eel and catfish. The size of the companies in the freshwater fish farming sector is diverse. There are 4 larger eel farms. These farms all work together in a cooperation. Other European eel farms are much smaller. . In the blue mussel sector, 4 companies are significantly larger then the rest of the sector. About half of the oyster companies (17) also produce blue mussels, these companies therefore are counted twice in the table above. The total number of freshwater fish farms has declined fast in 2007: 14 of the 37 catfish firms and 19 of the 55 eel firms have stopped in 2007.

Only the European eel sector (57 companies), African catfish sector (37 companies) and the mussel (50 companies) and oyster sector (32 companies) are large enough to be reported on. The marine fish sector (3 companies), hatcheries (2 companies), ornamental fish (10 companies) sea-vegetables (4 companies) and rag-worm sector (3 companies) are too small, in terms of number of companies, to include in the data collection. Because of the limited number of companies in these sectors it would not be possible to ensure anonymity.

In the European eel sector there are 3 companies which are significantly larger then the other companies. It will therefore be very important to have at least one of these companies in the survey, unfortunately all of the larger farms flat out refused to cooperate with our data request. In the blue mussel sector, 4 companies are significantly larger, 1 of the larger companies agreed to cooperate with our survey.

12.4. New developments

There are numerous new developments in both the shellfish farming sector and in the freshwater fish farming sector.

12.4.1. Shellfish farming

As mentioned earlier, due to shortage of spat the production of mussels is far lower then it could have been and will be almost shut down since February 2008 due to the prohibition of spat farming in the Waddenzee.. Therefore there are several initiatives to grow spat in a hatchery/nursery instead of capturing it in the wild. So far 2 commercial spat hatcheries have started producing spat in 2007. Beside that there are several test projects to grow spat and mussels in open sea and on land.

Since mid 2006, several test projects have started to produce common cockles in the Ooster- and Westerschelde. One of the companies trying to produce common cockles is combining this with the production of rag-worms. Waste water, generated during the production of rag-worms, is rich in algae and can potentially be used as a feed supply for cockles.

In 2007 one firm has started to produce tropical shrimps (pacific white shrimps), in the harbour of Rotterdam. These tropical shrimps, so-called 'happy shrimp', are produced using a recirculation system. The tanks are warmed by using residual heat from a nearby power plant, thus saving energy. The company is currently looking into the possibilities of combining shrimp production with the production of sea vegetables.

12.4.2. Saltwater fish farming

The province of Zeeland is actively trying to promote aquaculture as a means to support the local economy. In 2007 a new project has started called 'Zeeuwse tong' (Zeeland sole). The goal of the project is the produce sole on land using a recirculation system and combining the production of sole with the production of rag-worms (which can be used as fish food) and sea-vegetables. The production units should be pleasing to the eye and naturally incorporated in the local environment. In theory, if the project results are sufficient, about 12,500 ha of agricultural arable land could be made available for this type of aquaculture.

Another new initiative is the production of tilapia, barramundi and shrimps within a horticulture company. A project has started in 2007 trying to produce these fish together with the production of tomatoes. Waste water generated during the production of fish is used as feed source for growing tomatoes.

12.4.3. Freshwater fish farming

In the end of 2006 a barramundi firm and a pike-perch firm were established. The production of these species is still very new in the Netherlands.

12.4.4. Sea vegetables

Because of the increasing salinization of agricultural land in coastal areas, there is some interest in developing more advanced growing techniques of sea-vegetables. Several test projects have started in 2007 to produce 'glasswort' or other sea-vegetables. In one project the production of glasswort is combined with the production of rag-worms.

12.5. Economic performance

Before discussing the results per segment, it should be mentioned that the response in the catfish sector and the European eel sector was less than desired. For 2006 only 3 European eel farms and 2 catfish farms were willing to participate. To overcome the reluctance of the sector to participate in the data collection LEI is planning to organize several meetings for the fish farmers in cooperation with the Dutch journal for aquaculture to increase the familiarity with LEI activities. This, however, will be organized only in 2009. To be able to aggregate the supplied data by the few respondents to the complete sector, known data from the Ministry of Agriculture about production value and volume have been used. Also the results have been compared to the results of 2004 and 2005, when the response was higher and the data where found comparable.

12.5.1. European eel sector

The last three years (2004-6), the economic results were poor. The average total costs were higher then the revenues, resulting in a net loss for the sector. High energy costs, bad publicity and low demand were strong contributors to the poor results. The turnover in 2006 was about 42 million Euro. However, the sector made a total loss of 13.3 million Euro. These estimates, however, are based on the survey results and one respondent had very high losses. It maybe that the firms that did not respond to our survey had more positive economic results.

The respondents had relative high debts compared to their total assets resulting in negative equity capital and high interest costs.

Another problem was the high price for glass-eels. The cost price of the imported glass-eels (mostly from Southern-Europe) has a large impact on the overall cost-price of the produced eel. The share of costs of glass-eel in the total costs is about 35%. Due to the high demand for glass-eel from China, the price of glass eel fluctuates quite severely thus influencing the potential profits of the companies a lot.

The average total value of tangible assets in a company is about half a million Euro. Eels need large tanks and oxygen needs to be added to the water. The time to produce a fully grown eel is also relatively long. Eel farmers therefore usually work full time in the company. Based on a survey LEI has conducted in 2005, estimations show that only about 50% of the catfish farmers work full time in the company, for eel farmers this percentage is 65% . Based on the survey results, it can be concluded that most of the labour in the eel sector consists of unpaid workers. Since most of the work is done by unpaid workers the personnel cost per FTE are quite low (9,000/FTE) Considering that only small firms were willing to cooperate with our survey request this results is not completely surprising.

Large cost segments were live raw material costs (25%) and feed raw material costs (10%).

12.5.2. Catfish sector

The economic performance of the catfish sector is poor. Both the average cost price as well as the average sale price is about 1.35 Euro per kg. Therefore net profits are zero or even less than zero as family labour is usually not included in the cost price. One of the major problems in the catfish sector is poor marketing.

The poor economic performance calculated based on our survey results may, however, paint a bleaker picture than is necessary. Only small firms responded to our data request. Anecdotal evidence shows that the largest firms make more profit. However, these firms are so far not willing to share any data.

The production of catfish can potentially be profitable as the female catfish are extremely fertile (can produce up to 500,000 eggs, several times a year), can be kept in high density tanks, hardly need to swim and do not need oxygen added to the tanks. Most of the catfish production is exported to other European countries: Belgium, Germany, Austria, Switzerland, France and Great Britain.

The amount of debt in the catfish sector is quite high compared to the total assets resulting in a low amount of equity capital (0.3 million euro). The personnel cost per FTE in this sector were equal to 46,000 Euro.

12.5.3. Mussel sector - on bottom

The mussel sector was financially still doing quite well up to the year 2007. After four very good years (2000-2003) with total net profit of about 35 million on average per year, the total net profit has declined to 23 million in 2006. In 2007 the total net profit increased again to 33 million Euro. Most of the individual companies made a profit and were able to meet repayment obligations easily. The total equity capital of the sector has declined by 10% in 2005 but has stayed fairly constant since . Total outside capital of the sector was about 15 million Euro. There were hardly any investments in the shellfish fleet in 2007. No new vessels or engines were purchased.

Large cost items were personnel costs (22%) and other operational costs (25%). Energy and interest costs are relatively low in this sector. The area on which the mussels are grown has to be leased. The lease costs are about 10% of the total costs.

The biggest constraint to the sector is the availability of spat. The government allows less spat to be caught then the sector would want. Since February 2008 spat fishing has been completely prohibited although is seems likely that from November 2008 some spat fishing licenses will be issued.

12.5.4. Oyster sector - on bottom

The oyster sector had a turnover of almost 10 million Euro and a profit of about 3 million Euro in 2006. The gross cash flow was about 3.5 million Euro and the gross value added was about 5.9 million Euro. The sector has a relative high equity capital and low debts (7.7 million Euro of equity capital versus 2.7 million Euro of debts).

The total employment in the sector is estimated at 75 FTE. A fairly large percentage of the labour costs are in the form of unpaid labour. Therefore the employment costs per FTE are rather low at 32,000 Euro. Large costs items in this sector were personnel costs (38% of total costs) and costs made to lease the area on which the oysters are grown (25%)

12.6. Statistical tables

Stat. table 12..12.1 Netherlands - National overview – saltwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	0.0	0.2		
1997	0.0	0.2		
1998	0.0	0.2		
1999	0.0	0.0		
2000	0.0	0.0		
2001	0.0	0.0		
2002	0.0	0.0		
2003	0.1	0.7		
2004	0.1	0.7		
2005	0.1	0.8	3	
2006	0.1	0.8	3	

Source: LNV

Stat. table 12.12.2Netherlands - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	3.0	19.7		
1997	3.0	19.7		
1998	5.1	33.7		
1999	5.7	36.8		
2000	6.4	40.9		
2001	7.0	41.2		
2002	8.4	32.4		
2003	9.0	39.1		
2004	9.4	42.7		
2005	9.8	47.4	98	159
2006	11.0	48.3	93	160

Source: LNV, trout, carp and ornamental fish are not included in these tables due to missing data

Stat. table 12.12.3Netherlands - National overview – shellfish farming blue mussels

	Volume of production (1000 t)		Value of production (mln Euro)	Number of companies	Employment
	Mussels 1000 tonnes *	Oysters Mln. Pieces *			
1996	92		48	64***	222***
1997	88		54	66**	225**
1998	97	22.7	49.5	65**	228**
1999	90	29.0	55.8	63**	231**
2000	58	29.8	75.9	58**	219**
2001	42	31.4	74.1	55**	213**
2002	48	32.7	70.1	51**	207**
2003	52	27.9	69.7	51**	201**
2004	68	29.2	63.3	50**	195**
2005	58	32.2	69.4	82	194**
2006	42	32.0	69	88	250

* Oysters are measured in million pieces and not in tonnes like mussels, volume of production of oyster (pieces) and mussels (tonnes) can therefore not be aggregated.
** Only includes the mussels sector
Source: LEI, Productschap Vis

Stat. table 12.12.4Netherlands - Hatcheries and nurseries

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996				
1997				
1998				
1999				
2000				
2001				
2002				
2003				
2004			1	
2005			2	
2006			2	

Source: Productschap Vis

Stat. table 12.12.5Netherlands - Review by sub-sector and species (value and volume), 2005

	Volume (1000 t)	Value (mln Euro)	Number of companies	Types of on-growing unit	Employ-ment
Mariculture (marine fish)					
- Sole	0.0	0.1	1	Re-circulated	
- Turbot	0.1	0.7	2	Re-circulated	
Freshwater fish culture					
- European eel	4.8	42.2	57	Re-circulated	119
- African catfish	4.0	4.2	37	Re-circulated	40
- Tilapia	1.0	1.0	4	Re-circulated	
- Trout	0.1		4	Re-circulated	
- Ornamental fish			10	Re-circulated	
- Pikeperch			1	Re-circulated	
Molluscs and crustaceans					
- Blue mussels	58.0	56.0	50	On-bottom	194
- European flat oyster (mln pieces)*	1.0	0.3	32	On-bottom	
- Creuses (mln pieces)*	31.2	3.1		On-bottom	
Hatcheries			2	Re-circulated	
Other					
- Sea vegetables			4	Other	
- Rag-worm			3	Other	

* Oysters are measured per piece instead of per kg

Stat. table 12.12.6 **Netherlands - Indicators by segment, 2006**
(segment totals, value in million Euro),

On-growing technique	Rec	Rec	On-bottom	On-bottom
Species	Eel	Catfish	Mussels	Oysters
Environment	Freshwater	Freshwater	Saltwater	Saltwater
OPERATIONS – COSTS AND REVENUES				
Turnover	42.00	6.48	69.00	9.76
Other income	0.00	0.00	3.86	0.02
Personnel costs	1.19	1.38	8.00	2.40
Value of unpaid labour	3.17	0.97	3.08	3.14
Energy costs	6.27	0.47	2.50	0.44
Live raw material costs	11.89	0.54	6.80	0.50
Feed raw material costs	11.29	3.62	0.00	0.00
Repair and maintenance	0.92	0.49	3.60	0.69
Other operational costs	6.56	0.58	9.00	1.74
Depreciation	2.12	0.27	5.00	0.55
Profit (EBIT)	-13.29	0.39	33.00	2.92
Interest costs (net)	7.33	0.86	1.10	0.03
Gross cash flow	-3.83	1.52	39.10	3.50
Gross value added	-2.65	2.90	47.10	5.90
BALANCE SHEET – ASSETS AND LIABILITIES				
Net investment in tangible goods	-	-	4.94	0.45
Equity capital	-36.39	0.28	106.00	7.69
Debts	151.77	10.51	189.63	2.71
Total assets	115.38	10.80	312.76	10.40
EMPLOYMENT				
Total number of persons employed	-	-	-	-
Full time equivalents (FTE)	130	30	170	75
LEGAL STATUS				
Total number of firm	55	37	56	32
Single holder	41	35	16	5
Limited and anonymous co.'s	14	2	40	27
SALES VOLUME				
Volume in (1000 tonnes)	5.00	4.50	58.00	
OTHER DERIVED INDICATORS				
Turnover / FTE (1000 Euro)	322.19	219.05	405.88	130.68
Gross value added / FTE (1000 Euro)	-20.30	98.01	277.06	79.03
Personnel costs / FTE (1000 Euro)	9.11	46.53	47.06	32.20
Tonnes / FTE (tonnes)	38.36	152.03	341.18	0.00
Turnover / firm (1000 Euro)	386.63	175.24	1,380.00	0.00
EBIT / Total assets (%)	-11.50	3.65	10.55	28.02

13. POLAND

13.1. Situation in 2005-7

Although Poland's total area of inland waters is more than 600,000 ha (Final report, 1994), for fishery purposes (i.e. for commercial fisheries, recreational fisheries and fish culture) are used the following areas of particular categories of the waters: 270,000 ha of lakes, 138,000 ha of rivers, 55,000 ha of dam reservoirs, and approx. 70,000 ha of artificial ponds. Although the theoretical area of ponds exceeds 70,000 ha, only about 50,000 ha are used for fish culture. The second important remark is that in principle there are no completely "natural" lakes, rivers and reservoirs in Poland with respect to their ichthyofauna, since most of them have been stocked artificially with the stocking material of several fish species produced in hatcheries, nurseries and traditional ponds.

There are approx. 900 fish farms operating in Poland, among them 200 trout farms, 670 carp farms and 30 farms specialized in production of sturgeons and torpedo-shaped catfish. Most of the farms are specialized, and can be clearly allocated to one segment - carp or trout farms, producing mainly common carp or rainbow trout. Some of the companies produce additional food fish species and/or possess hatcheries and nurseries and produce various life stages of stocking material introduced to natural waters (lakes, rivers and dam reservoirs).

In 2005-2007 total employment in Polish aquaculture exceeded 2,600. The total volume of production in 2005-2006 amounted to 36,400 and 35,500 tonnes respectively. At the same time value of aquaculture production was 77.2 and 79.7 million Euro. In 2007 total volume of production was 35,600 tonnes, and its financial value amounted to approx. 94 million Euro.

13.2. Main trends

There is no saltwater farming and shellfish farming in Polish coastal waters. In the past 11 years (1996-2006) average volume of aquaculture production amounted to 33,700 tonnes. A maximum of 36,800 tonnes was observed in 2003, then slight decrease occurred – in 2005-2006 average food fish production amounted to 36,000 tonnes. The main reason of the decrease is declining trend in table carp production. In the years 1996-2006 the total carp production varied between 22,600 tonnes (year 2000) to 15,600 tonnes (2006). It also exceeded 20,000 tonnes in the years 1996, 1999, 2001 and 2003. Taking into account the last three years, it may be concluded that there was decreasing trend as regards table carp production. Year 2006 with the total production of 15,600 tonnes was the worst since several years, comparable with the levels of carp production in the 60ties and 70ties of the 20th century. The main reasons of the decline in carp production were following: 1) KHV[36] disease which has spread through many farms located mainly in southern Poland, 2) shortage of water, mainly during summer on-growing periods, 3) connected with these two reasons shortage of the stocking material, mainly 2-yearlings. Trout culture is quite new form of fish production in Poland. It has started practically in 1972.

Whilst in the first few years' production of rainbow trout barely exceeded 200 tonnes, it reached 3,500 tonnes and 4,152 tonnes in the years 1985 and 1992 respectively. In the 80ties the number of trout farms exceeded 100 and since the beginning of the 90ties has rapidly grown up to the level of 200 in 2006. This resulted in stable increase of trout production: in 1996 this production amounted to 7,300 tonnes, in 1998 exceeded 10,000 tonnes, and in 2006 amounted to 17,000 tonnes. The observed rapid increase of rainbow trout production has been based on three main reasons: 1) increasing number of fish farms, 2) implementation of the newest technology, including aeration, oxygenation, re-circulation systems, 3) usage of the most advanced high-energy feed with small amounts of biogens causing water deterioration and eutrophication. A derivative of the volume of food fish production was financial value of fish sale in 1996-2006. Average value of aquaculture production in studied period amounted to 71.2 million Euro, and varied between 54.5 million in 1996 to 87.0 million in 2003. In 2006 total value of food fish production was 79.7 million Euro. Totally 26 fish species were produced by Polish aquaculture and introduced into

[36] KHV – Koi Herpes virus disease

inland natural open waters in 2006, hence the total financial value of fish farming in Poland is higher. The total value of stocking natural running waters in 2006 amounted to approx. 8 million Euro (incl. financial support from the state budget). It means that the most realistic value of the whole aquaculture sector in Poland was 87.7 million Euro.

In the analyzed period 1996-2006 fish prices were rather stable: the price of table carp increased from 1.78 Euro to 2.13 Euro, the price of food rainbow trout increased from 2.05 Euro to 2.19 Euro.

Although precise data on employment for the whole period 1996-2006 are not available, it can be stated that employment in Polish aquaculture sector was rather stable. Since 2005-2006 complete data on employment have been gathered, as a special system of data collection for the Main Statistical Office has been implemented. Total employment in Polish inland fisheries, including part-time employees, amounted to 4,300 employees in 2006. Carp farms employed approx. 1,960 employees, trout farms 650, and users of natural running waters 1,700. It can be estimated that the total employment in the whole aquaculture sector exceeded 2,600 employees in 2006.

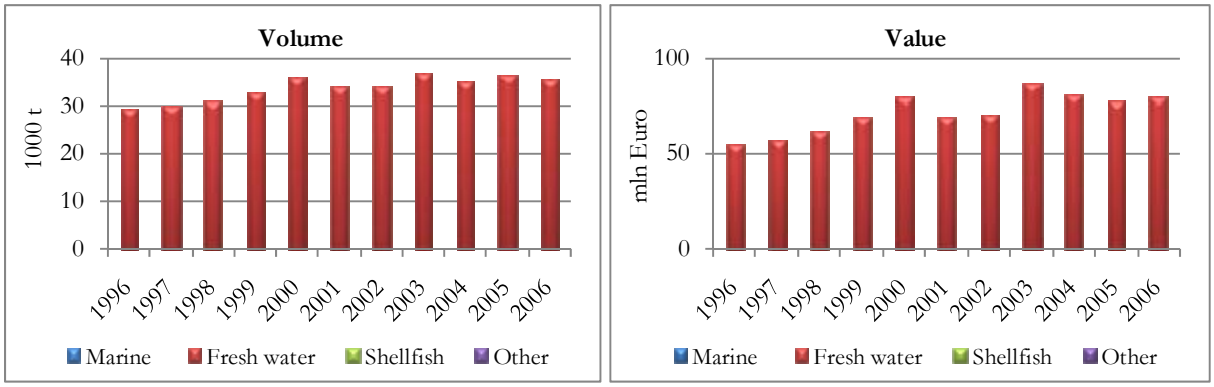

Figure 13.1 Poland - Volume and value of aquaculture production, 1996-2006

13.3. Structure of the sector

Carp culture

Majority of carp farms are located in southern, south-western and south-eastern parts of Poland. At present almost all carp farms are private, belong to limited companies or to the Polish Anglers' Association, but a few of the biggest carp farms are still state property. The present fish pond area varies according to various authors. Carp farming has been several years surveyed by the Inland Fisheries Institute using various types of questionnaires. In 2004 approx. 50% of the total number of surveyed farms (478) represented small farms (less than 5 ha), only 2.5% were bigger than 500 ha (including 4 farms with over 1,000 ha of pond area). In 2005 total common carp production amounted to 52.1% of the total volume of aquaculture production, and its value achieved 48.8% of the total value of this production.

On the other hand, many carp farms developed production of other food fish species, as well as various stages of stocking material to be introduced to natural open waters. The total volume of other table fish species production in 2006 amounted to 2,245 tonnes, i.e. represented 12% of the total carp production, which partly contradicted declining changes in food carp production. The main table fish species are the following: bullhead and silver carps, grass carp, European catfish, crucian carp, tench, pike, rainbow trout, sturgeon, ide, pikeperch, roach, perch, bream, chub. Very important from the economical point of view, is new phenomenon of increasing production of stocking material. It may be assumed that almost all older stages of stocking material (1 year fry, 2-yearlings, table fish, brood stock) were produced in carp ponds.

Trout culture

Most probably in 2006 for the 1st time total trout production was higher than table common carp production. Most of the trout farms, yielding about 90% of total production, are located in northern Poland (Western Pomerania, Gdańsk Pomerania, Western Lakeland, Mazurian Lakeland) and the remainder in Carpathian region and Sudety Mountains. In 2006 average trout production amounted to 106 tonnes per farm; the highest volume was produced in two farms (968 and 718 tonnes). The value of trout production amounted to 37.2 million Euro.

In 2005 total trout production amounted to 42.9% of the total volume of aquaculture production, and its value achieved 44.6% of the total value of this production. It is worth to underline that the above financial value of trout farms embrace only table rainbow trout. In fact an economic value of trout farming in Poland is much higher, because many of the farms produce also stocking material (mainly salmonids), and other table fish species as sturgeons, torpedo-shaped catfish, brook trout, common carp and European catfish. A part of the production of stocking material is financed by the state budget (through Ministry of Agriculture and Rural Development); in 2006 this budget supported production of the following species: sea trout, Atlantic salmon, whitefish, rainbow trout, eel, vimba, pike, tench. The total value of this support amounted to 1,251,000 Euro in 2006, and was 329,000 Euro higher than in 2005. Two species were dominant as regards the financial value. This value of sea trout amounted 604,000 Euro i.e. 57.8% of the total value of financial support. The 2nd species was Atlantic salmon and its value amounted to 257,000 Euro.

After the process of ownership transition in aquaculture sector in Poland, all the trout farms have become private, so now operate only private trout farms, limited companies and the Polish Anglers' Association. The latter organization is focused on fulfilling the anglers' needs and preferences; hence the production of trout farms belonging to this organization is concentrated on production of stocking material of brown trout, sea trout, Atlantic salmon, huchen, brook trout and grayling.

"Pond-lake" farms

There is one specific type of fish farms in Poland, the co-called "pond-lake" farms. There are 41 such enterprises of the total area 3,393 ha of ponds. These ponds are mainly carp ponds. However, some of the enterprises possess also trout farms. The total employment of these "pond-lake" farms is rather high, and amounted 602 employees in 2006. Volume of carp and rainbow trout production was included to presented total production of carp (15,600 tonnes) and rainbow trout (17,000 tonnes) in 2006. The employment was also included to the total employment of carp farms (1960) and trout farms (650) in 2006.

Re-circulation farms producing European eel

At present there is only one farm is producing reared fry of European eel (set up in 2001), and all its production is introduced into natural waters as stocking material. In 2006 this farm produced approx. 1,400 kg of reared eel fry. This volume constituted approx. 13% of the total eel stockings performed in 2006; the rest approx. 9,400 kg were imported from western Europe (e.g. Denmark).

Torpedo-shaped catfish and sturgeons farms

There are approx. 30 farms producing torpedo-shaped catfish and sturgeons. Part of them, mainly producing catfish, are specialized farms, the rest are farms producing these species together with carp and trout in ponds, raceways, tanks and recirculation systems. In 2006 total production of torpedo shaped catfish amounted to 380 tonnes, and production of sturgeons was approx. 300 tonnes. In 2005 value of production of these two species amounted only 2.9% of the total value of aquaculture production.

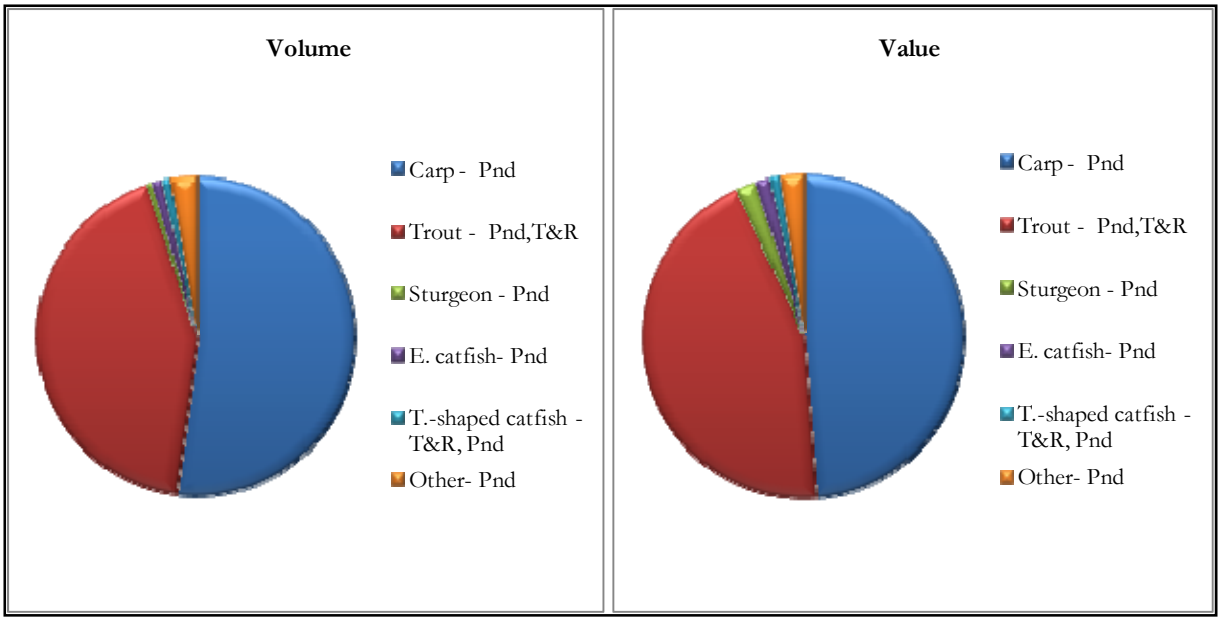

Figure 13.2 Poland - Composition of the volume and value of aquaculture production by species and on-growing technique, 2005

Production of stocking material

Artificial stocking is one of the most important measures to maintain proper status of ichthyofauna inhabiting natural inland water ecosystems i.e. lakes, rivers and dam reservoirs. The necessity of stockings is connected with a few main reasons: 1) eutrophication and deterioration of lakes, rivers and dam reservoirs, 2) substantial angling and poaching pressure upon fish stocks, 3) increasing pressure of cormorants and other fish-eating animals, 4) commercial fisheries management. In recent years fishery enterprises (approx. 600) using natural running waters have substantially increased financial value and number of fish species used for stocking purposes. In 2006 totally 26 fish species plus 1 species of crayfish were introduced into inland running waters. Apart from eel fry imported from EU countries, the rest stocking material was produced in hatcheries and nurseries operating within carp, trout and "lake-pond" farms, which constitutes a large social and economic importance for the whole aquaculture sector in Poland. The total value of stockings (including stockings into estuaries supported from the state budget) amounted to approx. 8 million Euro. The main species as regards financial value of stockings were following: pike, common carp, pikeperch, brown trout, European eel, sea trout, tench, vendace, European catfish, ide.

13.4. New developments

Since the mid-90ties, especially after 2000, new technologies, mainly for production of stocking material, have been implemented in Polish aquaculture. These technologies were invented and implemented first on experimental scale, and afterwards gradually on production scale. The main basis of these new technologies are closed recirculation systems set up in hatcheries and nurseries, using tanks, where various life stages (mainly summer and autumn fry) of many species are reared. Some of nurseries operate within large carp farms, and part of stocking material is subsequently reared in traditional earthen ponds. The following fish species are produced in such rearing systems for stocking purposes: whitefish, pike, pikeperch, European catfish, perch, burbot, asp, ide, chub, barbel, nase, tench, crucian carp, vimba, grayling, lake trout, sea trout, Atlantic salmon, European eel. Part of the species are produced only in 1-2 nurseries (e.g. pikeperch, pike, whitefish, perch, burbot, barbel, lake trout, nase, chub), some in more than 3 systems, and few species in 20-30 production units (sea trout, brown trout).

Few hatcheries and nurseries produce material for on-growing purposes to produce table fish. This refers to sturgeons, torpedo-shaped catfish and barramundi. Sturgeons and catfish are produced in approx. 30 farms, and barramundi in 1 recirculated system. Since the mid-90ties many new aquaculture enterprises

have been established, producing both stocking material and fish for consumption. Three of them are worth mentioning:

- Nursery Guzianka, the owner Regional Department of the Polish Anglers' Association in Suwałki. This nursery was established in 2001, and its most important purpose is production of European eel for stocking purposes (from the stage glass eel to summer fry). The nursery produces also stocking material of pike and European catfish, and is based on recirculation system, Weiss jars, tanks. The water temperature is fully controlled, artificial feeds are used. In 2006 approx. 1,400 kg of eel fry were produced from 80 kg of glass eel.
- Stocking centre Szczodre, the owner Regional Department of the Polish Anglers' Association in Wrocław. The hatchery and nursery was established in 2002, and is equipped with the biggest recirculation system in Poland, Weiss jars and tanks. The water temperature is fully controlled, artificial feeds are used. The following species are produced in this stocking centre: vimba, common carp, chub, European catfish, asp, tench, pikeperch, sea trout and whitefish. In 2006 among others were produced: 20,000 specimen of sea trout summer fry, 14,300 specimen of summer fry and 1800 kg of 1-year whitefish, 203,000 summer fry and 22,000 autumn fry of vimba.
- Big recirculated system for torpedo-shaped catfish production, established in Zelkowo (private ownership, location in Pomerania Lakeland). Total production of this species amounted to 105 tonnes in 2007.

13.5. Economic performance

Economic performance in 2005-6

Economic performance of aquaculture enterprises was studied only once in the period 1996-2006. The pilot survey embraced altogether 70 fish farms: 32 trout farms, 20 carp farms and 18 pond-lake enterprises (Wołos et. al. 2006). General economic performance in 2005 was assessed taking into account the following average parameters calculated for 1 farm of each category of enterprises: turn-over, total costs, gross profitability (ratio of gross profit to total costs in %), total income per 1 employee, gross profit per 1 employee, index of development (ratio of investments to total income in %), average price of 1 kg of fish.

The best economic performance was noted in case of trout farms. On average trout farm obtained total income 417,300 Euro, gross profitability 18%, total income per employee 51,000 Euro, gross profit per employee 7,790 Euro, index of development 6.9%, average price of per kg of food fish 2.22 Euro. Pond-lake enterprises were characterized by the following parameters: total income 625,400 Euro, gross profitability 10.4%, total income per employee 27,870 Euro, gross profit per employee 2,620 Euro, index of development 3.2%, average price per kg of food fish 1.78 Euro. Decidedly the worst economic performance was observed in carp farms. Although average total income was high (647,900 Euro), the rest of economic parameters were rather low: gross profitability (expressed as the ratio of gross profit to total costs in %) -3.0%, total income per employee 19,850 Euro, gross income per employee -605 Euro. Index of development amounted to 6.8% and price of 1 kg of food fish with the average level of 2.20 Euro was similar to trout farms. Generally weak economic performance of carp farming was caused by the worst economic parameters characterizing the biggest few farms, which have not been privatized yet.

Trout farms and pond-lake enterprises were characterized by sufficient economic performance, which guarantee proper perspectives of further developments of these segments of aquaculture. One of the reasons of proper profitability of trout farming is export, which amounted to 6,200 tonnes (Seremak-Bulge 2007), i.e. 36.5% of the total rainbow trout production in 2006. Sufficient economic performance of pond-lake enterprises is connected with two main reasons: 1) complete process of privatization, 2) substantial share of recreational fishing licenses, which constituted as much as 7% of the total income obtained by these companies in 2005.

In recent few years many fish farms in Poland used substantial funds from EU through Sector Operational Program "Fishery and Processing 2004-2006" (FIFG/EFF). Until September 2006 totally 3,046 projects were approved for the total amount of 240 million Euro, in this 408 agreements with fish farms within the action "Fish culture" for the total amount of 33.3 million Euro.

Economic performance in 2007

The survey conducted under the project embraced totally 31 fish farms, among them 18 carp farms and 13 trout farms. As a principle mainly those enterprises were surveyed which provide full accountancy. Following this principle the questionnaires were sent by post to the farms which employ accountants, and full financial data were given mainly by the accountants. The obtained data were extrapolated to the overall sector i.e. to the total production of carp and trout in Poland in 2007.

Carp culture in ponds

Totally 18 questionnaires were collected. The total area of ponds used by the farms (16,079 ha) embraced approx. 31.1% official area of ponds in the whole country. The total fish production in the surveyed farms was 4,700 tonnes, in this common carp embraced 92.3%. The rest species produced in 2007 were following: grass carp, bighead carp, tench, pike, crucian carp, wels and other species. The production results obtained by the surveyed enterprises embraced 28,1% of the total common carp production in the whole country, which amounted to 15,432 tonnes in 2007 (Lirski, Myszkowski 2008).

Extrapolation of the survey results to the overall sector (15,432 tonnes of common carp production) gave the total turnover of 42.3 million Euro in 2007. Other incomes were much lower and amounted only to 2.76 million Euro.

The main item in the overall costs were personnel costs (including unpaid family labour) constituting as much as 39.2% of the total costs. The second place took costs of feed raw material (25.3%), and the next were other operational costs (13.0%), repair and maintenance (7.9%), deprecation (6.4%), live raw material (5.0%), energy (1.7%). EBIT was calculated as 2.18 million Euro, which constituted 5.2% of the total turnover.

The cost of unpaid family labour was mentioned only by 2 private farms, and calculated directly by the owners of the enterprises; they were rather low and amounted only to 0.06 million Euro.

Intangibles (permits, etc. which have or may get monetary value

There are the so-called water permits for using water from natural running inland waters, but they do not have monetary value.

Major constraints in carp culture

Relatively bad economic performance of carp farming is caused by four main reasons:

- not finished process of privatization of the biggest carp farms (the biggest one possess over 7,600 ha of ponds i.e. approx. 15% of the total pond area in Poland),
- KHV disease, wide-spread especially in farms located in southern Poland,
- shortage of water, especially in southern and central part of Poland,
- competition with other sources of food, among them imported food fish; in 2006 totally 20,100 tonnes of Norwegian salmon and 42,000 tonnes of Vietnamese panga were imported and sold on the domestic market in Poland (Seremak-Bulge 2007).

Trout culture in ponds, raceways and tanks

Totally 13 questionnaires were collected. The total fish production in the surveyed farms was 3,791 tonnes, of which rainbow trout amounted to 86.6% of the overall fish sale in 2007. The other species produced in 2007 were following: torpedo-shaped catfish, sturgeons, common carp, stocking material of salmonid species, and lake fishes in 2 enterprises possessing rights to harvest fish in lakes which are leased by the farms from the State. The total rainbow trout production obtained by the surveyed enterprises embraced 22.8% of the total production of this species in the whole country, which amounted to 16,650 tonnes in 2007 (Bontemps 2008).

Extrapolation the survey results to the overall sector (16,650 tonnes of rainbow trout production) gave the total turnover of 52.1 million Euro in 2007. Other incomes were much lower and amounted only to 0.9 million Euro.

The cost of unpaid family labour was mentioned only by 2 private farms, and calculated directly by the owners of the enterprises; they were rather low and amounted only to 0.09 million Euro.

The main item in the overall costs was feed constituting as much as 42.7% of the total costs. Personnel costs (including unpaid family labour) embraced 24.3% of the costs, and the next were following costs: live raw material (11.8%), other operational costs (8.6%), repair and maintenance (4.6%), energy (3.7%) and depreciation (3.4%). Especially costs of feed, live raw material and energy were substantially higher in comparison with carp farms, and on the contrary cost of labour was much lower. EBIT was calculated as 5.7 million Euro, which constituted 10.9% of the total turnover. In comparison with carp farms the latter index was more than twice higher.

All mentioned parameters were relatively high, especially when comparing them with indicators calculated for carp farms. For example, total fish production (in tonnes/FTE) in trout farms was 2.7 times higher than in carp farms, and total turnover per 1 firm was 4.1 times higher.

Intangibles (permits, etc. which have or may get monetary value

There are the so-called water permits for using water from natural running inland waters, but they do not have monetary value.

Major constraints in trout culture

The following main constraints in functioning and further development of trout farming were indicated:

- competition with other sources of food, among them imported food fish – mainly rainbow trout from Turkey, Norwegian salmon and Vietnamese panga.
- increasing cost of production, especially costs of feed and labour, lack of qualified personnel,
- VHS disease which affected fish stocks in several trout farms in Pomaranian Region of Poland,
- lack of suitable sites for establishing new trout farms.

13.6. Statistical tables

Stat. table 13.1 Poland - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	29.2	54.5	900	na
1997	30.0	56.2	900	na
1998	30.9	61.2	900	na
1999	32.5	69.2	900	na
2000	35.8	79.5	900	na
2001	34.0	68.9	900	na
2002	34.0	69.9	900	na
2003	36.8	87.0	900	na
2004	35.2	80.3	900	na
2005	36.4	77.2	900	na
2006	35.5	79.7	900	2,610

Stat. table 13.2 Poland - National overview – nurseries and hatcheries

	Volume of production (mln juveniles) a)	Value of production (mln Euro)	Number of companies	Employment
1996			84	
1997			85	
1998			85	
1999			85	
2000			85	
2001			85	
2002			86	
2003			86	
2004			87	
2005			87	
2006	410.0	8.0 a)	87	

a) the data include numbers of larvae and summer fry used for stocking; they do not include older stages used for stocking (i.e. autumn fry, 1+2-yearlings) as well as stages used for production of food fish in aquaculture units

Stat. table 13.3 Poland - Review by sub-sector and species (value and volume), 2006

	Volume (1000 t)	Value (mln Euro) d)	Number of companies	Types of on-growing unit	Employ-ment
Freshwater culture					
- Carp	15.6	33.3	670	ponds	1,960
- Trout	17.0	37.2	200	ponds, raceways, tanks	650
- Torpedo-shaped catfish (Clarias spp.)	0.4	0.9	15-18	recirculated, tanks, ponds	na
- Sturgeons	0.3	1.9	12-15	ponds, tanks, recirculation	na
- Other a)	2.2	6.4	few hundred	ponds and tanks	na
Other					
- Other: crayfish b)	few 100 kg	na	few	ponds	na
- Hatcheries c)	-	8.0	87	mainly Weiss jars, Californian devices	
- Nurseries c)	1.1		60	ponds, tanks, recirculation	

a) mainly food fish produced in carp ponds: grass carp, bighead carp, silver carp, European catfish, Crucian carp, pike, tench, pikeperch; b) produced in carp or trout farms; c) together value of production of hatcheries and nurseries. data include only stocking material introduced into natural running waters; employment together with carp farms, trout farms, pod-lake enterprises. d) The total value in table 2 is 18% lower than the sum of the segments in table 3 as the two tables refer to different years and 2007 there was a major price increase.

Stat. table 13.4 Poland - Indicators by segment, 2007
(segment totals, value in million Euro)

On-growing technique	Ponds	Ponds & Tanks & Raceways
Species	Carp + supplementary species	Trout + supplementary species
Environment	Freshwater	Freshwater
OPERATIONS – COSTS AND REVENUES		
Turnover total	42.28	52.11
Other income	2.76	0.93
Personnel costs	16.54	11.12
Value of unpaid labour	0.06	0.09
Energy costs	0.72	1.79
Live raw material costs	2.13	5.59
Feed raw material costs	10.7	20.40
Repair and maintenance	3.35	2.19
Other operational costs	5.87	4.41
Depreciation	2.73	1.87
Profit (EBIT)	2.18	5.68
Interest costs	0.14	0.08
Gross cash flow	5.67	7.45
Gross value added	21.70	18.83
BALANCE SHEET – ASSETS AND LIABILITIES		
Net investment in tangible goods	-4.76	6.55
Equity capital	48.03	43.91
Debts	21.87	10.63
Total assets	93.45	70.09
EMPLOYMENT		
Total number of persons employed	1960	650
Full time equivalents (FTE)	1945	642
LEGAL STATUS		
Total number of firm	670	200
Single holder	630	185
Limited and anonymous co.'s	40	15
OTHER DERIVED INDICATORS		
Turnover / FTE (1000 Euro)	21.73	81.17
Gross value added / FTE (1000 Euro)	11.16	18.83
Personnel costs / FTE (1000 Euro)	8.50	17.32
Tonnes / FTE (tones)	9.50	25.93
Turnover / firm (1000 Euro)	63.10	260.54
EBIT / Total assets (%)	2.33	8.10

14. PORTUGAL

14.1. Situation in 2006-7

The aquaculture sector has 1,472 licensed farms which occupy a total area of 1,992 ha, of which 87% are bivalve bottom farms, 11% are earthen pond fish farms, and 2% are offshore farms (fish and bivalves). This represents approximately 1,084 active companies, where the biggest employment sources are the mollusc farms, a centennial form of aquaculture which employs an estimated 3,900 people.

Production values oscillate between 6,000 and 8,000 tonnes due to mainly fluctuations in bivalve production. Finfish production has slowly but steadily increased and currently represents a higher value and volume than bivalve molluscs. The total production for 2006 was of 6,485 tonnes, with a value of 34 million Euros.

14.2. Main trends

Saltwater farming

Marine production is the greatest contributor to the aquaculture sector. It includes both fish and bivalve species but they have distinct performances. Fish production is slowly increasing to similar volumes and superior values, recuperating well from the 2000-01 price crash in the seabass and seabream markets, when the values dropped from 17-18 million to 10.5 million in 2002. The value of the production has since been steadily increasing as the market stabilizes and is presently worth 14.8 million Euros. The production volume has continually increased since 1996, from 1,000 tonnes to the present value of 3,320 tonnes. The increase in production is achieved despite a decrease in number of companies, 9 less than in 2003. This performance is most likely due to the consolidation of surviving companies and their increased efficiency.

Freshwater farming

Freshwater production is limited to brown and rainbow trout, the first being reared mainly for restocking and the latter for food. The production volume has slowly decreased over the last 10 years, from 1,300 tonnes to 800 tonnes per year. This is due to strong competition from neighbouring countries which has reduced profit margins, falling from 3.1 million Euros in 1997 to just 1.8 million in 2006. The decrease in both value and volume is also attributed to a reduction in the number of active companies, although this value is very small.

Shellfish farming

Shellfish farming has long been the base of aquaculture production, being the largest contributor both in volume and value. The most significant species is the clam which, at 13.7 million Euros, accounts for 45% of the total production value. The production volume fluctuates greatly because of high mortality rates which are attributed to pollution. There is a marked decrease in production volume, almost 2,000 tonnes since 1997. The volume has also decreased because producers are more cautious when investing in seed, buying less in order to reduce their risk. This has resulted in a price increase, but this is mainly supported by the end consumer. Oysters and mussels, the second and third most significant bivalve species are of lesser importance mainly because they are not traditionally consumed locally, their production being mainly for export.

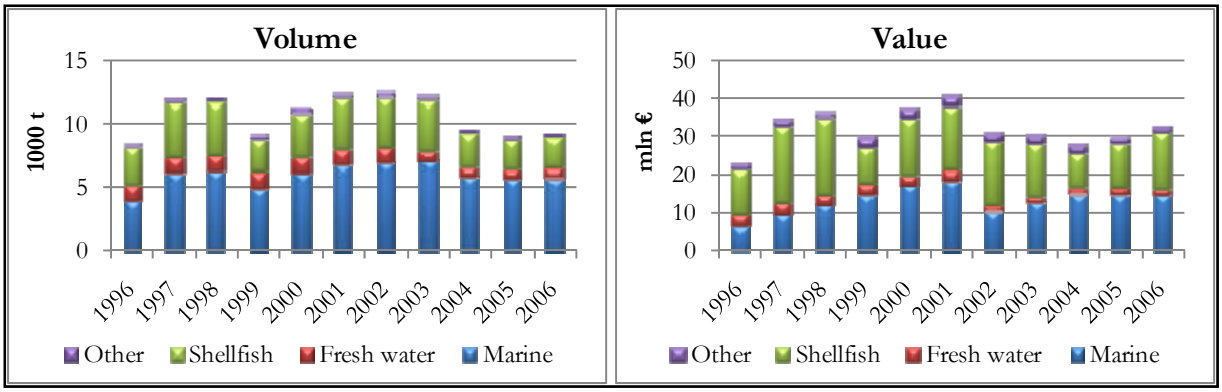

Figure 14.1 Portugal - Volume and value of aquaculture production, 1996-2006

14.3. Structure of the sector

Marine fish

There are a total of 183 companies working in this sector, employing 264 individuals. Approximately 97% of all fish production is done in earthen ponds, where the circulation system is dependent on tidal flow for water renovation. These companies operate in a semi-intensive regime (natural food source with supplement) producing seabass and seabream. The remaining 3% operate either using offshore cages (seabass and tuna) or recirculation systems (turbot). Only two companies integrate several production phases and the vast majority can be clearly segmented as seabass/bream earthen pond producers. Due to the relatively small production levels of each company, the larger producers fail, for now, to have a significant impact on the total production volume/value. These segments can all be surveyed

Freshwater fish

Freshwater production is limited to rainbow trout (food) and brown trout (restocking). This sector has a total of 37 companies and employs 28 individuals. Of the animals produced, 99% is reared in raceways and one company also has an offshore production unit which uses cages. Several companies integrate various production phases. The Companies that perform restocking operations are all state owned, supplying the private sector with rainbow trout eggs or fry in order to supplement their income. There is one large producer, with a fully integrated infrastructure, which accounts for the majority of the production. This segment can be surveyed.

Shellfish

Over 97% of the shellfish production comes from bottom cultures and there is a very low level of specialization. This sector is estimated to employ over 3,700 individuals as its is considered that each company employs 3 people, part-time and full time. There are no bivalve nurseries so all juveniles are either imported from France or are captured in natural banks. Four companies have set up depuration and expedition centres and it is through them that most of the production is channelled. There is a growing interest in oyster production due to high mortalities of clams. It is difficult do identify any large producers regarding clam production but not so in oyster, the only offshore and off bottom producer, where one company accounts for 80% of the total production volume. All mussel production is off bottom, on rafts and located in rias (bar built estuaries). The clam segment can be surveyed but not the oyster segment as the weight of a single company distorts the entire segment.

Microalgae

There is only one company which produces microalgae. This product goes either to the cosmetic industry or to fish and bivalve nurseries as a source of food. They utilize a unique and patented photobioreactor

which resembles a solar panel. As it is the only company in this area, it is not possible to survey this segment.

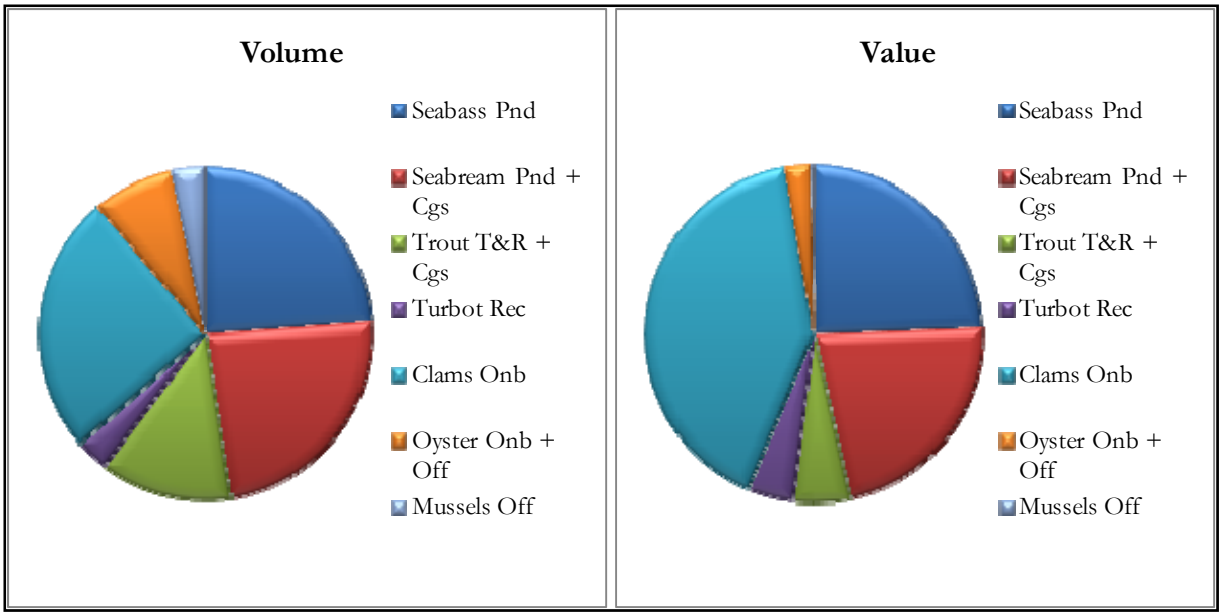

Figure 14.2 Portugal - Composition of the volume and value of aquaculture production by species and on-growing technique, 2005

Table 14.1 Portugal - Main segments of the national aquaculture sector

Group of species	On-growing technique	Number of firms in population
Seabass & Seabream	Ponds	96
Turbot	Recirculation	3
Clams	On bottom	895
Trout	Tanks & raceways, cages	16

General section on the way of structuring will refer to FADN practices: bi-annual structural survey of the population, definition of thresholds and field of observation, size typology based on gross margin (gross value added), etc.

14.4. New developments

The objective stated in the National Strategic Plan for Fisheries (PEN Pescas) is for the aquaculture sub-sector to become the main factor in the growth and development of the fisheries sector. In the next 4-6 years, Portugal intends to more than double its present production. In numbers, this means a two fold increase in productivity from 7,000 to 15,000 tonnes, increasing from a 3% weight in the fisheries sector to 8% and the introduction of several new species that have recently become economically viable (sole, zebra seabream, common seabream, blackspot seabream and meagre). 300 to 400 new jobs are expected to be created in the sector.

There is a discernable move towards offshore (open sea) production thanks to technological developments in the cage industry. Although offshore production is quite common in many European countries, Portugal has a completely exposed shoreline and is frequently subjected to storms with 10-11 meter waves. Now that the industry has greatly improved the "submersible" aspect of the technology, especially the reliability, 10 new companies are applying for licenses to produce finfish. Although they will begin their activity producing seabass and seabream, they will also be licensed to produce the new finfish

species such as meagre, sole, sharpsnout seabream, white seabream and common seabream. These are already being produced at pilot levels and, although their reproduction is already controlled, there is still much development to come. Specific feeds are necessary and certain husbandry techniques need to be adapted to the specificities of these fish.

Offshore and off bottom bivalve production is also attracting new investors, there are 12 new companies applying for licenses. This is due to the fact that there are now functional and reliable long-line structures available, capable of withstanding the severe sea conditions. The pacific oyster is already produced on offshore long-lines and there is interest in producing flat oyster, Portuguese oyster, scallops and mussels. With the exception of the Portuguese oyster and mussel, all the seed will be imported so there is considerable interest in building a bivalve hatchery. The vast majority of this production will be for export as there is not much of an internal market for these species.

Land based farms are also of great interest for the production of sole. This high value species is attracting the attention of investors which are already present as turbot producers, but no new companies are applying for licenses. Reproduction and husbandry techniques are already at a very developed stage so the investors are planning to construct large units.

The traditional earthen pond farms are also embracing change. As it is difficult to obtain new licenses for these farms due to the fact that they are invariably located in nature reserves, they are going green. The reality is that most, if not all, companies already qualify for certification as organic producers due to the very low stocking densities, the fact that artificial feed are used as a complement to the natural foods available, and that they actually increase the biodiversity of bird species. In addition, some companies are beginning to use bivalves, mainly oyster and mussels, as natural filters for the farms' effluent. The bivalves, which have very good growth rates due to the constant current of nutrients, are then also sold.

14.5. Economic performance

Seabass and seabream in ponds

The traditional seabass and bream earthen pond production suffered a serious blow with the development of offshore production in the Mediterranean. The warmer waters there allow for a growth rate that is twice as fast but offshore production also allows for much higher stocking densities and eliminates the energetic cost of water pumps, aeration systems as well as the use of oxygen. Energy represents 16% of the costs, which includes diesel for back-up generators. Some companies tried to compete, increasing stocking densities and the use of feed but their success was short lived due to increased costs with diseases and the necessary use of chemicals to disinfect ponds in a short period of time.

The only option left was to stop competing with Greek and Spanish imports and concentrate on reducing production costs and providing a product of superior quality. By reducing stocking densities to 1 to 1.5 kilograms per m^3 (offshore farms use densities up to 60 times greater) they were able to cut energy costs and practically eliminate the incidence of disease. Most importantly, they were able to reduce the expenditure on feed, which represents 31% the operational costs. This also coincides with the maximum carrying capacity before an environmental impact assessment is necessary.

One of the most important decisions was to stop competing in the same niches as the imported products, 250g-400g range, and focus on the quality of their product. Freshness is of great importance in the internal market so it was a strong bargaining point when the imported product was reaching the final consumer when it was already 5 days old. For these reasons, the national product commands a slightly higher price than imported fish with price/kg staying above 4,50 Euro, in some cases reaching 6,00 Euro.

These measures have been successful in restoring the interest in this type of production, especially since it has unintentionally developed into what may be classified as biological or organic production. For this reason, there is renewed interest, with the established companies buying either inactive farms or investment projects, which have never been concluded. The area in which these farms may be constructed

is becoming a highly valued asset and permits are exchanging hands for increasingly higher prices. This practice is illegal when it concerns areas in the public domain, which are the majority, and many companies, which failed to produce successfully, are recuperating their losses by selling off their permits. Some companies consider and include the value of the public domain as their assets.

Since the production from ponds is limited, mainly due to spatial constraints, and Portugal continues to import aquaculture products, which it could produce internally, the logical option is offshore production. Although there will still be some difference in production rates comparatively to Mediterranean waters, offshore production will permit higher densities and lower production costs, enabling companies to compete with imported products, still having freshness and proximity as advantages.

Clams -bottom culture

The persons working with bivalve bottom culture are presently having production difficulties. A combination of pollution and reduced water circulation has increased mortality rates. This is not yet reflected in the data relevant to 2006. Producers, now, tend to rely on natural recruitment as opposed to buying seed as this would account for 55% of the operational costs.

It is considered that some simple alterations to the production methods would greatly reduce mortalities but the license holders do not demonstrate any interest in changing their husbandry techniques. However, they seem to be aware that higher production levels are clearly possible since licenses exchange hands for considerable values, up to 20,000 Euros per hectare. Again, this is an illegal practice since all farms are located in the public domain

Turbot in recirculation

There is great interest in flatfish production in tanks or recirculation systems. Turbot is especially attractive due it is excellent conversion rate (1:1 or better) and high market value. By comparison to seabass and seabream, feed costs are marginally higher by 6% (37% for turbot and 31% for seabass/bream) of the total revenue. Energy costs are significantly lower, representing only 7% of the total revenue in comparison to 15%.

The main problem for the companies investing in this segment, apart from the high initial cost in infrastructures, is that the farms must be located in either extremely valuable land or on environmentally sensitive areas (e.g. NATURA 2000). These investment costs, and the fact that these types of farms are incorrectly associated with high pollution levels, are the strongest impediment to the development and expansion of this segment. No intangibles were identified in this segment, most likely because the extremely high value of the infrastructures when compared to the value of the land.

In the surveyed year, one of the companies suffered from very high mortality rates and had negative results at the end of the fiscal year. As there are only three companies in this segment and the one experiencing the losses was the largest producer, the overall value is negative.

Trout in raceways

Freshwater production is limited to trout production and there is not much interest from investors for this segment. The highest operational costs regard feed (42%) and personnel (21%). Energy costs are very low as water circulation only requires gravity and eggs/juveniles are also of comparatively low cost. Small profit margins, due to strong competition from Spain, and lack of entrepreneurial skills results in many inactive or abandoned farms. This situation is not helped by the fact that all privately owned farms are located on private property, and since in this segment acquiring the farm represents the largest part of the initial investment, the low value of the product does not make for an attractive business.

14.6. Statistical tables

Tables 1a-1b refer to the number of licensed companies which is a different value than commercially active companies. Tables 2, 3 and 4 refer only to commercially active companies

Stat. table 14.1 Portugal - National overview – saltwater fish farming

	Volume of production (1,000 t)	Value of production (million Euro)	Number of companies	Employment
1996	1	6.5	-	-
1997	1.5	9.5	224	238
1998	1.9	12.1	144	241
1999	2.4	15	169	267
2000	2.8	17.3	168	306
2001	3.1	18.8	173	356
2002	3.1	10.5	172	378
2003	3.2	12.9	186	314
2004	3.2	15.2	183	285
2005	3.3	14.9	180	264
2006	3.3	14.8	177	267

Stat. table 14.2 Portugal - National overview – freshwater fish farming

	Volume of production (1,000 t)	Value of production (million Euro)	Number of companies	Employment
1996	1.3	3.2	-	-
1997	1.2	3.6	38	46
1998	1.3	2.9	29	48
1999	1.3	2.9	40	47
2000	1.3	3	37	44
2001	1.2	2.9	37	39
2002	1.2	1.7	40	47
2003	0.9	1.6	41	29
2004	0.8	1.5	40	33
2005	0.8	1.8	38	28
2006	0.8	1.8	37	27

Stat. table 14.3 Portugal - National overview – shellfish farming

	Volume of production (1,000 t)	Value of production (million Euro)	Number of companies	Employment
1996	3	12.1	-	-
1997	4.4	20.1	1,006	3,009
1998	4.3	20.3	945	2,862
1999	2.5	9.6	1,282	3,846
2000	3.3	14.6	1,266	3,798
2001	3.9	16.8	1,292	3,876
2002	3.9	17	1,308	3,924
2003	3.9	13.9	1,285	3,855
2004	2.7	9	1,286	3,858
2005	2.4	11.7	1,253	3,759
2006	2.5	14.8	1,253	3,759

Stat. table 14.4 Portugal - National overview – Nurseries and hatcheries

	Volume of production (million juveniles)	Value of production (million Euro)	Number of companies	Employment
1996	9,270.9	-	-	-
1997	17,573.8	-	26	38
1998	19,091	-	22	38
1999	19,555	-	20	43
2000	34,048.6	-	24	37
2001	28,421.5	-	20	40
2002	26,120.8	-	26	64
2003	29,289.4	-	24	43
2004	26,423.6	-	25	37
2005	18,466.1	-	27	36
2006	20,633.8	-	26	36

Stat. table 14.5 Portugal - Review by sub-sector and species (value and volume), 2006

	Volume (1,000 t)	Value (million Euro)	Number of companies	Types of on-growing unit	Employment
Mariculture (marine fish)					
- Seabass/Bream	3.1	13.7	96	E&P	264
- Turbot	0.4	1.5	3	Rec	
Freshwater fish culture					
- Trout	0.8	1.8	16	T&R, Cages	28
Molluscs and crustaceans					
- Mussels	0.2	0.1	18	Off b	3,759
- Oysters	0.5	0.7	38	On & Off b	
- Clams	1.6	13.7	894	On b	
Microalgea	0.3	0.1	1	Photobioreactor	-
- Hatchery (seabass/Bream)		-	6	T & R	50
- Hatchery (trout)	38	-	12	T & R	21

Stat. table 14.6 Portugal - Indicators by segment, 2006
(segment totals, value in million Euro)

On-growing technique	Enclosures / pens	On bottom	Recirculation	Raceways
Species	Seabass/Seabream	Clams	Turbot	Trout
Environment	Saltwater	Saltwater	Saltwater	Freshwater
OPERATIONS – COSTS AND REVENUES				
Turnover	36.00	22.64	2.33	3.49
Other income	1.28		0.08	0.1
Personnel costs	5.59		0.54	0.74
Value of unpaid labour			0	
Energy costs	5.64	0.36	0.18	0.07
Live raw material costs	4.03	8.51	0.78	0.10
Feed raw material costs	11.09		0.88	1.48
Repair and maintenance	0.21		0.08	0.13
Other operational costs	1.31	0.47	0.01	0.39
Depreciation	0.32		0.12	
Profit (EBIT)	7.03	13.30	-0.14	0.57
Net Interest costs	2.43		0.03	
Gross cash flow	8.16	22.64	-0.06	0.67
Gross value added	15.37	13.30	0.54	1.32
BALANCE SHEET – ASSETS AND LIABILITIES				
Net investment in tangible goods				
Equity capital	53.61		3.40	
Debts	24.08		2.59	
Total assets	166.71		10.08	
EMPLOYMENT				
Total number of persons employed	243	983*	35	61
Full time equivalents (FTE)**	198	152	10	55
LEGAL STATUS				
Total number of firm	96	894	3	13
Single holder	46	870	0	4
Limited and anonymous co.'s	50	24	3	9
SALES VOLUME				
Volume in (1000 tonnes)***	7.20	2.51	0.33	1.16
OTHER DERIVED INDICATORS				
Turnover /FTE (1000 Euro)	0.09	0.07	0.12	0.03
Gross value added/FTE (1000 Euro)	0.04	0.05	0.03	0.01
Personnel costs /FTE (1000 Euro)	0.01		0.03	0.01
Tonnes / FTE (tones)	18.72	8.57	17.38	10.99
Turnover / firm (1000 Euro)***	375.03	25.32	777.38	268.88
EBIT / Total assets (%)	4.22%		-1.40%	

Note: Data for the indicators was not available on 2006. This data reflects information from the survey. The data concerns only active companies.

* The figures reflect low employment numbers in the clam segment. It was previously estimated that each company employed 2-3 people but the real values are closer to 1 per company, with sometimes 2 or more companies sharing the same workforce.
**Values are based on the total number of hours of the workforce per segment, considering 242 working days/year and 8 hours/day.
*** The values for production determined through the survey are higher than those in the official statistics. This difference is to be expected especially in the seabass/seabream and clam segments. Personal interviews allowed for greater detail to be determined. The existence of a "parallel market", where no invoices are used, is well known but has never been quantified. These values are a closer indication of the reality of the segments.

15. SPAIN

15.1. Current situation in 2006

The Spanish aquaculture sector is composed of a total of 3,029 companies with 5,710 facilities, of which 325 are freshwater and the rest of them are saltwater. In 2006, total employment in the aquaculture sector was estimated in 25,240 persons. The total gross output in value in 2006 was 485.8 million Euro, and the total volume was 295,276 tonnes.

The saltwater aquaculture has an important production of bivalve molluscs, in particular the *Mediterranean* mussel, whose cultivation is carried out on floating rafts, mainly along the Galician coast. Significant productions of other bivalves also take place: clams, oysters, cockles, etc. The marine fish species produced in Spain at a commercial scale are: seabream, turbot, seabass, eel, red seabream, meagre, and tilapia. The semi-intensive culture is developed in tidelands and in old salines, and the intensive one in concrete or plastic tanks and in floating cages. The freshwater aquaculture is based on the production of rainbow trout, although other species like tench, eel, sturgeon and crab are also cultivated.

15.2. Main trends

In terms of volume of production, the Mediterranean mussel is the main species produced in Spain, with an average output *of* 243,000 tonnes in the period 1996-2006. *The cultivation of mussel* constituted in 1996-2006 80% of the total volume of the aquaculture production, but it only represents 37% of the total production value. The year-to-year fluctuations are mainly due to the red tides (harmful algal blooms).

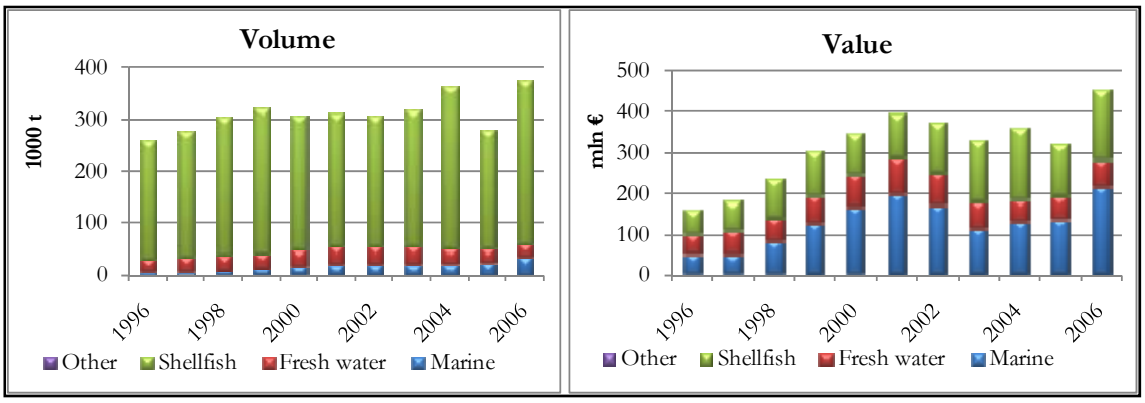

Figure 15.1 Spain - Volume and value of aquaculture production, 1996-2006

In terms of economic value, the more important cultivated species are: mussel, seabream, tunas, trout, turbot, seabass, Japanese clam, fine clam and oysters.

There was a growing development of the saltwater fish culture in the period 1996-2005, with a total rate of increase of 269%. The main species are: seabream (17,836 tonnes in 2006), seabass (9,439 tonnes), and turbot (6,214 tonnes). The value of the production was also growing until 2001, falling in 2002 and 2003, and growing again in 2004, 2005 and 2006. These fluctuations are due to the fall of turbot production in 2003 and to the fall of seabass price in 2001-2006, probably due to the importations of this species.

The freshwater fish production was quite constant along the period 1996-2006, with an average output of 31,300 tonnes and 24,940 tonnes in 2006, mainly *of* rainbow trout.

15.3. Structure of the sector

There is a wide variety of technologies in the Spanish aquaculture. Shellfish is produced by both on bottom and off bottom systems. *Mussels* are cultivated by an off bottom system consisting in floating rafts, where *the mussels are fixed* to ropes, extracting their food from the surrounding water. Oysters, and a small volume of octopus, are also produced this way. Clams and cockles are produced utilizing on bottom culture on the intertidal flats. Seabream and seabass are produced in extensive or semi-intensive culture in ponds, while the turbot is cultivated by an intensive system in concrete tanks. Trout is generally cultured by intensive systems in raceways supplied with flowing water. Tuna fattening consists of feeding captured fish to improve meat quality, and it takes place in offshore cages.

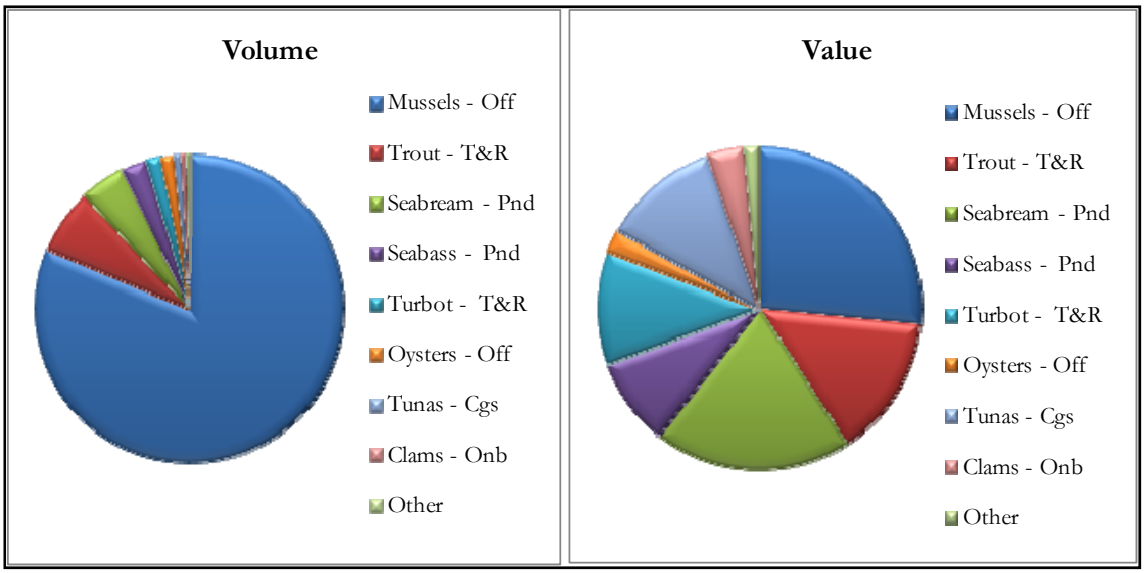

Figure 15.2 Spain - Composition of the volume and value of aquaculture production by species and on-growing technique, 2006.

The level of specialization is high, with most companies clearly allocated to one segment, and producing only one species. In the case of the seabream and the seabass, some companies produce both species, since the on-growing technique is exactly the same. In the case of the turbot culture, some companies have a small production of other species, like red seabream and sole. Most of the turbot companies also integrate to some extent several production phases: hatchery, nursery, on-growing and processing.

The turbot segment is represented by a small number of large producers, with big farms that produce a significant share of the total production volume and value. The shellfish segment*, on the other hand,* is characterized by a great number of small producers, with only one or two rafts per company. The rest of the segments is composed of medium-size companies.

Turbot, seabream/seabass, trout, tuna, mussel and oyster segments have been surveyed taking into account the number of firms.

Table 15.1 Spain - Main segments of the national aquaculture sector.

Group of species	On-growing technique	Number of firms in population
Mussel	Off-bottom	2,065
Oyster	Off-bottom	107
Turbot	Tanks and raceways	19
Seabream	Enclosures	110
Seabass	Enclosures	100
Tuna	Cages	14
Trout	Tanks and raceways	50

15.4. New developments

The period 1996-2006 has been characterized by a remarkable diversification of the produced species. The red seabream, and the meagre, have been successfully introduced. In the case of the red seabream, the only company that controls its culture has programmed production increments for next years. The meagre is a species that can be produced under similar conditions as seabream and seabass, so several companies are producing it. The commercialization of this species is their main challenge. The pollack is also already produced by one Galician company.

Tuna fattening began in 1997 and it has become a highly profitable activity oriented to the Japanese market. The tunas are captured, transported, and enclosed in floating cages distributed along the Mediterranean coast, where the fattening takes place. The 14 existing farms possess between 3 and 10 circular cages of 30-60 m in diameter.

The turbot culture, since it was established in the Galician coast in 1983, has experimented a strong development, and Spain has become the first world producer. The 19 turbot companies utilize concrete tanks or, in some cases, floating cages, and some of them have an annual production above 1,000 tonnes.

The sole, is a species with high potential, but diverse technical and production circumstances prevent its definitive launching. Its production in 2006 remained at about 60-70 tonnes, although several companies produce it.

Other species are in phase of advanced investigation, like the common seabream, the mullet and the octopus, whose fattening in floating rafts has been recently developed successfully.

A small number of companies have recently introduced the culture of seaweeds and new mollusc species like the abalone.

The Ministry of Agricultural, Fishing and Food is elaborating a Strategic Plan of the saltwater aquaculture activity for the next ten years.

15.5. Economic performance

Mussels

The total mussel production in 2006 was 301,866 tonnes and 120.6 million Euro, and profit was 43.6 million Euro. The productivity ratio was 14,500 Euros per employed, and the average price was 0.40 Euro/kg.

New installation and processing technologies are being developed, to open new product lines: refrigerated, frozen and ready-prepared (protected atmospheres).

The shellfish farming needs an Authorisation, conceded to associations for 5 years (extendable) and non-transferable, and an individualised Exploitation License (Permex) for 5 years, extendable and transferable under the authorisation of the Public Administration. Cultures under public maritime property need a Granting of 10 years, (extendable up to 30 and transferable) that implies obligatory royalty payment.

Oysters

In 2006, the total production of oyster was 4,788 tonnes and 12.26 million Euro, and profit was 6.45 million Euro. The productivity ratio was 12,502 Euro per employed, and the average price was 2.56 Euro/kg. Oyster sector is quite stable, with a traditional technology and organisation.

Turbot

The turbot segment is consolidating and increasing the firm size and the production, which is expected to rise from 5,000 to 18,000 tonnes in the next 12 years.

Total production in 2006 was 6,214 tonnes and 51.75 million Euro, and profit was 11.25 million Euro. The productivity ratio was 156,355 Euro per employed. The average price was 8.33 Euro/kg, higher to previous years, in spite of the successive production increments.

The aquaculture turbot is marketed through diverse channels, mainly the traditional fishmarket, but also in supermarkets and big surfaces. There is, however, a bigger tendency to the export that in the other species. Spain produces 81.2% of the turbot of all Europe.

Farming in fixed installations on Maritime-Terrestrial Zone (space between the maximum equinox low tide line and the maximum equinox high tide line) needs an Activity License, of exclusive use. Granting is the only right with monetary value.

The main constraints to the turbot aquaculture development are related to environmental and social welfare costs, as a large portion of the coast is being protected by the National Administration. For example, the Red Natura spaces cannot be used for aquaculture purposes.

Seabream and seabass

The seabream and seabass segment is growing in investments and production. There is not a production quota, like in other European countries.

The total combined production of seabream and seabass in 2006 was 27,275 tonnes and 129.35 million Euro. Profit was 61.97 million Euro. The productivity ratio was 82,600 Euro per employed, and the average price was 4.74 Euro.

The average first sale price of aquaculture seabream in Spain in 2006 was 4.41 Euro/Kg, lightly higher than it was in 2005. Its aggregate first sale value was 89.2 million Euro. The average first sale price of the aquaculture seabass has fallen in 2006 to 4.50 Euro/Kg. Its aggregate first sale value was 40.2 million Euro. Spain is the second European market for the seabass, after Italy. Besides the own production, Spain imports between 5,000 and 8,000 annual tonnes from Greece, Turkey and France. Only a small part of the Spanish production of this species is exported. The commercialization of the aquaculture seabass is carried out mainly through supermarkets and big surfaces, and, in smaller proportion, in traditional fish markets.

Tuna

The total tuna production in 2006 was 2,872 tonnes and 53.49 million Euro, and profit was 3.98 million Euro. The productivity ratio was 19,010 Euro per employed, and the average price was 18.63 Euro.

The tuna production is stabilized in the last years, after a very fast growth. The current constraint for the growth of this activity is the catches of tunas.

Trout

The total trout production in 2006 was 24,940 tonnes and 65.01 million Euro, and profit was 15.10 million Euro. The productivity ratio was 149.795 Euro per employed, and the average price was 2.61 Euro.

The trout farming sector is stabilized, with a quite constant number and size of the firms and production.

15.6. Statistical tables

Stat. table 15.1 Spain - National overview – saltwater fish farming.

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	7.1	51.2	40	510
1997	6.7	48.8	38	483
1998	12.2	105.1	71	729
1999	17.2	176.7	91	995
2000	21.3	225.8	112	3,198
2001	24.6	272.3	127	3,384
2002	27.0	245.4	136	3,501
2003	26.0	175.3	130	3,429
2004	28.9	200.9	145	3,503
2005	29.9	195.1	144	3,597
2006	36.4	190.0	123	3,802

Note 1. Relevant species: Seabream (*Sparus aurata*), Turbot (*Psetta maxima*), Seabass (*Dicentrarchus labrax*), Bluefin tuna (*Thunnus thynnus*).
Note 2. Bluefin tuna volume and value is included for all the period, except 1996, 1997 (not available).

Stat. table 15.2 Spain - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	25.2	46.8	48	101
1997	29.3	59.8	54	113
1998	30.4	59.2	56	117
1999	30.4	68.7	56	117
2000	33.6	81.5	62	129
2001	35.6	90.4	65	137
2002	35.4	81.0	65	136
2003	35.3	66.8	65	136
2004	30.9	55.1	57	119
2005	27.3	55.6	50	105
2006	na	na	na	na

Relevant species: Rainbow trout (*Oncorhynchus mykiss*).

Stat. table 15.3 Spain - National overview – shellfish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies	Employment
1996	227.0	60.3	2,075	19,352
1997	238.4	69.7	2,078	19,849
1998	263.8	97.1	2,078	19,572
1999	277.7	106.9	2,088	17,653
2000	257.2	98.1	2,091	18,034
2001	253.5	108.7	2,100	17,997
2002	249.3	122.8	2,114	17,579
2003	262.1	149.2	2,126	17,153
2004	310.8	171.2	2,126	16,634
2005	226.3	126.1	2,126	15,856
2006	315.3	167.1	na	na

Relevant species: Mussel (*Mytilus galloprovincialis*).

Stat. table 15.4 Spain - National overview – Nurseries and hatcheries

	Volume of production (mln juveniles)	Value of production (mln Euro)	Number of companies	Employment
1996	na	na	na	na
1997	na	na	na	na
1998	na	na	na	na
1999	na	na	na	na
2000	na	na	na	na
2001	na	na	na	na
2002	na	na	na	na
2003	83,650	25.2	12	138
2004	72,965	22.5	12	138
2005	84,380	22.9	13	150
2006	88,707	27.8	14	161

Relevant species: Seabream, seabass, turbot.

Stat. table 15.5 Spain - Review by sub-sector and species (value and volume), 2005

	Volume (1,000 t)	Value (million Euro)	Number of companies	Types of on-growing unit	Employ-ment
Mariculture (marine fish)					
- Turbot	4.3	37.5	19	T&R	270
- Seabream	15.6	67.9	110	E&P	1,100
- Seabass	5.5	25.3	100	E&P	1,100
- Tuna (fattening)	3.7	58.5	14	Cgs	1,939
Freshwater fish culture					
- Trout	26.0	48.4	50	T&R	120
Molluscs and crustaceans					
- Mussels	205.2	97.8	2,065	Off-b	8,200
- Oysters	2.8	9.7	107	Off-b	954
Other					
- Hatcheries / Nurseries (Seabream, seabass, turbot)	84,380.0	22. 9	13	T&R	150

Stat. table 15.6 Spain - Indicators by segment, 2006
(segment totals, value in million Euro),

On-growing technique	Off-b	Off-b	T&R	E&P	Cgs	T&R
Species	Mussel	Oyster	Turbot	Seabream Seabass	Tuna	Trout
Environment	Saltwater	Saltwater	Saltwater	Saltwater	Saltwater	Fresh-water
OPERATIONS – COSTS AND REVENUES						
Turnover	120.59	10.39	51.75	129.35	53.49	65.01
Other income	0.00	0.00	9.27	1.43	13.53	
Personnel costs	39.56	3.02	6.66	15.58	8.97	9.75
Value of unpaid labour						
Energy costs	8.75	0.00	4.88	0.41	4.81	5.85
Live raw material costs	7.23	0.61	0.00	0.00	41.51	0,00
Feed raw material costs	0.00	0.00	12.59	34.50	0.00	27.81
Other costs (1)	21.44	2.18	16.03	12.78	5.08	1.95
Depreciation	0.00	0.00	9.61	5.54	2.67	4.55
Profit (EBIT)	43.60	6.45	11.25	61.97	3.98	15.10
Interest costs (2)	3.01	0.03	0.21	2.88	0.13	0.16
Gross cash flow	46.62	6.48	21.07	70.40	6.79	19.81
Gross value added	86.18	9.50	27.73	85.98	15.76	29.56
BALANCE SHEET – ASSETS AND LIABILITIES (3)						
Net investment in tangible goods	0.11	na	18.61	1.90	9.91	na
Equity capital	0.38	na	13.29	1.22	0.39	na
Debts	0.13	na	5.29	3.03	11.55	na
Total assets	1.66	na	39.77	5.16	23.67	na
EMPLOYMENT						
Total number of persons employed	8,319	981	331	1,566	2,814	434
Full time equivalents (FTE)	1,468	130	285	1,308	935	335
LEGAL STATUS						
Total number of firm	2,065	107	19	110	14	50
Single holder	2,057	96	1	53	0	31
Limited and anonymous co.'s	8	11	18	57	14	19
SALES VOLUME						
Volume in (1000 tonnes)	301.87	4.79	6.21	27.27	2.87	24.94
OTHER DERIVED INDICATORS						
Turnover / FTE (1000 Euro)	82.13	94.07	181.37	98.91	57.21	194.06
Gross value added / FTE (1000 Euro)	58.69	72.87	97.17	65.74	16.85	88.24
Personnel costs / FTE (1000 Euro)	26.94	23.15	23.34	11.91	9.59	29.11
Tonnes / FTE (tones)	205.59	36.72	21.78	20.86	3.07	74.46
Turnover / firm (1000 Euro)	58.40	114.62	2,723.87	1,175.96	3,820.98	1,300.22
EBIT / Total assets (%)	26.22	na	0.28	12.02	0.17	na

Notes:
(1) Includes repair and maintenance and other operational costs.
(2) Interest costs are 'paid interest' (received interests are included in 'other income').
(3) Mean data per firm (not for the whole population): mussel 1 firm, turbot 3 firms; sea bass+sea bream 26 firms, tuna 2 firms.

Stat. table 15.7 Spain - Sales by segment and species.

	Species	**Volume (1000 tonnes)**	**Value (million Euro)**
Segment 1	Mussel	301.87	120.59
Segment 2	Oyster	4.79	10.39
Segment 3	Turbot	6.21	51.75
Segment 4	Seabream/Seabass	27.27	129.35
Segment 5	Tuna	2.87	53.49
Segment 6	Trout	24.94	65.01

16. SWEDEN

16.1. Situation in 2006

The total volume of aquaculture production in Sweden was 9,625 tonnes[37], corresponding to a value of 30.5 million Euros [38]. The total number of farming units was 535 (302 active and 233 under construction or temporarily inactive)[39], corresponding to 219 juridical persons[40]. The total number of persons employed has been estimated at 400[41].

The majority of production took place amongst a few large firms; the 6 largest accounted for 51.9% of the total value of all aquaculture production in Sweden. The most profitable segment was rainbow trout (for human consumption) reared in freshwater using cages, which had a mean turnover per firm of 0.5 million Euros and a mean profit of 0.06 million Euros The second most profitable segment was rainbow trout produced for both human consumption and stocking purposes using a combination of production techniques[42], which had a mean turnover per firm of 0.3 million Euros and a mean profit per firm of 0.02 million Euros.

The main species produced in 2006, was rainbow trout with a total volume of 6,787 tonnes, corresponding to a value of 22.9 million Euros and representing 70% of Sweden's total aquaculture production. The production of rainbow trout was undertaken by 110 firms (50% of the total number of aquaculture firms) who had rainbow trout as their main species (measured as share of sales value). Production of brown trout amounted to 232 tonnes and a value of 1.8 million Euros and was undertaken by 25 firms. In addition, there were 7 firms producing a total of 567 tonnes of arctic char valued at 1.7 million Euros and 5 firms producing 1,791 tonnes of blue mussels, corresponding to a value of 1.0 million Euros.

16.2. Main trends

Over the period 1996 to 2006, the recorded production levels ranged from 5,500 tonnes (in 1998) to 9,700 tonnes (in 2006). Meanwhile, the value of total production increased from 14.5 million Euros in 1998 to 30.5 million Euros in 2006. During the same period, there was a decline both in terms of farming units and employment[43] indicating a process of consolidation and streamlining within the sector, and there has been a steady growth in both volume and production value since 1999, with the exception of minor dips in 2002 and 2005.

When looking at the aquaculture production segment by segment, it is clear that trends both in terms of production volume and value vary greatly between segments. Marine production had its peak in 1996, when a total of 2,900 tonnes were produced at a value of 6.7 million Euros and reached its low in 2003 at 1,300 tonnes, corresponding to a value of 3.3 million Euros. However, since 2003 both the volume and value of saltwater aquaculture has been increasing steadily although not reaching the figures recorded in the beginning of the period.

In 1996, freshwater production amounted to 3,200 tonnes, corresponding to a value of 9.4 million Euros, after which it decreased to 3,000 tonnes in 1998, corresponding to a value of 9.2 million Euros. It reached its highest figures yet in 2006 when a total of 6,100 tonnes was produced corresponding to a value of 24.6 million Euros. To sum up, both the volume and value of freshwater production increased significantly

[37] Statistics Sweden 2006
[38] Pilot study
[39] Statistics Sweden 2006
[40] Pilot study
[41] Pilot study
[42] The technique employed is a combination of cages, raceways and ponds.
[43] Statistics Sweden 1996-2006

over the period; the volume increased by 91% and the value by 162%.[44] At the same time, the number of firms declined.

Shellfish production fluctuated over the same period (1996-2006), especially during the first 5 years, but both production volume and value have stabilised since 2001. Shellfish production amounted to a mere 500 tonnes, corresponding to a production value of 0.6 million Euros in 1998 as well as in 2000, while peak production volumes of 1,800 tonnes were recorded in 1996 as well as in 2006. The value of shellfish production reached its highest value yet at 1.3 million Euros in 2006. Recently (in 2007 and 2008) large production sites, mainly producing mussels and oysters (including one oyster hatchery), have been established which ought to have a positive impact on future production. Experts in the aquaculture sector assess that there is also an increasing interest for crayfish farming; the production volume is likely to increase over the next few years.

In conclusion, the total volumes and values of fish production in marine waters have decreased while fresh-water and shellfish production is small but growing.

It should be noted that during the period 1996 to 1999, only data on fish for consumption were collected. Since fish for stocking purposes is mostly produced in freshwater, this mainly affects the times series for freshwater production.

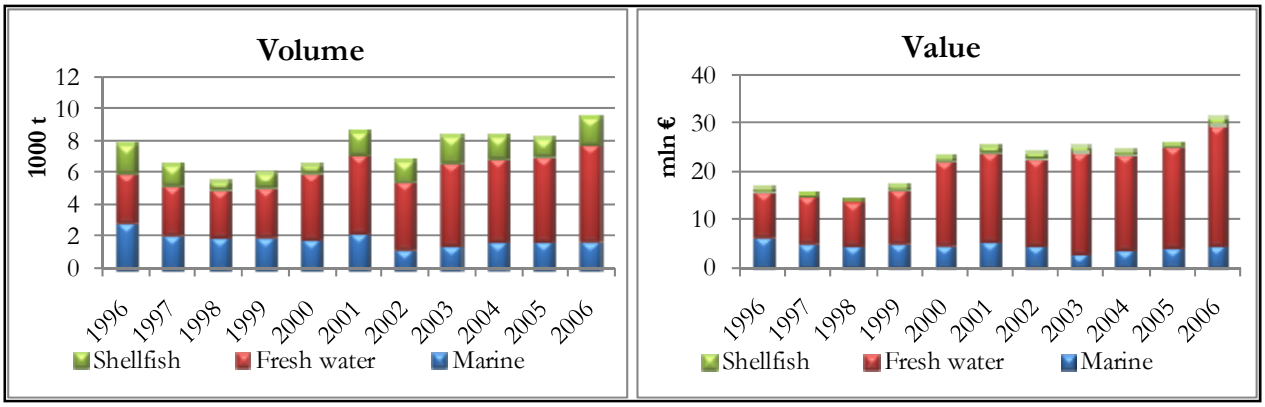

Figure 16.1 Sweden - Volume and value of aquaculture production, 1996-2006

16.3. Structure of the sector

Companies are mostly specialised in production for either consumption or stocking purposes, but there are also companies that produce both fish for consumption and for stocking purposes.

Next to rainbow trout, Arctic char, brown trout and European eel are the fish species mainly produced in Swedish aquaculture. Production of Arctic char represents 6% of total aquaculture production, both in terms of volume (600 tonnes in 2006[45]) and value (1.7 million Euros in 2006[46]). Although the production of European eel only amounted to 200 tonnes in 2006, its value was 2.2 million Euros accounting for 7% of the total value of the aquaculture production. The main technique used in both Arctic char and brown trout production is cages while European eel is produced, using recirculation systems. A small number of firms produce salmon for stocking purposes using raceways. In 2006, approximately 50 tonnes of salmon were produced at an estimated value of 0.7 million Euros[47]. Crayfish is held in ponds and produced for consumption as well as for stocking purposes. The volume of crayfish produced as presented in the

[44] Volumes refer to Statistics Sweden 1996-2006 while the value of production for 2006 refers to the pilot study and value of production for the years 1996-2005 refer to Statistics Sweden 1996-2006.
[45] Statistics Sweden 2006
[46] Pilot study
[47] Calculations based on data from Statistics Sweden 2006

national statistics is low; only 7 tonnes were reported in 2006[48], but earlier specific studies indicate a production about ten times higher.[49]. Blue mussels are produced at sea, on long-lines or nets (off-bottom), and to a very small degree, harvested by dredgers[50].

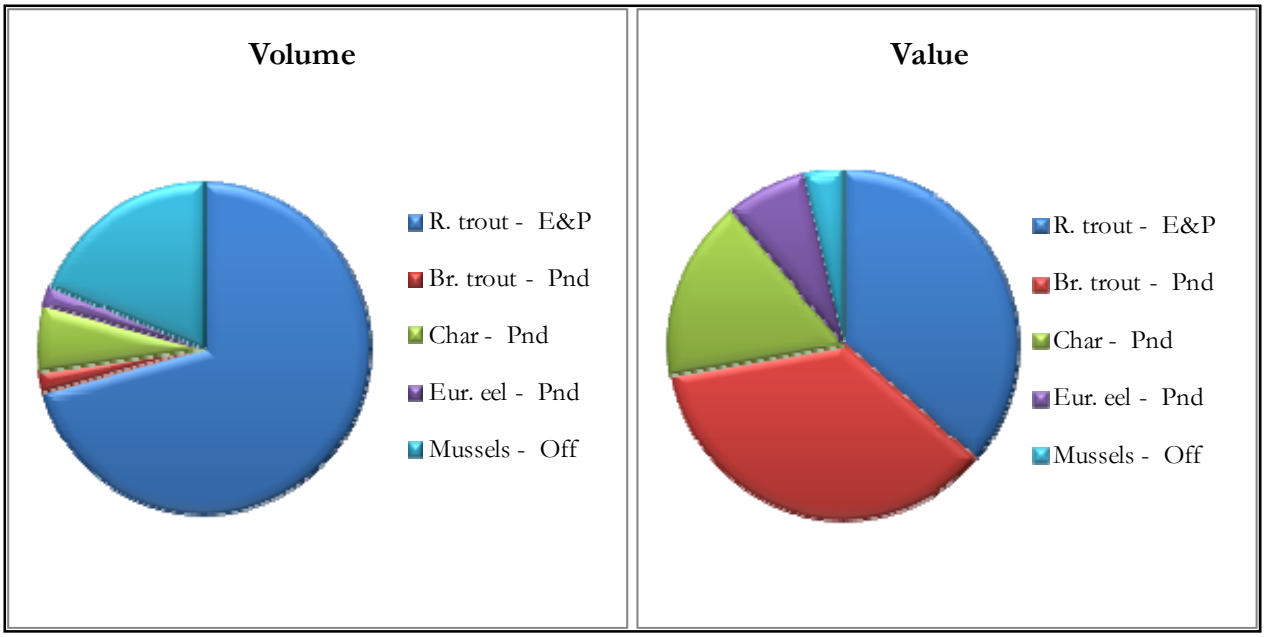

Figure 16.2 Sweden - Composition of the volume and value of aquaculture production by species and on-growing technique, 2006

Table 16.1 Sweden - Main segments (by value) of the aquaculture sector

Group of species	On-growing technique	Number of firms in population
Rainbow trout	Cages	60
Rainbow trout	Ponds	20
Rainbow trout	Tanks and raceways	5
Rainbow trout	Combination of ponds, cages and tanks/raceways	25
European eel	Recirculation system	2
Brown trout	Ponds	23
Brown trout	Cages	2
Arctic char	Cages	7
Blue mussels	Off bottom (long-lines and nets)	5

For rainbow trout farming as a whole, irrespective of environment (i.e. saltwater or freshwater), rainbow trout is the sole species for 76% of all firms while the remaining 24% raise several species. Approximately 48% of all rainbow trout farms have hatcheries. It is the sole species for 72% of the freshwater firms and for 91% of the saltwater firms. More than half of the freshwater firms have hatcheries while the situation is opposite in production of rainbow trout in marine environment.

The economic data of aquaculture production in Sweden indicate a large gap between small and large producers. The 6 largest firms account for more than half of the total turnover. Further, the lower half of the total number of companies has a mean sales value of 574 Euros while the mean sales value for the entire population of firms is 0.1 million Euros. Looking at each segment and sub-group, the picture of a few large firms dominating the aquaculture sector in Sweden is further strengthened. Production of rainbow trout in freshwater for stocking purposes reveals a more even spread of company sizes as the

[48] Statistics Sweden 2006
[49] Pilot study
[50] Swedish Parliament 2007

mean turnover of the forth quartile is 3 times that of the third quartile, while the mean turnover of the higher median is almost twice as high as the mean turnover of all companies in the subgroup. The production of arctic char is undertaken by a mere of 7 firms, producing 600 tonnes to a value of 1.7 million Euros.

Table 16.2 Sweden - Segments that can be surveyed in production of rainbow trout

Species	Environment	On-growing technique	Number of firms in population	Number of firms in population when separating for end-use
Rainbow trout	Freshwater	Cages	38	23
Rainbow trout	Freshwater	Ponds	20	7
Rainbow trout	Freshwater	Combination of cages, ponds and tanks/raceways	25	16
Rainbow trout	Marine environment	Cages	22	21

*End-use refers to if the firm is producing fish for consumption, fish for stocking purposes or fish for both consumption and stocking purposes.

In terms of brown trout production, it is possible to survey the freshwater production regardless of whether the fish is for consumption or for stocking purposes, as you have a total of 23 firms. If separating between fish for consumption, fish for stocking purposes and firms producing fish for both consumption and stocking purposes, it is possible to show brown trout in freshwater for stocking purposes as there are 18 firms involved in this group. As regards crayfish production, there are a total of 63 firms; 48 firms producing signal crayfish (pacifastucus leniusculus) and 15 firms producing noble crayfish (astacus astacus,). However as the statistics are not reliable, no data are given.

Because of the low number of firms involved in rainbow trout production using raceways, the production of blue mussels, European eel and salmon respectively, it has not been possible to produce statistics on these segments.

16.4. New developments

A new segment in Swedish aquaculture is oyster production, where small pilot farms have been established along the west coast of Sweden in recent years. For example, hatcheries for oyster fry are underway, and one large-scale oyster production company opened its oyster fry hatchery in August 2008. The production technique used for rearing the oysters from fry to consumption-ready size is long-lines with hanging bags.[51, 52]

Perch is currently being farmed in two small-scale pilot projects, both using environmentally friendly techniques. Further, there is experimental cultivation of African catfish.[53] A report from the Ministry of Agriculture concluded that, in terms of new species, catfish, cod and bass has the best development potential.[54] The potential for cod farming is highest along the southern Baltic and west coasts of Sweden[55].

The same report from the Ministry of Agriculture identifies some further possibilities for the aquaculture sector in Sweden. In particular the possibility of blue mussels to be farmed on the basis of environmental concerns, as mussels can absorb nutritive salts from the water and hence reduce impact from agriculture and other sources. An increased production of blue mussels is made possible by the fact that many

[51] Personal communication, Björn Lindblad 071206
[52] Swedish Parliament 2007
[53] Personal communication, Ulf-Peter Wichardt 071130
[54] Swedish Parliament 2007
[55] Bailey et al. 2005

permits are currently underutilised (if used at all).[56] Recent interest in mussel production as a method of reducing nitrogen levels has resulted in discussions to create a system for mussel producers whereby they can be compensated by either the state or by farmers who are emitting nitrogen to the sea. Within the framework of these discussions, it has also been put forward that the mussels produced, could be used as an organic fertilizer or as organic fodder, apart from for human consumption. For example, the municipality of Lysekil, a town on the west coast of Sweden, has an on-going pilot project to grow and harvest mussels instead of expanding their sewage-treatment plant.[57] A number of new firms in mussel farming have been established in the last couple of years[58].

There are some incentives for new developments in the aquaculture sector in the way of structural support from the European Fisheries Fund (EFF). The Swedish Operational Programme gives priority to measures increasing profitability, new production techniques, new techniques that reduce the environmental impact and measures in the field of preventing damage caused by wild predators (seals etc.). In the first call for applications, which included applications submitted up until 30 June 2008, applications relating to aquaculture exceeded the budget available by a factor of two. No decisions have been taken yet by the competent Swedish authorities. Applications cover a whole range of activities and segments but the bulk of applications concern increased production of arctic char and blue mussels.

16.5. Economic performance

Swedish aquaculture struggles with low profitability in all segments apart from the farming of fish for stocking purposes. During the last ten years, the aquaculture sector has undergone structural changes. Large firms have become increasingly larger whereas the number of small firms has decreased. The trend of consolidation is expected to continue. No intangibles were reported.

The majority of new firms consists of investments from Finland and Norway - either through market entries or through take-overs of existing permits held by Swedish firms. The relatively good profitability in the production of Arctic char might be offset by a reduction in the currently high price level as production increases.

The market for blue mussels in Sweden is good and there is a potential for increased production, although the main share is currently exported. The price level for fresh mussels ready for consumption on the Swedish market is low compared to other European markets. However, no Swedish mussels are used in the domestic processing industry.[59] A number of new mussel firms have been established in the last couple of years - a development of the sub-sector that is expected to continue over the next few years. New firms have also entered the sector of crayfish culture during the past couple of years[60].

Large-scale firms, especially in the northern parts of Sweden, show a good profitability, but the market potential for Swedish fish farming as a whole remains bleak. The County Administrative Board of Västra Götaland puts the uncertain future for Swedish farmed fish down to fierce competition between the Nordic countries while perceiving the presence of toxic algae as the main obstacle for mussel production. The competition is particularly fierce from Norway; Norwegian farmed salmon dominate the Swedish fish market along with farmed, portion sized rainbow trout from Denmark.[61]

16.5.1.

[56] Swedish Parliament 2007
[57] Lindahl et al. 2005
[58] Swedish Parliament 2007
[59] Kollberg 1999
[60] Swedish Parliament 2007
[61] Swedish Parliament 2007

16.5.2. Surveyed segments

In this section, the results from the Swedish aquaculture pilot study of 2008 are presented, covering the sector in 2006. The pilot study consisted of surveys conducted by Statistics Sweden and Fiskhälsan AB. Statistics Sweden yearly collects, calculates and publishes production volume and income of the sector.

While the production volume figures have been retrieved directly from Statistics Sweden's publication, the data on economic indicators, e.g. turnover, profits and staff costs, have been obtained by Statistics Sweden from the company income declaration. All mean values presented by Statistics Sweden have been correlated according to the response rate. The figures have been supplemented by information gathered by Fiskhälsan AB on energy costs, costs for juvenile fish and feed raw material as well as on the amount of full time, seasonal and unpaid labour.

In order to deliver the economic indicators requested, it has been necessary to make a number of assumptions; e.g. the price of a certain species was assumed to be the same irrespective of the farming technique used. Further, it was assumed that the price of certain species will not be affected by its end use.

Rainbow trout in cages (freshwater)

In 2006, a total of 23 firms were engaged in the production of rainbow trout in freshwater for consumption using cages as on-growing technique. All 23 firms were included in the survey conducted by Statistics Sweden but only the responses of 10 firms could be processed.

The segment showed a mean profit per firm of 57,000 Euros, equivalent to 1.3 million Euros for the segment in total, while the mean turnover per firm was 0.5 million Euros (12 million Euros for the segment as a whole). Personnel costs amounted to 31,000 Euros per firm, representing 8% of total costs per firm, while the value of unpaid labour amounted to an estimated value of 2,000 Euros (54,000 Euros for the segment as a whole). The gross cash and the gross value added flow indicate a profitable segment, albeit at a low level

Rainbow trout in ponds (freshwater)

In 2006, there were 7 firms producing rainbow trout for stocking purposes in freshwater using ponds as the on-growing technique. All 7 firms were included in the survey but only 4 firms responded.

The segment showed a mean profit per firm of 12,000 Euros, totalling 82,000 Euros the segment as a whole, while the mean turnover per firm was 51,000 Euros (0.4 million Euros for the segment as a whole). The segment has the highest estimated number of unpaid labour among the segments surveyed: Both the indicators of gross cash flow and gross value added are low.

Rainbow trout in combinations of ponds, cages and raceways (freshwater)

In 2006, there were 58 firms producing rainbow trout in freshwater using a combination of ponds, cages and raceways or using one of these techniques. It was not possible to look at each technique individually as production is divided into fish for consumption, fish for stocking purposes and production for both consumption and stocking purposes. 23 firms responded to the survey.

The segment showed a mean profit per firm of 3,000 Euros, equivalent to 0.2 million Euros for the segment as a whole, while the mean turnover per firm was 97,000 Euros (5.6 million Euros for the segment as a whole). The estimated number of unpaid labour per firm in the segment is slightly above the average. Gross cash flow (0.8 million Euros) is average compared to the other segments while the segment has the second highest gross value added: 2.2 million Euros.

Rainbow trout in cages (saltwater)

In 2006, a total of 21 firms were producing rainbow trout, for consumption, in marine environment using cages. 13 firms responded to the survey.

The segment showed a mean profit per firm of 33,000 Euros, equivalent to 0.7 million Euros for the segment as a whole, while the mean turnover per firm was 0.2 million Euros (4.7 million Euros for the segment as a whole). The estimated number of unpaid labour per firm is the lowest among the segments studied, indicating a low dependence on unpaid labour. Gross cash flow (0.9 million Euros) is average compared to the other segments while the segment has a relatively high gross value added: 2.1 million Euros.

Brown trout in cages (freshwater)

In 2006, a total of 23 firms produced brown trout in freshwater using ponds. 8 firms responded to the survey.

The segment showed a mean profit per firm of 9,000 Euros while the mean turnover per firm was 76,000 Euros. Both gross cash flow and gross value added showed average figures.

Arctic char in cages (freshwater)

In 2006, a total of 7 firms were producing Arctic char in freshwater using cages. 4 firms responded to the survey.

The segment showed a mean profit per firm of 4,000 Euros while the mean turnover per firm was 0.2 million Euros. Gross cash flow is negative while gross value added is at the lower end of the segments surveyed.

Signal and noble crayfish in ponds (freshwater)

Since the figures are only indicative and not statistical reliable, no figures are inserted into the tables except for the number of companies which is 63. Among the 48 firms producing signal crayfish only 6 firms responded to the survey and among the 15 firms producing noble crayfish only a third responded.

Blue mussels on long-lines/off-bottom

By definition, all firms farming blue mussels did so in a marine environment. Although there were 5 firms cultivating blue mussels using long-lines (off-bottom technique) in 2006, only 2 firms responded to the survey conducted by Statistics Sweden and it is therefore not possible to present any detailed data regarding the segment's economic performance.

If looking at the figures provided in the annual publication on aquaculture by Statistics Sweden, the segment has a turnover of 1 million Euros, corresponding to a remarkable turnover per firm of 200,000 Euros. Hence, the profitability ought to be high amongst the firms producing blue mussels. It is important, however, to keep in mind that the turnover has been deducted from the annual publication by Statistics Sweden and so not compiled in the same manner as the turnover figures for the other segments surveyed.

16.6. Statistical tables

Stat. table 16.1 Sweden - National overview – saltwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies*	Employment**
1996	2.9	6.7	52	
1997	2.2	5.2	51	
1998	2.0	4.7	37	
1999	2.0	5.3	36	
2000	1.9	4.9	35	
2001	2.3	5.5	33	
2002	1.3	4.9	36	
2003	1.5	3.3	34	
2004	1.7	3.9	31	
2005	1.8	4.3	26	
2006	1.8	4.9	24	26

Stat. table 16.2 Sweden - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies*	Employment**
1996	3.2	9.4	136	
1997	3.1	9.7	132	
1998	3.0	9.2	133	
1999	3.1	10.9	128	
2000	4.3	17.7	261	
2001	5.0	19.0	287	
2002	4.2	18.3	263	
2003	5.3	21.4	248	
2004	5.4	20.1	245	
2005	5.4	21.3	230	
2006	6.1	23.2	127	271

Stat. table 16.3 Sweden - National overview – shellfish farming

	Volume of production (1000 t)	Value of production (mln Euro)	Number of companies*	Employment**
1996	1.8	0.8	144	
1997	1.4	0.8	143	
1998	0.5	0.6	134	
1999	1.0	1.0	139	
2000	0.5	1.0	116	
2001	1.5	1.3	110	
2002	1.4	1.1	123	
2003	1.7	1.0	125	
2004	1.4	0.8	122	
2005	1.1	0.7	110	
2006	1.8	1.3	68	

Source: Statistics Sweden 1997 – 2007 (volumes and value) and pilot study data gathered/processed by Statistics Sweden and Fiskhälsan AB (number of companies and employment)

*The number of companies for the years 1996 – 2005 reflects the number of aquaculture sites. Since each company can have several sites the numbers do not reflect the number of companies. The number of companies is only available for 2006 and will also be available for the forth-coming years.
**The total number of employed in aquaculture in Sweden has previously been calculated to approximately 400 persons, where an estimated 85 % are male and 15 % are female.

Stat. table 16.4 Sweden - Review by sub-sector and species (value and volume), 2006

	Volume (1000 t)	Value (mln Euro)	Number of companies	Types of on-growing unit	Employ-ment
Mariculture (marine fish)					
- Rainbow trout	1.8	4.7	22	Cages	24
- Brown trout			2	Cages	2
Freshwater fish culture					
- Rainbow trout	4.5	15.2	38	Cages	159
- Rainbow trout	0.0	0.4	20	Ponds	23
- Rainbow trout	0.0	0.0	5	Tanks and raceways	10
- Rainbow trout	0.5	2.6	25	Combined Pnd, E&P, T&R	33
- Arctic char	0.6	1.7	7	Cages	13
- Brown trout	0.2	1.8	23	Cages	23
- European eel	0.2	2.2	2	Recirculation systems	6
- Salmon	0.0	0.7	3	Tanks and raceways	4
Molluscs and crustaceans					
- Blue mussels	1.8	1.0	5	Off bottom	
- Crayfish	0.0	0.2	63	Ponds	

Source: Own processing of data from Statistics Sweden 2007 and pilot study (Statistics Sweden and Fiskhälsan AB)

Stat. table 16.5 Sweden - Indicators by segment, 2006
(segment totals, value in million Euro)

On-growing technique	Cages	Ponds	All other*	Cages	Cages
Species	Rainbow trout	Rainbow trout	Rainbow trout	Rainbow trout	Brown trout
Environment	Freshwater	Freshwater	Freshwater	Saltwater	Freshwater
OPERATIONS – COSTS AND REVENUES					
Turnover	12,2	0,4	5,6	4,7	1,8
Other income	-0,9	0,0	0,0	0,6	0,0
Personnel costs	0,7	0,0	1,3	0,9	0,4
Value of unpaid labour	0,1	0,0	0,2	0,1	0,1
Energy costs	0,1	0,0	0,2	0,0	0,1
Live raw material costs	0,5	0,0	0,2	0,6	0,4
Feed raw material costs	4,7	0,1	1,6	2,2	0,3
Repair and maintenance	0,0	0,0	0,0	0,0	0,0
Other operational costs	2,7	0,1	1,6	0,8	0,5
Depreciation	0,4	0,0	0,4	0,2	0,1
Profit (EBIT)	1,3	0,1	0,2	0,7	0,2
Interest costs	0,1	0,0	0,1	0,2	0,0
Gross cash flow	2,7	0,1	0,8	0,9	0,1
Gross value added	2,5	0,2	2,2	2,1	0,8
BALANCE SHEET – ASSETS AND LIABILITIES					
Net investment in tangible goods	6,1	0,1	2,3	2,5	0,6
Equity capital	5,1		3,0	2,4	0,5
Debts	2,4		3,8	3,5	0,2
Total assets	8,6		7,3	6,2	0,7
EMPLOYMENT					
Total number of persons employed	96,1	7,9	122,0	22,6	23,0
Full time equivalents (FTE)	96,1	7,9	122,0	22,6	23,0
LEGAL STATUS					
Total number of firms	23	7	58	21	23
Single holder	11	0	25	5	15
Limited and anonymous co.'s	12	7	33	16	8
SALES VOLUME					
Volume in (1000 tonnes)	3,6	0,1	1,3	1,8	0,2
OTHER DERIVED INDICATORS					
Turnover / FTE (1000 Euro)	126,8	45,0	46,2	206,9	76,2
Gross value added / FTE (1000 Euro)	26,4	25,9	18,1	92,1	36,9
Personnel costs / FTE (1000 Euro)	7,3	6,2	10,6	38,1	18,1
Tonnes / FTE (tonnes)	37,9	8,0	10,7	78,2	10,1
Turnover / firm (1000 Euro)	529,8	50,9	97,3	222,9	76,2
EBIT / Total assets (%)	15		3	11	29

Source: Own processing of data from Statistics Sweden 2007 and pilot study (based on data provided by Statistics Sweden and Fiskhälsan AB)
*Combinations of ponds, cages and tanks/raceways

Table 16.5 cont.

On-growing technique	Cages	Ponds	Ponds	Off bottom
Species	Arctic char	Signal crayfish	Noble crayfish	Blue mussels
Environment	Freshwater	Freshwater	Freshwater	Saltwater
OPERATIONS – COSTS AND REVENUES				
Turnover	1,72			1,00
Other income	0,18			
Personnel costs	0,41			
Value of unpaid labour	0,11			
Energy costs	0,10			
Live raw material costs	0,67			
Feed raw material costs	0,74			
Repair and maintenance	0,01			
Other operational costs	0,36			
Depreciation	0,06			
Profit (EBIT)	0,03			
Interest costs	0,05			
Gross cash flow	-0,39			
Gross value added	0,66			
BALANCE SHEET – ASSETS AND LIABILITIES				
Net investment in tangible goods	0,98			
Equity capital	0,48			
Debts	1,09			
Total assets	1,56			
EMPLOYMENT				
Total number of persons employed	13,22			
Full time equivalents (FTE)	13,22			
LEGAL STATUS				
Total number of firms	7	48	15	5
Single holder	6			
Limited and anonymous co.'s	1			
SALES VOLUME				
Volume in (1000 tonnes)	0,57			1,80
OTHER DERIVED INDICATORS				
Turnover / FTE (1000 Euro)	130,01			
Gross value added / FTE (1000 Euro)	49,93			
Personnel costs / FTE (1000 Euro)	31,07			
Tonnes / FTE (tonnes)	42,88			
Turnover / firm (1000 Euro)	245,57			200,00
EBIT / Total assets (%)	0,02			

Source: Own processing of data from Statistics Sweden 2007 and pilot study (based on data provided by Statistics Sweden and Fiskhälsan AB)

17. UNITED KINGDOM

17.1. Situation in 2006-7

The UK aquaculture sector produced 178,000 tonnes of product in 2006 worth 688 million Euro with 624 companies employing 2,207 people.

17.2. Main trends

The last ten years has seen significant consolidation in the UK's most economically important sector, salmon. Salmon production grew from 83,000 tonnes in 1996 to 169,000 tonnes in 2003 but then reduced to 131,000 tonnes in 2006. Production has now stabilized and increases are likely over the short-term with the strengthening of salmon prices. With the slump in salmon prices over the mid 1990s in the face of production competition from Norway and Chile, a number of farms have diversified into new marine species such as cod and halibut, but the salmon sector remains the dominant aquaculture businesses in volume and value terms.

Trout (predominantly rainbow trout, but also some brown trout for restocking, brook trout and Arctic char) is produced throughout the UK. Most English production is pond-based whilst much of Scottish production is cage farmed in both fresh and saltwater, although there has been a recent move to intensive recirculated raceway systems. Production has been relatively stable at around 17,000 tonnes since the mid 1990's. Prices have also remained consistent. This has been aided through the coordination of production to avoid harvest peaks and inter-industry competition. In Scotland one cooperative is responsible for almost 90% of the supply base and is creating considerable demand for its products. Demand is currently outstripping the supply of large trout to fulfil orders from UK supermarkets for vacuum packed fillet portions, in natural and value added formats, leading to a firming of prices in 2005 that continue today.

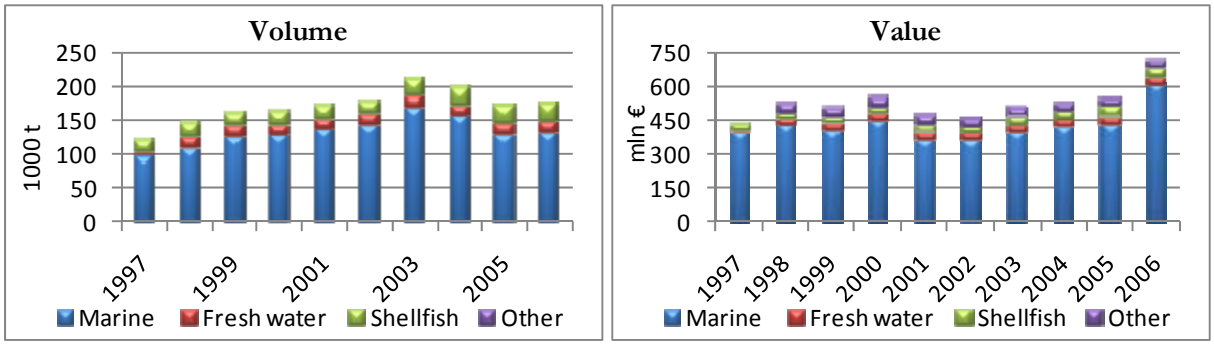

Figure 17.1 UK - volume and value of aquaculture production, 1997-2006
Sources: FRS Scottish Finfish Farm Survey, Shellfish Farm Survey; CEFAS Trout News, Shellfish News, Finfish News

17.3. Structure of the sector

UK aquaculture is dominated by the intensive cage production of Atlantic salmon in the Highlands and Islands of Scotland. While overall the industry has shown considerable growth, this growth stalled in the late 1990's with an outbreak of ISA[62] reducing expected growth in annual production and hindering planned production as sites were quarantined. Production continued to grow, however, to a peak of nearly 170,000 tonnes in 2003, which coincided with historically low prices being achieved for Scottish salmon. Production decreased to 2000 levels of between 120-130 thousand tonnes and maintained year on year increases in overall value of production from 367 million Euro in 2001 to just below 600 million Euro with the record prices seen in 2006. Further production recovery to around 137,000 tonnes is expected for

[62] Infectious salmon anemia

2007. Additionally, the total number of staff employed in salmon production in 2006 was 871, a decrease of 108 compared with 2005[63] .

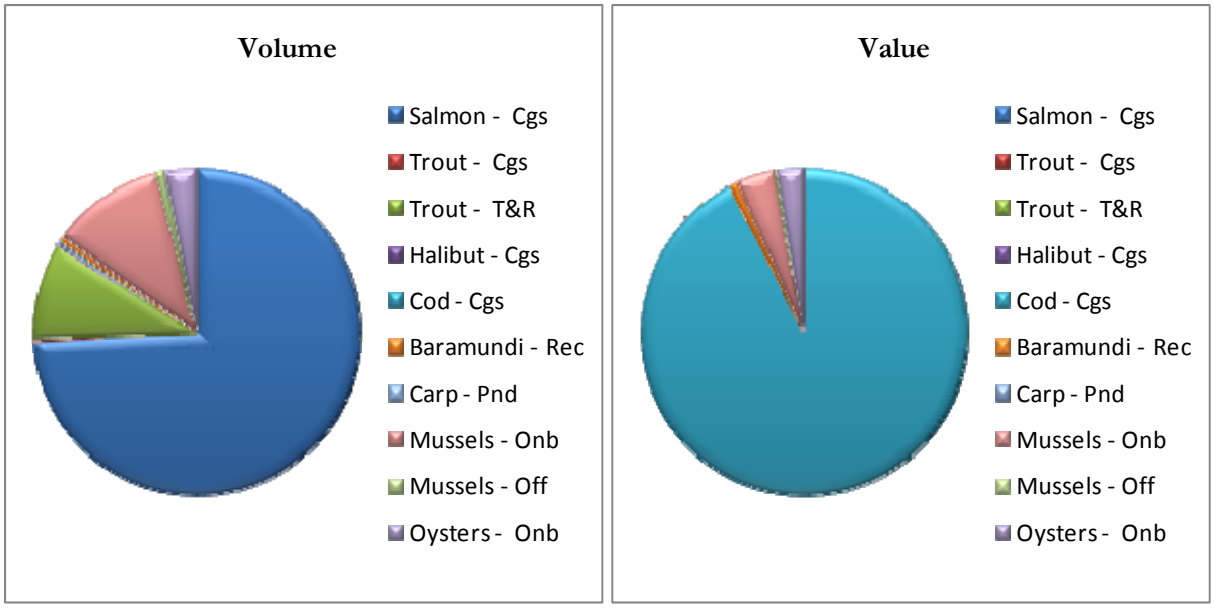

Figure 17.2 UK, Composition of the volume and value of aquaculture production by species and on-growing technique, 2006

Table 17.1 UK - Main segments of the national aquaculture sector

Group of species	On-growing technique	Number of firms in population
Marine salmon and trout	Cages, ponds, tanks & raceways	43
Other marine finfish	Cages, ponds, tanks & raceways	48
Freshwater trout	Ponds, tanks & raceways	202
Other freshwater finfish	Ponds	n/a
Molluscs	On-bottom, off-bottom	331

Whilst the UK aquaculture sector is dominated by Scottish salmon production, there is regionally important production of trout, halibut and cod and there is also a large shellfish sector, mainly comprising of mussels, oysters and scallops.

Trout production, which is approximately 13% by volume of that of salmon, involved 206 companies. This is because the scale of productivity is much smaller from the largely pond-based farms with low level of output and high labour requirements. This is echoed by the shellfish industry which involves 331 companies, often producing relatively small quantities of product from a large number of sites. Employment also reflects this diversity in productivity. Although salmon production involves the largest number of people (approximately 871), productivity is high at 132t per person. In contrast trout productivity is under a third of this at 39 t/person. The most labour intensive industry is shellfish farming which employed 793 persons in 2006, even though the total value of the industry is a tenth of that of salmon.

Shellfish farming is dominated by mussels (21,500 tonnes in 2006, worth 26.9 million Euros) and oysters (3,400 tonnes, worth 17.2 million Euros). The majority of English and Welsh shellfish production is bottom-grown in the Wash and the Menai Straits respectively. Scottish production tends to be the higher value rope-grown mussels produced in the sea lochs of Shetland and western Scotland.

[63] FRS, 2007 'Scottish Fish Farms Annual Production Survey, 2006'

The main new development in UK aquaculture is the diversification of many salmon interests into production of other marine finfish species. This is prompted by poor prospects for some salmon producers and increasing whitefish prices with low wild supplies making aquaculture of novel species economically viable. The various technical barriers that previously limited production of these species have gradually been overcome. It is likely that this segment will continue to grow. Most commercial production of novel species has been cod and halibut (with trials of haddock) at old salmon farming sites in Scotland. Some additional species including barramundi are now being grown using recirculation technology that can overcome environmental constraints such as sea temperature. Recent increases in sea temperature have not led to the culture of finfish species in open water systems, but culture trials are ongoing with warmer-water shellfish species such as abalone, which have historically been limited to the southern-most regions of the UK.

In general, UK aquaculture remains in distinct segments, with the great majority grown for the table. Trout production is more complex as there are a larger number of pArcticipants with a diverse number of production options e.g. fingerling production, on-growing for the table and on-growing for open-water stocking. There is some diversification into culture of other marine finfish species, which might utilise similar sites to salmon. There are also small-scale trials in new shellfish species such as clam and abalone for the table and a few examples of lobster and native crayfish hatcheries for restocking purposes.

The production of ornamental fish is characterised by small scale operators with individual outputs generally less than 1 tonne per annum[64]. There are no published figures, but the Ornamental Aquatic Trade Association (OATA) puts the first hand sales value at up to 22 million Euros.

In conclusion, the main segments to be surveyed will be the dominant salmon and trout farming, as well as the emerging marine species. In addition it will be important to understand more of the economic performance of shellfish production.

17.4. New developments

In general, trout and salmon has matured and thus the pace of technological development has slowed with one key development being the substitution of the fishmeal & oil component of feeds with vegetable-based meals and oils. The most significant scope for cost reductions in Scotland is through increasing production at the largest, best performing sites to obtain economies of scale. There is a growing polarity between these multi-national large-scale producers that are competing directly with other volume producers (currently Norway and Chile) and the remaining small-scale producers that are targeting high value niche markets including organic production.

Scottish trout farming has also changed in that around 40% of the industry has changed from freshwater cage sites on lochs (lakes) to intensive recirculation systems based on Danish technology. This has resulted in the economic improvement of trout farming, especially in the face of riding feed prices. This technology, which has historically been supported by FIFG, has a smaller environmental impact.

17.5. Economic performance

Salmon (cage culture)

Salmon production in 2006 was over 130,000t with a value of approx. 1,098 million Euros. This represents by far the largest aquaculture sector in the UK; ten times larger than the trout production sector.

[64] England and Wales ornamental fish production in 2006 (by number, in thousands) was orfe 4,479; ghost koi 1,861; shubunkins 1,217; koi 432; goldfish 266; carp 215; tench 206; barbel 50; chub 50; clownfish 38; sturgeon/starlet 4; angelfish 3; rudd 3; bream 3; and roach 2 thousand (Iain Laing, CEFAS, pers. comm., 2008).

Major consolidation in the salmon industry has occurred over the last decade with 44 companies remaining. The largest six companies account for the greater proportion of production volume is Norwegian-owned.

The consolidation and increase in scale of operations has been achieved with increasing levels of mechanisation (e.g. in feed systems) and economies of scale that mean production per employee has increased to 167t per FTE (compared to trout at 20t per FTE). The next highest productivity per employee is 110t per FTE in the mussel sector which is influenced by the highly mechanised bottom culture sector (407t/FTE).

UK salmon production occurs almost solely in Scotland (a Northern Ireland producer recently suspended operations after a catastrophic mortality event caused by jellyfish infestation). Some smolt production is based in the north of England.

2006 represented a good year for salmon production with the companies surveyed showing an average pre-tax profit margin of almost 30%. This is due to record high salmon prices peaking in 2006; several previous years saw loss-making operations due to poor salmon prices. The high level of interest costs paid (4% of turnover) and the level of debts reported indicates the high level of borrowing within the sector.

Net investment in tangible goods by the sector is calculated to be around 80 million Euro. Therefore even in a year with very good prices, representing 15% of equity, which reflects the significant level of ongoing investment required in the industry. This contrasts with the trout sector which shows a negative net investment (due to the depreciation of assets).

Intangible assets include planning consents and discharge consents, which are both needed before production is permitted. These licenses both contribute to the value of the company to some extent. The discharge consent is reviewed every two years, while the planning consent now awarded by the local authority is in perpetuity rather than the previous 15 year basis when authorised by the Crown Estate. A rent of approx €0.2/kg is payable to the Crown Estate on an annual basis based on the value of production. This typically represents 0.5% to 1% of company turnover.

Feed costs are the largest single category cost in salmon production as producers are reliant on pelleted feed with high fish meal and fish oil content. This key input cost has increased in recent years, along with the costs for the other key input, smolt (juvenile salmon).

Salmon prices have decreased significantly since the record prices seen in 2006, while input costs have continued to show increases. This has inevitably resulted in reduced profitability within the sector in 2007.

Trout - pond, tank, raceway and cage culture

Trout farming in the UK is recognized for its relative stability in terms of farm-gate prices and productivity, especially considering the growth – albeit erratic – of salmon production in Scotland and elsewhere. In 2006 around 202 trout farms turned over nearly 44 million Euros, providing over 1,110 jobs, with a full-time equivalent of around 842.

Compared with 2001 when the last economic survey was conducted on the UK's trout sector (Nautilus, 2001), profit margins for the larger companies (>200t per annum) appear to have declined from around 30% to less than 10%, whilst those of the intermediate farms (e.g. 50 – 200 t) appear to have increased from 8% to over 30%. This indicates a considerable change over the past five years, and probably reflects a consolidation of this middle sector resulting from its previous weaknesses, e.g. intermediate economies of scale and lower flexibility, with unprofitable farms leaving the industry.

The cost of production remains fairly even across the sector at 2.67 Euro per kg of fish, with a slightly higher levels for the smaller producers. The major cost was feed (34% of total costs) and like in 2001, represented a much higher proportion of total operating costs in the case of large farms (37%) versus intermediate and smaller farms (29%). With the larger farms focusing purely on table production, this

likely to be nearly half total operating costs. The other major costs were wages (25%) and stocking (14%). Depreciation, like that in 2001, tended to be low at around 6%, suggesting that farms have written off most of their initial capital investment, and are not re-investing significantly. With the onset of the 'credit crunch', lending to relatively high risk ventures such as novel methods of fish farming are likely to be either reduced or at least more expensive.

Average wages tended to be low, ranging between 8,800 Euro for the small farms and 30 thousand Euro for the larger farms (>100t per annum) per FTE. The low level of wages for small farms reflects the use of family members as 'unpaid labour'. Labour productivity also varied strongly, from 71t per FTE for the larger farms (>200t per annum) and between 12–13t per FTE for the smaller (<50t per annum) and intermediate (51 – 200t per annum). This is very similar to the results of the 2001 survey, although the larger farms appear to be less productive than before (at 84t per annum).

The main intangible value behind UK trout farms, especially in England and Wales, is for good sites with water abstraction licenses and discharge consents. The second phase of the joint Defra / Environment Agency / Welsh Assembly Government 'Environmental Permitting Programme' is likely to result in simpler permitting procedures, including a single permit per site for ground water and surface water discharge consenting. Abstraction will be dealt with later. It is also worth mentioning that many trout farm sites in the UK have substantial asset value as they are often based around historical buildings in scenic settings.

It is evident that the UK trout industry faces a number of distinct challenges that have been triggered by a combination of rising commodity and fuel costs against a backdrop of deteriorating economic conditions. In particular, ex-farm trout prices have only risen by about 20% over the past two decades (roughly in line with inflation on consumer price index, CPI) yet feed and fuel costs have risen significantly over the period 2005–2008. This situation has been exacerbated recently by the weakness of the British pound sterling against the US dollar in which many commodities are traded.

Other current constraints considered as significant by the trout segment in the UK include:

- Stagnation in prices: despite the rises in ex-farm prices over the last two years, as mentioned above these have not risen in real terms. This is particularly for the multiple retail sector, to which more than 80% of UK trout production is destined. This is also combined with an apparent reduction in consumer willingness to accept higher prices for trout products, again another recent trend[65].
- Increased stock levels: Two summers with high rainfall ('07 and '08) have resulted in reduced stock losses to endemic disease such as Proliferative Kidney Disease (PKD) and consequent higher biomass on farms, out of line with market demand which has been depressed by weather conditions and economic uncertainty.
- Disease: notwithstanding the above, disease (e.g. white-spot and red mark syndrome) both affect the production economics and the marketability of trout. It has been estimated that the annual cost of disease to the UK trout industry is more than 6 million pounds sterling (4.1 million Euro). This situation is exacerbated by strict EU legislative framework for pharmaceutical development that has inhibited the level of investment into research on aquaculture vaccines and disease treatment for the trout industry that grows around one billion trout a year across Europe.
- Competition with nature conservation: given that many trout farms are situated in chalk stream valleys or other conservation areas, there is increasing potential for conflict with nature conservation objectives and designations, including the EC's Natura 2000 network.
- Decline in generic marketing: the trout market has long retained its market share in the face of completion from salmon and other similar products (and more recently from cheap imports of Vietnamese Pangasius catfish) due to a longstanding generic marketing campaigning. However, with the consolidation of the industry, especially in Scotland, there has been more of a focus on short-term product-specific campaigns in co-operation with retailers. The need for pan-UK generic promotion, as part of the overall marketing of trout, has been recognized by the industry and plans are being made to re-commence generic promotion.

[65] Nicholas Read, British Trout Association, pers. comm.., 16 September 2008

- Differing government support: whilst both Scotland and Wales have received considerable support from government in terms of strategy development for aquaculture and addressing common constraints, the support from Defra to the English industry has been less evident. However, it is understood that a strategy for English aquaculture is now under consideration.
-

Oyster -on-bottom culture

The UK's oyster farming industry is mostly composed of small producers in the SW England (64% of *C. gigas*) and East Anglia (30% of *C. gigas* and 82% of *O. edulis*). Although there are around 140 sites active in the UK (110 in England, 30 in Scotland and 20 in Northern Ireland), only about ten businesses produce more than 50t per annum, with many others either laying idle or having only low and /or intermittent production.

Profit levels for companies in oyster culture are generally low – less than 10,000 Euro per annum, although this is likely to be considerably higher in the case of small number (*c.* 10 out of 140) of larger companies. For instance one large oyster farm – which produces around 250t *C. gigas* per annum (around half the English production) – made nearly 340,000 Euro profit over 2006 (a profit margin of nearly 50%). Turnover per FTE at 21 thousand euros per FTE was the lowest of the four segments examined in the UK as was turnover per firm (47 thousand euros per company).

The costs of production vary from 1.20 Euro per kg for the larger, more efficient farms to 2 Euro for the small-holders. Given that oyster farming does not have the feed costs of finfish farming, most of the costs are found in labour (30 – 35%, although these were the lowest in terms of Euro per FTE for the four segments examined), live raw materials for stocking (15 – 30%) and depreciation (10 – 50%). As can be seen, these are highly variable, and reflect the highly stratified nature of the segment in terms of farm size and efficiency. Based on the depreciation costs, it is considered that the larger farms invest considerable sums in mechanization that reduces labour costs (and overcomes skilled labour shortages), even if it increases depreciation costs.

The main issues raised by oyster farmers were as follows:

- Shortage of skilled and willing labour: as with capture fisheries, there is a shortage of young people prepared to work in often difficult conditions and over long hours. This has been major driver towards mechanization of the industry, especially by larger commercial farms.
- Shortage of seed supplies: there is a shortage of good quality seen, especially larger animals, due to the limited number of hatcheries and nursery space.
- Potential conflicts with conservation objectives, tourism and other uses: oyster farming often takes place in shallow inter-tidal areas that are important feeding areas for birds and therefore often designated at Special Protection Areas under the Natura 2000 network. This has severely restricted the expansion of aquaculture, especially in areas such as the Solway Firth.

Mussels - on-bottom & rope culture

In 2006 UK production amounted to 27,557 tonnes with a value of approx. 32.4 million Euro. On a regional basis Northern Ireland and Wales each accounted for around 10,000t with Scotland producing just over 4,000t and England 3,000t. Compared to the previous year, these 2006 regional production figures show a significant decrease in Welsh production (mainly bottom culture) and a large increase in rope-grown production from Northern Ireland. 2005 to 2006 production growth in Scotland and England was more modest at around 2%.

Around two-thirds of UK production by volume and around half by value is grown under the licensing system of fishery orders. These production permits are an intangible company asset that does not appear within the asset forms reported in the survey, but would be important in any company valuation. The

most common permit to produce is a several order[66]; these allocate defined areas of seabed to particular individuals (owners of a company). The estimated value of mussel production of 17 million Euro contributed almost half of the total value of production from Fishery Orders[67]. Welsh Fisheries (predominantly bottom culture) continue to make up the majority of mussel production, contributing 74% of Fishery Order production in 2006, although this proportion is the lowest since 2001.

The year of 2006 was seen to be a good year for on-bottom culture operations. However, this snap-shot does not reflect the year on year experiences of the sector. Bottom production levels fluctuate year on year more so than rope-grown production as it is dependent upon collecting natural spat fall (either within a managed area or transplanted from ephemeral beds) is undertaken on a larger scale than rope culture, utilising 20-30m mussel dredgers to lay and harvest mussels. While the profit margins indicated in the survey for this sector were a very healthy 50% (compared to a mussel sector average of 15%), this is prior to the fuel cost rises seen since 2006. The sectors dependence upon large dredging vessels means that the recent increase in fuel prices has hit this sector hard resulting in significant reductions in profitability. The viability of bottom culture is therefore based on vessel operation (spat collection cost within 'other operational costs') rather than on farm operations, which is the case of rope culture.

The scale of production in bottom culture is far greater than most rope-grown operations. Our survey showing average bottom production is 2,850t while the survey average for rope-grown is 140t. Even this latter figure appears to represent the larger producers as around half the producers in Scotland produce less than 50t/annum. The levels of investment required for bottom culture are far greater as a result of vessel purchases with companies showing average assets of 4 million Euro compared to fixed assets for companies involved in rope culture being more than ten times less at 348,000 Euro.

Input costs in mussel culture are far less than other aquaculture sectors as culture is reliant on natural stocking through larval settlement and on natural feed. For rope culture the main costs relate to the purchase, setting and management of the ropes themselves; this is more labour intensive that bottom culture, with personnel costs representing 24% of turnover compared to 14% for bottom culture, which is more mechanised. This is further evidenced by productivity per FTE which amounts to 36t/FTE for rope culture and 407t/FTE for bottom culture.

The price of mussels has fluctuated between 1,100 and 1,500 Euro per tonne for several years with the larger European producers such as Spain and the Netherlands, along with newer market entrants such as Chile setting EC prices rather than the smaller volume UK production.

[66] Several Order: severs the rights to public fishery, allowing protection of shellfish stocks owned by individuals, companies or groups of fishermen.
[67] Regulated Fisheries Order: grants the right to regulate the exploitation of a shellfishery.

17.6. Statistical tables

Stat. table 17.1 UK - National overview – saltwater fish farming

	Volume of production (1000 t)	Value of production (million Euro)	Number of companies	Employment
1996	83.6	333.7	72	1,410
1997	99.7	398.0	70	1,314
1998	111.3	433.3	69	1,328
1999	127.3	413.3	71	1,394
2000	129.5	455.9	66	1,512
2001	139.2	368.9	74	1,370
2002	145.7	363.5	59	1,421
2003	170.8	400.4	52	1,329
2004	158.9	424.7	52	1,256
2005	131.0	439.8	45	1,085
2006	134.2	606.4	90	995

Stat. table 17.2 UK - National overview – freshwater fish farming

	Volume of production (1000 t)	Value of production (million Euro)	Number of companies	Employment
1996	4.2	7.9	n/a	170
1997	4.2	7.9	n/a	163
1998	15.9	30.7	171	167
1999	17.0	33.3	168	159
2000	15.7	34.0	233	151
2001	15.4	34.9	228	143
2002	16.6	33.5	216	144
2003	17.1	33.3	211	133
2004	16.1	32.7	211	136
2005	16.3	34.9	213	549
2006	16.7	37.6	202	541

Stat. table 17.3 UK - National overview – shellfish farming

	Volume of production (1000 t)	Value of production (million Euro)	Number of companies	Employment
1996	8.3	8.8	n/a	n/a
1997	17.6	25.3	n/a	n/a
1998	20.1	25.8	n/a	n/a
1999	17.3	25.2	198	232
2000	19.3	27.5	206	363
2001	19.9	31.3	195	463
2002	17.4	30.6	200	750
2003	24.6	40.2	210	812
2004	24.6	42.4	215	819
2005	26.3	44.9	331	796
2006	26.8	44.1	324	793

Stat. table 17.4 UK - National overview – Nurseries and hatcheries

	Volume of production (million juveniles)	Value of production (million Euro)	Number of companies	Employment
1996	147.8	n/a	n/a	n/a
1997	163.5	n/a	n/a	n/a
1998	234.3	44.4	n/a	n/a
1999	226.0	38.4	n/a	n/a
2000	218.2	40.9	n/a	n/a
2001	246.7	42.1	n/a	n/a
2002	221.2	38.0	n/a	n/a
2003	217.6	36.4	n/a	n/a
2004	254.9	34.9	n/a	n/a
2005	209.7	29.4	n/a	n/a
2006	215.9	32.1	n/a	n/a

Stat. table 17.5 UK - Review by sub-sector and species (value and volume), 2006

Culture environment / species	Volume (1000 t)	Value (mln Euro)	No. of companies	Types of on-growing unit	Employ-ment
Mariculture (marine fish)					
- Salmon[1]	131.8	593.3	39	Cgs, T&R	871
- Trout[2]	0.8	2.4	4	Cgs	15
- Seabream / seabass	0.0	0.0	0	N/a	0
- Halibut[3]	0.2	1.2	47	Cgs, T&R	33
- Cod[4]	0.5	3.1	0	Cgs, T&R	76
- Barramundi[5]	0.8	6.4	1	Rope	10
Sub-total	**134.2**	**606.4**	**91**		**1,005**
Freshwater fish culture					
- Carp	0.1	0.2	n/a	Ponds	n/a
- Trout [2]	16.7	37.6	202	Ponds, Cgs, T&R	556
- Other (specify)					
Sub-total	**16.8**	**37.8**	**202**		**556**
Molluscs and crustaceans					
- Mussels[6]	27.6	26.9	125	On-b, Rope, Inter-tidal	250
- Oysters[7]	1.1	4.5	94	Inter-tidal	214
- Scallops[8]	1.8	0.0	n/a	On-b	n/a
- Other (specify)			n/a		n/a
Sub-total	**24.5**	**31.4**	**331**		**793**
Other (millions of organisms)					
- Other organisms (specify)	Insignificant quantities				
- Hatcheries (salmon ova)	64.051	2.370	n/a		n/a
- Nurseries (salmon smolts)	40.827	19.710	n/a		n/a
- Trout (ova)	58.635	2.169	n/a		n/a
- Trout (fry)	52.366	7.855	n/a		n/a
- Hatcheries/nurseries (marine)	n/a	n/a	n/a		n/a

Stat. table 17.6 UK - Indicators by segment (segment totals, value in million Euro), 2006

On-growing technique	Cages	Ponds	On-bottom	On-bottom/rope
Species	Salmon	Trout	Oyster	Mussel
Environment	Saltwater	Freshwater	Saltwater	Saltwater
OPERATIONS – COSTS AND REVENUES				
Turnover total	872.1	44.6	4.5	32.4
Other income	0.9	21.2	14.5	<0.1
Personnel costs	21.9	20.3	2.3	8.8
Value of unpaid labour	n/a	n/a	n/a	n/a
Energy costs	40.0	4.6	0.2	5.5
Live raw material costs	162.1	25.2	0.4	-
Feed raw material costs	23.8	22.5	<0.1	-
Repair and maintenance	37.8	2.9	0.7	3.8
Other operational costs	253.5	19.6	0.3	-
Depreciation	82.3	4.1	3.9	9.4
Profit (EBIT)	251.6	8.0	1.4	4.7
Interest costs	63.0	3.4	0.8	2.5
Gross cash flow	33.9	15.5	6.1	16.8
Gross value added	418.8	35.8	8.3	25.6
BALANCE SHEET – ASSETS AND LIABILITIES				
Net investment in tangible goods	80.4	- 0.8	1,6	-22.9
Equity capital	519.4	15.0	2.6	8.9
Debts	250.5	33.1	-	9.1
Total assets	951.2	31.4	2.6	61.6
EMPLOYMENT				
Total no. of persons employed	830	1,111	253	375
Full time equivalents (FTE)	790	842	214	250
LEGAL STATUS				
Total number of firms	44	202	94	125
Single holder	-	48	n/a	n/a
Limited and anonymous co.'s	44	71	n/a	n/a
SALES VOLUME				
Volume in (1000 tonnes)	131	17	1	27
OTHER DERIVED INDICATORS				
Turnover / FTE (1000 Euro)	1,104	53	21	130
Gross value added / FTE (1000 Euro)	534	43	39	102
Personnel costs / FTE (1000 Euro)	164	24	10	35
Tonnes / FTE (tonnes)	167	20	6	110
Turnover / firm (1000 Euro)	19,822	221	47	259
EBIT / Total assets (%)	15%	26%	52%	8%