GRANT AGREEMENT NUMBER: 635188

SUCCESS

STRATEGIC USE OF COMPETITIVENESS TOWARDS CONSOLIDATING THE ECONOMIC SUSTAINABILITY OF THE EUROPEAN SEAFOOD SECTOR

Start date of project: 01/04/2015 Duration: 36 Months

DELIVERABLE: D3.6

COMPARATIVE ANALYSIS OF PRODUCTION SYSTEMS IN FISHERIES AND AQUACULTURE

WP3 Competitiveness and sustainability of European fisheries and aquaculture sectors

Project co-funded by European Commission within the Seventh Framework Programme		
Dissemination level of this deliverable		
PU	Public	✓
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Document Status Sheet

Due date of deliverable:	Month no.
Actual submission date:	30.03.2018
Partner in charge of the deliverable and contributing partners	IFREMER (WP 3 leadership) + partners contributing to Case Studies (list provided)
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Version	1.0
Document Status	**Final Report (Draft)**

Change history:

Version	**Date**	**Details** (additions, changes, reviews, performed by whom)
1.0		Final

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Overview/Executive Summary

This work has been undertaken as part of the SUCCESS project (Work Package 3: Competitiveness and sustainability of European fisheries and Aquaculture sectors) funded by the EC (H2020, GA 635188).

Goals

According to the objective of the task 3.4, the D3.6 aims to assess the competitiveness and sustainability of fisheries and aquaculture primary sectors based on material and data collected under previous sub-tasks and already compiled within the D3.2 (Description of production systems) and D3.3 (Indicator report).

Executive summary

The D3.6 aims to assess the competiveness and sustainability of production systems (PS) for all case studies covered by SUCCESS (Whitefish, Flatfish, Coastal fish and shellfish, Mussels, Salmonids, Seabass & Seabream and Carp). This assessment relies on a number of selected indicators defined under the D3.3 which include indicators of economic performance, economic dependency, social and environmental sustainability indicators. In addition, the outcomes of the D3.2 concerning the characterisation of the PS relevant for each case study/ country have been used along with some elements of context. This concerns data on production, trade and apparent consumption which have been collected, processed and analysed by case study.

The seven case studies represent a significant part of the EU fisheries and aquaculture production (FAP) as they contributed to 55% of the total EU Seafood production in value (38% in volume) in 2014. In addition, within case studies, data provided include the main producer countries at the EU level (most of the time) and the main production systems (PS) concerned. They range from PS based on large production units and/or companies, strongly dependent on inputs availability and extra EU imports (whitefish in fisheries, salmon in aquaculture) to small units or firms with few dependencies to inputs availability and mainly focused on domestic markets (small scale fleets, mussels, carp). An example of intermediate situation is provided by the flatfish case study which involves several production systems according to country.

The assessment of competiveness and sustainability of these PS has relied mainly on data collected under the DCF framework, thanks to their public availability. For fisheries, a tool was created in order to process the existing data (DCF, ICES and EUMOFA) and generate the set of indicators. However, for some case studies (small scale fleet and in some extent flatfish and scallop), the DCF segmentation does not match the level required for the case study analysis. Moreover, for aquaculture where the data collection is more recent, time-series are short, not yet stabilized and do not already cover all the segments/variables (e.g. Seabass & Seabream). When indicators are complete, the comparisons of economic performance were not such easy in relation to unclear calculation methodologies for some key variables (FTE, capital values and cost structure) crucial for the assessment of performances (GVA/FTE, ROFTA, ROI). Furthermore, the level of vertical integration in some production systems make difficult the price indicator comparison and hence the profitability.

Key Highlights / outcomes

- The seven SUCCESS case studies represent a significant part of the EU fisheries and aquaculture production (FAP) as they contributed to 55% of the total EU Seafood production in value (38% in volume) in 2014.

- To assess fisheries and aquaculture competitiveness and sustainability, a set of common indicators is used and include economic, social and environmental dimensions.

- DCF available data have been used in most cases but have also been supplemented by national data (quantitative and qualitative) collected and reported by partners under the previous deliverables (D3.2 and D3.3).

- DCF data are not always complete neither stabilised especially for some aquaculture segments and for indicator calculation, data needs are sometimes expressed at disaggregated levels not available so far (regional data in general and more stock-related for some fisheries CS).

- Reliability of some DCF variables is still questionable (FTE, indebtedness and capital/asset values). However, they are crucial for economic performance assessment (labour productivity, remuneration of labour and return of capital/investment). At least meta data on methodology and data contents should be made available along with data. For some fisheries case studies, remuneration of crew seems not consistent (whitefish for instance).

- Bearing in mind shortcomings on FTE and capital assessments and/or lack of coverage of some segments, economic performances of FAP sectors appears rather positive in 2014 with high variability within case studies.

- Economic dependency varies according to case studies and production systems within case studies: for instance, large demersal trawlers for whitefish are the most dependent for all dimensions (species, energy and external market) while some flatfish productions systems may be strongly dependent on energy (traditional beam trawlers) or species (netters). In aquaculture, dependency is mainly related to monoculture and to feed for fish farming.

- For fisheries case studies, the recent recovery of some major EU stocks and the will to reduce the energy dependency of traditional segment fleets are not sufficient to ensure the competitiveness of production systems given the strong reliance on extra EU imports and the risk of boom and bust situation.

- For aquaculture, the growth objectives targeted by the multiannual national aquaculture plans (e.g. a 60% increase of marine finfish production at the EU level) will also require to develop appropriate tools to monitor and control the development of new productions and to support the consumption of EU aquaculture products.

- As a result, this emphasizes the relevance of marketing initiatives analysed under the D3.4 and resulting policy recommendations on further integration of market issues in fisheries and aquaculture management, in addition to marketing measures likely to be supported by EMFF.

Key highlights per case study

Whitefish:

- After decades of overexploitation of several stocks which have resulted on a drastic fleet capacity reduction at the EU level, the whitefish segment remains important at the EU level although its position at global level is weaker.
- Cod and Hake, the main targeted species at the EU level, are still in the top 10 of the most consumed seafood species. Extra EU imports are high as well as intra EU trade flows.
- EU production systems remain dominated by large demersal trawlers (over 40meters or between 24-40m) with full-time crew and the production is still concentrated in the 3 major "historical" countries (Spain, UK and France). Little information is available on vessels ownership and potential vertical integration in this production sector.
- Economic performances are highly variable between fleets but there is some doubt on the assessments of FTE and capital values in this segment. Economic sustainability remains fragile for this production system as dependencies on species, external trade and energy are high. There are still overexploited stocks particularly those targeted by the largest trawlers (over 40m).

Flatfish:

- The EU flatfish production is more significant at global level (2nd in the world) than it is at the EU level (6% of the total value of EU seafood production).
- Focused on 2 major species (Sole and Plaice), the EU production is dominated by 3 countries (the Netherlands, the UK and France) which are also the main suppliers of the EU flatfish market few dependent on extra EU imports.
- Production Systems (PS) are strongly different according to countries with large differences in gear used, vessel size and catches portfolio. The "historical" beam trawl model of Northern countries moves towards new technologies less energy consuming but controversial for some of them (pulse trawl for instance). In France, netters are dominant and still the lowest energy dependent.
- Economic performances are variable according to country/vessel size/gear but ROFTA are in majority positive. Environmental sustainability is rather good for fleets targeting plaice while it depends on targeted stocks for sole.

Coastal fish:

- This segment contains in fact two different sub-groups: the small scale fleet with small size vessels (less than 12m) using passive gears and highly developed in the Southern countries (Italy, Spain, Portugal and France) plus the group of vessels targeting coastal sedentary stocks.
- The coastal fish in Europe accounts for more than 10% of the total seafood production in value. The SSF contributes to 13% of the total value of EU landings and involves almost 75% of the registered vessels. King Scallop is the top sedentary species landed in Europe.

- Small scale Fleet:
  - Economic performances are rather good but sustainability remains very fragile considering several dimensions (except energy dependency);
  - A large number of key SSF species are also targeted by the large scale fleet (octopus, cuttlefish, seabass, sole…) and mismanagement is often the rule. Moreover, some EU markets (Cephalopod) are strongly dependent on extra EU imports;
  - No evidence of ex-vessel price differences in most situations except for specific cases of labelling or direct sales.
- Scallop fleet:
  - This segment gathers vessels of different size using dredges and mostly concentrated in France and the UK;
  - Compared to the UK vessels, economic performance of French vessels is in general better and French vessels are also lesser dependent on king scallops;
  - Scallop is an important consumed species for France and the French market is highly dependent on UK supplies as well as extra EU imports.

Mussel:

- Mussel farming is the first largest EU aquaculture activity in terms of employment and production in volume (the fifth in value). The EU mussel market is nearly self-sufficient and the bulk of the market is made up of fresh, live mussels
- It includes a variety of production systems characterised by different farming techniques (raft, “bouchot”, on bottom, longlines), cost structure, level of capital investment…but the main component of the EU mussel farming still relies on small-scale, family based enterprises
- Mussel farming is little dependent on inputs (no feed, low energy dependency at least for inshore production systems like “Raft” and “bouchot” mussel farming)
- The highest profitability indicators (ROI) are associated to the Dutch mussel farming, followed by the French “bouchot” and Spanish “raft” production systems. The Dutch mussel sector is more capital intensive, dependent on energy costs and largely relies on exports.
- The low levels of labour remuneration in some sectors (Spain, Greece, Italy) are related to insufficient production price and could be improved by further producer organisation, further integration in the downstream steps of the value-chain and by quality upgrading through the adoption of best farming practices.

Salmonids:

- Salmon farming is highly concentrated and integrated, and more capital intensive than trout aquaculture. The large size of the companies leads to economies of scale, a high profitability and comparative advantage in terms of energy efficiency and dependency.
- EU Trout farming sector shows positive but much lower profitability; conversely it provides more jobs than EU salmon farming and supplies further the EU fish market.
- The Scottish salmon sector is highly dependent on exports and relies strongly on the accessibility of foreign markets.
- Best practices charters are used on a large scale for fish production in Iceland and France, for feed production in Finland and Scotland. The market share for organic fish remains relatively low, even if France is the first EU country in organic trout production.

- The expansion of Scottish salmon fish farming versus the stagnation of EU trout farming is related to more stringent regulatory framework (e.g. France and Finland).

Sea bass and Sea bream

- The production of these two species soared till the mid-1980s in the EU, mainly driven by the development of intensive aquaculture in Greece, Spain (Italy to a lesser extent) and later followed and overtaken by Turkey
- The rapid growth of the aquaculture production of SBSB has been marked by several market crises, especially for seabream, after which the SBSB sector has experienced a general trend of consolidation in each of the 3 main EU producer countries
- The EU trade for seabass and seabream is mostly intracommunity with Greece as the main exporting country and Italy as the main importing country. Turkey is also a supplier to the EU and a direct competitor of Greece.
- Seabass & seabream PS analysed in Greece, Spain and Italy refer to a common type of marine aquaculture (cage), but with some differences linked to the size, the level of integration and the dynamic of development of the sectors in the 3 countries.
- Bearing in mind the heterogeneity and shortcomings of economic and financial data available, the assessment showed that the Greek sector, as the major EU producer, was not profitable in 2014 and had a high level of indebtedness.
- Improvement of data collection is required to assess more accurately the economic competitiveness and sustainability of the second largest EU aquaculture sector in terms of employment and the third in value (after salmon and trout).

Carp:

- Common carp is mainly farmed in Eastern Europe. Czech Republic and Poland are the main producer countries; each provided a quarter of total EU production in 2015
- The assessment of the sustainability of the carp sector has relied on a specific method, the "typical farm approach", which was applied in a common way in Germany and Poland to provide economic data for 2015. Five farm models (or PS) were defined as typical carp farms (2 in Germany, 3 in Poland), ranging from a level of production of 5 tonnes to 190 tonnes.
- Carp grow-out is globally labour intensive PS, and is characterised by the importance of livestock costs. Comparatively to other types of fish farming, feed costs are lower and range from 9% for the small-scale extensive PS to 27% for the biggest and more intensive PS.
- Among the main results, it appears that single grow-out and the traditional distribution of almost unprocessed fresh carp is not profitable for smallholders anymore. Conversely, medium and large scale farms present positive ROI, the first one because they could benefit from the "region marketing" effect, the latter due to the intensification of production.
- Room for improvement for smallholders relies on both diversification strategies and on the recognition of the multi-functionality of carp farms through the remuneration of ecosystem services.

1 Introduction

Complementary to existing reports on fleet or aquaculture economic performances (STECF 2017-12 AER; STECF 2016-19 EU aquaculture) or bio-economic studies aiming to adjust fleet structure and effort according to stock availability, the purpose of this report is broader. It aims to characterize the production systems and to assess their performance taking into account their economic and regulatory context (market and consumption, access to resource and space, energy…). This work has been done for all the SUCCESS case studies (see below).

The production systems are defined according to production techniques, species, economic scale (from small to large or even industrial scale) and level of intensification as it is commonly done for agricultural sectors (Ghersi G. & Rastoin J-L., 2010). This notion could be broadened by taking into account other relevant attributes (e.g. level of integration within the seafood supply chain, main targeted markets…). Their assessment is based on a selection of indicators including, on the one side, cost structure, profitability and valorisation indicators, and, on the other side, "dependence" indicators as well as indicators of social and environmental sustainability.

Based on the D3.2 and according to a common template, data were collected on characteristics of the production, structure of enterprises and employment including cost structure, capital features and, main features of first-hand sales organization. This set of data is used to describe the production systems by case studies.

Based on D3.3, a list of indicators is selected according to several steps:

- a first step was to agree on a common principle that sustainability should be assessed according to different dimensions (economic, social and environmental);
- a literature review on competitiveness and sustainability indicators was then undertaken and a proposal list of pre-selected indicators was submitted to the partners at the Helsinki meeting in September 2016. This first list was also based on already available indicators from the D3.1 & D3.2;
- the comprehensive list of about 40 indicators was discussed at the Helsinki meeting and partners finally agreed on a (common) short list of a dozen indicators.

The final list of indicators includes (see annex + complete):
- Economic performance of production systems (Labour productivity, Profitability, Indebtedness and Energy efficiency)
- Economic dependency of production systems on "external" shocks (economic dependency on species, external trade, energy and other inputs)
- Employment conditions and attractiveness of the sectors (Use of temporary/seasonal employment, Recourse to family work or unpaid labour, Level of Remuneration of work)
- Environmental sustainability (State of stocks, Level of producers' involvement in sustainable practices)

Most of the indicators are common to fisheries and aquaculture and few are specific (for aquaculture: economic dependency on feed costs and level of producers' involvement in sustainable practices; for fisheries the state of stocks).

The D3.6 is organized as follows:

- the first part proposes an overview of the domestic productions, external trade (imports/exports) and apparent markets of seafood in the EU28. Furthermore, this overview focus on SUCCESS case studies in order to assess their position in the EU and global context.
- The second part is dedicated to the synthesis of each case study. The context of EU production, trade and market is again specified, then the relevant production systems are described and compared. Finally, their performances are assessed and compared as far as possible, based on the selected list of indicators.

Most of the fisheries data are collected via DCF time series (2008-2014) per country and fleet segments made directly available via the JRC website[1]. The DCF dataset is completed with ICES and EUMOFA data for the calculation of some sustainability indicators (state of stocks, dependency to external trade). A tool was developed in order to provide the required indicators and is presented in the section 4 of the report. When DCF data are not matching the fleet segments studied within case studies, alternative datasets used are presented within the case study section.

For aquaculture, data used are presented within the case study section as well as expertise according to their coverage and reliability. For most cases, DCF data are provided. Other cases use national sources or/and one-off surveys.

This report aims to improve the current knowledge on fisheries and aquaculture sectors. First of all, it considers these primary sectors both as complementary and/or competitor suppliers of seafood markets and not separately as it is usually done. Second, the production systems and their performance are described and assessed according to the same set of indicators. Third, the data available at the EU level are used and their coverage, reliability and accuracy are examined. This data expertise could contribute to further progress in data collection for these sectors.

There are several questions behind this work. First and basically, what is the context of the EU demand and international competition within each case study? This knowledge is often weak and particularly under documented in fisheries studies and bio economic modelling. Is there any direct linkage between fisheries and aquaculture production systems and their contexts? How far constraints specific to fisheries or aquaculture sectors influence the features of production systems and their performances? Is there one or multiple production systems within case studies? Beyond the sustainability based on economic performances, what are the weaknesses or the elements of vulnerability of these EU major seafood producers?

[1] https://stecf.jrc.ec.europa.eu/reports/economic

Case Studies addressed within SUCCESS (reminder)

For fisheries, 3 groups are considered and defined as follows:

- **Whitefish**: All species belonging to the Gadidae, Lophiidae and Merlucciidae families (Cod, hake, Haddock, Whiting, Pollack, Saithe, Anglerfishes…);
- **Flatfish**: All species belonging to the Pleuronectiformes order (Sole, Plaice, Turbot, Megrim, Brill, Flounder, Halibut…);
- **Coastal Fish (including Shellfish)**: All species landed by the group of small-scale vessels (vessels less than 12 m. using passive gears) + Coastal shellfish (excluding landings of vessels belonging to the small-scale fleet, to avoid double counting).

NB: potential double count may exist between Coastal fish and Whitefish/Flatfish for some species targeted by SSF (Sole, Hake, Cod…).

For Aquaculture, 4 groups are considered and defined as follows:

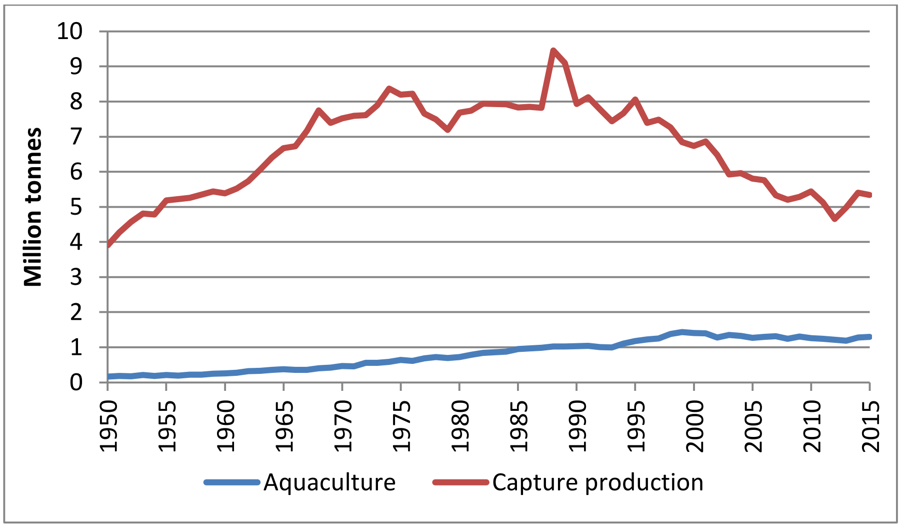
- **Mussels:** Blue mussel and Mediterranean mussel
- **Salmonids:** Species belonging to the Salmonidae family particularly salmon, rainbow trout, sea trout and arctic char;
- **Carp:** European carp (common carp)
- **Seabass and seabream:** European seabass (Dicentrarchus labrax) and Gilthead seabream (Sparus aurata)

2 EU Overview of production, trade and consumption of Seafood

This section aims to present the main features and trends of the EU Seafood sector. More specifically, it intends to pinpoint the role of the Case studies addressed within the SUCCESS project at the EU level specifically as regards their contribution to the EU seafood production, trade and consumption.

2.1 Production

EU production of fish and seafood products is mainly based on capture fisheries. From the 1950s onwards, fishing effort increased immoderately in the EU and catches soared from 3.9 million tonnes in 1950 to 7.7 million tonnes in 1968. Until the 1990s, fishing effort was kept at a high level and catches reached a historical high of 9.5 million tonnes in 1988. Due to overfishing, catches have declined for the last two decades (-34% between 1995 and 2015) and amounted to about 5.3 million tonnes in 2015. However, the decrease in fisheries production has been partly offset by the growth of the aquaculture industry. Cultured species in the EU were historically mussels, oysters but also carp and trout. But, since the late 1980s/early 1990s, the production of new farmed species, such as salmon, seabass and seabream, has grown. Thus, aquaculture production in the EU rose steadily from 162,000 tonnes in 1950 to 1.4 million tonnes in 1999 and has remained constant since then (1.3 million tonnes in 2015). In 2015, the European Union provided 5.8% of global capture production (around 94 million tonnes) and 1.7% of global aquaculture production (around 74 million tonnes). (FAO – FishStatJ, 2016)



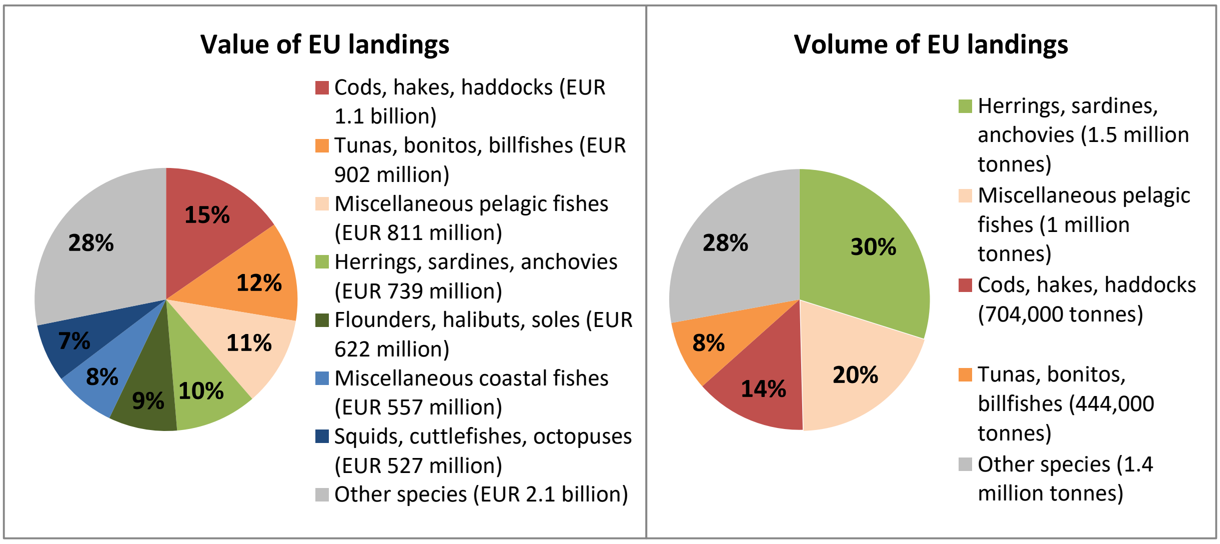
EU28 production of fish and seafood products by production source (in volume), 1950-2015 (Source: FAO – FishStatJ, 2016). Note: Excluding aquatic plants.

According to STECF (2016), the EU fleet landed 5.1 million tonnes of fish and seafood products in 2014, amounting to a reported value of EUR 7.4 billion. According to FAO (2016), aquaculture production in the EU amounted to 1.3 million tonnes and EUR 3.9 billion in the same year. Thus, EU production of fish and seafood products reached 6.4 million tonnes in 2014, of which 80% were wild-caught products and 20% were farmed products. In terms of value, production reached EUR 11.3

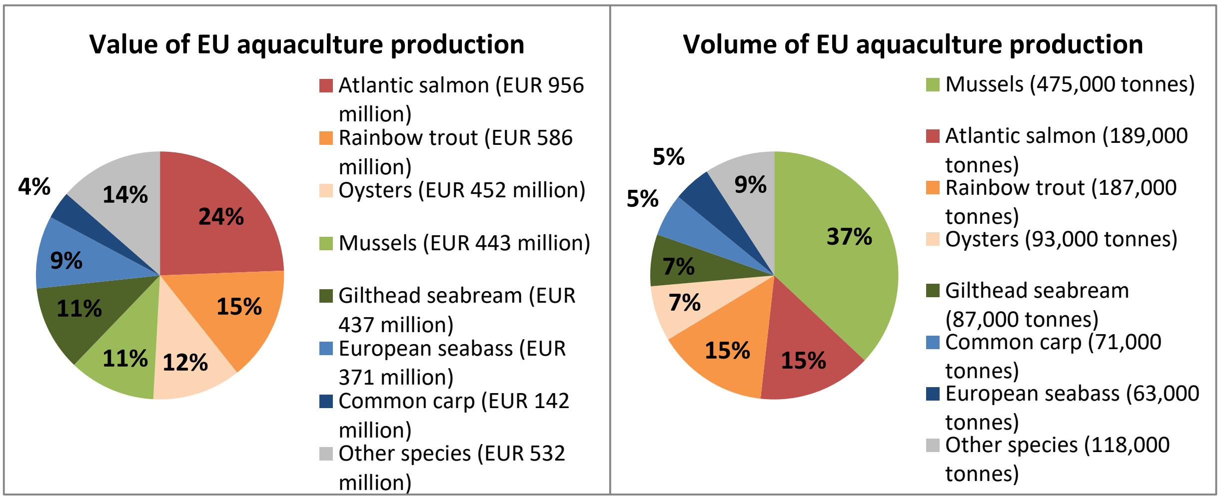
billion, of which 65% were provided by the fisheries sector and 35% by the aquaculture sector. In the rest of the world (and especially in China), aquaculture is better developed than in the European Union; aquaculture industries provided 46% of total production of fish and seafood products in volume in 2014 (FAO – FishStatJ, 2016).

Looking at the EU fisheries production (STECF, 2016) and according to the ISSCAAP (International standard statistical classification of aquatic animals and plants), the main groups of species landed by the EU fleet in 2014 are small pelagic (herring, sardine, anchovies) accounting for 1.5 million tonnes - but this amount reaches 2.5 million if adding miscellaneous pelagic (horse mackerel, mackerel, etc.). Next come the landings of Groundfish (cod, hake, haddock, etc.) with 0.7 million tonnes just before large pelagic (tunas, bonitos…) accounting for 0.4 million tonnes. In contrast, and as regards the value of landings, Groundfish is the most important group with 1.1 € billion and contributes to 15% of the EU total landings in value. Flatfish (flounders, halibuts, sole…) and cephalopods (squid, cuttlefish, octopuses…) also become significant (9 and 7% respectively) if considering value of landings.

Aquaculture production in the EU is dominated by mussels in terms of volume and by salmonids in terms of value. Mussels are low-value species and accounted for only 11% of the value of total EU production in 2014. Conversely, salmon but also oyster, seabass and seabream are high-value species. (FAO – FishStatJ, 2016)

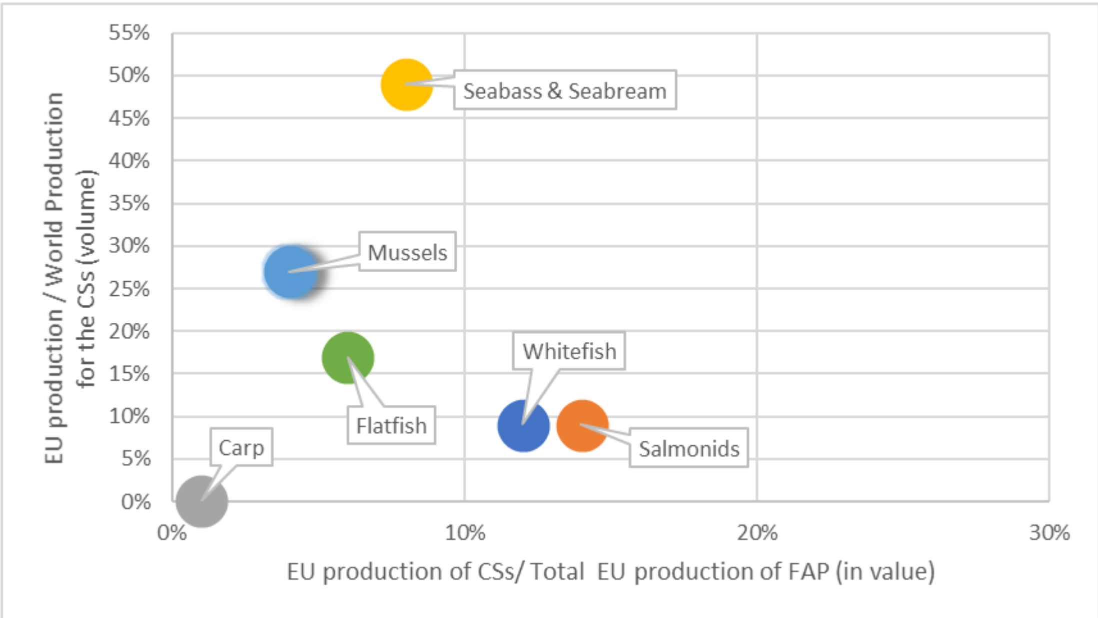


Breakdown of total EU landings by main ISSCAAP groups of species, 2014 (Source: STECF, 2016)



EU aquaculture production by main species, 2014 (Source: FAO – FishStatJ, 2016)

The major role of SUCCESS case studies in the EU Seafood production is summarized in the next table. For fisheries, groups of species have been rearranged according to the SUCCESS case studies perimeter (see introduction). In total, SUCCESS case studies account for 38% of the total EU production in volume and around 55% in value.



The figure above distinguishes in the horizontal axis the whitefish and the salmonids as the main contributors to the EU production value. On the vertical axis and according to the weight of EU production in global production, Seabass & seabream ranks first as a specialised aquaculture product of Mediterranean countries, followed by Mussels and Flatfish.

Position and trends in production are not similar according to case studies:

- Salmonids and Whitefish are by far important sectors at the EU level but not at the world level, at least compared with Seabass & Seabream, Mussels and Flatfish;

- The decline of major EU stocks in the last decades due to stock overexploitation has recently stopped and trends in whitefish and flatfish landings differs according to species and stocks (upward trends for cod and plaice, steady for sole); trends in Coastal fish and shellfish landings are difficult to assess first because of data quality (coverage first but also reliability of fishing forms). The big challenge for EU fisheries is now to achieve and maintain the balance between fishing capacity (fleets) and fishing opportunities (stocks) and not to repeat mismanagement errors of the 2nd part of the 20 century.

Key features of production by case study, 2014 (Sources: FAO-FishStatJ, 2016; STECF, 2016)

	Mussels	**Salmonids**	**Carp**	**Seabass & Seabream**	**Whitefish**	**Flatfish**	**Coastal fish**	**Total EU production (fisheries and aquaculture)**
EU production (in thousand tonnes)	523	387	92	161	752	212	(333)	6,400
% of EU total capture fisheries and aquaculture (volume)	8%	6%	1%	3%	12%	3%	(5%)	
Share of EU production in world production (% volume)	27%	9%	< 1%	49%	9%	17%	*No data available*	
EU production (in million euros)	458	1,597	169	924	1,349	703	(1,091)	11,300
% of EU total capture fisheries and aquaculture (value)	4%	14%	1%	8%	12%	6%	(10%)	
EU prices (€/kg)	0.88	4.1	1.8	5.7	1.8	3.3	3.3	1.8
Share of the main production mode at EU level (in volume)	91% aquaculture	100% aquaculture	96% aquaculture	93% aquaculture	100% fisheries	94% fisheries	100% fisheries	80% fisheries
Share of the main production mode worldwide (in volume)	95% aquaculture	79% aquaculture	95% aquaculture	95% aquaculture	100% fisheries	84% fisheries	100% fisheries	55% fisheries
Main producer countries in the world	China, Chile and Spain	Norway, Chile	China	Turkey and Greece	Russia, USA and Norway	USA, China and Russia	*No data available*	China, Indonesia and India
Main producer countries in the EU	Spain, France, Italy, NDL and Greece (86%)	UK (salmon); France, Denmark, Italy (rainbow trout)	Czech Republic, Poland and Hungary	Greece, Spain	Spain, UK and France	NDL, UK, France	Italy, Spain, Portugal France, UK	

2.2 Trade

The European Union, as a whole, is the largest trader of fishery and aquaculture products (FAP) in value in the world with € 54.3 billion and 14.1 million tonnes (EUMOFA 2017) and the largest importer of fish and seafood products in the world, followed by the United States and Japan. According to EUMOFA (2017), EU imports (intra EU trade and imports from non EU countries) are valued at € 49 billion in 2014 (around 38% of world imports of fish and seafood products according to FAO, 2016) with six countries (Spain, France, Germany, Italy, Sweden and United Kingdom) accounting for two third of total EU imports. At the end, the EU trade balance deficit of FAP reached EUR 19.6 billion in 2016 (+7% per year in average since 2010) with an Extra EU trade deficit increasing over the years.

EUMOFA (2017) – EU Trade flow (source Eurostat)

Extra EU imports (€ 24,4 billion in total) are mainly coming from Norway (26%), China (7%), Iceland (5%), Morocco (5%), Ecuador (5%) and USA (4%). Both in volume and value terms, the main group of species[2] imported by Member States from non EU countries are Groundfish (Cod), salmonids (salmon), tuna and crustaceans (tropical shrimp and miscellaneous shrimp).

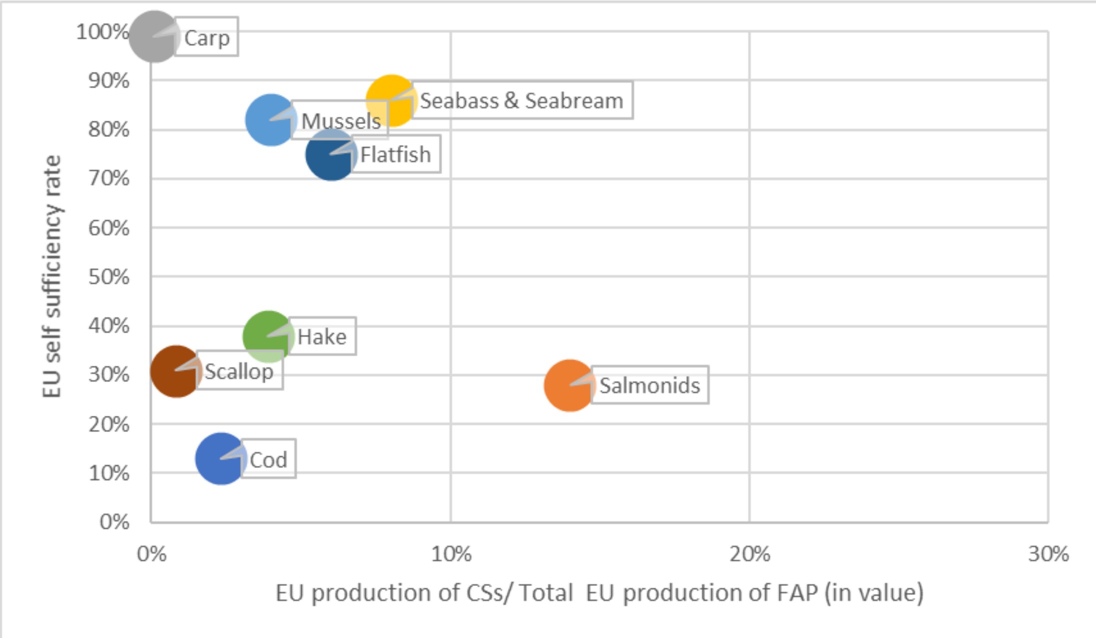
Extra EU exports (€ 5 billion in total) are originating from 6 major EU countries (Spain, Denmark, Netherlands, UK, France and Germany by order of importance). The countries of destination are USA (12%), Norway (10%), Switzerland (9%) and China (8%) for the main ones. The main commodities exported to non EU countries are salmonids in value, and small pelagic & tuna in volume.

A large part of the trade flows occurs within EU countries (€ 25.2 billion in 2016 according to EUMOFA). They mainly concern salmonids (31% in value and 13% in volume), Groundfish (13% and 12% resp.) and crustaceans (12% and 5%). Small pelagics account for 18% in volume but 6% in value.

[2] Trade in Non-food use are not considered in that list and account for 477 million tonnes for extra EU imports, 376,000 tonnes for extra EU imports and 460,000 as intra EU imports.

Top FAP flows within MS involve the Netherlands, Sweden and Denmark as main suppliers, France and Italy as main importers. Spain and Germany are both main suppliers and importers.

Focusing on our SUCCESS Case studies, difficulties appear according to fisheries CS. For instance, the group of whitefish does not exist as such, as well as the group of Coastal fish. In order to overcome this, we have focused on key whitefish (Cod and Hake) and coastal shellfish (Scallop) species. As data are available for flatfish, we consider this group as a whole.



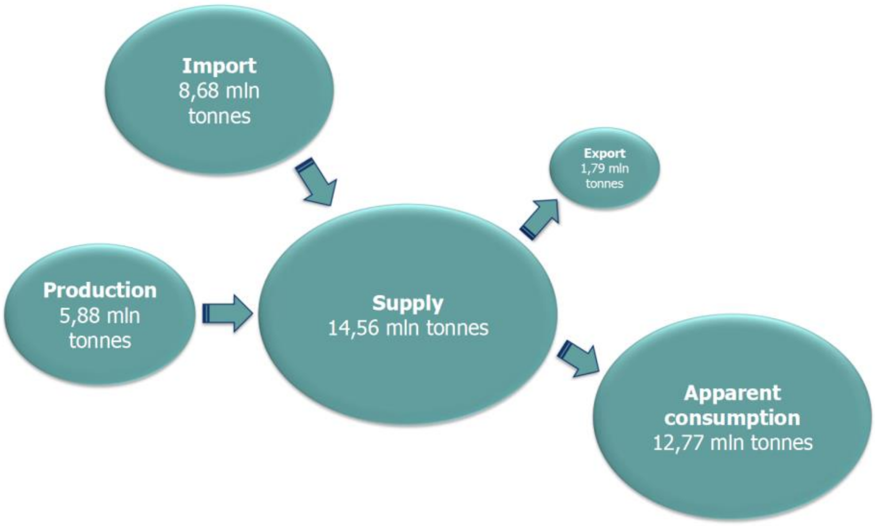
The EU markets analysed under the project can be divided into two groups according their dependency on extra-EU imports: EU markets of carp, flatfish (sole and plaice), trout, seabass& seabream and mussels are mostly intra-community while markets of salmon, scallop, hake and cod mostly rely on extra-EU imports.

*Key features of EU trade by main species covered by SUCCESS case studies, 2015 (Source: Eurostat – COMEXT) - * trade flows measured with imports*

		Mussels	Salmonids	Carp (whole)	Seabass & seabream	Cod	Hake	Flatfish	Scallop
EU trade flows (in value) € million	Extra-EU imports	EUR 145 million	EUR 4.9 billion	EUR 5 million	EUR 215 million	EUR 2.2 billion	EUR 572 million	EUR 288 million	EUR 258 million
	Intra-EU trade*	EUR 265 million	EUR 5.6 billion	EUR 21 million	EUR 630 million	EUR 1.8 billion	EUR 345 million	EUR 774 million	EUR 290 million
	Extra-EU exports	EUR 16 million	EUR 828 million	EUR 906,000	EUR 49 million	EUR 181 million	EUR 24 million	EUR 252 million	EUR 10 million
EU self-sufficiency rate		82%	28%	99%	86%	13%	38%	75%	31%
Main suppliers (extra-EU countries)		Chile	Norway	Myanmar	Turkey	Norway	Namibia, South Africa, Argentina	Greenland, China	Peru, USA, Argentina
EU net imports (in thousand tonnes)		150	906	11	111	486	221	151	28
Main preservations states (% in total EU net imports)		Live, Fresh (62%)	Fresh whole (65%)	Live (79%)	Fresh whole (95%)	Frozen cut (33%) Frozen whole (22%) Dried, salted or smoked (22%)	Frozen cut (53%) Frozen whole (23%) Fresh whole (22%)	Fresh whole (55%)	Frozen whole (71%)
EU import price		Live, Fresh: EUR 1.35 kg	Fresh whole: EUR 4.9 kg	Live: EUR 1.80 kg	Fresh whole: EUR 5.59 kg	Frozen cut: EUR 4.72 kg Frozen whole: EUR 2.90 kg Dried, salted or smoked: EUR 5.70 kg	Frozen cut: EUR 3.42 kg Frozen whole: EUR 2.54 kg Fresh whole: EUR 3.44 kg	Fresh whole: EUR 4.69 kg	Frozen whole: EUR 12.52 kg
Main EU importing countries (in volume)		France and Italy	Poland, Germany, France	Poland, Germany	Italy	United Kingdom, Portugal, France	Spain, Italy, Portugal	Netherlands, Spain, Italy, France, Poland	France
EU exports (in thousand tonnes)		144	242	15	87	57	34	109	12
Main EU exporting countries (in volume)		Spain and Netherlands	Poland, United Kingdom, Denmark	Czech Republic	Greece	Denmark	Spain	Netherlands, Denmark	United kingdom

2.3 Consumption

The EU supply of fish and seafood products is assessed around 14.6 million tonnes (live weight equivalent) in 2016, of which 40% was ensured by domestic production and 60% by extra-EU imports and the apparent consumption around 13 million tonnes.



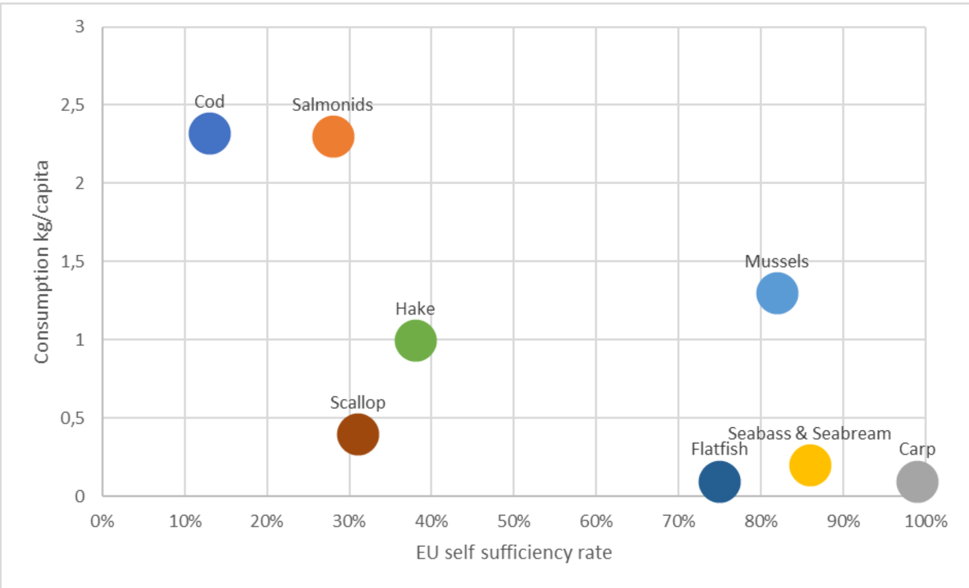
Supply balance in 2015 (live weight equivalent – Food Use only) – EUMOFA, 2017

Per capita consumption of fish and seafood products in the EU reached 25.5 kg (live weight equivalent) in 2014 (+3.5% from 2013) and was above the world average (about 20 kg according to FAO). Tuna is the most consumed product in the EU, with a per capita consumption of 2.6 kg in 2014, followed by cod (2.4 kg). Salmon is the most consumed farmed species (2.1 kg), followed by mussels (1.3 kg) and tropical shrimps (0.69 kg).

In the EU, Portugal registers the highest per capita consumption of fish and seafood products (55.3 kg in 2014), followed by Spain (46.2 kg) and Lithuania (44.7 kg). Among the Member States with a per capita consumption above the EU average, Portugal, France and Latvia did not register an overall positive trend in 2014. (EUMOFA, 2016)

Key features of apparent consumption by case study, 2015 (Sources: FAO – FishStatJ, Eurostat – COMEXT)

	EU apparent consumption in LWE (kg per capita)	Trends in apparent consumption
Mussels	1.30	Slightly fluctuating trend from 2005 to 2015, around 1.28kg per capita in average
Salmon	2.30	Apparent consumption of salmon has increased steadily from 2005 (+51% between 2005 and 2015).
Trout	0.43	Apparent consumption of trout in the EU has been quite stable from 2005.
Carp (whole)	0.19	Quite stable
Seabass	0.17	Quite stable
Seabream	0.30	Seabream is the first species consumed in Italy (9% of the total fish quantities consumed fresh) and has significantly increased its position in the years 2005-2010 (market share rising from 7.7% to 8.9%). Since 2010 its share is quite stable.
Cod	2.31	The most consumed whitefish species in 2014 were cod and hake. After a drop in consumption in 2005-2008, the consumption of cod followed an upward trend (+18% between 2005 and 2014). According to EUMOFA (2017b), the consumption of fresh cod in the UK (in volume) increased by 26% between 2010 and 2016. Conversely, the consumption of hake has slightly decreased.
Hake	1.00	
Sole	0.06	Sole and plaice are the most consumed flatfish species in the EU (EUMOFA, 2016). Their apparent consumption is quite stable.
Plaice	0.19	
Scallop	0.41	The EU apparent consumption of scallops was quite stable between 2005 and 2014 and decline by 11% between 2014 and 2015, mainly due to reduced catches in the United Kingdom and France.



The most consumed species (Cod and Salmonids) corresponds to the leading production sectors at the EU level but are also the most dependent on the extra EU imports.

3 Comparative analysis by case study

Quantitative and qualitative information from the D3.2 templates for the description of production systems as well as indicators calculated on the basis of a common list of dozen agreed under the D3.3 have been compiled for each case study in order to achieve this comparative analysis.

First the context of EU production, exploitation and trade is presented by case study. The objective is to point out the major countries involved in the production side at the EU level and to emphasize the specificities of each case study context in terms of consumption, self-sufficiencies and trade flows. Trends are also reported.

Secondly and on the basis of partner contributions for the D3.2, main production systems existing at the EU level are described, highlighting country specificities, if any. Apart from a general outline, there was not common format for the section related for the description of production systems.

Third, indicators compiled by case study under the D3.3 are reported and assessed by group of indicators. The reference year for the comparison is 2014 and in some cases times series are provided. The assessment starts with the indicators of economic performance (Labour productivity and Profitability) followed by indicators of economic dependency (species, energy and external trade) in order to have a whole overview of the economic sustainability. The social sustainability is assessed based on indicators of employment conditions and attractiveness of the sector. Last, the environmental sustainability is based on the state of targeted stocks for fisheries and the level of producers' involvement in sustainable practices for aquaculture. Governance elements are sometimes available and were discussed under aquaculture case studies. For fisheries, management systems are often transversal to several case studies and were largely described in the D3.1.

Indications of data source as well as expertise on their coverage and reliability have been provided by partners for the D3.2 and D3.3 and reported at least for aquaculture case studies. It is recalled that for fisheries, most of the data exist through the DCF[3] (Data Collection Framework) from 2008 and made available via the STECF website and the quality of fisheries data was already assessed during STECF expert meetings. The STECF Annual Economic Report provides a useful source of additional information for our work.

General outcomes from each case study conclude the section, including limits resulting from data source and expertise if relevant. Relevant references by case study are provided in case study section.

[3] COMMISSION IMPLEMENTING DECISION (EU) 2016/1251 of 12 July 2016 adopting a multiannual Union programme for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017-2019

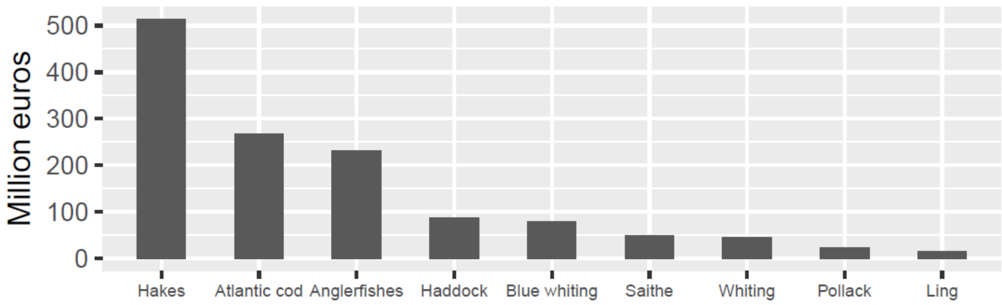
3.1 Whitefish Case study

Whitefish is the usual term referring to several fish species with white or very light coloured meat which are often offered as fillets on the market and used for processed seafood products like fish fingers or fish sticks and fish and chips. Whitefish species, such as cod, hake, haddock and saithe, used to dominate the world whitefish market but they are now experiencing strong competition from farmed species, such as tilapia and *Pangasius* (FAO, 2016). In the EU, white fish production relies on fisheries and aquaculture production of tilapia and *Pangasius* is virtually zero.

3.1.1 Context of EU production, exploitation and trade

3.1.1.1 Production

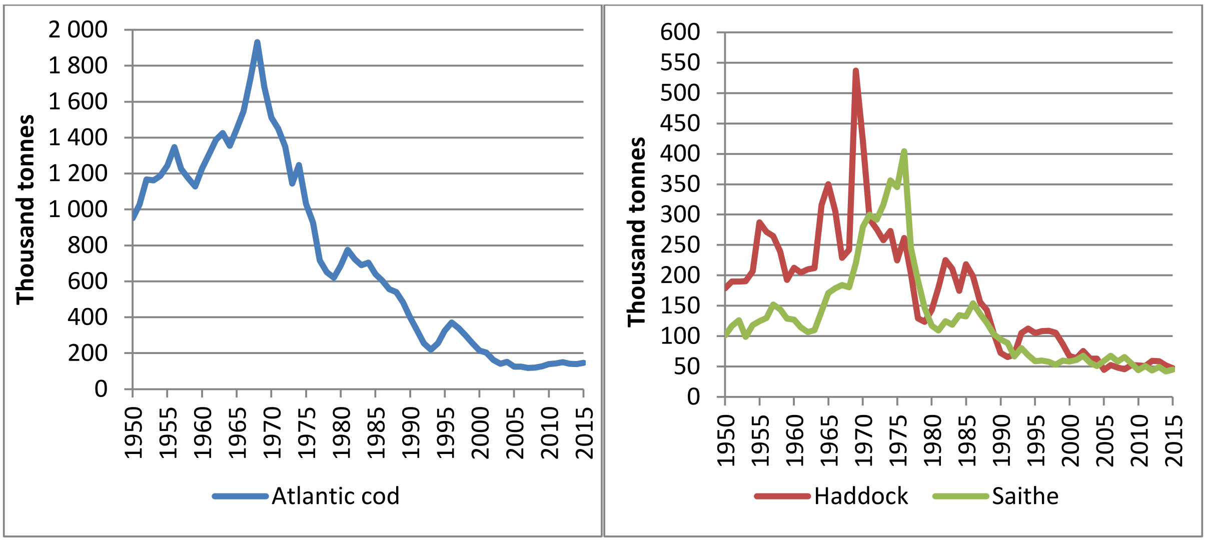
Whitefish landed in the EU belong primarily to Gadidae, Merlucciidae and Lophiidae families. Landings of species belonging to these three families amounted to around 752 000 tonnes (15% of total EU landings) and € 1.3 billion (18% of total EU landings) in 2014. In terms of value, the main species landed were European hake (€ 367 million), Atlantic cod (€ 267 million) and anglerfishes (EUR 231 million). In terms of volume, the main species landed were blue whiting[4] (193 000 tonnes), Atlantic cod (138 000 tonnes) and European hake (110 000 tonnes). (STECF, 2016)



Top whitefish species landed in the EU (in value), 2014 (Source: STECF, 2016)

Catches of major whitefish species collapsed in the 1970s after 2 decades of growth since the end of the 2nd World war. This decrease stopped in the 2000s thanks to the recovery in several stocks as a result of good management practices and drastic fleet capacity deduction. Since the middle of the 2000s, the Cod landings slightly rise while trends remains steady for Haddock and Saithe at least in comparison with the 6 last decades (FAO – FishStatJ, 2016).

[4] Although Blue whiting belongs to the Gadidea family, it is questionable to include this specie into the Whitefish group because it is primarily dedicated to Surimi. Conversely, plaice belongs to the Flatfish group (see next CS) but is often used as fillets or for "fish and chips" like common whitefish species.



Capture production of Atlantic cod, haddock and saithe (in thousand tonnes), 1950-2015 (Source: FAO – FishStatJ, 2016)

The major fishing countries for whitefish production at global level are Russia, USA and Norway. In the EU, Spain, United Kingdom and France are the main producer countries for whitefish:

- Spain catches contribute to 21% of the EU whitefish landings and are concentrated on Hake (around 35 000 tonnes per year) and Cod (18 000 tonnes);
- The UK contribution to EU whitefish landings is almost similar to Spain (21%) but much more diversified. The UK landings contain Haddock (36 000 tonnes), Cod (31 000 tonnes), Anglerfishes (16 000 tonnes) but also Saithe, Whiting and Hake;
- France is also very diversified but compared to the UK, the French top landings are dedicated to high value species like Hake (41 000 tonnes) and Anglerfishes (23 000 tonnes). Then come Cod, Saithe and Whiting with yearly landings around 12 000 tonnes each;
- Denmark and Germany are also part of the top EU whitefish producers. Denmark is specialized on Cod (22 000 tonnes) and Germany lands Cod (15 000 tonnes) and Saithe (9 000 tonnes).

Breakdown of landings by main species and by main producer countries (in tonnes), 2014 (Source: STECF, 2016)

	Spain	United Kingdom	France	Denmark	Germany	Others	Total
Atlantic cod	**18,602**	**30,723**	**12,206**	**22,309**	**15,221**	38,716	137,777
European hake	**34,393**	**11,301**	**41,365**	3,076	758	19,290	110,183
Anglerfishes	**7,588**	**15,860**	**22,784**	1,444	843	7,786	56,305
Haddock	490	**36,359**	**6,847**	2,909	1,145	4,389	52,138
Saithe	24	**12,706**	**12,615**	4,981	**8,904**	2,535	41,765
Whiting	56	**11,832**	**10,292**	2,400	583	9,566	34,727
Ling	1,577	4,874	2,613	495	79	694	10,332
Pollack	293	2,475	3,672	312	150	1,294	8,196
Other whitefishes	67,629	1,879	7,506	25,553	21	5,729	108,317
Total*	**156,213**	**155,842**	**131,929**	**98,734**	**52,191**	**157,460**	**752,368**
Share of production*	**21%**	**21%**	**18%**	**13%**	**7%**	**20%**	**100%**

** The total and the share include all landings of Gadidae, Merlucciidae and Lophiidae and so Bluewhiting which is important but not reported in the table.*

Ex-vessel prices of whitefish are in average 1.49 €/kg, from 5 €/kg for Anglerfishes (the most valued species just before Hake and Pollack) to 1€/kg for the less valued species like whiting and saithe. Cod ex-vessel prices was 2.41 €/kg on 2015 and is increasing since 2006 (EUMOFA, 2017). Conversely, Hake ex-vessel prices has decreased compared to 2006 from 4.31 to 3.28 €/kg. A decreasing trend is also observed for Anglerfishes.

3.1.1.2 Exploitation

Demersal Trawl (DTS) is the dominant gear for all the top Whitefish species. DTS is responsible of more than 65% of catches for Anglerfishes, Cod, Haddock, Saithe and Whiting. In addition to Demersal trawls, Nets and Gillnets (DFN) and Hook and lines (HOK) are used for Pollack, Hake and Ling catches.

EU landings by main class gear in weight (%), 2014 (Source: STECF, 2016)

	Gillnets and entangling nets	Hooks and lines	Seine nets	Trawls	Unknown or other gears	Total
Angler	3	0	0	65	31	100
Atlantic cod	12	1	2	70	15	100
Blue whiting	0	0	0	81	19	100
European hake	12	9	1	24	54	100
Haddock	0	0	14	78	6	100
Ling	7	13	1	54	24	100
Pollack	38	7	1	31	23	100
Saithe	1	0	2	88	8	100
Whiting	1	1	14	70	15	100

Almost all the key whitefish species are subject to TAC and quotas within Union waters. These fisheries are also impacted by the landing obligation[5] implementation.

Furthermore, three recovery plans concern whitefish species:

- The recovery plan for cod: North Sea, Kattegat, Skagerrak, the Eastern Channel, Irish Sea and West of Scotland (established in 2004 and revised in 2008 and 2016);
- The recovery plan for Northern hake (established in 2004);
- The recovery plan for Southern hake and Norway lobster (established in 2005).

Cod is also subject to the "multi-annual plan for the stocks of cod, herring and sprat in the Baltic Sea", established in 2016 and replacing the "multi-annual plan for cod, Baltic", established in 2007.

3.1.1.3 Consumption and Trade

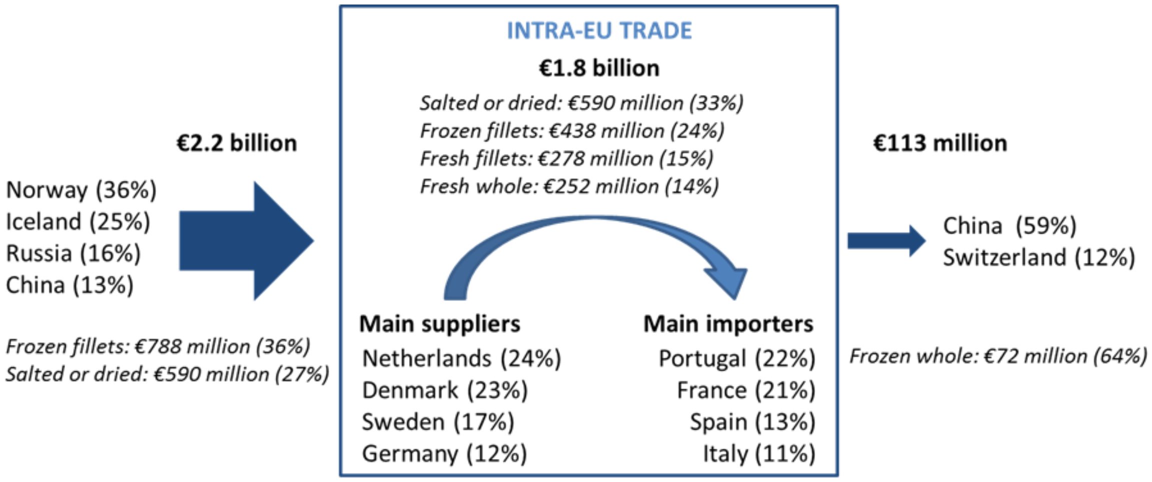
In 2014, cod and hake were respectively the second (2.40 kg per capita) and the eighth (1.00 kg per capita) most consumed species in the EU (EUMOFA, 2016).

The EU market for cod was estimated at 1.2 million tonnes in 2015, 40% more than in 2008. The UK is the main market for cod in the EU (270 000 tonnes), followed by Portugal (196 000 tonnes), France (175 000 tonnes) and Spain (156 000 tonnes). The EU apparent consumption of cod (in kg per capita)

[5] See the D3.1 and the D3.4 reports

varies strongly among countries. The value is very high in Portugal (18.9 kg/capita) while it is around 2-4 kg/capita in UK, France and Spain.

The EU market for Cod is strongly dependant on Extra EU imports. Self-sufficiency rate for cod is only 13% in 2015, constant since 2008. Extra EU imports of Cod amount € 2.2 billion and mainly come from Norway[6] and Iceland. They are consisting in frozen fillets as well as salt & dried cod. Intra EU trade flows are also very high and amounted € 1.8 billion in 2015. They are consisting first in Salt & Dried Cod (5.7 €/kg), then in frozen fillets (4.7€/kg), fresh fillets (8.4 €/kg) and fresh whole. Main EU importing countries are the UK, Portugal, France, Spain, and Italy. The UK cod imports reached € 600 million in 2015 of which 66% were frozen fillets and 17% fresh fillets. Iceland is the main supplier for the UK Cod market (37%), followed by China (18%). In the Netherlands[7], Denmark, Germany, Sweden and Poland, Cod is imported as well as exported.

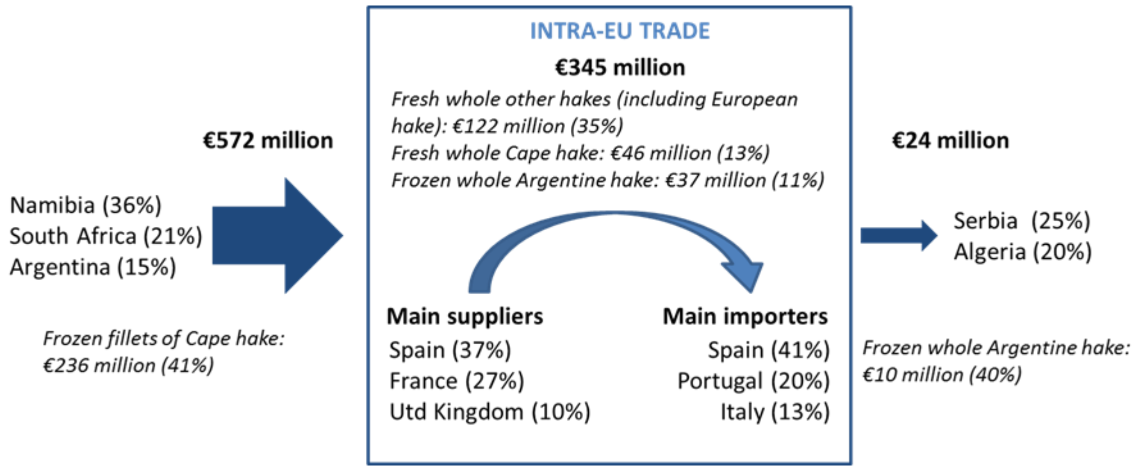


EU cod trade market in value in 2015 (Intra EU-trade is estimated through imports) (Source: COMEXT)

The EU market for Hake was estimated at 500 000 tonnes in 2015, 8% more than in 2008. Spain is the main market for hake in the EU (238 000 tonnes), followed by Italy (79 000 tonnes), France (67 000 tonnes) and Portugal (44 000 tonnes). The EU apparent consumption of Hake is 1 kg/capita in average and is the highest in Spain (5.13 kg/capita).

The EU market for hake is dependent on Extra EU imports and the EU self-sufficiency for Hake is 38% in 2015. EU trade flows for Hake account for € 572 million of Extra EU imports, € 345 million of Intra EU trade and € 24 million of Extra EU exports. The main non-EU suppliers are Namibia, South Africa and Argentina. Extra EU imports are mostly frozen while intra EU trade are concentrated on fresh hake. The main import countries in the EU are Spain, Italy and Portugal. Spain, France and the UK are the main suppliers for intra EU trade of hake.

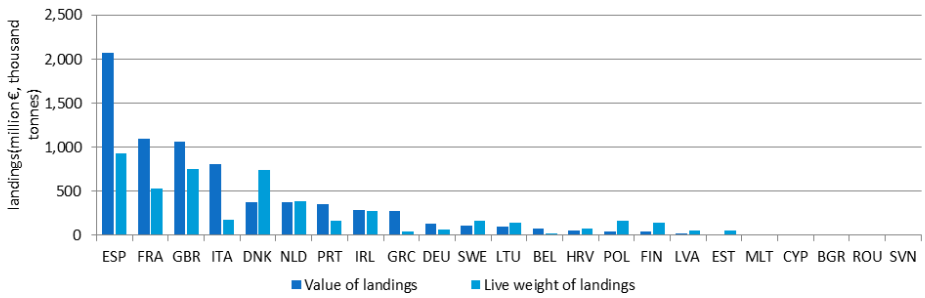
[6] Norway mostly exports to Sweden and Denmark which re-export to the other Member States such as France
[7] Netherlands is a trading platform.



EU hakes trade market in value in 2015 (Intra EU-trade is estimated through imports) (Source: COMEXT)

3.1.2 Description of productions systems

The main producers of whitefish species at EU level are Spain, United Kingdom and France, and in a less extent Denmark and Germany. DCF data were directly used for the production system description and indicator calculations (for most of them). As reported by DCF data summarized in the AER,2017, Spain, France and UK are also currently the 3 most important fishing countries at EU level.



Landings in weights and value per country (in average 2008-2014) (AER,2017)

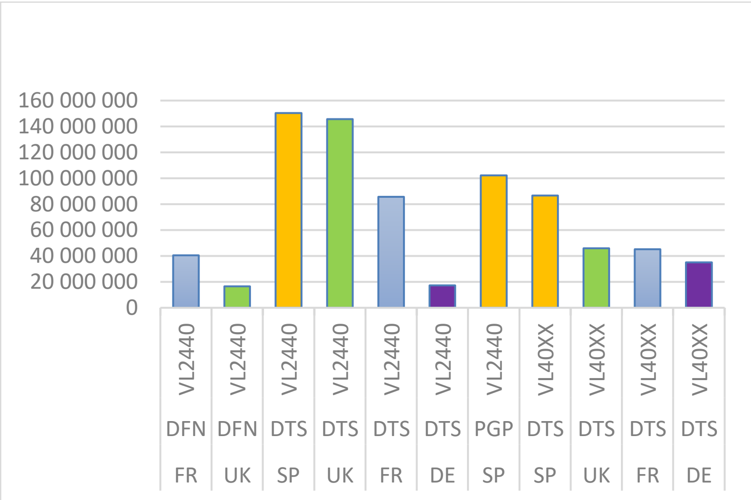
According to the AER terminology, most of the vessels targeting whitefish belong to the Large Scale Fleet (LSF) group[8] but not all LSF vessels are targeting whitefish species.

Vessels landing whitefish are mostly large Demersal Trawlers (DTS over 18m) and vessels targeting almost exclusively whitefish are often over 24m long. Indeed, catches composition of DTS 18-24 in UK and France where these fleet segments are important show the predominant part of nephrops for English vessels and a high diversity of catches for the French ones.

The rest of the analysis will be concentrated on the fleet segments of over 24m in Spain, UK, France and Germany (excluding pelagic trawler and seiners). AER DCF data show that whitefish segment fleets differ slightly between countries according to the size of vessels and the gear used. Based on total value of landings per year and per fleet segment it is shown that:

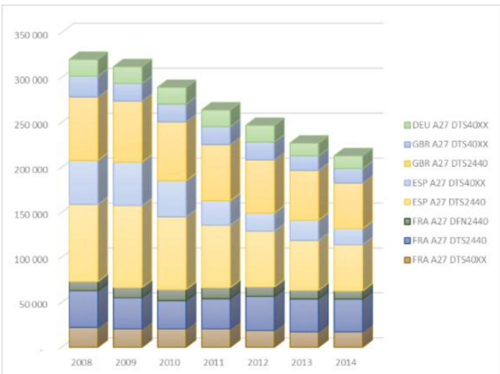
[8] Large scale Fleet gathers all EU vessels using towed gears and all vessels over 12m using passive gears.

- In Spain, whitefish species are mostly caught by vessels between 24-40m using demersal trawls DTS for a large part (€150 million) but also Polyvalent passive gears (PGP). The total landings from this last fleet segment amount €102 million per year. A significant amount of catches also belongs to DTS over 40m (€87 million);
- In the UK, whitefish are almost exclusively caught with demersal trawls. DTS 2440 is the most important segment for whitefish (€146 million) followed by DTS 40XX (€46 million);
- In France, DTS 2440 (€85 million) and DTS 40XX (€45 million) are the 2 main segments involved in the whitefish fishery. However, netters are also playing a significant role and the value of landings related to DFN 2440 amounts €40 million, close to the DTS 40XX one;
- The most important whitefish segment in Germany is DTS 40XX with €35 million followed by DTS2440. German demersal trawlers targeting saithe have a length between 35 and 41m and therefore are included in the 2 DCF segments DTS2440 and DTS40XX.



Value of landings (€) per country and Fleet segment involved in Whitefish catches (2014, AER data)

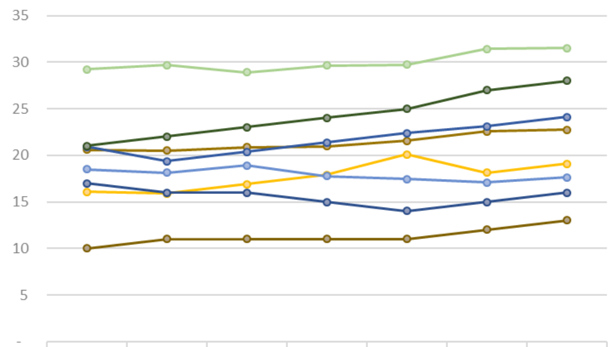
Whitefish fleet capacity (measured with engine power) show a continuous decreasing trend since 2008 which seems to have mostly affected Spanish vessels[9], consistent with the decrease in the number of vessels. (NB: due to incomplete time-series on ESP A27 PGP2440, this fleet is not included in the following figure).



Cumulative engine power (kW) per fleet segment from 2008-2014 (AER DCF data)

[9] In the other countries, the decrease in capacity happened long before.

Consecutive to the capacity trend, the structure of the Whitefish fleet has changed with a major role of the 24-40m length category in place of the 40XX length category. Another outcome is the ageing of the fleet and particularly the German trawlers and the French netters which are close or beyond 30 years old in average. Strong disparities in vessels age exist between EU whitefish segments and the youngest whitefish vessels are found in Spain.



	2008	2009	2010	2011	2012	2013	2014
FRA A27 DTS40XX	16	16	17	18	20	18	19
FRA A27 DTS2440	19	18	19	18	17	17	18
FRA A27 DFN2440	29	30	29	30	30	31	32
ESP A27 DTS2440	10	11	11	11	11	12	13
ESP A27 DTS40XX	17	16	16	15	14	15	16
GBR A27 DTS2440	21	21	21	21	22	23	23
GBR A27 DTS40XX	21	19	20	21	22	23	24
DEU A27 DTS40XX	21	22	23	24	25	27	28

Average age of vessels per fleet segment (AER DCF data)

One major feature of the EU Whitefish fleet segments is the small number of vessels specialized in this fishery while catches and landings are important. The number of vessels belonged to our 8 whitefish fleets accounts 343 in 2014, representing less than 1% of the total EU fleet and 1.6% of the EU large scale fleet (LSF). However, they contribute to 10% of the total income from the EU fishing fleet.

These segments are also well known to be highly capitalistic and concentrated (a large amount of capital is owned by a small number of firms) but current DCF database do not cover these features and data collection has not been easy to implement in the time-being of the project. Vertical integrations of processing or retailing companies in this primary whitefish sector are often reported by fishing newspapers (example of the big retailer “Intermarché” in France which have started to invest in large demersal trawlers since the end of the 1990s and is expanding since, even in small units using passive gears) but no detailed data are available to assess how far they occur and how quick and spread this movement happens at EU level.

According to qualitative information collected on the German saithe fishery, the production system of the German saithe fishery presents the particularity that it is vertically integrated. The processing and marketing of the landings of saithe are done by the same organization which is a subsidiary of Kutterfisch. This organization is directly connected to the producer organization corresponding to the saithe fishing fleet. Kutterfisch owns almost all the vessels (with the exception of one individual owning one vessel) and the whole value chain of saithe is integrated in one single organization.

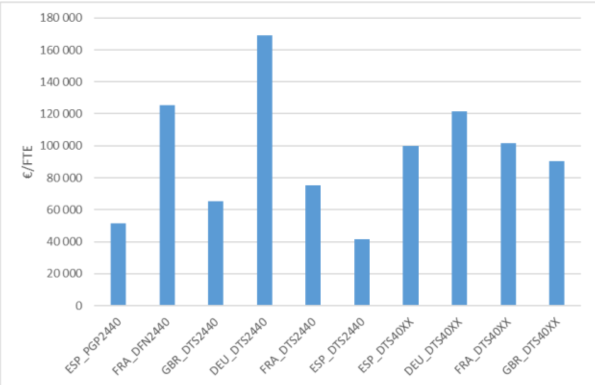
Another aspect of the recent years is the increase number of eco-certified fisheries (MSC, FoS) involving large scale demersal vessels. It has been reported by fishing companies as a prerequisite to enter whitefish markets.

3.1.3 Comparison of Selected indicators – Analysis

3.1.3.1 Economic sustainability - Economic performance

The economic performance of the whitefish fleets in Spain, UK, France and Germany are indicated by the following metrics: Labour productivity, Profitability (i.e. ROFTA), Financial position and Energy efficiency.

Labour productivity



Labour productivity (=GVA/FTE) by fleet, 2014

The labour productivity indicator varies between segments with the lowest value (40 000 €/FTE) is registered for the Spanish DTS2440 and the highest (169 000 €/FTE) for the German DTS2440. The indicator of labour productivity is sensitive to the estimation of the FTE variable which seems to be highly dependent to country. The German segments present the lowest value of FTE compared to similar size segments, specifically the Spanish ones.

Looking to labour productivities of fleets within countries (in order to avoid variations in FTE calculation methods), it appears that, whatever the country studied, the ratio GVA/FTE in 2014 is higher for DTS40XX compared to DTS2440, except for Germany. The DTS 40XX ratio is even higher than one observed for PGP2440 in Spain while it is not the case in France with DFN2440.

Profitability (ROFTA)

FRA_DFN 2440	ESP_PGP 2440	ESP_DTS 2440	FRA_DTS 2440	GBR_DTS 2440	DEU_DTS 2440	GBR_DTS 40XX	ESP_DTS 40XX	FRA_DTS 40XX	DEU_DTS 40XX
41%	52%	23%	-7%	34%	9%	90%	134%	NA	-4%

The large differences between the values of the indicators, ranging from -7% for the French DTS 2440 to +134% for the Spanish DTS40XX, is difficult to explain. The age and length of the vessels may provide an explanation. Instead, the cause of the differences should be found in the different assumptions taken for the estimation of capital values (including depreciation costs).

Regarding the gross profit, it should be mentioned that many of the vessels in these segments belong to vertically integrated firms (e.g. German fleets), where the profit could be made further down the value chain. Therefore, this segment´s profits are estimated based on internal prices, and may present lower values compared to other segments that are not vertically integrated. The profitability should therefore be seen in the wider context of the vertical firm, including the processing.

Indebtedness (financial position)

FRA_DFN 2440	ESP_PGP 2440	ESP_DTS 2440	FRA_DTS 2440	GBR_DTS 2440	DEU_DTS 2440	GBR_DTS 40XX	ESP_DTS 40XX	FRA_DTS 40XX	DEU_DTS 40XX
NA	0.08	0.03	NA	0.37	1.89	0.28	0.07	NA	0.27

The financial position is defined as the percentage of debt in relation to assets (total capital value) and is often reported as extremely difficult to assess. Moreover, this indicator shows high variability across fleet segments in the EU, which brings doubts on the comparability of the approaches across member states or the quality of the data.

Energy efficiency (energy consumption per kilo landed, litre/kg)

FRA_DFN 2440	ESP_PGP 2440	ESP_DTS 2440	FRA_DTS 2440	GBR_DTS 2440	DEU_DTS 2440	GBR_DTS 40XX	ESP_DTS 40XX	FRA_DTS 40XX	DEU_DTS 40XX
0.3	0.9	1.3	1	0.6	0.5	0.6	0.5	0.6	0.6

Energy efficiency indicator ranges from 0.3 to 1.3 l/kg according to fleet segments. For most of the fleet segments and specifically DTS 40XX, it is closed to 0.6 litre per kg. The indicator for Spanish and French DTS 2440 is close or more than one, reflecting the distance of the fishing areas which is penalizing these fleets compared to English ones for instance. The lowest value is observed for the French DFN 2440 which is 0.3 l/kg and is related to the fishing gear which is low energy consuming compared to demersal trawl.

3.1.3.2 Economic sustainability - Economic dependency

The economic dependency of the whitefish fleets in Spain, UK, France and Germany are indicated by the following metrics: Economic dependency on species, Economic dependency on external trade, and Economic dependency on energy.

Economic dependency on species **(N80)**

FRA_DFN 2440	ESP_PGP 2440	ESP_DTS24 40	FRA_DTS24 40	GBR_DTS 2440	DEU_DTS 2440	GBR_DTS 40XX	ESP_DTS 40XX	FRA_DTS 40XX	DEU_DT S40XX
1	1	9	14	7	4	4	4	4	3
Hake	Hake	Anglerfish, Hake, Megrim	Anglerfish, Hake, Whiting…	Cod, Saithe, Megrim, Haddock, Anglerfis h	Saithe	Cod, Haddock	Cod, Halibut	Cod, Saithe	Cod

The number of species which contributes to 80% of the total value of landings is an indicator of the fleet specialisation and hence its vulnerability to resource depletion. The most dependent fleet are those which passive gears (DFN 2440 and PGP2440) for which Hake is the target specie. The largest vessels (over 40m) concentrate their effort on a few number of species as 3 or 4 are responsible of almost all their annual revenues. On the contrary, demersal trawls between 2440m are much more diversified and the highest number of species is for the French demersal trawlers 2440.

Economic dependency on external trade

Based on species targeted by whitefish fleet segments, the self-sufficiency of the country is considered as an indicator of fleets vulnerability to external market competition.

	Species	Landings	Net exports	Net imports	Self-sufficiency
Spain	Hake	97,317	35,347 (90% frozen whole and 10% prepared or preserved)	163,746 (61% frozen cut, 31% fresh whole and 8% frozen whole)	43%
France	Cod	12,206	92 (100% dried or salted)	170,031 (37% frozen cut, 28% fresh cut, 14% dried or salted, 14% fresh whole)	7%
France	Hake	41,365	6,411 (99% fresh whole)	22,664 (93% frozen cut)	72%
France	Saithe	12,615	-	32,481 (61% frozen cut, 29% fresh cut, 10% fresh whole)	28%
UK	Anglerfish	15,860	1,985 (95% fresh whole, 5% frozen cut)	190 (100% frozen whole)	113%
UK	Cod	30,723	6,551 (95% dried or salted)	246,961 (76% frozen cut, 10% fresh cut, 8% frozen whole)	11%
UK	Haddock	36,359	-	67,739 (67% frozen cut, 20% fresh whole, 12% frozen whole)	35%
UK	Hake	11,402	4,964 (99% fresh whole)	7,316 (87% frozen cut, 13% frozen whole)	83%
UK	Saithe	12,706	3,727 (90% fresh whole)	3,613 (64% fresh cut, 35% frozen cut)	101%
Germany	Saithe	8,904	7,764 (88% fresh whole, 12% frozen whole)	20,633 (69% frozen cut, 27% fresh cut, 4% prepared or preserved)	41%

Production and trade flow per specie and country (in tonnes – live weight equivalent), 2014 (Source: STECF, 2016; Eurostat – COMEXT)

Self-sufficiency are very low (less than 20%) for Cod in France and UK. In France, landings are almost all dedicated to domestic production but imports are very high. In the UK, a small part of the production is dedicated to exports which are still very weak compared to the huge volume of Cod imports.

Self-sufficiency are low (less than 50%) for Hake in Spain, Saithe in France and Germany and haddock in the UK although a large part of landings are destined to domestic markets (saithe in France, haddock in Germany and hake in Spain).

For the other species, self-sufficiency is above 70% and sometimes more than 100% (Saithe and Anglerfish in the UK).

Economic dependency on energy **(fuel costs/landings value)**

FRA_DFN 2440	ESP_PGP 2440	ESP_DTS 2440	FRA_DTS 2440	GBR_DTS 2440	DEU_DTS 2440	GBR_DTS 40XX	ESP_DTS 40XX	FRA_DTS 40XX	DEU_DTS 40XX
8%	11%	27%	29%	18%	19%	23%	13%	22%	20%

Not surprisingly, fuel costs account for a high proportion of the revenue of large demersal trawlers and the highest ratio are observed for Spanish and French DTS 2440. Not surprisingly again, the segments using passive gear (FRA_DFN2440 and ESP_PGP2440) present the lowest dependency of revenues on fuel.

3.1.3.3 Social sustainability – Employment conditions and attractiveness of the sector

The social sustainability of the whitefish fleets in Spain, UK, France and Germany are indicated by the following metrics: Temporary/seasonal employment, and Level of remuneration of work.

Use of temporary/seasonal employment

FRA_DFN 2440	ESP_PGP 2440	ESP_DTS 2440	FRA_DTS 2440	GBR_DTS 2440	DEU_DTS 2440	GBR_DTS 40XX	ESP_DTS 40XX	FRA_DTS 40XX	DEU_DTS 40XX
1	1	1	1	0.8	1.3	0.8	0.9	1	1.3

The indicator is calculated as "Total employees/FTE" is often close to 1 but with some variations among countries. German DTS segments present part time work (the number of employees is more than their full time equivalent) while on the other side English ones' present overtime work (the number of full time equivalents is higher than the number of employees).

As said before regarding the labour productivity, this indicator is sensitive to the estimation of the FTE for each segment. Some of the segments operate for a number of days at sea that is over the value generally considered as a maximum, which should be reflected in higher than one full time equivalent for each person employed.

Level of remuneration of work (labour costs/FTE/days at sea per vessel)

The indicator is standardised to reflect the remuneration of a full time fisher per day. There are some data issues with the calculation of FTE (as said above) and with the number of vessels, as for example some vessels fish in two areas. Consequently, this indicator is not provided.

Large differences in level of remuneration can also be due to differences in the calculation of wages and unpaid labour, due among others to different national tax and accounting criteria. The remuneration of skippers that are owners of the vessel as profit is alternatively included in the labour costs under "unpaid labour" for the smallest vessels.

3.1.3.4 Environmental sustainability

The method for assessing the environmental sustainability is described on the section 4.5 and was applied to the DTS_2440 from the UK as an example. After identifying the first species which account for 80% of the total value of landings for each fleet, the stock status provided by the ICES (2016) is reported.

The stock status of stocks targeted by the whitefish segment are summarized in the following table with the terminology used by the EC for stock status reporting (*see EC 2015 poster on TAC and quotas*).

	Rate consistent with MSY	**Overfished but inside biological limits**	**Outside safe biological limits**	**Unknowm**
Cod	NAFO3M (PT)	IIa,IIIa,IV (UK,DK,DE) Sub22-24 (DK,DE,SE) VIIbc,VIIe-k,VIII.. (FR) Skagerrak (DK)	Kattegat VIa, Vb VIIa	
Hake	Vb,VI,VII,XII,XIV (FR,ES,UK) VIIIabde (FR, ES) VIIIc,IX… (ES)			
Anglerfishes				IIa,IV (UK) VII (FR) VIIIabde (FR)
Saithe	IIa,IIIa,IIIbc,IV (FR,DE,UK)	Vb,VIa,XII,XIV (UK,FR)		
Haddock	IIa,IV (UK)	Vb, VIa (UK) VIIb-k… (FR)	VIb,XII,XIV (UK)	
Whiting	VIIb-k (FR, IE)		IV, VI…	

Based on ICES advices, Reg (UE) 2018/120, Poster Fishing TAC and quotas 2015 (EC)

Based on ICES last advices (2017), the rate of exploitation of some stocks of cod, haddock and whiting remains outside safe biological limits. Otherwise, the stocks of hake and saithe for the EU whitefish fleets are harvested sustainably. Stock status of anglerfishes are unknown.

3.1.4 General outcomes

Whitefish is a major case study at the EU level. It contributes to almost 20% of the total EU landings in value and more than 10% of the total EU seafood production, including farming. Within the whitefish landings, cod and hake are major species and cod is also the second most consumed seafood at the EU level. The EU market for whitefish is dependent on imports but self-sufficiency varies according to species (lesser for cod than for hake).

Spain, UK and France are the main fishing countries for whitefish, with some species' specialisations according to countries. The most used gear is the demersal trawl (DTS) but some vessels using netters or polyvalent passive gears are also involved (from France and Spain). Whitefish vessels are generally over 24 meter and belong to the large scale fleet (LSF). Whitefish fleet capacity has decreased over time according to the reduction in fishing opportunities but there is no detailed information on the change in the industry structure behind this. Whitefish fleet is ageing with strong age differences between country however.

Economic performance indicators show huge differences between fleet segments according to labour productivity and ROFTA. The main explanation is linked to the quality of FTE and Capital data used for these calculations which differ among countries with few information on methodologies.

Energy efficiency differs among fleets from 0.3 l/kg for the French large netters to 1.3 l/kg for large Spanish trawlers and close to 0.6 l/kg for the rest of segments. Economic dependency (ED) on energy is generally higher than 20% (with the lowest value for netters). ED on species goes from 1 for the most specialized fleets to 14 for the less ones. This number is not linked with a particular size of vessel or gear used. Whitefish fleet vulnerability to external markets depend on species and countries. Finally, employment conditions and attractiveness of the sector are very difficult to assess and AER data pointed problems on FTE data reliability.

References

Mardle, S. and S. Metz (2017). "Impacts of current EU regulation on the UK whitefish value chain." Marine Policy 84: pp52-59.
STECF (2017). The 2017 Annual Economic Report on the EU Fishing Fleet (STECF-17-12), Scientific, Technical and Economic Committee for Fisheries (STECF), Publications Office of the European Union, Luxembourg: 494p.
European Commission (2016). Facts and Figures on the Common Fisheries Policy. Basic statistical data - 2016 Edition: 56 p.
EUMOFA (2013). Price structure in the supply chain for fresh cod in United Kingdom, EC: 32p.
EUMOFA (2017b). Fresh cod in the United Kingdom. Price structure in the supply chain. Price structure analysis, June 2017. 36pp
ICES 2017 advice (www.ices.dk)

3.2 Flatfish Case study

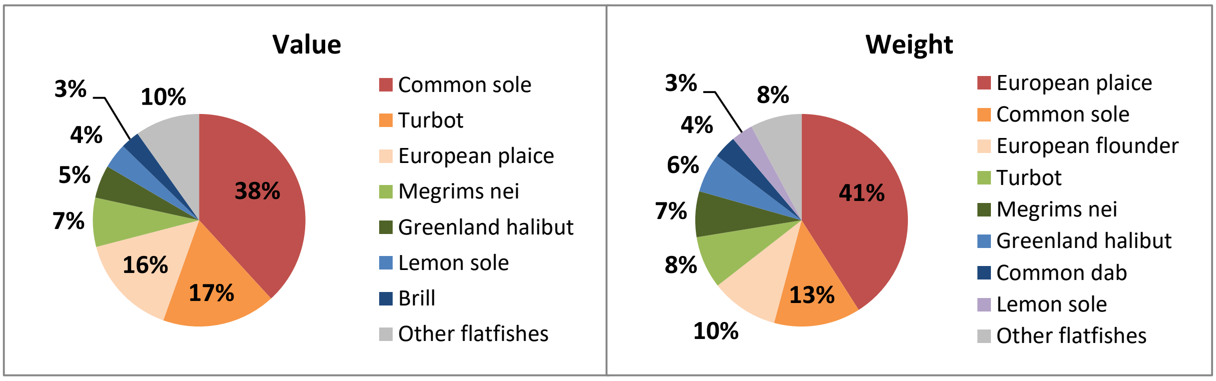
Flatfish is the common name used for species belonging to the Pleuronectiformes order like sole, plaice, turbot, megrim, brill, flounder, halibut, etc.

3.2.1 Context of EU production, exploitation and trade

3.2.1.1 Production

The European Union is the second largest producer of flatfish in the world (18% of global production in 2015), after the United States (23%). It is followed by China (12%) and Russia (11%). (FAO, FishStatJ, 2016).

In 2014, flatfish production in the EU amounted to about 212 000 tonnes (3% of total EU production of fish and seafood products) and EUR 703 million (6%). Production is dominated by plaice in terms of volume (41%) and by common sole in terms of value (38%). With the exception of turbot[10], flatfish production in the EU is based almost entirely on capture fisheries (94% in terms of volume and 88% in terms of value in 2014).



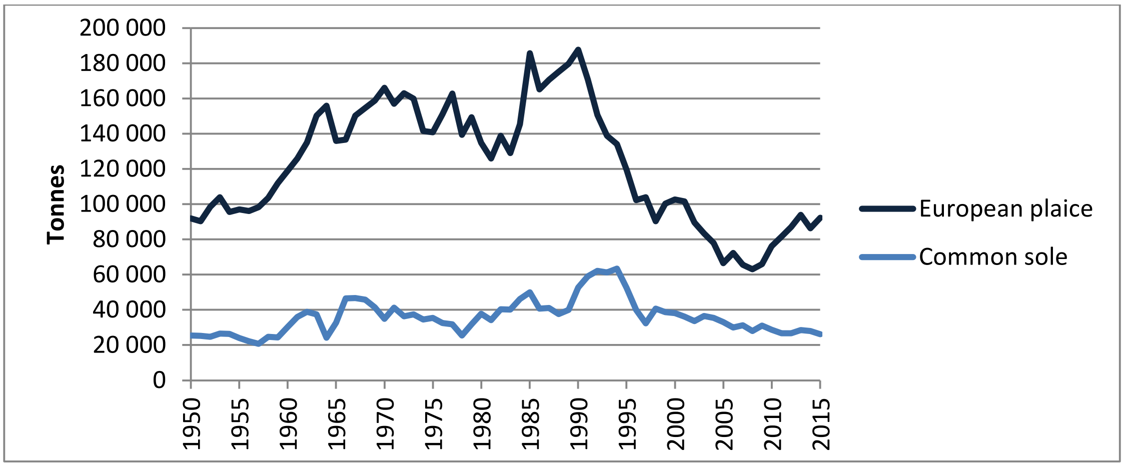
Breakdown of EU flatfish production (fisheries and aquaculture) by main species, 2014 (Sources: STECF, 2016; FAO – FishStatJ, 2016)

Due to overexploitation, catches of flatfish in the Community waters have strongly declined after a long period of rise since the end of the 2nd World War and were submitted to high fluctuations during the last two decades:

- Plaice catches were divided by three between 1990 and 2008 after reaching a peak in 1990 (179,801 tonnes). In 2000, the EU council decided to reduce the TAC for the major stock in the North Sea. Shortly afterwards, results have been felt and the spawning stock biomass for plaice picked up in 2007. Moreover, in the same year, a multi-annual plan for sole and plaice in the North Sea was established; it aims to ensure precautionary biomass for plaice and for sole by gradually reducing fishing mortality. Thus, catches of plaice have increased again and amounted to around 92 400 tonnes in 2015 (+46% between 2008 and 2015). Furthermore, fishing mortality in the North Sea has been estimated at around F_{MSY} and the stock has been harvested sustainably since 2013.

[10] Turbot is the only flatfish species for which aquaculture is well developed in the EU. In 2015, farmed turbot production amounted to 10,173 tonnes (66% of total turbot production in the EU) and EUR 64 million. Spain and Portugal are the main producers and provided 74% and 34% of total production in that year. (FAO – FishStatJ, 2016)

- The results are more moderate in sole fisheries after 3 multi management plans: catches topped 63,346 tonnes in 1994 and then dropped by 49% between 1994 and 1997; they picked up by 26% in the following year but since then, they have been falling (-36% between 1998 and 2015). Thus, one of the main issues for flatfish fisheries is the decline in catches of sole which is the species generating the largest share of landings in value.



Landings of European plaice and common sole in the EU28, 1950-2015 (Source: FAO – FishStatJ, 2016)

In the EU, Netherlands is the main producer of flatfish (22% of total EU Flatfish production in volume in 2014), followed by United Kingdom (15%) and Denmark (14%). Netherlands, United Kingdom and Denmark mostly produce European plaice whereas France and Spain mainly produce common sole and turbot, respectively.

Breakdown of flatfish production (fisheries and aquaculture) in the EU by main producer countries and by main species (in tonnes), 2014 (Source: STECF, 2016 for fisheries production; FAO – FishStatJ, 2016 for aquaculture)

	Netherlands	United Kingdom	Denmark	France	Spain	Others	Total
European plaice	**29,280**	**19,143**	**20,876**	**3,193**	6	14,253	**86,751**
Common sole	**9,184**	**2,318**	598	**7,702**	116	8,015	**27,934**
European flounder	**1,319**	76	**2,585**	96	18	17,713	**21,807**
Turbot	**1,723**	840	647	**1,051**	**7,808**	4,818	**16,887**
Megrims nei	-	**4,996**	-	**1,780**	**4,857**	3,111	**14,743**
Greenland halibut	-	359	-	386	**4,436**	7,400	**12,581**
Common dab	**3,243**	653	**1,326**	562	-	1,658	**7,443**
Lemon sole	460	**2,850**	907	**1,051**	37	1,738	**7,043**
Witch flounder	26	993	**1,514**	278	485	1,137	**4,434**
Megrim	6	-	36	**2,644**	3	101	**2,790**
Brill	867	385	180	485	20	625	**2,562**
Other flatfishes	22	133	304	1,349	2,704	2,230	**6,742**
Total	**46,132**	**32,745**	**28,974**	**20,577**	**20,489**	**62,800**	**211,718**
Share of production	**22%**	**15%**	**14%**	**10%**	**10%**	**30%**	**100%**

Sole belongs to the commercial category of "high value species" with an average ex-vessel price of approximately 9.60 €/kg compared to the EU average ex-vessel price (all species) of 1.49 €/kg in

2014. In fact, all flatfish species are above this average except for plaice (1.25 €/kg in 2014), dab and witch.

3.2.1.2 Exploitation

Most of the plaice landings come from North Sea and Norwegian Sea stocks (ICES division 2a and subarea 4), more than 80% according to the TACs share.

For sole, different stocks are of high importance, such as the North Sea stock (ICES subarea 4), the Bay of Biscay stock (ICES divisions 8ab) and the eastern Channel stock (ICES division 7d). Dutch vessels target mostly the North Sea stock whereas several stocks are of interest for the French and English fleet. Indeed, in 2014, the Bay of Biscay stock and the eastern Channel stock contributed respectively to 51% and 33% of total landings of sole in France. Evenly, the English Channel stocks (ICES divisions 7de) and the North Sea stock contributed to 48% and 36% of total landings of sole in United Kingdom, respectively. Thus, the North Sea stock and the English Channel stocks are of interest for different Member States.

Landings distribution for common sole by main stocks (in volume), 2014 (Source: STECF, 2016)

Stock	France	Netherlands	United Kingdom
North Sea (subarea 4)	9%	**100%**	**36%**
Bay of Biscay (8ab)	**51%**	0%	0%
Eastern English Channel (7d)	**33%**	0%	**28%**
Western English Channel (7e)	5%	0%	**22%**
Bristol Channel, Celtic Sea (7fg)	1%	0%	**11%**
Other stocks	3%	0%	3%
Total	**100%**	**100%**	**100%**

Different fishing techniques are used to catch sole. In the North Sea as well as in the Celtic Sea, sole is mostly caught with trawls (91% of total landings in the North Sea) whereas in the Bay of Biscay sole is mostly caught with nets (68% of total landings). In the eastern English Channel, netters and beam trawlers contributed equally to sole total landings.

Landings distribution for common sole by fleet in 2016 as estimated by and reported to ICES

Stock	Landings (in tonnes)	Nets / gillnets	Otter trawl	Beam trawl	Inshore trawl	Other gears	Total
North Sea (Subarea 4)	14,127	7%	-	**91%**	-	2%	100%
Bay of Biscay (8ab)	3,266	**68%**	15%	9%	8%	-	100%
Eastern English Channel (7d)	2,538	**43%**	16%	**40%**	-	1%	100%
Western English Channel (7e)	913	8%	24%	**63%**	-	5%	100%
Bristol Chanel, Celtic Sea (7fg)	831	-	13%	**83%**	-	4%	100%

It must be emphasised that, according to (Turenhout *et al.,* 2016), the fisheries with pulse technique and SumWing technique have largely replaced conventional bream trawling in the Dutch flatfish fisheries since 2009. This change has led to various consequences and effects on costs and revenues, notably an increase in profitability but it has also caused a westward displacement in fishing areas of the North Sea more towards the English coasts as well as Dutch and Belgian coasts.

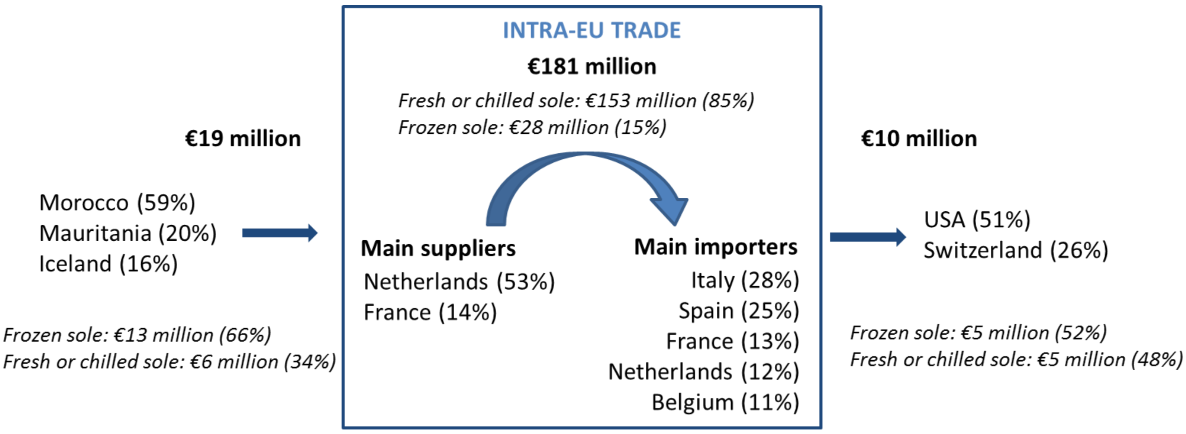
The exploitation of major flatfish species within EU waters is subject to TAC and Quotas. Furthermore, sole and plaice are subject to multi-annual plans: "multi-annual plan for Sole in the Bay of Biscay" (EC N°388/2006), "multi-annual plan for Sole in the Western Channel" (EC N°509/2007), and "multi-annual plan for Sole and plaice in the North Sea" (EC N°676/2007).

3.2.1.3 Consumption and Trade

According to EUMOFA 2017, sole and plaice are not in the top 15 main species consumed at EU level. However, this level may be strongly different across countries. Sole consumption is almost steady and averages 0.06 kg/capita at the EU level. However, it could be more than 0.2 kg in the Northern countries like Netherlands or Belgium. For plaice, consumption is about 0.19 kg/capita in average in the EU but is higher in UK, Italy, Netherlands and Sweden (around 0.5 kg) and reaches 1.72 kg/capita in Denmark.

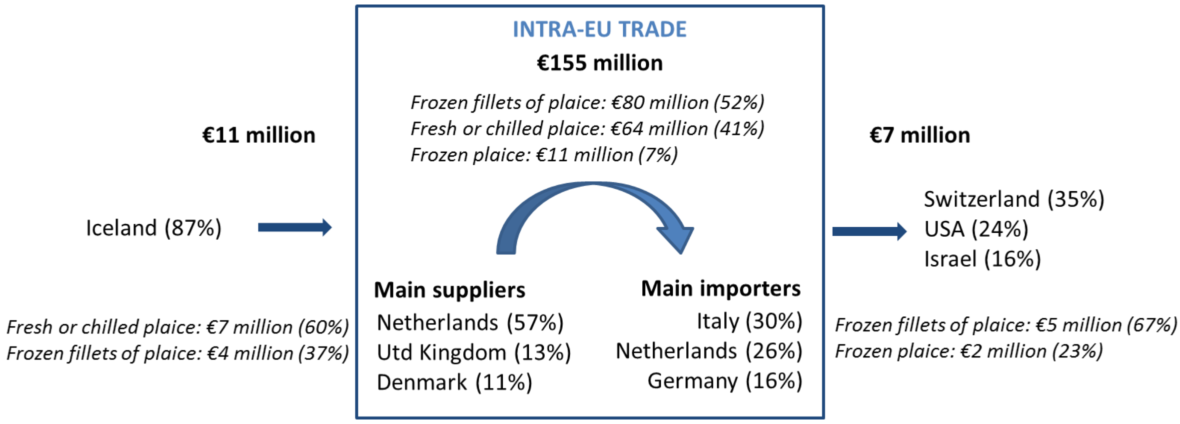
The European market for sole and plaice, more generally for flatfishes, is mainly driven by intra-EU exchanges and shows little dependence to extra EU imports:

- In 2015, the EU market for sole was estimated at 30 000 tonnes (equivalent live weight), 11% lower than in 2010, mainly because of a decreasing supply. This EU market is almost self-sufficient (90% in 2105) and this rate has increased since 2015. Over the period 2000-2015, intra-European flows of sole have registered a significant drop of approximately 16 000 tonnes (equivalent live weight), a 52% decrease both for fresh sole (-51%) and frozen sole (-54%). Sole import prices are volatile. In 2006, the peak of fresh sole price (around 12€ compared to 8€/kg in 2000) was due to a strong decrease in sole landings, in particularly in the North Sea (poor state of the stock and effort reduction as a result of increasing fuel price). In 2015, fresh sole import price averaged 10.36 €/kg. Netherlands are the leading exporting country in the EU for sole, and Spain and Italy are the main European markets.



EU sole trade market in value in 2015 (intra EU-trade is estimated through imports) (Source: COMEXT)

- In 2015, the EU market for plaice was estimated at 95 000 tonnes (equivalent live weight), 19% higher than in 2010, mainly because of an increasing domestic production. The self-sufficiency rate is close to 100% in 2015. After falling in 2009, intra-European flows of plaice rose again and were estimated 85 000 tonnes (equivalent live weight) in 2015, of which 58% products were frozen fillets, 38% were fresh (whole) and 4% frozen (whole). Plaice import prices have been fairly constant since 2000 (around 4 to 5€/kg for frozen fillets). Netherlands, Italy, Germany and United Kingdom are the major markets for plaice. Netherlands is also a major player in terms of trade and processing for plaice, importing mainly fresh whole plaice and exporting frozen plaice (whole and fillets).

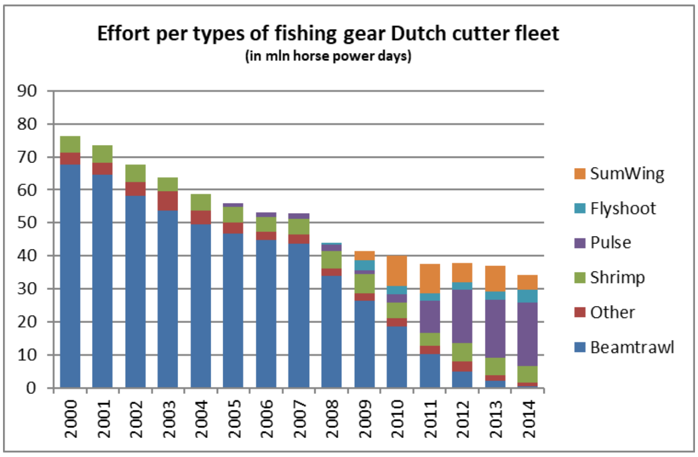


EU plaice trade market in value in 2015 (intra EU-trade is estimated through imports) (Source: COMEXT)

3.2.2 Description of productions systems

The flatfish production system description concentrates on the 3 main countries at the EU level (Netherlands, France and the United Kingdom) and includes some considerations on the national management systems according to flatfish fisheries.

In the Netherlands, the total landings of Sole and Plaice was around 38 500 tonnes in 2014 (22% for Sole and 78% for Plaice) and the catches are mainly concentrated in the North Sea and Norwegian Sea (II, IV Ices areas). In this fishing area, the Netherlands holds almost all the TAC of Sole and 35% of the TAC of Plaice. Flatfish are caught with several techniques: beam trawl, SumWing and Pulse techniques (all regrouped in the DCF segment TBB), but also “TwinRig” and Gillnet. Since 2009, there has been a significant change in the Dutch cutter fleet in terms of the fishing methods used in flatfish fishery. The fisheries with pulse technique and SumWing technique have largely replaced conventional beam trawling, with positive effects on fuel use and costs.



Turenhout (2017), D3.2

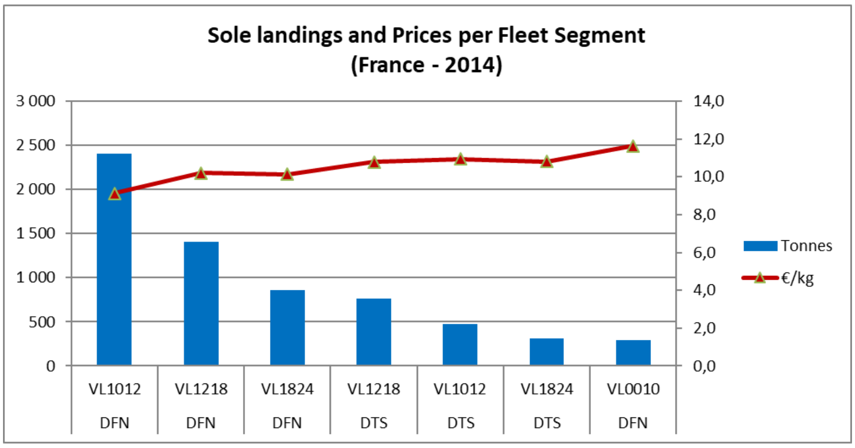
The Cooperative Fisheries Organisation (CVO) is an association of seven producer organizations regrouping cutter fleets active in the North Sea, the Wadden Sea & coastal waters, Skagerrak and the English Channel. Their members cover a large part of the Dutch trawlers operating in the North Sea. Via their membership of a POs, 95% of all cutter fishermen are member affiliated. In the Netherlands, since 1993 the national government and fisheries industry share the responsibility of dividing the national quota for fish by into Individual Transferable Quota (ITQ) for each fisherman. The ITQs may be transferred only to companies which are already in possession of a fishing licence. By means of multiannual management plans, the PO's distribute the available ITQ's among the members.

The sole quota was relatively low in 2015 (9 281 tons). Because of good availability of sole, and the increased fisheries efficiency with pulse technique, sole rent prices rose sharply, with an average of 556% between the first quarter of 2012 and the last quarter of 2015. The average rent for sole was 3,38 €/kg at the end of 2015. Despite the higher available sole quota (10 292 tonnes in 2016), sole quota prices are expected to remain high.

The ITQ system and the co-management system of the POs facilitates flexibility in the utilization of the various quota for the Dutch fishing sector, but has a costs. Fishermen who have timely invested in quota have the possibility to lease and rent out their quota in order to adjust their rights to their fishing opportunities. Fishermen that do not have enough rights will encounter extra costs for leasing/buying quota which will limit their economic returns. This makes it more difficult for newcomers to enter, as they require investments in a ship as well as quota especially in periods when demand for fishing rights is relatively high and supply low. Moreover, banks find it too risky to finance the purchase of quota. A further complication to competitiveness is that of quota, cautiously estimated, may be in the hands of non-active fishermen (Hoefnagel and Buisman, 2013). The consequences for the competitiveness of the Dutch fishing sector are not unambiguous, but it is clear that fishermen with rights have competitive advantage under the current circumstances.

Large pelagic companies have started to buy cutters to enter the flatfish fisheries; managing several cutters. They form a threat to the majority of family owned companies with mainly only one vessel, that do not have the flexibility not the assortment required by the consumer (large retail). The level of organisation among the cutter fleet is low.

In France, the total landings of flatfish (sole and plaice) in 2014 were around 10,000 tonnes (80% for Sole). Flatfish vessels in France commonly use Drift and Fixed Nets (DFN) or Demersal Trawls (DTS), with a large range of vessel size from small scale vessels (SSF) to larger ones (LSF) located along the French Atlantic coast. According to the DCF segmentation, the French Flatfish segments are concentrated on vessels below 24m and 2 main segments in this fishery belong to the small scale fleet category (DFN1012 and DFN0010). There is no strong difference in ex-vessel sole price according to the vessel size and the fishing gear used.



Sole landings and Price by fleet segment (2014), DCF data, SIH Ifremer

2 stocks of Sole are targeted by the French fleet: The Bay of Biscay Sole (VIIIabd) and the Eastern Channel Sole (VIId). The Bay of Biscay Sole VIIIab is captured by a group of vessels concentrated along the South Atlantic coast (from South Brittany to Basque country) landing 3,900 tonnes of Sole in 2014. Conversely the Sole VIId is captured by vessels located on the Channel and North Sea harbours landing 2,500 t of Sole in 2014. While the competition on Sole VIId involved UK and BE vessels, for the Sole VIIIab, French vessels hold almost all the TAC.

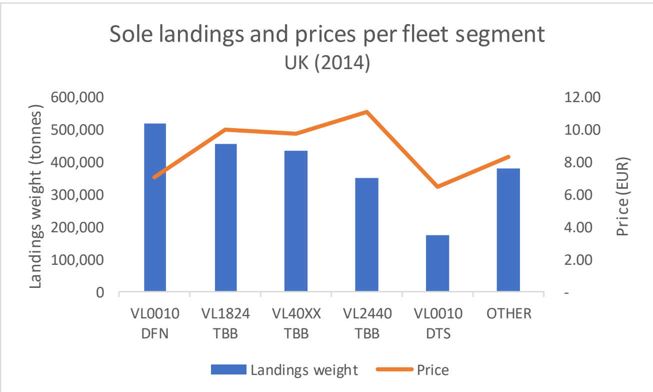
Vessels involved in the Sole fishery are more than 20 years old in average (close to the average at national level). The number of persons on board increases with the size of the vessel (around 2-3 for DFN1012, 3-4 for DFN1218 and 8 for DFN1824) but varies also with the gear used (only 2-3 for DTS1218). In a large majority and in conformity with a large part of the French fleet, the owners of vessels are single holders and the skipper-owner on board is in average 45 years old. In the recent years, there is a tendency of regrouping the ownership of 2-3 vessels into legal entities (Commercial Society) and this trend also includes coastal vessels, but this status remain minority.

A large part of the French Atlantic fleet (around 65% in the beginning of the 2010's) belongs to a Producer Organization (PO). The involvement of POs in fisheries management is particularly relevant for Sole VIIIabd fishery since the Recovery plan implemented in 2002 following by the Management Plan in 2006[11] for this fishery where landings have been superior to TACs for a long time (Biseau, 2011) and quotas subjected to high level of tensions. The French quota management system (Decree 2006) enforces the role of POs and states that they have to establish each year a management plan for their sub quotas (Larabi, 2013). This creates incentives for vessels to become PO members' as shown for the Sole VIIIabd fishery where almost all vessels are PO members at the end of the 2000s

[11] See also SUCCESS, WP3, D 3.1

(Lagière, 2012). Sole VIIIabd fishery involved 9 POs in the middle of the 2000s and a merging process is in progress since. The 2 biggest POs (OPOB and PMA, respectively 325 and 519 vessels in 2008) became recently 'Les Pêcheurs de Bretagne', and also in the French South Atlantic coast, Cap Sud and Arcacoop merge to become 'Pêcheurs d'Aquitaine' (Guyader, 2014). The "apparent" concentration of catches in a small number of POs does not result in dominant market positions as vessels still sell their landings individually and mostly via auctions.

In the UK, the total landings of Sole and Plaice accounted for more than 20,000 tonnes in 2014 (90% for Plaice). Most flatfish (including plaice, megrim, lemon sole etc.) is landed by beam trawl (TBB) and demersal trawl (DTS) by over 10 meters' vessels. However, Sole is landed mostly by over 10 m vessels using beam trawl (TBB) but also by under 10m vessels using drift and fixed nets (DFN). The main stock of sole targeted by under 10m vessels is sole in the Eastern Channel (VIId) and the Southern North Sea (IVc), approximately 82% of under 10m sole landings. For over 10m vessels, the three main stocks of sole targeted are in the Western Channel (VIIe), Celtic Sea (VIIf and VIIg) and North Sea (IVb and IVc), approximately 43%, 15% and 30% respectively of sole landings for these vessels in 2013.



The small under 10m vessels involved in the sole fishery are more than 20 years old in average (23 years in 2014) with the number of persons on board close to one on average. The beam trawl vessels are large vessels, greater than 18m, with 2.6 FTEs for the 18-24m and 5.5 FTEs for the 24-40m vessels (note that data for the Beam trawlers >40m is not available due to low numbers of companies involved). The 18-24m and >40m beam trawl vessels age follow close to the national average of around 20 years but the 24-40m beam trawls have an average vessel age over 40 years.

The under 10m vessels are not typically members of POs, they are managed under the "non-sector" which is managed through monthly quotas and limits applied by the Marine Management Organisation (MMO). The beam trawl vessels on the other hand are almost all members of POS, even though some may belong to the "non-sector". Approaches to quota management vary across POs in England; some manage through the allocation of monthly quotas and others through the allocation of individual quotas to vessels directly through their "fixed quota allocations".

3.2.3 Comparison of Selected indicators – Analysis

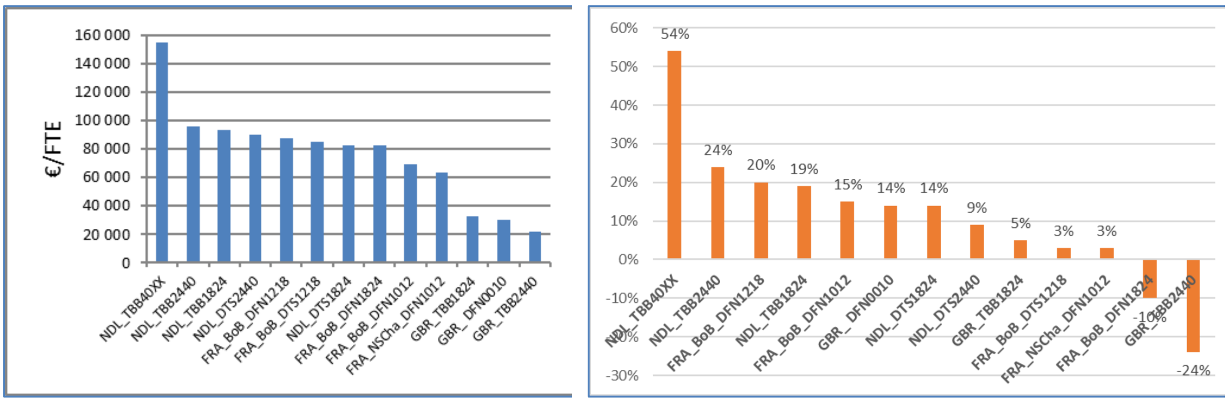
Indicators were calculated for a large number of fleet segments (13) with data more or less available via DCF (AER). For instance, and for France, AER reported data for fleet segments at the supra region level. That means that vessels of similar size and fishing gear are included in the same fleet segment while they are involved in different fisheries. This is particularly annoying when resource availabilities and/or management measures strongly differ as they may influence economic performances differently. That's why French flatfish segments have been separated according to their involvement in the Bay of Biscay or in the English Channel. Thanks to the availability of more detailed transversal and economic data at national level.

3.2.3.1 Economic sustainability - Economic performance

The economic performance of the sole fleets in Netherlands, France and UK are indicated by the following metrics: Labour productivity, Profitability (i.e. ROFTA), Financial position and Energy efficiency.

The first two indicators show that the Dutch sole fleets have a particularly high economic performance. This is due to the fleets investing in SumWing and pulse trawl technologies in recent years. Before this time the lack of fuel efficiency of the traditional beam trawl was making the activity unprofitable. This is shown in the litres per kg of fish landed at around 1.3 l/kg, which compared to the much older UK 24-40m vessels at around 4 l/kg is significantly lower. The static gear of drift and fixed nets do not drag their gear which means their fuel efficiency is much greater than the mobile gear and comparable between UK and France.

In contrast the UK fleets are particularly low regarding labour productivity (i.e. GVA/FTE) and with a low to average profitability. It is noticeable that the UK beam trawlers 24-40m ageing fleet has a particularly low ROFTA.

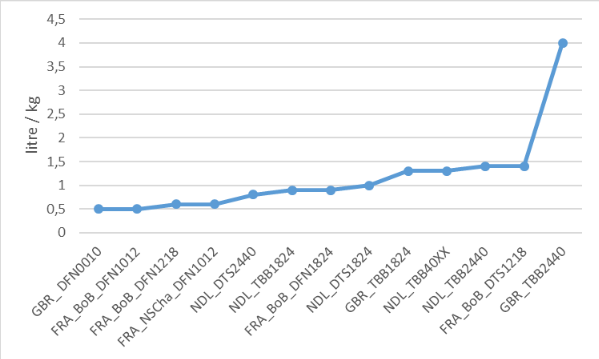


Labour productivity (GVA/FTE) by fleet, 2014 – (left); ROFTA by fleet, 2014 (right)

Indebtedness (Financial position) – NB: Data are missing for France

GBR DFN0010	GBR TBB1824	NDL DTS1824	GBR TBB2440	NDL TBB40XX	NDL TBB2440	NDL TBB1824	NDL DTS2440
0%	0%	0%	1%	3%	3%	3%	6%

Energy efficiency (Energy consumption per kilo landed)



Litre per kg by fleet (2014)

3.2.3.2 Economic sustainability - Economic dependency

The economic performance of the sole fleets in Netherlands, France and UK are indicated by the following metrics: Economic dependency on species, Economic dependency on external trade, and Economic dependency on energy.

Economic dependency on species (Top species in value (2014), % total earnings)

France	Sole	Seabass	Anglerfish	Pollack	Hake
BoB DFN VL1012	31%	12%		8%	
BoB DFN VL1218	45%	13%			7%
BoB DFN VL1824	31%		17%		28%
BoB DTS VL1218	10%		15%		5%
NSea Channel DFN VL1012	76%				

UK	Sole	Plaice	Anglerfish	Megrim	Seabass	Norway lobster
VL0010 DFN	24%	3%	4%	0%	28%	0%
VL1824 TBB	30%	4%	17%	3%	0%	0%
VL2440 TBB	20%	9%	23%	11%	0%	0%
VL40XX TBB	23%	59%	0%	0%	0%	0%
VL0010 DTS	7%	2%	1%	0%	2%	57%

Netherlands	Sole	Plaice	Shrimp	Turbot	Brill
TBB_VL1824	14%	2%	81%	1%	0%
TBB_VL2440	41%	21%	19%	9%	4%
TBB_VL40XX	59%	21%	0%	10%	4%
DTS_VL2440	1%	15%	2%	3%	1%

Regarding economic dependency on species, Dutch fleets seem more specialized than English and French fleets which operate in a mixed species environment. Sole, plaice and shrimp are the main species landed by the Netherlands beam trawl fleets comprising over 80% of landings value in each case. The French fleets in the Bay of Biscay (BoB) mostly target sole but with economic dependence on other species such as seabass, anglerfish and hake also. For the UK, drift and fixed netters target sole and seabass, similar to the French, but the beamers focus on sole, plaice, anglerfish and megrim.

Economic dependency on external trade

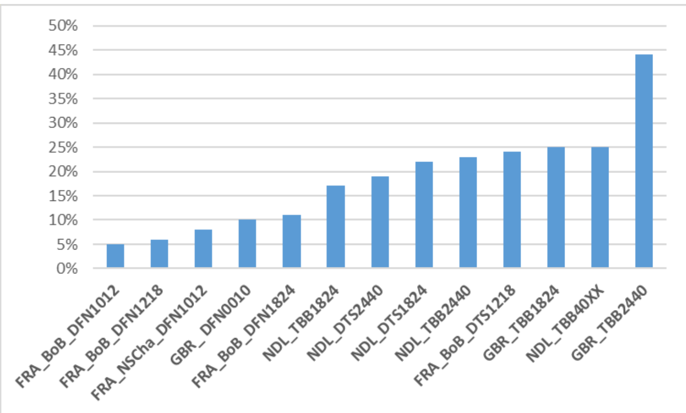
The Netherlands is a major player in terms of trade and processing for flatfish (economic dependency on external trade). In the case of sole, Netherlands, France and UK keep a significant amount of production for their home markets, but in the case of plaice the picture is less clear as indicated by net imports and net exports in the Netherlands. It should be noted that 70% of UK production is landed directly in the Netherlands, however this is not recognised in the UK export statistics. Further, where most sole is traded whole, plaice has a significant proportion that is filleted.

Production and trade flow by partner countries and by species (in tonnes – live weight equivalent), 2014 (Sources: Eurostat – COMEXT; STECF, 2016)

		France	Netherlands	United Kingdom
Sole	**Production**	7,702	9,184	2,317
	Net exports	265 (100% fresh whole)	3,965 (77% frozen whole and 23% fresh whole)	713 (100% fresh whole)
	Net imports	263 (100% frozen whole)	0	34 (100% frozen whole)
Plaice	**Production**	3,193	29,280	19,143
	Net exports	0	41,225 (96% frozen cut and 4% frozen whole)	45 (100% frozen whole)
	Net imports	829 (84% frozen cut, 12% fresh whole and 4% frozen whole)	24,118 (100% fresh whole)	7,351 (73% frozen cut and 27% fresh whole)

Economic dependency on energy

The economic dependency of fleets on energy is dependent on two aspects: the age of the fleet and the main gear used. As above, static gear such as drift/fixed nets is far less energy dependent than mobile gear. The Dutch mobile fleets are relatively efficient compared to the ageing UK beam trawl 24-40m fleet segment which shows an energy dependency of around 44% energy costs to landings value ratio.



Fuel costs / landings value by fleet (2014)

3.2.3.3 Social sustainability – Employment conditions and attractiveness of the sector

The economic performance of the sole fleets in Netherlands, France and UK are indicated by the following metrics: Temporary/seasonal employment, and Level of remuneration of work.

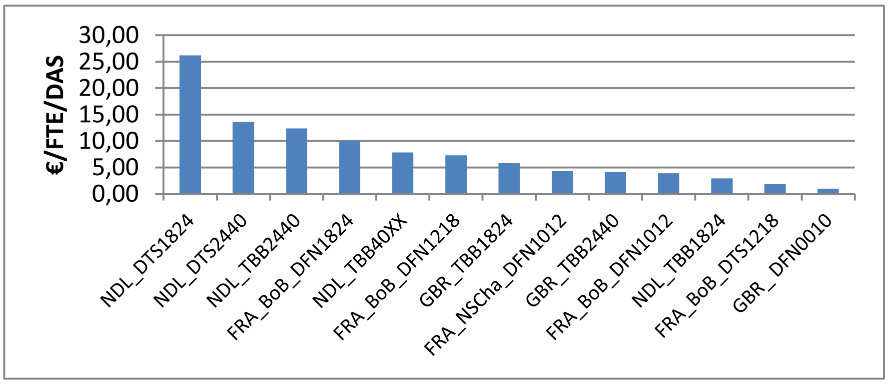
Use of temporary/seasonal employment

It is reported by the data that in the Netherlands there is full time employment on vessels with total number of employees equal to number of FTEs. In France, a degree of seasonality / temporary employment is evident. In the UK, the under 10m drift/fixed netters are indicated to be highly seasonal. This can be explained by many vessels indeed being seasonal but there are some also that do not fish. The UK beam trawlers in the two segments 18-24m and 24-40m are indicated to have overemployment. This is reportedly as the hours indicated for employees on these vessels is on average up to an additional half more than the national requirement, for example if 7.5 hours per day is the requirement then these beam trawl fleet segments employees are reportedly working 11 hours per day. It should be noted that there are some questions regarding missing data and the reliability of some data used.

Fleet	Total employed/FTE
GBR_TBB1824	0.6
GBR_TBB2440	0.6
NDL_TBB40XX	1
NDL_TBB2440	1
NDL_TBB1824	1
NDL_DTS2440	1
NDL_DTS1824	1
FRA_BoB_DTS1218	1.1
FRA_BoB_DFN1824	1.1
GBR_ DFN0010	4.8

Level of remuneration of work

The level of remuneration (in euros per FTE per day) indicated is greatest for the Netherlands fleets, followed by France and then UK.



Level of remuneration of work (crew wage + unpaid labour/FTE/Days at sea), 2014

3.2.3.4 Environment sustainability

Among the key sole stocks, the stock in division 7e (western English Channel) is the only stock harvested sustainably. Although the fishing mortality has showed a downward trend for the last few years, all of the other stocks remain overexploited.

Conversely, the key plaice stocks are harvested sustainably.

Overview of the state of the key sole stocks (ICES advice, 2017; COM/2017/0645, 2017)

Stock	State of the stock*	TAC proposal for 2018 (in tonnes)	2018/2017 (%)	Main countries holding the TAC
North Sea, Norwegian Sea (4, 2a)	Overexploited (F_c>F_{MSY})	14,027	-13%	Netherlands (75%)
Bay of Biscay (8ab)	Overexploited (F_c>F_{MSY})	3,621	+6%	France (92%)
Eastern English Channel (7d)	Sustainably exploited in 2016 (F_c around F_{MSY}) but stock size still below trigger	2,933	0%	France (54%) Belgium (27%) United Kingdom (19%)
Western English Channel (7e)	Sustainably exploited (F_c<F_{MSY})	1,202	+2%	United Kingdom (59%) France (38%)
Bristol Channel, Celtic Sea (7fg)	Overexploited (F_c>F_{MSY})	901	+7%	Belgium (62%)

*According to MSY approach

Overview of the state of the key plaice stocks (ICES advice, 2017; COM/2017/0645, 2017)

Stock	State of the stock*	TAC proposal for 2018 (in tonnes)	2018/2017 (%)	Main countries holding the TAC
North Sea (4, 2a)	Sustainably exploited (F_c around F_{MSY})**	Not yet available. In 2017, TAC was equal to 129,917 tonnes.	-1% between 2016 and 2017	Netherlands (36%) United Kingdom (26%) Denmark (19%)
Skagerrak		Not yet available. In 2017, TAC was equal to 17,639 tonnes.	+50% between 2016 and 2017	Denmark (78%) Netherlands (15%)
English channel (7de)	Sustainably exploited (F_c<F_{MSY})***	10,360	+3%	France (55%) United Kingdom (29%)

*According to MSY approach

** Stock assessment is undertaken in subarea IV (North Sea) and subarea 20 (Skagerrak) together

*** Stock assessment is undertaken in division 7d (eastern English Channel) and division 7e (western English Channel) separately

3.2.4 General outcomes

The EU is the second largest producer of flatfish in the world. Landings are dominated by Sole and Plaice. The EU markets for flatfish are almost self-sufficient and mainly driven by intra EU trade flows. Three major countries are involved in the EU production: Netherlands, the UK and France.

2Flatfish vessels are different size (small scale as well as large scale) and use several gears according to the country: large beam trawlers in Netherlands which have been progressively replaced by pulse trawlers and SumWing trawlers, mostly small scale and large netters in France and a mix of large beam trawlers and small netters in the UK.

DCF data are mostly used for the sustainability indicators calculation but the data available do not systematically match the relevant flatfish fleet segment. Thanks to available national data sets allowing for disaggregation, particularly for the French flatfish segments.

The UK TBB2440 fleet segment has particularly bad calculated economic performance compared to other fleets specifically the comparable Netherland TBB2440. This appears mostly due to the use of traditional beam trawl technologies along with ageing vessels. The Netherlands TBB40XX fleet segment has the highest eco performance of this class of vessel, mostly as a result of the investment in the new technologies of SumWing and pulse trawl, even though there is still as strong dependency to species, fuel and external trade.

The French fleet segments and the under 10m UK fleet that uses drift/fixed nets have a mixed catch composition, partly seasonal and partly targeting-based that focuses on high value species such as sole and seabass. In using a static gear, there is less dependency on energy (i.e. fuel) and to some extent a larger proportional amount of labour required than mobile gears.

The large sole stocks are overexploited (e.g. North Sea and Bay of Biscay), however the English Channel is indicated to be at sustainable levels. The goal and current trend for both overexploited stocks is towards achieving MSY levels by 2020. It is unclear whether this will be met given uncertainties in levels stock biomass and quotas that remain close to recent average levels.

References:

Bjorndal, T., et al. (2015). Sole: Production and Markets. Globefish Research Programme Vol 118: 72p.

Guyader, O., et al. (2014). Self-imposed catch shares by French producers' organizations. IIFET 2014 Conference Proceedings, Brisbane.

Hoefnagel, E.W.J. en Erik Buisman (2013) Evaluatie Nederlands ITQ-systeem naar aanleiding van de herziening van het Gemeenschappelijk Visserijbeleid. Wageningen, Wettelijke Onderzoekstaken Natuur & Milieu, WOt-werkdocument 357

Larabi, Z., et al. (2013). "Quota management in a context of non-transferability of fishing rights: The French case study." Ocean & Coastal Management 84: 13-22.

STECF (2017). The 2017 Annual Economic Report on the EU Fishing Fleet (STECF-17-12), Scientific, Technical and Economic Committee for Fisheries (STECF), Publications Office of the European Union, Luxembourg: 494p.

Turenhout, M., et al. (2016). Pulse fisheries in the Netherlands - Economic and spatial impact study, Wageningen Economic Research, NL: 36p.

ICES 2017 advice (www.ices.dk)

3.3 Coastal Fish Case Study

The coastal fish case study concerns not only a large diversity of species (fish, crustaceans and shellfish) but also a large diversity of vessels using different fishing techniques with a common denominator, short trip duration (actually around 24 hours), given the proximity of fishing areas to home port. Most of these vessels belong to the so-called small-scale fleet (SSF) segment which includes all vessels under 12 meters using passive gears[12] as defined by the EU regulation, and usually active in their national coastal band. The other vessels target high sedentary species in the coastal band, such as scallops and clams, but do not belong to the SSF segment because they use towed gears such as dredge. The coastal fish case study will include these two groups of vessels.

3.3.1 Context of EU production, exploitation and trade

3.3.1.1 Species targeted by the small-scale fleet

Production

According to the DCF data, the small-scale fleet (SSF) in the EU landed about 302 000 tonnes of fish and seafood products in 2014 (6% of total EU landings). The total reported value is of around € 955 million[13] (13% of total EU landings). Both in volume and value terms, the SSF production is mostly concentrated in the EU southern countries (Italy, France, Greece, Spain and Portugal) but also in the United Kingdom. The SSF landings from these six major countries contribute to more than 80% of the total EU SSF production in value.

Breakdown of total SSF landings by Member States (in volume and in value), 2014 (Source: STECF, 2016)

	Landings in value		**Landings in weight**	
	Million euros	*% total*	*Million tonnes*	*% total*
Italy	203	21%	28	9%
France	184	19%	77	26%
Greece	147	15%	18	6%
United Kingdom	123	13%	47	15%
Spain	105	11%	30	10%
Portugal	82	9%	20	7%
Other Member States	111	12%	82	27%
Total	**955**	**100%**	**302**	**100%**

However, and in each of those countries, SSF landings are not predominant in the national landings. With the exception of Greece where the SSF contributes to more than 50% of the national landings in value, the SSF contribution is often less than 30%, at least for the 5 main countries for this sector.

The small-scale fleet within the EU lands a wide range of species as the first 20 species contribute to less than 50% of the total value of landings. In terms of value, the five main species landed in 2014

[12] According to the DCF gear definitions passive gears include: « drift and/or fixed netters », « pots and/or traps», « hooks », « passive gears only », « other passive gears », « polyvalent passive gears only » and « active and passive gears ».
[13] This last value is generally considered as largely underestimated because of misreporting from small vessels.

were common octopus (7% of total SSF landings), common sole (6%), European lobster (5%), European seabass (5%) and common cuttlefish (4%).

Breakdown of SSF landings by main species in value and share in total EU production (in volume and in value), 2014 (Source: STECF, 2016)

	Landings in value (in million euros)				Landings in weight (in thousand tonnes)			
	SSF	*SSF / Total SSF*	*EU*	*SSF / EU*	*SSF*	*SSF / Total SSF*	*EU*	*SSF / EU*
Common octopus	66	7%	109	60%	13	4%	23	56%
Common sole	53	6%	267	20%	5	2%	28	19%
European lobster	49	5%	59	83%	4	1%	5	83%
European seabass	48	5%	80	60%	4	1%	7	54%
Common cuttlefish	42	4%	98	43%	7	2%	19	37%
Whelk	37	4%	45	83%	29	10%	36	80%
Edible crab	33	3%	83	40%	21	7%	48	44%
European hake	31	3%	367	8%	4	1%	110	4%
Sur mullet	29	3%	63	47%	2	1%	7	33%
Gilthead seabream	25	3%	36	69%	2	1%	4	59%
Norway lobster	23	2%	310	7%	2	1%	52	4%
Atlantic cod	18	2%	267	7%	11	4%	138	8%
Red mullet	16	2%	61	27%	1	0%	11	13%
Other species	484	51%	5,524	9%	196	65%	4,612	4%
Total	**955**	**100%**	**7,369**	**13%**	**302**	**100%**	**5,099**	**6%**

Some key species are specific to the SSF, like European lobster or Whelk of which more than 80% of landings at the EU level belong to SSF. The others mainly come from the SSF (around 60% of landings are provided by SSF) but competition with large scale fleet (LSF) can be important, like Common octopus or Seabass. Conversely, some key SSF species like common sole and common cuttlefish are mainly landed by vessels that do not belong to the SSF segment. A striking example of this is the breakdown of landings of common sole: in terms of volume, the SSF landings of common sole accounted for only 19% of total EU landings for this specie in 2014, whereas 59% were provided by vessels over 18 meters using trawl (STECF, 2016). In such cases, the main challenges for the small-scale fleet is to differentiate its production in order to add value and influence the choice of consumers with the pre-requisite of fisheries sustainability and fair access to stocks and fishing areas.

The EU contribution of key SSF species to global production is ranging from less than 10% for cephalopods (9% for cuttlefish and 7% for octopus) to 44% for European Seabass (including aquaculture production) through 78% for common sole and 93% for European lobster. According to the volume produced at national level and including aquaculture production (FAO, 2015) the major EU countries for the key SSF species are:
- the Netherlands and France for common sole (see the flatfish case study);
- Greece and Spain for European Seabass (see the Seabass & Seabream case study);
- the United Kingdom for the European lobster;
- France, Italy and the United Kingdom for the cuttlefish;
- Spain, Portugal and Italy for octopus.

Exploitation

According to the STECF AER 2017, the SSF represents 74% of the EU fleet in number of vessels. This rate is generally high for all member states. Fishing areas visited by SSF vessels are quasi-exclusively within the national coastal band (12nm) where the fishing activity is submitted to national legislations. The description of coastal fisheries management principles within the EU was already done in the D3.1. where it was pointed that national/local measures must be compatible with the objectives of the CFP. In that perspective, the SSF may be affected by stock management measures like quotas or management plans related to their targeted stocks (sole for instance). For most of the key SSF species, there is no stock assessment available (cephalopods for instance) or for a short time (seabass for instance) and situation is rather a lack of management or mismanagement. This is particularly worrying for non-sedentary shared stocks where the stock competition involves several groups of vessels in addition to small scale vessels.

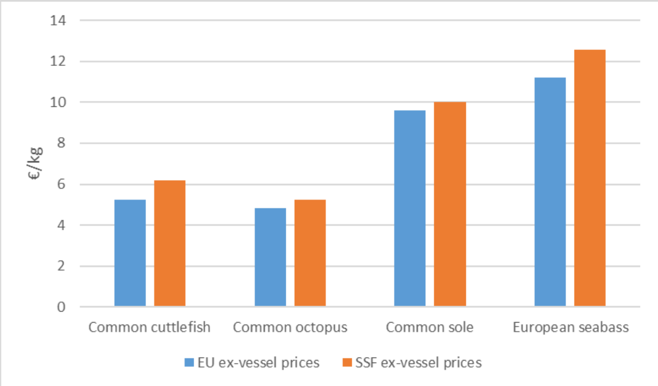
Weight landed by vessel length and by type of fishing gear (S: Static gear and T: Towed gear) and by major species in 2014 (Source: STECF, 2016)

Common octopus				**European seabass**			
	Passive G	**Towed G**	**Total**		**Passive G**	**Towed G**	**Total**
< 12m	56%	1%	**57%**	**< 12m**	54%	5%	**58%**
12-18m	23%	4%	**27%**	**12-18m**	9%	7%	**16%**
> 18m	4%	12%	**16%**	**> 18m**	5%	21%	**26%**
Total	**82%**	**18%**	**100%**	**Total**	**67%**	**33%**	**100%**
European lobster				**Common cuttlefish**			
	Passive G	**Towed G**	**Total**		**Passive G**	**Towed G**	**Total**
< 12m	82%	2%	**84%**	**< 12m**	37%	9%	**46%**
12-18m	13%	0%	**13%**	**12-18m**	3%	19%	**22%**
> 18m	2%	1%	**3%**	**> 18m**	1%	32%	**32%**
Total	**97%**	**3%**	**100%**	**Total**	**40%**	**60%**	**100%**

For common octopus, more than 80% of the EU landings come from passive gears but the share coming from vessels over 12m is important (27%). Conversely, for common cuttlefish, towed gears contribute to 60% of the total landings of which 32% come from large active vessels (over 18m.). Within the SSF, main gears used are Gillnets/entangling nets or Pots/Traps for common cuttlefish. The seabass situation is more complex with competition from large vessels using active gears (21% of the total landings in value) but also from recreational fishers and aquaculture production (see D4.2 Description of the Seabass value chains). Passive gears used to catch seabass are Hook/lines or Nets. Pots/Traps are the most used gears to catch European lobster. As already mentioned in the flatfish case study the SSF catches of common sole come mostly from nets.

Ex-vessel prices

The SSF landings are mostly related to "high value species", as regards the EU average ex-vessel price of 3.16 €/kg for this segment compared to the EU average ex-vessel price for all fisheries landings of 1.49 €/kg. However, when focusing on the key SSF species also targeted by LSF, the comparison between the ex-vessel price for SSF landings and the EU average price show that so far there is not much price differences between the 2 products.



Comparison between EU ex-vessel price and SSF ex-vessel price for some key SSF species in €/kg (STECF, 2014)

While EU seafood consumers reveal some willingness to pay for seafood attributes like greater freshness, low environmental impacts and localness, the challenge for SSF is to make their products enough visible for seafood buyers. Indeed, recent studies have shown that labelling and differentiation initiatives implemented by small scale fishers have often generated high price premiums (see D3.4).

This weak difference between national price and SSF vessels is not true for all countries/species. In Italy for instance, common cuttlefish landings are found in several regions and the most important volume are landed in the Northern Adriatic (GSA17). As a consequence, the ex-vessel price of cuttlefish is the lowest in this region (6.94 €/kg) compared to 12.11 €/kg in Southern and Central Tyrrhenian region. Beyond the high level of landings, the difference in prices may also be explained by the quality of landings (linked to the fishing technique[14]) and the local demand of the product. Common cuttlefish is a highly appreciated food item in Southern Italy where it is mostly caught by small scale vessels using nets and sold directly.

Consumption and Trade

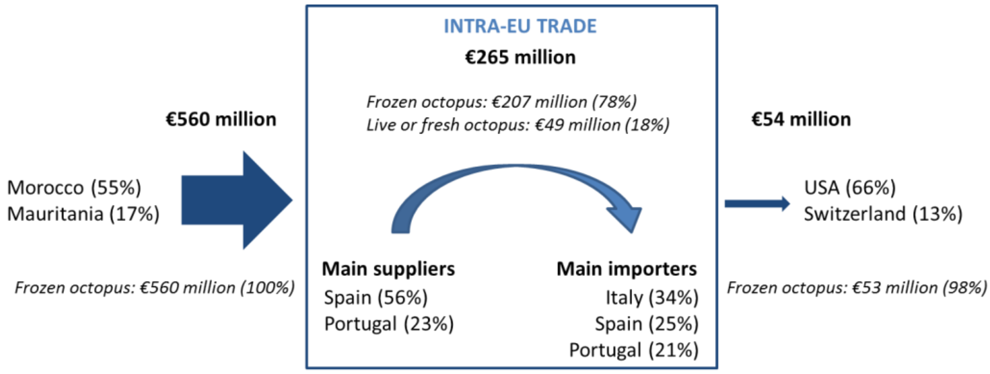
The consumption and trade for common sole and seabass has been already described respectively within the flatfish and the seabass & seabream case studies. Data on European Lobster consumption and trade has been difficult to compile at EU level. Thus, the following description is focusing on cephalopods (octopus and cuttlefish).

In 2015, the EU apparent consumption of octopus and cuttlefish averaged 0.28 kg and 0.16 kg per capita, respectively. The main consumers of cephalopods at the EU level are found in southern countries: Cyprus and Italy for octopus (respectively 1.58 and 1.14 kg/capita), Spain and Italy for cuttlefish (respectively 0.77 and 0.64 kg/capita). Over the period 2012-2015, the EU consumption of octopus has increased by 12% while consumption of cuttlefish has decreased by 27%.

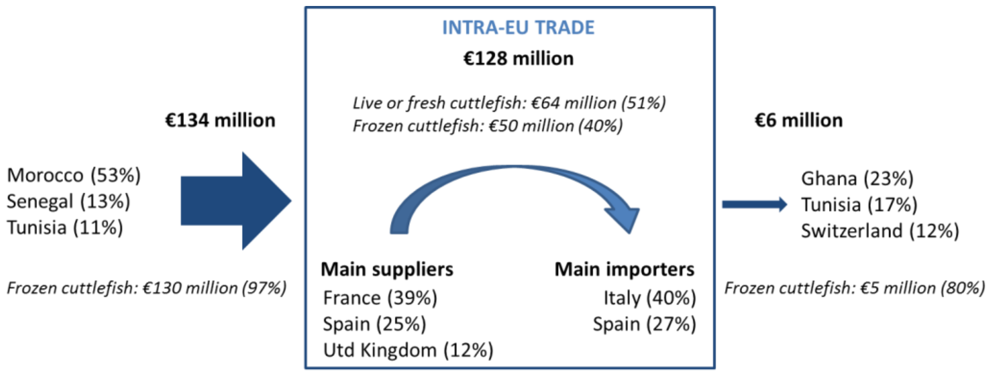
Italy and Spain are the main markets for octopus and cuttlefish in the EU. In 2015, the EU markets for octopus and cuttlefish averaged 143 000 tonnes and 82 000 tonnes (live weight equivalent), respectively. They are strongly dependent on extra-EU imports. Main extra EU imports of cephalopods come from North Africa (Morocco mostly). The self-sufficiency rate is 16% for octopus

[14] In Italy, common cuttlefish is also landed by demersal trawlers

and 32% for cuttlefish. This rate has decreased for octopus while the EU market has risen by 20% over 2012-2015 period due to a fall in the domestic production. The EU market for cuttlefish is not steady and the self-sufficiency has slightly increased in the last years due to an increase in the EU domestic production.

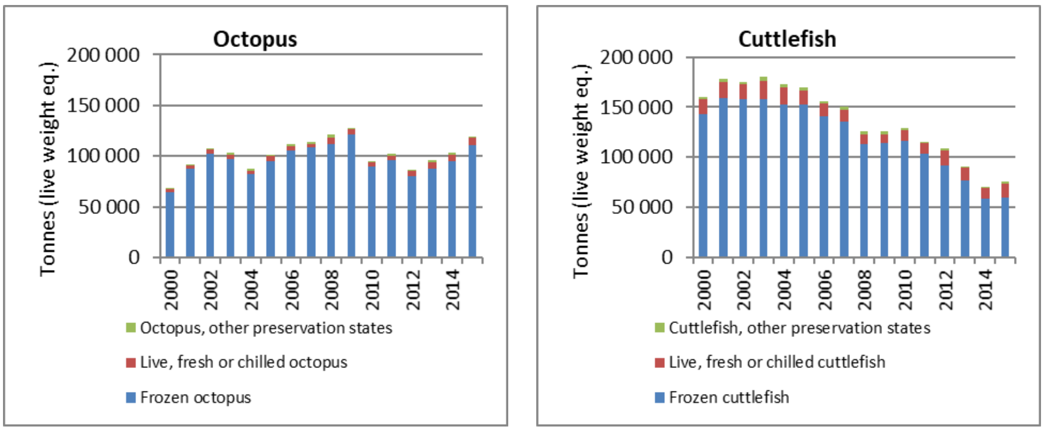


EU octopus trade market in value in 2015 (intra-EU trade is estimated through imports) (Source: COMEXT)



EU cuttlefish trade market in value in 2015 (intra-EU trade is estimated through imports) (Source: COMEXT)

European countries mostly import frozen octopus and frozen cuttlefish (respectively, 93% and 80% of net imports in 2015). Octopus imports fluctuated around 100,000 tonnes per year (live weight equivalent) whereas cuttlefish imports dropped sharply (-53% over 2000-2015).



EU28 net imports (import minus export) of octopus and cuttlefish by preservation state, 2000-2015 (Source: COMEXT)

Over the period 2000-2015, EU import prices of octopus and cuttlefish have registered a significant increase (+106% for frozen octopus and +65% for frozen cuttlefish). In 2015, EU import prices of frozen octopus and frozen cuttlefish averaged 5.69 €/kg and 3.87 €/kg, respectively.

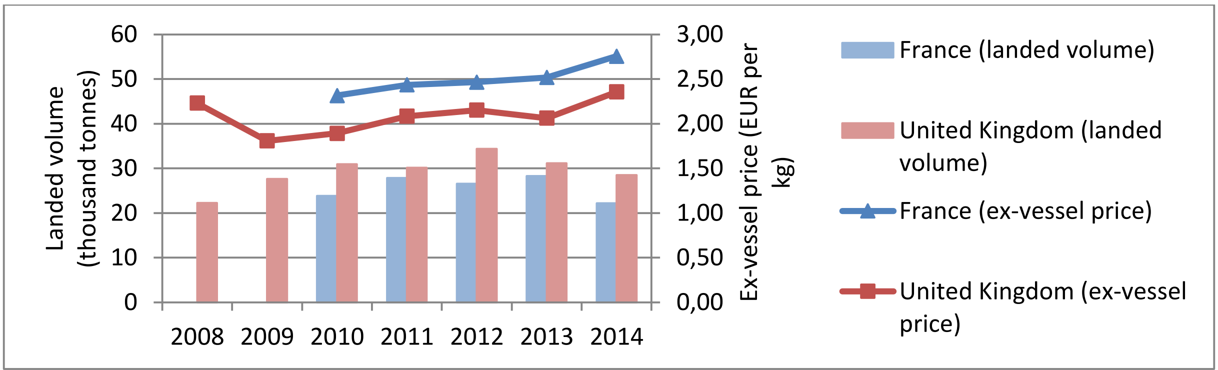
3.3.1.2 High sedentary species

Production

According to STECF (2016), the Great Atlantic scallop (*Pecten maximus)* is by far the main scallop species landed in the EU, both in volume (56 000 tonnes, 81% of total scallop landings in 2014) and value terms (€136 million, 92%). Queen scallop (*Aequipecten opercularis*) landings amounted to 12 269 tonnes and €8 million (STECF, 2016).

United Kingdom and France are the major producer countries of Great Atlantic scallop in the EU (51% and 40% of total landings in volume in 2014, respectively). However, the EU scallop production compared to the global production is insignificant (around 3%). Main producers at global level are China, Japan and the USA.

Between 2010 and 2014, scallop landings of United Kingdom (around 30 000 tonnes) remained higher than French ones. However, ex-vessel prices were higher in France than in United Kingdom. The year 2014 was marked by a decline in scallop production as compared to the previous year (-9% for United Kingdom and -21% for France) and a rise in ex-vessel price (+14% for United Kingdom and +9% for France). (STECF, 2016)



Landings of Great Atlantic scallop in United Kingdom and in France (in volume) and ex-vessel price (nominal value), 2008-2014 (Source: STECF, 2016)

Exploitation

Scallops are mostly caught with dredges. Vessel size can belong to 3 length categories but in majority vessels are over 12m and for a large part of them over 18 meters.

EU landings of king scallop by vessel length and by type of fishing gear (S: Static gear and T: Towed gear) in 2014 (Source: AER, 2016)

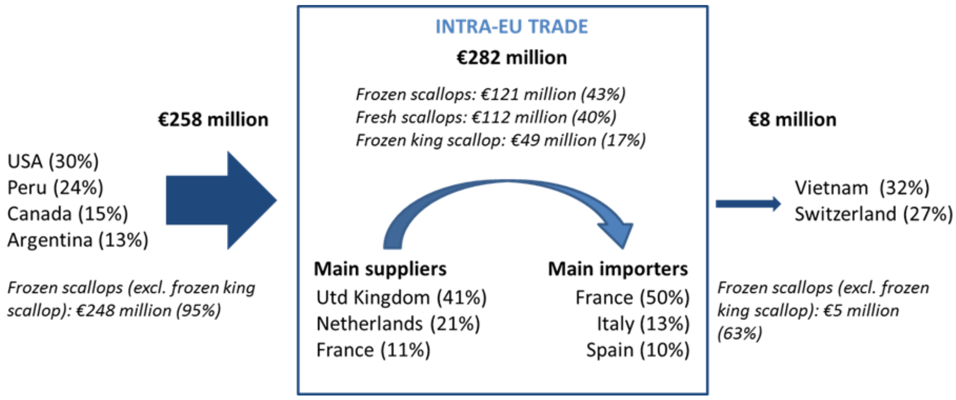
King scallop			
	S	**T**	**Total**
< 12m	6%	22%	**28%**
12-18m	1%	36%	**37%**
> 18m	1%	34%	**35%**
Total	**8%**	**92%**	**100%**

The main scallop fisheries are located in the English Channel. Thus, United Kingdom and France target Great Atlantic scallop in the same geographical area, leading to a strong competition between the two countries for the same resource. The management systems applied to coastal shellfish fisheries was already described in the D3.1 and included the Scallops fisheries using dredges in France and United Kingdom[15].

Consumption and Trade

In the EU, France is one of the main consumer countries of scallops: its consumption averaged 1.87 kg per capita in 2015, far above the EU average (0.41 kg per capita). Nevertheless, French consumption has registered a decreasing trend over the recent years (-21% from 2013 to 2015).

The EU scallop market amounted to about 201 000 tonnes in 2015 and is dependent to extra EU imports. The self-sufficiency rate is 31% in 2015 and this rate is increasing since 2008.



EU scallop trade market in value in 2015 (intra-EU trade is estimated through imports) (Source: COMEXT)

The extra-EU imports come in majority from the USA and Peru. Extra EU imports are almost exclusively frozen scallops while intra EU trade both concern frozen and fresh scallop. The UK is the main suppliers for intra EU scallop trade while France and Italy are the main import countries.

NB: In March 2016, the EU lifted a nearly twenty-year ban on imports of scallops from China. This ban was established in July 1997 due to the presence of vibrio parahaemolyticus found in large-sized pectinidae Patinopecten yessoensis, a bacterium prone to cause gastrointestinal illness in humans.

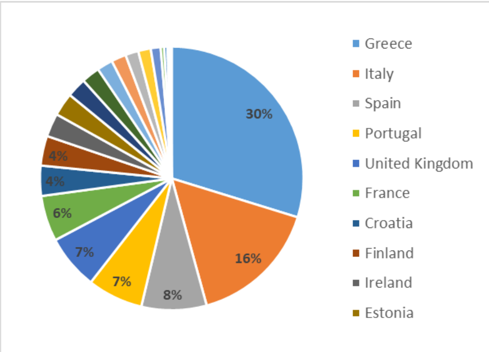
[15] The D3.1 description also described the management systems applied to the "fasolari" (Callista chione) and clam fishery using hydraulic dredges in Italy and the Chlamys varia fishery using "zamburiña" and "volandeiras" in Spain. In addition, the D3.4 report emphasized the emergency of a joint management system in the Eastern Channel King Scallop fishery in order to fully benefit for marketing strategies implemented to overcome imports.

This species was highly appreciated in the EU before the ban and it will be interesting to see how this will impact international scallops trade moving forward.

3.3.2 The small scale fleet

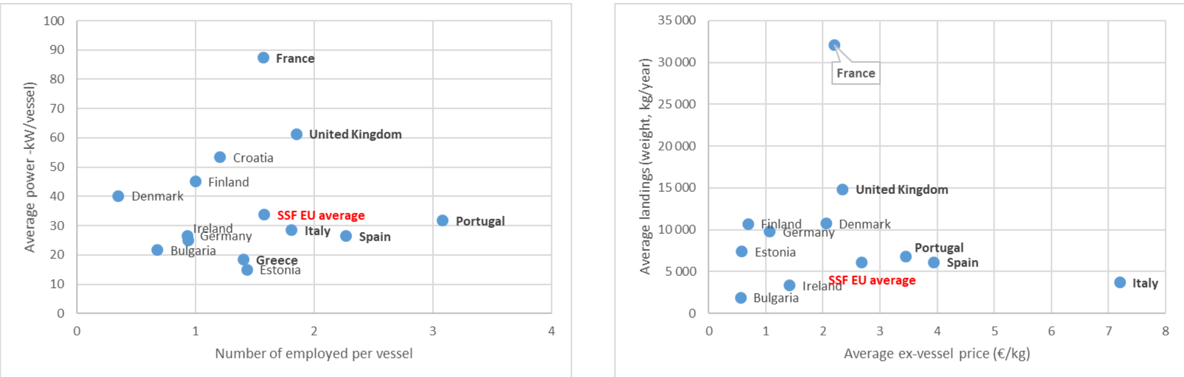
3.3.2.1 Description of production systems

Based on STECF 2015, the SSF in Europe[16], measured with the number of vessels, is mostly concentrated in the southern countries (Greece, Italy, Spain, Portugal and France) with the exception of the United kingdom. These 6 countries account for almost 75% of the number of SSF vessels in Europe. The



The SSF in Europe – Number of vessels (STECF 2015, 2013 data)

All the vessels belong to the SSF are less than 12 meters and use passive gears but the average structure (engine power, total of person employed[17]) as well as the fishing activity differ across countries.



SSF - Average structure of vessel and landings per country (based on STECF, 2015 - AER data 2013) – in bold the major countries for the SSF in Europe – in red and bold, the mean values at the EU level.

Compared to the EU SSF vessel, which is 34 kW with 1,5 persons employed in average, the largest SSF vessels are found in France and United Kingdom according to the engine power of the vessels, and in

[16] The SSF in outermost regions is not include in this analysis.
[17] In most cases, SSF crew is part-time and FTE per vessel is usually smaller then total persons employed but as the FTE calculation is still unclear so far, total persons employed have been preferred.

Portugal, Spain and Italy according to the size of the crew. Based on the structure and the average landings profile of the SSF vessel in each country, two productions systems coexist in the EU:

- one more “intensive in capital” with higher volume of landings but ex-vessel prices close to the EU average price for the SSF (2.7 €/kg); this production system is depicted by France and the UK;
- one more “intensive in labour” with higher ex-vessel prices but volume of landings closes to the EU average catches for the SSF (6 tonnes per year per vessel); this production system is depicted by Italy, Spain and Portugal.

Based on the D3.2, the description of the production systems within the SSF can be develop based on 2 examples: the small scale fleet involved in the cuttlefish fishery in the Gulf of Salerno and the coastal liners involved in the seabass fishery in France. These 2 examples also rely on SSF key species at the EU level as reported in the 3.3.1.

Typical to the Italian SSF, the mean small scale vessel of the Gulf of Salerno[18] is 6.8 metres long, with 26.80 kW and a crew of 1.2 men. Its average ex-vessel price is close to 10 €/kg. The common cuttlefish is the first species in value but the catches composition observed a given year is extremely diverse as well as the fishing activity during the year. For instance, the fishery of common cuttlefish with trammel net is very seasonal and occurs between February and April first and between October and December last. The vessel owner is often on board as the single crew member. He is about 50 years old and small scale fishery is affected by a reduction in recruits. Although the majority of the fishermen are full time, some of them are involved in fishery tourism (“pescaturismo”) generating a supplementary income. The capital invested in the vessel is estimated at around 13 000€ in 2014. Direct sale is the traditional way to sell fish and is ensured by the fisherman himself or someone from his close family.

Another example of SSF production system is given by the Seabass coastal liners[19] in France (see section 5.7.6 of the D3.2). This group is representative of the SSF in France according to the size of the vessel. However, the fishing strategy is rather oriented towards valuing the landings instead of high volume like it is reported for the French average small scale vessel. Indeed, the average landings of a Seabass coastal liner in France is 16 tonnes for an average ex-vessel price of 6.2 €/kg. Conversely to the Italian SSF of the Gulf of Salerno, the French Coastal liner landings are very much specialized as almost 50% of the yearly income is coming from the Seabass. However, the Seabass fishery is seasonal and the catches occur between April and November. The capital invested is around 103 k€ per vessel according to the DCF methodology calculation. In a large majority and in conformity with a large part of the French fleet, the owners of Coastal liners are single holders and the skipper-owner on board was in average 46 years old in 2013. Almost all the landings are sold via auctions and a large part of the coastal liner landings are tagged with private commercial brands[20].

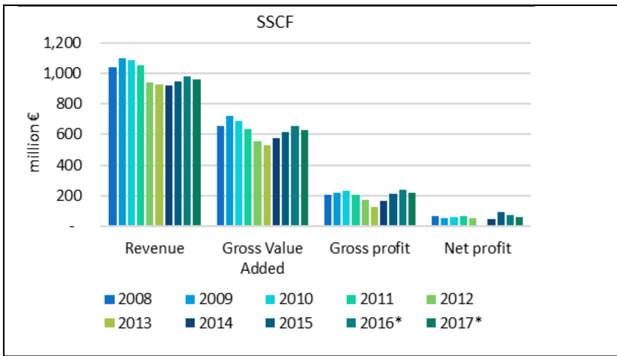
[18] Detailed description is found in the D3.2 report, section 5.7.1

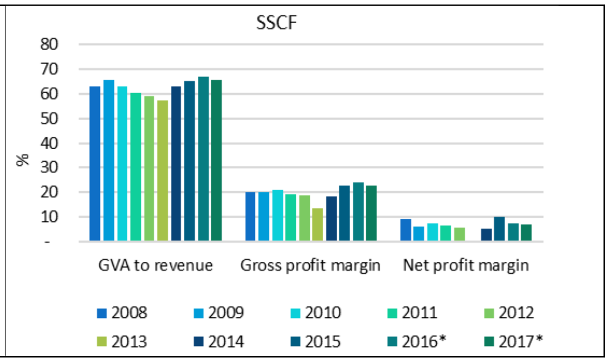
[19] Detailed description is found in the D3.2 report, section 5.7.6

[20] See the D3.4 section 3.2.2.5 on the brand “Brittany Seabass Coastal liners”

3.3.2.2 *Comparison of Selected indicators – Analysis*

According to the AER (STECF, 2017), the overall economic performances of the SSF at the EU level is globally good considering gross value added, gross profit and net profits. The trends from 2008 show that after a decrease over the period 2008-2012, the performances started to increase then. The projections made for 2016 and 2017 forecast the upward trend to continue in 2016 but not in 2017.





*Trends on fleet economic performance indicators for the EU SSCF. *projections (based on MS data submissions under the DCF 2017 Fleet Economic (MARE/A3/AC (2017)); All monetary values have been adjusted for inflation; constant prices (2015). Source STECF, 2017 - AER*

At the EU level and according to STECF, 2017, the labour productivity (GVA/FTE) is fluctuating around 20 000€ over the period (2008-2015) and the ROFTA (Return on fixed tangible assets) around 12% with high variability among years. The energy efficiency indicator is about 0.5 l/kg landed and has registered a sharp decrease from 2008 and a level of 0.8 l/kg. The fuel costs to income ratio is 11% in 2014.

Compared to these average levels, data provided on the (1) SSF involved in the cuttlefish fishery in the Gulf of Salerno (PGP 0006 and 0612) and (2) on the coastal liners involved in the seabass fishery in France (HOK 0010 and 1012) show strong differences in performance indicators:
- (1) While GVA/FTEs are close to the EU level, ROFTA are a bit much higher (between 16% to 19%). The efficiency energy differs strongly according to the size of the vessel. It is close to the EU average for the smallest category while very high for the other. Energy costs are much higher that the EU average.
- (2) Economic performances are high compared to the EU average for both size categories. While energy efficiency ratio is higher than the EU average, the share of fuel costs in the total income are under the EU average.

Fleet segments data (2014)	**Unit**	**FRA_HOK0010**	**FRA_HOK1012**	**ITA_Saler_PGP 0006**	**ITA_Saler_PGP 0612**
GVA/FTE (national)	Euro	74 536	88 240	16 098	20 034
ROFTA	%	21%	46%	19%	16%
Energy consumption per kilo landed	L/kg	0,95	0,82	0,49	1,35
N80: number of species making up 80% of the total production in value	Number	4	6		
Energy costs/Landings value	%	9%	8%	19%	14%
Total employed/FTE (national)	/	1,8	1,8	1,8	1,2
(Crew wage + unpaid labour)/FTE/ Days at sea	€	510	390	85	60

SUCCESS Partners' contribution (based on DCF data, disaggregated level for Italy)

Both fleet segments employed part time crew members (ratio higher than 1). The remuneration of the crew is very difficult to compare from one country to another.

Note that DCF data (provided for the supra region 27) were directly used for the French coastal liners although there are clearly separate fleets according to the Seabass stocks targeted (the Northern stocks for vessels located on fishing harbours along the English Channel coast; the Southern stocks for the vessels located on fishing harbours along the Bay of Biscay coast; it could finally be both for some of vessels registered in fishing harbours close to both fishing areas). Conversely, for the Italian group of vessels, DCF data have been disaggregated in order to match the studied fleet, thanks to their availability at national level.

3.3.2.3 Outcomes from the small scale fleet analysis

The small scale fleet in Europe accounts for 13% of the total EU landings and involves almost 75% of the registered vessels. The SSF production is concentrated in a limited number of countries (Italy, Spain, Portugal, France and the UK). Targeted species may be specific (European lobster) or belonged to stocks shared with other fleets (sole, seabass, cephalopods). In some cases, the access to “shared” stocks is conflictual and not clear (Seabass) in other cases there is no stock assessment neither management plans.

The SSF fleet is composed with small vessels using passive gears, where the vessel owner is also the skipper, fisheries are often seasonal and crew member often employed part-time. Because of the gear used and the small amount of catches, the fuel costs divided by income are weak (less than 10%) and energy efficiency is generally less than for large vessels.

However, production systems may differ according to the relative capital intensity, the catches composition (specialised versus diversified) or the main commercial outlets (direct sales versus auctions). The Italian SSF targeted common cuttlefish and the French Seabass coastal liners provide good example of this diversity.

Although SSF economic performances are fluctuating over time, ROFTA is high in average at the EU level and for our specific case studies and the SSF is still not so dependent on the energy prices. However, economic performance is also linked with stocks availability and market context. Most of the SSF targeted species are shared with large scale fleets and makes the SSF highly vulnerable according to the absence of management for most of these stocks. In addition, the EU markets for these species are mostly driver by extra EU imports (cephalopods and in less extent Seabass). Local markets are still the first outlets for the SSF products but the trends in consumer demands may open new perspectives for this fleet segment (see D3.4) as long as access to stocks and areas are guaranteed.

References

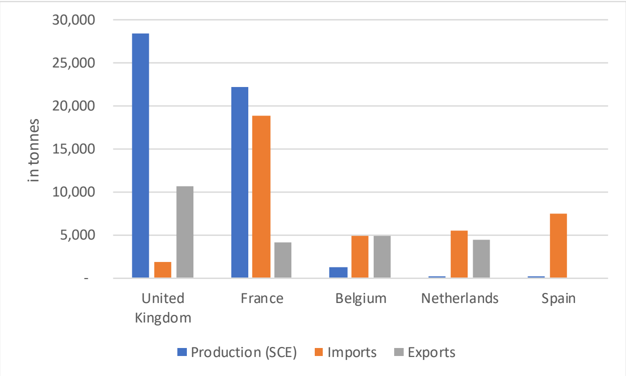
Guyader, O. et al. (2013). "Small scale fisheries in Europe: A comparative analysis based on a selection of case studies." Fisheries Research, 140, pp 1-13.

Stobberup K. et al. (2017), Research for PECH Committee – Small-scale Fisheries and “Blue Growth” in the EU, European Parliament, Policy Department for Structural and Cohesion Policies, Brussels, 156p
TBTI (2017) European Small-scale Fisheries: A regional synthesis. Too big to Ignore Report Number R-02/2017, St Iohn’s, Newfoundland, Canada, 28p
Josupeit, H. (2016). Small-scale fisheries markets: value chain, promotion and labelling, European Parliament - Directorate-General for internal policies - Policy Department B: Structural and cohesion policies - Fisheries - Research for PECH Commitee: 62p.

3.3.3 The King Scallop fishery in the English Channel (UK and France)

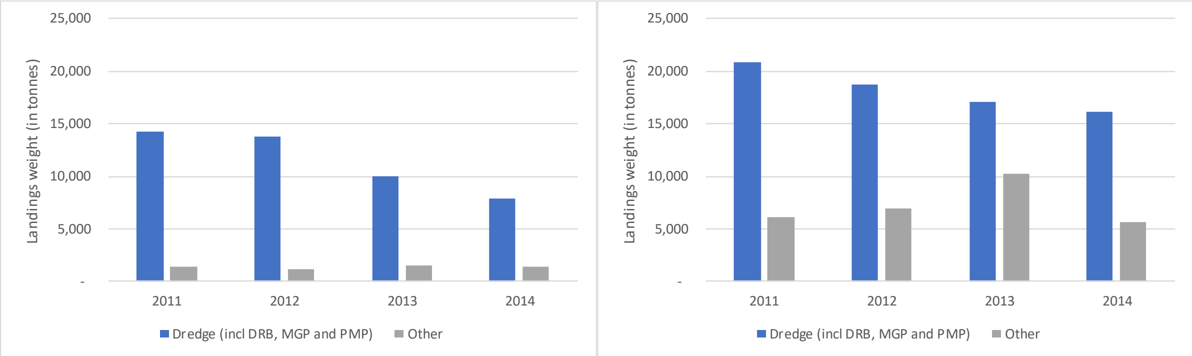
In 2014, scallops were 3rd most valuable species in the UK and the 4th in France (domestic catches). The picture of King scallops production and trade of all scallops in the EU is shown in figure 1. As indicated, France is the largest overall market for scallops in the EU (with combined production and net imports) followed by UK and Spain.

Figure 1. Production of king scallops (SCE) in the EU with imports and exports of all scallop products (source: STECF AER, 2016; EUMOFA, 2017)



Scallops are a coastal species but targeted by a range of vessels mostly using dredge (see figure 2). The English Channel is the most productive sea area for King scallops with greater than 50% of production in 2014. It is a highly regulated fishery but not by total allowable catch as historically stock status has been difficult to assess.

Figure 2. UK (left) and France (right) landings weight of king scallops by gear (dredge Vs other) in the English Channel (source: STECF AER, 2016)



Note: DRB=Dredge; MGP=Polyvalent mobile (active) gears; PMP=Polyvalent mobile (active) and passive gears

Where figure 1 shows total production, figure 2 concentrates on king scallops production in the English Channel only. The purpose of this report on the UK/FR king scallops in the English Channel is to demonstrate through example the data provided for by the indicator tool developed for the SUCCESS project for D3.3.

3.3.3.1 Coastal fleets

Economic data for EU fishing fleets is collected on a yearly basis by the STECF Annual Economic Report (AER). Fleet segments are defined by country, main gear and vessel length category. For example, UK and France dredge fleets are segmented into the following vessel lengths: <10m, 10-12m, 12-18m, 18-24m, 24-40m and >40m. Scallops are caught by vessels around the UK coast. As part of the case study evaluated, vessels less than 18m in length are assessed as it is this group that best represents the coastal nature of scallop activity.

A significant number of technical measures are imposed for scallop fishing. These include:

- Number of vessels (e.g. vessel license);
- Licenses (e.g. shellfish, gear used);
- Number of dredges (e.g. different inshore / offshore);
- Closed seasons (e.g. May-September for France);
- Inshore closed areas (e.g. Natura etc);
- Days at sea (e.g. Western Waters Management Scheme)
- Inshore quotas (e.g. daily, weekly limits).

As indicated, the three main UK and France coastal dredge fleets for king scallops in the English Channel selected for evaluation in D3.3 are the under 10m vessels, 10-12m vessels and 12-18m vessels. A summary of the fleet structure with high level indicators describing fleet activity is presented in Table 2. For the UK, there are a total of 495 vessels reported in these fleets with 677 fishermen employed. For France, there are also 495 dredge vessels and 778 employed.
For the selected three fleets (i.e. <10m, 10-12m and 12-18m) in the UK, king scallops is the main species produced and contributes 66%, 86% and 63% of the total value of landings by the fleets in 2014 respectively with a total landings weight of 2,164 tonnes from the Channel.

Table 1. Fleet structure for UK coastal king scallops fleets in the English Channel (source: STECF AER, 2016)

	2008	2009	2010	2011	2012	2013	2014
UK dredge <10m:							
#species @80% value	5	5	3	3	4	3	3
Weight king scallops	1,470,556	1,243,965	1,483,498	2,066,794	2,187,142	1,784,863	1,610,041
% value king scallops	54%	56%	63%	63%	65%	65%	66%
Days at sea	7,128	6,698	5,616	6,336	6,551	6,432	5,664
#vessels	234	228	198	242	212	208	218
#employed	226	233	216	255	251	195	226
Energy consumption (l)	2,461,720	2,509,235	2,070,005	2,260,935	2,504,405	2,474,160	2,173,215
UK dredge 10-12m:							
#species @80% value	2	1	1	1	1	1	1
Weight king scallops	1,098,680	1,414,546	1,818,368	1,867,046	2,506,045	2,165,773	1,917,049
% value king scallops	70%	82%	87%	85%	97%	87%	86%
Days at sea	2,927	3,266	3,452	3,182	3,183	3,699	3,030
#vessels	50	58	62	60	52	62	58
#employed	64	83	88	83	81	79	80
Energy consumption (l)	1,391,850	1,655,250	1,787,550	1,714,400	1,709,250	2,011,450	1,609,500
UK dredge 12-18m:							
#species @80% value	2	2	2	2	2	3	2
Weight king scallops	4,356,673	5,231,306	5,990,828	6,861,922	8,499,039	7,399,077	8,068,649
% value king scallops	80%	53%	79%	73%	76%	62%	63%
Days at sea	6,452	8,244	8,992	11,462	11,712	13,046	13,505
#vessels	108	120	138	168	166	208	219
#employed	189	218	259	331	358	342	371
Energy consumption (l)	4,476,200	5,755,150	6,135,750	7,492,800	7,895,250	8,789,000	9,403,150

For the selected three fleets (i.e. <10m, 10-12m and 12-18m) in France, king scallops is the main species produced and contributes 37%, 47% and 71% of the total value of landings by the fleets in 2014 respectively with a total landings weight of approx. 12,000 tonnes from the Channel. The number of species making up 80% of the fleets value is considerably more than in the UK, presumably as the scallop fishery in France has a 6 month closed season over the summer months. The species targeted additionally to king scallops include blue mussels, sole and various clam species.

Table 2. Fleet structure for France coastal king scallops fleets in the English Channel (source: STECF AER, 2016)

	2008	2009	2010	2011	2012	2013	2014
France dredge <10m:							
#species @80% value	-	-	7	7	6	7	7
Weight king scallops	-	-	1,051,539	1,451,967	987,725	1,004,907	861,322
% value king scallops	-	-	46%	49%	45%	40%	37%
Days at sea	-	-	-	-	5,163	5,538	5,300
#vessels	82	75	151	161	138	139	130
#employed	89	74	64	65	53	41	40
Energy consumption (l)	1,099,128	1,031,316	821,053	587,273	532,382	878,770	502,139
France dredge 10-12m:							
#species @80% value	-	-	8	6	6	6	7
Weight king scallops	-	-	2,611,016	3,857,628	3,706,806	3,600,158	3,358,568
% value king scallops	-	-	46%	54%	55%	57%	47%
Days at sea	-	-	-	-	10,613	10,182	10,791
#vessels	77	90	195	179	185	196	215
#employed	117	152	164	140	131	135	137
Energy consumption (l)	3,646,492	4,098,316	4,609,745	4,314,458	3,804,200	4,254,622	3,568,792

France dredge 12-18m:							
#species @80% value	-	-	5	5	3	4	3
Weight king scallops	-	-	7,502,060	8,346,258	8,504,966	7,589,620	7,720,339
% value king scallops	-	-	65%	63%	67%	69%	71%
Days at sea	-	-	-	-	14,492	12,686	14,715
#vessels	103	82	212	213	186	174	198
#employed	307	255	273	302	284	274	303
Energy consumption (l)	13,605,669	10,481,966	11,625,979	11,964,022	12,375,387	8,401,854	10,602,450

3.3.3.2 Landings of selected King scallop fleets in the English Channel

Across the French and UK fleets, over 50% landings in the English Channel are from <18m vessels. In France, it is estimated that 95% of scallops are landed from <18m vessels whereas in the UK the figure is approximately 48%.

Landings of king scallops for the selected UK and France fleets are presented in Figure 3 and Figure 4 respectively. The profiles of landings of the 3 fleets in each country are similar for the <10m and 12-18m but the 10-12m dredge fleet segment in France is considerably more valuable than that in the UK which can be explained by the number of vessels operating in this size class. French landings between 2011-12 and 2014-15 were stable in 7d and 7e but 2013 saw a 'spike' (+60%) in French landings for 10-15m and >15m vessels. UK landings have been stable in 7d, but decreasing in 7e since 2013. Note that UK landings from >15m vessels are decreasing more.

Figure 3. UK King scallop landings Vs total landings of selected scallops dredging fleets (source: STECF AER, 2016)

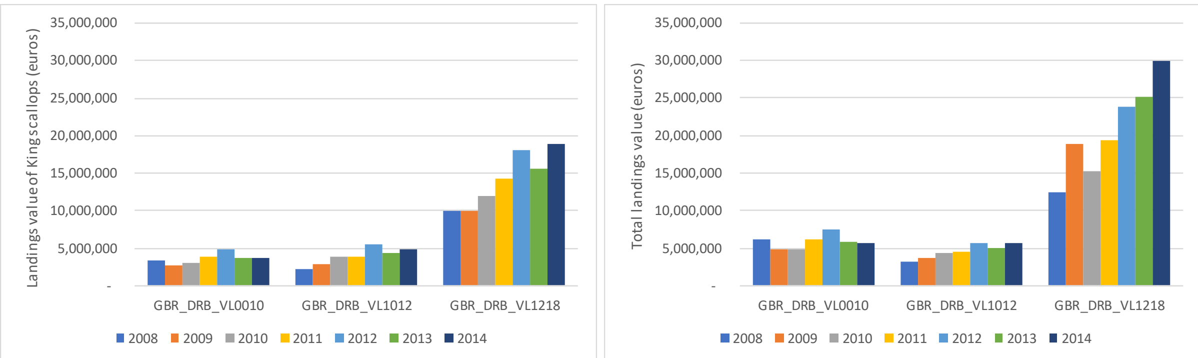
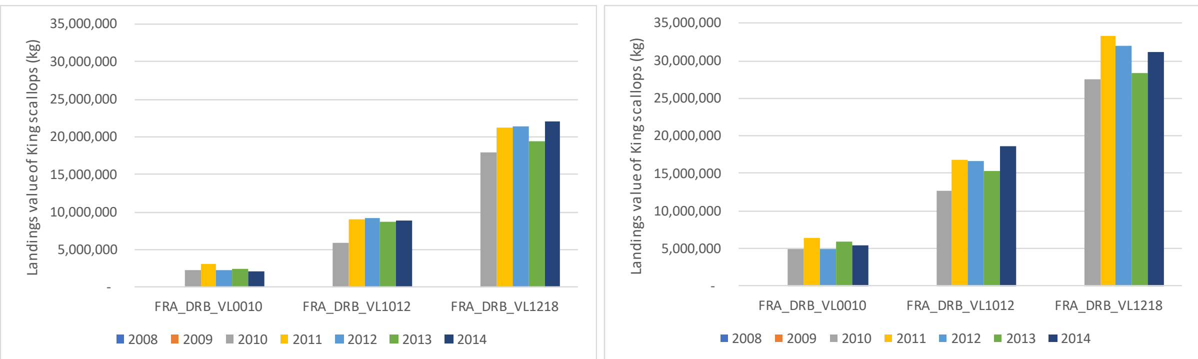


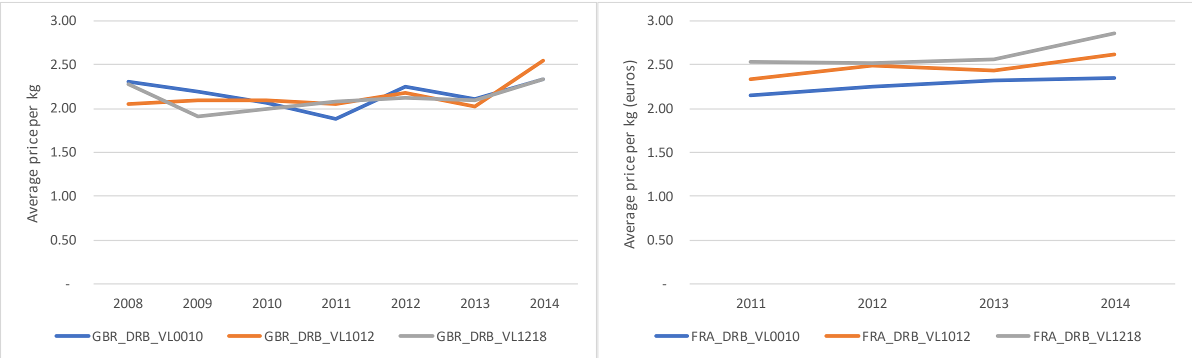
Figure 4. France King scallop landings Vs total landings of selected scallops dredging fleets (source: STECF AER, 2016)



The average price per kg (in euros) for king scallops achieved by <18m fleets in UK and France are presented in Figure 5. As indicated for the UK, the average price has tended to fluctuate between

2.00 and 2.30 euros between 2008 and 2013. Slightly higher prices were gained by the 10-12m fleet in 2014. However, compared to the French fleets this appears lower, where the selected fleets fluctuate between 2.30 and 2.50 euros. It is not clear why French fleet gain a higher price other than that a significant proportion of the UK product is exported to France. It could be surmised therefore that factoring in transportation costs is a potential reason why a lower price is reflected on UK producers.

Figure 5. Average prices per kg of scallops by dredging fleets <18m in UK (left) and France (right)



3.3.3.3 Fleet performance

The gross and net profit of the selected UK and France scallop fleets per vessel are presented in figures 6 and 7. Gross profit in this case is after crew costs, fixed costs and variable costs have been taken into account, where net profit also includes investment costs (e.g. depreciation). As indicated, the small scallop vessels on average are considerably less profitable than larger vessels. The gross or operating profits of the 10-12m and 12-18m fleets indicate an average level of approximately 25,000 euros for the UK and 20-30,000 euros for France. Net profits are lower at on average around 15,000 euros for the UK and around 5,000 euros for France in recent years. In the UK, the under 10m vessels on average are making around 5,000 euros gross profit per year per vessel on average and France's under 10m vessels almost double. In 2011 and 2013, the UK <10m dredge fleet is estimated as not profitable, similarly for the France 12-18m dredge fleet in 2012.

Figure 6. Gross profit / vessel and Net profit / vessel for UK scallop dredge fleets <18m (source: STECF AER, 2016)

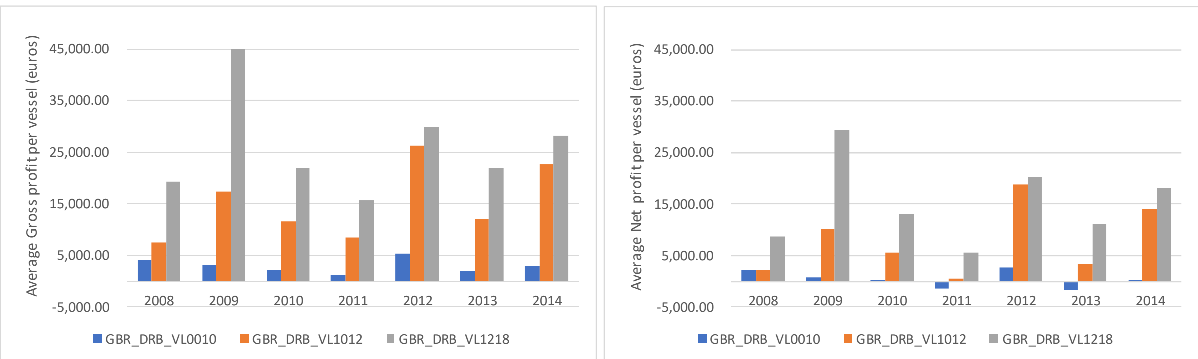
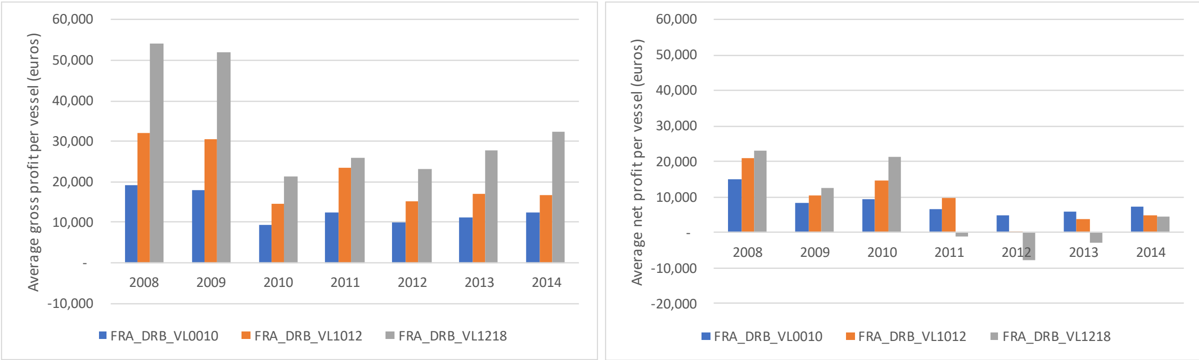


Figure 7. Gross profit / vessel and Net profit / vessel for France scallop dredge fleets <18m (source: STECF AER, 2016)



Gross value added and a competitiveness indicator (i.e. net profit divided by landings income / turnover) are presented in Figure 8 and Figure 9. It is clear that the 12-18m scallop fleet makes the greatest contribution to GVA of the selected fleets with the <10m and 10-12m showing similar level across the period analysed for GVA. It is noticeable that France contributes almost double the GVA for each fleet segment than the UK.

The competitiveness indicator provides an indication of the level of profits versus income gained. The UK 10-12m and 12-18m scallop dredge fleets appear competitive and economically sustainable at a ratio greater than 10% for much of the period evaluated. The UK <10m vessels on average are much less competitiveness. The picture is opposite for the France fleets evaluated, where the <10m fleet segment is above 10% for the whole period and the other 2 fleet segment below 5% in the last 3 years, with the larger 12-18m fleet showing negative values.

Figure 8. GVA, left, and Competitiveness, right, for UK scallop dredge fleets <18m (source: STECF AER, 2016)

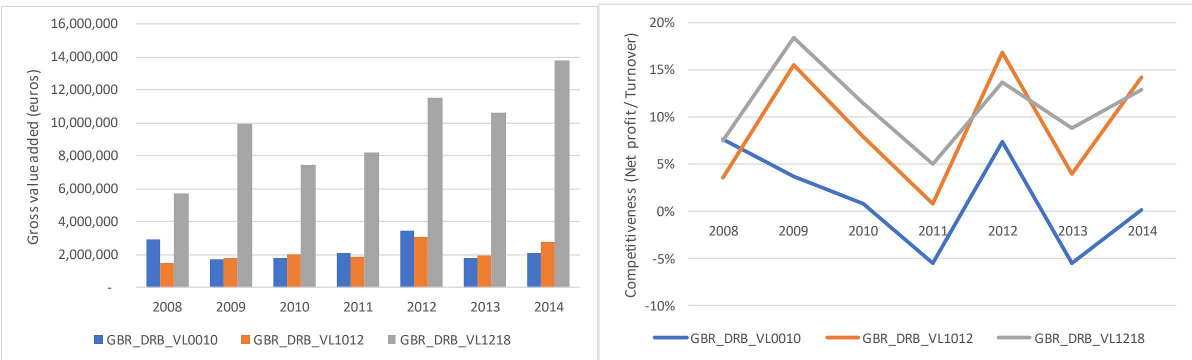
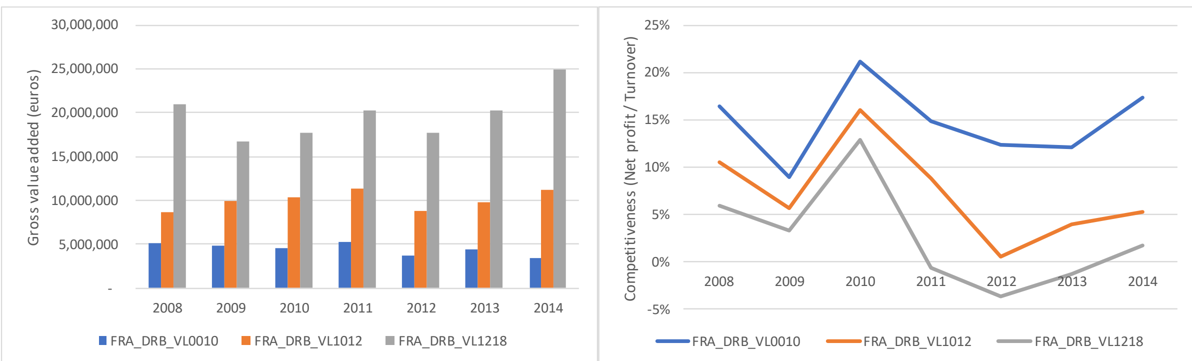


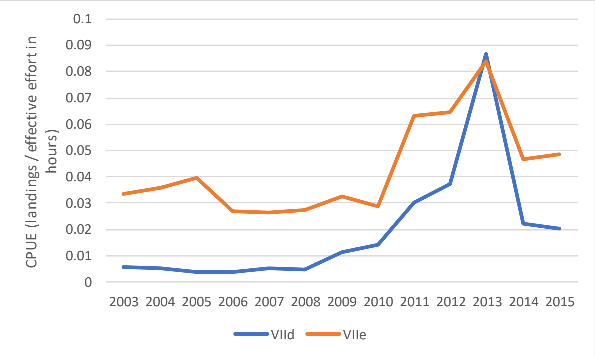
Figure 9. GVA, left, and Competitiveness, right, for France scallop dredge fleets <18m (source: STECF AER, 2016)



3.3.3.4 Stock status of King scallops in the English Channel

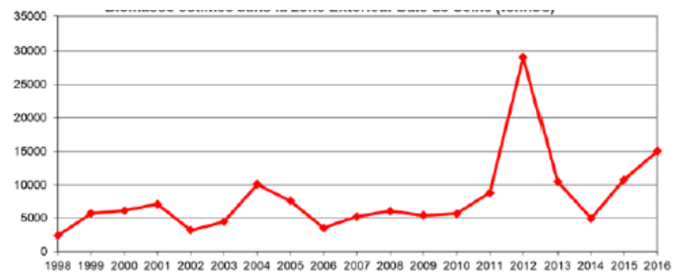
The stock status of king scallops in the English Channel is not well known, however a proxy for stock status is often taken to be catch per unit effort (CPUE) over time, because as stock is higher more catch will typically be achieved for the same effort (i.e. days fished). CPUE for king scallops in the eastern and western Channel is presented in figure 10. It is shown that CPUE peaked in 2013 at a significantly higher level than previous years.

Figure 10. King scallops catch per unit effort (CPUE) index in English Channel (source: STECF FDI database, 2016)



An available estimate from ICES of king scallop biomass is a small area of the eastern Channel in a zone outside the Bay of Seine (see Figure 11). This follows a similar trend to the above CPUE analysis of the whole Channel.

Figure 11. Trends of estimated exploited biomass (tons) in the area "Proche Exterieur" (source: ICES, 2016)



3.3.3.5 Outcomes from the king scallop analysis

The king scallop fisheries of the English Channel are an important resource to both France and UK. It is evident that the French fleet is more coastal and made up of smaller vessels, where in the UK some larger (more nomadic) vessels prosecute the fishery at certain times of the year. Even though France imposes a closed season on fishing for scallops between 1 May and 30 September, the productivity of coastal vessels is typically greater than in the UK. Further, the UK vessels almost only target king scallops whereas the France vessels target a range of mussels, clams, cockles and high value species such as sole. Even so, the profitability of French vessels is greater when considering gross profit but less for net profit once all investment costs are accounted for. Even though net profit is used to indicated a level of competitiveness, it may be for these French fleets gross profit would be a better indicator as the level of net profit calculated may be a factor of the accounting process.

The number of vessels in the 12-18m dredge fleets for UK and France has doubled in the period evaluated indicating that the fishing has been able to support such an increase. In the UK landings have increased also but in France landings appear to have remained similar across the period. With no specific TAC for king scallops, it is not clear how this has affected the stocks status. However, there is some indication that after a high catch per unit effort (cpue) was seen in 2013 for east and west channel, the cpue in 2014-15 has decreased significantly. This may have an effect on the fleets targeting king scallops in the coming years.

References

ICES. 2016. Report of the ICES Scallop Assessment Working Group (WGScallop), 3–7 October 2016, Aberdeen, UK. ICES CM 2016/ACOM: 24. 39 pp.

STECF AER. 2016. The 2016 Annual Economic Report on the EU Fishing Fleet. JRC Scientific and Technical Policy Reports, Scientific, Technical and Economic Committee for Fisheries.

STECF FDI. 2016. https://datacollection.jrc.ec.europa.eu/dd/effort

3.4 Mussels Case study

Mussel farming is a well-established aquaculture sector in some European countries, but has registered a downward production trend since the beginning of the 2000's while it is still expanding in other parts of the world (esp. in Asian countries, Chile, New-Zealand). The volume share of production in the EU progressively decreased from 47% to 27% over the 2000-2015 period; in the meantime the share of new comers like Chile rose substantially from 2% up to 12% (FAO Fishstat). Although different factors on the supply side may constrain recovery and further development of European mussel farming in the future, on the demand side the outlook is favourable. This type of production is well positioned to meet increasing consumer demand for affordable fresh seafood, and it also fits with social demand for low-input aquaculture, contributing significantly to employment in coastal areas.

3.4.1 Context of EU production, exploitation and trade

3.4.1.1 Production

The worldwide production of mussel developed over the last 20 years mainly thanks to aquaculture. Globally, the production of farmed mussels has exceeded that from the wild since the end of the 1950s, and the volume share of capture fisheries fell below 10% in 2005 and is today around 5%.

In 2014, on the global mussel production amounted to about 2 million tonnes; China ranks first, followed by Chile and then Spain. Five EU countries are part of the top ten countries; among them only the Danish production still mainly relies on capture fisheries.

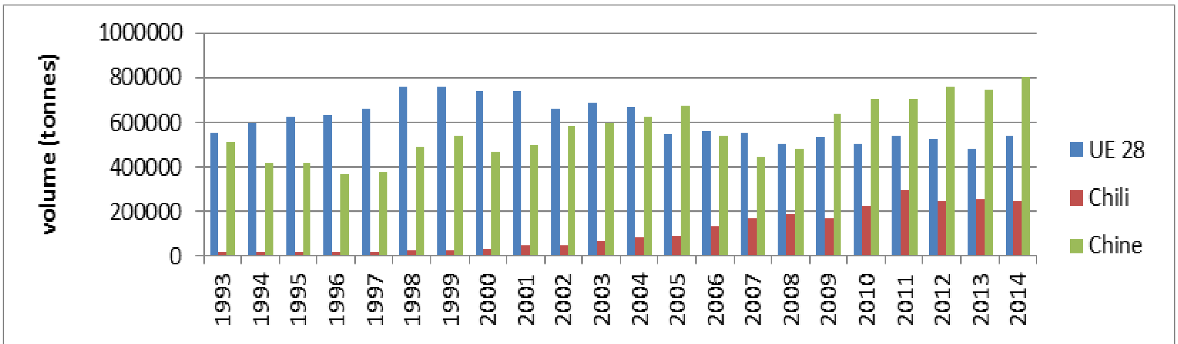


Figure 1. Evolution of the aquaculture production of mussels from China, EU28 and Chile (FAO data)

At the European level, the production of mussels relies mainly on two species, *Mytilus edulis* and *M. galloprovincialis,* from northern countries and southern countries respectively. From 2000 to 2013, mussel production in the EU dropped from 740 to about 450 thousand tons due to a downward trend in aquaculture and the dramatic decline of capture fisheries (mainly from Denmark). The level of production then recovered to above 500 thousand tons in 2014 and 2015 (FAO FishStat). The top 4 farmed mussel producers have not changed since 2000, and accounted for 82% of EU production in volume (average 2000-2015). Spain comes far ahead (42%) followed by France and Italy (15% each), the Netherlands (10%), Ireland (6%), the UK (5%) and Greece (4%). In value, the share of the top 4 countries is unchanged, but the ranking is modified due to the higher pricing of blue mussels compared to Mediterranean mussels. France ranks first followed by Spain, the Netherlands, and Italy.

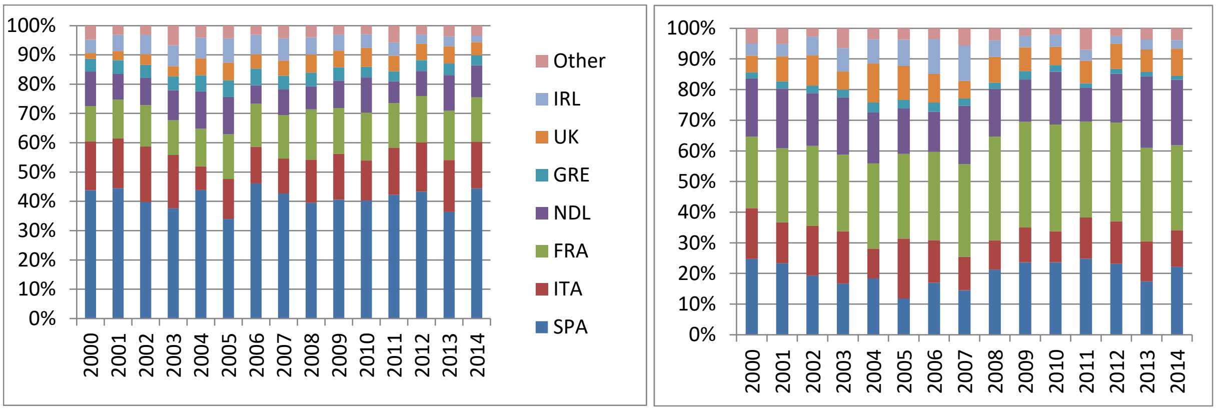


Figure 2. Evolution of the main producers of mussels in EU28 (% in volume and value; FAO FishStat)

Among the bottlenecks identified for the development of mussel farming production, the most critical are related to environmental concerns and to regulatory constraints, limiting the access to new farming sites. Environmental bottlenecks refer to all factors causing mussel mortalities or other economic losses due to periods of sales closure: epizootic events, red tides, climatic events, natural competitors and predators, blooms of toxic phytoplankton, water quality degradation... For instance, red tides are responsible for significant fluctuations in Spanish mussel production. Impact of predation by seabream is significant too, insofar as it has hindered the development of mussel long lines in the French Mediterranean coast. Recent virus outbreaks causing mass mortalities of adult mussels in France in 2014 and 2016 are also worrying. Achieving the objectives of national strategic plans for the development of sustainable aquaculture (+25% of growth for the whole shellfish production at the EU level) is particularly challenging in that context and a prerequisite will be to mitigate water quality degradation in some areas and to build up the conditions of the resilience of the mussel sectors to environmental hazards (EC, 2016).

3.4.1.2 Trade

Since 2000, the deficit of the EU mussel market has been increasing to meet the demand for mussels, but extra-EU imports have been relying exclusively on processed products. For the bulk of the European mussel market (live, fresh products), the level of intra-EU trade over the period 2000-2015 fluctuated between 125 and 175 thousand tons for imports (144 on average) and between 130 and 185 thousand tons for exports (147 on average) (Figure 3). Net importers of fresh mussels over the period are in decreasing order France (37 thousand tons on average), Belgium (25) and Italy (20) in volume, while in value the highest deficit is related to Belgium. Net exporters include Spain (28 thousand tons), the Netherlands (20), Denmark, Greece and Ireland (10-15), albeit in value the Dutch trade surplus is by far the largest. Despite erratic export trends, striking features to be noticed are the progressive growth of Spanish mussel exports in live/fresh form and the recovery of Dutch mussel production and exports in the most recent years.

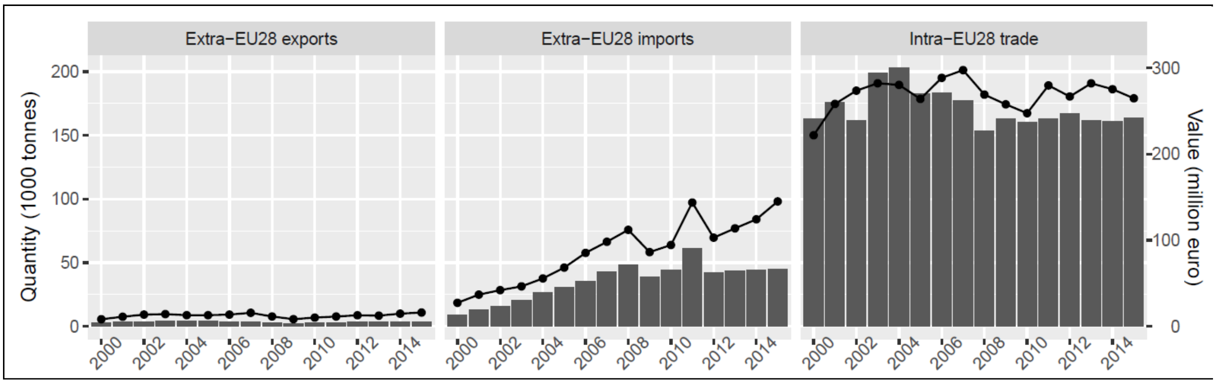


Figure 3. Evolution of the extra and intra EU trade of mussels in volume and value

The evolution of mussel trade over the period 2000-2015 actually highlights the rising share of prepared or preserved mussels and conversely the decline of imports of frozen, dried or salted mussels in extra-EU imports (Figure 4). As concerns the supplying in preserved mussels, extra-EU imports have been progressively expanding and competing with intra-EU imports (mainly from Spain). Chile became the leader for this type of product, reaching 76% of EU imports in 2015. Comparatively, the structure of the intra-EU trade of mussels remained more stable, but the share of fresh mussel trade in value showed a progressive increase from about 60% in 2000 to 70% at the end of the period.

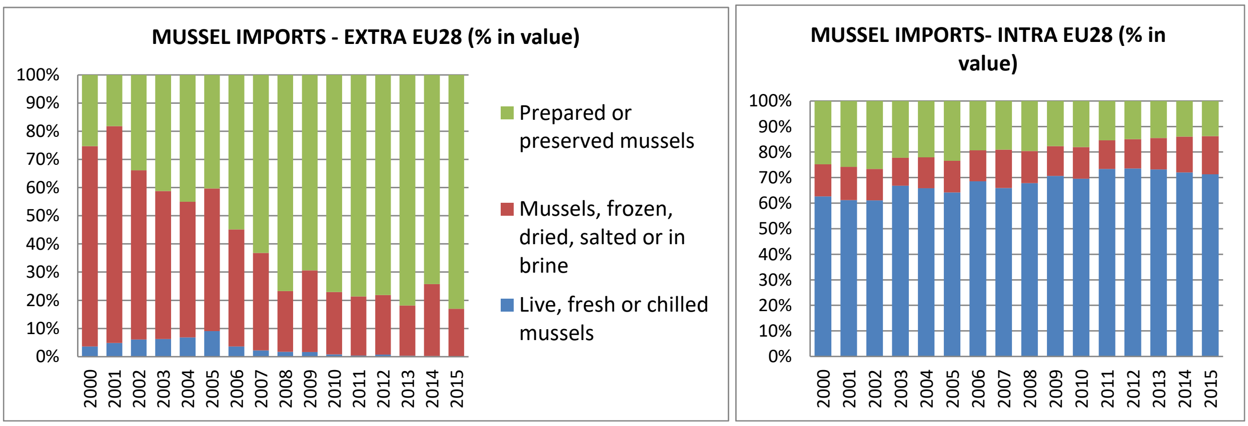


Figure 3. Evolution of the Intra & Extra EU28 imports of mussels by type of product (Comext Eurostat)

In 2015, extra-EU imports reached €145 million including €25 million of frozen or dried mussels and €120 million of prepared or preserved mussels. The majority of mussel trade which occurs at the intra-EU level amounted to €265 million. It is always dominated by import of live, fresh or chilled mussels (71% in value). Figure 4 summarises the main mussel products exchanged and main players of the EU mussel trade (extra and intra) in 2015.

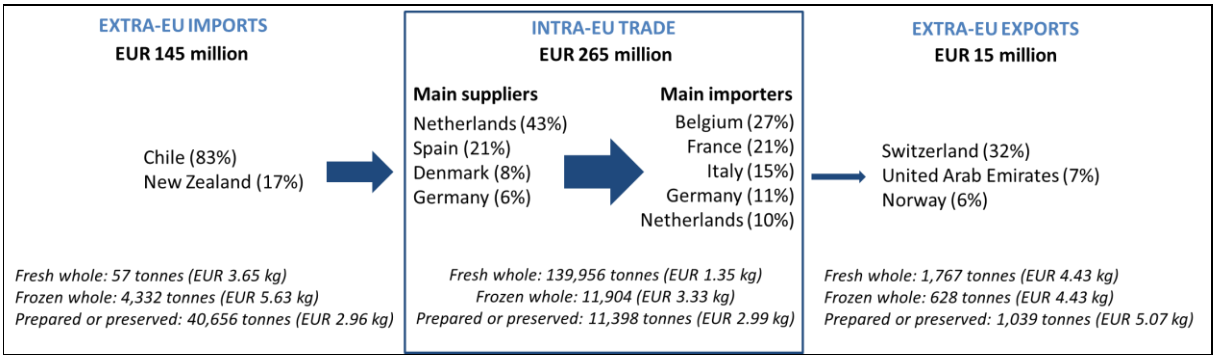


Figure. 4. Synthesis of main trade flows (Extra and Intra-EU trade) of mussels in 2015 (Comext Eurostat)

3.4.1.3 Apparent market and consumption

As a result of the downward trend in production, the seafood balance sheet for mussels showed a decrease at the EU scale, from about 750 to 650 thousand tons (live weight) between 2000 and 2015. Concomitantly, the rate of self-sufficiency of the EU mussel market was slightly reduced. It reached about 80% in 2015 compared to more than 90% at the beginning of the 2000s.

At its lowest, the European apparent market for mussels barely reached 570 thousand tons in 2013 and consumption per capita was 1.1 kg (live weight). In 2014 and 2015, this indicator went up again to 1.3 kg per capita (all forms included). This average indeed hides significant disparities since the consumption markets for mussels are concentrated in some countries. France and Spain each represented a quarter of the EU28 mussel consumption in 2015 and Italy had at least 20% of the market share. The following countries fell to 4-5% (Belgium, UK), and a main producer/exporter such as the Netherlands only counted for 2% of the mussel consumption in the EU. By level of consumption per inhabitant, Spain ranked first in 2015 (3.5 kg), followed by Denmark, Belgium, France and Italy (2-3 kg). In exporting countries like Greece, Ireland and the Netherlands, the level of mussel consumption is less than one kg per year.

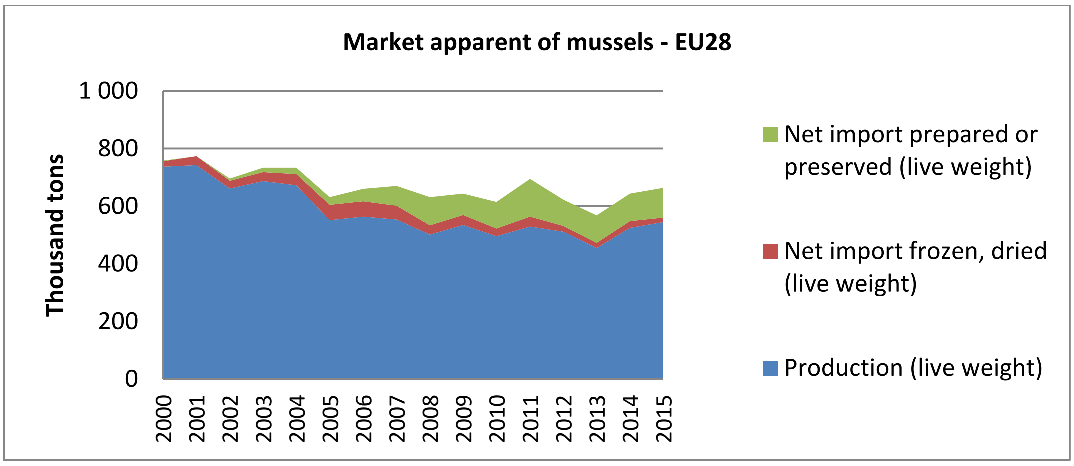


Figure 5. Evolution of the apparent market of mussels of the EU28 by type of product (Comext Eurostat)

3.4.2 Description and comparison of productions systems

Mussel farming, which has a long history in some European countries, relies on a variety of cultural techniques originally developed in different natural environments (in intertidal areas, lagoons, "rias", at sea…). Traditional production modes such as rafts in Galician rias ("bateas"), culture on wooden stakes (like "bouchot" in France), and even bottom culture on plots in the Netherlands and Germany still represents the majority of the EU mussel production in volume (at least 70% in 2015). Despite the predominance of longlines in other countries (like in Italy and Greece) and outlooks of development based on this technique, this is far from being the most widespread cultivation system for mussels in the EU today.

The description of production systems (PS) in D3.2 mainly focused on the dominant farming techniques in Spain, France, Italy, the Netherlands and Greece. It was carried out thanks to national statistical sources and data from the aquaculture data collection framework (DCF) which provided complementary and valuable indicators for the characterisation and comparison of PS (except for Greece where only production data are collected).

Globally the European mussel farming remains a small-scale activity at the production stage, with a low level of employment by enterprise. However, beyond this common feature, the characteristics of the dominant PS can differ significantly. The Dutch production system, using fishing boats for dredging mussels grown on bottom concessions, shows the highest indicators of concentration and is the most capital intensive. This "hybrid system" (in between fisheries and aquaculture) remains actually dependent on the fishery of mussel seeds in dedicated areas. However, this issue is being solved with the progressive introduction of seed collectors, as compelled by new regulatory restrictions. In addition, the Dutch mussel production sector is backed by a highly integrated and mechanised processing (packing) and marketing sector, where four companies are responsible for the sales of 80% of all live mussel traded by the country (Monfort M.C., 2014). This mode of coordination of the value-chain provides the Dutch mussel industry with significant economies of scales. At the opposite, the mussel farming sector in Spain, which plays a significant role in the development of certain areas, is characterised by a high level of employment, by multiple activities, and relies on family labour and part-time jobs. Added to a cost structure dominated by labour cost, this production system can be defined as labour intensive.

Table 1. Key features of mussel farming in the Netherlands, France, Spain, Italy and Greece based on their main DCF segment (STECF 16-19)

	NDL Bottom 2013/2014	FRA "Bouchot" 2013/2014	SPA Raft 2013/2014	ITA Long-line (2013)	GRE Long-line (2014)
Number of enterprises	56	285	2 034	159	na
Number of employees	na	1 819	8 600	996	na
Number of FTE	154	1 077	2 312	829	na
Total mussel sales (tonnes)	41 812	59 155	190 062	67 385	21 643
Mussel price indicator	1,40	1,87	0,50	0,73	0,39
Number of FTE/enterprises	2,8	3,8	1,1	5,2	na
ratio Employees/FTE	na	1,7	3,7	1,2	na
Total mussel sales/enterprise (tonnes)	753	208	93	424	na
Total mussel sales/FTE (tonnes)	272	55	82	81	na
Total value of assets/FTE (1000 €)	545	181	95	68	na

The characterisation of production systems also considered aspects related to the integration by producers of purification, dispatching operation, and even packaging, and to the development of differentiation strategies (quality schemes). In this respect, it could be assumed that the differential in the price indicator calculated from mussel sales not only depends on the species (blue mussel or Mediterranean mussel) or the cultivation mode but also reflects different level of integration and coordination along the mussel value chains. The related DCF indicator ranged from 0.39€/kg (average price of Greek mussels in 2014) to 1.89€/kg (average price of French bouchot mussels in 2013/2014).

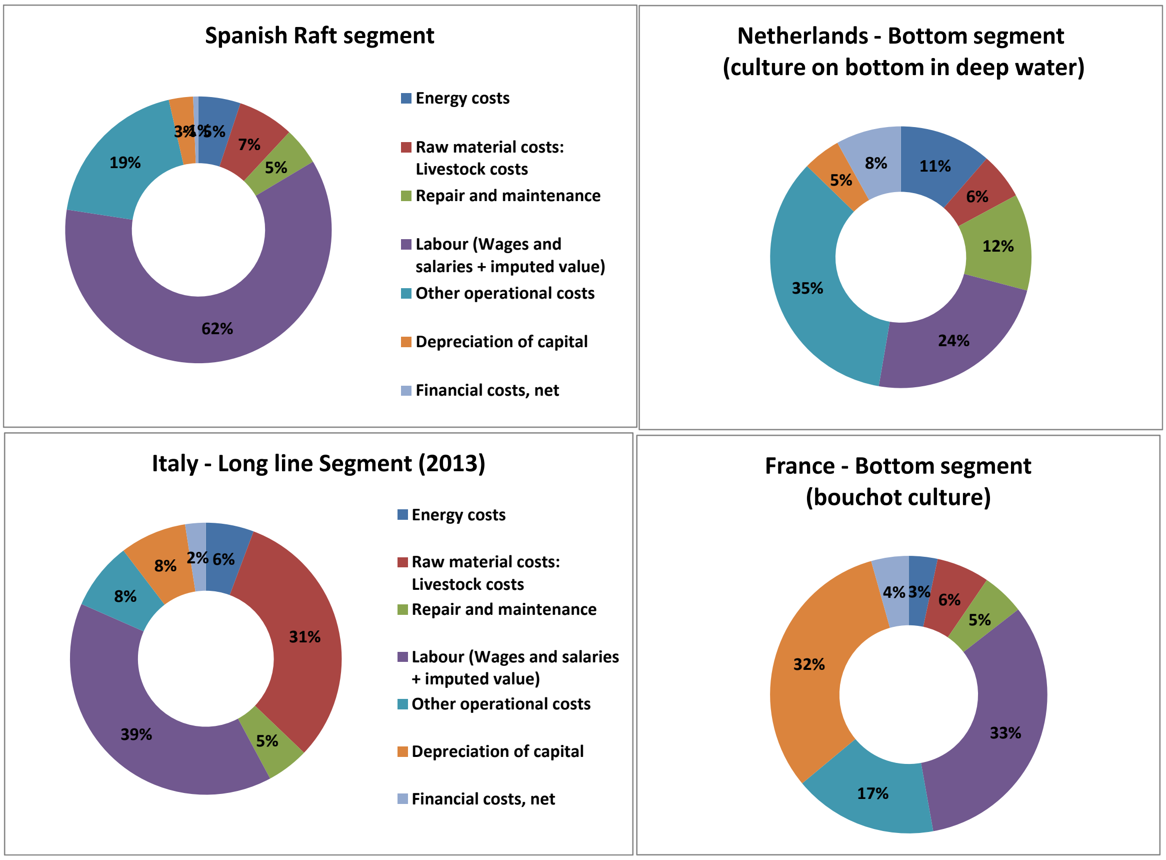


Figure. 6. Comparison of cost structure for different PS in EU mussel farming (STECF Aquaculture 2016)

In the same way, the comparison of cost structure between different production systems should take into account the structure of the sectors, in addition to the mode of farming. For instance, the higher share of capital costs in the French mussel PS can be explained by the integration of dispatch and purification facilities by most of the enterprises, which add to farming investments. Conversely, Dutch depreciation costs are found to be very low (lower than financial costs), and we may wonder whether they are underestimated or if their mode of calculation is comparable with other sectors.

Moreover, in Italy, the weight of livestock costs is very high compared to other countries (31% versus 6-7%). Thus, in addition to the purchases of mussel seed, this cost item may include purchases of adult mussels for resale. In that case, this indicates an integration of trade activities by mussel farmers, making more difficult the comparison of cost structure with other segments.

3.4.3 Comparison of Selected indicators – Analysis

3.4.3.1 Source of data and coverage in terms of production systems

Indicator reports (D3.3) were provided for 5 countries: Spain, France, the Netherlands, Italy and Greece, thus encompassing a large majority of the EU mussel farming sector. As previously mentioned, the main source of data for the calculation of indicators relies on the aquaculture DCF (STECF 16-19), except for the Greek mussel farming which was subject to a specific survey for collecting 2014 data (Papaharisis & Advelas, 2015). The segments covered in each country are the most representative of the mussel farming sectors concerned. In Spain, the production system associated to raft cultivation in Galicia is nearly exclusive. In Italy and Greece, the cultivation on long-lines constitutes the dominant system. In France, the "Bouchot" mussel farming cultivation is dominant too, but represents only two-thirds of the whole mussel production, including the Mediterranean[21].

In view of the comparative analysis of economic indicators, the expertise of data undertaken by country provides elements (or points out shortcomings) to be considered in the assessment of the performances of the mussel farming sectors:

- In Spain the data collection for mussel aquaculture started in 2008 and since then there has been no methodological changes. The reliability of the data is ensured by the method of stratification applied to the whole population of farms in Galicia. The stability of data over time is however a critical issue, not for methodological reasons, but due to the high dependency of mussel farming towards environmental problems (red tides) which generate a great volatility in the levels of production and sales.
- In France, economic data provided for the Mussel Bouchot segment from 2010 are assumed to be consistent, if considering the sampling rate, the homogeneity of the farming technique and the specialisation in terms of species (higher than in the reference population). On the other hand, information is missing about the geographical breakdown of the enterprises included in the sample, which could be a source of variability of the economic results.
- For the Netherlands, the data provided for the D3.3 report are revised data compared to data included in the latest STECF report. The revision by LEI mainly concerns some variables such as livestock costs, other operational costs and the total value of assets and was needed to suit the current evolution of practices (seed collection) and to improve the coverage of costs/assets.
- As concerns the Italian STECF data, attention was paid to the inconsistency of the energy costs for 2014 (disproportionate increase compared to previous years) which biases all economic indicators. As things stand, it seems preferable to assess the competitiveness of the Italian Long-line segment based on the 2013 data.

[21] In France, other mussel farming activities referring to raft in Mediterranean lagoons and longline segments are no longer included in the DCF due to the lack of statistical representativeness of data collected in 2012.

3.4.3.2 Economic and social sustainability

3.4.3.2.1 Economic performance

The return of investment (ROI) is an indicator commonly used to assess the profitability of economic sectors. It corresponds to the ratio EBIT/total value of assets and as such can be influenced by the method of calculation of depreciation costs, in addition to be dependent on the content of the value of assets[22] .

To take into account the possible discrepancies resulting from different coverage of capital costs, the return on investment before depreciation costs (OCF/total value of assets) is also presented in Figure7. When considering the ROI, the Dutch production system is by far the most profitable, followed by the "raft" PS and the "bouchot" PS (integrating dispatching and purification operations) and then longline PS which achieved the lowest economic profitability, and even negative for the Greek mussel farmers in 2014. As regards the ratio OCF/total value of assets, the differential of profitability between the Dutch (31%) and French mussel PS (28%) is significantly reduced; the same levelling is observed as concerns the profitability of the Spanish and Italian PS which reach 12% each.

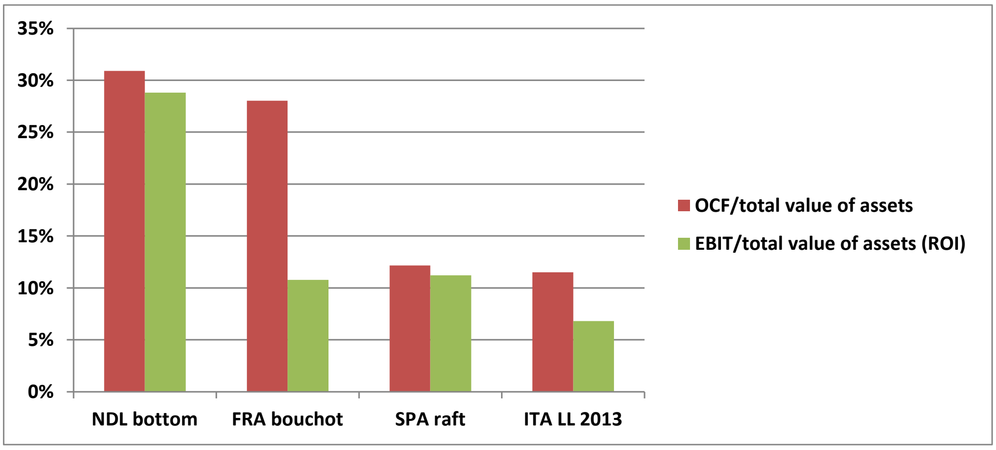


Figure 7. Comparison of economic profitability of the main PS for mussel farming (source DCF data 2013/2014)

For other economic performance indicator like labour productivity the Dutch mussel PS is again far ahead other mussel production systems (Table 2). French labour productivity shows intermediate values compared to Spanish raft and Italian longlines PS, despite lower indicators of productivity in volume (Table 1). This differential is largely due to the higher level of price of the French mussels.

In terms of indebtedness, the situation of mussel bouchot farmers appears to be nearly balanced, compared to the Dutch mussel PS which is strongly dependent on debts. Moreover, the Greek economic survey report a lack of debt dependency of the mussel longline sector, which can also be interpreted as a lack of investment, provided that this result is considered representative of the situation of the Greek mussel farming sector.

[22] This variable covers all assets from fixed assets to currents assets, including inventory (stocks of bivalves), accounts receivable and cash/cash equivalent. Fixed assets include tangible assets related to farming activities and possibly to purification centres, dispatching & packaging activities. They can also include intangible assets related to the value of shellfish farming concessions. This indeed constitutes a source of discrepancies which could limit the comparison between enterprises

The energy efficiency, measured by the cost per kg of shellfish is found to be the highest for the Spanish raft system (€0.02/kg), and the lowest for the Dutch cultivation on bottom (€0.11/kg).

Table 2. Economic performances of mussel farming production systems

Purpose	Indicator	Variable	NDL "bottom" 2013-2014	SPA "raft" 2013-2014	FRA "bouchot" 2013-2014	ITA Longline 2013	GRE Longline 2014
Economic performance of PS	Labour productivity	GVA/FTE (€/FTE)	230 315	29 347	82 747	22 999	8 660
	Profitability	ROI = (EBIT/total value of assets)	29%	11%	11%	7%	-9%
	Indebtedness	Debt/total value of assets	95%	69%	54%	60%	0.14%
	Energy efficiency	Energy costs per kg of shellfish (€)	0.11	0.02	0.06	0.04	0.09

3.4.3.2.2 Economic dependency

The N80 (number of species making up 80% of the total production in value) is not a really discriminative indicator for shellfish farming activities which mostly rely on monoculture. However, we must bear in mind that the French mussel DCF segment which is highly specialised is not representative of the whole mussel sector, where a number of shellfish producers are involved in both oyster and mussel farming (especially in Normandy and North Brittany).

The highest dependency on export after the Dutch mussel industry (which is also involved in trade and do not only export its own production) is observed for the Greek and Italian mussel production sectors. Conversely, the export outlets of the French mussels are very low as more than 95% of the production is dedicated to the domestic market. As long as the demand for French mussel is high (and probably exceeding the supply, especially in the recent years when significant mortalities led to supply shortage), there will be probably little incentive to diversify outlets towards export markets.

Table 3. Economic dependency of mussel farming production systems

Purpose	Indicator	Variable	NDL "bottom" 2013-2014	SPA "raft" 2013-2014	FRA "bouchot" 2013-2014	ITA Longline 2013	GRE Longline 2014
Economic dependency of PS	Dependency on species	N80	1	1	1	1	1
	Dependency on external trade	Rate of export	>100%	6.5%	<5%	26%	38%
	Dependency on energy	Energy costs / value of total sales (%)	11%	5.2%	3.1%	6%	18%
	Dependency on inputs	% of feed costs compared to total costs	0%	0%	0%	0%	0%

The share of energy costs is higher for the Dutch production system (11%) than for the bouchot cultivation system in inshore areas (about 3%). According to the Greek survey, energy costs were estimated at 18% of the total costs in 2014, which highlights a strong dependency of the longline PS towards energy (however first DCF data in 2014 provided a very lower estimation at 2%). At this stage, due to uncertainties related to some data sources, there is only evidence of the lower energetic dependency of mussel aquaculture activity located inshore (bouchot farming in France, raft farming in Galicia) compared to offshore aquaculture like the Dutch mussel bottom culture system and, to a lesser extent, to longline PS. In Italy, increasing energy costs since the beginning of 2010's would be linked to a tendency in multiple regions to move long-line installations beyond 3 miles.

3.4.3.3 Social sustainability

The ratio Total employees/FTE is only available for France and Spain from DCF data. In the first case, the use of temporary jobs is required in "bouchot" mussel farming to deal with the seasonality of harvesting and of selling operations. The ratio total employees/total FTE fluctuated between 1.6 and 1.8 in 2013-2014. In Spain, the mussel farming is traditionally a sector where there are a lot of people working a part of the year, most of them are self-employed workers, and the ratio employees/ FTE reached 3.7. However, in recent years, data suggest that a process of specialization has taken place leading to a reduction in temporary/seasonal employment. The high level of unemployment in Spain during this period, the lack of opportunities in other economic activities and sectors and the profitability of the mussel production have facilitated the return of people to this family-owned activity and to full-time work. In Italy, supplementary information provided within the SUCCESS project, show that most of the employees are full-time jobs, with a ratio of Total employees/Total FTE estimated at 1.2. Part time jobs are also required to meet the seasonality of the mussel harvesting phases.

Table 4. Social indicators of the mussel farming production systems

Purpose	Indicator	Variable	NDL "bottom" 2013-2014	SPA "raft" 2013-2014	FRA "bouchot" 2013-2014	ITA Longline 2013	GRE Longline 2014
Employment conditions and attractivity of the aquaculture sector	Use of temporary jobs	Total employees/ FTE	na	3.7	1.69	na	na
	Recourse to family work	% of imputed value of unpaid labour	0	72%	52%	1%	49%
	Level of Remunerat° of work	Labour costs/FTE (€/FTE)	61 282	18 524	32 220	15 923	8 887

The use of family work is an inherent feature of family-owned companies in Spain, France and in Greece, whereas in Italy it seems really anecdotal. In France, the share of imputed value of unpaid labour on total labour costs (52%) suggests that employment in mussel "bouchot" farming relies at least for one half on family labour, unless it results from the number of associate producers. In Spain, the share of the "unpaid labour" raised to nearly 75% in 2014, which suggests a decrease in the level of hiring of salaried workers, and an increase in the involvement of the families that own the raft to the business. In Greece, almost half of the employment in the sector is provided by the owner and family members.

In terms of labour costs, the Dutch mussel PS ranks first followed by the French bouchot mussel PS (intermediate level), and then the Spanish, Italian and Greek production systems. In Greece the level of remuneration is very low, like the labour productivity, even if considering that mussel farming relies on unskilled personnel and family workers. In Spain, an increase in the level of remuneration was particularly observed in 2013 and 2014, along with the trend in specialization and reduction of seasonal jobs. Finally, if we compare the labour productivity indicator with average labour costs, it appears that the latter are really constrained by the low level of labour productivity in Greece, Italy and even in Spain (Figure 8). The concerned production systems are all characterised by a low price of mussel sales. In the French and Dutch mussel sectors, labour costs represent respectively 39% and 27% of the GVA.

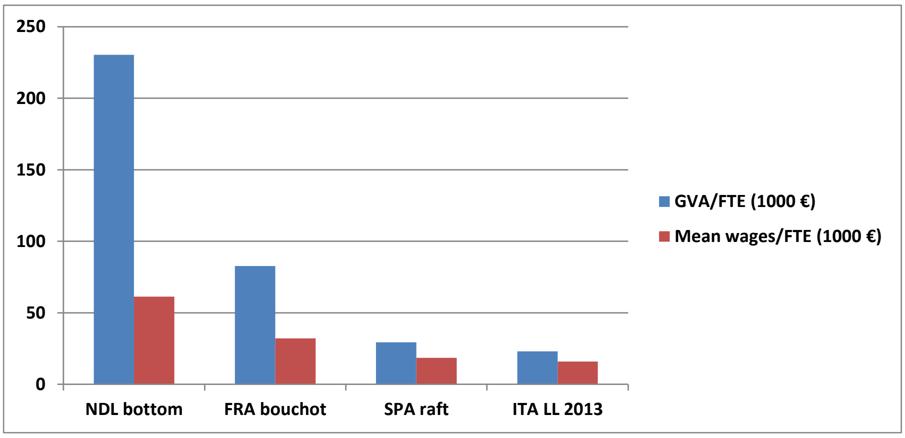


Figure 8. Comparison of labour productivity and total labour costs for the 4 DCF mussel segments (average 2013/2014 data except 2013 for Italy)

3.4.3.4 Environmental sustainability

The selected indicator for assessing the environmental sustainability of aquaculture case-studies is the level of involvement of producers in code of best practices, ecolabels, organic label or any environmental certifications. We have considered here this indicator in a broad acceptance and taken into account other initiatives like quality schemes which also contribute to further improvement of environmental sustainability, in addition to existing regulatory framework (Table 5).

Table 5. Environmental indicators of the mussel farming production systems

Indicator	Variable	NDL "bottom"	FRA "bouchot"	SPA "raft"	ITA Longline	GRE Longline
Level of producer involvement in sustainable practices	% of production in volume complying with code of best practices or ecolabels or any environmental certifications (including organic labels)	100% (MSC)	20% PDO + little organic label production	63 % PDO	20% (incl. 8% of organic label production)	-

NB. For PDO, the % is related to the volume of production in France and to the number of raft in Spain

As regard the Dutch production system, all the mussel production is certified under MSC. In this respect, it is noteworthy that the mussel Dutch mussel PS has been considered as a fishery in the framework of MSC certification. “The desire to certify the Dutch mussel fishery came from the Dutch mussel trade as important clients, particularly supermarkets, are asking for MSC certified fish and shellfish" (*https://fisheries.msc.org/en/fisheries/netherlands-blue-shell-mussel/@@view*). According to the MSC website, the Dutch fleet certified is made up of 65 vessels which harvest using two or four mussel dredges. To improve the sustainability of the Dutch mussel production, "mussel seed no longer only originates from the wild seed fishery, but is increasingly captured with spat collectors, such as underwater ropes, which intercept the seed as it floats towards the sea bed and are easy for fishers to access without impacting on the habitat". Other sustainability measures include area closures.

In France, the "environmental" indicator of bouchot mussels in a strict meaning relies on few initiatives in terms of organic labelling and ecolabels (like Friends of the sea). On the other hand, the improvement of the quality of blue mussel production and related involvement in more sustainable practices has been mainly based on quality schemes for many years. The PDO "*Baie du Mont Saint Michel*" for bouchot mussels is particularly concerned because its specification, which is related to the quality based on origin, also include measures for "protecting natural resources" (i.e. limitation in farming density). This PDO covers about 10 000 tons of bouchot mussels per year which represents nearly 20% of the French production of bouchot mussels (or 16% of the whole production of blue mussels).

On the same principle, the PDO of the Galician mussel has been including for the assessment of the environmental indicator, provided that it improves the level of involvement of producers in sustainable practices. For Italy, the production complying with best practices in general was estimated at 20%. This figure should include the 8% of mussel production under organic label, as estimated by the EUMOFA study for the year 2015. Besides, no involvement of Greek producers in sustainable practices was reported.

3.4.4 General outcomes

The mussel farming sector is currently the first aquaculture activity in terms of employment and production in volume in the EU28 (the fifth sector in value in 2014), although it has experienced a downward trend in production since the 2000's. In a context of limited production for supplying the market of fresh and live mussels, the increasing importations have exclusively relied on processed products and hence mainly competed with the processing industry in Spain. In return, the Spanish producers have progressively increased their mussel trade in live/fresh form to supply the EU market. Notwithstanding the downward trend in production, the EU mussel market remains nearly self-sufficient (80%) and even supplied by domestic productions only for the fresh mussel market.

The mussel case study includes a variety of production systems (PS), which are representative of the diversity of natural environments, of techniques and models of development of this activity in Europe. Beyond the farming mode, these production systems are characterised by different levels of investment, structure of employment, cost structure, level of integration of the value-chain etc. At both ends, the Dutch mussel PS based on hybrid fisheries/farming system is by far the most concentrated and capital-intensive whereas the Spanish "raft" system is the most labour intensive and the biggest contributor to employment. Different mussel production systems are also associated with diverse energy efficiency and energy dependency. In terms of efficiency, the Spanish "Raft" PS ranks first as it allows the lowest cost of energy per kg, while for the indicator of dependency, it is the French "bouchot" PS which shows the best performances. Conversely, the Dutch mussel production system appears to be less efficient and more dependent on energy.

The assessment of economic performances and social sustainability through the selected indicators provides initial outcomes. In terms of profitability indicators (labour productivity, return on investment) and level of remuneration of labour, the Dutch production system clearly ranks first. Other production systems have lower but also contrasted economic results. For instance, the Spanish shows a similar return on investment compared to the French "bouchot" culture, but a lower labour productivity and hence remuneration of labour. More generally, the low labour productivities encountered in some countries (Spain, Italy, Greece) are caused by insufficient level of price in mussel productions. This could be related to the lack of professionalization of the activity and lack of integration of dispatch/purification centres like in Spain, to the need for further producer organisation as in Italy or to the lack of outlets on the domestic market (Greece).

Anyway, the assessment of the economic performances of mussel PS would deserve a longer period of analysis to take into account the yearly fluctuations of production. In addition, a clear insight of the content of the value of assets (including or not intangibles, for instance) is also required for more accurate assessment and comparison of the ROI (return on investment) and indebtedness ratio.

So far we have seen that a number of key challenges remain for improving the sustainability and profitability of the mussel farming sectors. One major issue is to mitigate a decrease in profitability due to environmental risks or/and to unsustainable cultural practices, in particular through the setting up of co-management systems. Another issue is to stay competitive while consolidating the market power of producers along the value chain, thanks to more efficient and sustainable production systems, sales organisation, new outlets and quality schemes. The analysis of labelling initiatives in D3.4 have proved their ability to create a dynamic within the sector and the value-chain that improves economic and environmental sustainability and meets current consumer expectations.

References:

European Commission, 2016. Summary of the 27 Multiannual National Aquaculture Plans. Document prepared by FAME SU under contract to DG MARE, May 2016.

Monfort M.C., 2014. The European market for mussels. Globefish Research Programme, volume 115. Rome, FAO 2014. 65 p.

Papaharisis L. and Avdelas L. (2015). Economic evaluation of applied practices. In Sustainable Mussel culture. Innovative practices for sustainable and environmental friendly mussel culture. Technical Report. Scientific Coordinator Dr. Galinou-Mitsoudi S., OP Fisheries 2007-2013, 377 pages (in Greek).

STECF (2016). Economic report of EU aquaculture sector (STECF-16-19), Scientific, Technical and Economic Committee for Fisheries (STECF), Publications Office of the European Union, Luxembourg: 485p.

3.5 Salmonids Case study

This CS focuses on the main salmonid species produced by European aquaculture: Atlantic salmon *(Salmo salar*) and rainbow trout (*Oncorhynchus mykiss)*. It covers both marine fish farming (sea cage system for both salmon and trout) and freshwater fish farming (inland production systems of trout).

3.5.1 Context of EU production, exploitation and trade

Global salmonid production amounted to about 4.4 million tonnes in 2015, of which 76% were farmed fish and 24% were wild-caught fish. Atlantic salmon is by far the main farmed species (71% of salmonids in 2015), followed by rainbow trout (23%). Regarding fisheries production, the main species landed are Pacific salmons, especially pink salmon (43% of global fisheries production in 2015), chum salmon (34%) and sockeye salmon (18%).

3.5.1.1 Worldwide production of Atlantic salmon and rainbow trout

Atlantic salmon production comes almost entirely from aquaculture. Farmed Atlantic salmon production soared in the 1980s with the successful growth of the Norwegian aquaculture industry, followed by the development of the Scottish and Chilean salmon sectors. Although rapid production growth has led to several market collapses, and the industry has experienced considerable fish disease, salmon lice, salmon escapes and pollution problems, the industry continues to grow (EUMOFA N°2/2018). Norway is now the first largest producer of farmed Atlantic salmon worldwide; its production amounted to 1.3 million tonnes in 2015 (54% of the global production). Chile is the second largest producer (609 thousand tonnes, 25% of global production in 2015). While Norwegian production grew exponentially till 2015, Chilean production experienced a substantial drop of 68% in volume between 2008 and 2010 due to infectious salmon anaemia (ISA) and now is struggling with salmon Rickettsial syndrome (SRS), in addition to various natural phenomena (EUMOFA No4/2017). The UK (Scotland) is far behind the third largest producer of Atlantic salmon in the world.

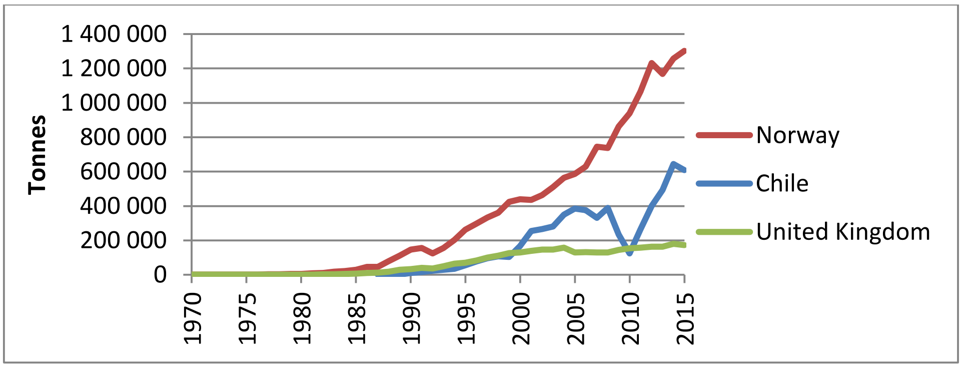


Figure 1. Production of farmed Atlantic salmon by main producer in the world, 1970-2015 (FAO FishStatJ)

The aquaculture production of farmed rainbow trout, which was established prior to that of salmon, rose steadily since the 1950s and topped to 883 thousand tonnes in 2012. The global trout production grew at a more moderate pace than farmed Atlantic salmon production, albeit with a yearly growth rate of 7.1% over the period 1960-2015. More recently, the global production of trout declined by 14% between 2012 and 2015, mainly due to a dramatic fall in Chilean production of 63% over this period. Finally, in 2015, the global supply of farmed trout reached 762 thousand tons, three times less than farmed salmon (2 381 thousand tons). The main trout producers worldwide are currently Iran, Turkey, Chile and Norway. EU production weighted 33% of the global supply in 2015.

3.5.1.2 EU Production of Atlantic salmon and Rainbow trout

In the EU, Atlantic salmon showed an overall upward trend in production between 2000 and 2015, despite a period of decrease between 2004 and 2008 (-19%) due to a lower production of juveniles three years before. Then the EU production rose again and amounted to around 188 thousand tonnes in 2015 (99% from aquaculture). The UK is by far the main producer country (92% of total production in 2015), followed by Ireland. The vast majority of UK salmon farming is located in Scotland. Since 2008, its production has steadily increased (+34%) and reached 172 thousand tonnes in 2015 while the Irish production has been more fluctuating and amounted to 13 thousand tons in 2015.

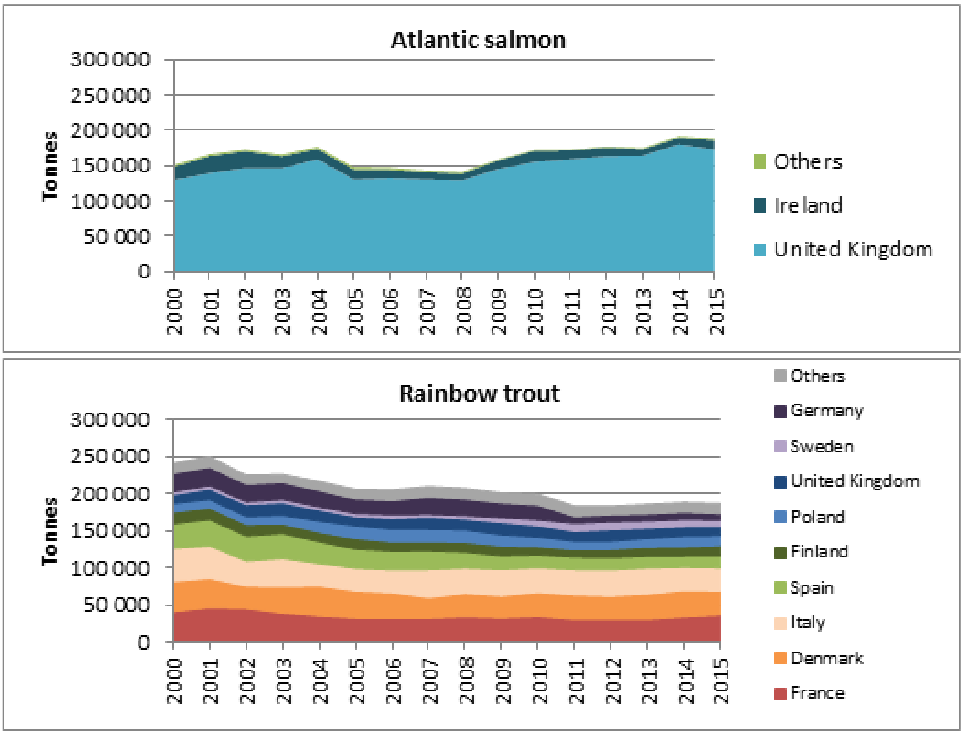


Figure 2. EU production of Atlantic salmon and rainbow trout by major producers, 2000-2015 (FAO FishStat)

Unlike salmon, the EU production of trout concerns many MS and in addition followed a downward trend over the period 2000-2015. More exactly, the production of rainbow trout decreased between 2000 and 2011 (-24%) and just started a slight recovery from 2014. In 2015, the top 3 producers of trout in the EU were France (20% in volume), Denmark (17%) and Italy (17%), far behind Spain, the production of which was divided by 2 between 2000 and 2011. The French production which had topped to 51 thousand tonnes in 1996, then declined until 2012 (-40%) before showing signs of some recovery (+19%). In 2015, the level of French production was worth 36.5 thousand tonnes. Finland ranked fifth (8% of EU production), Poland sixth (7%) and Germany ninth (5%). Trout productions in Finland and Poland have been improving since 2012 after a period of decline (respectively +23% and +21% between 2012 and 2015) while the trout production in Germany dropped by 63% between 2007 and 2015.

Regarding salmon price evolution, the UK average ex-farm price topped to GBP 4.16 per kg in 2013 but fell to GBP 3.72 per kg in 2015 (-11%). However, due to the appreciation of the sterling, the salmon producers could not benefit from increased price-competitiveness on the EU market as the ex-farm price rose from € 4.89/kg in 2013 to € 5.12/kg in 2015 (+5%). By comparison, the ex-farm price of Norwegian salmon soared in 2013 (NOK 32.5 per kg) due to a drop in production resulting from sea lice and harsh winter. It increased again by 5% between 2013 and 2015 and averaged NOK 32.2 per kg in 2015. Exchange rates were more favourable for Norwegian salmon producers as far as the ex-farm price fell from € 4.16 per kg in 2013 to € 3.82 per kg in 2015 (-8%).

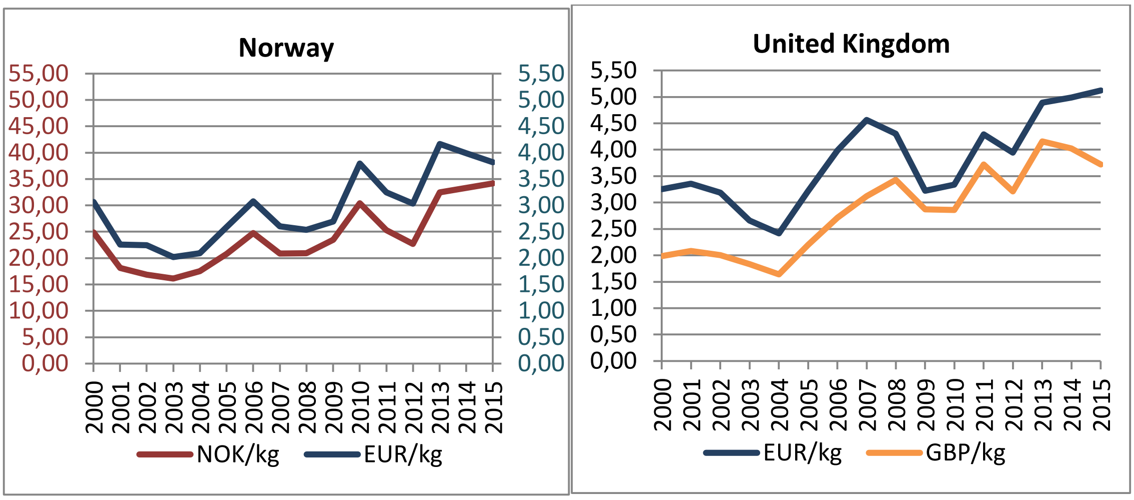


Figure 4: Ex-farm prices of salmon in Norway and in United Kingdom over the period 2000-2015 (Source: FAO FishStat and OECD for Exchange rates). Non-deflated price series.

As concerns the EU ex-farm price of rainbow trout, they held steady since 2008 and averaged € 3.14 per kg in 2015. Ex-farm prices were relatively close for the main producer countries in the EU: in 2015, rainbow trout averaged € 3.20 per kg in France, € 3.09 per kg in Denmark and € 2.78 per kg in Italy.

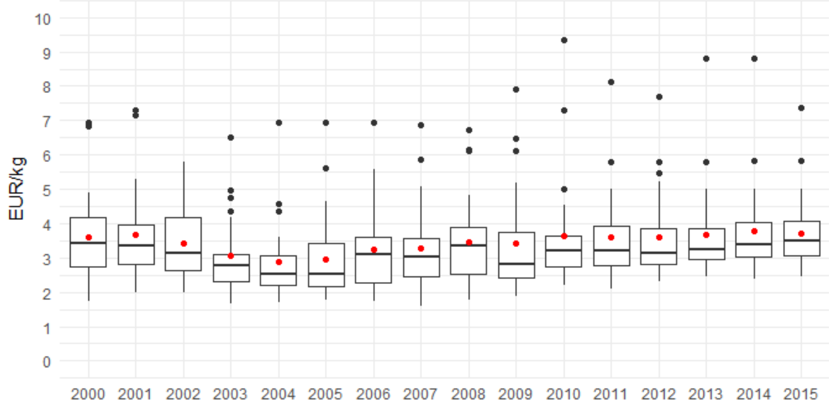


Figure 5: Ex-farm prices of rainbow trout in the EU (€/kg), 2000-2015 (Source: FAO FishStat and OECD for Exchange rates). Non-deflated price series.

3.5.1.3 EU Trade of Atlantic salmon and Rainbow trout

The share of salmon and trout in world trade has increased strongly in recent decades, becoming the largest single commodity in value in 2O13, ahead of shrimps and prawns (SOFIA, 2016). In volume, the top3 commodities are, by decreasing order, “cod, hakes, haddocks”, other pelagic fish and tunas.

3.5.1.3.1 Salmon

Salmon is also the first species traded on the EU seafood market in value. The EU supply mostly relies on extra-EU imports which rose steadily from 361 thousand tonnes to 915 thousand tonnes between 2000 and 2015 (+253%) and in value increased three fold from € 1.5 billion to € 4.8 billion. Norway is by far the main supplier of the EU. It exports to the EU market almost entirely fresh whole salmons, either directly or via Sweden and Denmark, as first entry points in the EU market.

Extra-EU import values soared between 2004 and 2006 (+60%) and again in 2009-2010 (+30%) and 2012-2013 (+29%). These breaks in trends were primarily due to dramatic rises in Norwegian salmon prices. From 2004 to 2006, EU import prices of Norwegian fresh salmon increased by 47%, from € 2.78 kg to € 4.08 kg. In 2010, they increased by 32% compared to 2009 (€ 4.71 kg) in a context of low global supplies due to harsh winter in Norway and diseases in Chile (GLOBEFISH vol. 2/2011). In 2013, the drop in Norwegian production and strong demand saw prices reach new record levels (GLOBEFISH, vol. 2/2014) and EU import price of fresh salmon rose by 37% (€ 5.06 kg).

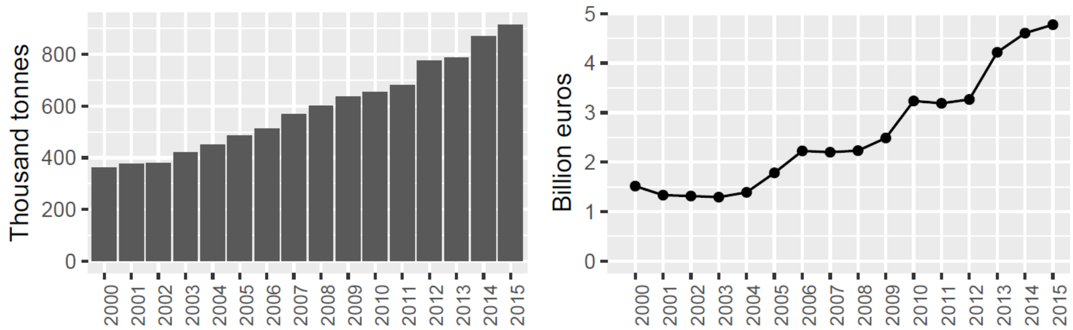


Figure 7: Extra-EU28 imports of salmon in quantity and in value, 2000-2015 (Source: Eurostat – COMEXT)

As regards the total extra-EU imports, Norway is by far the main salmon supplier to the EU market and this leadership was even strengthened between 2005 and 2015 since the market share of Norwegian imports increased from 72% to nearly 83% in value. Conversely, the market share of North-American imports declined for the last ten years, from 9.2% to 4.3% in value. As for Chilean imports, their market share which was worth 11% in 2005, fell to around 2% at the height of the crisis in 2009-2010, and only slightly recovered afterwards (3.2% in 2015).

Within the EU28, United Kingdom is the major net exporter with a trade balance accounting for € 167 million in 2015. Its salmon exports amounted to about 116 thousand tonnes in 2015, of which 75% were fresh whole salmons and 12% frozen whole salmons. It is followed by Poland (€53 million) and Lithuania (€41 million), which are processing countries exporting mainly smoked salmon. The international trade for the Scottish salmon sector has increased over the last decade, since the exports doubled between 2004 and 2014 (from 54 to 109 thousand tonnes) while imports were multiplied by 5 over the same period (from 11 to 53 thousand tonnes). The imports of fresh salmon mainly come from Norway whereas the USA is becoming the first export market for Scottish salmon.

A general upward trend in salmon import prices is observed for all the types of products, despite a short decline in 2014 and 2015. EU imports of fresh whole salmon averaged € 4.94/kg in 2015, corresponding to a 3% and 5% decrease compared to 2014 and 2013. EU import price of smoked salmon, as the most valued product, averaged € 11.27/kg in 2015 (-2% from 2014). However in 2016, the import prices of salmon to the EU began rising again (+25%), resulting from the shortage in global supply caused by algae-bloom in Chile and sea-lice in Norway and Scotland (EUMOFA N°2/2018). In France, importers have responded to rising prices by increasing purchase of relatively cheaper frozen fillets from Chile in place of fresh fillets from Norway (GLOBEFISH Market report 2017).

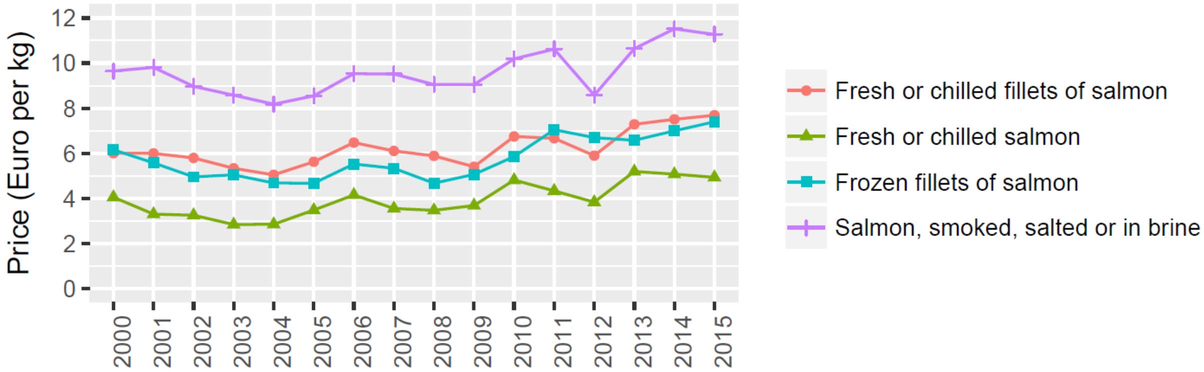


Figure 8: EU28 import prices of salmon by preservation state (€/kg), 2000-2015 (Source: Eurostat COMEXT)

Figure 9 summarises the EU (extra and intra) trade of salmon in 2015. To recap, salmon is mainly traded in fresh and whole form and the main supplier of the EU for fresh whole salmon is Norway (directly or through Sweden and Denmark). The average price of intra-EU imports is very close to that of Norwegian imports (€ 5.07/kg versus 4.85/kg). In France, as the main salmon market in the EU, imports are dedicated to the fresh retail market, the catering sector and the processing sector. Poland and Germany are processing countries; they import fresh whole salmon from Norway and export smoked salmon to Member States.

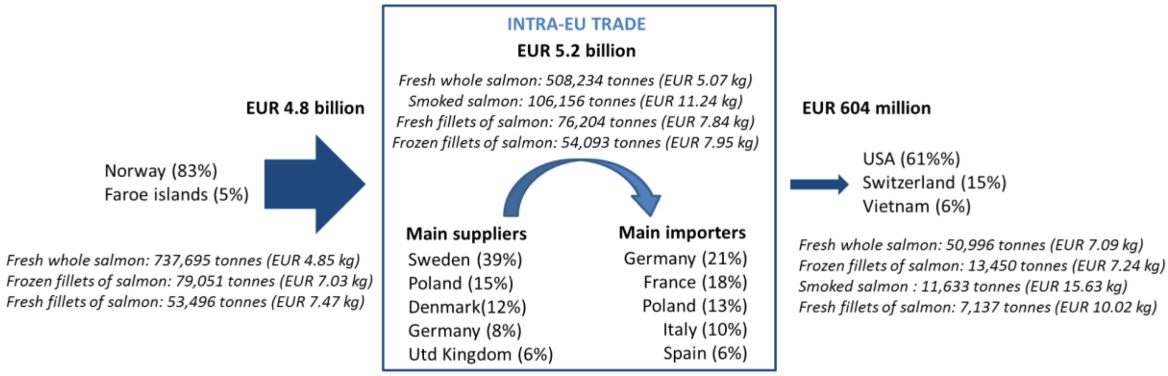


Figure 9: EU trade flows for salmon, 2015 (intra-EU trade is measured by imports) (Source: Eurostat COMEXT)

3.5.1.3.2 Trout

The trout market in the EU mostly relies on domestic production and on intra-EU trade. EU28 net imports of trout increased by 155% over 2000-2015 and amounted to circa 107 thousand tonnes LWE in 2015. EU28 net exports of trout have fluctuated around 60,000 tonnes and amounted to circa 72 thousand tonnes LWE in 2015. The trends in EU external trade of trout over the period 2000-2015 shows that the growth of imports was mainly driven by fresh or chilled trout and by smoked trout.

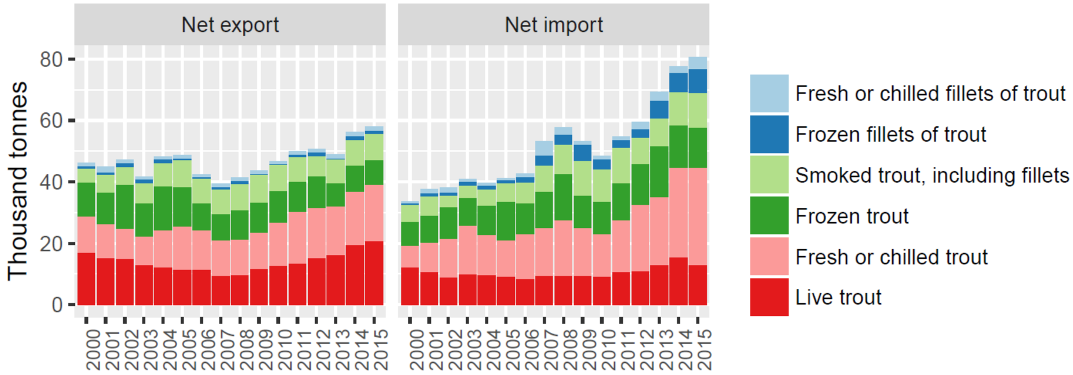


Figure 10: EU28 net imports and net exports of trout by preservation state (in volume, net weight), 2000-2015 (Source: Eurostat COMEXT)

EU average Import prices have been slightly and progressively increasing over the last 15 years for live trout, fresh or chilled and frozen. The evolution of the EU import price of smoked trout (mainly fillets) was less linear. After having witnessed fluctuations during the 2000s, the import prices rose steadily from 2011 to 2014 and then levelled off in 2015. Smoked trout is indeed the most valued product and the EU import price averaged € 9.50/kg in 2015 while live trout and fresh whole trout reached respectively € 3.43/kg and € 3.92/kg. Compared to smoked salmon, the import price of smoked trout is lower by 16% (€ 9.50/kg versus € 11.27/kg).

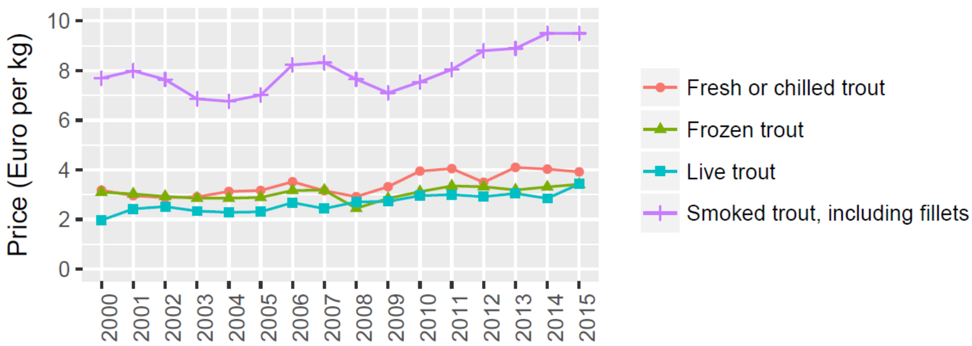


Figure 11: EU28 imports prices of trout by preservation state (€/kg), 2000-2015 (Source: Eurostat – COMEXT)

Figure 12 summarises the EU trade of trout in 2015. Extra-EU imports were valued at € 126 million (92% from Turkey and Norway) corresponding to the double of Extra-EU exports but to barely a third of the intra-EU trade (€ 398 million). Denmark is the main supplier of trout within the EU market, with exports based on both domestic production and trade of Norwegian and Turkish trout. On the other side, Germany is by far the main net importer of trout in the EU. German imports accounted for € 177 million in 2015, of which 52% were smoked trout, 14% frozen whole trout, 12% fresh whole trout and 10% live trout. The main suppliers of Germany in 2015 were Denmark (28% in value), Poland 25%) and more recently Turkey 13%).

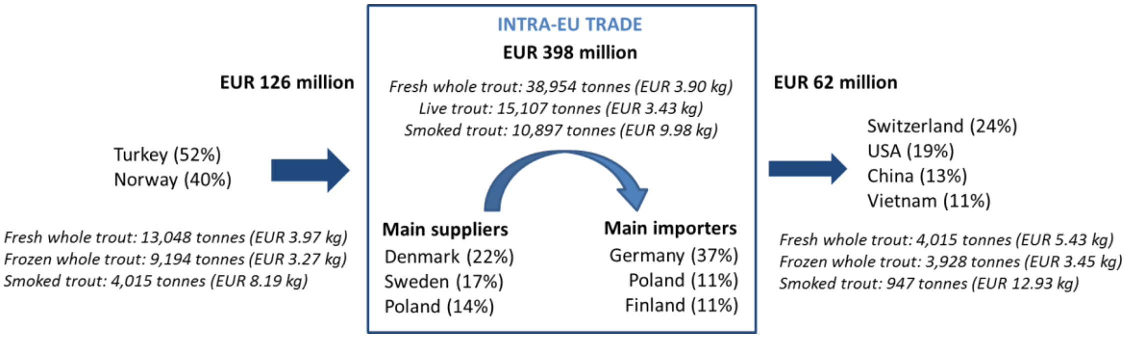


Figure 12: EU trade flows for trout in value, 2015 (intra-EU trade is measured by imports; Eurostat COMEXT)

3.5.1.4 EU Apparent market and consumption

Salmon is the third species consumed in the EU28 after tuna and cod. EU apparent market for salmon has been increasing and amounted to about 1.2 million tonnes LWE in 2015, up 4% from 2014 and 37% from 2008 (Table 1). It is strongly dependant on third countries imports, and in 2015 only 16% of the salmon consumed was produced by Member States. The major markets for salmon are France (+3% between 2014 and 2015), Germany (-6%), the UK (-3%) and Italy (+12%). They entirely depend on imports, except for the British market which is self-sufficient. Processing industry is an important outlet for salmon, which is one of the most important species used as raw material by the seafood processing sector. The EU is notably the most important market for consumption of smoked salmon, with Germany and France as the most significant markets (EUMOFA, 2018)

Table 1. Main European markets for salmon (in live weight equivalent, thousand tonnes) and rate of EU self-sufficiency (calculated with FAO Fishstat production data and Eurostat Comext data)*

	2008	2009	2010	2011	2012	2013	2014	2015
EU apparent market	**851**	**890**	**899**	**912**	**1 018**	**1 016**	**1 123**	**1 169**
rate of self-sufficiency	***17%***	***18%***	***19%***	***19%***	***17%***	***17%***	***17%***	***16%***
France	157	178	188	185	197	194	183	189
Germany	120	140	140	144	147	175	195	184
United-Kingdom	148	145	142	134	138	132	140	136
Italy	47	51	57	64	75	77	96	108
Spain	48	57	62	62	57	56	65	77

* *The conversion factors used to calculate imports and exports in live weight equivalent (LWE) are referenced in the Annex VII "Conversion factors by CN8 from 2001 to 2016" of EUMOFA*

EU apparent consumption of salmon averaged 2.30 kg per capita in 2015, showing a 35% increase compared to 2008. The biggest consumers are the Finnish and the Swedish (above 6kg/capita/year). Seven other countries show a level of consumption above the EU average: The Luxembourg (5.5 kg), Belgium and Ireland (about 3.5 kg), France (nearly 3 kg) and Malta, Denmark and Cyprus (2.5-2.6 kg).

Compared to the salmon market, the size of the EU trout market varied little between 2008 and 2015 (from 205 thousand tonnes at the lowest to 227 thousand tons at the highest). It amounted to 218 thousand tonnes (live weight equivalent) in 2015, corresponding to around one fifth of the EU salmon market. This market is nearly self-sufficient, with a rate of 89% in 2015, slightly decreasing over the five past years, due to the rise by 22% in extra-EU imports (mainly from Norway). Germany, which is the major market for trout, has been increasingly depending on imports due to the drop in domestic production. As a result, its self-sufficiency rate for trout strongly declined between 2008 and 2015, from 44% to 16%.

Table 2. Main European markets for trout (in live weight equivalent, thousand tonnes) and rate of EU self-sufficiency (calculated with FAO Fishtat production data and Eurostat Comext data)*

	2008	2009	2010	2011	2012	2013	2014	2015
EU apparent market	**227**	**219**	**218**	**207**	**205**	**213**	**216**	**218**
rate of self-sufficiency	***94%***	***95%***	***95%***	***92%***	***92%***	***90%***	***90%***	***89%***
Germany	50	50	49	41	41	51	55	57
France	34	34	34	30	30	29	31	35
Italy	31	32	29	29	29	28	27	28
Finland	23	22	19	20	20	22	23	24
Poland	12	13	12	10	12	16	18	17

Trout apparent consumption in the EU remained relatively stable over the period considered and averaged 0.43 kg per capita in 2015. By level of consumption, Finland ranks first (around 4 kg/capita/year), followed by Estonia (2.6 kg), Denmark (1 kg), Austria (0.9 kg) and Germany (0.7 kg).

3.5.2 Description of productions systems

The production systems described here refer to salmon farming in Scotland, trout farming in Finland, France and Poland and arctic char production in Iceland. They have been characterised thanks to national quantitative and qualitative data and with available DCF data.

The UK is part of the top 3 countries producing salmon worldwide with Norway and Chile. Scottish aquaculture sector is highly integrated with almost every aquaculture company part of a larger group integrating hatcheries, growing sites, processing and marketing activities in one group. It is also highly concentrated, with the top five companies representing close to 93% of the total production. The largest salmon producers are almost all owned by foreign interests (mainly Norwegian). Due to this foreign ownership, Scotland should not be seen as a competitor of Norway but as affiliates within the European supply chain. The salmon production is based in areas where interactions with wild populations are at a minimum level: the islands surrounding Scotland (Shetland, Orkney and the Hebrides) and the west coast of Scotland. The salmon aquaculture industry is polarized on one main technique: seawater cages are by far the main farming mode, mainly due to the Scottish geography which allows a high number of sites to be installed along the Scottish coast. Although the number of active seawater cage sites is only slightly increasing between 2010 and 2014 (+4%), the cage capacity shows a much stronger increase (+15%), as well as the salmon production (+16%). These trends highlight the fact that the sector is moving toward larger sites while maintaining the cage density, which may be more effective to operate from an economic perspective. Furthermore, the Scottish sector is relying more and more on imported ova to maintain and develop its production. Over the last 10 years, the share of imported ova has increased from 26% in 2003 to 77% in 2014. The most part of imported ova is sourced in Norway, with EU member states and Iceland as secondary suppliers. Companies are less reliant of juvenile trade, which represent only 1% to 2% between 2003 and 2013.

The majority of Finnish fish farming and thereby trout production is located in coastal areas in Southwest Finland, in Turku archipelago and Åland Island (brackishwaters). Stringent national environment policy has been limiting the production of fish farming in Finland, especially in Baltic Sea (eutrophication). Thus, the domestic production has stagnated during the past 15 years (about

13,500 tonnes and € 60 million in 2014) and the growing demand for salmonids has been supplied by rising imports of salmon and trout. Finnish farmers have also established fish farms in Sweden, with similar production volume than in Finland, which is imported to the Finnish fish market. Norwegian salmon compete in the same salmonids market than the Finnish rainbow trout and Norwegian prices are the leading prices. Indeed, Norwegian salmon has become a dominant species in the Finnish market whereas the market share of Finnish rainbow trout has declined. Finnish producers are not as competitive as Norwegian producers, largely because Finnish fish farms are not able to create economies of scale due to the restrictive licensing policy. The average size of Finnish farms is low compared with Norwegian farms. Notwithstanding, the Finnish aquaculture sector has been increasingly concentrated during the recent years, leading to a decrease in employment and nowadays, the ten biggest companies account for 80% of the total sector production. The largest companies are integrated vertically to processing and wholesale.

In France, rainbow trout is one of the first species farmed. Trout production has been developing over more than sixty years: it increased until the mid-1990s along with the progresses in farming technologies, reaching more than 50,000 tonnes. Since then, production has been nearly halved (around 30,000 tonnes in 2014), due to low prices and alleged competition with imported marine salmon. Rainbow trout has remained the main farmed salmonid species produced (93% of total production in volume in 2014). In link with the market evolution, the French salmonid industry has developed big trout production and introduced new products (such as trout eggs or organic fish). Unlike Finland, trout production in France is located in land-based farms, using flow-through systems. The top region in inland salmonid farming is Aquitaine (30% of the national production in volume). Enterprises producing trout are mostly small (less than five employees) and show different levels of vertical integration upstream (owning hatcheries or not) and downstream depending on the integration of slaughtering, filleting and even processing operations.

Trout sector in Poland has 140 years of history. Rainbow trout is the second species farmed in the country. There are estimated about 150 trout farms in Poland. The large majority of them are located in the North of the country, due to the access to warm river waters. Trout farming is a modern, technology advanced intensive aquaculture. The intensive production is mainly done in concrete raceways and juvenile fish are farmed in plastic ponds. The trout production is performed in big farms using scale advantages. Indeed, according to the data collected and estimated by Inland Fisheries Institute (InFish) on the probe of 117 farms, the production volume of salmonid fish in Poland is determined by large farms with a capacity of more than 100 tonnes per year. Polish trout production rose by 38% between 2000 and 2015, mainly due to the introduction of a new packaging method (MAP), which has strongly developed the demand on domestic market. Current main challenges for Polish trout farmers are salmonids diseases, environmental issues connected with the quality of waste water and also the competition of imported rainbow trout from other countries e.g. Turkey (about 23% of all quantity imported). The price differential between the overall import price and the import price from Turkey rose from 0.4% in 2012 to 19.7% in 2014, which leads to a creation of a relatively strong substitution effect (Hryszko, 2015). In the recent years, the volume of Polish imports of trout equalled that of domestic production.

The Production of Arctic char for human consumption in Iceland stabilised (after losses in 2006-2008 due to bacterial kidney disease) and kept on increasing and was about 3,400 tonnes in 2014. One company produces approximately 60-70% of the total production of Arctic Char and its production takes place at three land-based farms. Other four companies have in recent years contributed on average 20-30% of domestic production. The production of Arctic char is export-oriented and the largest markets are in the United States, followed by Europe (United Kingdom and Germany). However, the domestic market has been increasing lately, mainly because of the high number of tourists.

Then, the comparison of production systems involved in salmonid farming is quantified by some indicators provided by DCF data (except for arctic char in Iceland) for the relevant aquaculture segments.

- As already mentioned, the Scottish salmon farming corresponds to the highest concentrated and integrated aquaculture PS, including mostly “combined” enterprises (i.e. with their own hatcheries). According to DCF data, the UK salmon farming is clearly the most capital intensive and shows the highest productivity indicators in volume. It is also featured by its dependency to foreign capital, as the largest salmon producers are almost all owned by foreign interests (mainly Norwegian) and by its increasing dependency to ova supplying (77% imported in 2014).
- The Finnish DCF segment (trout farming in sea cage) also appears to be capital intensive, although it is composed of small-scale enterprises with respect to the indicators number of FTE or production in volume. However, this segment shows lower size and productivity indicators compared to the total EU segment “trout sea cage”.
- The inland trout farming in France (combined or on-growing segment) is based on a similar employment structure (small-scale activity, mostly full time jobs) than the Finnish trout cage segment but shows lower indicators of productivity. The characteristics of French trout farming seems to be representative of the EU sector made up of small-scale enterprises with similar size (FTE/enterprise) and productivity indicators in volume (Table 3).

Table 3. Key features of segment analysed, 2014 data (Sources: STECF 16-19)

	UK Salmon combined	FIN trout sea cage	FRA trout combined	FRA trout on-growing	POL trout on-growing	**EU trout farming***	**EU trout sea cage****
Number of enterprises	47	19	97	201	131	**787**	**26**
Number of employees	1 693	89	464	704	1 296	**3 306**	**244**
Number of FTE	1 540	69	375	572	na	**2 620**	**172**
Total fish sales (tonnes)	179 397	5 175	9 937	24 514	13 991	**95 585**	**19 255**
price indicator (€/kg)	4,98	3,85	3,80	3,07	2,83	**3,35**	**4,02**
% of enterprises <=5 employees	55%	84%	73%	83%	59%	**81%**	**73%**
%of enterprises >10 employees	26%	0%	10%	4%	15%	**7%**	**15%**
Number of FTE/enterprises	32,8	3,6	3,9	2,8	na	**3,3**	**6,6**
ratio Employees/FTE	1,1	1,3	1,2	1,2	na	**1,3**	**1,4**
Total sales/enterprise	3 817	272	102	122	107	**121**	**741**
Total sales/FTE (tonnes)	116	75	27	43	na	**36**	**112**
Total value of assets/FTE (1000 €)	346	299	100	115	na	**111**	**387**

* *All segments “trout on growing” and “trout combined” except the Italian and Polish segments for which FTE data are not available or uncomplete*

*** At the EU level, the “trout sea cage” segment mainly concerns Finland and Denmark*

In addition, it should be noted that several factors impact the ex-farm prices:
- a composition effect in relation with the size of fish - portion size vs big sizes for trout,
- another composition effect linked to the degree of integration by the producers of the downstream stages of the value chain (raw fish vs processed products),

- quality strategies such as labelling schemes (Label Rouge in Scotland for instance).

The expansion of salmon fish farming versus the stagnation of inland trout farming should be related to more stringent regulatory framework in the latter case. In France, for instance, the decline in trout farming over the last 20 years has been attributed for a substantial part to regulatory constraints (licensing procedure and conditions of EIA implementation), leading to the difficult (or even impossible) access to new farming sites (see D3.1). In Finland, fish farms were not able to create economies of scale and improve their competitiveness due also to the restrictive licensing policy.

3.5.3 Comparison of Selected indicators – Analysis

3.5.3.1 Source of data and coverage in terms of production systems

Indicator reports were provided for Finland trout, French trout, Icelandic arctic char, Polish trout and Scottish salmon farming. The diversity of farmed species and environment (marine, inland) is added to the diversity of data sources, ranging from DCF to the *agri benchmark* method used in Poland, through other data source used in Iceland. In the case of Poland, only one-off data were provided (2015) corresponding to the first time implementation of the *agri benchmark* method.

<u>Expertise of data for comparative analysis (availability, quality)</u>

- In terms of geographical coverage, the DCF data for salmon farming corresponds to Scottish data, as the UK production is mostly located in Scotland. DCF data now aggregates the two subsectors of hatcheries and on-growing, but this is representative of the high level of integration of the Scottish sector. As regards the reliability of data, some inconsistencies between the year 2012 and the following years (2013-2014) were observed, with some costs that seem to be underestimated (energy, livestock costs, financial costs).
- The coverage of Finnish trout farming by DCF data is limited to the sea cage farming segment, which represented barely 40% of the whole trout production in 2014.
- The coverage of French trout farming by the DCF data relies on two segments, the “on-growing” and the “combined” representing respectively 70% and 30% of the sales in volume (60%-40% of FTE).The stability of data over time is questioned as some accounting figures appear quite variable from one year to another. Some data inconsistencies are particularly pointed out for the on-growing segment, with an unexplained increase in labour costs in 2013 (doubling of mean wages) and, conversely, a significant decrease in feed costs.
- Trout farming in Poland is presented as a technology advanced intensive aquaculture, but the lack of DCF makes it difficult to assess the economic performances of the sector in a representative way. The study conducted on big farms (400 tonnes of yearly production) with the *agri benchmark* method could be a first step to create a data collection system.
- No DCF data are available for Arctic Char farming in Iceland. The use of other public database led to the production of most of the selected indicators but neither the profitability indicator (ROI) nor the level of indebtedness could be calculated.

3.5.3.2 Economic sustainability - Economic performance and economic dependency

The economic sustainability can be analysed through various indicators summarised in Table 4 and Table 5 which allow for a comparison between all case-studies (but note that, due to the different methodology used for calculating the indicators of Polish trout farming, the comparison with other countries should be very cautious).

For all indicators, salmon farming clearly distinguishes from trout farming. Scottish salmon farming exhibits by far the best results in terms of labour productivity and profitability, in link to the size of companies which leads to economies of scale. Profitability is eight times higher than for the French trout farming industry. Aggregated DCF data for all EU segments provide a ROI of 30% for salmon farming versus 7% for trout farming in 2014.

The Icelandic Arctic char sector ranks second in terms of labour productivity in relation with high prices (Table 3) but profitability figures are not available.

Indebtedness is higher in on-growing sectors (Finland and France) than in combined ones (The UK and France). This raises questions about the values of investment and depreciation of capital[23] For Poland, long term and short term debts are considered as negligible, which is surprising if we compare with the other cases-studies but may be explained by the differences in the methods.

Table 4. Economic performances of salmonids farming production systems

Indicator	Variable	UK Salmon combined	FIN trout sea cage	FRA trout combined	FRA trout on-growing	POL TRR-400	ISL Arctic char
Labour productivity	GVA/FTE (€)	193 977	68 858	38 938	36 151	47 200	114 670
Profitability	ROI = (EBIT/total value of assets)	33%	8%	4%	7%	11%	na
Indebtedness	Debt/total value of assets	45%	63%	42%	61%	0%	na
Energy efficiency	Energy costs per kg of fish (€)	0.08	0.20	0.13	0.20	0.12	0.21

Economies of scale provide the Scottish salmon PS with the lowest energy cost per kg of fish and the lowest dependency on energy as well (Table 5). Conversely, the French trout on-growing PS is less efficient and exhibits the highest energy costs per kg of fish, as the Finnish trout, but also the highest dependency on energy (Table 5). The share of energy costs for this French trout segment (7%) was slightly above the EU average for the aggregated trout on-growing segments (6%).

The Scottish salmon sector is highly dependent on exports outside the EU which can be interpreted as a weakness in terms of sustainability: the national industry depends in a large proportion on external markets. Nowadays, the major outlet of Scottish salmon is the American market. Thus production disposal relies strongly on the opening of foreign markets, which is a big issue in the Brexit context. In addition, foreign trade is exposed to fluctuations in foreign exchange rates and hedging for the risk of variations in exchange rates may be costly.

Poland provides an interesting case-study, exhibiting a high dependency on exports. This illustrates the recent emergence of this country on the market for intermediate products. Polish processing plants export relatively high value products but import raw fish.

[23] Note that the size of the STECF sample for 2014 was 58 enterprises, "representing 19.5% of the population". The STECF reports 2016-19 adds: "As these segments show a high variation from small farms to very important ones, this sampling rate give a medium precision for economic data."

Table 5. Economic dependency of salmonids farming production systems

Indicator	Variable	UK Salmon combined	FIN trout sea cage	FRA trout combined	FRA trout on-growing	POL TRR-400	ISL Arctic char
Dependency on species	N80	1	1	1	1	1	1
Dependency on external trade	Rate of export	68%	20%	32%		60%	100%
Dependency on energy	Energy costs / value of total sales (%)	1.9%	5.3%	3.3%	6.6%	4.4%	4.6%
Dependency on inputs	% of feed costs compared to total costs	38.2%	43.9%	34.5%	43.0%	54.6%	35.9%

It is well known that fish feed is a major source of costs for the fish farming sector which is to supply itself on a global speculative market. Feed costs have to be considered jointly with the feed efficiency (cost per kg of fish). As it has been observed above with other indicators, the comparison of feed costs should take into account the segment (combined or just on-growing), the species, and the size of fish, and in addition the differential of exchange rate insofar as the countries concerned have not all the same currency.

Compared to the trout combined segments, the trout on-growing farms are more impacted by feed costs which ranged from 43% of the total costs in France (2014) to nearly 55% in Poland (2015). At the EU level, this indicator reached 51% for trout on-growing in 2014.

3.5.3.3 Social sustainability – Employment conditions and attractiveness of the sector

As far as social sustainability is concerned, Table 6 highlights the more relevant indicators.

The use of temporary jobs is limited and quite stable from a case-study to another (from 10 to 30%).

Table 6. Social indicators of salmonids farming production systems (DCF data 2014, agri benchmark 2015 and other for Iceland)

Purpose	Indicator	Variable	UK Salmon combined	FIN trout sea cage	FRA trout combined	FRA trout on-growing	POL TRR-400	ISL Arctic char
Employment conditions and attractivity of the aquaculture sector	Use of temporary jobs	Total employees/ FTE	1.1	1.3	1.2	1.2	na	1.0
	Recourse to family work	% of imputed value of unpaid labour	0%	8%	11%	18%	57%	0%
	Level of Remunerat° of work	Labour costs (€/FTE)	53 641	32 374	27 115	23 837	16 100	37 506

As already mentioned, the Polish indicators are based on a sample of big firms. Surprisingly, the share of family work is very high, more than a half, far beyond all other national case-studies! This result is to be considered cautiously and requests a confirmation in the future.

The average wages varies a lot, in a range from 1 to 3.5 *i.e.* 16100 € in Poland to 53 641 in Scotland. This partly stems from the economic profitability but also reflects the domestic standard of life and the bargaining power of employees. This is illustrated by the comparison of labour productivity and cost per country (Figure 13).

The chart below shows that the labour productivity is higher than wages in all case-studies. The balance is relatively low in France and poorly contributes to investment financing (or capital remuneration) but in Finland labour productivity is twice the average wage while the ratio is three and more in Poland, Iceland and Scotland.

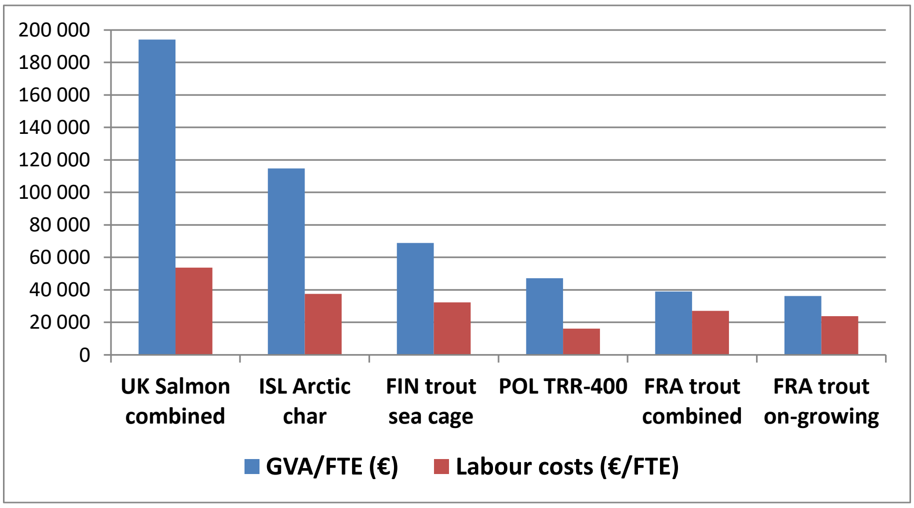


Figure 13: Comparison of labour productivity and labour cost per country/PS

3.5.3.4 Environmental sustainability

Environment sustainability measures the level of producers' involvement in sustainable practices. An indicator of this involvement is the share of production which complies with eco labelling or best practices schemes (Table 7).

All the Icelandic production of Arctic Char is covered by a best practice scheme; the small size of the industry encourages the implementation of such a scheme.

Apart from the 'Freedom Foods' scheme, the Scottish farmed salmon is more concerned by quality schemes (such as the French Label Rouge: Scottish salmon was the first non-French labelled product in 1992) than by ecolabels or best practices charters. The share of organic production in the whole production does not exceed 1.3 % in 2015 with 2,400 t (source: Eumofa, 2017), far behind Ireland where the totality of the production (13 000 t in 2015) is organically certified.

For trout, Finland only exhibits a best practice certification in the production of feed through a private brand launched by a feed company.

French trout has achieved differentiation on the market through a national charter for best practices which covers two thirds of the production (source: Cipa website). Organic products have developed substantially, reaching 6% of the total production in 2015, with 2,300 t. According to EUMOFA, France was the first organic trout producer in the EU in 2015 (40% of the EU production) ahead of Denmark (1,600 t and 28%).

But at this stage, neither code of best practices nor labelling schemes seems to help the industry to overcome the environmental constraints in terms of production limitation.

Table 7. Environmental indicators of salmonids farming production systems (DCF data 2014, agri benchmark 2015 and other for Iceland)

Variable	UK Salmon	FIN trout sea cage	FRA inland trout	POL trout on-growing	ISL – Arctic char
% of production in volume complying with code of best practices or ecolabels or any environmental certifications (including organic labels)	- High share of production accredited under (RSPCA*) 'Freedom Foods' scheme. - 1.3% of total production under organic label.	- Feed company launched a sustainability and quality brand called Benella for rainbow trout that is certification for best practices in production.	-Two thirds of the production complying with the best practice charter ("Aquaculture de nos régions"). 6% of total production under organic label.	100% (best practice)	100% (best practice)

3.5.4 General outcomes

While the EU salmon farming industry is highly geographically specialised and remains a relatively small player worldwide (7% in volume), the EU trout farming sector, despite declining trends, remains a significant contributor to the global supply of trout (33% in volume). Trout farming is carried out in many MS and, with a similar level of production at the EU level, provides more employment than salmon farming and further supplies the EU market.

The comparison of salmon and trout sectors leads to a clear distinction since they differ from almost all the indicators, except the use of temporary jobs which is limited and quite stable in all cases. The Scottish salmon farming corresponds to the highest concentrated and integrated aquaculture PS, the most capital intensive and is also very affiliate to the Norwegian industry. Above all, the large size of the Scottish companies leads to economies of scale and a high profitability with a rate of return on investment of 33% in 2014. The Finnish trout farming in cage also appears to be capital intensive, but is composed of small-scale enterprises. However, we must bear in mind that this Finnish segment shows lower size and productivity indicators compared to the total EU segment "trout sea cage". Finally, the inland trout farming in France, which is quite representative of the EU sector, is based on a similar employment structure (small-scale activity, mostly full time jobs) than the Finnish trout cage segment but shows lower indicators of productivity. In the end, the trout farming sector shows positive but much lower profitability indicators than salmon farming.

As for profitability, economies of scale provide the Scottish salmon industry with a comparative advantage in terms of energy cost per kg of fish and its dependency on energy is the lowest. The French trout on-growing sector is more energy intensive sector and shows the highest dependency on energy. Conversely, the Scottish salmon sector is highly dependent on exports and relies strongly on the accessibility of foreign markets whereas the trout farming sector is less dependent on external trade.

Concerning conditions of employment and labour issues, it has been found that wages vary a lot from a country case-study to another, as a result of gap in economic profitability and also domestic standard of life. Balance between labour productivity and wage is lower in France and poorly contributes to financing capital.

The EU salmonid industry is facing various challenges. Competition with imports on the one hand, environmental regulations, on the other hand, which limit the level of production through provisions on discharge of effluents and reduce the availability of sites, are major sources of concern. The expansion of salmon fish farming versus the stagnation of inland trout farming is related to more stringent regulatory framework in the latter case. In France, for instance, the decline in trout farming over the last 20 years has been attributed for a substantial part to stringent regulatory constraints. In Finland, fish farms were not able to create economies of scale and improve their competitiveness due also to the restrictive licensing policy.

Differentiation through labelling is a widespread strategic answer to competition. Organic labelling is one of the options, but it should be kept in mind that organic labelling is not enough to achieve differentiation (see D3.4), and should be associated with other complementary labels. In particular labels or collective brands which refer to the regional territory are required. Best practices charters are used on a large scale for fish production in Iceland and France, for feed production in Finland and Scotland. The market share for organic fish remains relatively low, even if France is the first EU country in organic trout production.

As far as environmental constraints are concerned, producers have to invest in new methods which aim at increasing production in a sustainable manner in the context of water use conflicts (e.g. recirculation systems). Farmers also have to communicate, on an individual basis but preferably at a collective level, on their production methods, showing that they are environmentally friendly even with recirculation systems. This may be done by charters built collectively to mutualise the costs of designing and dissemination.

References

Anon., 1995. Numéro spécial : La salmoniculture française, *la pisciculture française*, n°119, 52 p. (data 1991)

Anon., 2000. Recensement de la pisciculture française en 1998, Salmoniculture et pisciculture marine, Agreste, Données chiffrées, Agriculture n° 12, 138 p.

Bisault Laurent, 2009. La salmoniculture française à l'étiage, Agreste, Primeur, n° 227, 4 p.

Definition of data collection needs for aquaculture. Final report, 2009. Part 1- Review of the EU Aquaculture sector (country reports).

EUMOFA – Monthly highlights, No 4/2017

EUMOFA – Monthly highlights, No 2/2018)

GLOBEFISH Highlights, vol. 2/2011

GLOBEFISH Highlights, vol. 2/2014

STECF (2016). Economic report of EU aquaculture sector (STECF-16-19), Scientific, Technical and Economic Committee for Fisheries (STECF), Publications Office of the European Union, Luxembourg: 485p.

3.6 Seabass Seabream Case study

3.6.1 Context of EU production, exploitation and trade

This section presents some striking features of production and trade of seabass & seabream in the EU28. The brief production overview of the whole aquaculture production has been based on FAO data. Although these data show difference with the levels of production estimated by the industry sector (FEAP), they highlight similar trends in production. The fast development of the aquaculture of these species in Mediterranean countries since the beginning of the 1990s was marked by several market crises and fall in prices, especially for seabream.

3.6.1.1 Production

Until the early 1990's, production of European seabass and gilthead seabream in the EU was based mostly on capture fisheries. According to FAO, seabass catches topped to 10,370 tonnes in 2004 but then have shown a downward trend and amounted to 5,914 tonnes in 2015 (-43%), whereas Seabream catches have remained fairly constant in the last decade (3,558 tonnes in 2015). Aquaculture production of seabass and seabream soared in the late 1980s in the EU, mainly driven by the development of intensive production systems in Greece and in Spain. In Greece it was boosted with subsidies from both the European Commission and the Greek government (FAO, 2016). The production of farmed seabass production rose from 3,350 tonnes in 1990 up to 69,031 tonnes in 2015, corresponding to a yearly growth rate of 12%. The production of farmed seabream climbed from 3,185 tonnes in 1990 to 82,526 tonnes in 2015, showing a yearly growth rate of 13%, in average.

In 2015, the EU production of European seabass reached 74,945 tonnes, of which 8% were wild-caught fish and 92% were farmed fish. The same year, the EU production of gilthead seabream amounted to 86,084 tonnes, including only 4% of wild fish (FAO – FishStatJ, 2016).

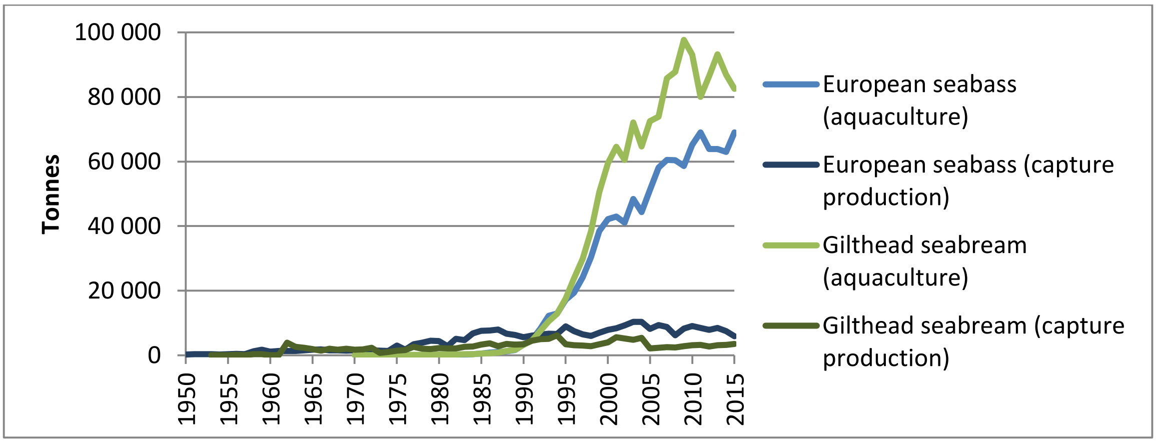


Figure 1. EU28 production of European seabass and Gilthead seabream by production source, 1950-2015 (Source : FAO – FishStatJ, 2016)

Greece is the largest producer of seabass and seabream in the EU, but ranks second after Turkey worldwide according to FAO data. Since the beginning of the financial crisis, the Greek production of SBSB has shown a downward trend: -11% for European seabass between 2010 and 2015 and -22%

for gilthead seabream between 2009 and 2015. Conversely, the Turkish production soared over the recent years: +61% for seabass between 2011 and 2015 and +69% for seabream between 2012 and 2015. At the EU level, Spain is the second largest producer of seabass and seabream; its production of seabass has increased steadily and reached 18,600 tonnes in 2015, while for seabream it decreased by 31% over the period 2009-2015. Italy is the third largest producer of seabass and seabream in the EU, showing a declining trend for European seabass between 2007 and 2015 (-32%) but a steady production of gilthead seabream.

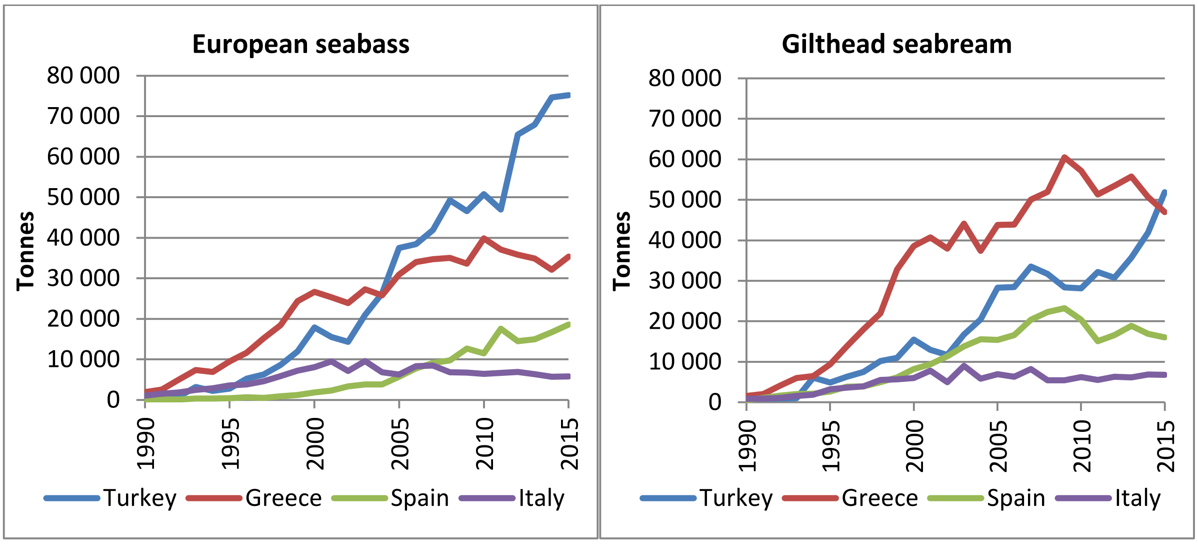


Figure 2. Aquaculture production of seabass and seabream by main producer countries (in tonnes), 1990-2015 (Source: FAO – FishStatJ, 2016)

The analysis of ex-farmed prices over the period 2000-2015 shows that the general trend of average EU prices continued to follow the evolution of Greek prices, while Turkish prices were globally lower, notably for seabass. The differential of about € 1.00 per kg in 2015 not only results from cost competitiveness but also reflects differences in size composition of the production. It should also be noted that the evolution of seabream prices is affected by higher yearly fluctuations compared to seabass (relatively more steady market). Seabream production prices reached their lowest levels in 2001-2002 and in 2008. The overproduction situation of 2008 led to a price crisis which entailed a reduction of the production of the two leaders in 2009 and 2010 (EUMOFA 2016), but the production of Turkey rose again afterwards.

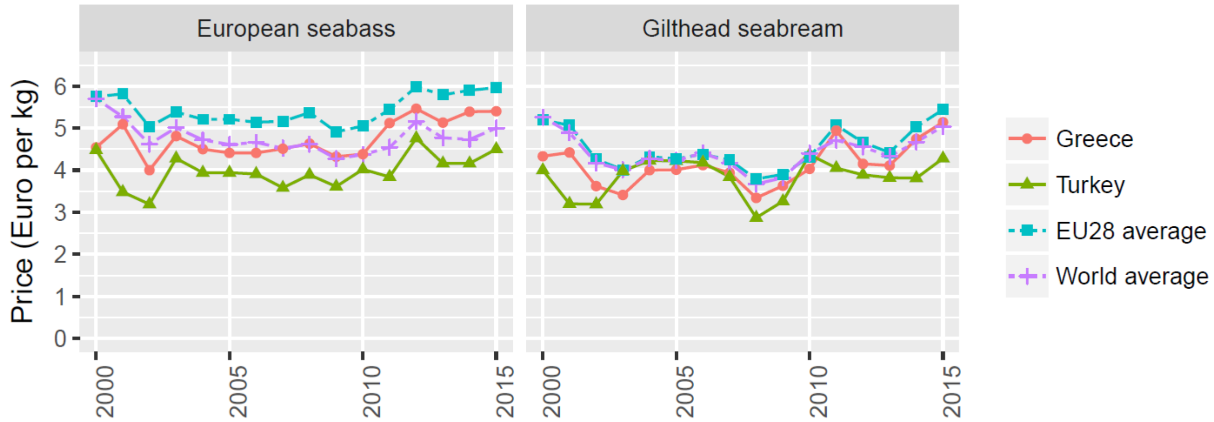


Figure 3. Ex-farm prices of European seabass and gilthead seabream in Greece and Turkey (in Euro per kilo), 2000-2015 (Sources: FAO – FishStatJ, 2016 and OECD Data for exchange rates)

3.6.1.2 External Trade

EU trade flows of seabass and seabream are mostly intra-community. Intra-EU imports of seabass nearly tripled between 2000 and 2015 (from 18,500 to 52,500 tonnes), but seem to level off since the beginning of the 2010s (Eurostat – COMEXT). Intra-EU imports of seabream also expanded rapidly, from 31,200 tonnes in 2000 to 67,300 tonnes in 2013, and then decreased by 13% to reach 59,000 tonnes in 2015. Extra-EU imports of seabass and seabream remain well below intra-EU imports, however they increased markedly between 2013 and 2015 (+34% and +65%, respectively) and amounted to 15,000 tonnes for seabass and 26,000 tonnes for seabream in 2015.

The analysis of EU imports by country of provenance shows that Greece remains by far the main supplier of the EU28 market for seabass and seabream, although its market share decreased from 60% to less than 40% in value between 2000 and 2015. It is followed by Turkey which gained nearly a 10% market share over the last decade. This market share is however probably underestimated as imports of SBSB from the Netherlands are mainly made up of Turkish products. Finally, the third largest supplier of EU markets is Spain which nearly doubled its market share in value between 2000 and 2015 (Table 1).

Table 1. EU imports of seabass and seabream (including intra-UE trade) by main country of origin (% in value) 2000-2015 (Source: Eurostat –COMEXT)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Greece	60%	59%	62%	59%	56%	54%	53%	52%	49%	51%	57%	57%	54%	50%	44%	38%
Turkey	4%	5%	7%	9%	12%	13%	12%	15%	16%	14%	10%	10%	10%	13%	18%	21%
Spain	7%	9%	7%	8%	7%	8%	11%	10%	11%	13%	12%	10%	12%	12%	12%	13%
Netherlands	1%	1%	1%	2%	1%	2%	2%	3%	4%	4%	5%	5%	5%	7%	7%	8%
Croatia	1%	1%	1%	1%	1%	1%	2%	1%	1%	1%	1%	2%	2%	2%	3%	4%
France	11%	10%	9%	10%	9%	9%	10%	9%	9%	8%	6%	6%	5%	5%	4%	3%
Italy	4%	4%	3%	3%	5%	4%	3%	3%	3%	3%	2%	3%	1%	2%	3%	3%
Others	12%	11%	9%	8%	8%	8%	8%	7%	7%	6%	7%	8%	10%	9%	9%	10%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

In the EU market, seabass and seabream are mostly traded in fresh and whole form. In terms of price, there was a significant gap between seabass and seabream imports from Greece and from Turkey before 2013. Afterwards, the gap decreased markedly and in 2015, the import price of fresh seabass averaged about € 5.30/kg for both the Greek and the Turkish origins. On the other hand, a slight price differential remained regarding fresh gilthead seabream. After successive price fluctuations over the 2000-2015 period (influenced by the trends in production prices), the EU average import prices of fresh seabass gilthead seabream increased significantly between 2013 and 2015: +9% and +26% respectively (Figure 4). But the recovery in both production and import price was very short-lived and was dampened in 2016 as the market was in 2016 hit by unexpectedly large volumes of farmed Turkish bream (Globefish, market report July 2017).

Finally, the evolution of price at the production and import levels shows that the market of seabass is proved to be more stable whereas seabream prices are subject to more volatility. “Addressing the imbalance in the bream market before prices fall further is now a priority for the Mediterranean industry as a whole” (Globefish, market report July 2017).

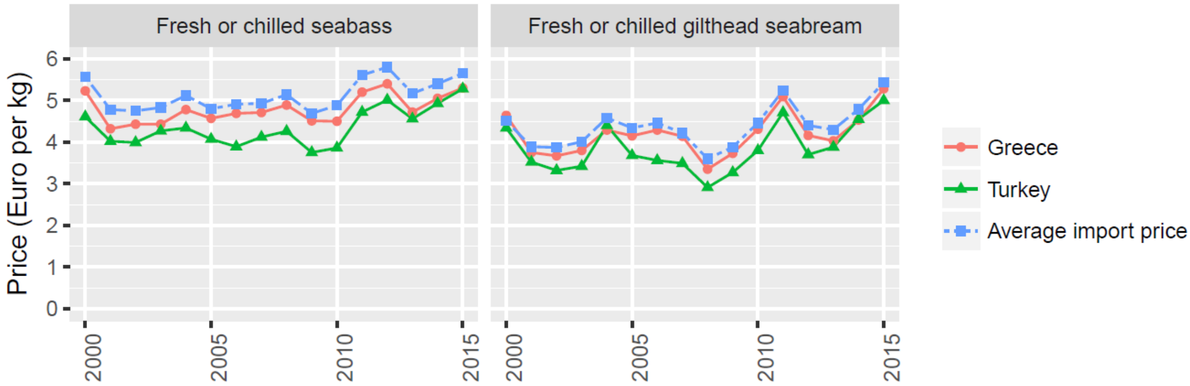


Figure 4: Evolution of EU import prices of fresh & chilled seabass and gilthead seabream (€/kg)) by main provenance (Source: Eurostat – COMEXT data 2000-2015)

3.6.1.3 Market and consumption

As a result of increasing domestic production and increasing extra-EU imports, the EU apparent market for seabass and seabream reached a peak in 2015 and amounted to respectively 87,000 tonnes and 152,000 tonnes, in live weight equivalent (source Fishstat and Eurostat Comext). The EU market for seabass and seabream is not far from being self-sufficient, despite the slight decline of the self-sufficiency rate observed recently due to the increase of imports from Turkey. In 2015, this rate was estimated at 86% for both seabass and seabream at the EU28 level.

Italy, as the main importer country of seabass and seabream, represents the largest market for these two species (around 69 thousand tonnes), closely followed by Spain (65 thousand tonnes). Apparent market in Italy was fairly constant over the period 2005-2015 while the apparent market in Spain increased mainly due to a growth of domestic production. These two countries represented 56% of the whole consumption of seabass and seabream in the EU28 in 2015. Other significant markets, but far behind, include France, Portugal and Greece.

As concerns the apparent consumption per inhabitant, the level of consumption reached barely 0.5 kg on EU average in 2015. This average indeed masks strong disparities among MS. The biggest consumers of aquaculture seabass and seabream are located in South EU countries. If considering only yearly consumption over one kg per inhabitant, the top countries in 2015 were, by decreasing order, Portugal and Cyprus (around 2 kg) and then Greece, Spain, Malta and Italy.

3.6.2 Description and comparison of productions systems

This section is documented from the partner contribution of the case study "seabass and seabream" for the three main EU producer countries of seabass and seabream, namely Greece, Spain and Italy. A common feature is that the bulk of production of seabass and seabream comes from sea cages farming and is mostly based on intensive culture.

In Greece, the sea bass and sea bream farming sector has been under consolidation for the last 10 years. Based on FGM data (2015), the number of companies decreased from 166 in 2003 to 106 in 2008 and further down to 63 companies in 2015. Even today the consolidation process continues under the pressure of Greek debt crisis and there exist many scenarios for acquisitions between major companies of the sector in the near future. This consolidation resulted in the creation of a small number of large companies that dominate marine finfish aquaculture production in Greece. Seven (7) out of 63 companies are estimated to produce and trade 67% of total production based on FGM (2015) production data. Large aquaculture companies have affiliated companies, and furthermore, they also form clusters with small independent companies based on a more permanent commercial relationship. Along with concentration, the Greek sector is also increasingly integrated. Nowadays the large integrated companies combine the operation of hatcheries with clusters of fish farms and packing plants and in three cases they also operate their own feed factories. As concerns the bulk of farming activities, on average 16 fish farms and 2 hatcheries are operated by each integrated aquaculture company. As regards the supplying in juvenile, it can be considered that the Greek marine fish farming is self-sufficient in juveniles. A very small percentage of juveniles (up to 5%) are imported from France and Italy, but in return 7% is exported to Greece.

Seabass and seabream aquaculture in Italy is more recent than in Greece or in Spain. The first seabass and seabream plants were rather similar to those used for trout, as the leading farmed fish until the 1980s, but gradually there has been a great evolution also in terms of engineering design of the marine species farms. In Italy, aquaculture has experienced a metamorphosis in terms of production structure, size and number of employees for each production segment over the last decade. The change has been most evident since the second half of 2008, when the Italian economic performance decreased significantly. The economic situation produced two opposite effects: many companies stopped their activities while other companies, more solid and diversified, started a restructuring phase. Resulting from the sector consolidation over the last decade, the number of companies decreased, to reach 22 SBSB companies with around 50 facilities (according to API and STECF data). Even today the consolidation process continues and has resulted in the creation of a small number of large companies that dominate marine finfish aquaculture production. It is estimated that the most part of supply (> 50%) is concentrated in 5 big companies, which are now vertically integrated. Upstream integration through the investment in fry reproduction facilities allows them to satisfy most of their needs juveniles/fingerlings. Downstream integration also mainly concerns the largest companies which can have direct agreement with organised distribution groups.

In Spain, at the beginning of the eighties, the Spanish aquaculture was composed mainly by small businesses with very traditional family economies, involved in the cultivation of rainbow trout, Mediterranean mussel and multispecies aquaculture in brackish waters in some coastal areas of south Spain. The industrial production of seabass started in the second half of the eighties, after a pilot stage. During the nineties the production experienced a continuous growth until the first market and price crises arrived in the new century. Between 2008 and 2014, there has been a change in the sector structure encouraged by the economic crisis, the decrease in fish consumption and the increase in competition of the seabream and seabass Mediterranean industry. The economic and market context facilitated that many companies went bankrupt while others needed to increase their scale of production and level of technology to be more cost-efficient and in a position to face the price falls and the competition of the Greek and Turkish producers. All of these changes led to a reduction in the number of companies and modified the structure of the sector. Between 2008 and 2014, the share of small enterprises of less than 5 employees and of large enterprises of more than 5 workers, were drastically reduced and replaced by medium-sized enterprises (STECF data). The latter have a larger scale of production and use more technology, so they require fewer employees than previous companies with more than 10 employees.

Apart from some production developed in brackish waters in southern Spain, the majority of the domestic seabass and seabream production is grown in cages. As the production of juveniles from Spanish hatcheries is not enough to meet the demand of the growing companies they must be imported from other countries. Moreover, the lack of vertical integration has traditionally been one of the causes of the competitiveness problems of the seabream and seabass industry in Spain. In the case of small producers, one example of vertical integration is the organisation of aquaculture farmers in Andalusia, which became involved in commercialisation. As for big producers, the Grupo Culmarex is an example of vertical integration, which has developed all stages of the cultivation process from reproduction to fattening and is also in charge of the packaging and distribution of the products. This group concentrates about 45% of the whole Spanish production of SBSB.

To recap, after successive market crises, the SBSB sector has experienced a common movement of concentration in the 3 main EU producer countries, with the emergence of big companies such as Nireus S.A., Selonda S.A. in Greece and Culmarex in Spain. The vertical integration is the most developed in Greece where the two leaders encompasses further steps of the value-chain from feed factories upstream to processing plants downstream. Table 1 presents key features of the sea bass and sea bream farming compiling both national statistical sources and data from the aquaculture data collection framework (DCF).

Table 1. Key features of SBSB farming in sea cage in Greece, Spain and Italy in 2014 based on DCF data and completed by data from Hellenic Statistical authority for Greece (*figures in italic*)

	GRE combined segment	SPA cage segment	ITA cage segment*
Number of enterprises	*63*	30	22
Number of employees	na	994	220
Number of FTE	*2 500*	706	**220**
Total mussel sales (tonnes)	85 103	32 966	12 754
Mussel price indicator	4,58	5,29	7,56
Number of FTE/enterprises	*39,7*	33,1	**10,0**
ratio Employees/FTE	na	1,4	**1,0**
Total mussel sales/enterprise (tonnes)	*1351*	1099	580
Total mussel sales/FTE (tonnes)	*34*	47	**58**

** The missing FTE data have been replaced by the number of employees for the calculation of FTE-dependent ratios*

Due to the combination of two statistical sources for the calculation of Greek structural indicators, and the approximation made for the Italian FTE data (i.e. the number of employees), the comparison should be cautious. Notwithstanding the possible bias in FTE estimation, the size of the Greek enterprises is found to be the largest (in both FTE and production volume), close to the Spanish and far above the Italian companies. However, despite a higher indicator concentration of production, the productivity in volume (sales/number of FTE) of the Greek sector appeared to be lower than for the Italian and Spanish sectors in 2014.

3.6.3 Comparison of Selected indicators – Analysis

The comparison of selected indicators was attempted for 3 countries: Greece, Spain and Italy, corresponding to the major EU producers (with Greece far ahead)[24]. Reports of indicators provided in D3.3 referred to a main common type of aquaculture (marine cage), but with some differences in the structure of the industry mentioned above. The comparison and related assessment of the performances of the Greek, Spanish and Italian SBSB aquaculture sectors could not be fully achieved due to the heterogeneity and shortcomings of economic and financial data.

- Greek report: Indicators are based on national sources of information and economic data come from corporate public financial statements of Greek marine aquaculture companies and correspond to integrated companies, representative of the vast majority of the Greek production sector. Some important indicators are missing, in particular the labour productivity and level of remuneration of work. DCF data which have only been available since 2013 could not be used as they do not cover all economic variables.
- Italian report: indicators refer to the DCF data for the main segment in volume terms, i.e. the Sea bass and Sea bream cage segment. All the DCF indicators are available for Italy, but the number of FTE was considered unreliable by the 2016 STECF working group, and therefore indicators like mean wages and labour productivity must be calculated with the number of employees instead of the number of FTE. Other inconsistency of data concerns the energy costs which were found to be disproportionate compared to data related to similar aquaculture segments (30% of total costs versus barely 3% in Greece and 1% in Spain).
- The Spanish report: Indicators also refer to the Sea bass and Sea bream cage segment which is dominant within this aquaculture sector.

3.6.3.1 Economic sustainability - Economic performance

The Greek finfish aquaculture sector was not profitable during 2014 and is highly dependent on debt. In Spain, the ROI was not positive either while the level of indebtedness for the cage segment reached around 60% in recent years.

Table 2. Economic performances of SBSB farming production systems (DCF data and national data for Greece)

Indicator	Variable	Greece	Italy	Spain
Labour productivity	GVA/FTE	NA	82,677 €/ employee	43,196 € /FTE
Profitability	ROI	0%	6%	-1%
Indebtedness	Debt/total value of assets	97%	53%	62%
Energy efficiency	Energy costs per kg of fish produced	NA	2.17 €/kg	0.08 €/kg

[24] The French SBSB sector could not be included in the indicator comparison as it is no longer covered by the aquaculture DCF, due to the low production and low number of enterprises at a national scale, which raised problems of data confidentiality and statistical representativeness

In Spain, as regards energy, the most efficiency segment is the production of seabream and seabass in cages, due to the high individual densities. Compared to the 0.08 € of energy cost per kg of fish at cages production in 2014, the semi-intensive production in brackish waters is more energy-consuming with costs reaching 0.83 €/kg.

The Italian sector was profitable in 2014 in spite of huge energy costs per kg of fish. The indicator of labour productivity is however not totally comparable with the Spanish one since it was calculated with the number of employees instead of the number of FTE.

3.6.3.2 Economic sustainability - Economic dependency

In all countries the SBSB industry produces mainly two species, and the diversification in other species is relatively low. The dependency to exports is particularly high in Greece where approximately 75% of the sector production (in value terms) was exported in 2014. In Spain and Italy the dependency to exports is lower. In Spain, traditionally, the proportion of seabream exports has been higher that the seabass but in the last two years, exports have stabilized around 30% in both species.

Table 3. Economic dependency of SBSB farming production systems (DCF data and national data for Greece)

Indicator	Variable	Greece	Italy	Spain
Economic dependency on species	Number of species making up 80% of total production in value	2	2	2
Economic dependency on external trade	Share of production exported (in value)	75%	26%	32%
Economic dependency on energy	Share of energy costs in total costs	3%	30%	1%
Economic dependency on inputs	Share of feed costs in total costs	55%	29%	46%

Italian data apart, the SBSB farming industry does not strongly depend on energy (2.6% in Greece, lesser in Spain). On the other hand, the main cost component in the production of farmed fish species is feed, which accounted for more than 50% of Greek costs in 2014. In the case of Spanish cage productions, feed cost has followed an increasing trend, both in absolute and relative values. In 2014, feed cost accounted for 46% of the total cost of production in the cage segment. Comparatively, the semi-intensive production in brackish waters has similar dependency on feed than cages production, but at the same time is more dependent on energy.

As concerns the Italian results, the relatively low share of feed costs is difficult to interpret as it is probably distorted by disproportionate energy costs (note that the share of energy costs dramatically increased from 6% in 2011 to 30% in 2014).

3.6.3.3 Social sustainability – Employment conditions and attractiveness of the sector

In Greece, the vast majority of the personnel work on a permanent basis for the aquaculture companies. The industrial structure of the sector does not rely on unpaid labour. However, the level of remuneration of work is unknown.

In Spain, In addition, these are more skilled jobs due to the greater biological and technical component of the production process. Consequently, there is less temporality and a higher level of remuneration than in other aquaculture sectors (i.e. mussel farming) because of the higher qualification of the workers.

Although the Italian labour costs were calculated with the number of employees instead of the number of FTE, they provide a similar level of remuneration of work compared to that of the Spanish cage segment. If considering that most of the employees are permanent workers (see D3.3 Italian SBSB report), it could be considered that labour costs are not too much overestimated.

Table 4. Social indicators of the SBSB farming production systems (DCF data and national data for Greece)

Indicator	Variable	Greece	Italy	Spain
Use of temporary employment	Total employees/FTE	1.03	-	1.41
Recourse to family work	Share of unpaid labour in labour costs	0%	0%	0%
Level of remuneration of work	Labour costs/FTE	NA	39,441 €/FTE	37,708 €/FTE

3.6.3.4 Environmental sustainability

For the different EU producer countries of seabass and seabream, the attention paid to the environmental sustainability of the activity is a priority for ensuring the viability of the aquaculture sector.

In Greece, approximately 25% of the production is certified with various certification schemes, such as GlobalGAP and/or ISO 14000 certification and few labels. The Business to Business (B2B) certification is more spread than Business to Consumer (B2C) labels. Among them, the production certified with “Friends of the Sea” represents less than 4% and the organic label less than 1%.

In Spain, there is not data available about the % of farms (or % of production in volume) complying with code of best practices or ecolabels or any environmental certifications. However, the seabream and seabass industry have been involved in different initiatives in recent years to develop production in a more environmentally sustainable way. On one side, the Business Association of Marine fish farming in Spain (APROMAR) has made available to marine aquaculture companies in Spain a Guide to Best Practices, which aims to provide sector workers with guidelines to minimize the impact of their activities on the environment and to develop sustainable management techniques of the cultivated species. On the other side, there are individual initiatives as the ones developed by Culmarex. The company "Grupo Culmarex", which produced around 16,500 tonnes of seabream and seabass in 2014 in Spain, began in 2010 the production of organic seabream and seabass. Moreover, Culmarex is the first Spanish aquaculture company which obtained the label "Friend of the Sea" for Seabream and Seabass products.

In Italy, all farming companies of sea bass sea bream in cages follow international certification procedures like ISO, GlobalGAP, or/and private retail label. As concerns environmentally-friendly labels, some companies have obtained the label Friend of the Sea or the Organic Label. According to EUMOFA study, the Italian production of organic seabass/seabream was estimated to reach 1,600 tonnes in 2015 representing 12% of the whole Italian production (EUMOFA, 2017).

3.6.4 General outcomes

Sea bass and seabream farming is an aquaculture sector which developed from Southern European countries and then extended to countries of the Mediterranean area. The aquaculture production of these two species soared till the mid-1980s in the EU, mainly driven by the development of intensive aquaculture in Greece, Spain and in Italy to a lesser extent. Greece lost its leadership worldwide and was overtaken by Turkey in the beginning of the 2010's. The fast evolution of SBSB production was marked by several market crises, especially for seabream, in 2001-2002 and in 2008 (and more recently in 2016). The overproduction situation of 2008 led to a price crisis which entailed a reduction of the production of the two leaders in 2009 and 2010, but the production of Turkey rose again afterwards.

The EU trade for seabass and seabream is mostly intracommunity with Greece as the main exporting country and Italy as the main importing country. In most cases, seabass and seabream are traded in fresh and whole form. Turkey is also a supplier to the EU and a direct competitor of Greece. Its value share in EU imports increased from 4% in 2000 to 21% in 2015. Despite this evolution, the EU apparent market for seabass & seabream which reached a peak in 2015 is nearly self-sufficient (86% in volume). Italy represents the largest market for the two species (around 69 thousand tonnes), closely followed by Spain (65 thousand tonnes), and far behind by France, Portugal and Greece.

Seabass & seabream productions systems analysed in Greece, Spain and Italy refer to a common type of aquaculture (marine cage), but with some differences linked to the size, the structure and the dynamic of development of the sectors in the 3 countries. Greece is by far the major EU producers, mainly focussing on export markets, whereas Italy which is the main market for SBSB consumption could not achieve significant growth. After successive market crises, the SBSB sector has experienced a general trend of consolidation in each of the 3 main producer countries, with the emergence of large and integrated companies. The vertical integration is the most developed in Greece and for the two leading companies encompasses further steps of the value-chain from feed factories upstream to processing plants downstream.

The comparison and related assessment of the performances of the Greek, Spanish and Italian SBSB aquaculture sectors could not be fully achieved due to the heterogeneity and shortcomings of economic and financial data. It seems however that the Greek sector was not profitable in 2014 and had a high level of indebtedness. The Spanish SBSB segment was not profitable either in 2014 according to DCF data and the labour productivity (GVA/FTE) was mostly used to the remuneration of labour costs. In spite of disproportionate energy costs, the Italian seabass seabream sector showed a positive return of investment and a quite high labour productivity thanks to a high indicator of price sales.

These few elements are however insufficient to assess the economic competitiveness and sustainability of the second largest EU aquaculture sector in terms of employment and the third in value (after salmon and trout). Furthermore, due to the outlooks of growth related to the multiannual national aquaculture plans, the improvement of DCF data for sea bass & sea bream fish farming, including the complete collection of Greek economic data, should be a priority.

References

FAO (2016). National Aquaculture Sector Overview. Greece. National Aquaculture Sector Overview Fact Sheets. Text by Theodorou, J.A. In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 18 March 2016. [Cited 27 October 2017]. http://www.fao.org/fishery/countrysector/naso_greece/en

EUMOFA (2017a). Gilt-head seabream in Italy. Price structure in the supply chain. Price structure analysis, September 2017. 34p.

APROMAR (2016). La acuicultura en España 2016. Retrieved from: http://www.apromar.es/content/la-acuicultura-en-espa%C3%B1a-2016

University of Stirling, 2004 - Study of the market for aquaculture produced seabass and seabream species. Report to the European Commission DG fisheries, Final report April 2004, 84 pp.

3.7 Carp Case study

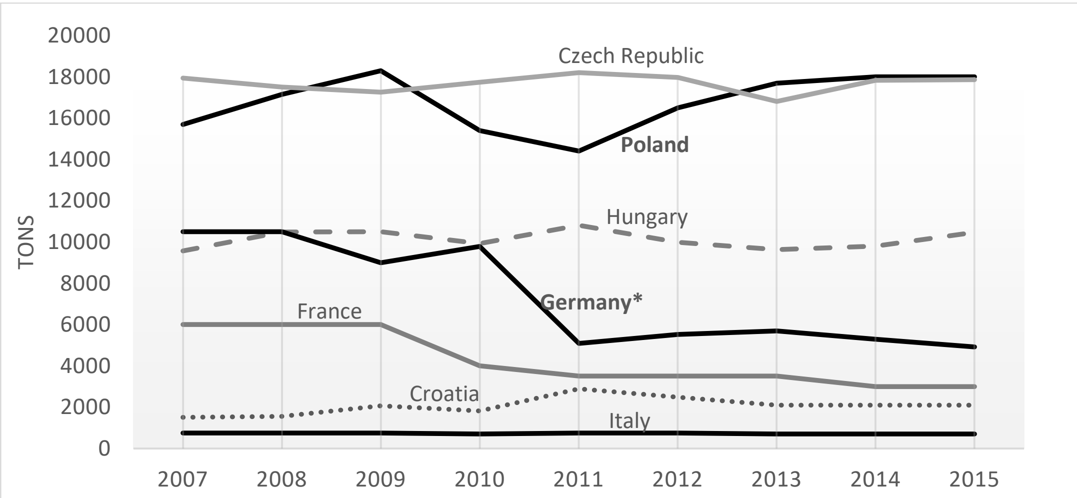
3.7.1 Context of EU production, exploitation and trade

Common carp (*Cyprinus carpio*) is the oldest freshwater species hold in European aquacultures (FAO 2017). Carp farming dates back to roman times (Currie 1991). Later, the Carolingians supported systematically the construction and maintenance of carp ponds in the medieval era (Füllner *et al.* 2007, Mück 2013). In particular, the Franconian royal courts and the order of the Cistercians played a central role in the domestication of carp and the development of fish farming techniques in Central and Eastern Europe. The monks reared carp mainly as food for the Christian fasting period. Even today, carp culinary culture is still characterised by religious tradition in some regions.

3.7.1.1 Production

The main carp species produced in the EU is common carp. Its production mostly relies on aquaculture sector, wild catches from inland waters are insignificant. Common carp is one of the first species farmed in the EU and its production topped more than 100,000 tonnes in 1989. Since then, its production has declined and amounted to about 78,000 tonnes in 2015 (EUMOFA 2016). Common carp is mainly farmed in the countries of Eastern Europe. Czech Republic and Poland are the main producer countries; each provided a quarter of total EU production in 2015. Production in Poland has fluctuated around 18,000 tonnes over the 20 last years. Production in Germany was divided by four over the period 1989-2015 (about 5,000 tonnes in 2015*) (FEAP 2016).

Aquaculture Production of carp by main producer countries (in tons), 1950-2015 (Source: FEAP 2016)



* The “decrease” in German carp production is caused by changed survey methods: Until 2011, aquaculture statistics based on data from federal states’ authorities. Since 2011 and according to EC No 762/2008, Germany’s National Statistic Agency *Destatis* conducts an aquaculture production census. The statistic only counts the fish, which is sold for human consumption. It does not consider sales for re-stocking purposes. Former data of federal states’ authorities counted the harvested fish, including fish for restocking. There is an ongoing discussion in Germany about how valid the current statistics are (Klinkhardt 2014). In particular, the cultured area and the aquaculture production at all seem to be underestimated in several regions (Oberle 2015, Rösch 2015).

3.7.1.2 Trade

The EU market for whole carp was estimated at 98,000 tonnes (live weight equivalent) in 2015. With exception of the exporter Czech Republic, the EU markets for common carp address domestic markets. Poland is the main European market for live carp, with a consumption of more than 21,000 tons and imports reaching EUR 5.6 million, of which 96 % were live carp. Czech Republic and Hungary were its main suppliers (54 % and 30 % of total imports in value, respectively). The domestic demand in Poland has a strong seasonal peak at Christmas time due to catholic culture. Germany is also a main importer of carp. In 2015, the total German market was around 10,000 tons (own estimation), whereof more than 2,600 tons came from abroad (BLE 2017). The imports amounted to about EUR 5 million in 2015, of which 93 % were live carp. Czech Republic and Hungary were also the main suppliers in terms of German carp imports (64 % and 23 % of total imports in value, respectively). Although, there is a range of different processed carp products, the tradition to buy fresh slaughtered carp or even alive to prepare it at home is still very present.

3.7.2 Comment on Data Availability and Quality

Until the end of SUCCESS project in 2018, the availability and quality of statistical data about economics of the freshwater aquaculture sectors has been insufficient. The poor economic data situation is mainly caused by the fact that data collection for freshwater aquaculture has not been mandatory in many EU member states (MS), so it has been in Germany and Poland. Hopefully, the 2017 reformed regulation No. 2017/1004 of the EU Data Collection Framework (DCF) and the linked national work plans of MS will lead to a better information base in the near future.

Regarding the poor availability of economic data on carp farming and the limited resources for undertaking own surveys, the Carp Case study team decided to apply an alternative, innovative method for data collection: the typical farm approach. The typical farm approach originates in agricultural economics and has been firstly applied for aquacultures in 2014 (Lasner *et al.* 2017). The core idea of the approach is to use a combination of farms observations, focus groups and interviews with farmers and stakeholders. In this way, a transdisciplinary group of expert engineers empirically grounded fish farm datasets, which can be seen as typical production systems for specific fish production regions. The resulting carp farm datasets contain a maximum of 245 economic variables. The quantity of variables allows a high detail of micro economic analysis on the one hand. On the other hand, the coherence of the high amount of variables serves as an indicator of data quality (validation). At all, 17 carp farmers and stakeholders have been interviewed either in face-to-face interviews or as participant of one out of two focus groups. The fieldwork took place between June 27th – July 1st at the Aischgrund (Germany) and September 12th- 16th, 2016 at Barycz Valley (Poland).

The typical farm datasets are not representative in a statistical manner, but provide very good and detail examples of productions systems out of a purpose sample. Our experiences with the new method confirm, that the typical farm approach is not only an alternative, where no statistical data is available. Where sector statistics on fisheries and aquaculture exist, it is a complementary dataset, which enables in-depth on farm level analyses, modelling and forecasting.

3.7.3 Brief Description of productions systems

Traditionally, carp farmers use earthen ponds and rear carp in polyculture with other species. The ponds only differ in their scale, their stocking density and their water source. By trend, ponds in Western Europe are smaller. Carp farming is often an additional business for farmers here. In contrast, ponds in Middle and Eastern Europe tend to be larger and carp farms are more professional organised. As example, the average pond size in the Bavarian Aischgrund (South Germany) is about 0.4 ha per farmer, while farms in Saxonian Upper and Lower Lusatia (East Germany) cultivate 158 ha of pond in an average (Füllner *et al.* 2007). Precipitation and surface water are the most common water sources. Carp production highly depends on annual climate conditions. Carp farming is a polyculture. The production cycles of carp are 3 years. The average final harvest weight differs a bit according to environmental factors (and consumer preferences), but is usually heavier than 1 kg/Fish. As example, the harvest weight is about 1.25 kg/Fish in the Bavarian Aischgrund (Germany) and 1.5 kg/Fish in the Lower Silesia Barycz Valley (Poland). Commonly natural plankton is the basic feed, grain is fed by the carp farmer in addition. Our five engineered carp farm datasets present typical and good practice farms out of the Bavarian Aischgrund in Germany and Lower Silesia Barycz Valley in Poland. Each model farm has a farm code, which refers to the ISO 639 country code, the FAO 3-Alpha Species Code (ASFIS) and the annual production of the main species of the farm in tons live weight. As example, the farm code «DE-FCP-5» refers to a German (DE) carp (FCP) farm model, which produces 5 tons of carp in a typical year (please cf. footnote no. 1 for reference year). The focus of our analysis is on the traditional grow-out and sale of live carp for human consumption.

Table: Key features of carp farm selected via typical farm approach and segment analysed (diverse sources)

Farm model	Example for a	Production (in tons)	FTE[25] in the farm model	Farms classified per scale in ha (segments)	Share in national production	National carp production (in tons)[26]
DE-FCP-5	Smallholder farm	5	0.27	≤ 5 ha = 4,286 carp farms	25 %	4,916
DE-FCP-20	Diversified farm	20	0.51	> 5 ha = 177 carp farms	75 %	
PL-FCP-10	Hobby farm	10	1.0	≤ 50 ha = 507 carp farms	17 %	18,000
PL-FCP-90	Diversified farm	90	1.5	51 to 500 ha = 207 carp farms	56 %	
PL-FCP-190	Specialised farm	190	1.4	501 to >1000 ha = 19 carp farms (not considered in the model farms)	27 %	
Source: Typical farm approach, own research				Source: according to Destatis (2014) for DE and Lirski and Myszkowski (2015) for PL		Source: FEAP 2016

3.7.4 Comparison of Selected indicators – Analysis

Five farm models were defined as typical carp farms from the two European carp production regions - the Aischgrund in Germany and Barycz Valley in Poland (cf. table above). The Aischgrund is a region within Bavaria and therein part of the district of Middle Franconia. 7,000 ponds with a total pond

[25] Full Time Equivalent

[26] Cf. remarks on German carp production linked to figure "Aquaculture production of common carp by main producer countries (in tonnes), 1950-2015" under "*".

area of around 2,300 ha form the landscape (Oberle 2016). Aischgrund carp farms are usually small-scaled and culturing less than 5 ha with very little machinery and assets. Most ponds are “sky ponds”. Their water supply depends on precipitation. In average, ponds have a size of 0.4 ha resulting in around 6 to 10 ponds per farm. Less than 5 farms in the region have more than 50 ha. It is common that (agricultural) farmers in Franconia earn an additional income with carp farming. Barycz Valley in Lower Silesia Province is one of the main centres of carp farming in Poland (Lirski and Myszkowski 2015). 48 carp farms are located in the Lower Silesia Province (8,493 ha), whereof 28 private farms (around 1,500 ha) and the public combine “Stawy Milickie” (around 6,300 ha) are domiciled close to or in the Barycz Valley. The ponds’ water systems are supplied primary by the river Barycz, which is one of the slowest flowing rivers in Europe. The average size of ponds in the valley is 54 ha.

In consequence, indicator reports were provided for two countries: Germany and Poland. The Carp Case study is apart from other aquaculture case studies, as data come from the typical farm approach previously described. This method was applied in a common way in 2016 in Germany and Poland to conduct carp farm economic data, which refer to the year 2015[27]. Our analysis focuses on the performance of the traditional core business of carp farmers: the grow-out stage, where two-summer old fingerling are fed up to three-summer old carps for human consumption.

DE-FCP-5 represents a small scale farm, which can be seen as typical for the Aischgrund and for the peasant carp farming of German smallholders in general. The owner of the farm has additional income as an employee or/and from agricultural farming. The carp farmer concentrates on grow-out only and sales his fish to one single wholesaler, who provides the harvest equipment and organize the fish harvest as well. Here, the carp farmer is a real price taker. **DE-FCP-20** is an example of the very few medium-scaled and good practice farms in the Aischgrund, which combine agriculture and aquaculture business. The carp enterprise is vertical integrated, includes hatchery, nursery and grow-out. Beside wholesalers, the farmer sells his fish to local restaurants too. The owner of **PL-FCP-10** is working in the public sector and runs the carp farm as an extra (recreational) business with one employed farmer. PL-FCP-10 cannot be seen as typical for Barycz Valley, but complete the Polish purpose sample with an additional case. **PL-FCP-190** represents a good practice farm, which intensify its production of carp thanks to specialization. The farm is vertical integrated and the carp farmer also cultures grain to produce his own fish feed. **PL-FCP-90** is less specialized and the fish stocking density is very low. But, the farm is fully integrated (including processing) and runs a farm restaurant to improve the direct marketing of its products. This kind of diversification strategy is a quite new phenomenon in Barycz Valley and is linked to the establishing marketing of the region as holiday area.

The micro-economic data of the chosen carp farms has been embedded into production data of the sector, if it has been available.

3.7.4.1 Economic sustainability - Economic performance

Interviews and focus groups in both regions carry out a list of challenges; carp farmers have to face in our times. The most important are: changes in consumers’ preferences (trend towards processed fish

[27] 2015 is the reference year of the SUCCESS project. Anyway, it should be taken into account that 2015 was an outstanding negative year in terms of carp harvest in Southern Germany, where the main production is located. The carp production in the Bavarian region Aischgrund – as example - had been affected by a serious drought, which resulted in up to -20 % of productivity loss (Speierl *et al.* 2017). For comparability reasons, this extreme situation is not considered in our analysis in terms of the typical farm approach.

product); price competition with Czech imports[28]; lack of skilled successors (rural flight); high fish losses due to protected wild life predators like cormorant, grey heron and other (which leads in some regions to extremely high losses in hatchery and nursery ponds of up to 75 % of one summer old carps); diseases; shortage of water due to extremely hot summers. All listed difficulties weaken directly or indirectly the economic situation of carp farms. They lead to worse returns via traditional (whole-)sale channels or to increasing costs due to high mortalities. After all, the profitability of carp farming might be questioned. Indeed, the economic performance of the carp farms detected during the field research and discussed in the focus groups is variable: it depends on scale of production and the degree of professionality from quite profitable shown by a Return Of Investment (ROI) of 8 % to very unprofitable with a ROI of -26 %.

Table: Economic performance by production system, 2015

Indicator	Variable	DE-FCP-5	DE-FCP-20	PL-FCP-10	PL-FCP-90	PL-FCP-190
Labour productivity	GVA/FTE (in €/FTE)	*12,600*	*54,900*	*9,800*	*29,900*	*51,600*
Profitability	ROI	*- 2 %*	*1 %*	*- 26 %*	*8 %*	*5 %*
Indebtedness	Debt/total value of assets	*0 %*	*16 %*	*0 %*	*0 %*	*0 %*
Energy efficiency	Energy costs per kg of fish produced (in €/kg)	*0.05*	*0.04*	*0.10*	*0.20*	*0.10*

In particular, smallholders struggle. Our results infer that the single (part-time) grow-out of carp for human consumption of small scaled carp farms is not profitable any more. Smaller farms like DE-FCP-5 and PL-FCP-10 hardly overcome the challenges of our time. Because of the nature of economies of scale, they have to cover higher fixed costs. Further, they are hardly able to adapt new business strategies on their own. It is a vicious circle: As small scale carp farming is un-profitable, fish farming is not carp farmer's core business; as it is not carp farmer's core business, the degree of innovativeness and capital for investments needed for adaptation are very low. But, in particular in the Aischgrund, where small-scaled carp farms characterize the landscape and the landscape attracts tourists, a disappearance of (small) carp farming would cause a serious crisis for the whole region.

In contrast, larger farms in Poland (PL-FCP-190) have intensified their production, which let them profit from scale effects and high productivity. They have to compete on Polish national market and lower their costs via intensification of production. Other farms like DE-FCP-20 and PL-FCP-90 have paved already the way of closing the carp production cycle as well as diversifying their business. This lowers costs for fingerlings, makes them less vulnerable towards diseases and offers the opportunity to sell fish for re-stocking or fish for human consumption directly to the consumer. Notwithstanding, DE-FCP-20 stocking costs have increased significantly and are higher compared to PL-FCP-90, because its production cycle suffer from fish losses caused by cormorant and other predators. This factor negatively influences DE-FCP-20 overall profitability. The carp farmer can hardly balance this (extra) cost factor by new investments (resulting in the only notable indebtedness out of the sample), the high labour productivity and good energy efficiency.

[28] 1.83 €/kg Live Weight (LW) compared to around 2.00 €/kg LW in PL and 2.30 €/kg LW in DE (wholesale price). In addition, private carp farmers in Barycz Valley compete with the public combine Stawy Milickie.

Thinking in long terms, which mean to consider the total costs (cash costs, linear depreciation and opportunity costs), higher returns are needed to ensure economic sustainability for all model farms of the sample. Taking the current cost structure into account, mean returns of 2.68 €/kg Live Weight of carp (LW) (DE-FCP-20) up to 3.82 €/kg LW (DE-FCP-5) in the Aischgrund and mean returns of 2.95 €/kg LW (PL-FCP-90) up to 3.25 €/kg LW (PL-FCP-190) seems to be necessary.

3.7.4.2 Economic sustainability - Economic dependency

Common carp definitely dominate carp aquaculture as a species, beside the fact that a range of other species - mainly sturgeon (*Acipenser ruthenus*), tench (*Tinca tinca*), pike (*Esox lucius*), perch (*Perca fluviatilis*), European cat fish (*Silurus glanis*) and pike perch (*Sander lucioperca*) - are cultured in addition. **Export** sale channels do not play a role for Polish and German carp farmers.

In contrast to other kinds of aquacultures, **livestock** costs (stocking fingerling) is the most important cost position in carp farming; not feed. In the Aischgrund, the high mortality of carp fry, which is one summer old and has a final weight of 25 g per piece, can reach 75 % due to predation by cormorants and other wildlife. For two summer old carp fingerling with a final weight of 300 g per piece the mortality is still between 50 % and 60 %. In consequence, the costs for stocking, can count for up to 37 % of operational and capital costs. Thus, they are significantly higher in the Aischgrund than in Barycz Valley, where livestock costs oscillate around 20 % for the carp farms. One explanation for this remarkable difference can be seen in a better and more aquaculture friendly wildlife management, which leads to a reduced fingerlings' loss caused by predators. Further, Carp grow-out is a very **labour** intensive production system: feeding, maintaining the dams, liming the pond and harvesting the fish are usually done with low machine use. Farmers of small enterprises generally work on their own (unpaid labour), while larger farms have permanent labour. In both cases, the labour costs count usually for around 10 % up to 20 % of operational and capital costs. Depending on the type of farm, **feed** costs (mainly grain) fluctuate in a similar rage, with exception of PL-FCP-90, where an unusually low stocking density might explain the comparable high dependency on feed input.

All other cost positions can be neglected in their importance of the operational cost structure. So it is for **energy** costs, where only a little consumption of fuel and power – mainly used for aeration in hot summer months – takes place. The share of fixed costs is higher in smaller farms than in larger farmers due to economies of scale.

Table: Economic dependency by production system, 2015

Indicator	Variable	DE-FCP-5	DE-FCP-20	PL-FCP-10	PL-FCP-90	PL-FCP-190
dependency on species	N80*	*1*	*1*	*1*	*1*	*1*
dependency on external trade	Share of production exported (in value)	*0.75 %*	*0.75 %*	*0.1 %*	*0.1 %*	*0.1 %*
dependency on energy	Share of energy costs in total costs	*2 %*	*1 %*	*3 %*	*6 %*	*4 %*
dependency on inputs	Share of feed costs in total costs	*9 %*	*17 %*	*11 %*	*18 %*	*27 %*

**Number of species making up 80% of total production in value*

3.7.4.3 Social sustainability – Employment conditions and attractiveness of the sector

The overwhelming majority of (part-time) carp farmers are not skilled fish farmers, but self-educated fish farmers. In Germany and particular for these typical smallholders in the Aischgrund, the interviews with farmers and stakeholders carried out a lack of skilled successors. The carp farmers see the permanent unprofitability of small-scaled carp farms as main reason for this phenomenon. Together with the hard work of carp culturing, it makes the succession of the business unattractive for young people in the Aischgrund. Moreover, there are a range of alternative sources of income working in the close-by metropolitan area Erlangen-Nuremberg. Taking into account that the majority of today carp farmers are advanced age, this situation endangers the future of the carp farming heritage in general.

The case of DE-FCP-5 shows that carp farming in the Aischgrund is done in part-time typically. Here, the carp farmer only works 363 h/year at the carp grow-out, which counts for 0.27 FTE. The concerned farmer invests 2/3 of his working time in an employment and his agricultural farm. Further, an increase of work-input in the carp enterprise would not automatically lead to a higher profitability, because of imbalances in the supply-chain and the high fish loss due cormorants in hatcheries and nurseries, which itself lead to a high price for fry and fingerlings. Both factors are hardly to influence by local carp farmers. The comparable high labour costs for own labour in this case results from the reference of his opportunity cost, which is an employee's salary. In contrast, DE-FCP-20 owner is a trained farmer with lower opportunity costs for his own labour.

The situation in Barycz Valley is much more positive. Because of a significant higher profitability of the professional farms PL-FCP-90 and PL-FCP-190 and the fact, that these farms provide a sufficient single subsistence by simultaneous absence of a very near metropolitan area, the carp farmers' business seems to be more attractive for successors. At the same time, it provides (full-time) jobs for people in the rural area.

Employment conditions by production system, 2015

Indicator	**Variable**	**DE-FCP-5**	**DE-FCP-20**	**PL-FCP-10**	**PL-FCP-90**	**PL-FCP-190**
Use of temporary employment	Total employees/FTE	*0*	*0*	*1*	*1.5*	*1.4*
Recourse to family work	Share of unpaid labour in labour costs	*100 %*	*100 %*	*35 %*	*52 %*	*48 %*
Level of remuneration of work	Labour costs/FTE (in €/FTE)	*16,416*	*8,704*	*11,600*	*10,500*	*15,600*

3.7.4.4 Environmental sustainability

Almost 15 % of ponds in the Aischgrund are classified as nature reserves, as special protected area or as "Natura 2000" area. The fish ponds in Barycz Valley are Europe's largest carp breeding center and Poland's largest nature reserve including valuable ornithological centers at the same time. Carp farms consume very low energy in terms of power, fuel or oxygen. Further, additional fish feed consists usually of grain without any animal protein ingredients like fish meal or fish oil. In consequence, it is not surprising, that literature describes carp farming as a very good example of sustainable food production with positive externalities for nature and society. With its polyculture and extensive rearing methods, carp farming can be seen as an aquaculture with low input and impact (Blanchard *et al.* 2017), which provides important ecosystem services (Blayac *et al.* 2014, Hutchinson 2006) at the same time. Applying the Millennium Ecosystem Assessment list (2005), Blayac *et al.* (2014) attempt to assess the different values - provisioning, regulating, cultural and supporting services - provided by pond fish farming in the East of France. Another study on the positive externalities of fish ponds is developed by Mathé & Rey-Valette (2005). Using the ecosystem services framework, the work of Cereghino *et al.* (2014) show the supporting services linked to carp ponds as they serve as natural enclaves of nature and support biological diversity. Supporting and regulating services of extensive fish ponds are also underlined by Cieśla *et al.* (2009) as ponds are simultaneously water reservoirs and thereby provide a habitat for wild aquatic animals and plants. To sum up, there is a strong link between the carp farming activity and its environment. Without the ponds, the nature and landscape would not be those of today. At the same time, the biological reserve generated and maintained by the ponds leads to a difficult coexistence with the carp farmers due to bird attacks and environmental regulations.

3.7.4.5 Governance

In contrast to the fact, that the fisheries and aquaculture sector is comparable small in Germany, there are several organizations representing different stakeholders of the sector. Against the background of the Federal Principle, there are representative institutions on federal state level and federal republic level. The following is a brief overview of existing organizations rather than an exhaustive list:

The Ministry of Food and Agriculture is the heading governmental authority for aquaculture in national areas, which is mostly the cultivation of mussels in near of the coast line. In case of inland aquaculture, in the 16 federal states, the ministries of agriculture, consumer protection, economy or environment are usually responsible for aquaculture. Depending on the importance of the aquaculture sector for the federal state, each state has at least one (supreme) fishery authority. The federal states of Bavaria, Baden-Württemberg, Saxony, Brandenburg, Mecklenburg-Vorpommern maintain their own research structure on aquaculture and inland fisheries. Further, those institutions are often responsible for consulting, qualification and education of the fish farmers, too. In some federal states, those services are not provided by research stations but by the federal Chambers of Agriculture, which are a kind of private public partnership.

Fish farmers are organized on regional, federal and national level. Usually, the regional fish farmer associations are automatically member of the concerning federal fish farmer associations, which is for its part member of a national fish farmer association. Most important the “Deutscher Fischerei-Verband” (DFV; German Fishers’ Association) represents the interests of marine and inland fishers as well as fish farmers. The “Verband der Deutschen Binnenfischerei und Aquakultur” (VDBA; Association of German Inland Fisheries and Aquaculture) addresses the topics of inland fish farmers as one out of four sub-groups of the umbrella organization DFV. Every federal state has at least one fish farmer association, which is again member of the VDBA. In 2011, the “Bundesverband Aquakultur” (Federal Republic Association of Aquaculture) was founded. The members are from different stages of the supply chain and not exclusively fish farmers. The World Wide Fund for Nature (WWF), Greenpeace, “Bund for Umwelt und Naturschutz Deutschland” (BUND) and the “Naturschutzbund Deutschland” are the most active non-governmental organisations on national level, which deal with aquaculture topics in public. In common, the mentioned NGOs concern about environmental risks from conventional aquacultures, but usually not from carp farms[29].

The Polish national administration in the area of fish farming is the Department of Fisheries in Ministry of Maritime Affairs and Inland Navigation (Ministerstwo Gospodarki Morskiej i Żeglugi Śródlądowej). The Stanisław Sakowicz Inland Fisheries Institute (IFI) in Olsztyn is the research institute subjected to Ministry of Maritime Affairs and Inland Navigation and focused on the cooperation with the aquaculture sector. Also important role for fish farming plays the Ministry of Environment which established the legislation in the area of environment protection, utilisation of water and waste water treatment e. g. Water Law Act. The local authorities mainly county authorities are responsible for issuing permits e.g. water or building permits and control its fulfilment. The county veterinary inspectors supervise the health safety of the farmed and sold fish. Currently there are two aquaculture production organizations which are inscribed on the ministerial list of the production organizations: Organization of Sturgeons Fish Producers in Toruń and the Association of Fish Producers – Producer Organization in Poznań. There are two others fish associations that comprise the carp producers: Polish Fishermen's Association in Poznań and the Association of Fish Promotion in Toruń. There is also one organization focused on the trout producers - Polish Trout Breeders Association registered in 2007, which belongs to Federation of European Aquaculture Producers. The membership in those associations is voluntary. The aim of those associations is the representation and participation of the carp and other fish producers in governmental and European law consultation. Those associations organize the fish conferences, seminars, workshops, and inform the fish producers about the legislation and technological changes important for them on the websites or in the publications.

3.7.5 General outcomes

Carp **supply chain** is short and focused on domestic or even regional market due to small share of processing. Scale of production determinates the share of costs types which is an important factor of the distribution strategy chosen by farmers. With higher production scale the share of capital cost increases, the costs of labour decrease. Anyway, the single grow-out and the traditional distribution of almost unprocessed fresh carp is **not profitable for smallholders** anymore. The sum of total costs is higher than the current weighted mean of market returns. At the same time carp farmers face many challenges from changed consumers' preferences to rural flight. There are only limited adaptation strategies to improve their profitability: upscaling, specialization, vertical integration and diversification. Further development of processing technology and promotion of carp as healthy, easy to prepare, 'all-year' product seems to be a (but not easy) path to increase demand. Moreover, the diversification of fish farming activities seems to be one of the most promising ways to increase sales revenue and financial condition of the entire farms.

Since the millennium and often supported by EU programs regional stakeholders have established a wide range of **region marketing** initiatives to attract tourists or strengthen the local identity with carp farming in the Aischgrund and Barycz Valley. Our fieldwork leads to the impression that stakeholder in both regions have understand the today's challenges of carp regions as well as how to meet them. Large farms in Poland (PL-FCP-190) have specialized their production. They have to

[29] Cf. The most radical (and disputed) fish consumption guide from Greenpeace, where carp is the only species, which is recommended without any concerns (Greenpeace 2018).

compete on Polish national market and lower their costs via intensification of production. A well-recognized, positive image of the carp region might be advantageously for the national distribution of their carp. For medium scaled farms (DE-FCP-20 and PL-FCP-90), the way of closing the carp production cycle as well as diversifying their business is already paved. For small farms (DE-FCP-5 and PL-FCP-10) upscaling, specialization or diversification is hardly put into practice. If they are not able to work closer together, far beyond the existing pond cooperatives in the Aischgrund towards real production, storage and marketing cooperatives to shorten the supply chain and strengthen their position within, small scale carp farming will further solidify as a hobby. Medium farms could directly benefit through higher customer frequency as a result of the region marketing, if their direct marketing is developed. But, how to let the small farms gain from the region's profit of a developing tourism sector?

One possibility could be a **remuneration of the multi-functionality** of carp farms, which preserve the unique landscape they created and provide various ecosystem services for the society. Reformed public programs should include compensation payments for fish loss through protected wildlife like it is common in the German wolves' resettlement programs. Further, a private transfer payment could contain a "visitors carp tax" system, which integrates a low extra payment for each touristic overnight stay or carp meal served in the restaurant. These payments seem to be necessary to enhance the profitability of small-scaled carp farms and thus the positive externalities resulting from the unique pond landscape for the society. The regional carp label for local restaurants in the Aischgrund is already a starting point. All these private payments could be collected in a fund, which pays small scale farmers a subsidy per pond ha as recognition for their contribution towards the attractiveness of the region. Without their farming, ponds overgrow and turn into fallow land in a few years. The regions would lose the core of the region: the carp pond landscapes.

References

Blanchard, J. L., Watson, R. A., Fulton, E. A., Cottrell, R. S., Nash, K. L., Bryndum-Buchholz, A., Büchner, M., Carozza, D. A., Cheung, W. W. L., Elliott, J., Davidson, L. N. K., Dulvy, N. K., Dunne, J. P., Eddy, T. D., Galbraith, E., Lotze, H. K., Maury, O., Müller, C., Tittensor, D. P., & Jennings S. (2017). Linked sustainability challenges and trade-offs among fisheries, aquaculture and agriculture. Nature, Ecology & Evolution, 1, 1240-1249. doi: 10.1038/s41559-017-0258-8

Blayac, T., Mathé, S., Rey-Valette, H. and Fontaine, P. (2014). Perceptions of the services provided by pond fish farming in Lorraine (France), Ecological Economics, 108, 115-123.

BLE (2017). Answer of the Federal Office for Agriculture and Food on request of Dr Tobias Lasner, Thünen Institute of Fisheries Ecology. The German Seafood Market, annual data with focus on carp imports from 2000 to 2015. Unpublished (March 23rd, 2017).

Cereghino, R., Boix, D., Cauchie, H., Martens, K., & Oertli, B. (2014). The ecological role of ponds in a changing world. Hydrobiologia, 723 (1), 1-6. doi: 10.1007/s10750-013-1719-y

Cieśla, M., Błaszczak, B., & Lirski, A. (2009). Traditional carp farming in Poland as an example of sustainable animal production. Animal Science, 46, 329-337.

Currie, C. (1991). The early history of carp and its economic significance in England. The Agricultural History Review, 39 (2): 97-107.

Destatis (2014). Erzeugung in Aquakulturbetrieben 2013. Fachserie 3, Reihe 4.6. Land und Forstwirtschaft, Fischerei. Statistisches Bundesamt, Wiesbaden. (transl. Production of aquaculture farms 2013. Vol. 3, issue 4.6. Agriculture and forestry, fisheries. National Agency for Statistics, Wiesbaden).

EUMOFA (2016). European Market Observatory for Fisheries and Aquaculture Products. Case study. Price structure in the supply chain for fresh carp in Central Europe. European Commission, Directorate-General for Maritime Affairs and Fisheries, Brussels.

FAO (2017). Cyprinus carpio (Linnaeus, 1758). Cultured Aquatic Species Information Programme of the Food and Agriculture Organization of the United Nations. Retrieved from http://www.fao.org/fishery/culturedspecies/Cyprinus_carpio/en#tcNA003C (October 25th, 2017).

FEAP (2016). European Aquaculture Production Report 2007-2015. Prepared by the Federation of European Aquaculture Producers (FEAP), Liege.

Füllner, G., Pfeifer, M., & Langner, N. (2007). Karpfenteichwirtschaft. Bewirtschaftung von Karpfenteichen. Gute fachliche Praxis. Sächsische Landesanstalt für Landwirtschaft, Dresden. (transl. *Carp aquaculture. Farming carp ponds. Best practices*. Saxony State Agency for Agriculture, Dresden).

Greenpeace (2018). Fisch-Ratgeber 2014 online. Online source accessed on 2018/03/23. (transl. *Fish (Shopping) Guide 2014 online*). http://www.greenpeace.org/austria/Global/austria/code/2014/fish-guide/fish-guide-full.html?c=de

Hutchinson, L. (2006). Ecological aquaculture. A sustainable solution. Permanent Publications Hyden House, East Meon, Hampshire.

Klinkhardt, M. (2014). Wieviel Fisch erzeugen wir wirklich? FischMagazin, 10, 3. (transl. *How much fish do we really produce?* FischMagazin, 10, 3).

Lasner, T., Brinker, A., Nielsen, R. & Rad F. (2017). Establishing a Benchmarking for Fish Farming. Profitability, Productivity and Energy Efficiency of German, Danish and Turkish Rainbow Trout Grow-out Systems. Aquaculture Research, 48, 3134-3148. Lirski and Myszkowski (2015)

Mathé, S. and Rey-Valette, H. (2015). Local knowledge of pond fish-farming ecosystem services : Management implications of stakeholders' perception in three different context (Brazil, France and Indonesia), Sustainability, 7, 7644-7666.

Millennium Ecosystem Assessment (2005). Ecosystem and Human Well-being : A Framework for Assessment. Island Press, Washington DC.Ministerstwo Rolnictwa i Rozwoju Wsi (2017, October 25). Stawy rybne. (transl. Ministry of Agriculture and Rural Development. Fish ponds). Retrieved from www.minrol.gov.pl

Mück, W. (2013). Überlegungen zum Beginn der Teichwirtschaft im Aischgrund. In Geschichts- und Heimatverein Neustadt an der Aisch (Hrsg.), Aischgründer Karpfenmuseum im Kulturareal Altes Schloss. Druckerei Münch, Neustadt an der Aisch. (transl. *Thoughts about the beginning of carp farming in the Aischgrund. In History and Homeland Association Neustadt a. d. Aisch (Eds.), The Carp museum in the Culture Forum of the Old Castle*. Printery Münch, Neustadt an der Aisch).

Oberle, M. (2016). Face-to-face interview with Dr Martin Oberle, Head of Carp Farming Department, Bavarian Institute of Fisheries, Bavarian State Agency for Agriculture, Höchstadt i. A. on June 30th, 2016.

Oberle, M. (2015). Phone interview with Dr Martin Oberle, Head of Carp Farming Department, Bavarian Institute of Fisheries, Bavarian State Agency for Agriculture, Höchstadt i. A. on September 18th, 2015.

Rösch, R. (2015). Phone interview with Dr Roland Rösch, senior researcher, Fisheries Research Station of Baden-Württemberg, Langenargen on October 8th, 2015.

Speierl, T., Abt, S., Schwinger, V., Kuhlen, K. & Thoma, P. (2017). Rückblick auf den Hitzesommer 2015 – Auswirkungen auf die Teichwirtschaft in Oberfranken. In: Fischer & Teichwirt 05/2017, 167-170. (transl. *Review of the hot summer 2015 – impacts on the fish farming in Upper Franconia*. In: Fischer & Teichwirt 06/2016, 167-170).

4 A tool for comparative analysis of economic indicators using AER time-series

As part of Task 3.4 to identify quantitative and qualitative indicators, in order to evaluate the competitiveness and sustainability of fisheries and aquaculture, a tool was developed in Microsoft Excel to provide those indicators using available fisheries data with some degree of automation for case study analysis. Fisheries case studies cover whitefish, flatfish and coastal fish.

This section provides a summary of the tool developed, data used and an example of it in use for a selected case study. The tool described is implemented with fisheries data.

4.1 Indicators selected

The indicators selected (see Appendix 7.1) have been developed for both fisheries and aquaculture case studies. This common list of indicators includes a process of describing the indicators, with comments about the reliability and coverage of the data. The data and indicators calculated are done so at a fleet level and therefore a case study may have several fleets which contribute to the analysis of the competitiveness and sustainability for that case study. The environmental indicators cannot be calculated by the indicator tool, these must be addressed by the user from other sources, e.g. http://www.ices.dk/ .

Note that the reference year for comparing data between case-studies and countries is 2014. This was determined as the year for which most complete data across fleets is available. In cases where 2014 data is missing then the most recent data available is used. Time series analysis using the indicators is possible, however it is dependent on the availability of data

4.2 Data

Fleet economics data in the EU is collected by is the Scientific, Technical and Economic Committee for Fisheries (STECF) as part of the Annual Economic Report (AER). The AER dataset is one component of the Data Collection Framework (DCF) that collects data annually by member states and reported to the EU. This data includes the economics of fishing fleets as well as landings and other data. It is compiled on a yearly basis and is designed to report the costs and earnings of the main fleet segments for the European Union fleets.

The landings data collected is typically provided from national log books submitted by fishing vessels and is based on complete datasets. Fleet economic data, even though it is sometimes collected by regulation in member states, it is more generally sampled from vessels at a fleet level through survey and data obtained through fishing company accounts.

The landings and economics data reported in the AER is presented at the fleet level, that is country, main fishing gear and vessel length level by year. Landings weights and values are also available for ICES sub-area for each fleet. In the 2016 report, data from 2008-2014 is presented. Therefore, cost data covers fleets operating over a wide area and may include vessels that exploit several different target species in several sea areas. For example, UK whitefish vessels, typically fishing with mesh size

greater than 100mm, are part of the same fleet segment in the AER as UK nephrops vessels, typically fishing with mesh size between 80-100mm – in addition the fleet segment does not differentiate differences in costs between the fleets operating on the West of Scotland or in the North Sea.
In addition to the selected indicators, the tool also summarises the data held for a fleet segment on the physical characteristics of the fleets, e.g. number of vessels, total days fished, number of employees etc.

Note also the trade data is summarized in the tool from EUMOFA.

4.3 Process

The indicator tool includes three pivot tables, for economics, landings weight and landings value, where the fleet to be summarised must be selected. These are based on landings and economics data worksheets from the AER and trade data from EUMOFA. It is the responsibility of the user to make sure the fleet selected for each pivot table are all the same. Then there are two output sheets: data summary and selected indicators.

4.4 Calculating the indicators of fleets

The data from the AER regarding landings and economics, and the data from EUMOFA regarding trade are summarised in the first output worksheet ("Indicator Data Summary Report"). This report is shown for the UK 24-40m demersal trawl/seine fleet in Figure 12.
There are six sections to this report describing the main data for the selected fleet:

- Fleet structure – vessel age, days at sea, engine power, number of vessels etc
- Employment – full time equivalent and total employed
- Other indicators – energy (i.e. fuel) consumption, fishing rights etc
- Economics – calculation of economic performance of the selected fleet using income and costs
- Landings – a summary of landings weight, value and number of main species
- Trade – total value of exports for the country selected

The calculation of fleet performance in the economics section follows the following form (raw data in bold):

- Income = **income from landings** + **other income** + **direct subsidies** + **income from fishing rights**
- Operating costs = (**repair costs** + **other non-variable costs**) + (**energy costs** + **other variable costs**)
- Operating (gross) profit = Income – **crew costs** – Operating costs
- Gross value added = Operating (gross) profit + **crew costs**
- Net profit = Operating (gross) profit – **annual depreciation** – Operating cost of capital

From these calculations and collated data, the indicators described in Appendix A are presented in the second output worksheet ("SUCCESS WP3 Indicators"). This report is shown for the same fleet as above (i.e. UK 24-40m demersal trawl/seine fleet) in Figure 13.

As shown, the main economic and social indicators are provided from the data described above for all years provided in the data, in the AER dataset used 2008 to 2014.

Information for the environmental indicators is sourced from ICES working documents and other national analysis of the target species for the selected fleet.

Figure 12. Indicator data summary report for the selected fleet, in this case UK 24-40m demersal trawl/seine

Indicator Data Summary Report

country_code	GBR	Discount rate:	3.0%
supra_reg	(All)		
fishing_tech	DTS		
vessel_length	VL2440		

FLEET STRUCTURE

Indicator name	Unit	Indicator code	Source	2008	2009	2010	2011	2012	2013	2014
Average vessel age	years	avgage	STECF AER (2016)	21	21	21	21	22	23	23
Average vessel length	metres	avgloa	STECF AER (2016)	28	28	28	28	28	28	28
Fishing days	days	totfishdays	STECF AER (2016)	19,331	19,657	18,707	16,620	14,650	14,212	13,856
Vessel tonnage	tonnes	totgt	STECF AER (2016)	29,696	29,054	28,646	27,546	25,953	25,037	23,089
GT fishing day	gtdays	totgtfishdays	STECF AER (2016)	5,443,927	5,619,719	5,441,214	4,896,436	4,336,217	4,138,377	4,015,231
Engine power	kw	totkw	STECF AER (2016)	70,652	68,002	65,524	62,553	59,172	55,432	50,646
kW fishing days	kwdays	totkwfishdays	STECF AER (2016)	12,513,295	12,847,455	12,115,684	10,880,765	9,571,389	8,873,810	8,583,288
Days at sea	days	totseadays	STECF AER (2016)	22,733	22,637	21,523	19,700	17,441	16,987	16,470
Number of fishing trips	trips	tottrips	STECF AER (2016)	3,371	3,648	3,539	3,466	3,225	3,319	3,218
Total number of vessels	vessels	totves	STECF AER (2016)	220	216	210	200	190	182	170

EMPLOYMENT

Indicator name	Unit	Indicator code		2008	2009	2010	2011	2012	2013	2014
Full-time equivalent (national)	fte	totnatfte	STECF AER (2016)	976	1,330	1,258	1,175	992	917	889
Full-time equivalent (harmonised)	fte	totharmfte	STECF AER (2016)	976	1,330	1,258	1,175	992	917	889
Total employed	job	totjob	STECF AER (2016)	909	828	857	779	787	728	722

OTHER INDICATORS

Indicator name	Unit	Indicator code		2008	2009	2010	2011	2012	2013	2014
Energy consumption	litres?	totenercons	STECF AER (2016)	59,429,500	60,817,900	57,125,450	52,834,700	47,126,550	43,074,950	41,559,450
Financial position	%age	finpos	STECF AER (2016)	94	70	53	48	59	36	37
Fishing rights	euros	totrights	STECF AER (2016)	38,412,820	38,696,001	48,565,706	58,128,552	77,711,776	37,382,533	39,911,722

ECONOMICS

Indicator name	Unit	Indicator code		2008	2009	2010	2011	2012	2013	2014
Direct income subsidies	euros	totdirsub	STECF AER (2016)	0	0	0	0	0	0	0
Income from leasing fishing rights	euros	totrightsinc	STECF AER (2016)	0	451,590	702,639	437,901	1,435,319	621,322	794,138
Income from landings	euros	totlandginc	STECF AER (2016)	116,119,551	107,588,884	124,410,872	128,686,076	130,982,775	128,115,998	145,720,586
Other income	euros	tototherinc	STECF AER (2016)	4,331,181	1,525,244	2,420,883	2,868,262	5,886,056	7,818,717	10,005,827
TOTAL INCOME	**euros**			**120,450,732**	**109,565,719**	**127,534,394**	**131,992,240**	**138,304,150**	**136,556,037**	**156,520,551**
Wages and salaries of crew	euros	totcrewwage	STECF AER (2016)	26,852,756	26,078,084	26,921,037	25,710,389	28,306,779	28,811,944	33,554,067
Energy costs	euros	totenercost	STECF AER (2016)	33,786,775	24,137,663	26,963,181	33,336,729	32,854,389	27,982,538	25,983,679
Other non-variable costs	euros	totnovarcost	STECF AER (2016)	7,752,657	6,887,156	9,230,134	6,929,011	7,645,547	8,140,361	7,981,306
Other variable costs	euros	totvarcost	STECF AER (2016)	26,444,852	25,482,298	24,537,017	24,844,271	30,180,983	26,367,102	31,544,542
Repair & maintenance costs	euros	totrepcost	STECF AER (2016)	12,472,977	10,527,963	11,482,282	11,536,959	12,279,882	11,880,594	14,131,997
Rights costs	euros	totrightscost	STECF AER (2016)	5,967,069	8,141,576	10,376,908	12,987,451	16,185,737	18,724,901	18,822,573
Capital asset value	euros			113,499,749	105,704,686	116,537,906	120,625,144	130,820,247	88,448,528	89,657,879
Unpaid labour value	euros	totunpaidlab	STECF AER (2016)	0	0	0	0	0	0	0
TOTAL EXPENDITURE	euros			113,277,086	101,254,740	109,510,559	115,344,811	127,453,317	121,907,440	132,018,165
GROSS PROFIT	**euros**			**7,173,647**	**8,310,979**	**18,023,835**	**16,647,429**	**10,850,833**	**14,648,597**	**24,502,386**
GROSS VALUE ADDED (GVA)	euros			34,026,403	34,389,063	44,944,871	42,357,818	39,157,611	43,460,541	58,056,453
Annual depreciation costs	euros	totdepcost	STECF AER (2016)	8,768,294	9,980,115	11,306,658	11,018,992	8,135,778	6,799,039	7,521,385
Tangible asset value (replacement)	euros	totdeprep	STECF AER (2016)	75,086,929	67,008,685	67,972,199	62,496,592	53,108,470	51,065,995	49,746,157
OCC	euros			2,252,608	2,010,261	2,039,166	1,874,898	1,593,254	1,531,980	1,492,385
NET PROFIT	**euros**			**-3,847,255**	**-3,679,396**	**4,678,010**	**3,753,539**	**1,121,800**	**6,317,578**	**15,488,617**
Competitiveness				-3%	-3%	4%	3%	1%	5%	10%

LANDINGS

Indicator name	Unit	Indicator code		2008	2009	2010	2011	2012	2013	2014
Landings weight	tonnes		STECF AER (2016)	59,527	64,039	63,628	60,623	64,036	69,576	67,879
Landings value	euros		STECF AER (2016)	116,330,194	107,580,080	124,140,807	128,481,166	130,809,119	127,927,132	145,294,579
#species at 80% value	number			8	8	8	8	8	8	7

TRADE

Indicator name	Unit	Indicator code		2008	2009	2010	2011	2012	2013	2014
Total exports	euros		EUMOFA (2017)	1,308,405,040	1,348,815,530	1,599,885,770	1,766,193,930	1,736,342,250	1,834,148,880	2,023,434,200

Figure 13. SUCCESS Indicators for fisheries as described in Appendix A

SUCCESS WP3 Indicators

country_code	**GBR**
supra_reg	**(All)**
fishing_tech	**DTS**
vessel_length	**VL2440**

Indicator	Variable (see common templates Fisheries and Aquaculture)	Unit	2008	2009	2010	2011	2012	2013	2014
ECONOMIC									
Labour productivity	GVA/FTE	Euro	34,868	25,851	35,724	36,034	39,466	47,417	65,286
Profitability	Return of fixed tangible assets	%	-2%	-2%	10%	9%	5%	15%	34%
	Return on investment		-3%	-3%	4%	3%	1%	7%	17%
Competitiveness	Net profit/Total income	%	-3%	-3%	4%	3%	1%	5%	10%
Indebtedness	Debt/capital ratio	%	94%	70%	53%	48%	59%	36%	37%
Energy efficiency (fuel)	Litres of fuel consumed per kilo landed	L/kg	998	950	898	872	736	619	612
Economic dependency on species	N80: number of species making up 80% of the total production in value	Number	8	8	8	8	8	8	7
Economic dependency on external trade	Rate of exports (Exports/total production in value)	%	8.9%	8.0%	7.8%	7.3%	7.5%	7.0%	7.2%
Economic dependency on energy	% of fuel costs compared to value of landings	%	29%	22%	22%	26%	25%	22%	18%
SOCIAL									
Use of temporary/seasonal employment	Total employees/FTE	/	0.93	0.62	0.68	0.66	0.79	0.79	0.81
Level of remuneration of work	Labour costs (Crew wage + unpaid)/FTE/ Days at sea	Euro/FTE/Days	1.21	0.87	0.99	1.11	1.64	1.85	2.29
ENVIRONMENTAL									
State of stocks	For each of the main species (3-5), what is the state of the main exploited stocks?	?							

4.5 Best practice example to describe the fleet and its relevance to the case study

As above the fleet selected for demonstration is the UK 24-40m demersal trawl/seine fleet. The case study to which it relates is whitefish. This case study is identified as matching the DCF fleet segment.

A summary of the relevance of this fleet to the case study is given below (taken from D3.3):

> "For all STECF AER (2016) data for this fleet segment, it covers activity around the whole of the UK coast. The majority of vessels are estimated to target similar stocks using the same fishing method, so although the number of vessels is slightly over-estimated the average vessel is accepted to be representative of those in the case study area, although it is noted that there is some variability in this fleet segment.
>
> This fleet segment lands whitefish from the Northern North Sea and Western Scotland and also fishes in the Western Approaches (i.e. ICES sub-areas 7hjk). The North Sea and Western Scotland fleet segment focuses on Cod (94%), Haddock (95%), Saithe (93%) and Hake (81%). The Western Approaches fleet segment focuses on Anglerfish (36%), Megrim (48%) and Hake (13%) in addition to non-quota species, e.g. squid. The percentage value of landings for this fleet from the North Sea and West of Scotland is 73%. Therefore, this fleet is partly mixed but represents whitefish in the North Sea and West of Scotland mostly."

To complete the environmental indicators, a separate analysis was undertaken using ICES data to evaluate the species that represent 80% of the value of landings for the selected fleet. For the example fleet above, seven species are identified and the stocks relevant are assessed with regard to stock status. The results from this analysis are presented in Table 3.

Table 3. Environmental indicators for the main stocks landed (source: ICES, 2016)

Species	Stock	Stock status
Haddock	**Haddock (Melanogrammus aeglefinus) in Subarea 4, Division 6.a, and Subdivision 3.a.20 (North Sea, West of Scotland, Skagerrak)** - Fishing mortality (F) is above FMSY and SSB is below MSY Btrigger, it is a highly variable stock	*Overexploited*
Cod	**Cod (Gadus morhua) in Subarea 4, Division 7.d and Subdivision 3.a.20 (North Sea, eastern English Channel, Skagerrak)** - Fishing mortality (F) and SSB are both tending towards and close to MSY Btrigger	*Sustainably exploited – even though FMSY and SSB have to be improved*
Anglerfish	**Anglerfish (Lophius piscatorius and L. budegassa) in subareas 4 and 6 and Division 3.a (North Sea, Rockall and West of Scotland, Skagerrak and Kattegat)** - reference points for this stock are not definde but relative stock size has been increasing in recent years and fishing mortality decreasing.	*Stock status is unknown*
Megrim	**Megrim (Lepidorhombus spp.) in divisions 4.a and 6.a (northern North Sea, West of Scotland)** - Fishing mortality (F) is well below FMSY and SSB is above MSY Btrigger	*Sustainably exploited*
Whiting	**Whiting (Merlangius merlangus) in Subarea 4 and Division 7.d (North Sea and eastern English Channel)** - SSB fluctuates around MSY Btrigger but Fishing mortality (F) is above FMSY	Overexploited
Saithe	***Saithe (Pollachius virens) in subareas 4 and 6 and Division 3.a (North Sea, Rockall and West of Scotland, Skagerrak and Kattegat)*** *- Fishing mortality (F) is below FMSY and SSB is above MSY Btrigger*	*Sustainably exploited*
Squid	Not a quota species, no known assessment	Not assessed

5 Outcomes from the comparison

With the contribution of fisheries at 80% and aquaculture at 20%, the EU seafood primary sector is 6,400 thousand tonnes and € 11.3 billion. It provides a large number of species and commodities not exhaustively covered in this report. However, the SUCCESS case studies account for 38% of the total volume and 55% of the total value of the EU production.

Among these case studies, the top 3 production sectors are in value salmonids (€ 1.6 billion, 14%), then the whitefish (€ 1.35 billion, 12%) and coastal fish (estimated at €1.09 billion, 10%). The most consumed species (Cod and Salmon) correspond to leading production sectors in the EU which are also the most dependent on the extra EU imports. According to the weight of EU production in global production, Seabass & seabream ranks first as a specialized production of Mediterranean countries, followed by Mussels and Flatfish. These three sectors are nearly self-sufficient at the EU level (over 70%) but they also concern lower level of consumption per capita at least on EU average.

Bearing in mind shortcomings on FTE and capital assessments (see below) and/or lack of coverage of some segments, economic performances of Fisheries and Aquaculture Production (FAP) sectors appear rather positive in 2014 with high variability within case studies. Economic dependency varies according to case studies and production systems within case studies: for instance, whitefish is the most dependent for all dimensions (species, energy and external market) while some flatfish productions systems may be strongly dependent on energy (traditional beam trawlers) or species (netters). In aquaculture, dependency is mainly related to monoculture and to feed for fish farming.

As already reported in previous SUCCESS reports, DCF data provided a valuable material for the assessment of economic, social and environmental sustainability. Fisheries data are collected from 2000 but time-series are available from 2008. They are covering almost all EU countries, yearly updated and focusing on economic performance of fleet segments (common and basic segmentation at EU level). For aquaculture segments, they are collected from 2008, but not yearly updated and with data still missing/unreliable for some segments and/or countries.

As a general conclusion of this report, the emphasis is put on the need for data improvement as regards availability, reliability and dissemination. DCF data allow the calculation of almost all the indicators except market oriented indicators (like export rates) and environmental indicators (state of stocks for fisheries). It should be noticed however that the quality or the availability of DCF data are not exhaustive as for instance FTEs, Capital or indebtedness. Notwithstanding, these variables are crucial for the calculation of economic performance indicators (Labour productivity based on GVA/FTE and ROFTA or ROI based on the value of capital).

When DCF data are reliable and complete, a tool for compiling data from the AER database and for building requested indicators was set up and shared with fisheries case study partners. But DCF data does not always provide relevant inputs for all fleet segments or aquaculture enterprises depending on the analysis scale and the level of specialisation (species, techniques or both). For fisheries, the involvement in seasonal fisheries for some vessels (scallop dredgers for instance) and the resulting versatility is poorly taken into account by the DCF methodology (segmentation). In addition, geographical diversity is not considered while it is often precisely at this scale that production systems are useful to analyse (example of small scale fisheries). These limits for approaching geographical heterogeneity and species diversification also exist for aquaculture case studies (e.g. shellfish farming). Bearing in mind the needs to limit and harmonize the segmentation, one option would be to give access to more disaggregated data for research needs often focusing on specific cases.

To recap, in order to assess all the dimensions (economic, environmental and social) of sustainability for fisheries and aquaculture sectors, current DCF data are essential but can be improved with:
- the harmonization of FTE and capital values calculation or at least better knowledge on methodologies used;
- the access to disaggregated data to assess specialisation/diversification and geographical variability of some production systems, note that these data already exist at national level but not available at EU level for research and expertise;
- the collection of additional data allowing a whole description of production systems including capital-ownership structure, vertical integration, or detailed information on labour (education, family involvement, nationality…);
- some market oriented and environmental indicators at producers' level.

6 References

SUCCESS Deliverables WP3 already submitted by the same authors:
D3.1 Basic description of regulation systems applied to case studies (2016)
D3.2 Description of production systems – Synthesis of availability of data (2017)
D3.3 Indicators Report per case studies (2017)

Other general references

Bostock J., Alistair L., Hough C., Yamamoto K. (2016), An assessment of the economic contribution of EU aquaculture production and the influence of policies for its sustainable development, Aquaculture International, June 2016, Volume 24, Issue 3, pp 699–733

EUMOFA (2017). The EU Fish market, European Commission, Maritime Affairs and Fisheries: 107p.

EUMOFA (2017). EU organic labelling. Last update May 2017:43p.

EUMOFA (2017). EU Consumer Habits regarding Fishery and Aquaculture Products - Final report: 66p.

European Commission (2016). Facts and Figures on the Common Fisheries Policy. Basic statistical data - 2016 Edition: 56 p.

European Commission (2016). Summary of the 27 Multiannual National Aquaculture Plans. DG for Maritime Affairs and Fisheries.

FAO (2016). The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all, FAO Rome: 200p.

Link, J. S., et al. (2017). "Keeping Humans in the Ecosystem." ICES Journal of Marine Science 74(7): 1947-1956.

Ghersi G. & Rastoin J-L., (2010), « Le système alimentaire mondial. Concepts et méthodes, analyses et dynamiques » Versailles, Éditions Quæ, 2010, 565 p.

SAPEA (2017). Food from the Oceans: How can more food and biomass be obtained from the oceans in a way that does not deprive future generations of their benefits? , (SAPEA) Science Advice for Policy by European Academies, Evidence Review Report No. 1: 160p.

STECF (2017). The 2017 Annual Economic Report on the EU Fishing Fleet (STECF-17-12), Scientific, Technical and Economic Committee for Fisheries (STECF), Publications Office of the European Union, Luxembourg: 494p.

STECF (2016). Economic report of EU aquaculture sector (STECF-16-19), Scientific, Technical and Economic Committee for Fisheries (STECF), Publications Office of the European Union, Luxembourg: 485p.

Sumaila, U. R., et al. (2016). "Fishing for the future: An overview of challenges and opportunities." Marine Policy 69: 8p.

Swartz, W., et al. (2010). "Sourcing seafood for the three major markets: The EU, Japan and the USA." Marine Policy 34(6): 1366-1373.

7 Appendices

At the end, 10 indicators are selected for fisheries and 12 for aquaculture.

7.1 Final list of indicators for Sustainability assessment

7.1.1 Economic indicators

Purpose	Indicator	Variable	Fisheries	Aquaculture	Measure unit	Potential source of information
Economic performance of production systems	Labour productivity	GVA/FTE	X	X	€/FTE	DCF
	Profitability	ROFTA = (Gross profit – depreciation cost of capital)/tangible asset value	X		ratio	DCF
		ROI = (EBIT/total value of assets)*100		X	%	DCF
	Indebtedness	Debt/capital ratio	X		ratio	DCF
		Debt/total value of assets		X	ratio	DCF
	Energy efficiency	Litres of fuel consumed per kilo landed	X		L/kg	DCF
		Energy costs per kg of fish or shellfish produced		X	€/kg	DCF
Economic dependency of production systems on external shocks	Economic dependency on species	N80: number of species making up 80% of the total production in value	X	X	Number	
	Economic dependency on external trade	Rate of export: (Exports/total production in value)*100	X	X	%	
	Economic dependency on energy	% of fuel costs compared to value of landings	X		%	DCF

Purpose	Indicator	Variable	Fisheries	Aquaculture	Measure unit	Potential source of information
		% of energy costs compared to total costs		X	%	DCF
	Economic dependency on inputs	% of feed costs compared to total costs		X	%	DCF

7.1.2 Social indicators

Purpose	Indicator	Variable	Fisheries	Aquaculture	Measure unit	Potential source of information
Employment conditions and attractivity of the fisheries and aquaculture sectors	Use of temporary/seasonal employment	Total employees/FTE	X	X	ratio	DCF
	Recourse to family work (unpaid labour)	% of imputed value of unpaid labour (on total labour costs)		X	%	DCF
	Level of Remuneration of work	Labour costs/FTE/day at sea	X		€/FTE/day	DCF
		Labour costs/FTE		X	€/FTE	DCF

7.1.3 Environmental indicators

Purpose	Indicator	Variable	Fisheries	Aquaculture	Measure unit	Potential source of information
Environmental sustainability	State of stocks	For each of the main species (3-5), what is the state of the main exploited stocks?	X		-	ICES or expert inputs
	Level of producers' involvement in sustainable practices	% of farms (or % of production in volume) complying with code of best practices or ecolabels or any environmental certifications (including organic labels)		X	%	

7.2 Preliminary list of indicators for Sustainability assessment

Components	Principles	Criteria	Indicators	DCF	D3.1	D3.2
Economic	Financial management	Productivity	Labour productivity: GVA/FTE	X		
			Energy productivity: GVA/energy costs	X		
		Profitability	Short-term profitability: GRP/total income	X		
			ROI = (EBIT/total value of assets)*100	X		
			ROFTA = (net profit + opportunity costs of capital)/tangible asset value	X		
		Input efficiency	Labour cost/kg fish produced (and % of total cost/kg)			
			Unit production cost (total variable and fixed cost/kg of fish produced/operating costs)			
			Energy cost/kg fish produced (and % of total cost/kg)			
			Feed cost/kg fish produced (and % of total cost/kg)			
			Fry cost/kg (and % of total cost/kg)			
		Indebtedness	Debt/capital ratio			
			Debt/total value of assets			
		Ease of entry into industry	Trend in initial investment cost			
		Capacity to pass on enterprises	Presence or absence of a family buyer			
			Enterprise profitability (gross operating surplus/fixed capital)			
	Products valorisation	Price	Average price of icon species (trends)			
		Existence of a quality-based approach	Existence of trademarks (Y/N and %)			X
			Existence of quality certification schemes (Y/N and %)			X

Components	Principles	Criteria	Indicators	DCF	D3.1	D3.2
Economic	Capacity to cope with uncertainty and crises	Diversification	Number of products (species, gear, metier)			
			Integration of core business with complementary activities (eco-tourism, recreational fishing, restaurant)			X
			Diversification at first hand sales (number and % of main commercial outlets on total sales)			X
		Economic dependence	Market dependence on external (internal EU, external EU) trade trends: (EXP minus IMP)/Turnover			
			Dependence on species/area trends			X
		Input self-sufficiency	Average price trends and availability of juveniles			
			Commercial feed price trends			
			Fuel price trends			
		Subsidies	Links with FEAMP strategic choices			
		Research support	Number and amount of projects by CS			
Social	Labour organisation	Employment	Employment trends	X		
			Total employees/FTE	X		
			% of permanent (and seasonal) full time equivalent workers			X
		Salary levels	Labour costs/FTE	X		
		Qualification	Average education level			
			Trend in fisheries and aquaculture training (number of trainees)			
		Social protection	Access to the system of social protection (Y/N)			
			Number of foreign workers			
		Trade unions	Existence of trade unions (Y/N)			
	Corporate social responsibility	Working conditions	Trends in number of hours worked/days at sea	X		
			Frequency of occupational accidents			
		Women's access to the industry	% of women associated (professional status)			

Components	Principles	Criteria	Indicators	DCF	D3.1	D3.2
			Number of new sites created over the past 10 years			
		Importance of development initiatives	Number of new licenses and authorized production volume over the past 10 years			
	Integration in local development		Fleet capacity trends (by location)			
		Contribution of the sector to improve environment	Existence of incentives, direct or indirect, for environmental protection actions (e.g. FEAMP incentives)			
			Transparency of management systems			
		Transparency and efficiency	Efficiency of the licensing procedure (e.g. number of players involved, length for granting, …)		X	
		Controls	Number or frequency of controls			
	Management system	Decentralization	Local presence and geographical scale of management institutions			
		Management measures	Existence of management tools or management plans		X	
		Stakeholders' representativeness	Representativeness of fishing fleets/aquaculture producers of the CS into representative committees (eventually into European committees)		X	
Governance	Decision-making	Organisation	Number of stakeholders taking part in decision process		X	
	Research and sector-related information	Access to information system	Existence of an information system (geographic information system, database and technical sheets): Does the CS adequately provide with the available statistics data?			
	Institutional capacities in relation with	Level of national recognition	Analysis of the FEAMP and national strategic plans by CS			

	sustainable development	Level of commitment of the State	Number of fisheries/aquaculture officers (weighting by the share of the CS in total employment)			

Components	Principles	Criteria	Indicators	DCF	D3.1	D3.2
Environmental (fisheries)	Impacts of fishing on target resources	State of target resources	% of stocks outside safe biological limits (or overexploited from expert inputs) and fully and/or sustainably exploited			
		Fleet "overcapacity"	Fleet capacity trends (global and by fleet segment)			
		Management measures	% catches of the CS covered by management and/or research plans (e.g. bio-economic management plans)			
	Effects of fishing on non-target species	Directs effects of fishing gear on non-target species	Ratios catch/bycatch; discards/bycatch			
		Management measures	Number of “bycatch action plans” or bycatch reduction/management strategies implemented			
	General ecosystems effects	State of biotic communities	Presence of SAR species in catches (main species of the CS)			
		Habitat integrity	Sensitive fishing gear: % catches by gear (trends)			
Environmental (Aquculture)	Respect for natural resources	Importance of harvesting from fish stock	FIFO: kg of wild fish used to produce one kg of farmed fish			
		Pressure on resources (terrestrial and aquatic)	Feed conversion ratio (kg feed/kg fish or compared with theoretical one)			
			Existence of environmental certifications in the feed industry (e.g. Friend of the Sea)			
		Respect of water quality	% of aquaculture operations complying with Code of Conduct or ecolabels or environmental certifications			
		Importance of harvesting from wild shellfish (seed)	Sustainability of the seed production for the mussel farming			
	Protect biodiversity	Genetic pollution	Number of escapees (trends)			
			Alien species			
	Fish welfare	Animal health	Composite indicator (Frequency of diseases, Implementation of relevant measures to prevent diseases, Density, according to the farming system)			